Enbridge Line 6B MP 608
Marshall, MI Pipeline Release

Kalamazoo River Hydrodynamic and Sediment Transport Model

Prepared for United States Environmental Protection Agency

Enbridge Energy, Limited Partnership

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LIST OF ACRONYMS

1-D	1-dimensional
2-D	2-dimensional
3-D	3-dimensional
ADCP	Acoustic Doppler Current Profiler
cfs	Cubic feet per second
EFDC	Environmental Fluid Dynamics Code
Enbridge	Enbridge Energy, Limited Partnership
ft/s	Feet per second
GIS	geographic information system
HEC-RAS	Hydrologic Engineering Center River Analysis System
IDW	Inverse distance weighted
I-69	Interstate Highway 69
LiDAR	Light Detection and Ranging
Line 6B	The pipeline owned by Enbridge Energy, Limited Partnership that runs just south of Marshall, Michigan
m^2/s^2	Square meters per second squared
m^3/s	Cubic meters per second
Mg/day	Megagrams per day
mg/L	Milligrams per liter (parts per million)
mm/wk	Millimeters per week
MP	Mile Post
NCDC	National Climatic Data Center
Pa	Pascal
Q	Point accuracy value
r^2	Square of the distance
RTK GPS	Real-Time Kinematic Global Positioning System
U.S. EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USGS	United States Geological Survey

1.0 Introduction

1.1 Overview

This report has been prepared for the purpose of describing the development of the two models (riverine and floodplain) that were used to simulate Kalamazoo River hydrodynamics and sediment transport. The Environmental Fluid Dynamics Code (EFDC), was created and used to estimate sediment and oil transport following Enbridge Energy, Limited Partnership's (Enbridge) Line 6B Mile Post (MP) 608 crude oil release (Line 6B) on July 26, 2010. The report describes model applications that were performed to assess sediment transport associated with a range of flow conditions and to evaluate the potential performance of sediment traps in selected Kalamazoo River locations.

The modeling process included the development of two base models. The domain for one model included only the river channel (riverine model). The domain for the other model included both the river channel and the floodplain (floodplain model). Both models were developed in 2-dimensions (2-D). Horizontal grid networks were developed for the base models to provide cells with spatial descriptive data and also to support model numerical finite difference calculations. *Figure 1-1* shows a location map of the oil release and the extent of the model domain in the Kalamazoo River. Inputs for the base models were obtained from existing field data collected by Enbridge or from published literature sources. Discharge and sediment concentration (qualitative) boundary conditions were established. The models were calibrated to discharge, water surface elevation, and velocity using data from United States Geological Survey (USGS) Gaging Stations located on the Kalamazoo River along with field data obtained in 2011. The models were calibrated to velocity using point and transect data collected by Enbridge on the Kalamazoo River. Model calibration has been an iterative process resulting in model refinement as data gaps were defined and/or additional information became available to improve the models. Model validation was performed by comparing calibrated models to available data from historical events. Model scenarios or specified historical discharge events were simulated to assess potential sediment transport and the effectiveness of sediment trap control measures. A model sensitivity analysis was performed on several input parameters to assess the influence of the change increase and/or decrease in one base model input parameter on simulation results.

1.2 Purpose

The riverine and floodplain models were developed to assess Kalamazoo River hydrodynamics and sediment transport in support of the following:

- To characterize probable areas of sediment deposition and/or erosion which based on 2010 and 2011 field work relates to submerged oil occurrence. Areas of deposition/erosion were characterized for a range of flow conditions.
- To assess down river transport of sediment and potentially submerged oil for a range of flow conditions.
- To assess sedimentation rates for selected locations as a function of flow and sediment particle size.
- To assess the potential effectiveness of sediment traps for selected river locations.

Both models were developed as 2-D models. The EFDC code provides for 3-dimensional (3-D) model development should Enbridge determine 3-D modeling is valuable in the future. Model boundary conditions, input parameter values, calibration process, validation process, simulation scenarios, and sensitivity analyses are described in the following report sections.

2.0 Model Code Selection

2.1 EFDC Code

The Kalamazoo River simulations EFDC model code.provides the framework to conduct finite difference 1-dimensional (1-D), 2-D, or 3-D hydrodynamic (flow) and transport (sediment and contaminant) numerical simulations.

This code provides a basis for simulating Kalamazoo River flow, sediment transport, and potentially oil transport for specified flow events and/or sediment control options (scenarios). Additionally, the model code includes spatial resolution, hydrodynamics, and sediment transport capabilities.

2.2 Spatial Resolution

The model is capable of 1-D, 2-D, and 3-D spatial resolution. The model uses a curvilinear-orthogonal horizontal grid and a sigma terrain following vertical grid. Horizontal grid generation and preprocessing tools are available including Visual Orthogonal Grid Generator.

The grid discretization for an area in the model domain determines the cell size volume or area that is characterized through parameter input values, and is based on a number of considerations. These considerations include:

- Numerical time step selection,
- Data availability to characterize site conditions,
- The representative elementary volume or the smallest volume that can be used to represent a greater volume, and
- Model efficiency (run time).

2.3 Hydrodynamics

The model's hydrodynamic component uses a semi-implicit, conservative finite volume solution scheme for the hydrostatic equations with either two or three level time stepping. EFDC code has the capability to couple salinity and temperature transport with a choice of advection schemes. Additional hydrodynamic component features include, simulation of drying and wetting, representation of hydraulic control structures, vegetation resistance, wave-current boundary layers and wave induced currents.

2.4 Sediment Transport

The model allows the simulation of multiple size classes of cohesive and non-cohesive sediment. A sediment processes function library allows the model user to choose from a wide range of currently accepted parameterizations for settling, deposition, re-suspension and bed load transport. The sediment bed is represented by multiple layers and includes a number of armoring representations for non-cohesive sediment. Bed layer thickness, void ratio, and pore water advection predictions are used to characterize the sediment bed over time. The hydrodynamic and sediment transport components can be coupled to represent bed topography over time.

3.0 Base Model Development

The primary components of a model include a domain grid network or cells, inputs to characterize spatial hydrodynamic and transport parameters, and boundary conditions (e.g. flow, sediment). Model development or configuration is an iterative process that requires revisions as additional data become available. Data that support model development include additional or revised inputs to define the model domain (area included for simulations), the scale of the grid network in the domain, boundary conditions, and hydrodynamic/ transport conditions. Model refinement typically continues through the calibration process and may continue with insight from additional model simulations (validation and scenario simulations). Two separate 2-D models were developed for the Kalamazoo River to more efficiently represent in-channel and overbank hydrodynamics. The domain for the riverine model included only the river channel. The domain for the floodplain model included both the river channel and the floodplain.

3.1 Grid System

A grid system is developed to spatially define cells and nodes (intersection of grid lines) throughout the model domain. The cells and nodes provide a basis for inputting spatial hydrodynamic and transport parameter values. These values solve the numerical finite difference model solutions. The scale of the model is determined by the grid network which defines the cell area and number of cells in the domain.

3.1.1 Riverine

The Kalamazoo River banks were used to define the model domain for the riverine model using aerial imagery and geographic information system (GIS) applications. November 2011 aerial imagery raster files along with the existing river bank delineation shapefile were loaded in ArcMap 10. An ArcMap 10 scale of 1:100 was used to view the river bank features for digitizing. Each vertex of the river bank delineation shapfile was then carefully examined and manually moved, if necessary to achieve the best digital representation of the river banks.

A boundary fitted curvilinear-orthogonal horizontal grid was used for the riverine model to accommodate river sinuosity. The grid network for the riverine model extended from the Interstate Highway 69 (I-69) Bridge to the Morrow Lake Dam. The riverine bank to bank grid model boundaries conform to geomorphic surfaces, described in *Section 3.3.4*, that define the channel. Grid cells were also extended from the river channel and up contributing tributaries to the river to characterize momentum associated with mixing. Typically two to three single cells

were extended from the channel and into contributing tributaries. The riverine model grid included 26,078 cells. Horizontal grid cell dimensions ranged from 10 to 80 meters long (longitudinal resolution) and 5 to 40 meters wide (lateral resolution). The longitudinal: lateral aspect ratio for horizontal cells is typically about 1:2, although for Morrow Lake, a Cartesian riverine grid with aspect ratio of 1:1 was developed. Examples of the riverine grid and the cell aspect ratio are provided in *Figures 3-1* and *3-2*, respectively.

3.1.2 Floodplain

A finer scaled Cartesian grid cell network, relative to the riverine grid, was developed which included both the channel and floodplain of the model domain. The length and width of the grid cells are both approximately 15 meters with a total of 101,206 horizontal cells in the model domain. The floodplain grid system was typically extended into the floodplain about two cells beyond the 100-year flood inundation limits that were predicted by the AECOM Hydrologic Engineering Center River Analysis System (HEC-RAS) model simulation for the Kalamazoo River. Examples of the floodplain grid and the cell aspect ratio are provided in *Figures 3-3* and *3-4*, respectively.

3.2 Boundary Conditions

Numerical models typically require a boundary in the model domain that establishes the conditions for the simulation (e.g. flow and sediment concentration input). The characterization of flow and sediment from data input at the model domain boundaries provides a basis for simulating defined flow and sediment concentrations at the specified boundary locations. Flow and suspended sediment inputs were uniformly distributed across the boundary grid cells for model simulations. The flow and sediment concentrations defined as boundary condition inputs, along with parameter values, influence the model simulation outputs that characterize channel and floodplain hydrodynamics and sediment transport.

3.2.1 Flow Boundaries

The flow boundaries for the model include an ustream location in the Kalamazoo River and along with downstream tributary locations that discharge into the Kalamazoo River. Flow data from USGS Stations were used when possible to develop model boundary flow inputs and calibration benchmarks. *Figure 3-5* provides the locations of the USGS Stations that were used to support model simulations for either model boundary inputs or calibration.

The uppermost flow boundary for the riverine and floodplain model domains intersect the Kalamazoo River near Marshall, MI at the I-69 Bridge which is located above the confluence of Talmadge Creek and the Kalamazoo River. The Marshall USGS Station provides historical stage and flow (discharge) data at 15-minute intervals. Kalamazoo River flow inputs using historical 15-minute flow data from this station were used for various simulations to define the I-69 Bridge boundary conditions.

3.2.2 Tributary Flow

The model simulations also included flow inputs from tributaries within the model domain. The tributaries included Battle Creek as well as other smaller tributaries. The flow boundary for Battle Creek is approximately 3 miles from the confluence with the Kalamazoo River upstream in Battle Creek. The Battle Creek USGS Station (04105000) provides historical stage and flow, or discharge data at 15-minute intervals which were used to define the model boundary conditions, or Battle Creek flow inputs.

Additional tributaries were included in the model to simulate all of the watershed flows. These additional flows include the following tributaries:

1. Gull Creek – inactive gage,
2. Augusta Creek – active gage,
3. Harper's Creek and Minges Brook – no gage,
4. Sevenmile Creek – no gage,
5. Wabascon Creek – no gage,
6. Bear Creek – no gage, and
7. Talmadge Creek – no gage.

Figure 3-6 shows the major creek drainage areas that were used to develop tributary flow boundary conditions in the model. For the creeks without flow gages, the flow was calculated from the gaged creek using the following area weighting method:

$$Q_u = Q_g \left(\frac{A_u}{A_g}\right) \quad (1)$$

Where, Q_g and A_g are the flow and drainage area of the gaged creek, respectively.

Q_u and A_u are the flow and drainage area of the ungaged creek, respectively.

The flows for Bear Creek, Talmadge Creek and Harper Creek were calculated using the flows at the Battle Creek Station (04105000) and equation (1).

The flows for Gull Creek, Wabascon Creek and Sevenmile Creek were calculated using the flows at the Augusta Creek Station (04105700) and equation (1).

3.2.3 Dam Rating Curves

There are three dams along the Kalamazoo River within the model domain. The three dams include Ceresco Dam, Morrow Lake Dam, and Kalamazoo River Dam. The Ceresco and Kalamazoo River Dams consist of sills with no gates and therefore flow rates are not managed. The Morrow Lake Dam includes gates but is managed as a flow through dam. The three dams were defined as flow boundaries in the model domain with Morrow Lake Dam being the downstream boundary. For each dam a rating curve was developed to define the flow rate as a function of water surface elevation for model simulations. The rating curve for each dam was calculated by using a weir flow control structure equation that considers flow as a function of stage. The equation parameters are as follows:

$$Q = Cw \times B \times 2g^{0.5} \times H^{1.5}$$

Where:

Q=discharge (m^3/s)

Cw=discharge coefficient

B=weir width (m)

g=gravitational constant (m/s)

H=stage above weir surface (m)

The calculation required a measurement of the width for each structure which was done using available aerial photographs and GIS technology. The rating curves for the dams are provided in *Figure 3-7*.

3.2.4 Sediment Concentrations

For model simulations that considered sediment inputs, boundary locations were the same as those described for flow boundaries in *Section 3.2.1* to include locations on the Kalamazoo River near the I-69 Bridge and the tributaries, along with the USGS Battle Creek Station.

Sediment concentration data was not available within the model domain since USGS Stations on the impacted portion of the Kalamazoo River do not monitor suspended sediment concentrations. Limited suspended sediment data from the USGS Station on the South Branch of the Kalamazoo River near Albion were available. Seven suspended sediment samples were collected from September 1971 to April 1972 and the concentrations ranged from 14 milligrams per liter (parts per million)(mg/L) to 93 mg/L. The Albion USGS Station median daily flow for the corresponding sample collection days ranged from 44 cubic feet per second (cfs) to 254 cfs as compared to the Marshall median daily flow range for the same days of 157 cfs to 661 cfs.

A regression of suspended sediment concentration as a function of flow was developed using the suspended sediment data from the USGS Albion Station and corresponding median daily flow data for the USGS Marshall Station. The USGS Marshall Station flow data were used in the regression to account for the higher flow range in Marshall. The regression results are provided in *Figure 3-8*. The regression was used to establish the suspended sediment concentration rating curve that is provided in *Figure 3-9*. The sediment concentration rating curve was used to characterize boundary suspended sediment concentration inputs for the Kalamazoo River near the I-69 Bridge, the tributaries, and along with the USGS Battle Creek Station. The suspended sediment concentrations were limited to 120 mg/L, since limited available data does not suggest concentrations greater than this value. The suspended sediment concentration boundary inputs also require characterization of particle size distribution. The distribution percentages of sand, silt, and clay sized fractions associated with suspended sediment concentrations were based on the average particle size distribution from sediment core samples collected from the Kalamazoo River in 2011.

3.3 Data Inputs and Sources

Several data sources were used to develop and calibrate the model. Data sources consisted of data collected directly by field crews during submerged oil assessment and recovery activities, as well as data from published literature and government agency sources (i.e. USGS and United States Department of Agriculture (USDA)). A summary of the most pertinent model parameters

for which values were input into model grid cells throughout the model domain include the following:

- Channel bathymetry and floodplain topography,
- Channel and floodplain roughness,
- Meteorological conditions,
- Sediment physical characterization, and
- Critical shear stress for deposition.

3.3.1 Riverine Channel Bathymetry and Floodplain Topography

Multiple data sources were used to derive bathymetric and topographic inputs:

- Poling data collected during assessment activities, the longitudinal survey, and overbank or Strike poling,
- Single beam sonar survey of Morrow Lake and downstream end of Morrow Lake Delta conducted in September, 2010,
- HEC-RAS cross-sections, and
- Light Detection and Ranging (LiDAR) Data which consisted of 1 foot contours covering the full extent of the Kalamazoo River 100 year floodplain from the source to Morrow Lake Dam.

3.3.1.1 *Riverine*

Poling data collected between April 19 and October 27, 2011 from approximately 14,500 locations were filtered to identify locations with spatial information adequate for use in characterizing bathymetry. X, Y coordinates and water surface elevations were collected at each poling location using Leica RX1200 Real Time Kinematic Global Positioning System (RTK GPS) units. The Leica units were programmed to store an estimated point accuracy value (Q) measured in feet. Positional quality (Position Q) is a measure of the estimated x, y coordinate accuracy. Height quality (Height Q) is a measure of the estimated z coordinate accuracy. Lower values for Position and Height Q represent more accurate measurements. Position and Height Q estimates were used to filter poling locations for bathymetric use.

Water surface elevations were used as a proxy for bed elevation to filter for accurate height quality. To reflect the low gradient of the Kalamazoo River, a threshold Height Q value of 0.2 feet was used to screen poling data and remove those data with insufficient accuracy for determining

bed elevations. In addition, data without Height Q values were also removed. These initial filters reduced the dataset by approximately 60%, primarily due to tree canopy along the banks which reduced the accuracy of the RTK GPS. To filter accurate positional quality, the data from any points outside of the channel banks as delineated from leaf-off aerials at a 1:100 scale were removed. Likewise, data within mapped islands were removed since these areas were covered by LiDAR aerial surveys or Strike poling data. Locations with no elevation data and/or where water depth information was not recorded or was zero were removed from the dataset.

After filtering the data using the above methods, data were verified to ensure that locations with inconsistent positional data were removed from the dataset. This manual checking process compared water surface elevations of proximate locations to ensure consistency. Poling locations in Morrow Lake Delta were processed using the above methods and additional methods made possible by the uniform water surface across the delta. After the initial filters were applied, poling locations in the delta were analyzed by day to determine the mean and standard deviation of the measured water elevation surfaces. This analysis resulted in a range of water elevations in the delta for 2011. Days with measured water surface elevations outside the expected statistical range were removed from the dataset. The approximate variation in water surface elevation across the delta is 0.2 feet (Tetra Tech, 2011) and the RTK GPS vertical accuracy is 0.2 feet; therefore, days where the standard deviation of elevations was greater than 0.4 feet were removed from the dataset.

The final step was to remove any poling locations that overlapped with the single-beam bathymetry data that extended into the delta. In total, over 7,000 poling locations were used to generate bathymetric data.

The resulting poling bathymetry dataset was combined with the single beam dataset and the HEC-RAS cross-sections. This combined data were used to interpolate the bed elevations of the riverine channel grid using the Inverse Distance Weighted (IDW) method in ArcGIS, resulting in a continuous surface raster. IDW methods assume that the nearby points would exert greater influence on the interpolated surface than distant points. To calculate an unknown point, the known neighboring points were weighted by the inverse square of the distance ($1/r^2$). For each EFDC grid cell the average raster value was then calculated and assigned to the cell as bottom elevation. *Figure 3-10* shows the final riverine bathymetry input raster.

Cells that overlapped with islands in the river were initially interpolated from the LiDAR data set. However, this interpolation did not accurately define island topography. The elevations for island cell surfaces were manually increased by 0.5-1.0 meters in order to represent actual conditions rather than inundated during low flow.

3.3.1.2 Floodplain Grid

Bottom elevations for the floodplain grid were calculated in a similar manner as the riverine channel grid. The LiDAR data was processed to obtain 1 foot interval contours, which were then used to interpolate a raster surface with a resolution of 9 meters by 9 meters. Strike poling data, where available, was used to estimate bottom elevations in areas with standing water. The riverine bathymetry raster was used for floodplain areas categorized as channel.

To ensure that the bathymetry/topography interpolations were accurate, model-generated cross-sections were compared to HEC-RAS model generated cross-sections upstream of MP 18.00 and surveyed HEC-RAS cross-sections downstream of MP 18.00. *Figure 3-11* shows these comparisons. The bathymetry/topography were manually adjusted at locations (i.e. MP 10.00) where HEC-RAS modeled cross-sections and model-generated cross-sections differed significantly.

3.3.2 Channel and Floodplain Roughness

Roughness values define the channel and floodplain boundary surface influence on flow velocity. Rough boundary surfaces result in increased energy loss as compared to smooth surfaces. Since data was not available to characterize the variability in-channel roughness a representative value of 0.02 m was used in the base riverine model and the channel portion of the base floodplain model. The channel roughness value was determined from roughness value adjustments during the model calibration process, and is considered reasonable based on modeling experience.

Floodplain roughness values were based on an evaluation of land cover types using criteria developed by the USGS. These criteria define floodplain roughness using vegetation types. Land cover types were digitized from aerial imagery and placed in the following four classes:

- Brush or crops,
- Forested,
- Grass and forbs, and
- Pavement or bare ground.

Manning's *n* values were assigned to each class based on methods described in *USGS Water Supply Paper 2339 Table 3* (Arcement, G.J. and Schneider, V.R.). This method considers a base value, floodplain irregularity, obstructions, and vegetation. The base values of Manning's *n* relate to bed material type, bed material size, and the uniformity of the channel. Irregularity refers to the topography of the floodplain and is divided into four possible categories (smooth, minor, moderate, and severe). Each category has a range of values that increase as irregularity increases. Obstructions refer to the debris deposits, stumps, exposed roots, etc. that contribute to roughness. The effects of obstructions in the floodplain are divided into three categories that have a range of values associated with them (negligible, minor, and appreciable). Vegetation is divided into amount categories (small, medium, large, very large, and extreme) and has associated ranges of values that increase as the amount of vegetation increases.

Based on the methods described above, the following Manning's *n* values were applied:

- Base: 0.028,
- Irregularity: 0.003, and
- Obstructions: 0.045.

These values were subtotaled, for a value of 0.076. This subtotal was then added to each assigned vegetation value:

- Bare ground/pavement: 0.00 + 0.076 = 0.076,
- Grass/Forbs (Small category): 0.005 + 0.076 = 0.081,
- Crops/Brush (Medium/Large category): 0.025 + 0.076 = 0.101, and
- Forested (Very Large): 0.070 + 0.076 = 0.146.

Figure 3-12 shows the final vegetation categories and Manning's *n* value assigned to each. These values were then converted to equivalent roughness heights for use in the model.

3.3.3 Meteorological Conditions

Atmospheric and meteorological data were gathered from Surface Airways Station WBAN ID 14833-Jackson Co Reynolds. The data were downloaded from January 2010 through and including December 2011. National Climatic Data Center (NCDC) hourly observations were used for building the atmospheric and wind file through a program called MetADAPT. The NCDC file has the following hourly data:

- Sky conditions,
- Visibility,
- Weather type,
- Dry bulb temperature,
- Wet bulb temperature,
- Dew point temperature,
- Percent relative humidity,
- Wind speed,
- Wind direction,
- Station pressure,
- Pressure tendency,
- Sea level pressure, and
- Precipitation total.

All of the cells in the model domain have inputs for these meteorological conditions to consider water loss and/or gain related to these conditions. However, the amount of water loss and/or gain from these conditions is negligible compared to other flow boundaries (e.g. tributaries, I-69 boundary, etc.).

3.3.4 Sediment Physical Characterization

To accurately model sediment transport, several parameters were used as inputs to the model:

- Wet bulk density,
- Dry density,
- Porosity,
- Solid density, and
- Percentage of sand, silt, and clay.

Given that soil texture and density are variable and can be difficult to measure, classic interpolation methods or uniform distribution are not well-suited for the complex nature of river and floodplain systems. Therefore, a process that combines in-channel geomorphic surface mapping and overbank USDA soil survey mapping was used to estimate these parameters.

3.3.4.1 Riverine geomorphic surface mapping

Geomorphic surface mapping was completed for the Kalamazoo River to characterize depositional/erosional areas in support of the hydrodynamic and sediment transport model. Geomorphic surfaces were delineated in an iterative process that relied on several lines of evidence:

- Slope - Major breaks in slope (Tetra Tech, 2011) were delineated,
- Geomorphic Setting - Main geomorphic areas were delineated if possible (i.e. oxbows, islands, backwaters, etc) using the 2011 April aerial photos,
- Sediment Type - Surfaces were further edited using sediment type as identified by poling crews during the Spring 2011 Reassessment activities. Eight major sediment types were used ('gravel and larger', 'sand and gravel', 'sand', 'sand and silt', 'sand over silt', 'silt over sand', 'soft sediment', and 'organic'),
- Water depth - Surfaces were finalized using water depth as recorded by the poling crews during Spring 2011 Reassessment activities, and
- Surfaces were finalized using water depth as recorded by the poling crews during Spring 2011 Reassessment activities.

The final geomorphic surfaces are shown in *Figure 3-13*.

3.3.4.2 Sediment core assignment to geomorphic surfaces

Once the geomorphic surface boundaries were finalized, they were used to extrapolate core sediment textures and bulk densities from 110 sediment and bulk density cores taken in October and November 2011. The sediment cores were described using USDA and United States Classification System methods and sampled for grain size analysis. The bulk density cores (a 6-inch surface interval at sediment core locations) were analyzed for wet and dry bulk density. All of the 110 sediment cores were used to assign the percent of 'sand', 'silt', and 'clay' to the surfaces. However, to assign bulk density values to the surfaces, 32 cores were discarded due to the calculated solid density being lighter than water. The remaining 78 cores were used to assign bulk density information to each geomorphic surface.

The upper two described intervals of each sediment core were assigned sediment categories developed from the geomorphic mapping. 'Silt over sand' and 'sand over silt' discontinuities were identified by reviewing the two upper intervals and noting any textural changes from 'sand' or 'loamy sand' to 'loam', 'silt loam', or 'silt' and vice versa. The 'sand and silt' category was used for 'sand' or 'loamy sand' textures with no gravel noted in the log. The 'soft sediment' category was used for 'loam' or finer textures (i.e. silt, silt loam, etc.).

Once each core was assigned a sediment type category, a fluvial category was then assigned corresponding to the geomorphic surface in which it is located using the following methods (*Table 3-1*):

- Geomorphic surfaces were assigned their co-located core, if applicable. If a surface had multiple cores, then the core with the closest matching sediment and fluvial setting categories was assigned.
- Geomorphic surfaces with sediment-fluvial setting combinations that were matched by one or more cores were assigned a core with the same combination. Typically the core with the same combination of characteristics collected closest to the surface was assigned.
- If a geomorphic surface had a sediment-fluvial setting combination that did not match any of the collected cores, then priority was given to the sediment category of the core. The core with a matching sediment category that had the most similar fluvial setting *was selected.*

Figures 3-14 and *3-15* show the geomorphic surfaces with their assigned textural and bulk density cores. Geomorphic surfaces were assigned particle size distribution and bulk density values. Each grid cell was then assigned a sediment data value from the corresponding nearest geomorphic surface. The assigned sand percent, wet bulk density, and dry bulk density values for each grid are provided in *Figures 3-16*, *3-17*, and *3-18*, respectively.

The model code is structured to characterize bulk density for several vertical sediment layers. The bulk density surface value for a specific grid was applied to at depth vertical sediment layers. The initial sediment layer of 0.1 meter thickness was the only mobile layer, therefore values below the initial layer did not influence model results.

3.3.4.3 *Floodplain sediments*

Floodplain texture and bulk density values were estimated using slightly different methods than for in-channel values. Where Strike poling data was available, sediment categories were assigned based on the sediment characteristics described above. In-channel sediment cores with matching sediment categories from backwater settings were then assigned to these areas. The remaining areas of the floodplain were assigned estimated bulk density and texture values from USDA soil surveys for Kalamazoo and Calhoun counties. The final sediment core and USDA map unit assignments are provided in *Figure 3-19*. Grid values were assigned by overlaying the grid on the sediment core and USDA map units. Each grid cell was assigned a sediment data value that corresponds to the map unit or sediment core unit it fell within or was nearest. The values each floodplain grid were assigned for sand percent, wet bulk density, and dry bulk density are provided in *Figures 3-20*, *3-21*, and *3-22*, respectively.

3.3.5 Critical Shear Stress for Deposition

Critical shear stress is defined as the stress associated with flow velocity that begins to transport sediment at rest on the bed surface. Sediment bed critical shear stress data or a similar parameter is required to simulate the suspension and transport of bed deposits. The critical shear stress value used for model simulations was representative of fine-grained sediment since surface layers from core samples collected in 2011 and 2012 were typically fine grained silt or sand. . A typical value for fine sediment is 0.1 Pascal (Pa). The model uses kinematic stress (stress/water density of 1000 kilograms per cubic meter (kg/m^3)) which converts 0.1 Pa (1 Newton per square meter) to 1.0 x 10^{-4} square meter per second squared (m^2/s^2). Therefore, the normal and boundary critical shear stress value for deposition that was input into grid cells for base model simulations was 1.0 x 10^{-4} m^2/s^2. When the bed stress exceeds the critical shear stress for deposition, then no deposition occurs.

3.4 Data Gaps

Model simulations are used to estimate the hydrodynamic and/or constituent transport (e.g. sediment) response to specified conditions. The model capability to best represent actual hydrodynamic and/or or transport outcomes is dependent on the availability of data that is used to characterize those parameters that influence model performance. Following is a discussion of data parameters that were limited for model development and execution.

3.4.1 Bathymetry

Bathymetry data is required to develop the model in order to characterize channel and floodplain surface elevations. This data defines characteristics that influence hydrodynamics and transport including channel hydraulic gradient, wetted perimeter, and water depth. Limited bathymetry data was available to characterize the model domain that included approximately 40 linear miles of the Kalamazoo River system. Bathymetry was obtained from single beam sonar in specific locations, poling, cross-sections developed for HEC-RAS modeling, and LIDAR data.

3.4.2 Sediment Class Size

Sediment class size influences sediment bed erosion and transport. Limited data was available to characterize channel bed and suspended sediment. Sediment class size or particle size distribution for the sediment bed was determined from analysis of 'sand', 'silt', and 'clay' fractions from 110 core samples collected in 2011. Ideally, additional sediment size classes (e.g. fine sand) provide data to better predict bed erosion and were estimated from hand texturing descriptions of core sample surface sediment layers. Data to characterize the particle size distribution of suspended sediment samples were not available. The suspended sediment samplers installed in the Kalamazoo River were not in place for a sufficient period to obtain the sediment mass required for particle size distribution analysis. Therefore the particle size distribution for suspended sediment concentration boundary inputs were based on the average value of the particle size distribution data from the surface layers of the 110 core samples.

3.4.3 Silt Class and Associated Submerged Oil

Submerged oil transport is presumed to be at least partially associated with solids transport including suspended sediment. Data and/or published literature that define the relationships between solids and submerged oil transport were not available and therefore submerged oil transport was not quantified in model simulations.

3.4.4 Critical Shear Stress

The critical shear stress for deposition value used for model simulations was representative of fine-grained sediment. Submerged jet tests to measure critical shear stress were conducted at MP 10.75 and MP 12.75 in November 2011. Data was not available to characterize critical shear stress for deposition variability throughout the model domain.

3.4.5 Channel Aquatic Vegetation

Aquatic vegetation may influence flow velocity and sediment erodibility. The influence on hydrodynamic and transport processes is dependent on vegetation type and density. Information regarding aquatic vegetation was not available and not characterized for model simulations.

3.4.6 Flow and Suspended Sediment Concentrations

Often suspended sediment concentrations are directly related to flow within a specified flow range since the energy associated with flow increase results in increased suspended sediment concentrations. Suspended sediment concentrations were not measured at the USGS stations located in the model domain. Therefore limited suspended data from the USGS Station on the South Branch of the Kalamazoo River near Albion were related to the USGS Marshall Station flow data for corresponding periods to develop suspended sediment boundary inputs as discussed in *Section 3.2.2*.

Calibration of the sediment transport model simulations were not based on observed or measured relationships between flow and suspended sediment concentrations since such data were not available. Model output parameters including velocity vector and shear stress were compared to depositional and erosional geomorphic surfaces to calibrate the sediment transport base models.

3.4.7 Agitation and Submerged Oil Recovery

Model simulations have not been conducted to evaluate impacts related to agitation methods used to enhance submerged oil recovery. The inputs were not available to conduct these simulations. Addressing the relationships between agitation methods and submerged oil recovery will be dependent on model capability and data availability.

4.0 Model Calibration

Model calibration is the process used to refine model structure in order for simulation results best represent field observed conditions. Model calibration is an iterative process that is based on refinement or adjustment of model structure based on a comparison of model simulation results to known or observed conditions. Model parameters that may be refined through the calibration process include:

- Grid network (e.g. cell dimensions),
- Boundary condition locations and inputs, and
- Model inputs to characterize physical conditions that influence hydrodynamics or sediment transport (ASTM 1984; Donigian 2000).

The calibration process does not result in a model that precisely represents actual natural conditions, only an approximation. Calibrated base model performance was evaluated through qualitative and quantitative analyses including graphical comparisons and statistical tests.

4.1 Hydrodynamics

Hydrodynamics calibration was conducted independently for both the riverine and floodplain models since each model was developed separately. Model parameters with the most potential to influence results were adjusted before those parameters that have less influence. The calibration process parameters that were considered from the most to least potential to influence results included flow, water surface elevation, and flow velocity.

Model boundary flows have a significant influence on results since flow is the driving energy force for river systems. Therefore, upstream boundary flow inputs and downstream tributary flows were adjusted first in the calibration process. Predicting flow in rivers is entirely dependent on having correct upstream discharge boundary conditions and lateral inflows. When the observation location is sufficiently downstream of the upstream boundary the amplitude and phase of the flow and elevation hydrograph provide good calibration measures. A 10 percent error in hydrograph propagation is typically considered acceptable.

Model simulated Kalamazoo River downstream flows at the USGS Battle Creek (04105500) and Comstock Stations (04106000) were compared to USGS Station historical flow data for the simulated time series. Model simulated flows were also compared to field measured flows from

Acoustic Doppler Current Profiler (ADCP) transects. The calibration process resulted in the adjustment of the base model flow boundary inputs to account for flows that were not gauged.

Model simulated water surface elevations were then compared to measured water surface elevations which included data from the following:

- USGS Station on Kalamazoo River near Battle Creek (04105500),
- 9 staff gages located on Kalamazoo River measured daily in 2011, and
- Kalamazoo River floodplain high oil mark survey elevations conducted in November and early December 2010 (Tetra Tech, 2011).

The calibration of surface water elevations resulted in adjustments to bathymetry and also bottom roughness coefficients for the base model.

Finally, model simulated velocities were compared to measured ADCP velocities at locations in the Kalamazoo River. At each location a depth averaged measured velocity was calculated based on depth profile. Velocity measurements included the following:

- ADCP point measurements from 79 locations throughout the Kalamazoo River from October through and including early November 2011,
- ADCP point measurements from 62 Morrow Lake and Delta locations from October through and including early November 2011, and
- ADCP measurements from Kalamazoo River transects at 21 locations from October through and including early November 2011.

Point velocity prediction is sensitive to local bathymetry and flow. A 25 percent error between point measured and simulated velocities is typically considered acceptable. The calibration of velocity resulted in a final adjustment for the bottom roughness coefficient for the base model.

4.1.1 Riverine

4.1.1.1 Method-Flow Time Series

The base riverine model boundary input includes flow that was recorded at the USGS Marshall Station from October 28 through and including November 9, 2011. The hydrograph for the downstream flow at the Battle Creek USGS Station for the time series is provided in *Figure 4-1*. This time series was selected because water surface elevation data and ADCP data were measured within this period. Likewise 15 minute interval flow data from downstream USGS

Stations at Battle Creek and Comstock were available. The flow exceedance, which represents the percent of time a specified flow is equaled or exceeded, was developed for the calibration using historical flow data available from the USGS Battle Creek Station. The flow exceedance for the calibration simulation is provided in *Table 4-1*.

4.1.1.2 Results

A comparison of riverine base model simulated flows with measured downstream Kalamazoo River flows at the USGS Stations at Battle Creek and Comstock for the time series are provided in *Figure 4-2*. The flow rate differences between the base model simulation and recorded flow at the USGS Battle Creek Station ranged from 32 cfs (5%) to -42 cfs (-5%). The flow rate differences between the base model simulation and recorded flow at the USGS Comstock Station ranged from 25 cfs (3%) to -27 cfs (-2%), which is considered acceptable model performance.

A comparison of riverine base model simulated surface water elevations with measured values along the Kalamazoo River at defined mile posts for days within the time series are provided in *Figure 4-3*. The difference between model simulated and measured values ranged from 0.96 feet at MP 10.00 on November 8, 2011 to -1.27 feet on November 1, 2011at MP 5.25, which is considered acceptable model performance.

Velocity profiles along transects are provided in *Figure 4-4*. A comparison of riverine base model simulated velocities with ADCP measured velocities (average minus standard deviation) for days within the time series for Station 1 through Station 175 is provided in *Figure 4-5*. The difference between model simulated and measured velocities ranged from 0.23 feet per second (ft/s) on November 2, 2011 (Station 25) to -0.44 ft/s on October 31, 2011 (Station 105). Some of the scatter in the velocity data is attributed to the use of a depth averaged method for each location.

4.1.2 Floodplain

4.1.2.1 Method-Flow Time Series

The base floodplain model boundary input includes Kalamazoo River flow that was recorded at the USGS Marshall Station from July 23 through and including August 3, 2010. This time series corresponds to the crude oil release on July 26, 2010. The hydrograph for the downstream flow at the USGS Battle Creek Station for the time series is provided in *Figure 4-6*.

4.1.2.2 Results

A comparison of floodplain base model simulated flows with measured downstream Kalamazoo River flows at the USGS Stations at Battle Creek and Comstock (04106000-Morrow Lake Outlet)

for the time series are provided in *Figure 4-7*. The flow rate differences between the base model simulation and recorded flow at the USGS Battle Creek Station ranged from 19 cfs (3 %) to -23 cfs (-4%). The flow rate differences between the base model simulation and recorded flow at the USGS Comstock Station (Morrow Lake Outlet) ranged from 20 cfs (2%) to -35 cfs (-4%), which is considered acceptable.

A comparison of floodplain base model simulated surface water elevations with measured values at defined mile posts along the Kalamazoo River for the days within the time series are provided in *Figure 4-3*. The difference between simulated and measured values ranged from 1.77 feet at MP 21.50 on October 29, 2011 to -1.64 feet on October 28, 2011 at MP 16.75. The performance of the floodplain model was generally not equivalent to the riverine model with respect to observed water surface elevations at lower flows. The riverine model design is better for simulating less than bankfull flows.

A comparison of floodplain model simulated surface water elevations to surveyed high oil mark elevations along the Kalamazoo River for the period from July 25 through and including July 27, 2010 are provided in *Figure 4.8*. The difference between model simulated surface water elevations and measured high oil survey mark elevations ranged from 9.51 feet (Transect 469) to -4.50 feet (Transect 77) for July 27, 2010. Graphical comparisons of model simulated surface water elevations with measured high oil mark elevations for July 25, 26, and July 27, 2010 are included. Model simulated elevations were typically near or below measured oil mark elevations which was considered acceptable for the calibration.

Velocity profiles along transects are provided in *Figure 4-4*. A comparison of floodplain base model simulated velocities with ADCP measured velocities (average minus standard deviation) for days within the time series for Station 1 through Station 164 are provided in *Figure 4-7*. The difference between model simulated and measured velocities ranged from 0.34 ft/s on November 2, 2011 (Station 20) to -1.1 ft/s on November 8, 2011 (Station 20). A graphical comparison of model simulated velocities with average ADCP velocities is included in *Figure 4-7*.

4.2 Sediment Transport

Sediment transport calibration was not based on a comparison of measured suspended concentrations or sediment loads since such data were not available. The base sediment transport models were calibrated by comparing model outputs including shear stress, velocity vectors, and sedimentation rates to defined geomorphic surfaces that were developed for the

model domain. These comparisons provided a basis for refining the model so that outputs conformed to anticipated erosional or depositional processes associated with the defined geomorphic surfaces.

4.2.1 Riverine

4.2.1.1 Method-Flow Time Series

The base riverine model boundary input includes flow that was recorded at the USGS Marshall Station from October 28 through and including November 9, 2011. The riverine model was refined based on a comparison of model outputs to corresponding geomorphic surfaces. The rationale for developing the sediment input boundary conditions and selection of this time series were described previously in *Section 3.2.4* and *Section 4.1.1.1*.T he suspended sediment boundary inputs for the base riverine transport model for the time series are provided in *Figure 4-9*.

4.2.1.2 Results

The riverine base model simulated sediment mass flux in megagrams per day (Mg/day) for specified locations along the Kalamazoo River from Ceresco Dam to the Morrow Lake Dam for the time series are provided in *Figure 4-10*. Generally the simulated mass flux at all locations is greatest in the early days of the time series and diminishes over time. The highest mass flux values are simulated near the Battle Creek USGS Station during the initial day of the time series (October 28, 2011). The lowest mass flux rates were simulated at the Morrow lake Dam. The mass flux is influenced by the hydrograph and sediment boundary conditions.

4.2.2 Floodplain

4.2.2.1 Method-Time Series

The base floodplain model boundary input includes that was recorded at the USGS Marshall Station from July 23 through and including August 3, 2010. The rationale for selection of this time series and the method for developing the sediment input boundary conditions were described previously in *Section 4.1.2.1* and *Section 3.2.4*. The suspended sediment boundary inputs for the base floodplain transport model for the time series are provided in *Figure 4-11*.

4.2.2.2 Results

The floodplain base model simulated sediment mass flux in Mg/day for specified locations along the Kalamazoo River from Ceresco Dam to the Morrow Lake Dam for the time series are provided in *Figure 4-12*. Generally the simulated mass flux at all locations is greatest from July

25 through a portion of July 26, 2010 with the exception of the Morrow Lake Dam. The simulated mass flux at the Morrow Lake Dam was observed later on July 27, 2010 due to travel time. The highest mass flux values were simulated near the Battle Creek USGS Station. The lowest mass flux rates were simulated at the Morrow lake Dam.

4.3 Discussion

4.4 October-November 2011 Time Series

General patterns observed in the riverine model outputs for velocity, shear stress, and sedimentation rate are provided in *Figure 4-13* through and including *4-20*. Daily velocity data for the riverine model are provided in *Figure 4-13*, *4-14*, and *4-15*. Daily shear stress data for the riverine model are provided in *Figure 4-16*, *4-17*, and *4-18*. Daily sedimentation rate data for the riverine model are provided in *Figure 4-19* and *4-20*.

Observations include the following:

- The highest in-channel velocities are observed where the channel narrows, particularly at meanders.
- Oxbows and backwaters have minimal flow and typically depict the influence of backwater eddying.
- Deposition of silt and clay typically occurs in oxbows, backwaters, adjacent to islands, and in low channel gradient areas.
- Areas with the most erosion of silt and clay occur in the thalweg and areas of narrowing channel and increased gradient. Considerable erosion is observed downstream of the concrete channel.
- Deposition is not uniform in the delta and erosion of silts and clays occurs primarily in the main-channel.
- Deposition on the sediment fan extends about 1,000 feet into Morrow Lake.

4.5 July 2010 Time Series

General patterns observed in the floodplain model outputs for velocity, shear stress, and sedimentation rate are provided in *Figure 4-21* through and including *4-28*. Daily velocity data for the floodplain model are provided in provided in *Figure 4-21*, *4-22*, and *4-23*. Daily shear stress data for the floodplain model are provided in *Figure 4-24*, *4-25*, and *4-26*. Daily sedimentation rate data for the floodplain model are provided in *Figure 4-27* and *4-28*.

Observations include the following:

- Velocities are highest in the main-channel and decrease with distance from the channel into the floodplain. Floodplain velocities are rarely greater than 1 ft/s.
- Floodplain velocities are generally highest across point bars or when flow is constricted between areas of higher topography.
- Erosion of silt and clay on the floodplain is minimal.
- Most silt and clay deposition in Morrow Lake is between the entrance and MP 38.50 but some deposition occurs as far as MP 39.25.

5.0 Model Hydrodynamics Validation

Validation is the comparison of model results with numerical data independently derived from experiments or observations. Although no consensus on model validation criteria are found in model-related literature, a number of operating assumptions are accepted for model validation (ASTM 1984; Donigian 2000) as follows:

- Models are an approximation of field conditions; they cannot precisely represent natural systems.
- No single statistic or test determines the validity of the model.
- Models cannot perform more accurately than the confidence intervals derived from modelinput and observed data.

Model performance is evaluated by comparing measured data against simulated data for a specific period of time. The period of hydrodynamic validation for the two model grids are as follows:

- Riverine grid: May 13 through and including May 24, 2011, and
- Floodplain grid: May 25 through and including June 8, 2011.

For both model runs, the simulated results were compared to measured flow and water surface elevation data collected during the simulation period. Simulated average daily flow at the USGS Battle Creek Station and Comstock Station were compared to average daily flow measured by the USGS gauges at or near these locations. The flow exceedance, which represents the percent of time a specified flow is equaled or exceeded, was developed for the validation using historical flow data available from the USGS Battle Creek Station. The flow exceedance for the validation simulation is provided in *Table 5-1*.

Measured water surface elevations from Enbridge staff gauge locations, the USGS Battle Creek Station, and the USGS Comstock Station were compared to simulated water surface elevations at these same locations. The validation process considered the percent difference between simulated and measured data for water surface elevation and also normalized to measured water depth.

The following section summarizes the validation results for the riverine and floodplain models.

5.1 Riverine

5.1.1 Results

A comparison of riverine base model simulated flows with measured downstream Kalamazoo River flows at the USGS Stations at Battle Creek and Comstock for the time series are provided in *Figure 5-1*. The flow rate differences between the model simulated flow and recorded flow at the Battle Creek Station ranged from 30.6 cfs (2%) to -64.0 cfs (-6%). The flow rate differences between model simulated flow and recorded flow at the Comstock Station ranged from 123.3 cfs (10%) and -15.7 cfs (-1%).

A comparison of riverine simulated surface water elevations with measured values at defined mile posts along the Kalamazoo River for days within the time series are provided in *Figure 5-2*. The difference between model simulated and measured values ranged from 0.97 feet (29%) at MP 10.00 on May 20, 2011 and -1.0 feet (-18%) at MP 5.25 on May 18, 2011.

5.2 Floodplain

5.2.1 Results

A comparison of floodplain model simulated flows with measured Kalamazoo River flows at the USGS Stations at Battle Creek and Comstock are provided in *Figure 5-3*. The flow difference between model simulated and measured values at the Battle Creek Station ranged from 128.2 cfs (7%) and -188.5 cfs (-7%). The flow differences between model simulated and measured values at the Comstock Station ranged from 214.5 cfs (9%) and -333.7 cfs (-12%).

A comparison of floodplain model simulated water surface elevation with measured values at defined mile posts along the Kalamazoo River for days within the time series are provided in *Figure 5-4*. The difference between model simulated and measured values ranged from 1.94 feet (33%) at MP 16.75 on May 27, 2011 and -1.07 feet (-13%) at MP 38.00 on May 27, 2011.

5.3 Sediment Transport (Qualitative)

Sediment transport validation was not based on a comparison of measured suspended concentrations or sediment loads since such data were not available. The base sediment transport models were validated by comparing model outputs including shear stress, velocity vectors, and sedimentation rates to defined geomorphic surfaces that were developed for the model domain. These comparisons provided a basis for validating the model so that outputs conformed to anticipated erosional or depositional processes associated with the defined geomorphic surfaces.

5.3.1 Riverine

5.3.1.1 Results

The riverine model simulated sediment mass flux in Mg/day for specified locations along the Kalamazoo River from Ceresco Dam to the Morrow Lake Dam for the time series are provided in *Figure 5-5*. The highest mass flux values are simulated near the USGS Battle Creek Station during the initial day of the time series (May 13, 2011). The lowest mass flux rates were simulated at the Ceresco and Morrow Lake Dams throughout the time series.

5.3.2 Floodplain

5.3.2.1 Results

The floodplain model simulated sediment mass flux in Mg/day for specified locations along the Kalamazoo River from Ceresco Dam to the Morrow Lake Dam for the time series are provided in *Figure 5-6*. Generally, the simulated mass flux is highest for all locations on May 27 and 28, 2011 except at the Morrow Lake Dam. The simulated mass flux at the Morrow Lake Dam was highest on May 30, 2011. The highest mass flux values are simulated near the USGS Battle Creek Station. The lowest mass flux rates were simulated at the Morrow Lake Dam throughout the time series.

5.4 Discussion

5.4.1 Riverine Time-Series

The following section describes general patterns observed in the riverine model outputs for velocity, shear stress, and sedimentation rate. Daily velocity data for the riverine model are provided in *Figure 5-7* through and including *5-9*. Daily shear stress data for the riverine model are provided in *Figure 5-10* through and including *5-12*. Sedimentation rate data for the riverine model are provided in *Figure 5-13* and *5-14*.

Observations from the validation of the riverine model include the following:

- Most flow velocities were in the 0.1-1.0 ft/s range.
- The highest velocities (outside of anthropogenic/engineered areas) are in narrow, meandering segments of the channel.
- Erosion of silt/clay occurs mainly in meanders and the thalweg.
- Deposition of silt/clay is generally restricted to oxbows and backwaters, Morrow Lake Delta, and the Morrow Lake sediment fan.
- Most deposition in Morrow Lake is restricted to the sediment fan upstream of MP 38.50.

5.4.2 Floodplain Time-Series

The following section describes general patterns observed in the floodplain model outputs for velocity, shear stress, and sedimentation rate. Daily velocity data for the riverine model are provided in *Figure 5-15*, *5-16*, and *5-17*. Daily shear stress data for the riverine model are provided in *Figure 5-18*, *5-19*, and *5-20*. Daily sedimentation rate data for the riverine model are provided in *Figure 5-21* and *5-22*.

Observations from the validation of the floodplain model include the following:

- Floodplain velocities are generally ≤ 1 ft/s and highest across point bars or areas of constricted flow.
- Velocities generally decrease with distance from the channel.
- Overbank deposition of silts and clays upstream of MP 10.75 is highest on point bars and immediately adjacent to the channel. Deposition of silts and clays is more variable across the floodplain downstream of MP 10.75.
- A pool/riffle sequence in the channel emerges downstream of MP 20.50; overbank deposition is variable and erosion minimal.
- Deposition in Morrow Lake is mostly upstream of MP 38.50.
- In Morrow Lake Delta, the island/distributary channel system is a complex mix of erosion and deposition. Areas devoid of islands are mostly depositional in nature. The thalweg north of the island/distributary complex is mostly erosional.

6.0 Model Scenarios (Response to Historical Events)

The calibrated riverine and/or floodplain models were used to simulate the response to specific historical flow events. The rationale for the selection of the specific historical events and model outputs are discussed in the following sections. Hydrodynamic outputs include velocity and bed shear stress. Sediment transport outputs include sedimentation rates.

Additional model scenarios may be completed in the future under the direction from Enbridge if value is added by running more scenarios..

6.1 Low Flow Time Series

The calibrated riverine model was used to simulate the low flow scenario. The low flow riverine model boundary input includes Kalamazoo River flow that was recorded at the USGS Marshall Station from September 8-15, 2010. The hydrograph for the downstream flow at the USGS Battle Creek Station for the time series is provided in *Figure 6-1*. This flow event represents low flow conditions that were below 600 cfs. The boundary suspended sediment inputs for the low flow time series are near 40 mg/L and are provided in *Figure 6-2*. Only riverine model simulations were conducted for this low flow scenario since floodplain impacts were minimal.

6.1.1 Results

The riverine model simulated velocity vectors for domain grid cells on the days of September 8, 9, and 10, 2010 are provided in *Figure 6-3*, *6-4*, and *6-5*, respectively. The velocity throughout the model domain ranges from less than 1.0 ft/s to greater than 4.0 ft/s with most values less than 2.5 ft/s.

The riverine model simulated bed shear stress values for domain grid cells on the days of September 8, 9, and 10, 2010 are provided in *Figure 6-6*, *6-7*, and *6-8*, respectively. The bed shear stress throughout the model domain ranges from less than 1 Pa to greater than 20 Pa with most values less than 10 Pa.

The riverine model simulated sediment erosion or deposition rates (sand, silt, and clay particles) for domain grid cells during the time series are provided in *Figure 6-9*. The rates throughout the model domain range from erosion greater than 10 millimeters per week (mm/wk) to deposition greater than 10 mm/wk. The simulated erosion or deposition rates are variable and influenced by geomorphic surfaces. The riverine model simulated sediment erosion or deposition rate of

change for silt and clay sized particles over the time series is provided in *Figure 6-10*. The low flow model scenario indicated no net change for most grid cells.

6.1.2 Discussion

Observations for the low flow riverine model scenario simulation include the following:

- Most of the flow velocities were from 0.1-1.0 ft/s (77%) with a limited number of grid cells with velocities >3.0 ft/s (<1%).
- Overall average velocity is 0.49 ft/s, which is an 11% decrease from the October-November 2011 calibration period average velocity of 0.55 ft/s.
- Oxbows and backwaters have minimal flow and generally show the effects of backwater eddying. Some oxbows are not connected but receive flow at both ends.
- Cells with a net increase in silt mass have an average deposition rate of 1.54 mm/wk.
- Cells with a net decrease in silt mass have an average erosion rate of 4.84 mm/wk.
- Cells with only a change in silt or clay mass have an average deposition rate of 0.61 mm/wk.
- Deposition is minimal in the Morrow Lake Delta and there is no deposition on the Morrow Lake sediment fan.
- There is more probability of depositing silt in the main-channel due to the low flows.

6.2 100- Year Flow Return Period (High Flow)

The calibrated floodplain model was used to simulate the 100-year flow event for the Kalamazoo River. The peak flow for the 100-year flow return period was based on a Log Pearson Type III analysis of historical flow data from the Kalamazoo River USGS Stations at Marshall and Battle Creek. The hydrograph for the downstream flow at the USGS Battle Creek Station for the developed 100- year event is provided in *Figure 6-11*. This flow event represents high flow conditions with a peak flow that was between 6,000 cfs and 7,000 cfs. The boundary suspended sediment inputs for the entire high flow time series were 120 mg/L. Only floodplain model simulations were conducted for this high flow scenario.

6.2.1 Results

The floodplain model simulated velocity vectors for domain grid cells are provided in *Figure 6-12*. The velocity throughout the model domain ranges from less than 1.0 ft/s to greater than 4.0 ft/s with most values less than 3.0 ft/s.

The floodplain model simulated bed shear stress values for domain grid cells are provided in *Figure 6-13*. The bed shear stress throughout the model domain ranges from less than 1 Pa to greater than 50 Pa with most values less than 20 Pa.

The floodplain model simulated sediment erosion or deposition rates (sand, silt, and clay particles) for domain grid cells during the time series are provided in *Figure 6-14*. The rates throughout the model domain range from erosion greater than 10 mm/wk to deposition greater than 10 mm/wk. The simulated erosion or deposition rates are variable and influenced by geomorphic surfaces. The floodplain model simulated sediment erosion or deposition net rates of change for silt and clay sized particles over a week are provided in *Figure 6-15*. Net rates of change for silt and clay sized particles were often at the far end of the erosion and deposition range of 10 mm/wk for those portions of the river bed that were most and least influenced by shear stress.

6.2.2 Discussion

Observations for the 100-year floodplain model scenario simulation include the following:

- Overbank velocities exceed 1.0 ft/s in many areas and sometimes exceed 1.5 ft/s, particularly across point bars. Velocities are often below 1.0 ft/sec downstream of MP 21.50 where the floodplain is much wider.
- In-channel velocities between the confluence and Ceresco Dam are generally greater than 1.5 ft/sec across most of the channel except near the banks between MP 5.25 and the dam. Velocities upstream of MP 4.00 are above 2 ft/s across much of the channel.
- In-channel velocities decrease between MP 10.00 and MP 10.25 compared to upstream and downstream. In-channel velocities also decrease between MP 12.90 and MP 13.60.
- Levees at the north and south Mill Ponds are overtopped completely.
- In the engineered channel, velocities are often greater than 2.5 ft/s.
- Most flow exits at the top of the MP 21.50 oxbow. Flow from the oxbow does not enter the main-channel at the downstream end of the oxbow.
- In-channel velocities downstream from MP 21.50 often decrease at sharp meanders.
- The main-channel is almost entirely erosional between MP 6.00 and MP 14.00.
- The Mill Ponds remain depositional even at 100-yr flows.
- Little deposition or erosion occurs away from the main-channel between MP 30.75 and MP 33.00 even though the floodplain is very wide.
- The point bar between MP 34.25 and MP 34.50 is a significant depositional area.

- Morrow Lake Delta remains largely depositional.

6.3 50-Year Flow Return Period

The calibrated floodplain model was used to simulate the 50-year flow event for the Kalamazoo River. The peak flow for the 50-year return period was based on a Log Pearson Type III analysis of historical flow data from the Kalamazoo River USGS Stations at Marshall and Battle Creek . The hydrograph for the downstream flow at the USGS Battle Creek Station for the 50-year event is provided in *Figure 6-16*. This flow event represents flow conditions with a peak flow that was between 5,000 cfs and 6,000 cfs. The hydrograph for the 50-year event is similar to that of the 100- year event with a slightly lower peak flow. The boundary suspended sediment inputs for the entire high flow time series were 120 mg/L. Only floodplain model simulations were conducted for this flow scenario.

6.3.1 Results

The floodplain model simulated velocity vectors for domain grid cells are provided in *Figure 6-17*. The velocity throughout the model domain ranges from less than 1.0 ft/s to greater than 4.0 ft/s with most values less than 3.0 ft/s.

The floodplain model simulated bed shear stress values for domain grid cells are provided in *Figure 6-18*. The bed shear stress throughout the model domain ranges from less than 1 Pa to greater than 50 Pa with most values less than 20 Pa.

The floodplain model simulated sediment erosion or deposition rates (sand, silt, and clay particles) for domain grid cells during the time series are provided in Figures 6-19. The rates throughout the model domain range from erosion greater than 10 mm/wk to deposition greater than 10 mm/wk. The simulated erosion or deposition rates are variable and influenced by geomorphic surfaces. The floodplain model simulated sediment erosion or deposition net rates of change for silt and clay sized particles over a week are provided in *Figure 6-20*. Net rates of change for silt and clay sized particles were often at the far end of the erosion and deposition range of 10 mm/wk for those portions of the river bed that were most and least influenced by shear stress.

6.3.2 Discussion

Observations for the 50-year floodplain model scenario simulation are similar to those that were presented previously for the 100-year event.

6.4 Near Bank Full Flow

The calibrated riverine model was used to simulate the near bank full flow scenario. Aerial photographs during leaf off were available for this period to better define bank full flow boundaries. The low flow riverine model boundary input includes flow that was recorded at the USGS Marshall Station from April 6 -17, 2011. The hydrograph for the downstream flow at the USGS Battle Creek Station for the time series is provided in *Figure 6-21*. This flow event represents the near bank full flow conditions that were near 1,200 cfs. The boundary suspended sediment inputs for the low flow time series range from near 40 mg/L to near 100 mg/L and are provided in *Figure 6-22*. Only riverine model simulations were conducted for this flow scenario since floodplain impacts were minimal.

6.4.1 Results

The riverine model simulated velocity vectors for domain grid cells on the days of April 9, 12, and 16, 2011 and are provided in *Figure 6-23*, *6-24*, and *6-25*, respectively. The velocity throughout the model domain ranges from less than 1.0 ft/sec to greater than 4.0 ft/s with most values less than 2.5 ft/s.

The riverine model simulated bed shear stress values for domain grid cells on the days of April 9, 12, and 16, 2011 are provided in *Figure 6-26*, *6-27*, and *6-28*, respectively. The bed shear stress throughout the model domain ranges from less than 1 Pa to greater than 20 Pa with most values less than 10 Pa.

The riverine model simulated sediment erosion or deposition rates (sand, silt, and clay particles) for domain grid cells during the time series are provided in *Figure 6-29*. The rates throughout the model domain range from erosion greater than 10 mm/wk to deposition greater than 10 mm/wk. The simulated erosion or deposition rates are variable and influenced by geomorphic surfaces. The riverine model simulated sediment erosion or deposition rate of change for silt and clay sized particles over the time series is provided in *Figure 6-30*. The near base flow model scenario indicated some areas of erosion and deposition and no net change for many of the grid cells.

6.4.2 Discussion

Observations for the riverine model scenario simulation (near bank full) include the following:

- Velocities for most grid cells were less than 3.0 ft/s. The average velocity is 0.78 ft/s, which were a 42% increase from the October-November 2011 calibration period average

velocity of 0.55 ft/s and a 2.5% decrease from the May 2011 bank full flow (validation) average velocity of 0.8 ft/s.

- Oxbows and backwaters have some flow and generally show the effects of backwater eddying.
- The average deposition rate for cells with a net increase in silt mass is 1.52 mm/wk.
- The average erosion rate for cells with a net decrease in silt mass is 5.17 mm/wk.
- The average deposition rate for cells with a change in silt or clay mass is 0.84 mm/wk.
- Most deposition in Morrow Lake is upstream of MP 38.50. Some deposition occurs downstream to MP 39.00, mostly in and near the former channel.
- Morrow Lake Delta is largely depositional, with most erosion in the main-channel around MP 37.00.

7.0 Sediment Traps

7.1 Parameterization of Sediment Traps

The installation of sediment trap structures have been proposed for the Kalamazoo River to promote deposition of sediment and presumed associated oil. The traps will be installed in several depositional areas such as oxbows, cut-off channels, and backwaters. The traps dissipate energy upstream of the trap by raising water levels and decreasing velocity, resulting in increased sediment deposition (*Figure 7-1*). Two types of structures have been proposed including balsam fir trees and coir logs.

7.1.1 Balsam Fir Tree Parameters

Balsam fir trees were modeled as vegetative resistance to flow and parameterized with a tree height of 3 feet and porosity for each cell identified as a sediment trap structure. Porosity inputs were based on both measured values and literature values (Bitog *et al,* 2011). Literature values for coniferous tree porosity range from 75% (equivalent to 2 trees lying side by side) to 99% (equivalent to one tree). The porosity of balsam fir trees were estimated using the following water displacement methods.

7.1.2 Volume Calculations

Coniferous trees resemble the shape of a cone. The volume of a cone can be calculated using the following equation:

$V = 1/3\ \pi\ r^2\ h$, where V = volume; r = radius at the base of cone; and h = height of cone.

The radius was determined by measuring the circumference at the base of the tree. The radius was calculated using the following equation:

$r = C/2\pi$, where r = radius and C = circumference.

The solid tree volume was estimated using a water displacement method. A tub of water with a measured 73.25 inch diameter (36.625 inch radius) was filled with 15.5 inches of water. The tree was immersed underwater and the new water level was recorded. The displaced water is equal to the solid volume of the tree. The volume can be calculated using the following equation:

$V = \pi\ r^2\ h$, where V = volume; r = radius of the tub, and h = the increase in water level.

Two trees, one large and one small, were used to calculate solid volume. It was possible to submerge approximately only half of the large tree. Therefore, the displaced volume of water was doubled to estimate the total solid volume of the large tree. The small tree was fully submerged.

7.1.3 Porosity Calculation

The porous volume of the tree is equal to the total tree volume minus the solid tree volume. The porous volume was divided by the total tree volume to determine the porosity of the coniferous trees. The small tree had a 12,428.6 cubic inch total volume and a 526.5 cubic inch solid volume. Therefore, the small tree had an 11,902.1 cubic inch porous volume. The calculated porosity of the small coniferous tree was 95.8%. The large tree had a 42,994.1 cubic inch total volume and a 2,106.0 cubic inch solid volume. Therefore, the large tree had a 40,888.1 cubic inch porous volume. The calculated porosity of the large coniferous tree was 95.1%. Both of these values are within the range of porosities identified in the literature. To simulate the full range of porosities, the lower (75%) and upper (99%) porosity values were used in the model.

7.1.4 Coir Log Structure Parameterization

Coir logs are dense tubular structures made of compacted coconut fibers. For the purposes of this model, they were assumed to be non-porous and parameterized by raising bed elevation in the cell identified as a coir log structure by the diameter of the log which was 1.5 feet.

7.1.5 Flow Conditions

Four flow conditions were simulated for the sediment traps. October-November 2011 low flow conditions, the May 2011 near bank full flow conditions, the July 2010 flood conditions, and the 100-year flood conditions were simulated for balsam fir tree and coir log structures. For each model run, the change in velocity, shear stress and sedimentation rate were compared between the river without installed structures and with installed structure.

7.2 Results

The following sections describe the results of these simulations. The change in sedimentation rate during low flow conditions without installed structures and with the 99% porosity modeled structure, and without installed structures and with the 75% porosity structure are presented in *Figure 7-2* and *7-3*. The change in sedimentation rate during bank full conditions without installed structures and with the 99% porosity structure, and without installed structures and with the 75% porosity structure are presented in *Figure 7-4* and *7-5*. The change in sedimentation rate during

the July 2010 flood conditions without installed structures and with the 99% porosity structure, and without installed structures and with the 75% porosity structure are presented in *Figure 7-6* and *7-7*. The change in sedimentation rate during the 100-year flood conditions without installed structures and with the 99% porosity structure, and without installed structures and with the 75% porosity structure are presented in *Figure 7-8* and *7-9.*

Figure 7-10 shows the results for coir log structures during low flow conditions while *Figure 7-11* show the results at bank full conditions, and *Figure 7-12* show results during flood conditions.

Detailed velocity, shear stress, and sedimentation rate zonal summary results for each model run are provided in *Table 7-1* through and including *7-4*.

7.2.1 Balsam Tree Structures

Observations from the coniferous tree simulations include the following:

- MP 3.25 R1 is located in a cut-off channel. Deposition is negligible at low flow for both 99% and 75% porosity structures. At bank full levels deposition increases slightly at 75% PMS; however, the rate of deposition remains low. At flood levels, sediment trap structures add no measurable deposition. Because of low deposition rates, a structure is not recommended at this location.
- Ceresco Dam: Sedimentation rates upstream of Ceresco Dam are naturally elevated. The modeled structures at Ceresco provided no benefit for all flows.
- MP 10.40 North: Sedimentation rates are less than zero for all flows, indicating that erosion is occurring at this location. 99% porosity structure would have little impact on changing erosion rates. 75% porosity structure would reduce the rate of erosion, but does not result in significant deposition.
- MP 10.50 L2: Deposition is naturally high in this location. For both high and low flows, a 75% porosity structure does not increase deposition. However, during flood conditions a 75% porosity structure would decrease erosion. During flood condition, sediments are eroded with a 99% porosity structure installed. A 99% porosity structure increases deposition approximately 3-4% during low and bank full flows; however, this relatively low increase in deposition does not merit sediment trap installation.
- MP 10.75 LDB: At low flows, neither 99% or 75% porosity structures increase sedimentation rates. Likewise, a 99% porosity structure does not increase sedimentation at bank full or flood conditions. However, a 75% porosity structure increases

sedimentation during bank full and flood conditions. A 75% porosity structure is recommended for this location.

- MP 14.75 RDB: Both a 75% PMS and a 99% porosity structure increases sedimentation at all simulated flows at this location. However, a 75% porosity structure shows significant improvement in sedimentation compared to a 99% porosity structure, especially during flows below bank full. Therefore, a 75% porosity structure is recommended for this location.
- 19.25 LDB: 99% PMS simulate a 10% increase in sedimentation at low flows but would be ineffective at high flows. A 75% porosity structure is effective at all flows, especially during low flow and bank full conditions. A 75% porosity structure is recommended at this location.
- MP 21.50 RDB: Sedimentation rates in this oxbow are naturally high. Both a 99% porosity structure and a 75% porosity structure are ineffective for all flow conditions; this location is not recommended for sediment trap installation.
- MP 26.00 RDB: This area has naturally high sedimentation rates. Both a 99% porosity structure and a 75% porosity structure increased sedimentation at bank full and low flows. However, only a 75% porosity structure increased sedimentation during flood conditions. Therefore, a 75% porosity structure is recommended for this location.
- MP 28.25 RDB: Sedimentation in this oxbow is naturally low. Modeled structures appear to have no beneficial effect on sedimentation rate during low flow or flood conditions. During high flow conditions both a 99% and 75% porosity structures increases sedimentation (2% and 20%, respectively). Because modeled structures have minimal impact on sedimentation, no structures are recommended for this location.
- MP 30.80 LDB: Neither a 99% or 75% porosity structures increases deposition at bank full conditions. However, during flood and low flow conditions, both structures increase sedimentation rates. A 75% porosity structure is recommended for this location.
- MP 33.00 A: This location has naturally high levels of sedimentation during low flow conditions. The addition of structures decreases sedimentation during low flows. At bank full and flood conditions, the addition of structures has minimal impact on sedimentation. No structures are recommended for installation at this location.
- MP 33.00 B: This area has naturally high levels of sedimentation during low flow conditions. Neither a 99% or 75% porosity structures increases deposition rates appreciably for low or high flows. A 75% porosity structure increases deposition during

flood conditions. Because flood conditions are uncommon, no structures are recommended for this location.

- MP 36.10 NW: Neither a 99% or 75% porosity structures increase sedimentation during flood conditions. However, both modeled structures increase sedimentation during low flow and bank full conditions. A 75% porosity structure is recommended for this location.
- MP 37.75 Islands: Neither 99% or 75% porosity structures increase sedimentation appreciably for any of the simulated flows. No structure is recommended for this location.
- Delta A: Neither 99% or 75% porosity structures increase sedimentation during low flow conditions. Both structures increase sedimentation during bank full and flood conditions; a 75% porosity structure has the most impact on sedimentation rate. A 75% porosity structure is recommended at this location.

7.2.2 Coir Log Structures

Observations from the coir log simulations include the following:

- MP 11.21: A coir log structure does not increase sedimentation appreciably for any simulated flows at this location; a structure is not recommended.
- MP 11.78: A coir log structure is ineffective at low and bank full flow conditions. sedimentation is increased during flood conditions, but this area has positive sedimentation rates during flood conditions naturally. A structure is not recommended at this location.
- MP 26.25: The modeled structure at this location does not increase sedimentation appreciably for any simulated flows. No structure is recommended at this location.

8.0 Sensitivity Analysis

A sensitivity analysis was conducted on the calibrated riverine and floodplain models to evaluate the change in selected model input parameter values or boundary condition(s) on simulation results. The riverine sensitivity analysis considered impacts of localized areas on the Kalamazoo River. The floodplain sensitivity analysis considered impacts for longitudinal zones that included the entire model floodplain domain on the Kalamazoo River.

The 10 localized areas throughout the Kalamazoo River that were considered for the riverine sensitivity analysis model simulations include the following:

- MP 4.20 to MP 5.40,
- Ceresco Impoundment,
- MP 14.75 RDB Sediment Trap,
- Mill Pond Area,
- MP 21.50 RDB Sediment Trap,
- MP 26.00 RDB Sediment Trap,
- MP 33.00 A Sediment Trap,
- Sediment Fan,
- Morrow Lake Delta, and
- West end of Morrow Lake.

The 10 Kalamazoo River zones that were considered for the floodplain sensitivity analysis include the following:

- Confluence of Talmadge Creek with Kalamazoo River to Ceresco Dam,
- Ceresco Dam to Raymond Rd.,
- Raymond Road to Kalamazoo River Dam,
- Kalamazoo River Dam to Battle Creek River,
- Battle Creek River to Custer Drive,
- Custer Drive to M-96 Bridge,
- M-96 Bridge to Michigan Ave.,
- Michigan Ave. to 35th Street,
- 35th Street to MP 38.75, and
- MP 38.75 to Morrow Lake Dam.

One base model input value was changed for each sensitivity simulation. The model input parameters and adjusted values included the following:

- Roughness (± 50 % of base model value),
- Critical shear stress for deposition (± 50 % of base model value),
- Sediment settling velocity (± 50 % of base model value), and
- Boundary sediment concentration (± 50 % of base model value).

Boundary silt composition (maximum-68% and minimum-5% silt). The sensitivity model run names, sensitivity parameter adjustments, and pertinent riverine October-November 2011 or floodplain July 2010 simulation dates are provided in *Table 8-1*. The output parameters that were compared to base model results for sensitivity simulations included the following:

- Velocity,
- Shear stress,
- Sediment particle size distribution,
- Sedimentation rate,
- Change in sediment mass,
- Water surface elevation, and
- Sediment loading (Ceresco, Kalamazoo Dam, Kalamazoo Gage, 35h Street Bridge, Delta Neck, and Morrow lake Dam locations)

The parameter values that were adjusted for the sensitivity analysis and corresponding influence on simulation results for the 10 localized riverine model areas and 10 floodplain zone areas are discussed below.

8.1 Roughness Input

In general, an increase in roughness corresponds to an increase in the resistance to flow and a decrease in velocity and bed shear stress. Therefore an increase in roughness length corresponds to more deposition and a reduction in suspended sediment loads. A decrease in roughness length results in higher suspended sediment load.

The roughness value used throughout the riverine model was 0.02 m. The Manning roughness *n* coefficient (unitless) for the floodplain model ranged from 0.076 to 0.146. The sensitivity analysis includes increasing and decreasing the base model roughness length value for the riverine and floodplain models by 50%.

8.1.1 Riverine

8.1.1.1 Velocity Output

The comparison of average base model and sensitivity average velocity results are provided in *Table 8-2*. The model simulations with increased and/or decreased roughness values typically did not result in sensitivity simulation average velocity values that varied substantially from average base model velocity values.

8.1.1.2 Shear Stress Output

The comparison of average base model and sensitivity average shear stress results are provided in *Table 8-3*. The model sensitivity simulations with decreased roughness values typically had average shear stress results that were lower at most locations and simulations with increased roughness had average shear stress results that were higher at most locations than average base model shear stress values.

8.1.1.3 Sediment Particle Size Distribution Output

The comparison of average base model boundary sediment concentrations for sand, silt, and clay sized particles and average sensitivity simulation sediment particle size concentrations are provided in *Table 8-4*. The model simulations with an increase or decrease in roughness values typically had no influence on the average sensitivity simulation percent sand, silt, and clay sized particles.

8.1.1.4 Sedimentation Rate Output

The comparison of average base model weekly sedimentation rates and average sensitivity simulation weekly sedimentation rates are provided in *Table 8-5*. The model simulations with decreased roughness values had sensitivity simulation average weekly sedimentation rates that were either greater or less than base model results depending on location. The model simulations with increased roughness values had sensitivity simulation average weekly sedimentation rates that were less than base model results.

8.1.1.5 Change In Sediment Mass Output

The comparison of average base model sediment mass change for sand, silt, and clay sized particles and average sensitivity simulation sediment mass change are provided in *Table 8-6*. The model simulations with decreased roughness values typically had more average silt and clay and less average sand mass change. The model simulations with increased roughness values typically had less average silt, clay and sand mass change.

8.1.1.6 Water Surface Elevation Output

The comparison of base model water surface elevations and sensitivity simulation water surface elevations are provided in *Figure 8-1*. The model simulations with increased and/or decreased roughness values had minimal influence on water surface elevations.

8.1.1.7 Sediment Loading

The comparison of average base model and sensitivity average sediment loading results are provided in *Table 8-7*. The sensitivity model simulations with increased roughness resulted in average sediment loading values that changed from -6% to 13% as compared to average base values at the six locations. The sensitivity model simulations with decreased roughness resulted in average sediment loading that changed from -23% to 16% to that of average base values at the six Kalamazoo River locations.

8.1.2 Floodplain

8.1.2.1 Velocity Output

The comparison of average base model and sensitivity simulation average velocity results for channel and floodplain cells are provided in *Table 8-8*. The sensitivity model simulations with decreased or increased roughness values in the channel cells had slightly lower average velocities for zone areas as compared to average base model values.

The model simulations with decreased or increased roughness values in the floodplain cells had greater or similar average velocities for zone areas as compared to average base model values.

8.1.2.2 Shear Stress Output

The comparison of average base model and sensitivity simulation average shear stress results for channel and floodplain cells are provided in *Table 8-9*. The sensitivity model simulations with decreased or increased roughness values in the channel cells had lower average shear stress as compared to average base model values.

The sensitivity model simulations with decreased roughness values in the floodplain cells had lower average shear stress values as compared to average base model values. The sensitivity model simulations with increased roughness values in floodplain cells had greater sensitivity simulation average shear stress values as compared to average base model values.

8.1.2.3 Sediment Particle Size Distribution Output

The comparison of average base model and sensitivity simulation sediment sand, silt, and clay sized particles for channel and floodplain cells are provided in *Table 8-10*. The sensitivity model simulations for channel cells with decreased roughness values had lower or similar average silt, clay, and sand as compared to average base model values. The sensitivity model simulations for channel cells with increased values had lower average silt and clay and greater average sand as compared to average base model values.

The sensitivity model simulations for floodplain cells with decreased roughness values had more average sand, less average silt, and similar average clay as compared to average base model values. The sensitivity model simulations for floodplain cells with increased values had similar average sand, silt, and clay as compared to average base model values.

8.1.2.4 Sedimentation Rate Output

The comparison of average base model weekly sedimentation rates and average sensitivity simulation weekly sedimentation rates for channel and floodplain cells are provided in *Table 8-11*. The model simulations with decreased roughness values in the channel cells had sensitivity simulation average weekly sedimentation rates that were either greater or less than base model results depending on location. The model simulations with increased roughness values in the channel cells had sensitivity simulation average weekly sedimentation rates that were less than base model results.

The sensitivity model simulations for the floodplain cells with decreased roughness values had average sedimentation rates that were lower as compared to average base model values. The sensitivity model simulations for the floodplain cells with increased roughness values had similar or lower average sedimentation rates compared to average base model values.

8.1.2.5 Change in Sediment Mass Output

The comparison of average base model and sensitivity simulation sediment sand, silt, and clay sized particles for channel and floodplain cells are provided in *Table 8-12*. The sensitivity model simulations for channel cells with decreased and increased roughness values had average silt, clay, and sand net change values that varied depending on location as compared to average base model values.

The sensitivity model simulations for floodplain cells with decreased roughness values had average silt and clay net change values that varied depending on location. Average sand net

change values were lower as compared to average base model values. The sensitivity model simulations for floodplain cells with increased roughness values had average silt and clay net change values that varied depending on location and average sand net change values that were lower as compared to average base model values.

8.1.2.6 Water Surface Elevation Output

The comparison of base model water surface elevations and sensitivity simulation water surface elevations are provided in *Figure 8-2*. The model simulations with increased and/or decreased roughness values typically had minimal influence on water surface elevations.

8.1.2.7 Sediment Loading

The comparison of average base model and sensitivity sediment loading results are provided in *Table 8-7*. The sensitivity model simulations with increased roughness resulted in average sediment loading values that changed from -22% to 60% as compared to the average base values at the six locations. The sensitivity model simulations with decreased roughness resulted in average sediment loading that ranged from -28% to 62% to that of average base values at the six Kalamazoo River locations.

8.1.2.8 Critical Shear Stress for Deposition Input

The critical shear stress is the threshold bed stress above which no deposition occurs. Deposition increases as the bed stress declines below the critical shear stress. The critical shear stress for deposition that was used for all riverine and floodplain cells was 0.1 Pa.

The sensitivity analysis includes increasing and decreasing the base model critical shear stress for deposition value for the riverine and floodplain models by 50%.

8.1.3 Riverine

8.1.3.1 Velocity Output

The comparison of average base model and sensitivity average velocity results are provided in *Table 8-13*. The model simulations with altered critical shear stress values typically had sensitivity simulation average velocity values that were the same or slightly increased (<0.1 ft/sec increase) from average base model velocity values.

8.1.3.2 Shear Stress Output

The comparison of average base model and sensitivity average shear stress results are provided in *Table 8-14*. Both the model simulations with increased and decreased critical shear stress

inputs typically had average bed shear stress outputs that were slightly increased in most zones. However, the increase was greater for the sediment trap zones, particularly at MP 26.00 RDB and MP 33.00 A.

8.1.3.3 Sediment Particle Size Distribution Output

The comparison of average base model boundary sediment texture for sand, silt, and clay sized particles and average sensitivity simulation sediment particle size distributions are provided in *Table 8-15*. Changes to critical shear stress values typically have minimal influence on the sensitivity simulation particle size distribution for sand, silt, and clay sized particles (±1% change for each sediment class), as compared to the base model. Change was greater than 1% for the sediment trap zones at MP 21.50 RDB, MP 26.00 RDB, and MP 33.00 A, which generally showed an increase in silt over the base model run and a corresponding decrease in sand and/or clay.

8.1.3.4 Sedimentation Rate Output

The comparison of average base model weekly sedimentation rates for sand, silt, and clay sized particles and average sensitivity simulation weekly sedimentation rates are provided in *Table 8-16*. The model simulations with increased critical shear stress inputs had sensitivity simulation weekly average sedimentation rates that were generally greater than the average base model values. The model simulations with decreased critical shear stress inputs had sensitivity simulation average weekly sedimentation rates that were generally less than the average base model values.

8.1.3.5 Change In Sediment Mass Output

The comparison of average base model change in sediment mass for sand, silt, and clay sized particles and average sensitivity simulation change in sediment mass are provided in *Table 8-17*. The model simulations with increased critical shear stress values typically showed less average net change in silt mass, variable net change in clay mass both of which increased and decreased, and generally less average net change in sand mass. The model simulations with decreased critical shear stress values typically showed a greater average net change in silt mass, variable net change in average clay mass both of which increased and decreased, and generally less average net change in sand mass.

8.1.3.6 Water Surface Elevation Output

The comparison of base model water surface elevations and sensitivity simulation water surface elevations are provided in *Figure 8-3*. The model simulations with altered critical shear stress inputs had no effect on water surface elevations.

8.1.3.7 Sediment Loading Output

The comparison of base model sediment loading and sensitivity simulation sediment loading are provided in *Table 8-7.* The model simulations with a 50% increase in critical shear stress resulted in an increased average load of 8% to 13% at Ceresco Dam and at the neck of the Delta, a decreased average load of -1% to -5%, at Kalamazoo River Dam, 35th Street Bridge, and Morrow Lake Dam and had no effect at the Kalamazoo Gage at MP 16.75. The model simulations with a 50% decrease in critical shear stress resulted in a decreased average load of -4% to -23% at Ceresco Dam and g the neck of the Delta and an increased load of 2% to 16% at Kalamazoo River Dam, Kalamazoo Gage, 35th Street Bridge, and Morrow Lake Dam.

8.1.4 Floodplain

8.1.4.1 Velocity Output

The comparison of average base model and sensitivity simulation average velocity results for channel and floodplain cells are provided in *Table 8-18*. The sensitivity model simulations with increased critical shear stress had slightly lower velocities in the channel cells for zone areas as compared to average base model values.

The model simulations with decreased roughness values had greater average velocities in the floodplain cells for zone areas as compared to average base model values.

8.1.4.2 Shear Stress Output

The comparison of average base model and sensitivity simulation shear stress results for channel and floodplain cells are provided in *Table 8-19*. The sensitivity model simulations with increased critical shear stress input had decreased bed shear stress outputs in the channel cells as compared to average base model values and generally had increased bed shear stress outputs in the floodplain cells. The sensitivity model simulations with decreased critical shear stress inputs also generally had decreased sensitivity simulation average bed shear stress outputs in the channel cells as compared to average base model values and increased bed shear stress outputs in floodplain cells.

8.1.4.3 Sediment Particle Size Distribution Output

The comparison of average base model and sensitivity simulation sediment textures for sand, silt, and clay sized particles for channel and floodplain cells are provided in *Table 8-20*. The sensitivity model simulations with increased critical shear stress values had lower silt and clay concentrations and higher sand concentrations in the channel cells as compared to average base model values, and generally similar concentrations of sand, silt, and clay for the floodplain cells. The sensitivity model simulations with decreased critical shear stress values had decreased average silt, similar average clay, and increased average sand concentrations in the channel cells for zone areas as compared to average base model values. Changes in the floodplain cells were variable, with both increases and decreases of average values for each texture class.

8.1.4.4 Sedimentation Rate Output

The comparison of average base model weekly sedimentation rates for sand, silt, and clay sized particles and average sensitivity simulation weekly sedimentation rates, for both floodplain and channel cells, are provided in *Table 8-21*. The model simulations with increased critical shear stress inputs had sensitivity simulation average weekly sedimentation rates that were variable for channel cells, with some zones showing increased sedimentation and others showing decreased sedimentation. The model simulations with decreased critical shear stress inputs had sensitivity simulation average weekly sedimentation rates that were variable for channel cells, with some zones showing increased sedimentation and others showing decreased sedimentation.

For floodplain cells, most zones showed a decrease in sedimentation rate. For floodplain cells, most zones showed a decrease in sedimentation rate.

8.1.4.5 Change in Sediment Mass Output

The comparison of average base model change in sediment mass for sand, silt, and clay sized particles and average sensitivity simulation change in sediment mass are provided in *Table 8-22*. The model simulations with increased critical shear stress values typically showed greater average net change in silt, clay, and sand mass for channel cells and floodplain cells. The model simulations with decreased critical shear stress values typically showed less average net change in silt mass for both channel and floodplain cells, less average net change in clay mass for both channel and floodplain cells, typically greater average net change in sand mass for channel cells, and variable average net change, both increase and decrease, in sand mass for floodplain cells.

8.1.4.6 Water Surface Elevation Output

The comparison of base model water surface elevations and sensitivity simulation water surface elevations for the floodplain model are provided in *Figure 8-4*. The model simulations with altered critical shear stress inputs had no effect on water surface elevations.

8.1.4.7 Sediment Loading Output

The comparison of average base model and sensitivity sediment loading results are provided in *Table 8-7*. The sensitivity model simulations with increased critical shear stress resulted in average sediment loading values that changed from -32% to -7% as compared to the average base values at the six locations. The sensitivity model simulations with decreased critical shear stress resulted in average sediment loading that changed from 11% to 113% to that of average base values at the six Kalamazoo River locations.

8.2 Sediment Settling Velocity Input

Settling velocity determines the rate at which a particle settles in a water column. An increased settling velocity would result in less suspended sediment load.

The sensitivity analysis includes increasing and decreasing the base model sediment settling velocity value for the riverine and floodplain models by 50%.

8.2.1 Riverine

8.2.1.1 Velocity Output

The comparison of average base model and sensitivity average velocity results are provided in *Table 8-23*. The model simulations with adjusted settling velocities typically had sensitivity simulation average flow velocities that were the same or slightly increased (<0.1 ft/sec increase) from average base model flow velocities. Sediment trap zones at MP 21.50 RDB, MP 26.00 RDB, and MP 33.00 A showed greater increase in flow velocities.

8.2.1.2 Shear Stress Output

The comparison of average base model and sensitivity average shear stress results are provided in *Table 8-24*. Both the model simulations with increased and with decreased settling velocities typically had bed shear stress outputs that were slightly increased in most zones. However, increase was greater for the sediment trap zones, particularly at MP 26.00 RDB and MP 33.00 A.

8.2.1.3 Sediment Particle Size Distribution Output

The comparison of average base model boundary sediment texture for sand, silt, and clay sized particles and average sensitivity simulation sediment particle size distributions are provided in *Table 8-25*. Changes to settling velocity generally have minimal influence on the sensitivity simulation particle size distribution for sand, silt, and clay sized particles (±1% change for each sediment class), as compared to the base model. Change was greater than 1% for the sediment trap zones at MP 21.50 RDB, MP 26.00 RDB, and MP 33.00 A, which generally showed an increase in average percent silt over the base model run at the expense of sand and/or clay.

8.2.1.4 Sedimentation Rate Output

The comparison of average base model weekly sedimentation rates for sand, silt, and clay sized particles and average sensitivity simulation weekly sedimentation rates are provided in *Table 8-26*. The model simulations with increased settling velocity had sensitivity simulation weekly sedimentation rates that were generally less than the base model run. The model simulations with decreased settling velocity had sensitivity simulation weekly sedimentation rates that were greater or less than the base model run, depending on zone.

8.2.1.5 Change in Sediment Mass Output

The comparison of average base model change in sediment mass for sand, silt, and clay sized particles and average sensitivity simulation change in sediment mass are provided in *Table 8-27*. The model simulations with increased settling velocity had a variable effect on net change in silt mass, with some zones showing an increase and others a decrease. These simulations generally caused an increased net change in clay mass. These simulations resulted in less net change in sand mass. The model simulations with decreased settling velocities typically showed a smaller net change in silt mass, greater net change in clay mass, and had a variable effect on net change in sand mass.

8.2.1.6 Water Surface Elevation Output

The comparison of base model water surface elevations and sensitivity simulation water surface elevations are provided in *Figure 8-5*. The model simulations with altered settling velocity inputs had no effect on output water surface elevations.

8.2.1.7 Sediment Loading Output

The comparison of base model sediment loading and sensitivity simulation sediment loading are provided in *Table 8-7*. The model simulations with a 50% increase in settling velocity resulted in

a decreased average load at all six simulated locations. The model simulations with a 50% decrease in velocity resulted in an increased average load at all locations except the Kalamazoo Gage, which had a 2% decrease.

8.2.2 Floodplain

8.2.2.1 Velocity Output

The comparison of average base model and sensitivity simulation average velocity results for channel and floodplain cells are provided in *Table 8-28*. The sensitivity model simulations with increased settling velocity had lower average flow velocities in the channel cells as compared to average base model values and higher flow velocities in the floodplain cells. The model simulations with decreased settling velocities also had lower average flow velocities in the channel cells and higher average flow velocities in the floodplain cells as compared to average base model values.

8.2.2.2 Shear Stress Output

The comparison of average base model and sensitivity simulation shear stress results for channel and floodplain cells are provided in *Table 8-29*. The sensitivity model simulations with increased settling velocity had decreased average bed shear stress outputs in the channel cells as compared to average base model values and had increased average bed shear stress outputs in the floodplain cells. The sensitivity model simulations with decreased settling velocity also generally had decreased sensitivity simulation average bed shear stress outputs in the channel cells as compared to average base model values and increased bed shear stress outputs in the floodplain cells.

8.2.2.3 Sediment Particle Size Distribution Output

The comparison of average base model and sensitivity simulation sediment textures for sand, silt, and clay sized particles for channel and floodplain cells are provided in *Table 8-30*. The sensitivity model simulations with increased settling velocities had lower average silt concentrations, generally similar average clay concentrations, and higher average sand concentrations in the channel cells as compared to average base model values. For floodplain cells, average silt percent generally increased, average clay was similar, and average sand percent generally decreased. The sensitivity model simulations with decreased settling velocities had decreased average silt, similar average clay, and increased average sand concentrations in the channel cells as compared to average base model values, and variable changes in the

floodplain cells, with increases in average silt, similar average clay, and decreases in average sand.

8.2.2.4 Sedimentation Rate Output

The comparison of average base model weekly sedimentation rates for sand, silt, and clay sized particles and average sensitivity simulation weekly sedimentation rates, for both floodplain and channel cells, are provided in *Table 8-31*. The model simulations with increased settling velocity had sensitivity simulation average weekly sedimentation rates that increased for channel cells. For floodplain cells, most zones showed a decrease in sedimentation rate. The model simulations with decreased settling velocity had sensitivity simulation weekly sedimentation rates that generally increased for channel cells. For floodplain cells increases and decreases in sedimentation rates occurred depending on zone.

8.2.2.5 Change in Sediment Mass Output

The comparison of average base model change in sediment mass for sand, silt, and clay sized particles and average sensitivity simulation change in sediment mass are provided in *Table 8-32*. The model simulations with increased and decreased settling velocities typically had variable average net change in silt, clay, and sand mass for channel cells and floodplain cells depending on zone.

8.2.2.6 Water Surface Elevation Output

The comparison of base model water surface elevations and sensitivity simulation water surface elevations for the floodplain model are provided in *Figure 8-6.* The model simulations with altered settling velocities had no effect on water surface elevations.

8.2.2.7 Sediment Loading Output

The comparison of average base model and sensitivity sediment loading results are provided in *Table 8-7*. The sensitivity model simulations with increased setting velocity resulted in average sediment loading values that changed from -34% to -4% as compared to the average base values at the six locations. The sensitivity model simulations with decreased settling velocity resulted in average sediment loading that changed from 6% to 58% to that of average base values at the six Kalamazoo River locations.

8.3 Boundary Sediment Concentration Input

The boundary sediment concentration input directly relates to the simulated sediment load transport in the river. An increase in sediment concentrations results in increased simulated sediment load in the river.

The sensitivity analysis includes increasing and decreasing the base model sediment concentration value for the riverine and floodplain models by 50%.

8.3.1 Riverine

8.3.1.1 Velocity Output

The comparison of average base model and sensitivity average velocity results are provided in *Table 8-33*. The model simulations with decreased or increased sediment concentrations typically did not result in sensitivity simulation average velocity values that varied substantially from average base model velocity values.

8.3.1.2 Shear Stress Output

The comparison of average base model and sensitivity average shear stress results are provided in *Table 8-34*. The model simulations with decreased or increased sediment concentrations typically did not result in sensitivity simulation average shear stress that varied substantially from average base model velocity values.

8.3.1.3 Sediment Particle Size Distribution Output

The comparison of average base model and sensitivity average velocity results are provided in *Table 8-35*. The model simulations with an increase or decrease in sediment concentration typically had no influence on the sensitivity simulation percent sand, silt, and clay sized particles.

8.3.1.4 Sedimentation Rate Output

The comparison of average base model weekly sedimentation rate for sand, silt, and clay sized particles and average sensitivity simulation weekly sedimentation rate are provided in *Table 8-36.* The model simulations with decreased sediment concentrations resulted in similar or slightly lower sensitivity simulation weekly sedimentation rates. The model simulations with increased sediment concentrations resulted in sensitivity simulation weekly sedimentation rates that were similar or slightly greater than base model results.

8.3.1.5 Change in Sediment Mass Output

The comparison of average base model sediment mass change for sand, silt, and clay sized particles and average sensitivity simulation sediment mass change are provided in *Table 8-37.* The model simulations with decreased sediment concentrations typically had lower average silt and clay and variable average sand mass change rates. The model simulations with increased sediment concentrations typically had higher silt and clay and variable sand sediment mass change.

8.3.1.6 Water Surface Elevation Output

The comparison of base model water surface elevations and sensitivity simulation water surface elevations are provided in *Figure 8-7*. The model simulations with increased and/or decreased sediment concentrations had minimal influence on water surface elevations.

8.3.1.7 Sediment Loading

The comparison of average base model and sensitivity average sediment loading results are provided in *Table 8-7*. The sensitivity model simulations with increased sediment concentrations resulted in average sediment loading that changed from -59% to 482% to that of the average base values at the six locations. The sensitivity model simulations with decreased sediment concentrations resulted in average sediment loading that changed from -57% to 323% to that of base values at the six Kalamazoo River locations.

8.3.2 Floodplain

8.3.2.1 Velocity Output

The comparison of average base model and sensitivity simulation average velocity results for channel and floodplain cells are provided in *Table 8-38*. The sensitivity model simulations with decreased or increased sediment concentrations in the channel cells had slightly lower or similar average velocities for zone areas as compared to average base model values. The model simulations with decreased or increased sediment concentrations in floodplain cells had greater or similar average velocities for zone areas as compared to average base model values.

8.3.2.2 Shear Stress Output

The comparison of average base model and sensitivity simulation shear stress results for channel and floodplain cells are provided in *Table 8-39*. The sensitivity model simulations with decreased sediment concentrations in the channel cells had slightly lower or similar average shear stress as compared to average base model values.

The sensitivity model simulations with decreased sediment concentrations in the floodplain cells had higher or similar average shear stress as compared to average base model values. The sensitivity model simulations with increased sediment concentrations in the floodplain cells had greater average shear stress as compared to average base model values.

8.3.2.3 Sediment Particle Size Distribution Output

The comparison of average base model and sensitivity simulation sediment sand, silt, and clay sized particles for channel and floodplain cells are provided in *Table 8-40*. The sensitivity model simulations for channel cells with decreased sediment concentrations had slightly lower average silt and clay and average higher sand percent as compared to average base model values. The sensitivity model simulations for channel cells with increased values had similar or lower average silt and clay and average higher sand percent as compared to average base model values.

The sensitivity model simulations for floodplain cells with decreased sediment concentration had similar or higher average silt and clay and lower average sand percent as compared to average base model values. The sensitivity model simulations for floodplain cells with increased sediment concentrations had similar or lower average silt, clay, and sand percent as compared to average base model values.

8.3.2.4 Sedimentation Rate Output

The comparison of average base model weekly sedimentation rate change and sensitivity simulation average weekly sedimentation rate change for channel and floodplain cells are provided in *Table 8-41*. The model simulations with decreased sediment concentration in the channel cells resulted in sensitivity simulation average weekly sedimentation rate changes that were higher or lower than base model results depending on location. The model simulations with increased sediment concentration in the channel cells had sensitivity simulation average weekly sedimentation rates that were higher than base model results.

The model simulations with decreased or increased sediment concentration in the floodplain cells resulted in sensitivity simulation average weekly sedimentation rate changes that were lower or similar than average base model results depending on location.

8.3.2.5 Change in Sediment Mass Output

The comparison of average base model and sensitivity simulation sediment sand, silt, and clay sized particles for channel and floodplain cells are provided in *Table 8-42*. The sensitivity model simulations for channel cells with decreased or increased sediment concentration had silt, clay,

and sand net change values that varied depending on location as compared to average base model values.

The sensitivity model simulations for floodplain cells with decreased sediment concentrations had average silt, clay, and sand net change values that were similar or lower as compared to average base model values. The sensitivity model simulations for floodplain cells with increased sediment concentrations had average silt and clay net change values that were greater and average sand net change values that were lower depending on location as compared to average base model values.

8.3.2.6 Water Surface Elevation Output

The comparison of base model water surface elevations and sensitivity simulation water surface elevations are provided in *Figure 8-8*. The model simulations with increased and/or decreased roughness values typically had minimal influence on water surface elevations.

8.3.2.7 Sediment Loading

The comparison of average base model and sensitivity sediment loading results are provided in *Table 8-7*. The sensitivity model simulations with increased sediment concentrations resulted in average sediment loading that changed from 11% to 82% to that of the average base values at the six locations. The sensitivity model simulations with decreased sediment concentrations resulted in average sediment loading that changed from -57% to 30% to that of base values at the six Kalamazoo River locations.

8.4 Boundary Silt Composition Input

The sensitivity analysis includes increasing and decreasing the base model silt percentages to 68% and 5%, respectively.

8.4.1 Riverine

8.4.1.1 Velocity Output

The comparison of average base model and sensitivity average velocity results are provided in *Table 8-43*. The model simulations with adjusted boundary silt percentages typically had sensitivity simulation average flow velocities that were the same or slightly increased (<0.1 ft/sec increase) from average base model flow velocities. Sediment trap zones at MP 21.50 RDB, MP 26.00 RDB, and MP 33.00 A showed greater increase in flow velocities.

8.4.1.2 Shear Stress Output

The comparison of average base model and sensitivity average shear stress results are provided in *Table 8-44.* Both the model simulations with increased and with decreased silt percentages typically had bed shear stress outputs that were slightly increased in most zones. However, increase was greater for the sediment trap zones, particularly at MP 26.00 RDB and MP 33.00 A.

8.4.1.3 Sediment Particle Size Distribution Output

The comparison of average base model boundary sediment texture for sand, silt, and clay sized particles and average sensitivity simulation sediment particle size distributions are provided in *Table 8-45*. Increase of input silt percentage generally increased output percentage of silt slightly, had little effect on clay, and slightly decreased percentage sand, as compared to the base model. Decrease of input silt percentage generally resulted in a slight output decrease in silt percentage, with little change to clay, and a slight increase in sand percentage.

8.4.1.4 Sedimentation Rate Output

The comparison of average base model weekly sedimentation rates for sand, silt, and clay sized particles and average sensitivity simulation weekly sedimentation rates are provided in Table 8-46. The model simulations with increased silt percentage had sensitivity simulation weekly sedimentation rates that were generally the same or slightly greater than the base model run. The model simulations with decreased silt percentage had sensitivity simulation weekly sedimentation rates that were less than the base model run for all zones.

8.4.1.5 Change in Sediment Mass Output

The comparison of average base model change in sediment mass for sand, silt, and clay sized particles and average sensitivity simulation change in sediment mass are provided in *Table 8-47.* The model simulations with increased silt percentage input resulted in an increase of net change in silt mass, little difference for net change in clay mass, and a decrease in net change for sand mass. The model simulations with decreased silt percentage input typically showed a significant decrease in net change in silt mass, minimal difference in net change in clay mass, and a decrease in net change in sand mass.

8.4.1.6 Water Surface Elevation Output

The comparison of base model water surface elevations and sensitivity simulation water surface elevations are provided in *Figure 8-9*. The model simulations with altered silt percentage inputs had no effect on output water surface elevations.

8.4.1.7 Sediment Loading Output

The comparison of base model sediment loading and sensitivity simulation sediment loading are provided in *Table 8-7*. The model simulations with maximum silt percentage input resulted in an increased average load of 4% to 26% at all six simulated locations. The model simulations with minimum silt percentage input resulted in a decreased average load at all locations except Morrow Lake Dam, which had a 9% increase.

8.4.2 Floodplain

8.4.2.1 Velocity Output

The comparison of average base model and sensitivity simulation average velocity results for channel and floodplain cells are provided in *Table 8-48*. The sensitivity model simulations with increased silt percentage had lower average flow velocities in the channel cells as compared to average base model values and higher flow velocities in the floodplain cells. The model simulations with decreased silt percentage also had lower average flow velocities in the channel cells and higher average flow velocities in the floodplain cells as compared to average base model values.

8.4.2.2 Shear Stress Output

The comparison of average base model and sensitivity simulation shear stress results for channel and floodplain cells are provided in *Table 8-49*. The sensitivity model simulations with increased silt percentage had decreased bed shear stress outputs in the channel cells as compared to average base model values and had increased bed shear stress outputs in the floodplain cells. The sensitivity model simulations with decreased silt percentage also generally had decreased sensitivity simulation average bed shear stress outputs in the channel cells as compared to average base model values and increased bed shear stress outputs in the floodplain cells.

8.4.2.3 Sediment Particle Size Distribution Output

The comparison of average base model and sensitivity simulation sediment textures for sand, silt, and clay sized particles for channel and floodplain cells are provided in *Table 8-50*. The sensitivity model simulations with increased silt percentage had lower silt concentrations, generally similar clay concentrations, and higher sand concentrations in the channel cells as compared to average base model values. For floodplain cells, silt percent generally increased, clay was similar, and sand percent generally decreased. The sensitivity model simulations with decreased silt percentage had decreased silt, similar clay, and increased sand concentrations in the channel cells as compared to average base model values, and variable changes in the

floodplain cells, with increases in silt percent, decreases in clay percentages, and decreases in sand percentages.

8.4.2.4 Sedimentation Rate Output

The comparison of average base model weekly sedimentation rates for sand, silt, and clay sized particles and average sensitivity simulation weekly sedimentation rates, for both floodplain and channel cells, are provided in *Table 8-51*. The model simulations with increased silt percentage had sensitivity simulation weekly sedimentation rates that increased for channel cells. For floodplain cells, zones showed an increase in sedimentation rate upstream of Custer Drive and a decrease in sedimentation rate downstream of Custer Drive. The model simulations with decreased silt percentage had sensitivity simulation weekly sedimentation rates that were variable for channel cells, with some zones increasing and others decreasing. For floodplain cells, most zones showed a decrease in sedimentation rate.

8.4.2.5 Change in Sediment Mass Output

The comparison of average base model change in sediment mass for sand, silt, and clay sized particles and average sensitivity simulation change in sediment mass are provided in *Table 8-52*. The model simulations with increased silt percentage typically had increases in net change in mass for silt and clay, and decreases in net change in sand mass for channel cells and floodplain cells. The model simulations with decreased silt percentages had variable changes for channel cells, with some zones showing an increase in net change and other zones showing a decrease in net change. For floodplain cells there was generally a decrease in net change in mass for sand, silt, and clay.

8.4.2.6 Water Surface Elevation Output

The comparison of base model water surface elevations and sensitivity simulation water surface elevations for the floodplain model are provided in *Figure 8-10*. The model simulations with altered silt percentage inputs had no effect on water surface elevations.

8.4.2.7 Sediment Loading Output

The comparison of average base model and sensitivity sediment loading results are provided in *Table 8-7*. The sensitivity model simulations with increased sediment silt content resulted in average sediment loading that changed from 6% to 28% to that of the average base values at the six locations. The sensitivity model simulations with decreased silt content resulted in average

sediment loading that changed from -63% to 12% to that of average base values at the six Kalamazoo River locations.

9.0 Base Model Limitations

A numerical model, including the hydrodynamic and sediment transport model described in this report, is a tool designed to represent a simplification of field conditions. It is not possible for a numerical hydrodynamic model, or any model designed to replicate a complex system, to precisely replicate actual conditions. Fluvial systems are complex and influenced by many variables. Data to characterize fluvial systems are typically limited. Hydrodynamic numerical models, including EFDC, are used to simulate conditions including flow time series, sediment inputs, and physical changes (e.g. obstructions, channel alteration) and the corresponding physical response as measured by output variables. The model applications and interpretation of simulation results requires an understanding of model limitations.

Limitations of the base riverine and floodplain models are as follows:

- The base models were developed as 2-D models since limited data was available to characterize the 40 mile fluvial system and a 3-D model impacts utility due to run time. The base 2-D models therefore are not designed to characterize parameters in more than 2 dimensions (e.g. velocity profile).
- Base flows in the Great Lakes Basin, including the Kalamazoo River Watershed (Hydrologic Unit Code 04050003) were determined using hydrograph separation methods (Neff et al., 2005). The estimated long term average groundwater base flow index of stream flow for the Kalamazoo River ranged from 0.55 to 0.72 depending on the hydrograph separation method used. The riverine and floodplain base models accounted for flow including groundwater contributions using recorded inputs from Kalamazoo River USGS Stations and estimated inputs from tributaries. The downstream model simulated flows were compared to flows recorded at a USGS Station. Although the EFDC code is designed to consider groundwater inputs, the base models were not structured to simulate localized groundwater influence on sediment transport. Field and geomorphic evaluations indicate that surface water hydrodynamics, which include groundwater contributions, have the overriding influence on river erosion, deposition, and transport. Literature sources suggests that groundwater influence in fluvial systems has been associated with solute transport and not contaminants associated with sediment (Ge, Y., M. Boufadel, 2006 ; Ryan, R., M. Boufadel, 2006).
- The base models were developed to consider hydrodynamics and sediment transport for the 40 miles of Kalamazoo River that was impacted by the July 2010 crude oil release.

The base model does not consider submerged oil transport. Field data or literature that provide a basis for characterizing the complex relationships between solid phase sediment and associated oil transport were not available.

- The base models were not developed to consider submerged oil biodegradation.

9.1 Discussion and Interpretation

The hydrodynamic model simulates sediment transport for flow events of varying magnitude to assess deposition and erosion of sediment throughout the Kalamazoo River model domain. Field investigations have indicated a correlation between sediment deposition areas and submerged oil areas. Likewise, there is correlation between eroded areas and minimal or no occurrence of submerged oil. These observations are reasonable since the deposition or erosion of both sediment and or solid phase submerged oil are controlled by similar factors that influence settlement and transport including river velocity and particle settling rates.

The submerged oil deposition initially occurred following a 25-year flood event. Since the initial flood event, the predominant flow has been less than bank full. The potential for sediment remobilization during high flow events was estimated using model simulations. The mode simulations for the sediment remobilization analysis were based on four flow events below or at bank full condition and four flood events that included 50-year and 100-year flood events. The flow events and the potential for remobilization are shown in *Table10-1*.

The submerged oil remobilization riverine analysis shows a minimal amount of submerged oil movement during even the highest flow events. The potential remobilization areas and the 2011 year-end submerged oil delineation areas are shown in *Figure 10-1*. This does not include the 2011 gap in the Delta. A summary of interpretations associated with riverine model simulation results are provided below:

- At less than bank full flows (< 1500 cfs) only 0.7 acres or 1.4% of existing submerged oil delineation area has the potential to remobilize.
- At bank full flow (1500 cfs), approximately 0.8 acres or 1.5% of existing submerged oil delineation area has the potential to remobilize.
- If the July 2010 flow occurred again (3000 cfs), 1.0 acres or 2.0% of existing submerged oil delineation area has the potential to remobilize.
- During the 50-year flood event (approximately 5500 cfs), 0.9 acres or 1.8% of existing submerged oil delineation area has the potential to remobilize. The remobilization

potential is less than the July 2010 flood probably due to an increase in water depth and less flow shear stress in the submerged oil delineation areas.

- At flows up to 100-year flood level (approximately 6500 cfs), approximately 2 acres or 4% of existing submerged oil delineation area has the potential to remobilize.
- The remaining submerged oil has settled in long-term depositional areas and remobilization is unlikely.
- A small percentage of submerged oil continues to pass through actively mobile areas of the bed.

The remobilization analysis for the floodplain shows minimal erosion in the floodplain despite the size of the areas inundated by the flood flows. The inundated floodplain area, the acres of potential remobilization, and some interpretations are as follows:

- At 100-year flood flows, the inundated floodplain is 2,961 acres. The floodplain area with high potential for remobilization is 25 acres (<1%). The remobilization areas are shown on *Figure 10-2*.
- At 50-year flood flows, the inundated floodplain is 2,747 acres. The floodplain area with high potential for remobilization is 18 acres (<1%). The remobilization areas are shown on *Figure 10-3*.
- Most submerged oil within the channel banks is unlikely to remobilize during low, moderate, or high flow events.
- The submerged oil is a subset of silt and clay sediment that may be remobilized during different flow events in both the riverine and floodplain areas.

10.0 Summary

This report describes EFDC applications that were performed to assess sediment transport associated with a range of Kalamazoo River flow conditions and also to evaluate the potential performance of sediment traps in selected river locations. The modeling process included the development of two base models. The domain for one model included only the river channel (riverine model). The domain for the other model included both the river channel and the floodplain (floodplain model). Both models were developed in 2-dimensions. Horizontal grid networks were developed for the base models to provide cells with spatial descriptive data and also to support model numerical finite difference calculations. Inputs for the base models were obtained from USGS gage stations, existing field data collected by Enbridge, or from published literature sources. Only limited suspended sediment concentration data was available. Discharge and sediment concentration (qualitative) boundary conditions were established based on available data. The models were calibrated to discharge, water surface elevation, and velocity using data from USGS gage stations located on the Kalamazoo River and other field data obtained in 2011. The models were calibrated to velocity using point and transect data collected by Enbridge on the Kalamazoo River. Model calibration has been an iterative process resulting in model refinement as data gaps were defined and/or additional information became available to improve the models. Model validation was performed by comparing calibrated models to available data from historical events. Model scenarios or specified historical discharge events were simulated to assess potential sediment transport and also the potential performance of sediment traps in selected river locations. The sensitivity analysis indicates that the model is most influenced by flow and bathymetry.

The model simulations provide a basis for characterizing Kalamazoo River hydrodynamics and sediment transport associated with a range of flow conditions. Model simulation results typically agree with quantitative and qualitative field data and fluvial system characteristics. In particular, the model delineation of silt deposition areas, correspond with submerged oil delineation areas developed from 2010 and 2011field data and geomorphic interpretations. Overall, model results have provided insights to fluvial characteristics that are difficult to measure or quantify directly.

Some of the modeling results that can be used to assess future impacts or support effective management decisions are as follows:

- In-channel velocities, at bankfull and below, are highest where the channel narrows and lowest in oxbows, backwaters, and other areas away from the main-channel. Areas showing the highest deposition of silts and clays correspond with widespread submerged oil areas. These areas tend to be stable even at simulated high flows (50- year and 100-year events).
- Model results for Morrow Lake Delta generally show a largely depositional area with small areas of erosion, as flow moves around the many islands. Model results for Morrow Lake show silt being deposited on the sediment fan, with clay being deposited further into the lake, except during low flow conditions. Negligible or no erosion occurs in the lake, even at the highest flows, except immediately upstream of the dam.
- Silt deposition at high flow is restricted almost entirely to backwaters and other areas off the main-channel. At the highest simulated flows, some sections of the main-channel have decreased velocities as significant flow is directed onto the floodplain. At the highest simulated flows, overbank velocities may exceeded 1.5 feet/second.
- Once banks are overtopped during flood conditions, much of the river valley becomes inundated. The size of the floodplain varies little with the magnitude of overbank flooding. At flows of approximately 3,000 cfs at the Kalamazoo River near Battle Creek USGS gage, the floodplain is approximately 2,350 acres. If flow increases to 6,500 cfs (100 year event), the size of the impacted floodplain is about 2,950 acres, which is only a 25% increase. Based on simulated sedimentation rates, the potential for remobilization of sediment on the floodplain is very low, with less than 1% of the floodplain having a high potential for remobilization during any of the simulated flood events.
- Model simulations suggest that any remaining submerged oil is in long-term stable areas.
- The model provides a basis for evaluating remediation measures including sediment trap location and potential performance.

11.0 References

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Figure 1-1

Hydrodyanamic Model Grid Extent

ENBRIDGE

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Approved:	DBR 4/2/2012
Project #:	106-4186

Map Location

Legend

- Riverine Grid Extent
- Floodplain Grid Extent*
- Major Road or Highway
- Five Mile Grid Segment

*For Morrow Lake Delta and Morrow Lake, the riverine model and floodplain model use the same grid.

N

0 4,250 8,500 17,000

Scale in Feet

HYDRODYNAMIC MODEL
GRID EXTENT

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

Figure 3-1

Riverine Grid

Sheets 1 through 56

ENBRIDGE

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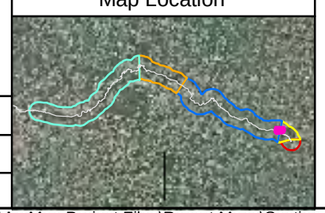
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: November 2011

ENBRIDGE

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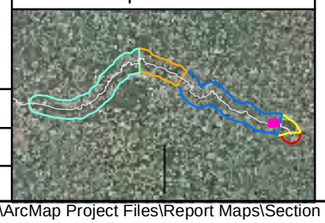
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

ENBRIDGE

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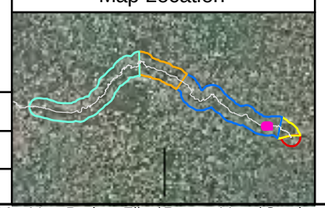
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 03.40 - MP 04.20

SHEET 3 OF 56

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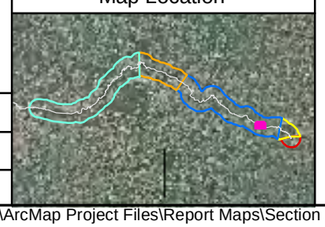
Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 04.15 - MP 05.00

SHEET 4 OF 56

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
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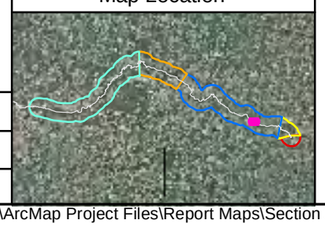
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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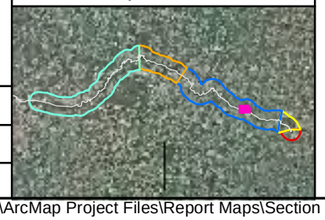
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

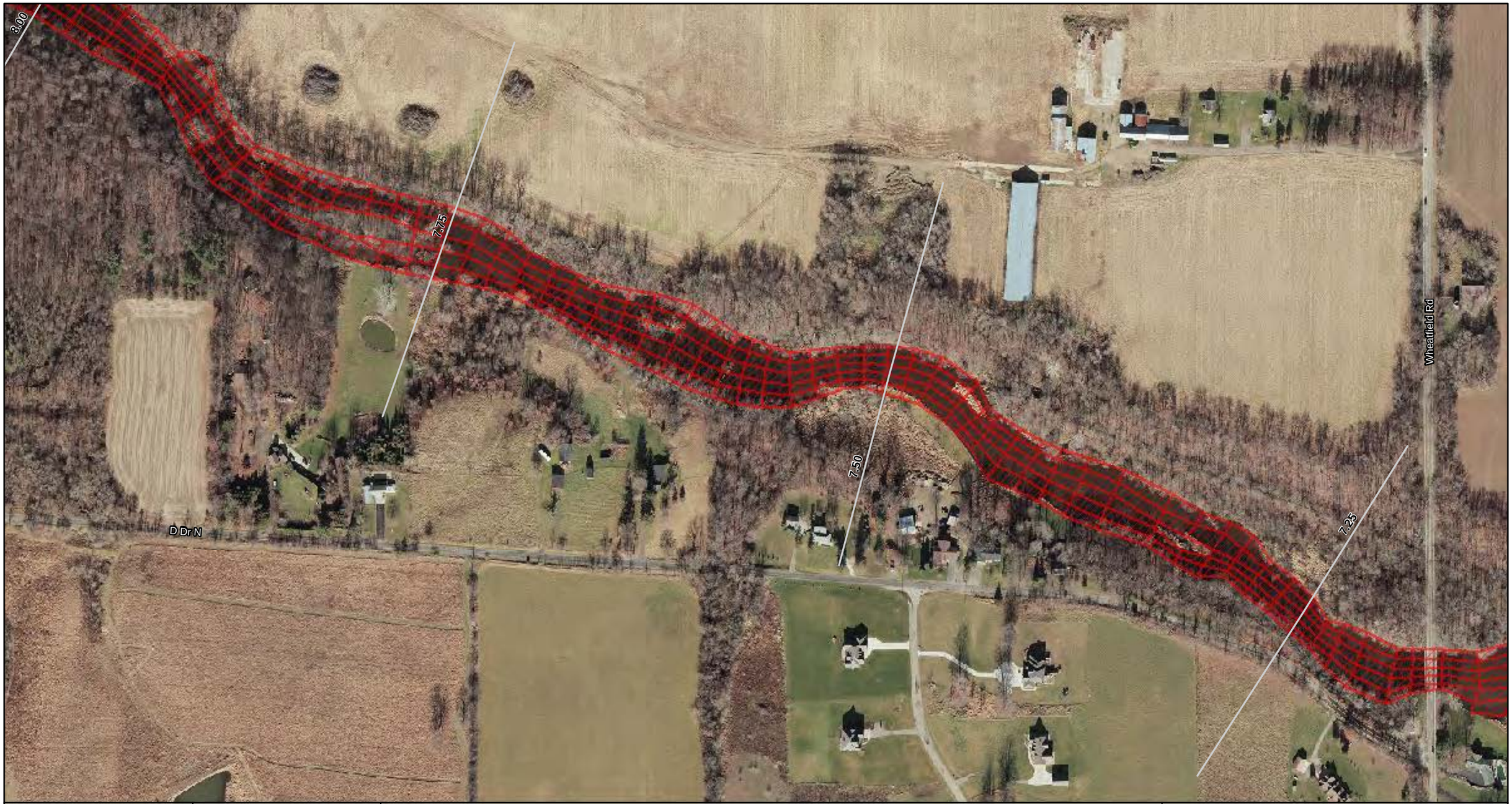
MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Grid.mxd

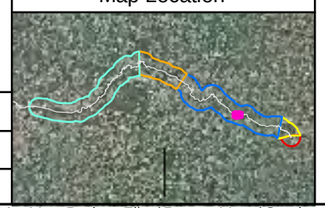
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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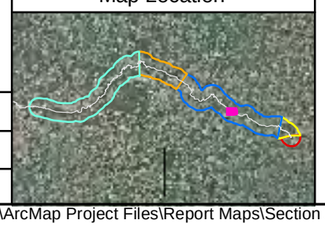
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Riverine Grid

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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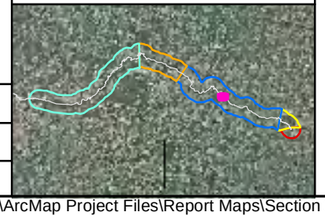
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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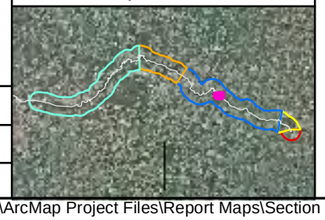
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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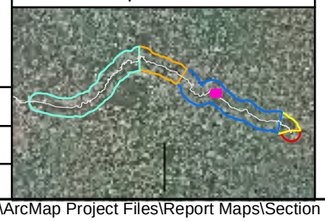
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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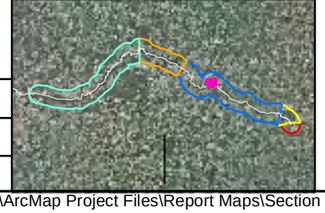
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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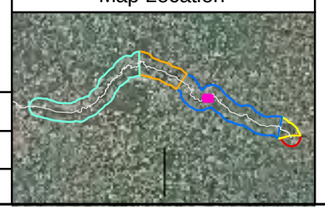
Aerial Photography Date: November 2011

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 12.30 - MP 13.05

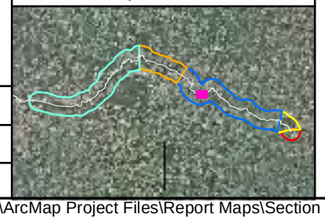
SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Grid.mxd

Aerial Photography Date: November 2011

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

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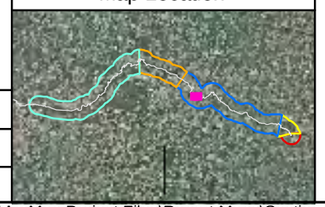
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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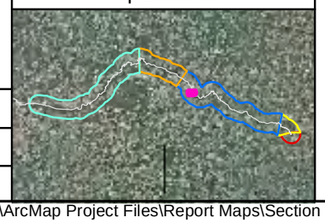
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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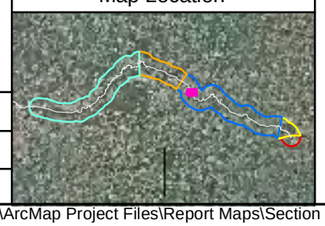
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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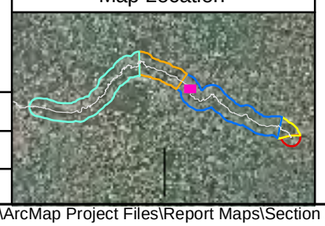
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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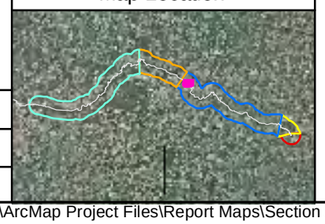
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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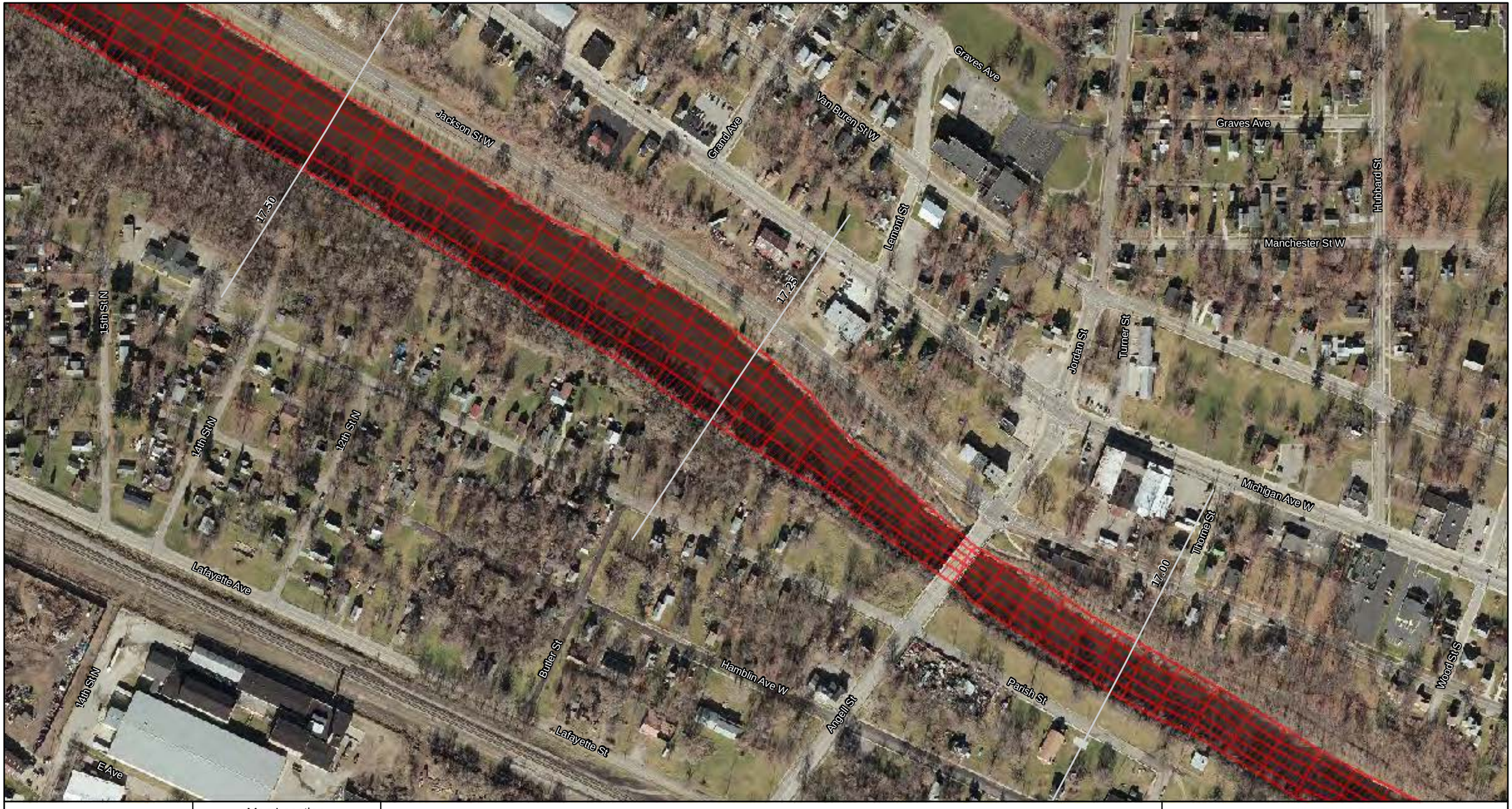
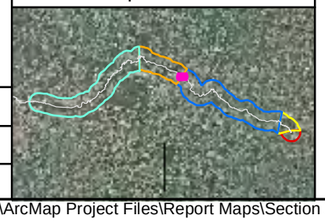
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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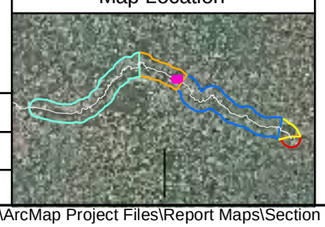
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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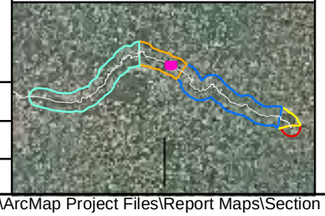
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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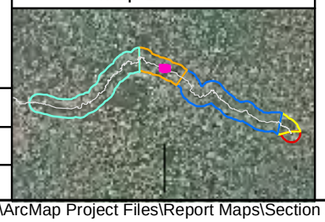
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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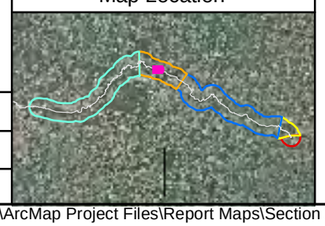
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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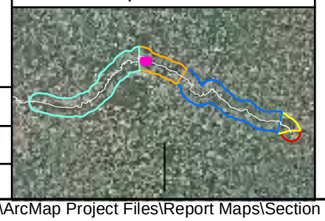
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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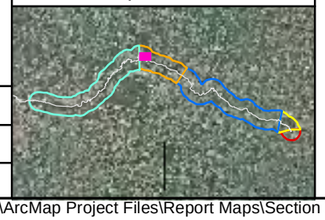
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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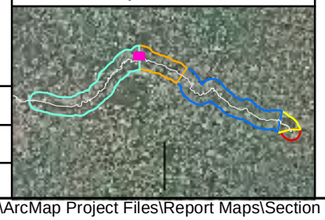
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

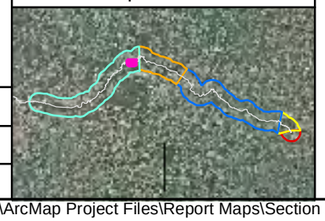
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Grid.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

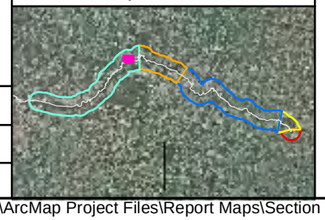
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Grid.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

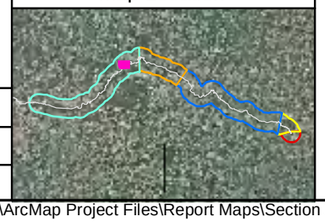
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Grid.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

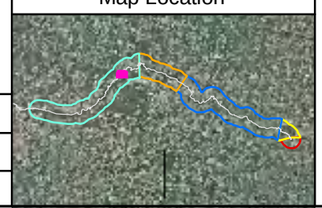
ENBRIDGE

Drawn: BRS 3/29/2012

Approved: DBR 3/29/2012

Project #: 106-4186

Map Location



Legend

Riverine Grid

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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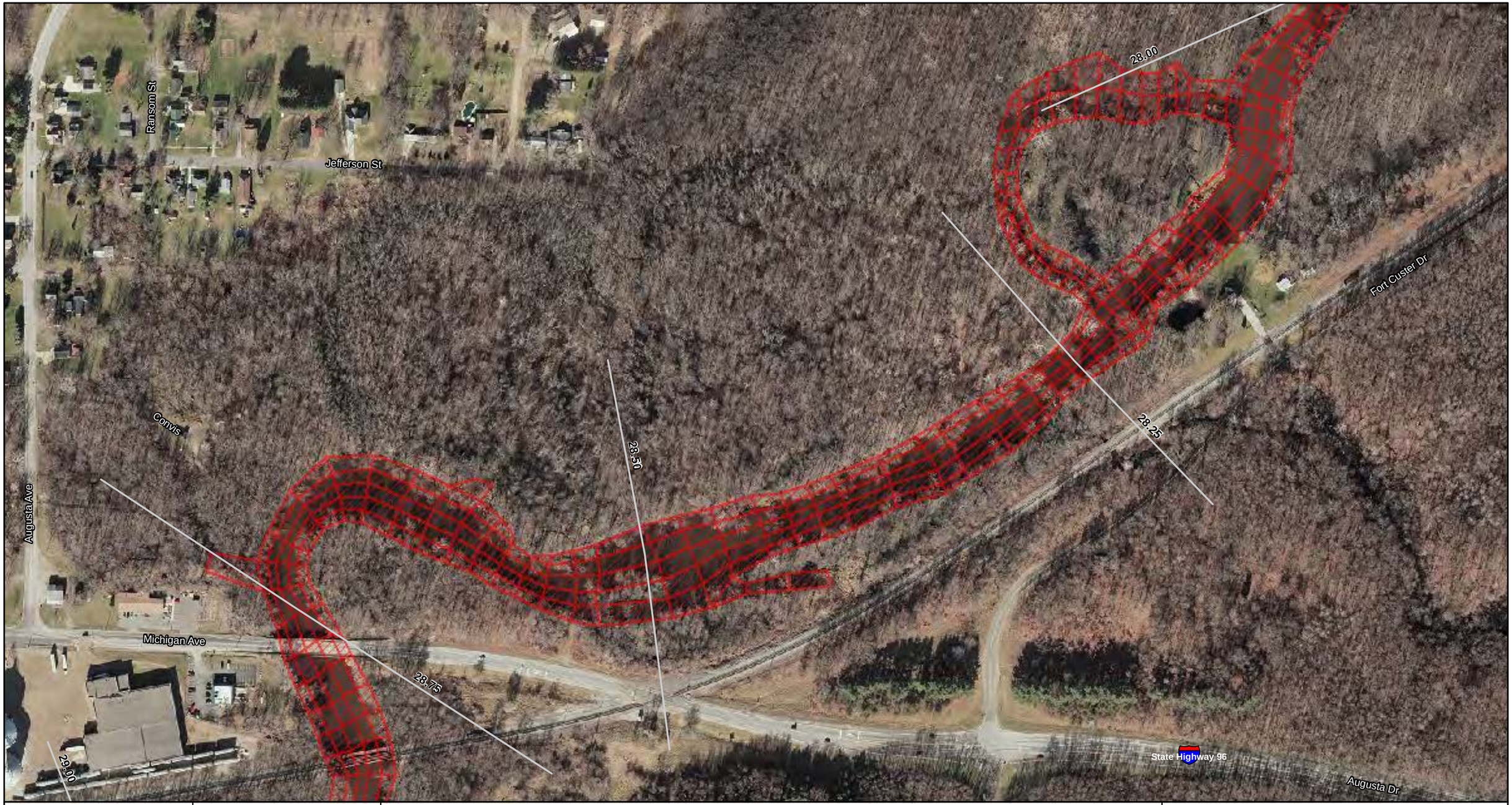
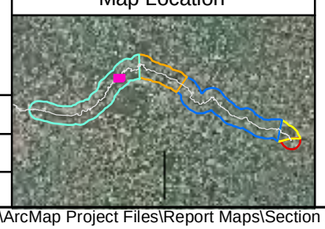
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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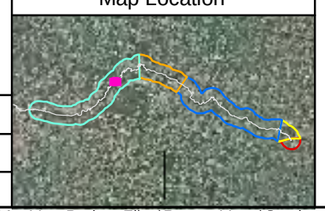
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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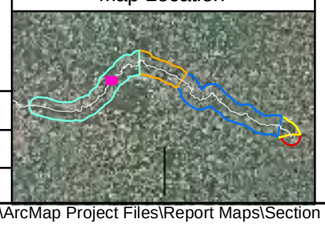
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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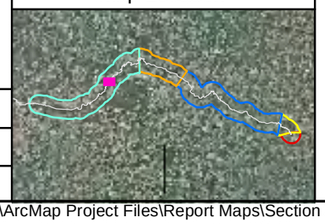
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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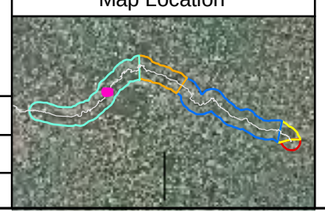
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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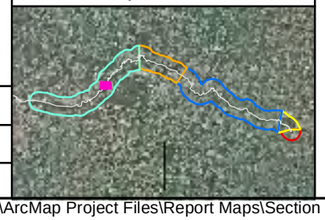
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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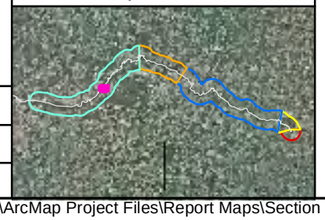
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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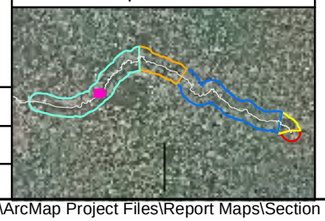
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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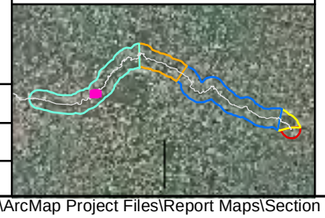
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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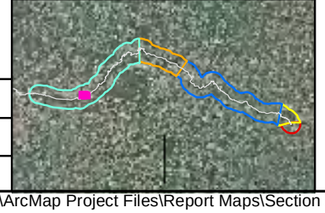
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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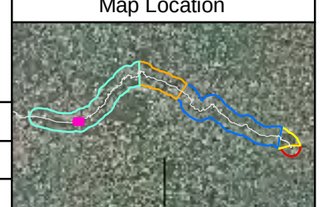
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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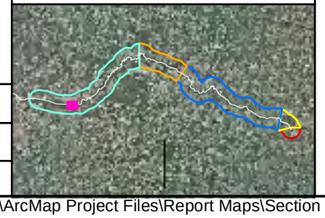
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

38.25

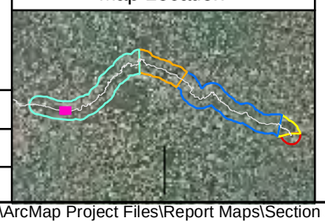
38.00

37.75

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

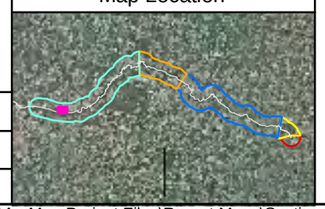
ENBRIDGE

Drawn: BRS 3/29/2012

Approved: DBR 3/29/2012

Project #: 106-4186

Map Location



Legend

Riverine Grid

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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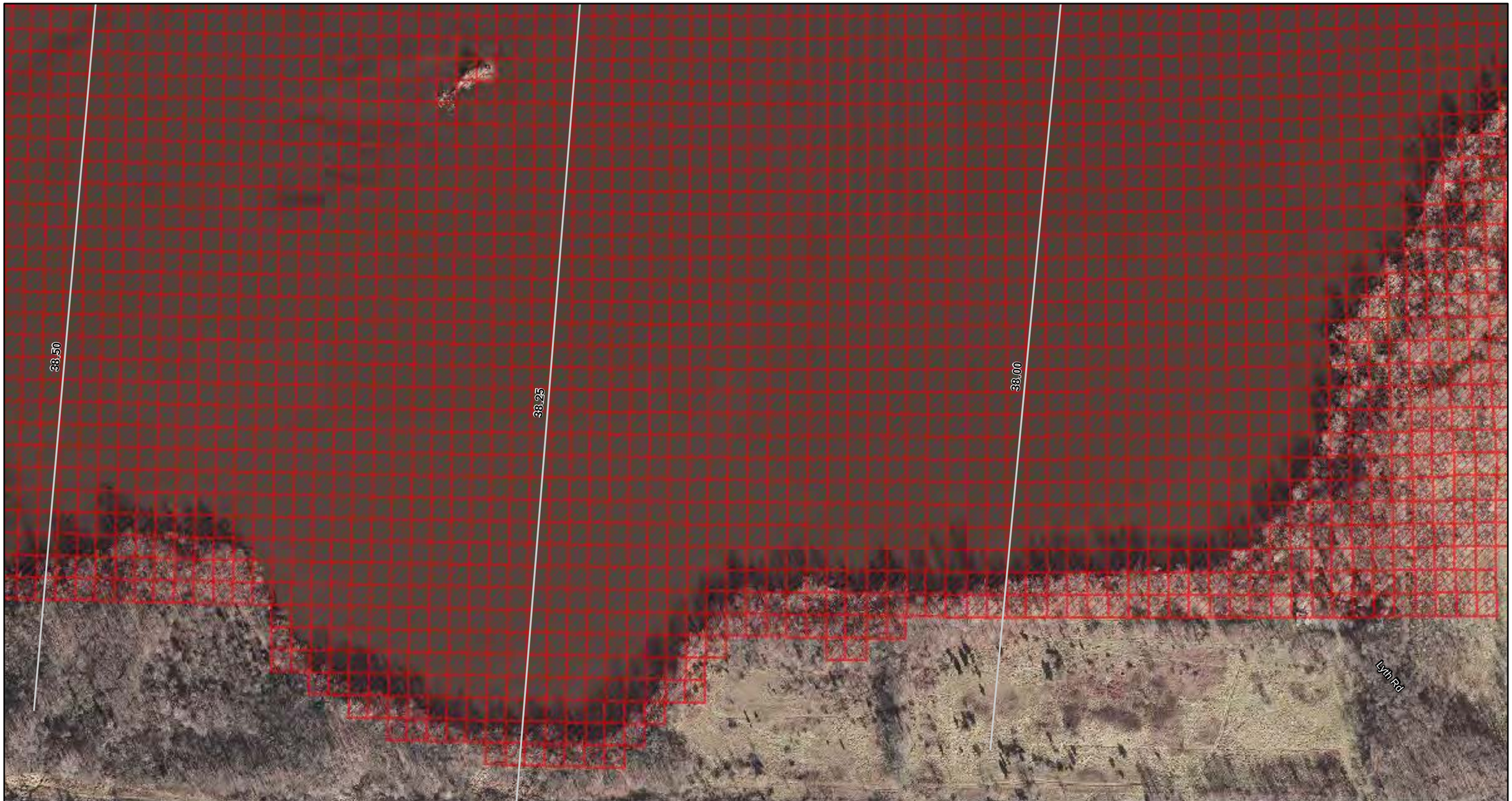
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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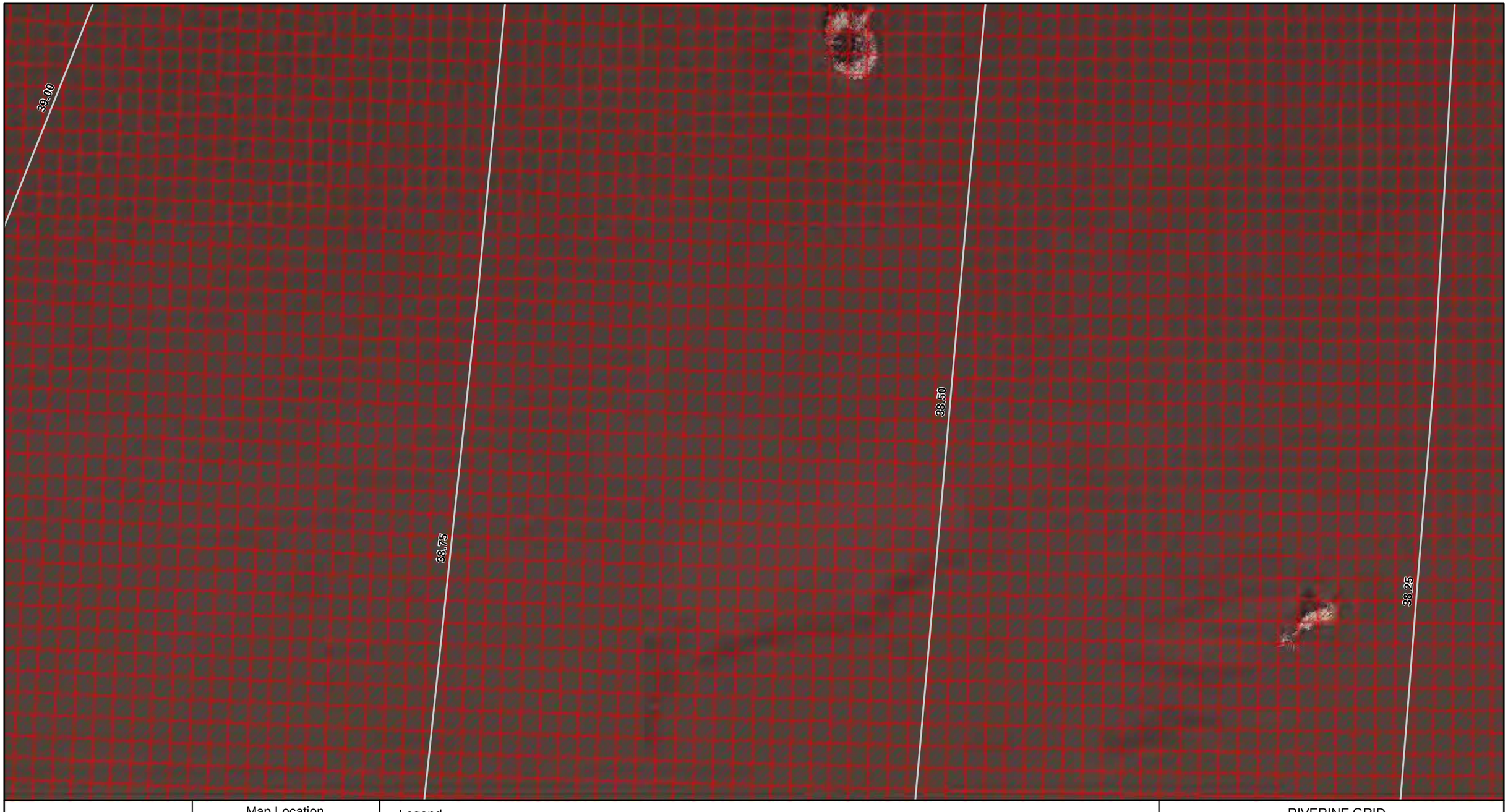
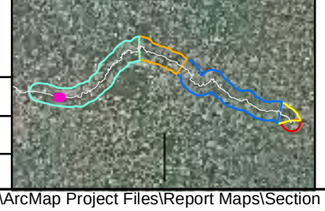
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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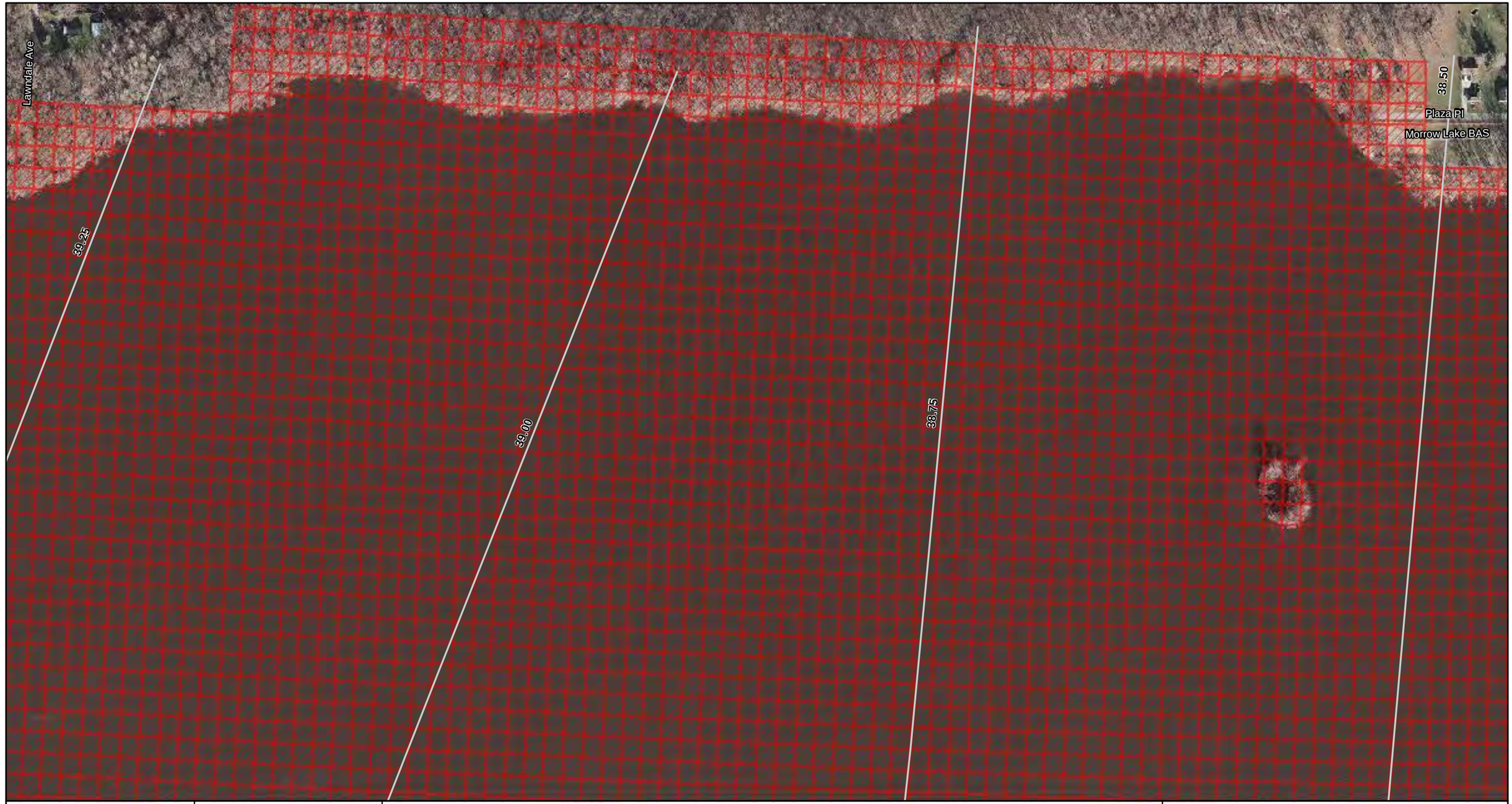
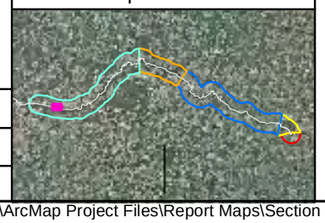
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

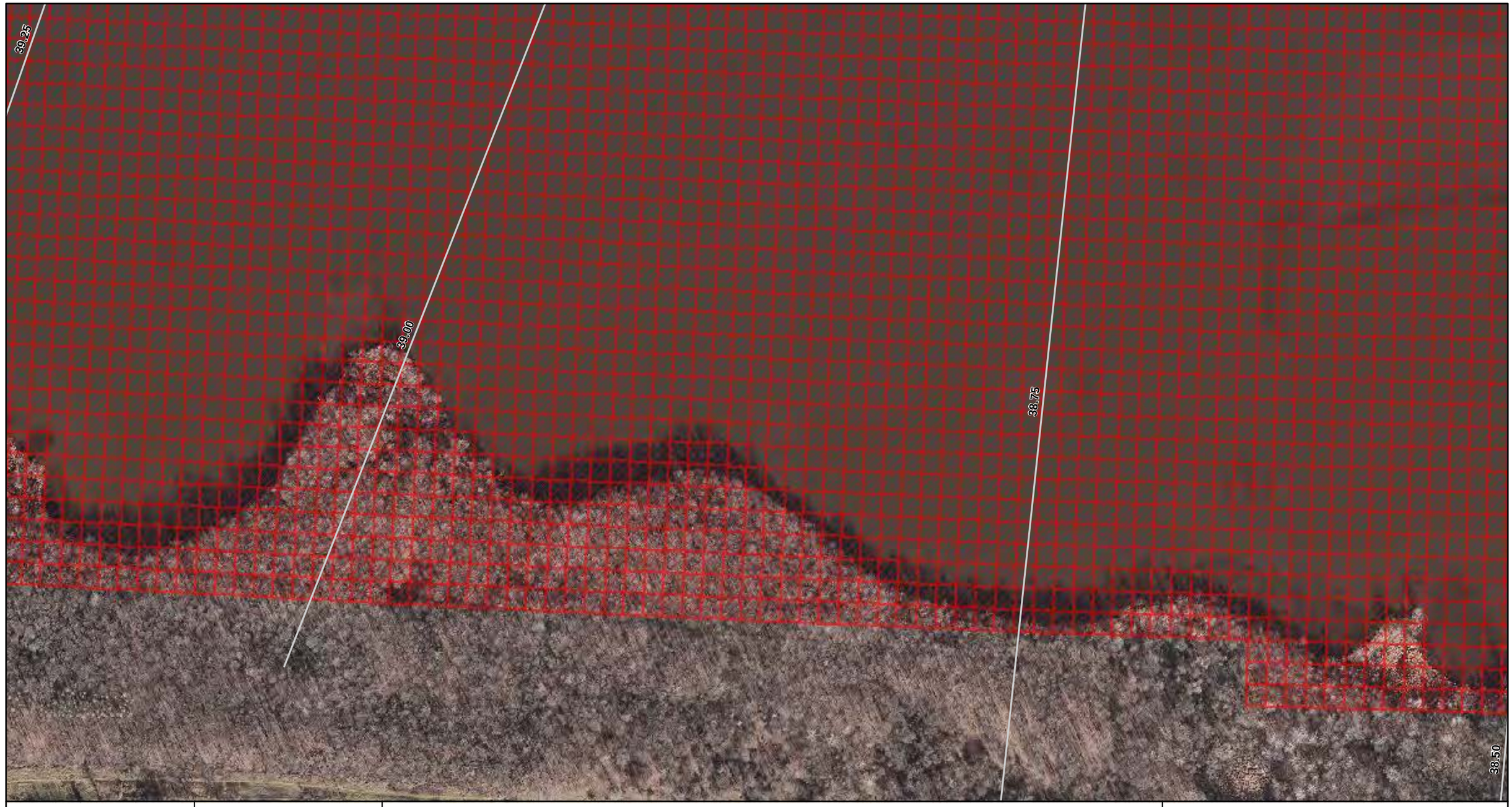
MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Grid.mxd

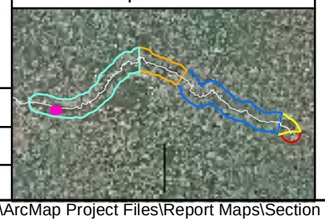
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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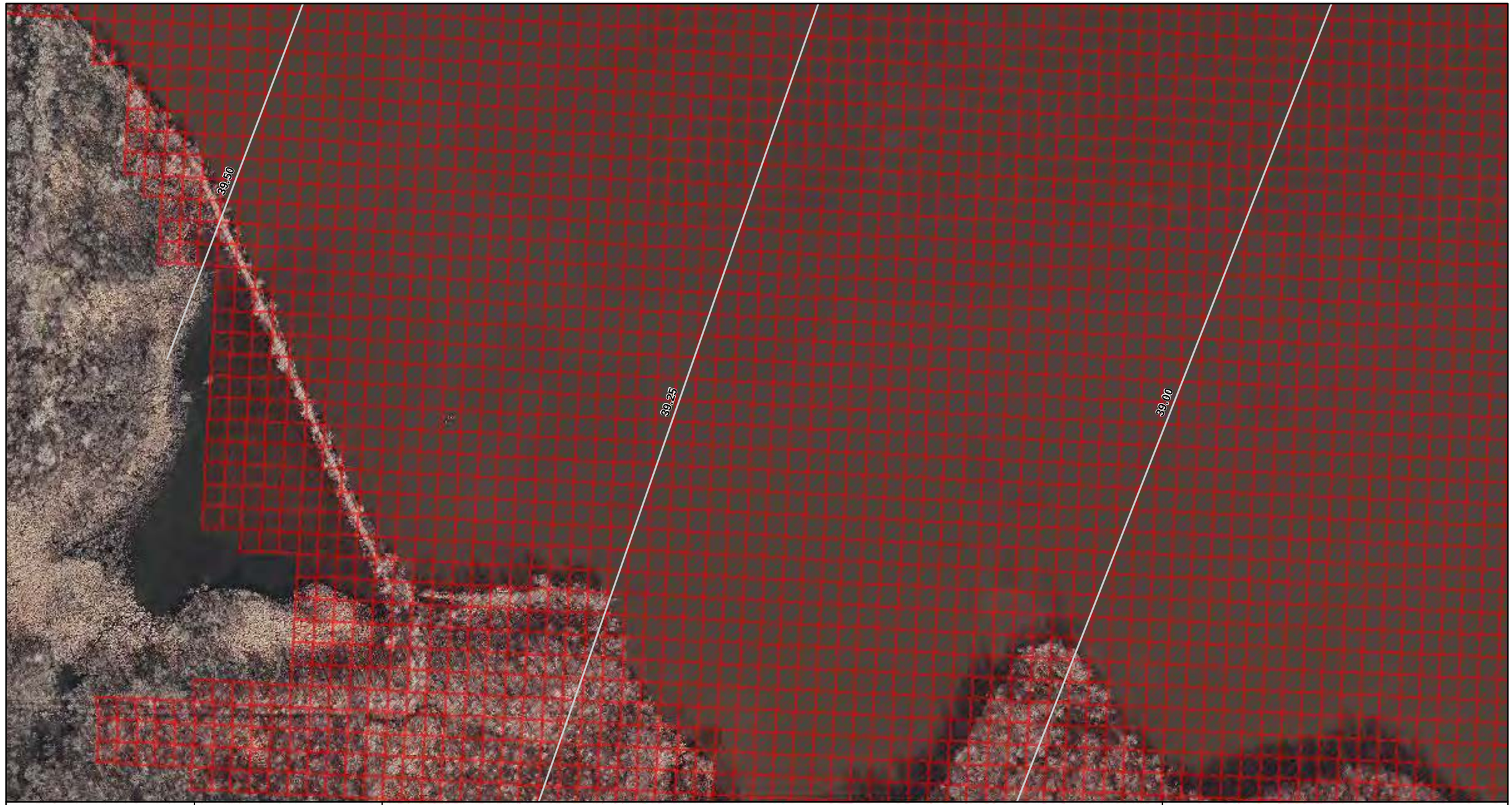
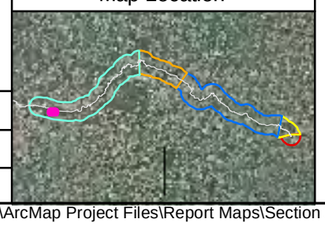
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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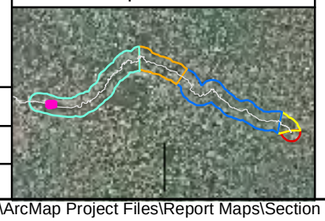
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- Riverine Grid
- Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

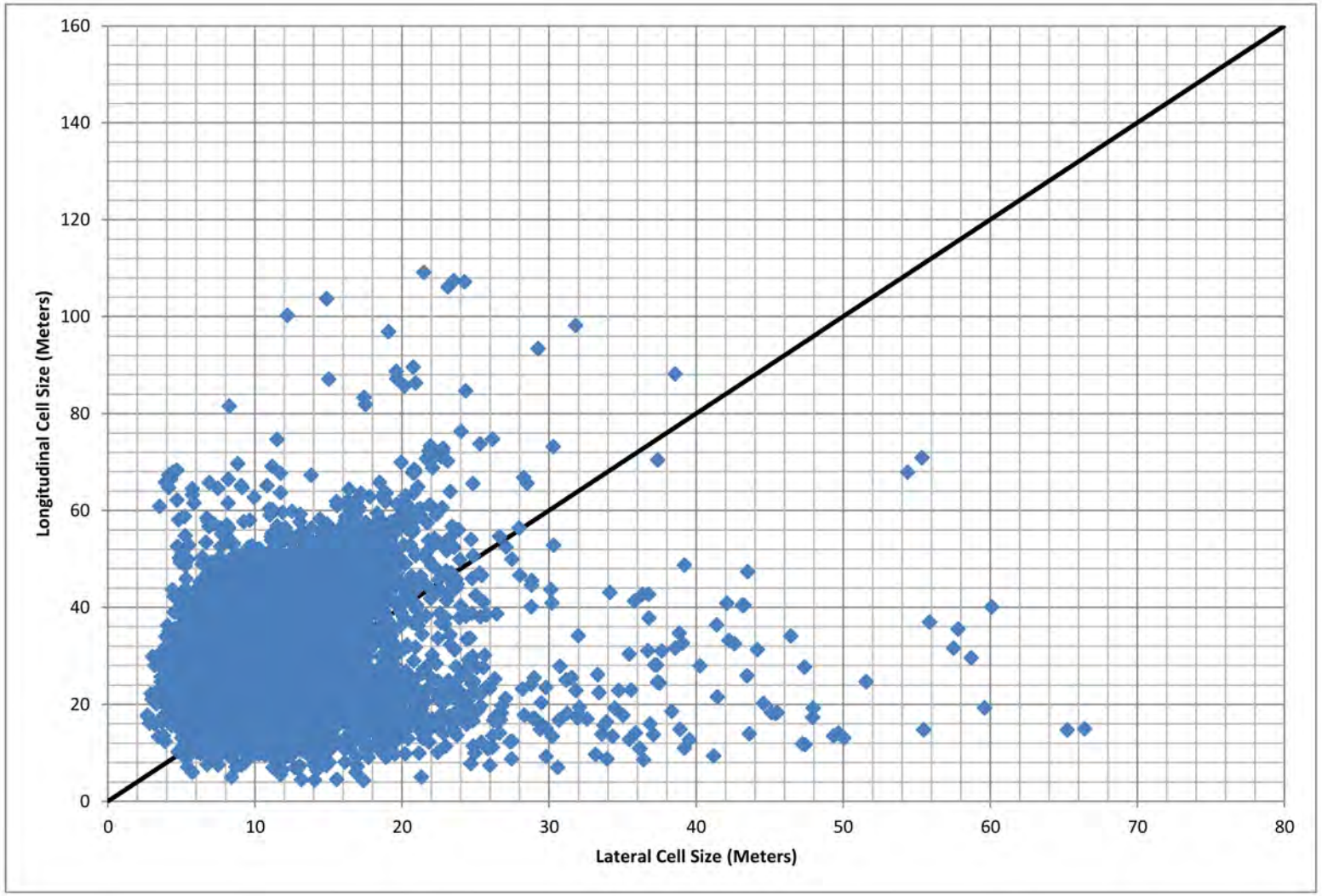
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Grid.mxd

Aerial Photography Date: November 2011

Figure 3-2

Riverine Grid

Aspect Ratio Approximately 1:2



ENBRIDGE

Drawn:	JLH	04/16/2012
Approved:	DBR	04/16/2012
Project #:	106-4186	

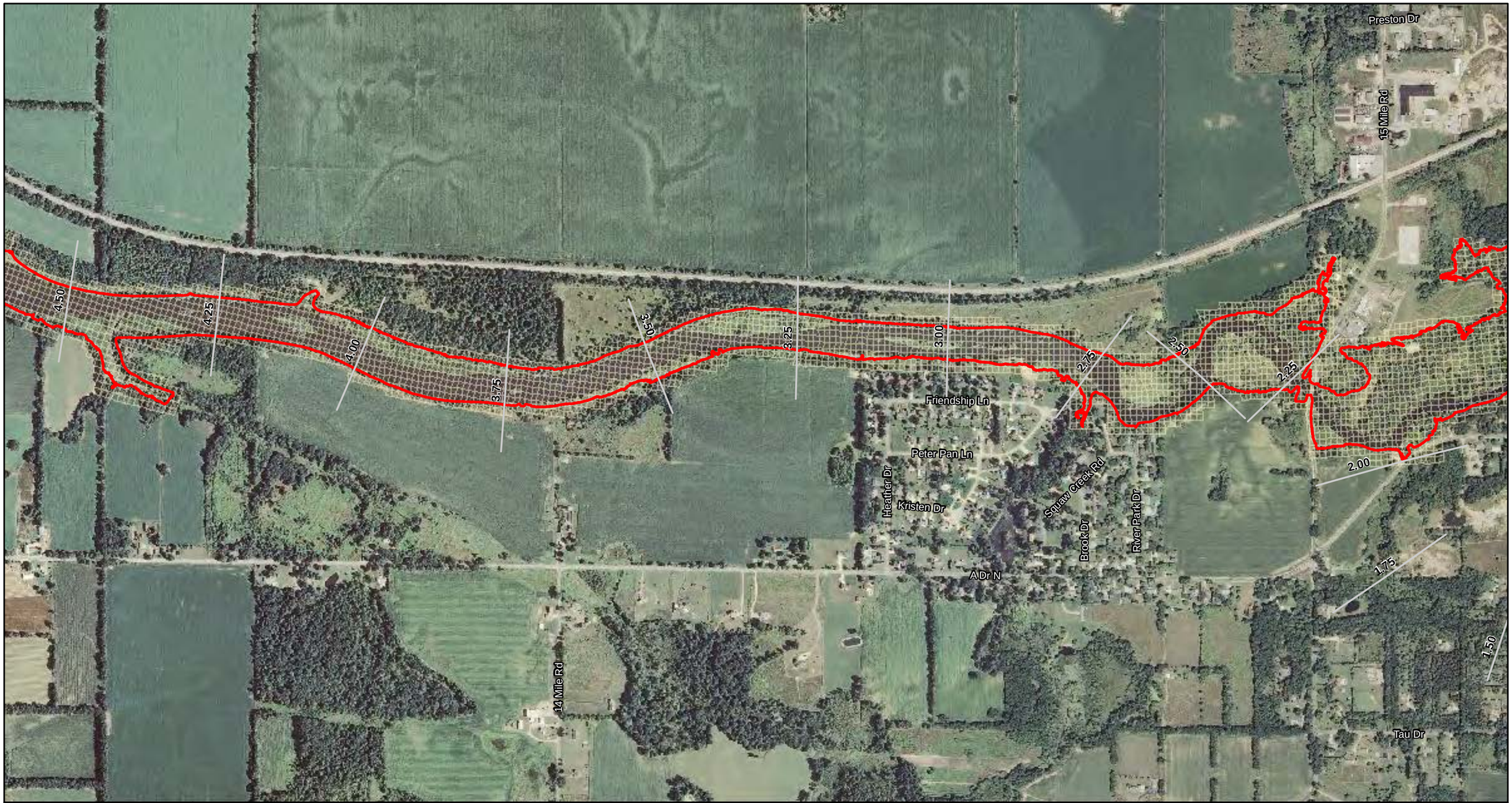
RIVERINE GRID
ASPECT RATIO APPROXIMATELY 1:2

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 3-3

Floodplain Grid

Sheets 1 through 16



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

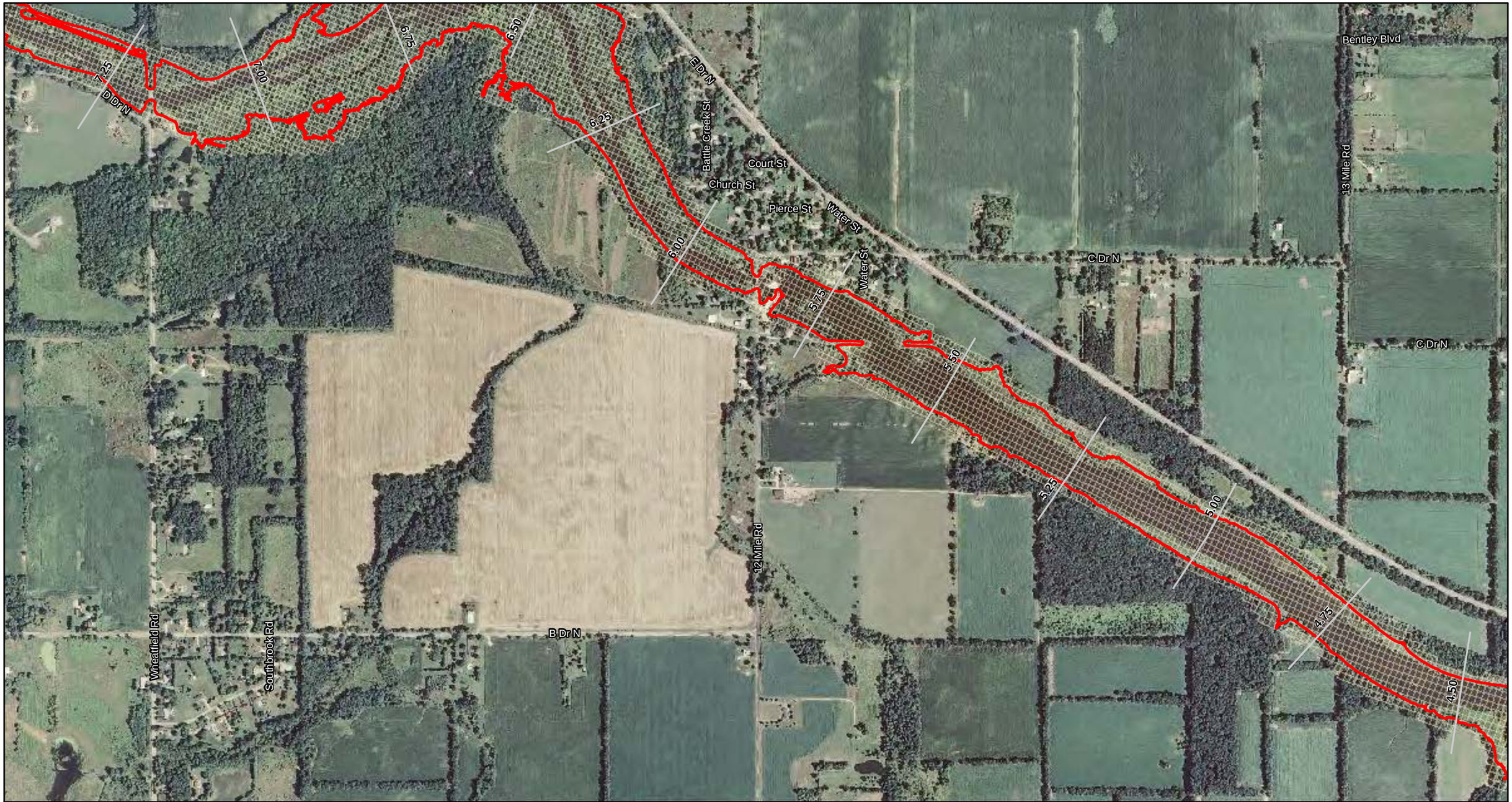
MP 1.50 - MP 4.50

SHEET 1 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 4.50 - MP 6.25

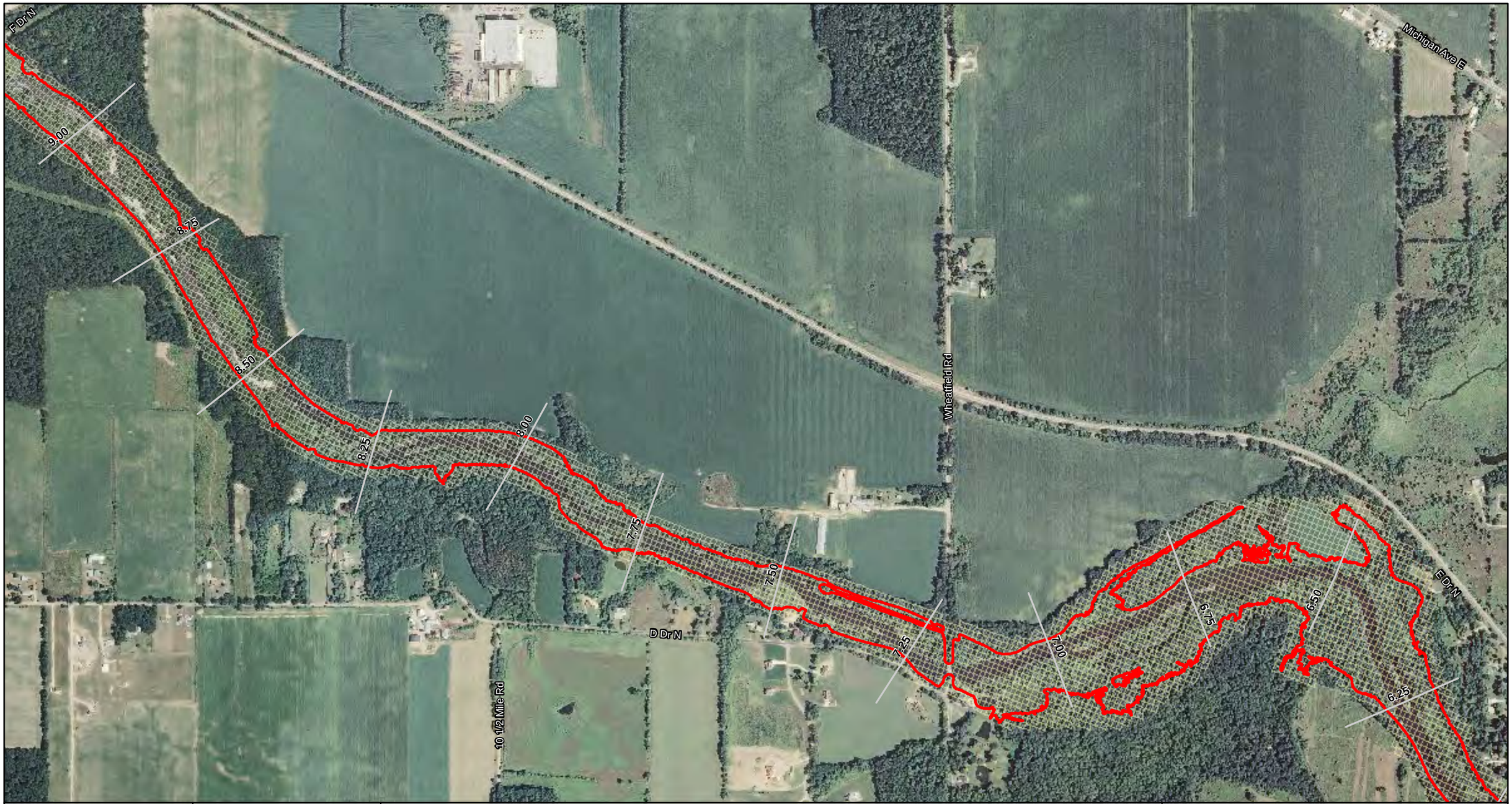
SHEET 2 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 6.25 - MP 9.00

SHEET 3 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

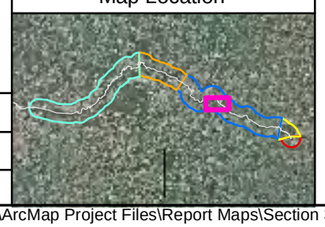
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 9.00 - MP 10.50

SHEET 4 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

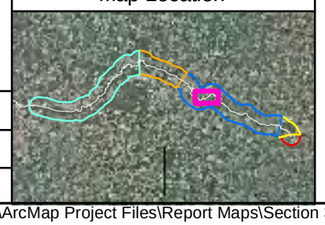
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 10.50 - MP 14.25

SHEET 5 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 14.25 - MP 16.00

SHEET 6 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 16.00 - MP 18.00

SHEET 7 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

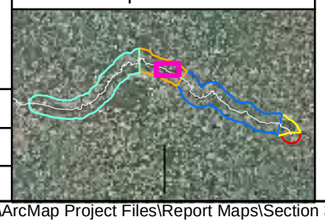
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 18.00 - MP 20.00

SHEET 8 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 20.00 - MP 22.50

SHEET 9 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 22.50 - MP 27.00

SHEET 10 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

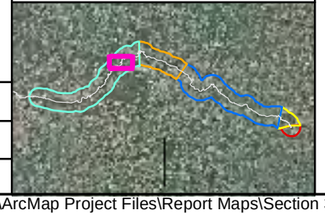
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

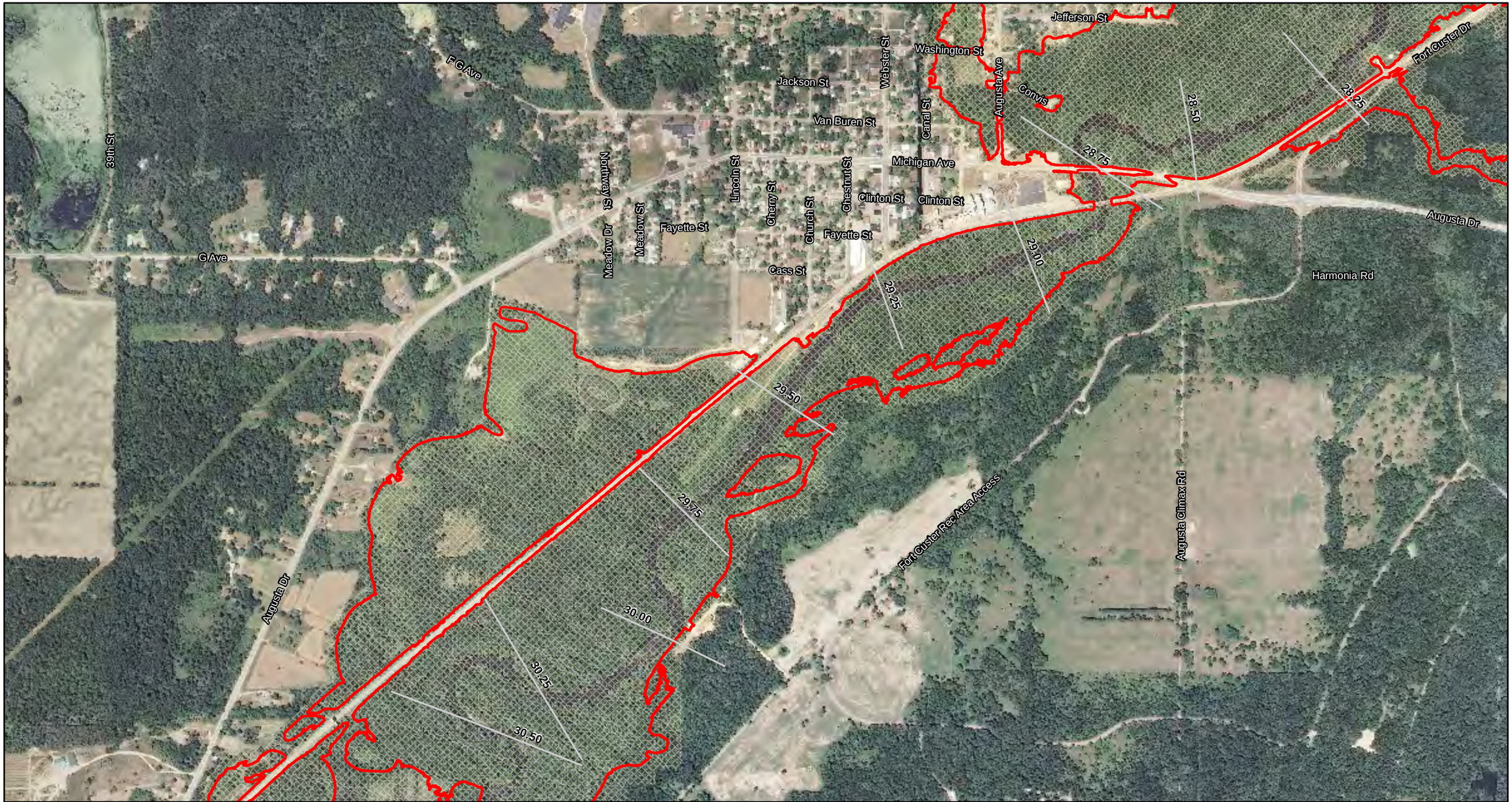
MP 27.00 - MP 28.75

SHEET 11 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

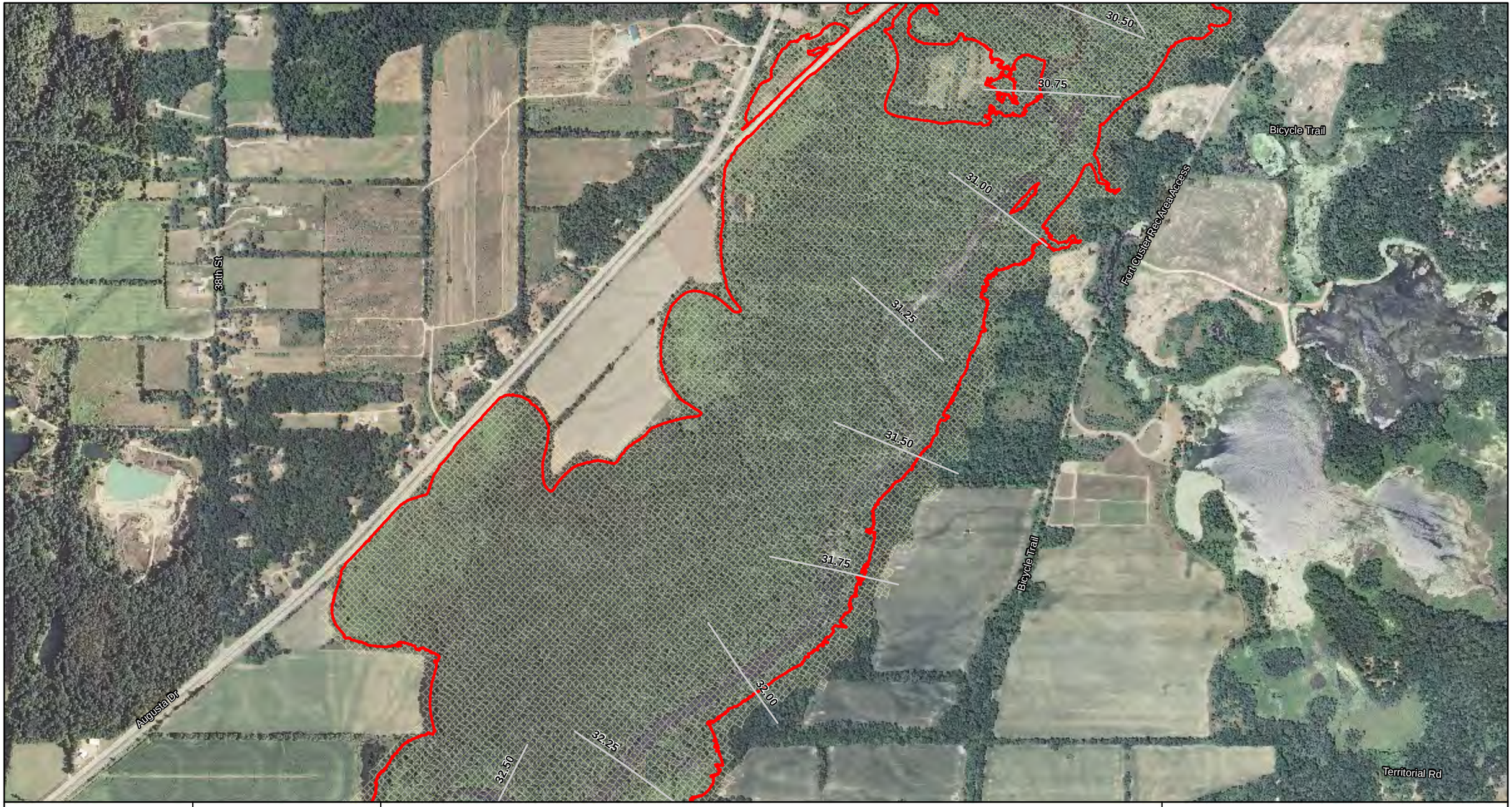
MP 28.75 - MP 30.50

SHEET 12 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

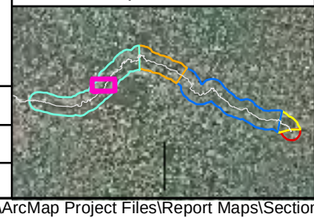
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 30.50 - MP 32.25

SHEET 13 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

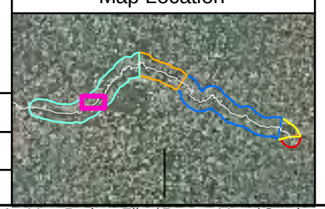
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

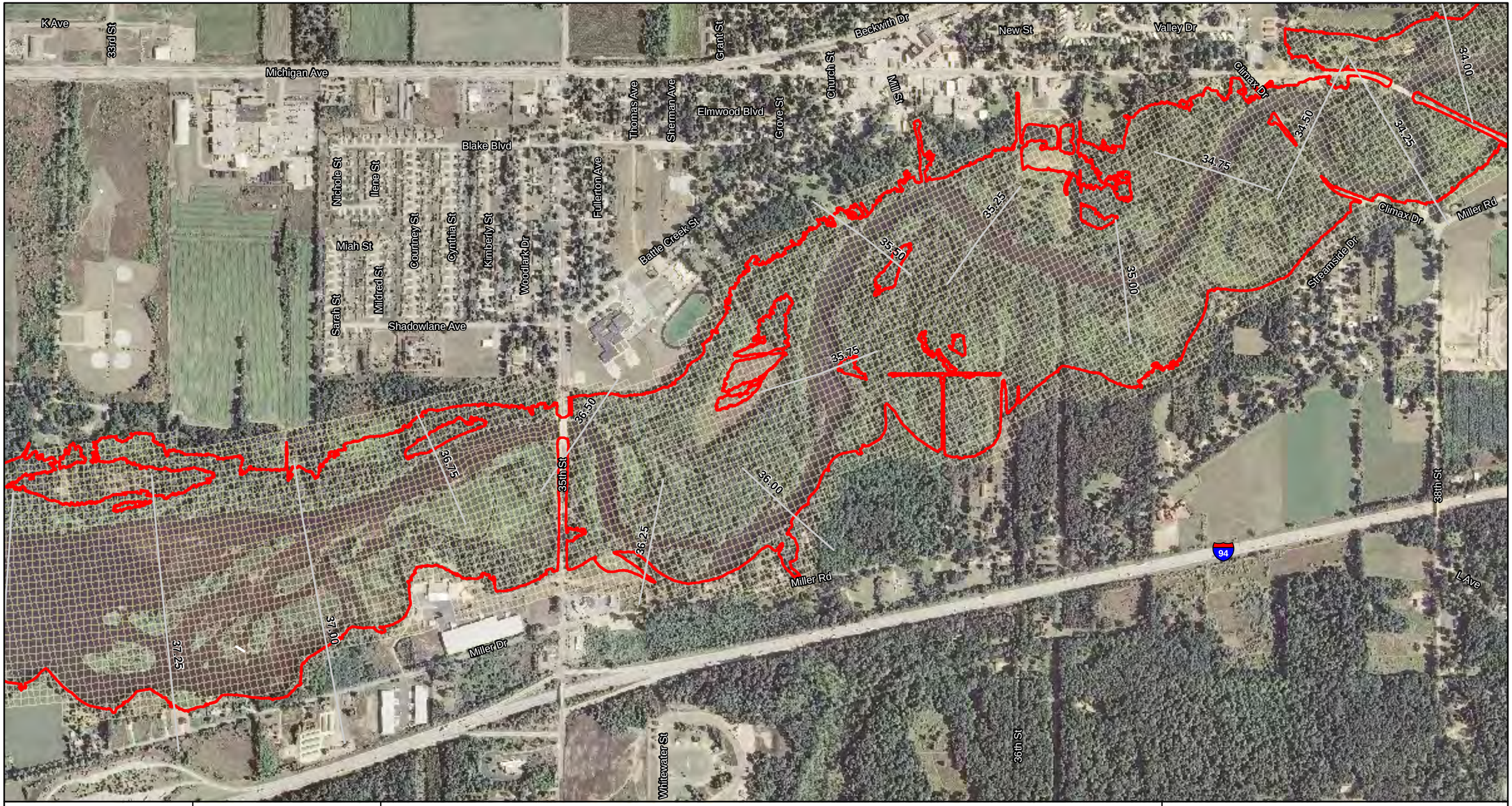
MP 32.25 - MP 34.75

SHEET 14 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

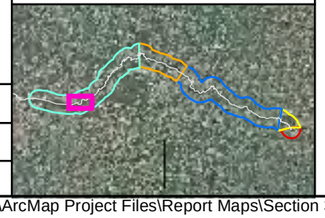
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

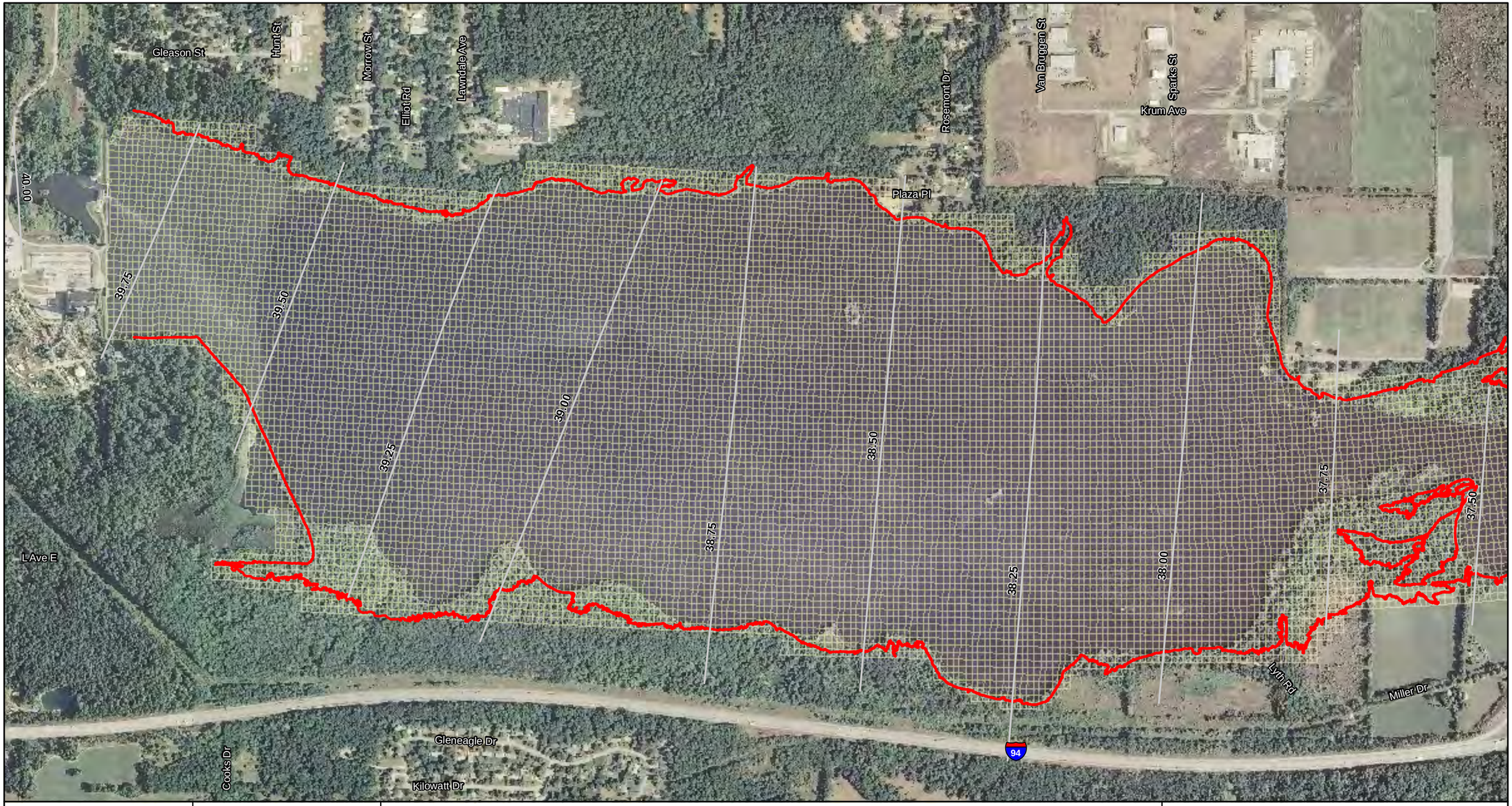
MP 34.25 - MP 37.50

SHEET 15 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

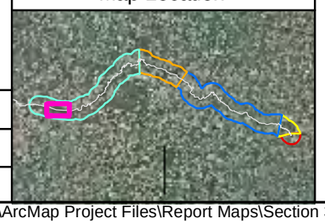
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



Legend

- Floodplain Grid
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID

MP 37.50 - MP 40.00

SHEET 16 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

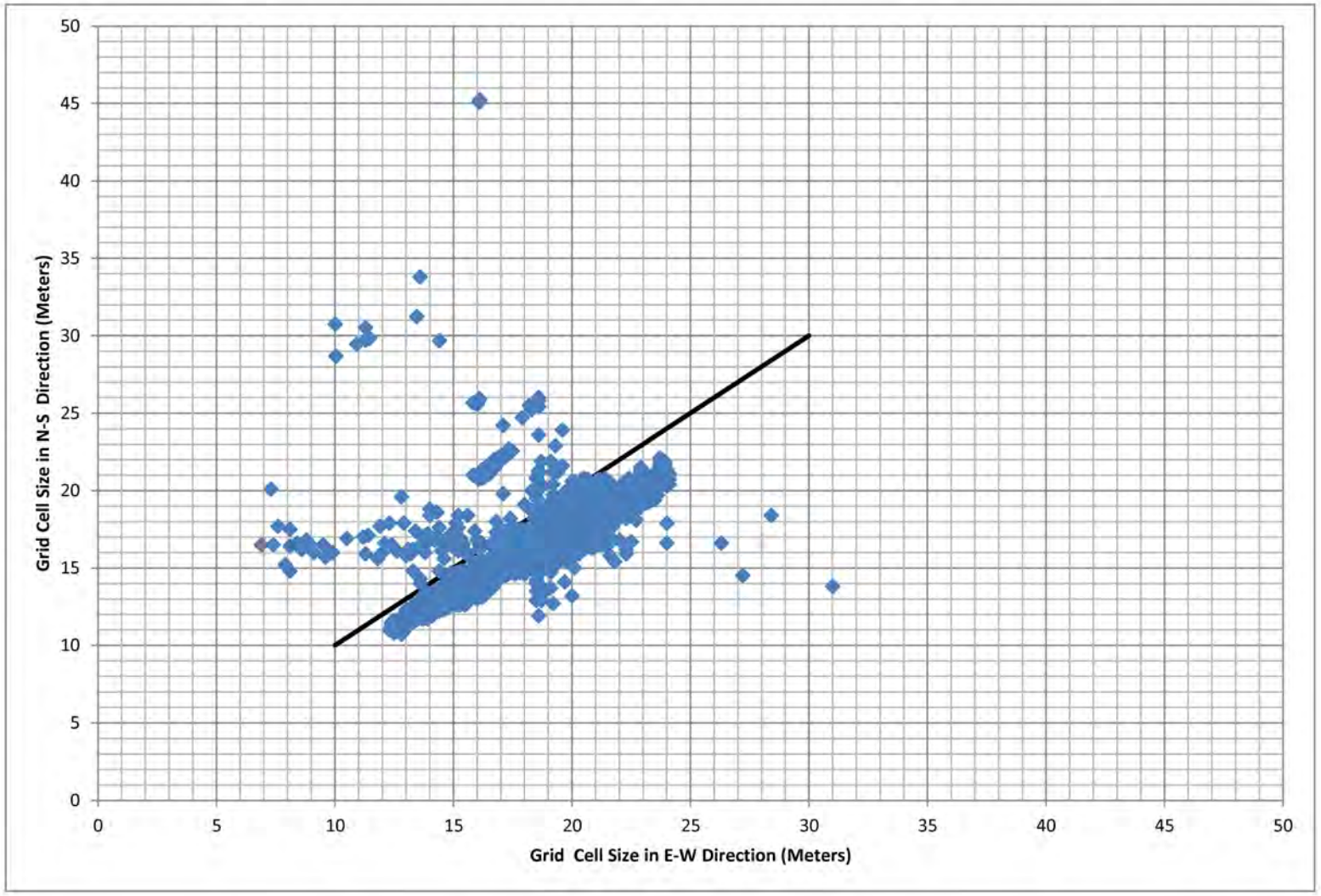
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Grid.mxd

Aerial Photography Date: July & August 2009

Figure 3-4

Floodplain and Lake Grid

Aspect Ratio Approximately 1:1



ENBRIDGE		FLOODPLAIN AND LAKE GRID ASPECT RATIO APPROXIMATELY 1:1
Drawn: JLH 04/16/2012		ENBRIDGE LINE 6B MP 608 MARSHALL, MI PIPELINE RELEASE ENBRIDGE ENERGY, LIMITED PARTNERSHIP
Approved: DBR 04/16/2012		
Project #: 106-4186		

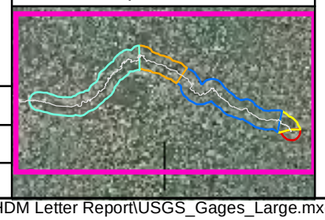
Figure 3-5

USGS Stream Gage Locations

Richplain Rd
32nd St
D Ave
D Ave
Gull Rd
AUGUSTA CREEK
NEAR AUGUSTA, MI
Michigan Ave W
20.00
Bedford Rd N
Bedford Rd S
Capital Ave NE
BATTLE CREEK
AT BATTLE CREEK, MI
78
69
Augusta Dr
25.00
30.00
Skyline Dr
KALAMAZOO RIVER
NEAR BATTLE CREEK, MI
Dickman Rd
Columbia Ave E
15.00
10.00
KALAMAZOO RIVER
AT COMSTOCK, MI
King Hwy
Michigan Ave
Augusta Dr
I 94 BL
40.00
35.00
Columbia Ave W
194
94
Wheatfield Rd
Michigan Ave E
5.00
KALAMAZOO RIVER
AT MARSHALL, MI
66
11 Mile Rd
17 Mile Rd

Drawn:	BRS 2/9/2012
Approved:	SD 2/9/2012
Project #:	106-4186

Map Location



Legend

USGS Stream Gage Location
- Boundary Inflow
- Model Calibration and Validation

Talmadge Creek and Kalamazoo River

Major Road or Highway

Five Mile Grid Segment

Quarter Mile Grid Segment

N

0 5,000 10,000 20,000

Scale in Feet

USGS STREAM GAGE LOCATIONS

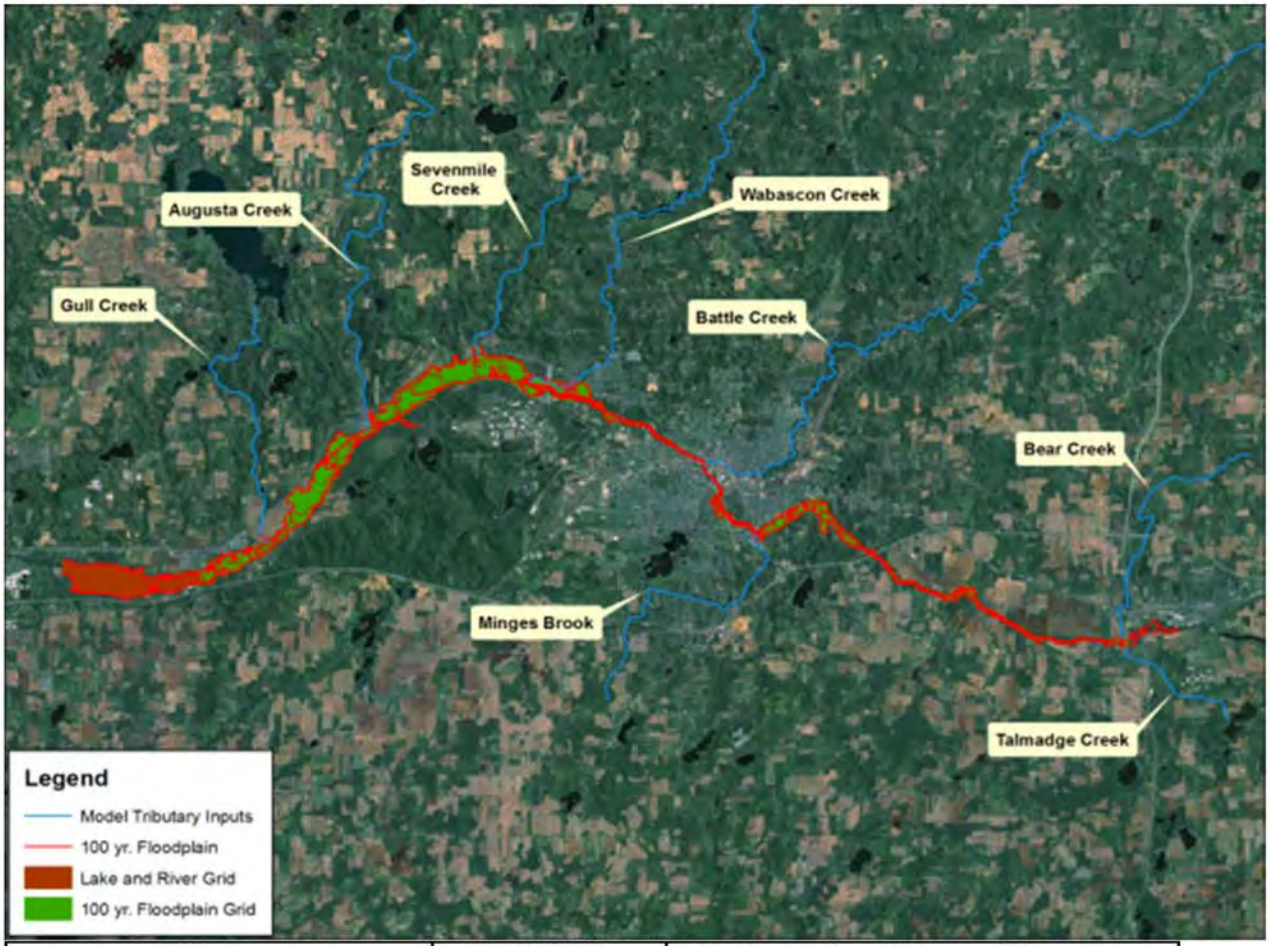
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\ArcMap Project Files\Report Maps\HDM Letter Report\USGS_Gages_Large.mxd

Aerial Photography Date: July & August 2009

Figure 3-6

Tributary Inflows



Tributary	USGS Station	Drainage Area (Square Kilometers)
Kalamazoo River at Marshall	41003500	1162.9
Battle Creek	4105000	624.0
Augusta Creek	4105700	38.9
Talmadge Creek	Ungaged	8.5
Bear Creek	Ungaged	38.4
Harper Creek and Minges Brook	Ungaged	116.3
Gull Creek	Ungaged	96.2
Wabascon Creek	Ungaged	92.4
Sevenmile Creek	Ungaged	40.7

ENBRIDGE

Drawn: JLH 04/17/2012

Approved: DBR 04/17/2012

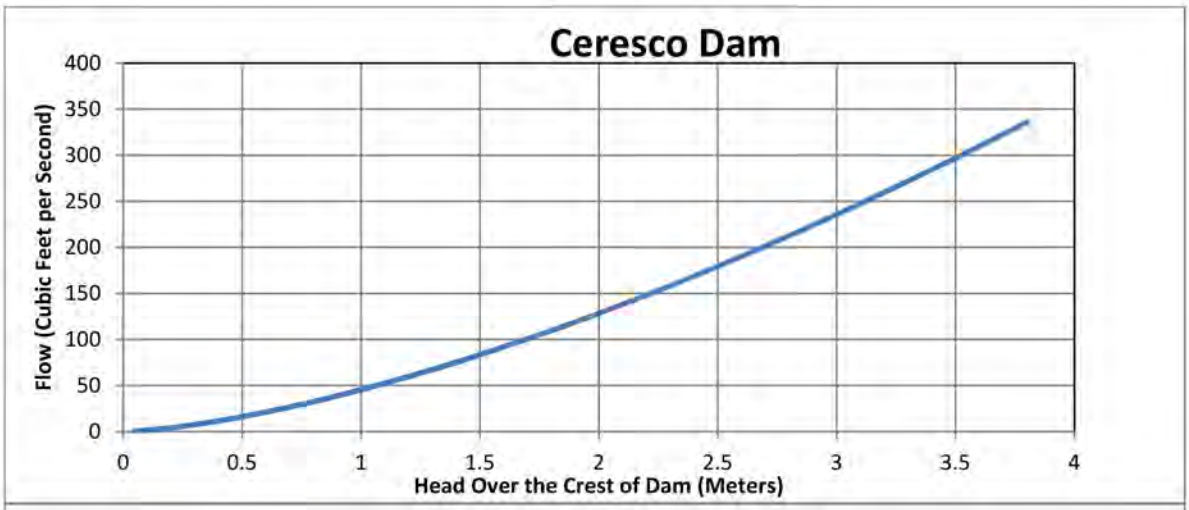
Project #: 106-4186

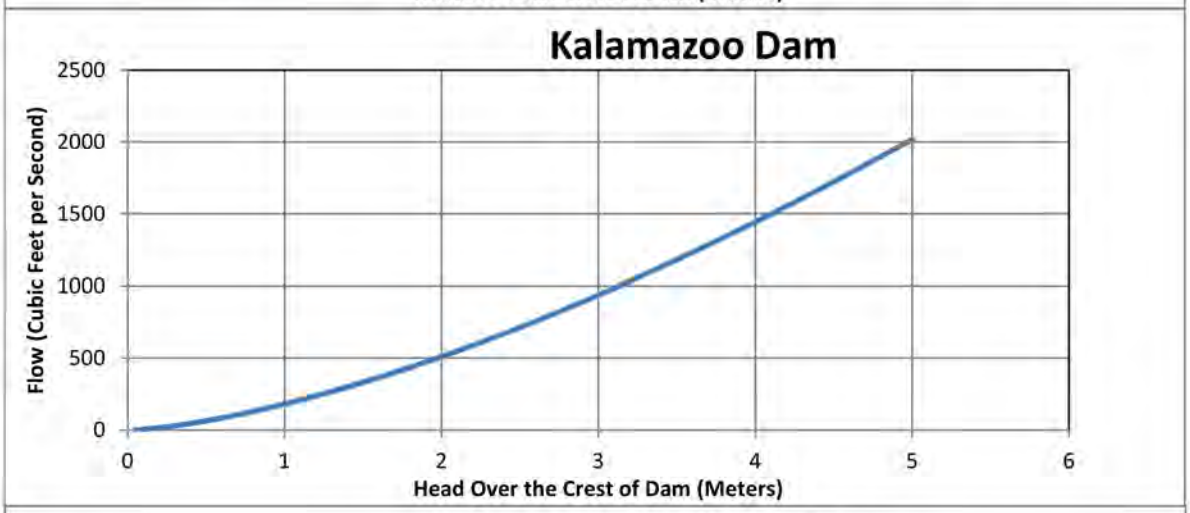
TRIBUTARY INFLOWS

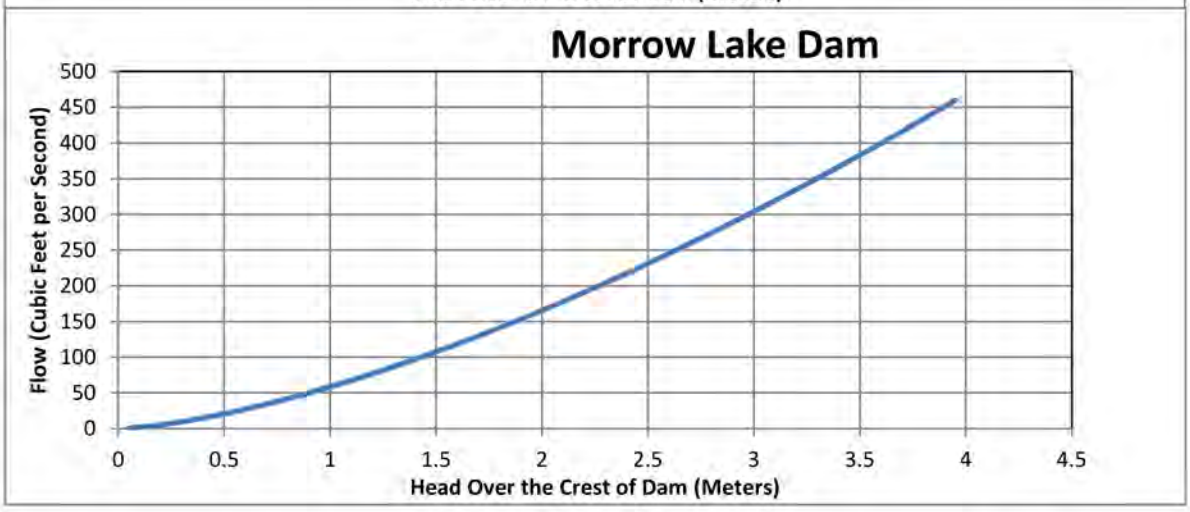
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 3-7

Dam Rating Curves



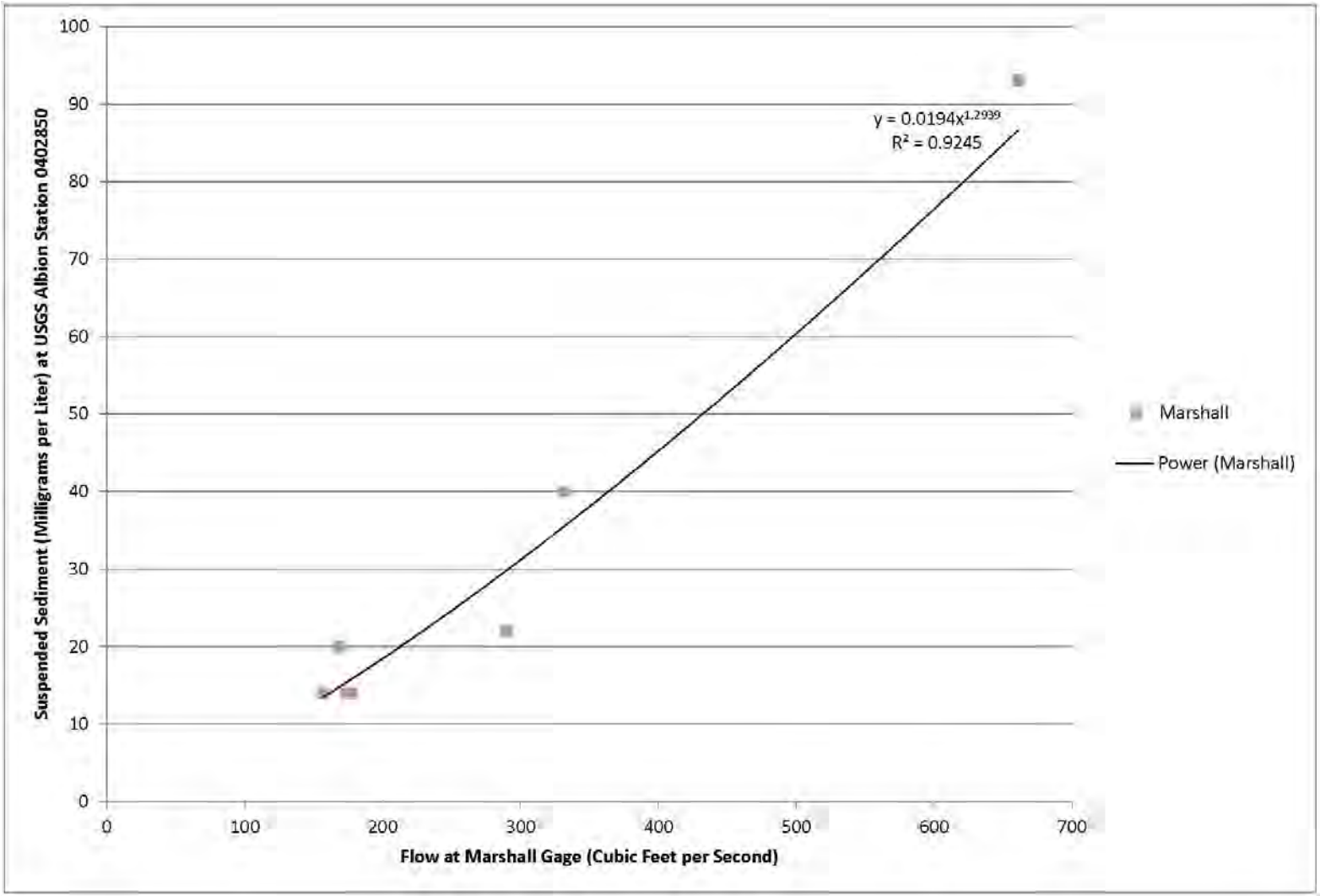




ENBRIDGE		DAM RATING CURVES
Drawn: JLH 04/16/2012		ENBRIDGE LINE 6B MP 608 MARSHALL, MI PIPELINE RELEASE ENBRIDGE ENERGY, LIMITED PARTNERSHIP
Approved: DBR 04/16/2012		
Project #: 106-4186		

Figure 3-8

Regression: Suspended Sediment as a Function of Flow



ENBRIDGE

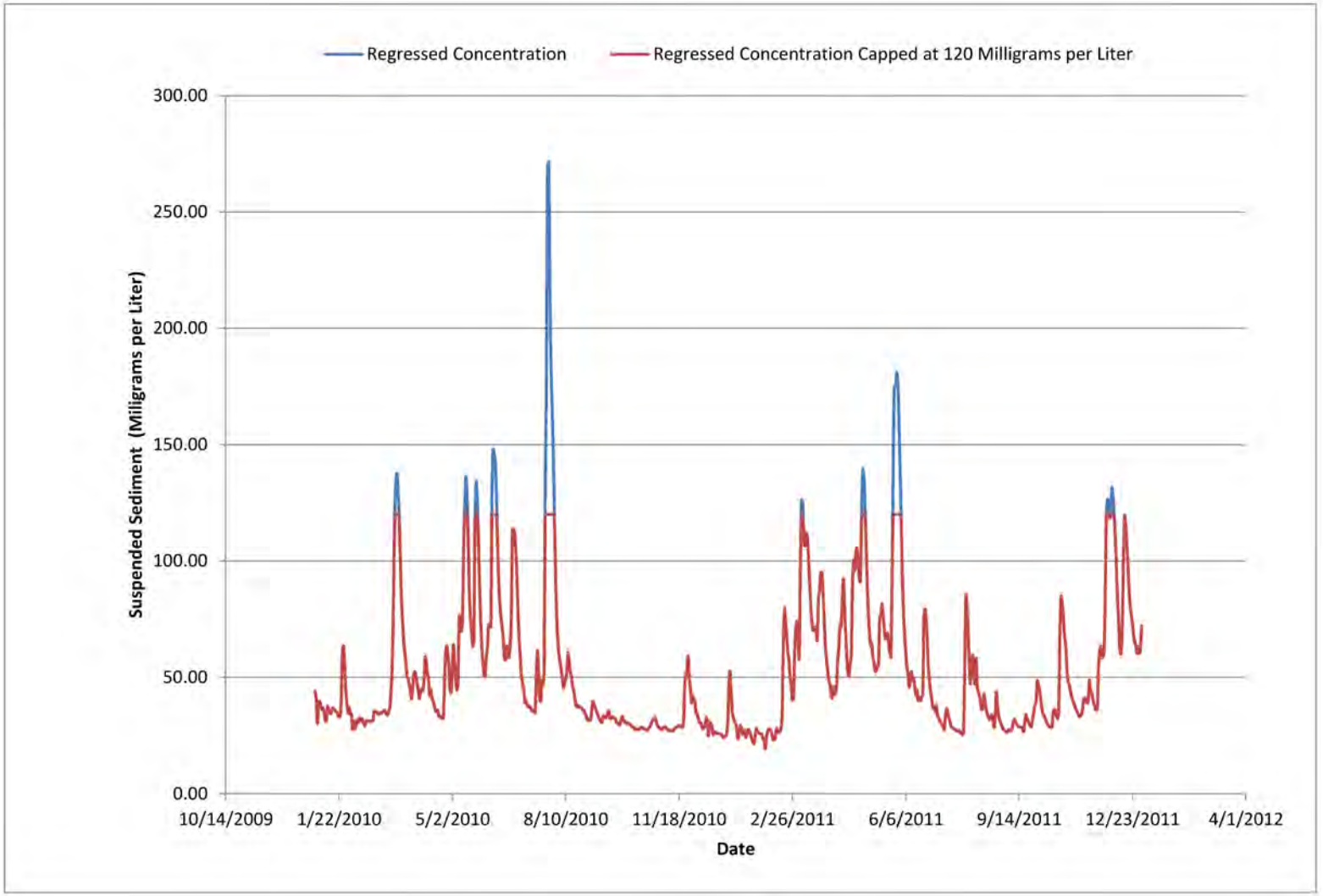
Drawn:	JLH	04/16/2012
Approved:	DBR	04/16/2012
Project #:	106-4186	

REGRESSION: SUSPENDED SEDIMENT AS A FUNCTION OF FLOW

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 3-9

Sediment Boundary Condition



ENBRIDGE

Drawn:	JLH	04/16/2012
Approved:	DBR	04/16/2012
Project #:	106-4186	

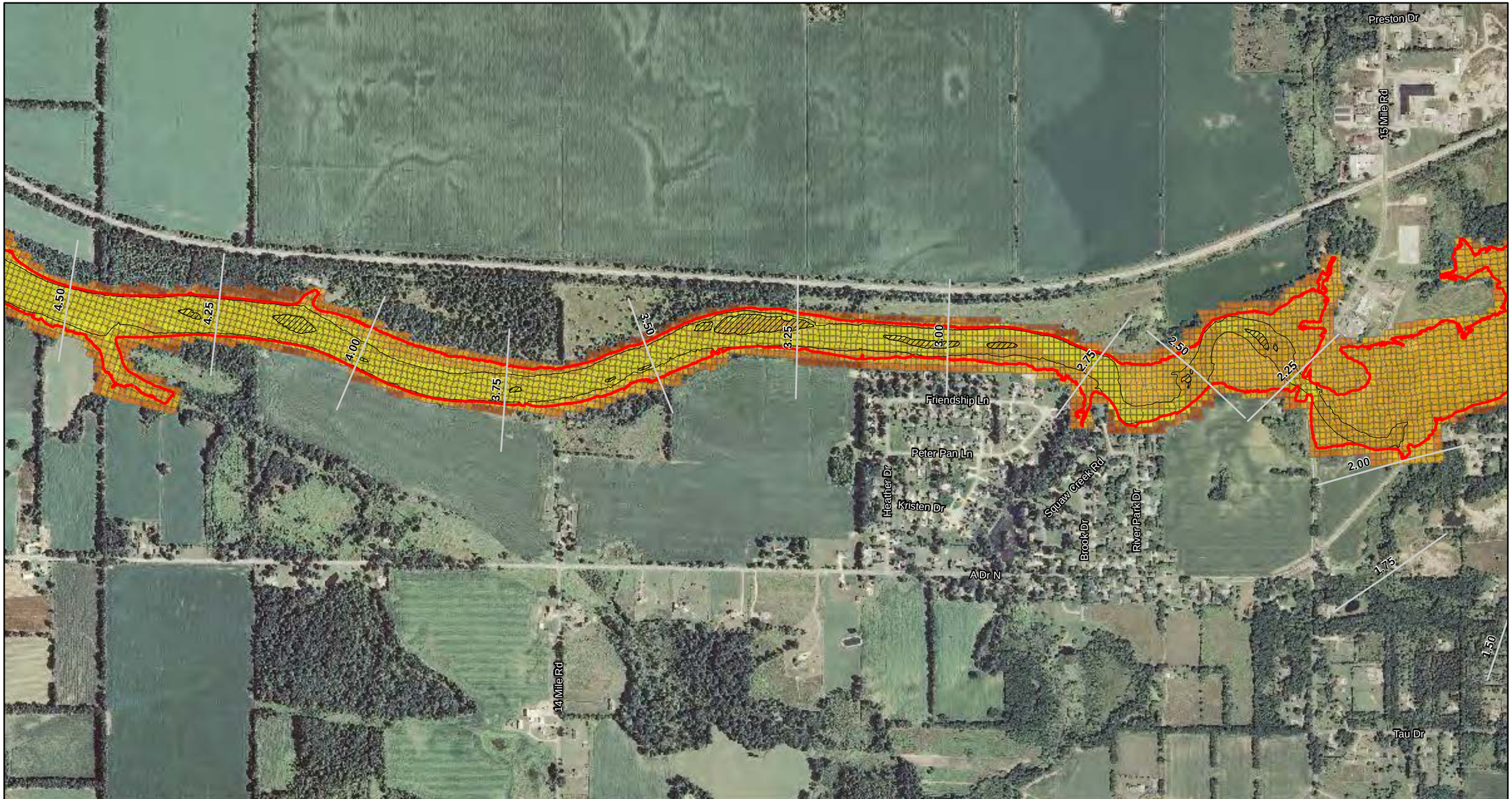
SEDIMENT BOUNDARY CONDITION

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 3-10

Bathymetry/Topography Model Input

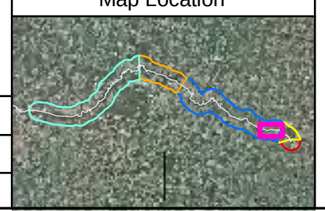
Sheets 1 through 16



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
- 780 - 790 ft
- 790 - 800 ft
- 800 - 810 ft
- 810 - 820 ft
- 820 - 830 ft
- 830 - 840 ft
- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

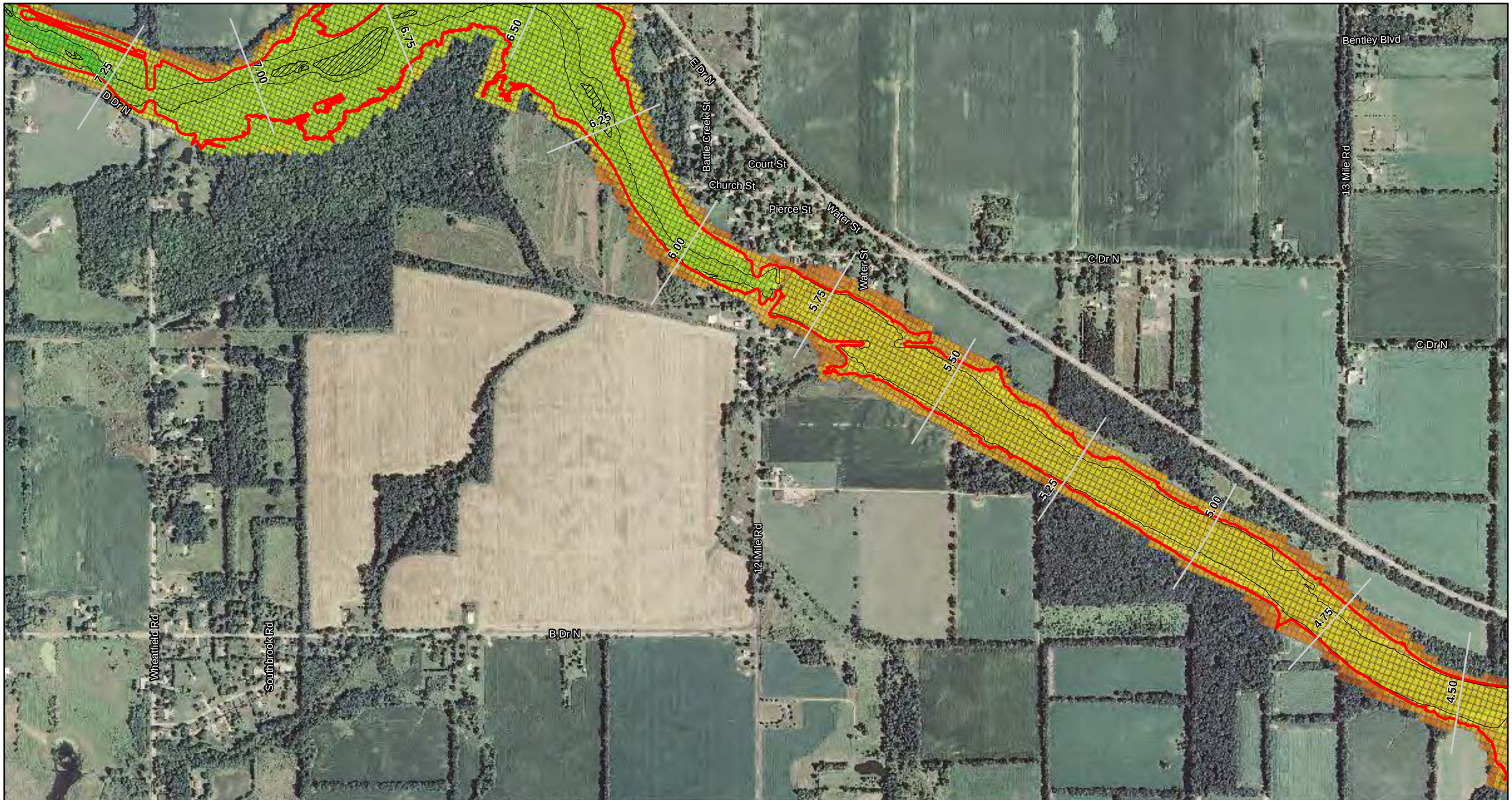
MP 1.50 - MP 4.50

SHEET 1 OF 16

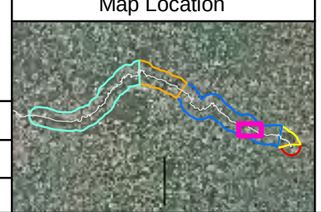
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

Aerial Photography Date: July & August 2009



Map Location



Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
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- 830 - 840 ft
- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

BATHYMETRY/TOPOGRAPHY MODEL INPUT

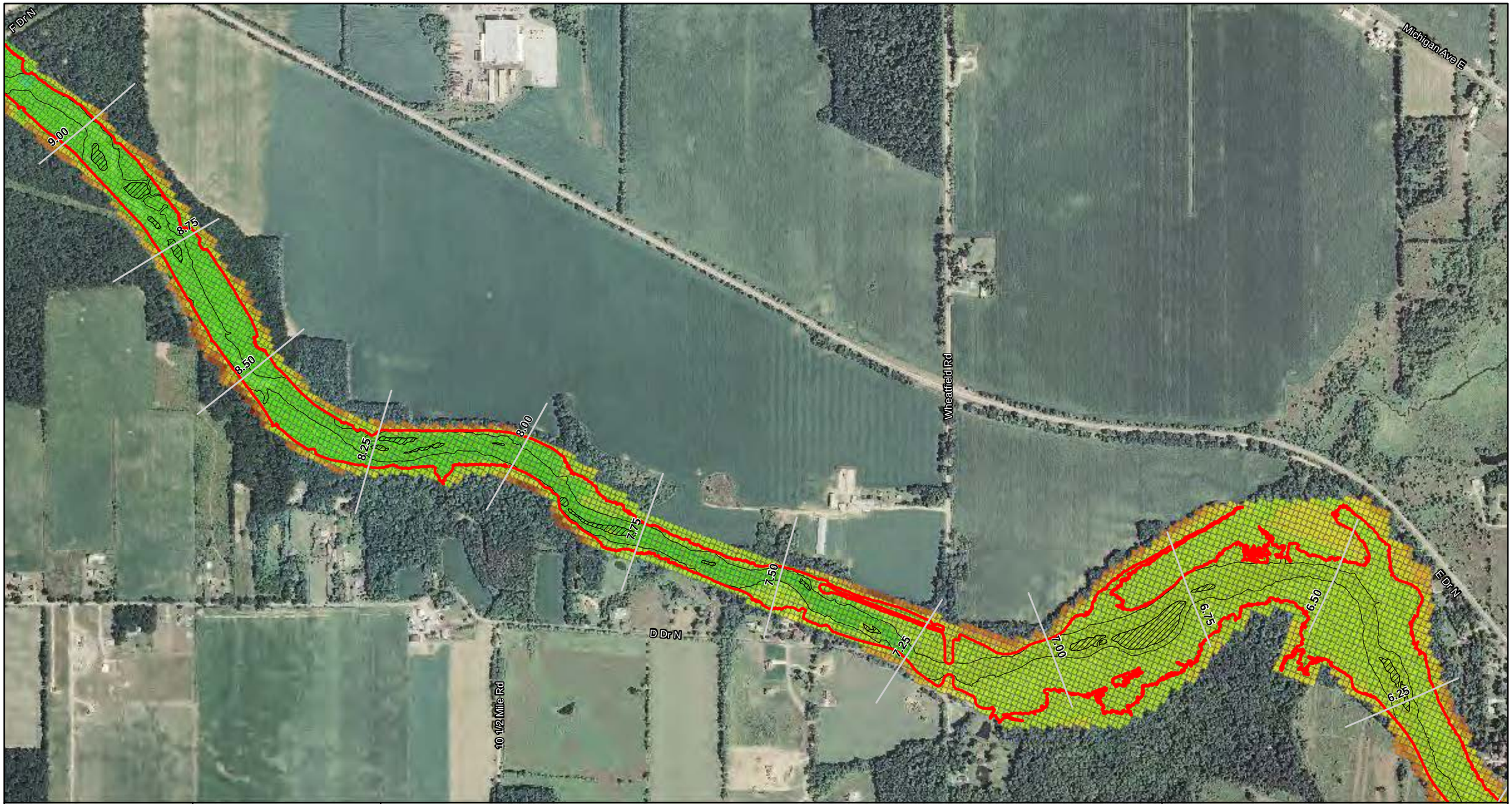
MP 4.50 - MP 6.25

SHEET 2 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
- 780 - 790 ft
- 790 - 800 ft
- 800 - 810 ft
- 810 - 820 ft
- 820 - 830 ft
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- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

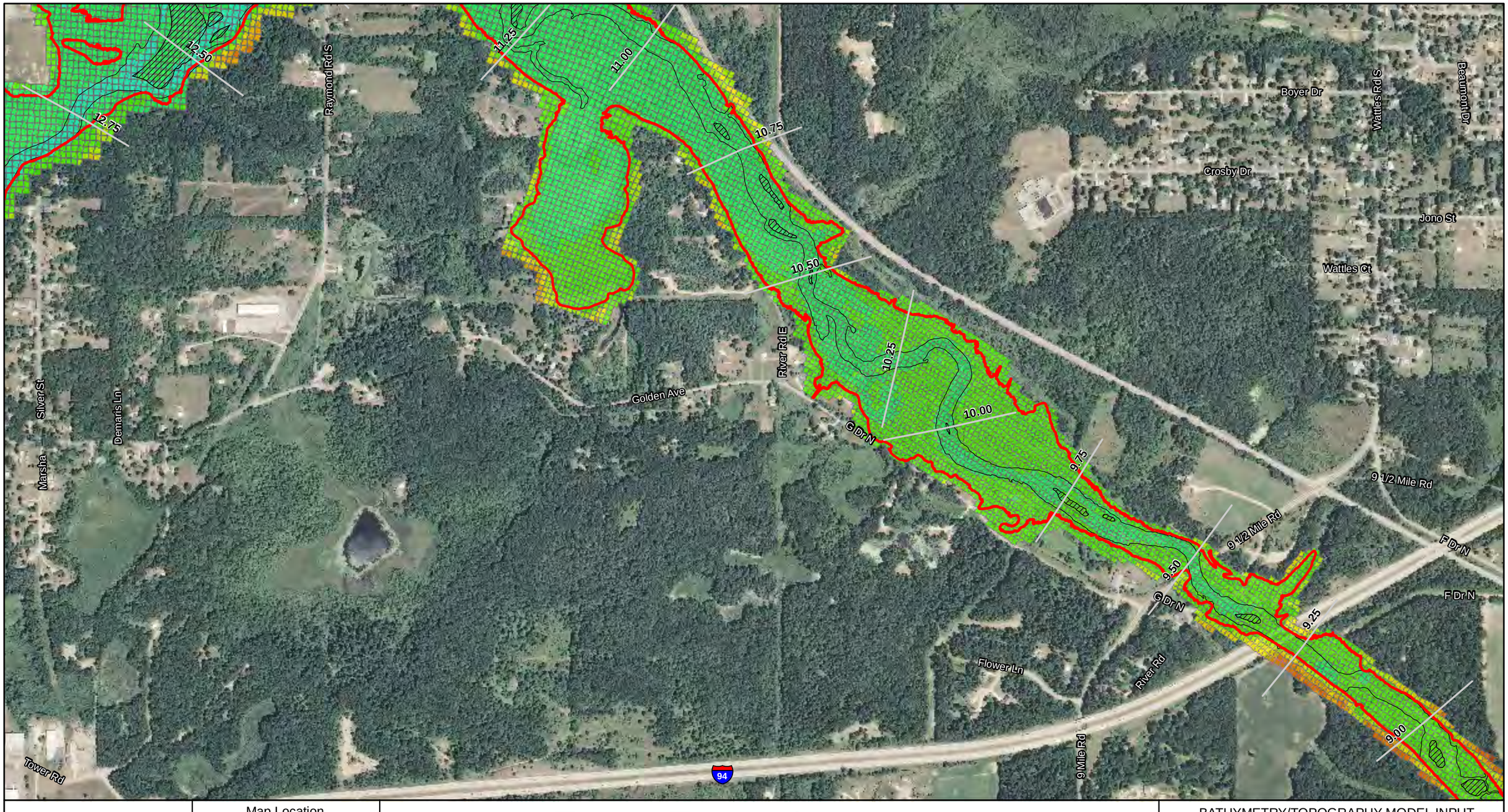
MP 6.25 - MP 9.00

SHEET 3 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

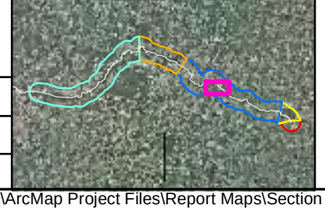
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
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- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

MP 9.00 - MP 10.50

SHEET 4 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

Aerial Photography Date: July & August 2009

Warren St
Mary St
High St
Horton St
Oak St
Willow St
Main St
Mott St
Midway Ct
Oak Hill Dr
Newark Ave
Lathrop Ave
Walnut Ave
Cliff St
Michigan Ave E
Row F
Park Dr
Front St
Burdge St S
Bell St
Cornwell St
Cliff Cutoff
Prospect Pl
Princeton St S
Interurban Ave
Dexter St
Clinton Dr
Crest Ave
Berrien Ave
Caine St
Vale St
James St
Grebe St
Hannah St
Marjorie St
Academy St
Nelson St
Post Ave
Illinois St
Jericho Rd
Highway St
Taft St
Kingman Ave W
Kingman Ave E
Inn Rd
Grenville St
Euclid Ave
Enwood St
Walnut Ct
Alden Ave W
Alden Ave E
Columbia Ave E
Bonita Dr
Lyda St
Richmond Ave
Taft Ct
Winding Way Dr
Shore Dr
Leonhard Wood
River Rd E
Belton Ave
Cherokee St
Row K
Row G
Linn Ave
Pawnee St
Auburn St
Fruin Ave
Pinewood Ave
Beadle Lake Rd
River Dr
Marion St
6 1/2 Mile Rd
Oneil St
Overton St
Silver St
Raymond Rd S
Demaris Ln
Golden Ave
Bard
Marsha
12.00
11.75
11.50
12.25
11.25
12.50
11.00
12.75
10.75
14.25
14.00
13.25
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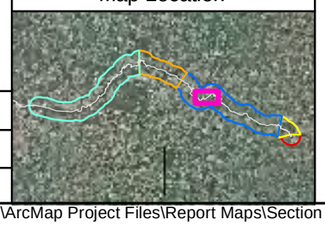
10.50

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Model Input Elevation (ft)

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- 760 - 770 ft
- 770 - 780 ft
- 780 - 790 ft
- 790 - 800 ft
- 800 - 810 ft
- 810 - 820 ft
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- 830 - 840 ft
- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

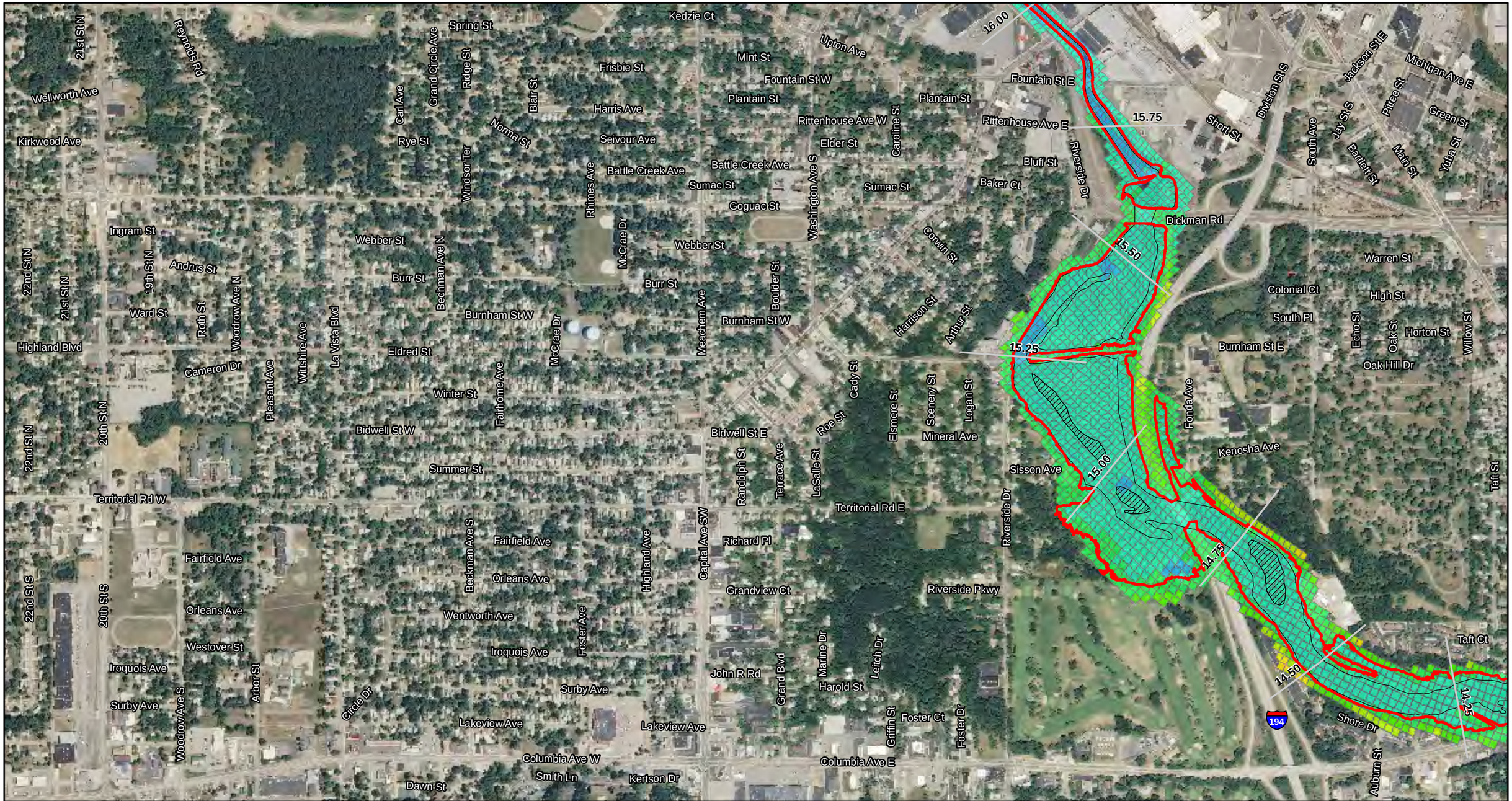
MP 10.50 - MP 14.25

SHEET 5 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

Aerial Photography Date: July & August 2009



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Model Input Elevation (ft)

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- 760 - 770 ft
- 770 - 780 ft
- 780 - 790 ft
- 790 - 800 ft
- 800 - 810 ft
- 810 - 820 ft
- 820 - 830 ft
- 830 - 840 ft
- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

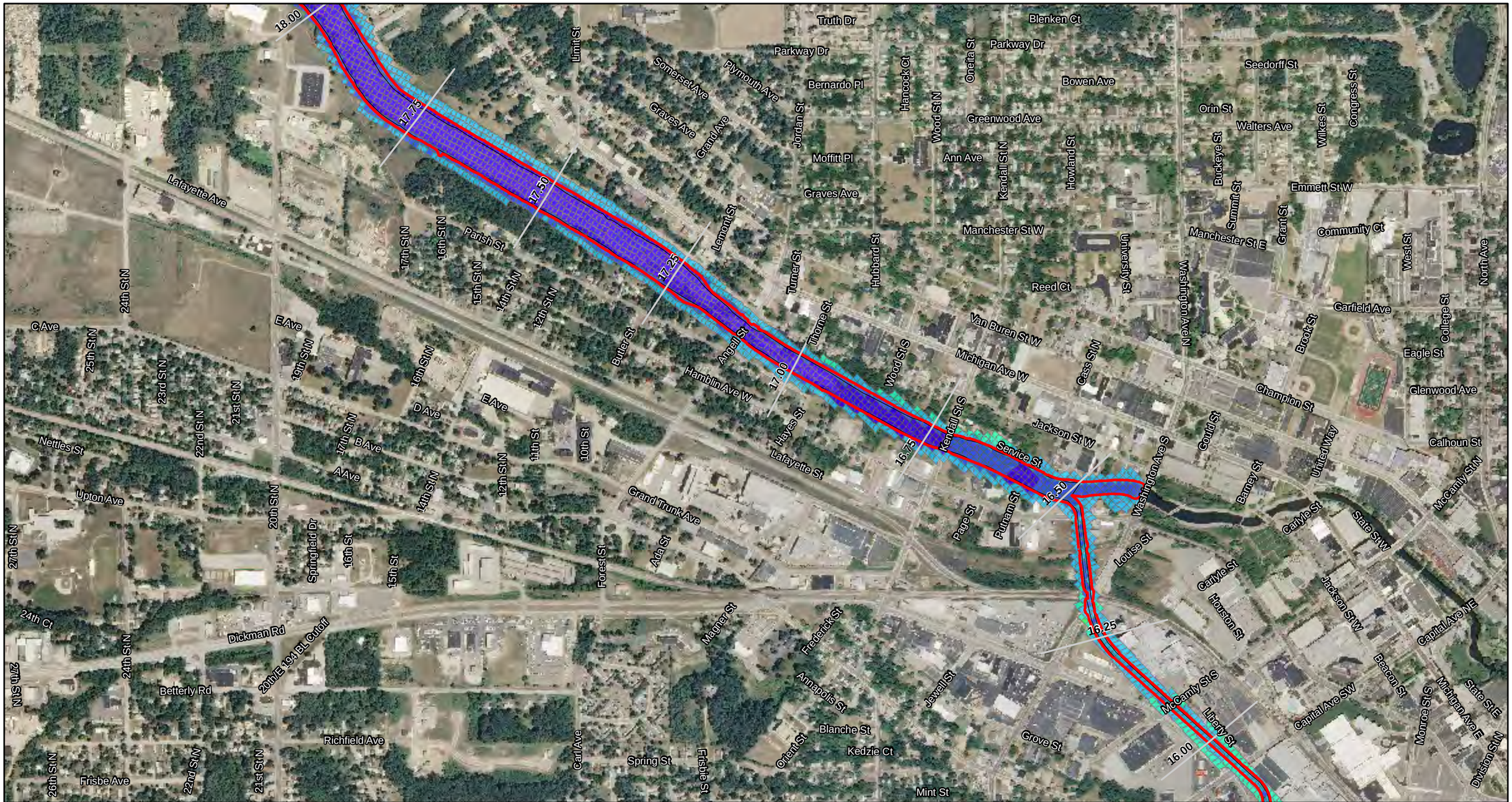
MP 14.25 - MP 16.00

SHEET 6 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

Aerial Photography Date: July & August 2009



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
- 780 - 790 ft
- 790 - 800 ft
- 800 - 810 ft
- 810 - 820 ft
- 820 - 830 ft
- 830 - 840 ft
- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

MP 16.00 - MP 18.00

SHEET 7 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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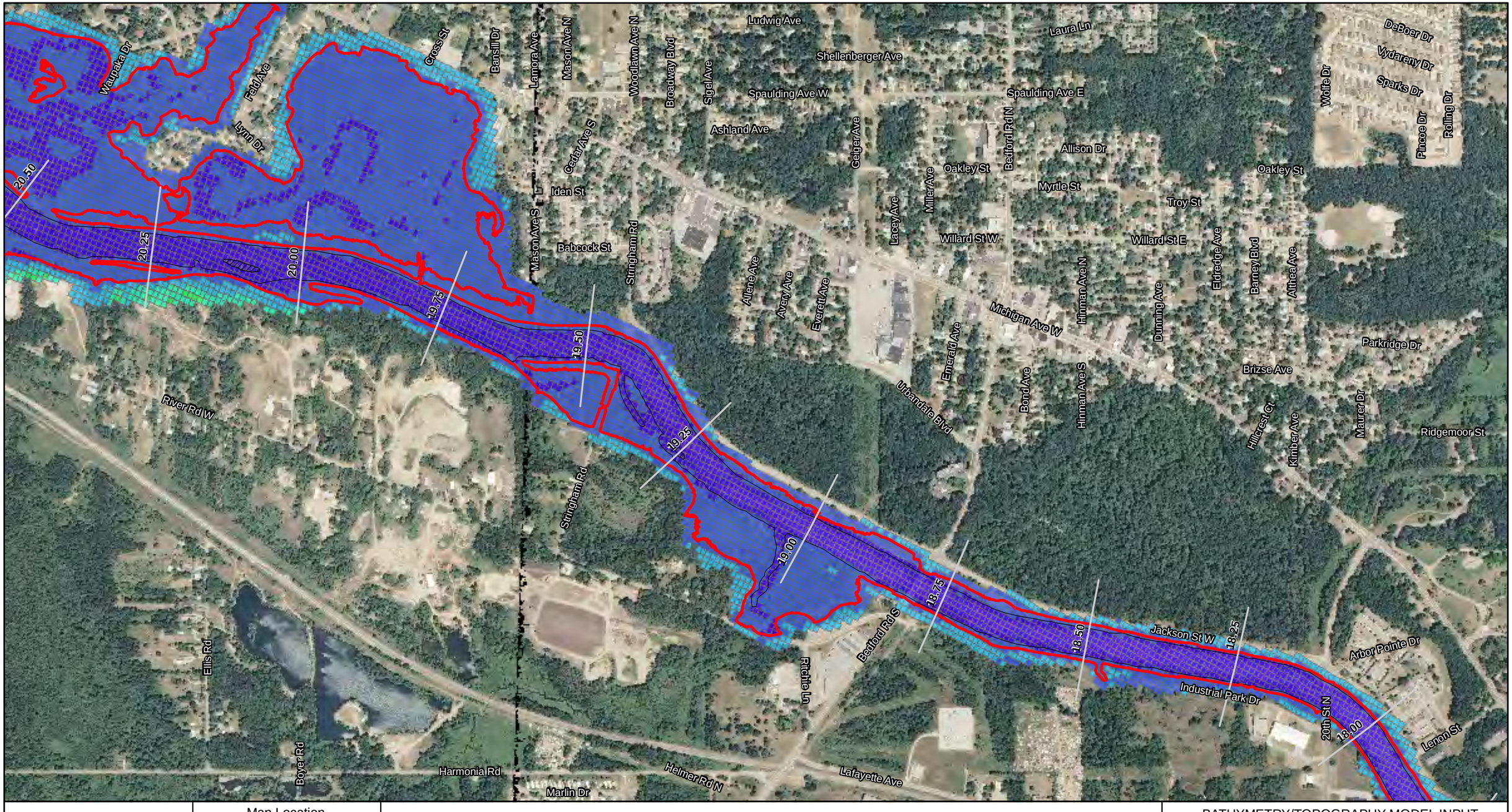
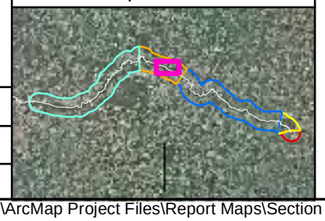
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
- 780 - 790 ft
- 790 - 800 ft
- 800 - 810 ft
- 810 - 820 ft
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- 830 - 840 ft
- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

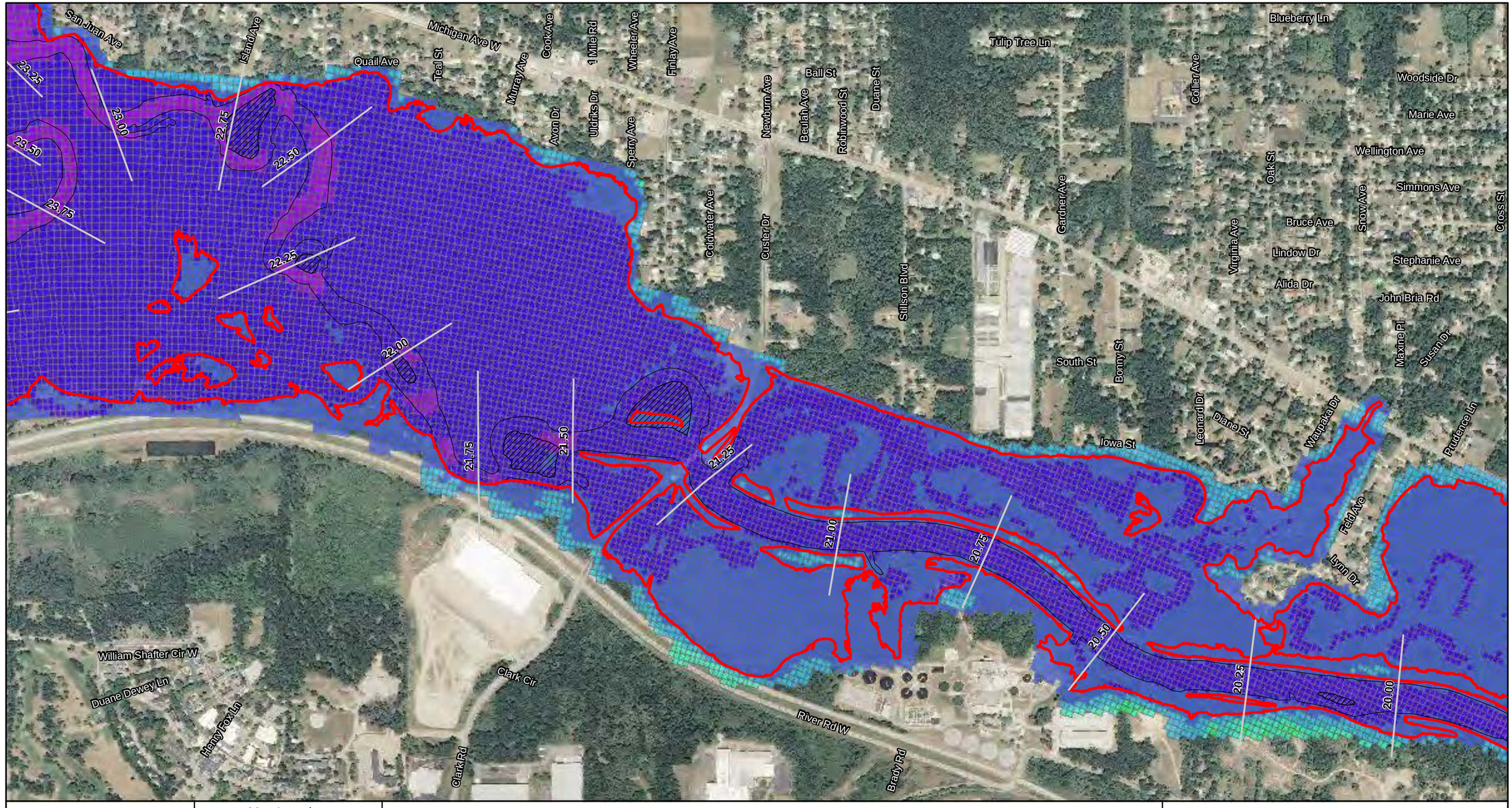
MP 18.00 - MP 20.00

SHEET 8 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

Aerial Photography Date: July & August 2009



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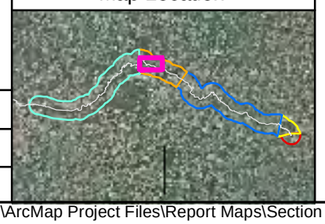

Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
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- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

BATHYMETRY/TOPOGRAPHY MODEL INPUT

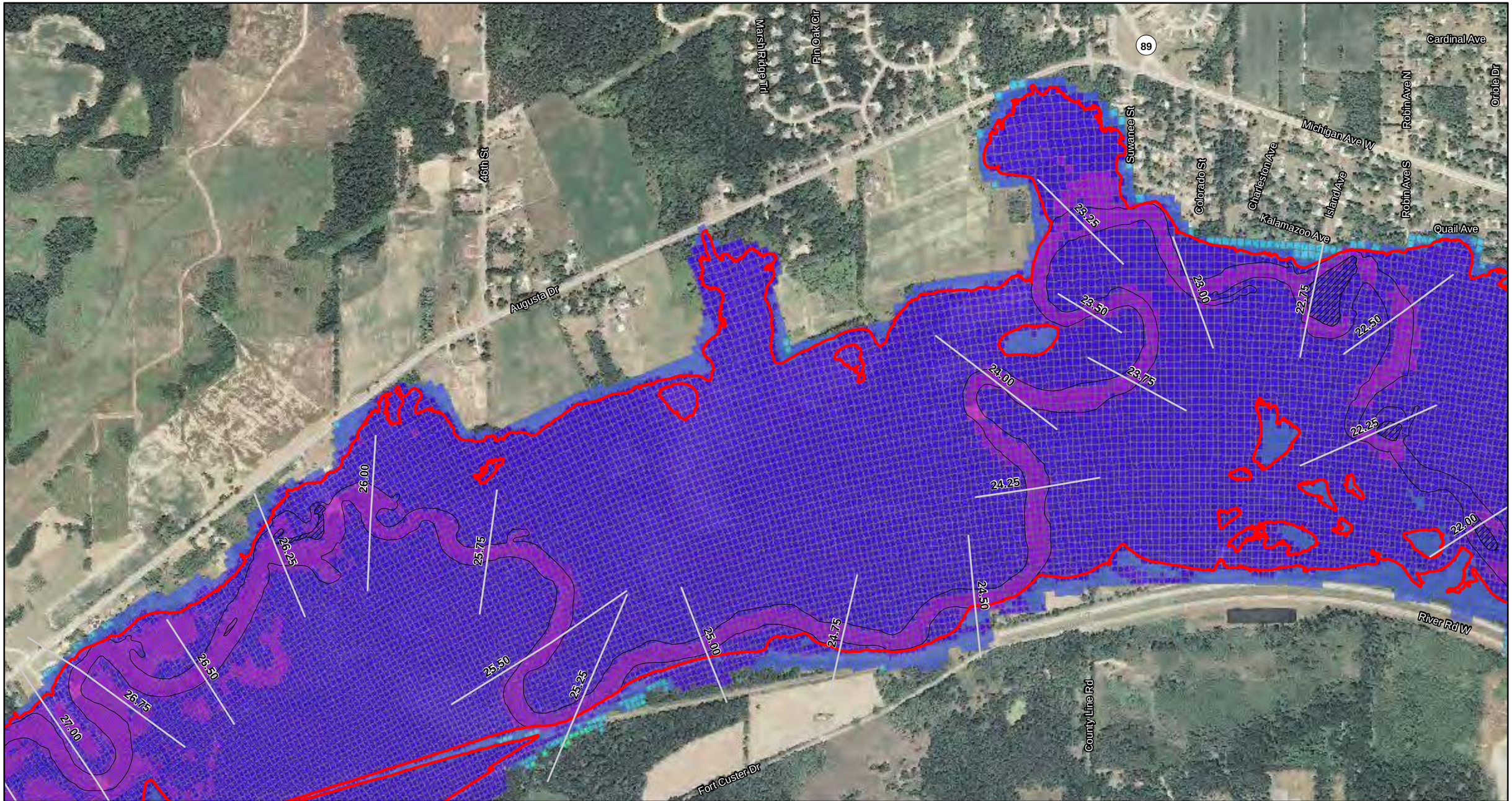
MP 20.00 - MP 22.50

SHEET 9 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
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- 800 - 810 ft
- 810 - 820 ft
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- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

MP 22.50 - MP 27.00

SHEET 10 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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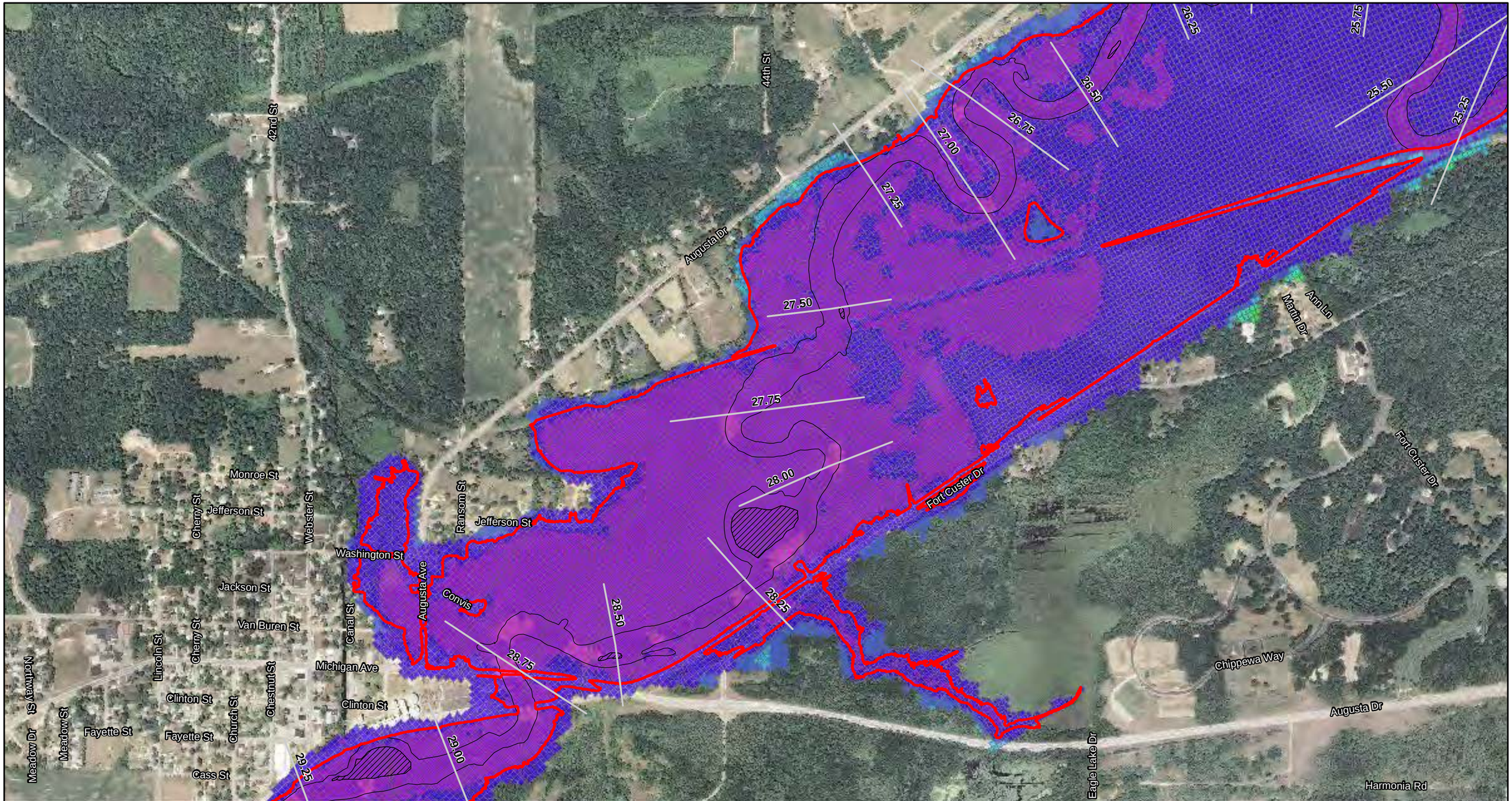
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
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- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

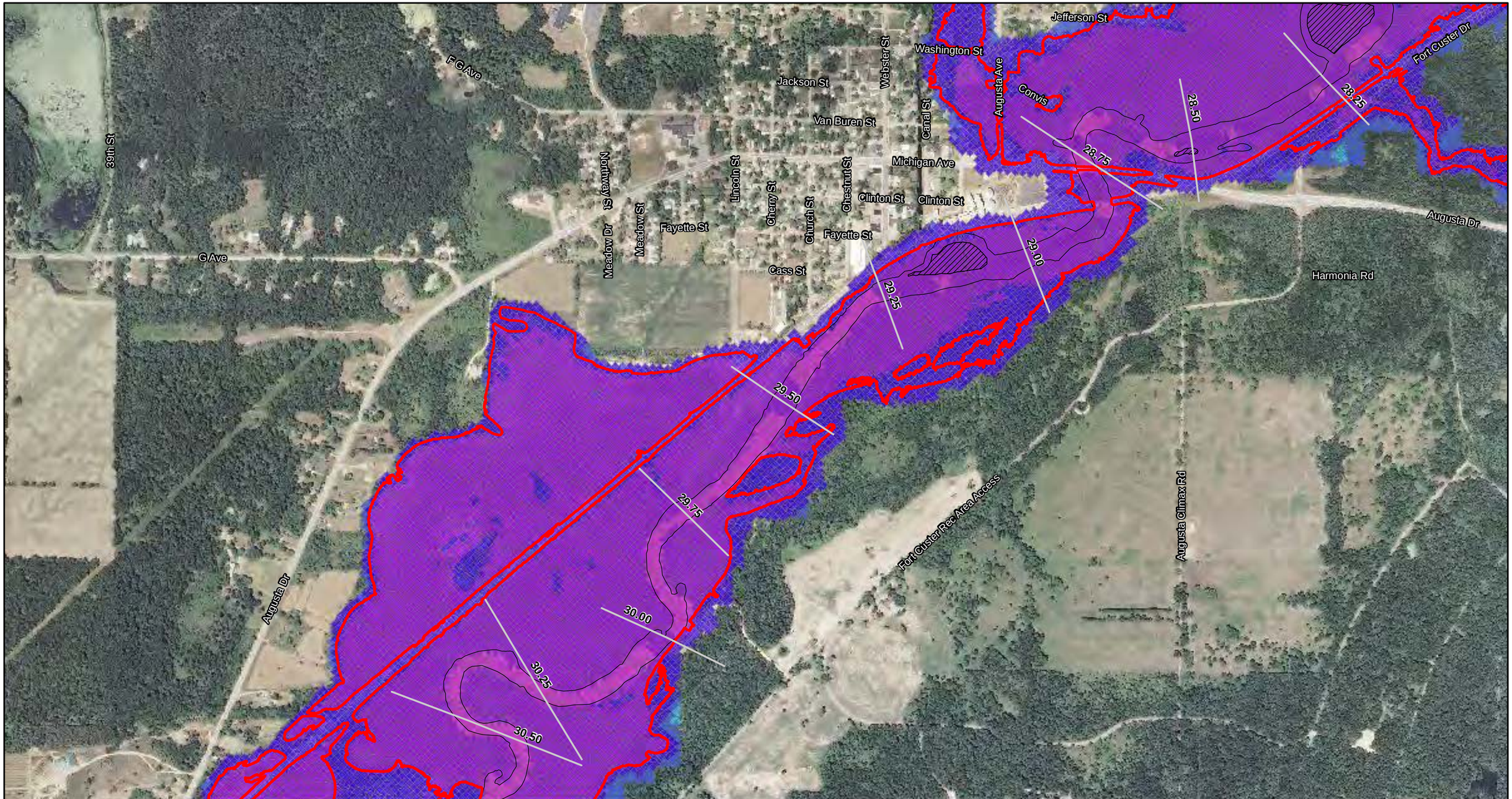
MP 27.00 - MP 28.75

SHEET 11 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

Aerial Photography Date: July & August 2009



Map Location

Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
- 780 - 790 ft
- 790 - 800 ft
- 800 - 810 ft
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- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

BATHYMETRY/TOPOGRAPHY MODEL INPUT

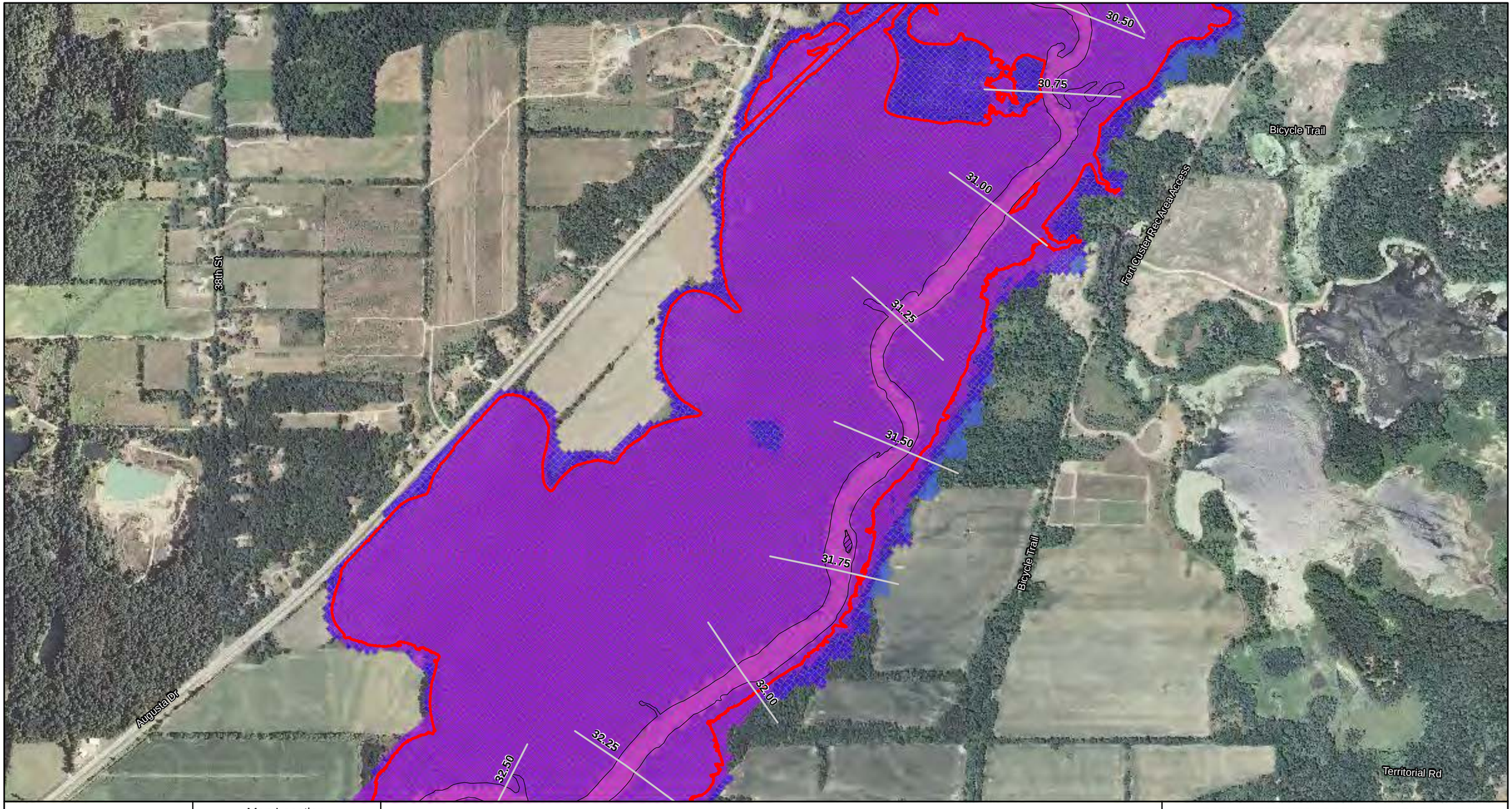
MP 28.75 - MP 30.50

SHEET 12 OF 16

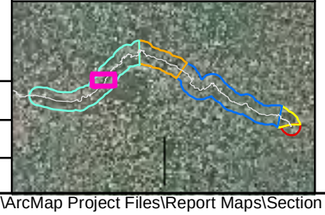
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

Aerial Photography Date: July & August 2009



Map Location



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- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

BATHYMETRY/TOPOGRAPHY MODEL INPUT

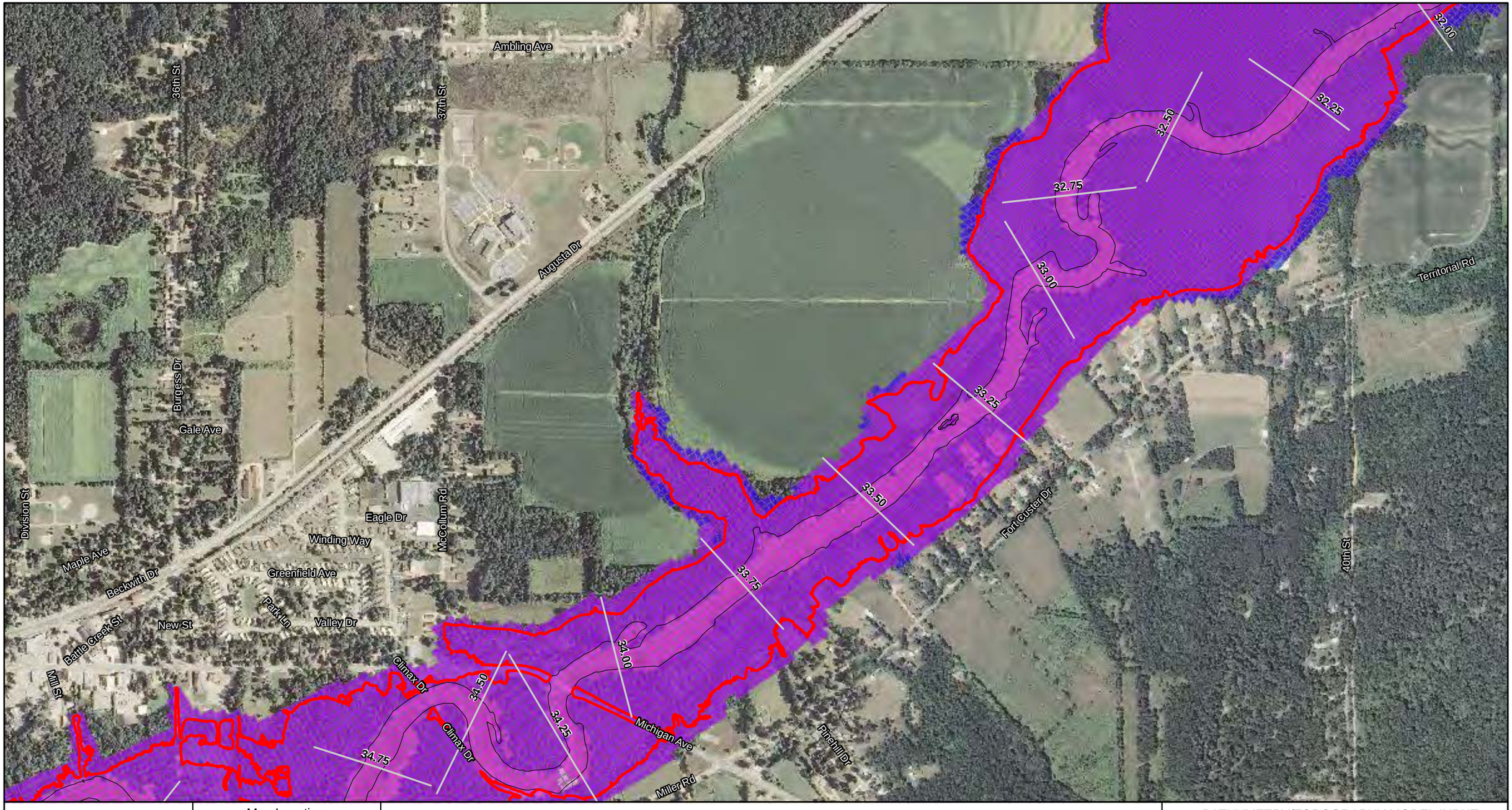
MP 30.50 - MP 32.25

SHEET 13 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

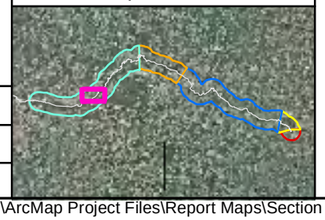
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
- 780 - 790 ft
- 790 - 800 ft
- 800 - 810 ft
- 810 - 820 ft
- 820 - 830 ft
- 830 - 840 ft
- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

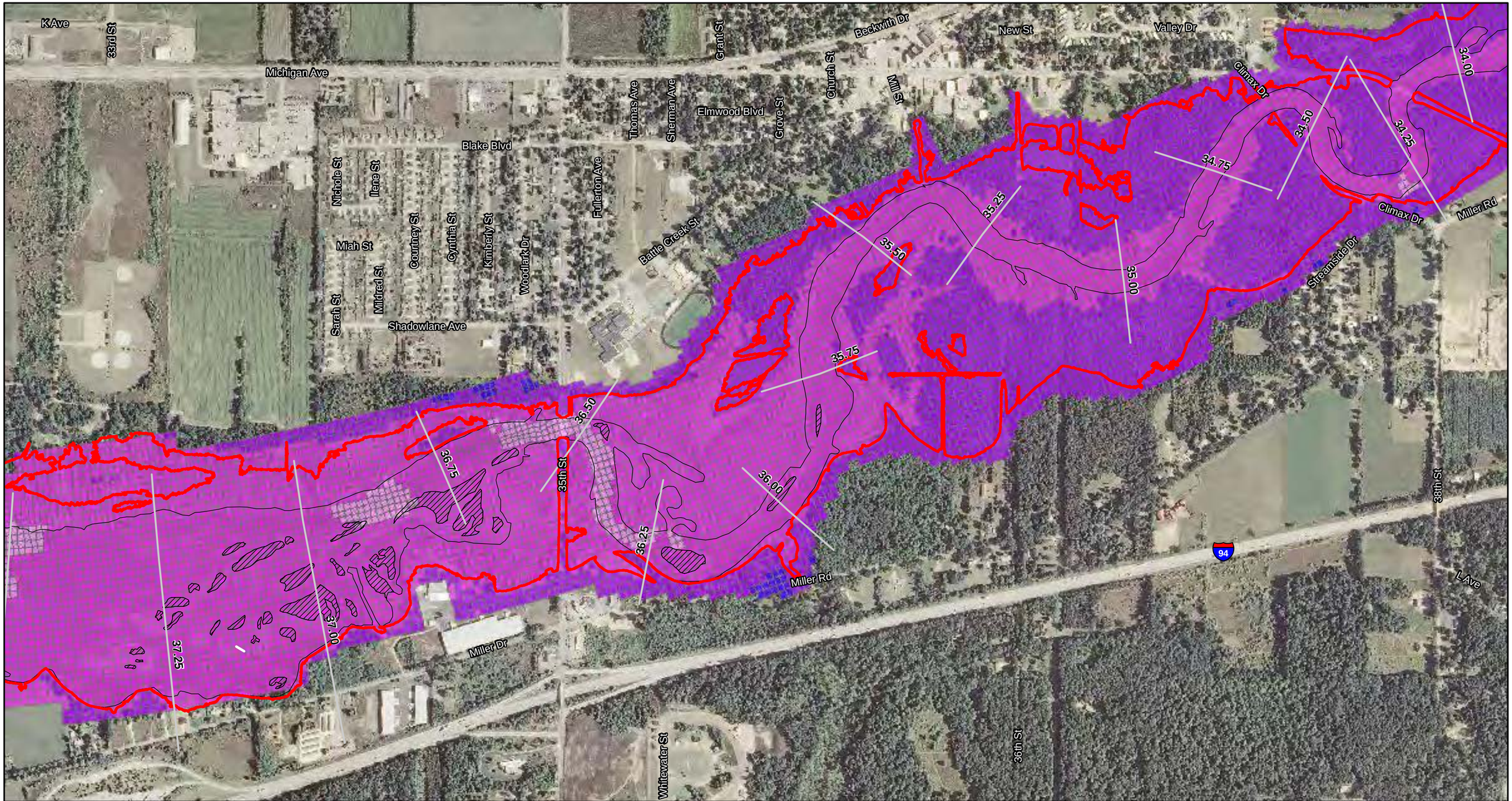
MP 32.25 - MP 34.75

SHEET 14 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Bathy-Topo Inputs.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
- 780 - 790 ft
- 790 - 800 ft
- 800 - 810 ft
- 810 - 820 ft
- 820 - 830 ft
- 830 - 840 ft
- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

MP 34.25 - MP 37.50

SHEET 15 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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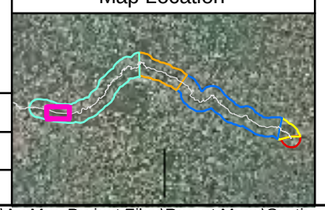
Aerial Photography Date: July & August 2009

Gleason St
Hunt St
Morrow St
Elliot Rd
Lawndale Ave
Rosemont Dr
Van Bruggen St
Sparks St
Krum Ave
Plaza Pl
40.00
39.75
39.50
39.25
39.00
38.75
38.50
38.25
38.00
37.75
37.50
L Ave E
Cooks Dr
Gleneagle Dr
Kilowatt Dr
94
Lyin Rd
Miller Dr

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Model Input Elevation (ft)

- <760 ft
- 760 - 770 ft
- 770 - 780 ft
- 780 - 790 ft
- 790 - 800 ft
- 800 - 810 ft
- 810 - 820 ft
- 820 - 830 ft
- 830 - 840 ft
- 840 - 850 ft
- 850 - 860 ft
- 860 - 870 ft
- 870 - 880 ft
- 880 - 890 ft
- 890 - 900 ft
- >900 ft

ft = Feet

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

BATHYMETRY/TOPOGRAPHY MODEL INPUT

MP 37.50 - MP 40.00

SHEET 16 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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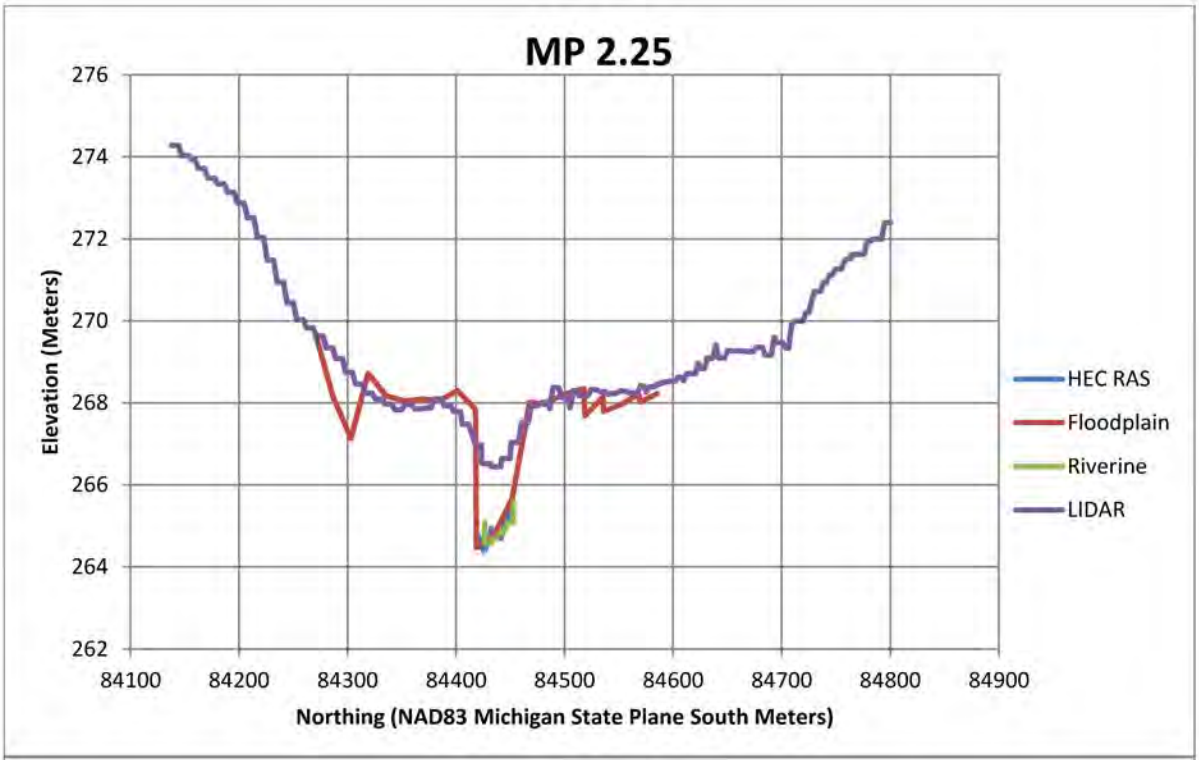
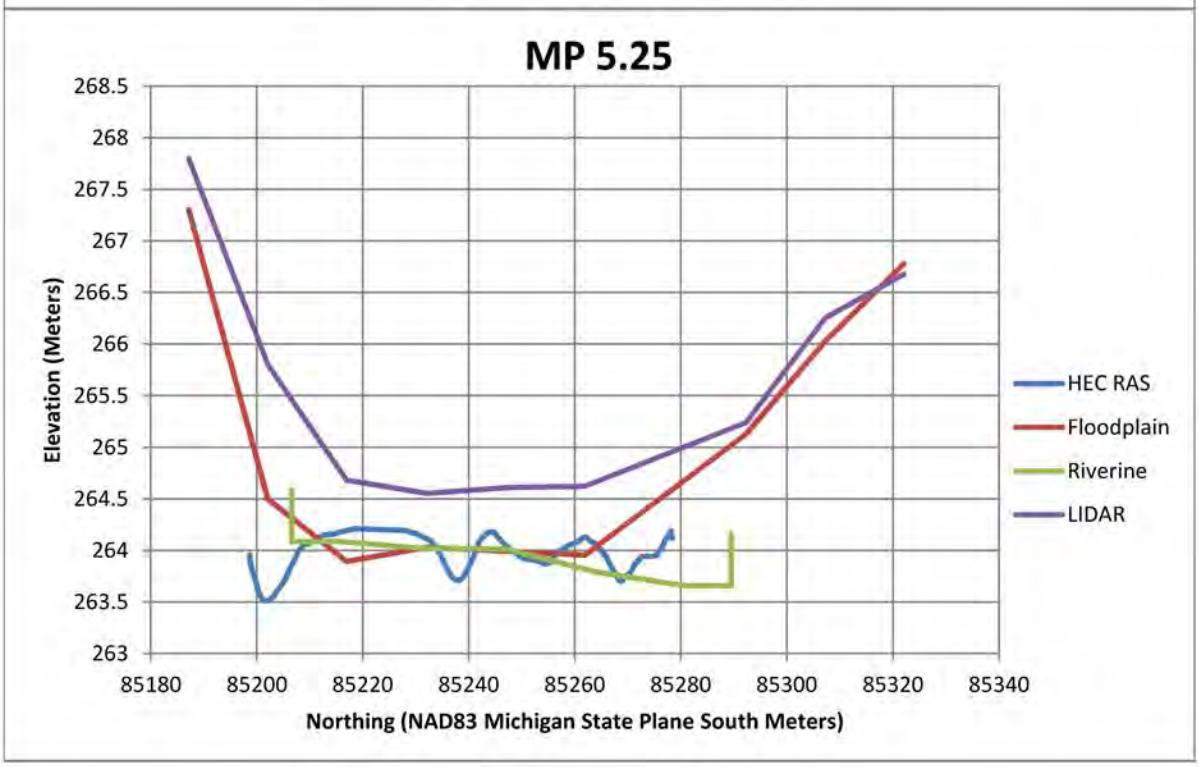
Aerial Photography Date: July & August 2009

Figure 3-11

Comparison of Model Cross-Sections to Surveyed HEC RAS Cross-Sections

Sheets 1 through 5





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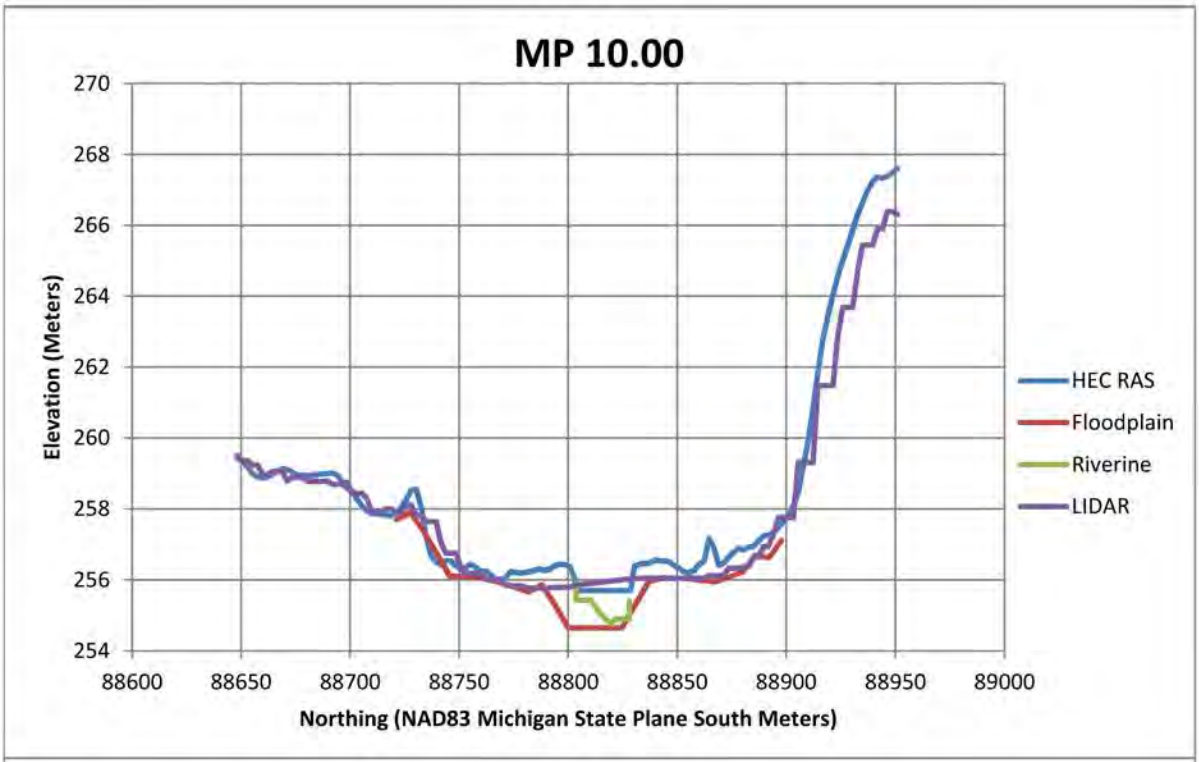
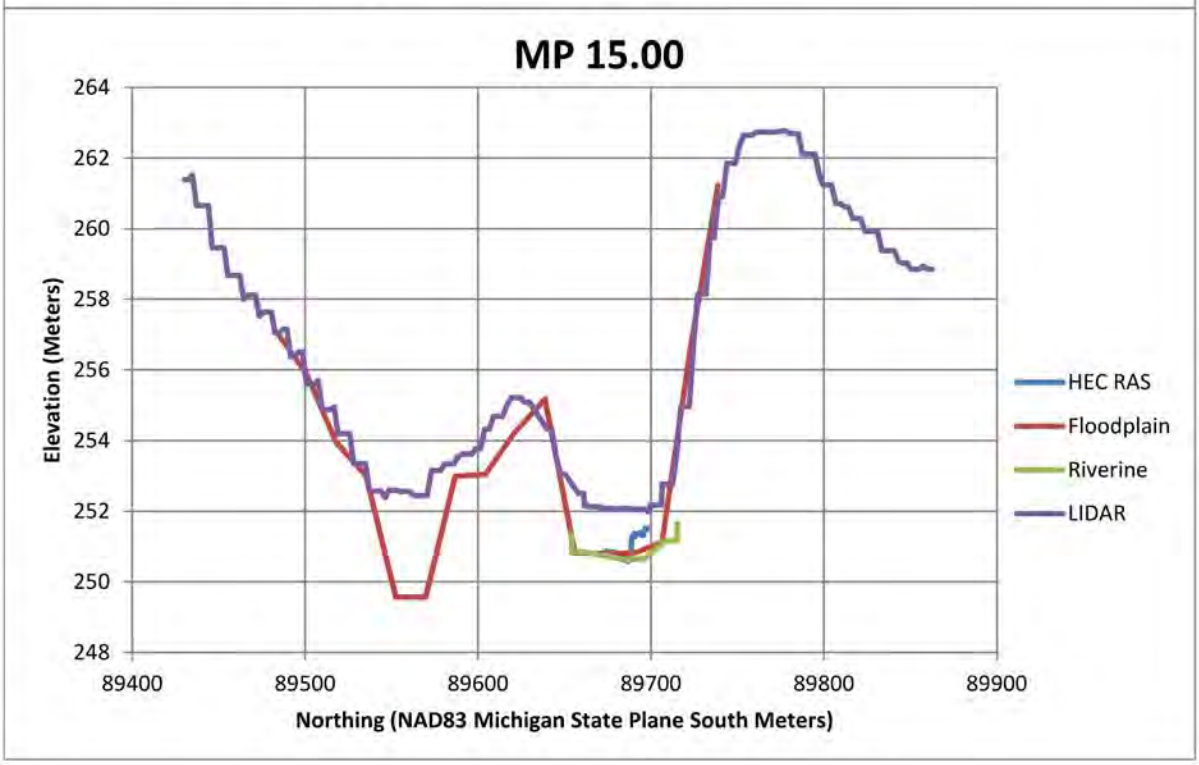
Drawn:	JLH 04/16/2012
Approved:	DBR 04/16/2012
Project #:	106-4186

COMPARISON OF MODEL CROSS-SECTIONS TO MODELED HEC RAS CROSS-SECTIONS

SHEET 1 OF 5

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP





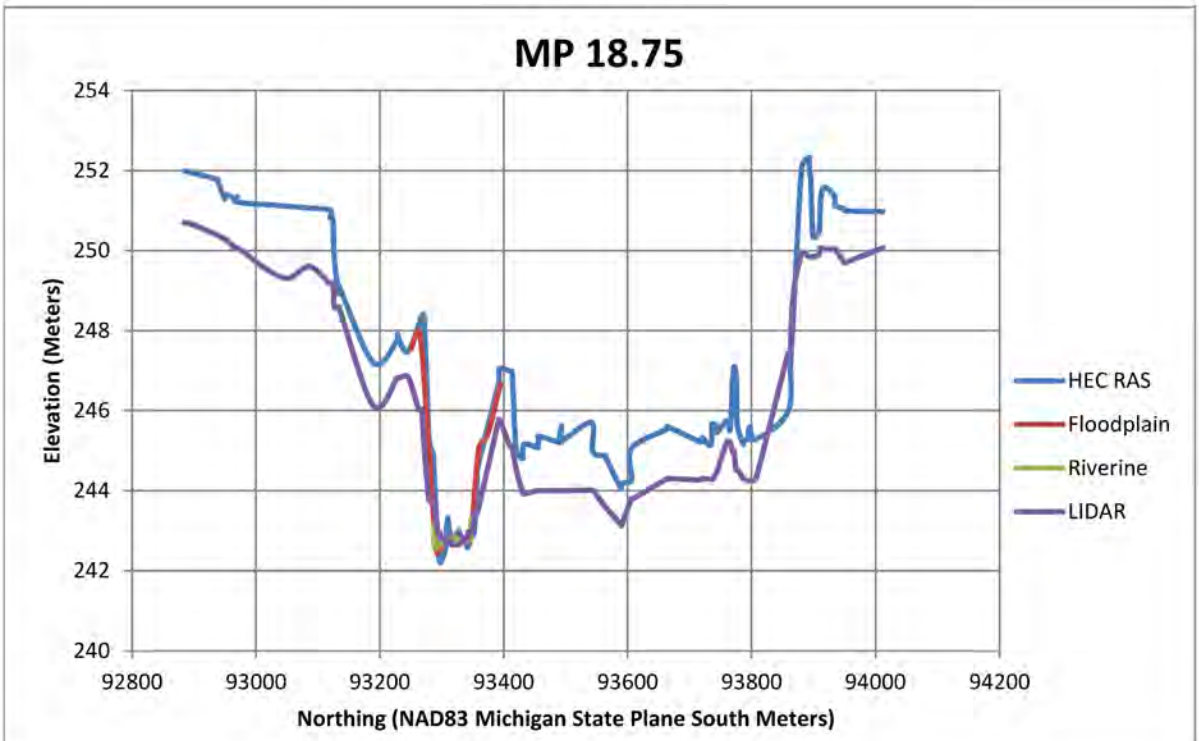
ENBRIDGE

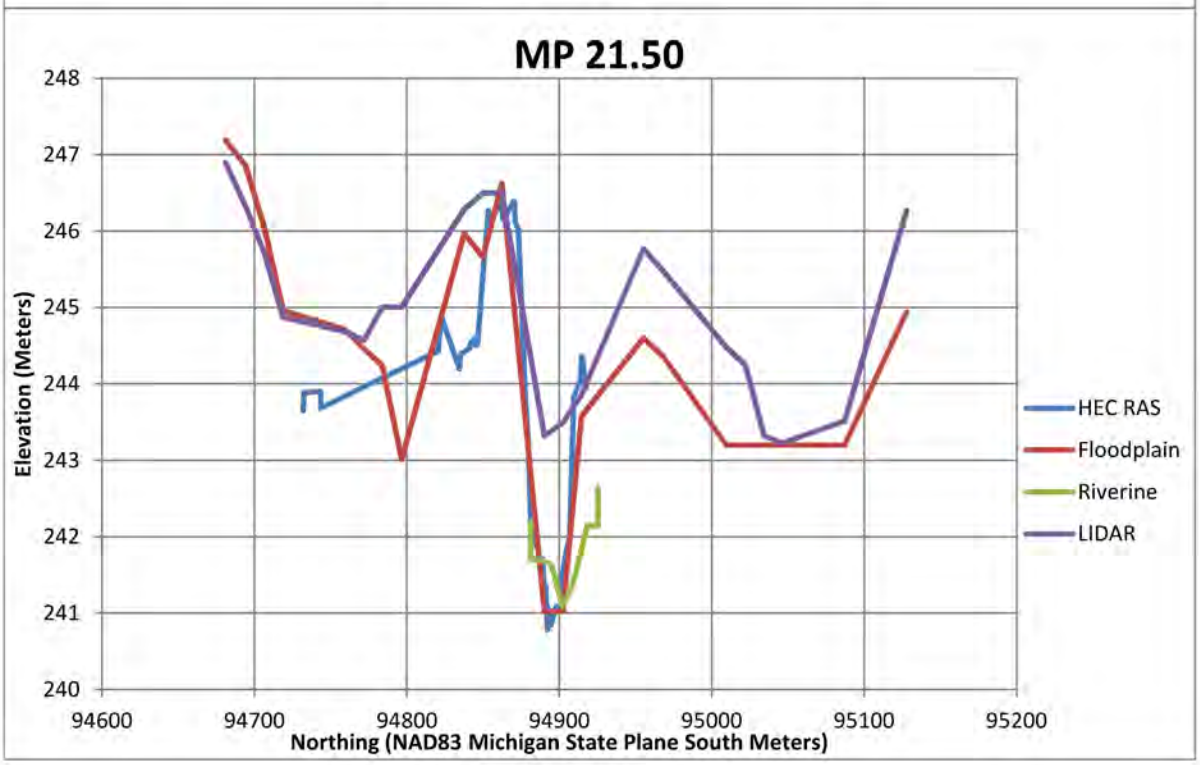
Drawn:	JLH 04/16/2012
Approved:	DBR 04/16/2012
Project #:	106-4186

COMPARISON OF MODEL CROSS-SECTIONS TO MODELED HEC RAS CROSS-SECTIONS

SHEET 2 OF 5

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP





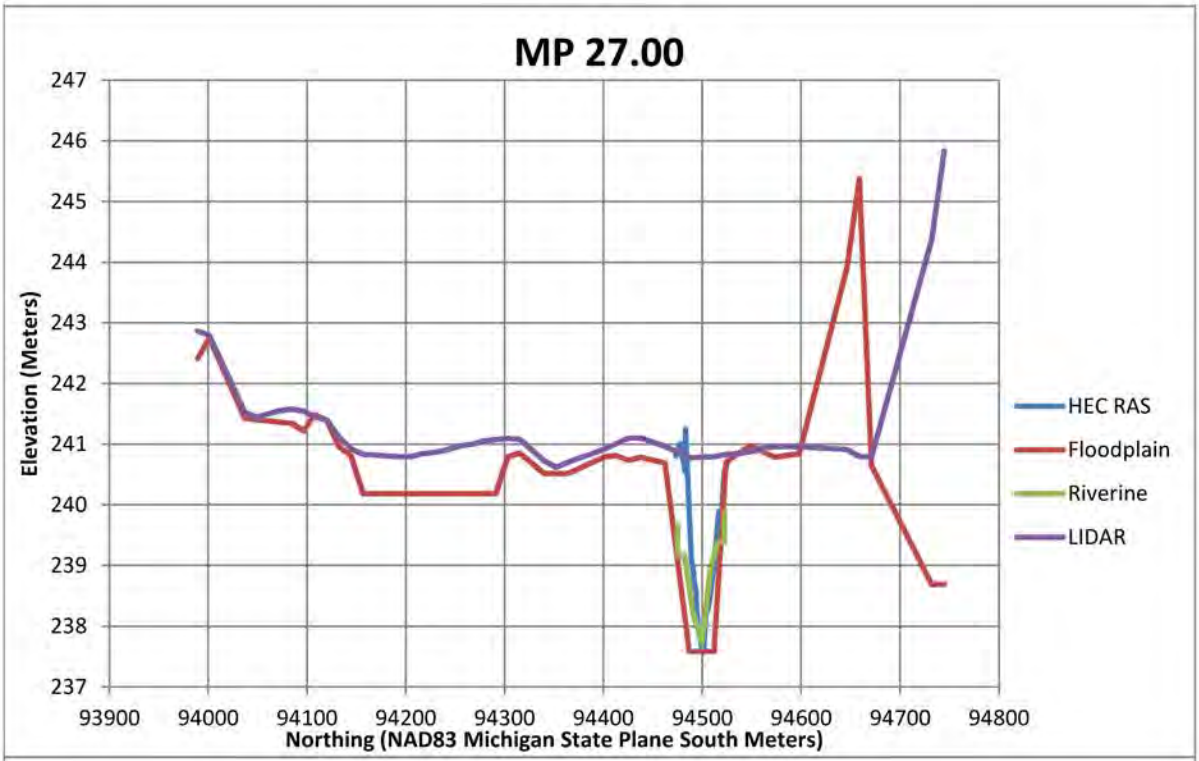
ENBRIDGE

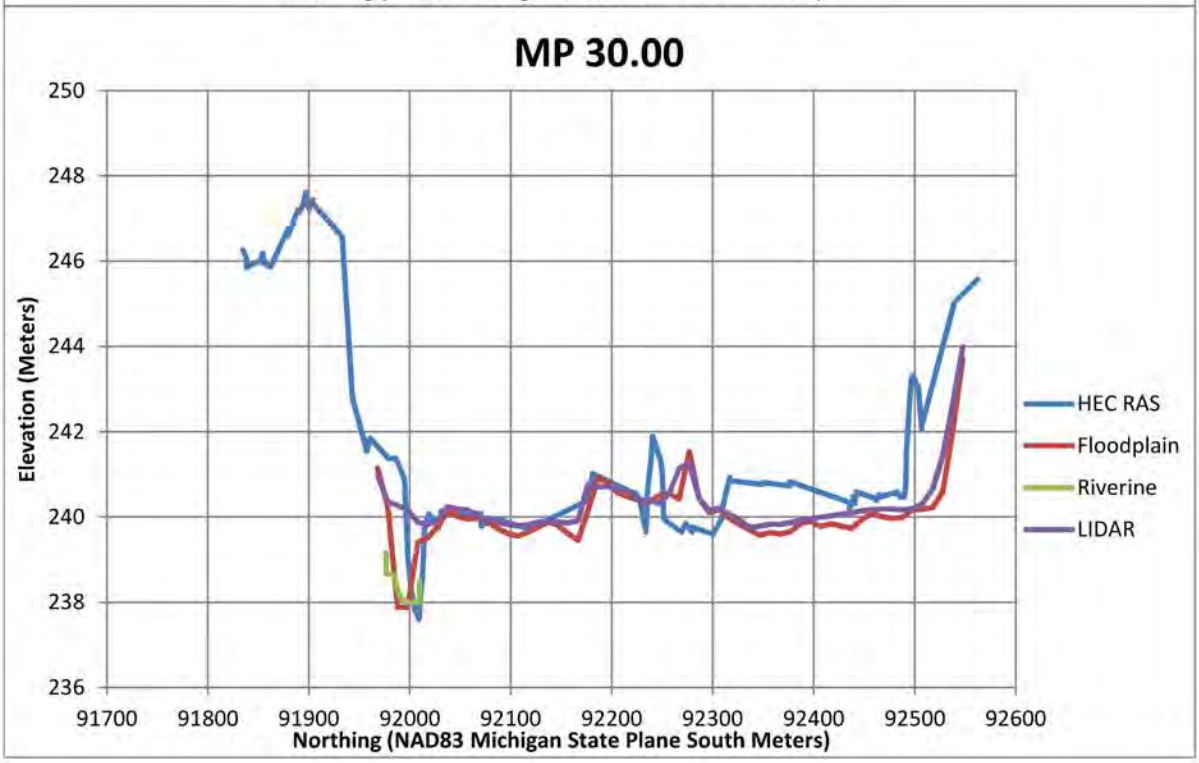
Drawn:	JLH 04/16/2012
Approved:	DBR 04/16/2012
Project #:	106-4186

COMPARISON OF MODEL CROSS-SECTIONS TO MODELED HEC RAS CROSS-SECTIONS

SHEET 3 OF 5

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP





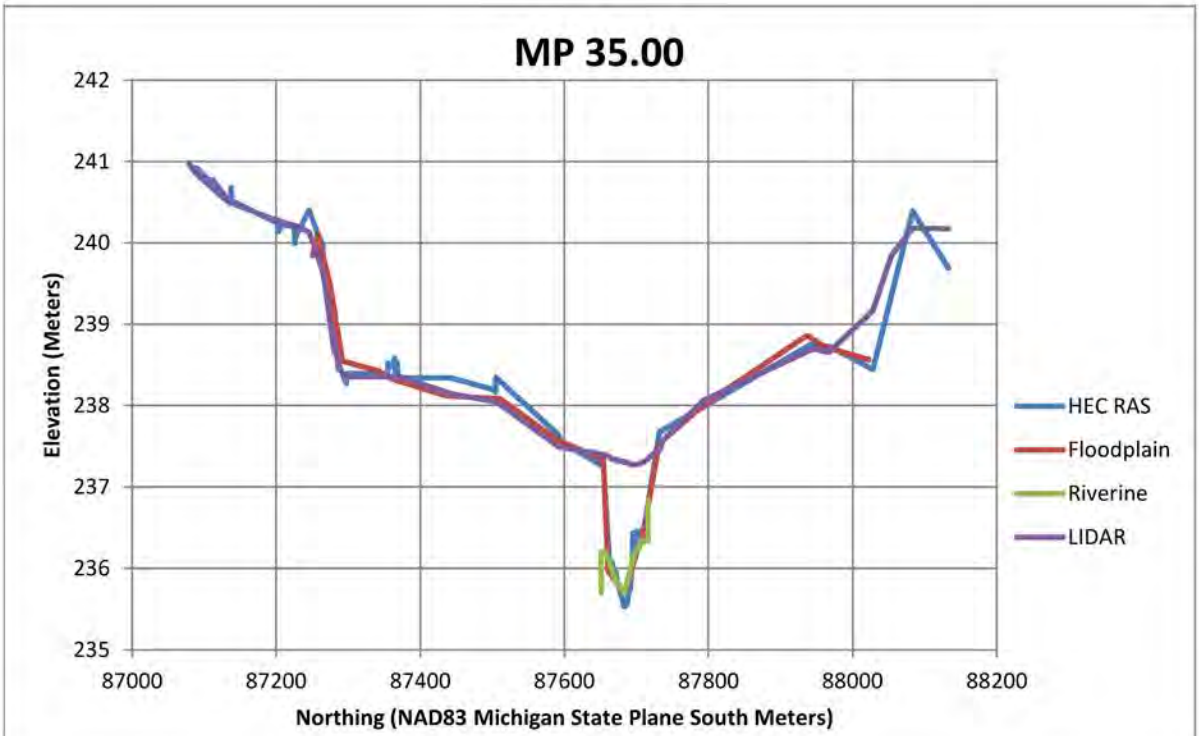
ENBRIDGE

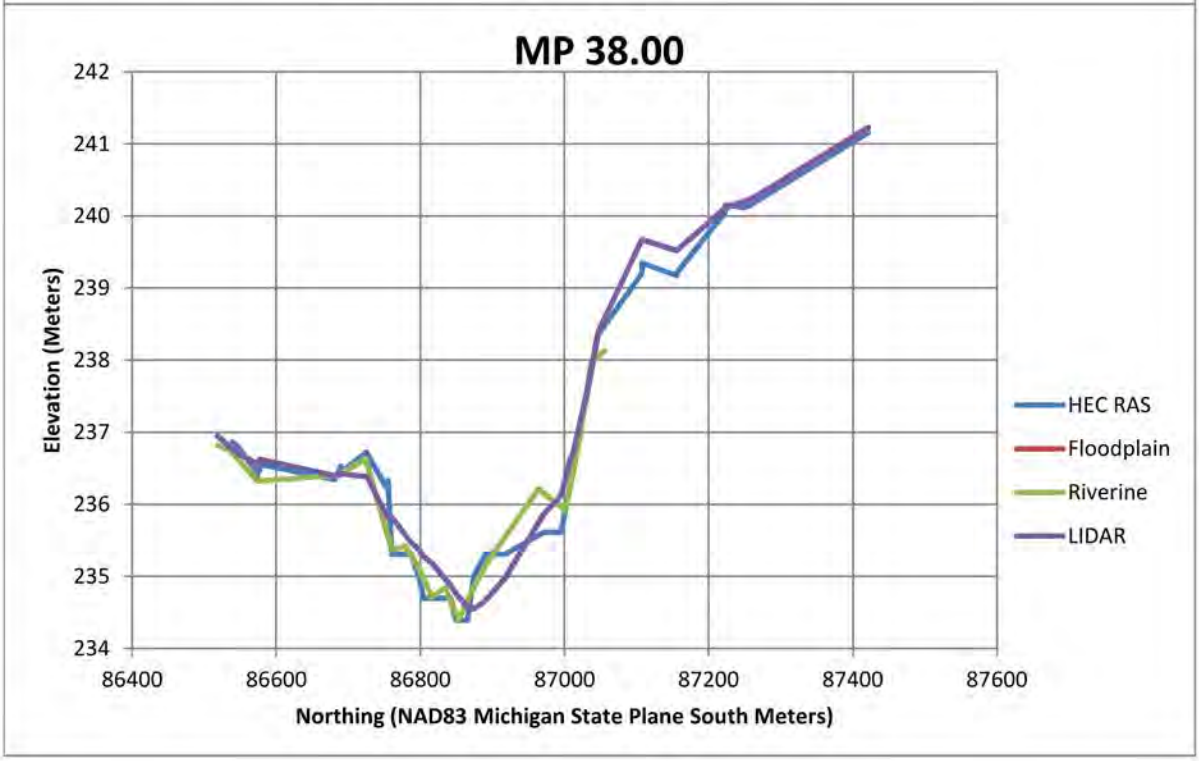
Drawn:	JLH 04/16/2012
Approved:	DBR 04/16/2012
Project #:	106-4186

COMPARISON OF MODEL CROSS-SECTIONS TO MODELED HEC RAS CROSS-SECTIONS

SHEET 4 OF 5

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP





ENBRIDGE

Drawn:	JLH 04/16/2012
Approved:	DBR 04/16/2012
Project #:	106-4186

COMPARISON OF MODEL CROSS-SECTIONS TO MODELED HEC RAS CROSS-SECTIONS

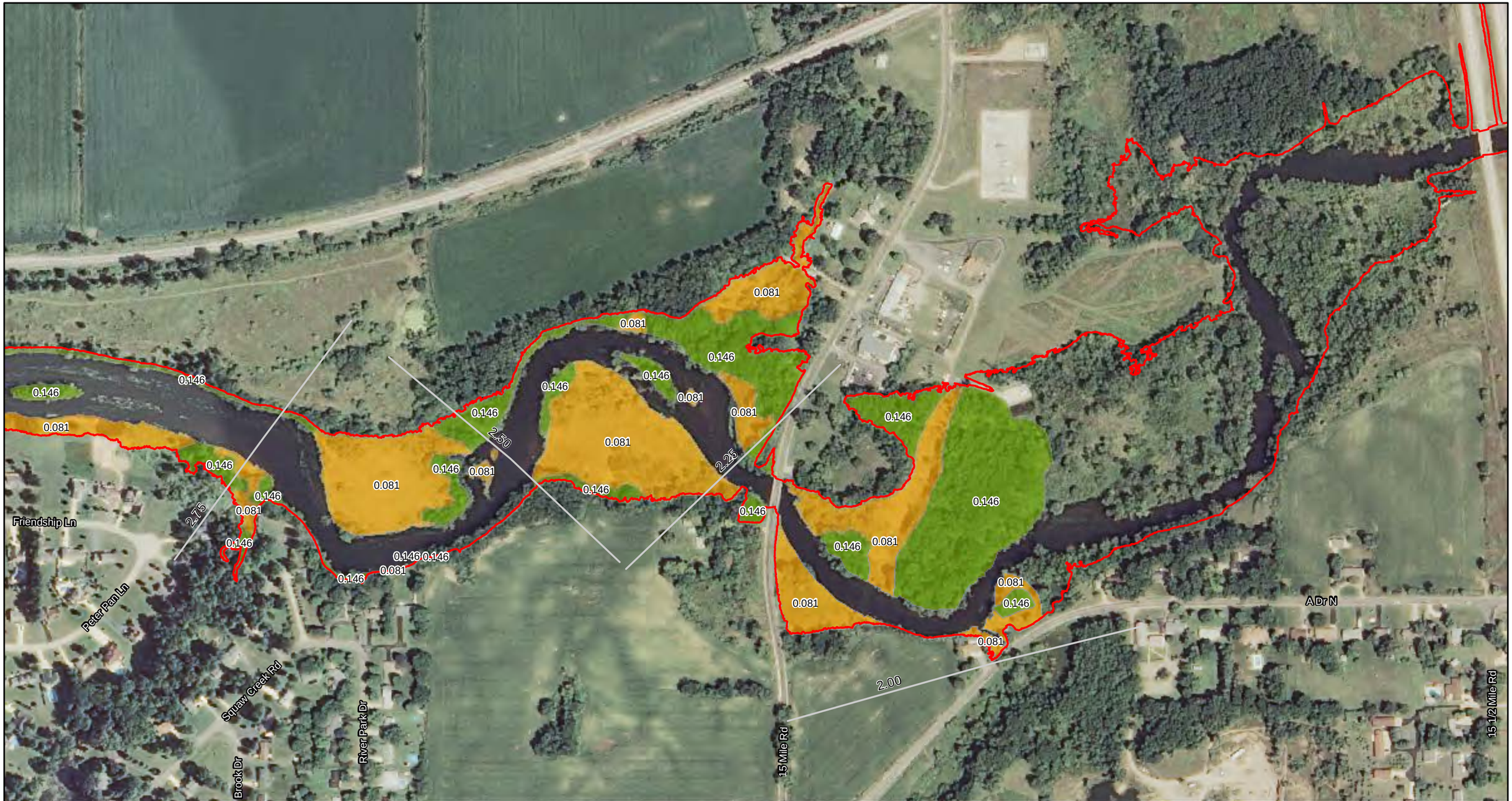
SHEET 5 OF 5

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 3-12

Floodplain Vegetation Categories with Roughness

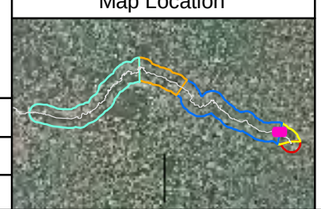
Sheets 1 through 45



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 01.88 - MP 02.91

SHEET 1 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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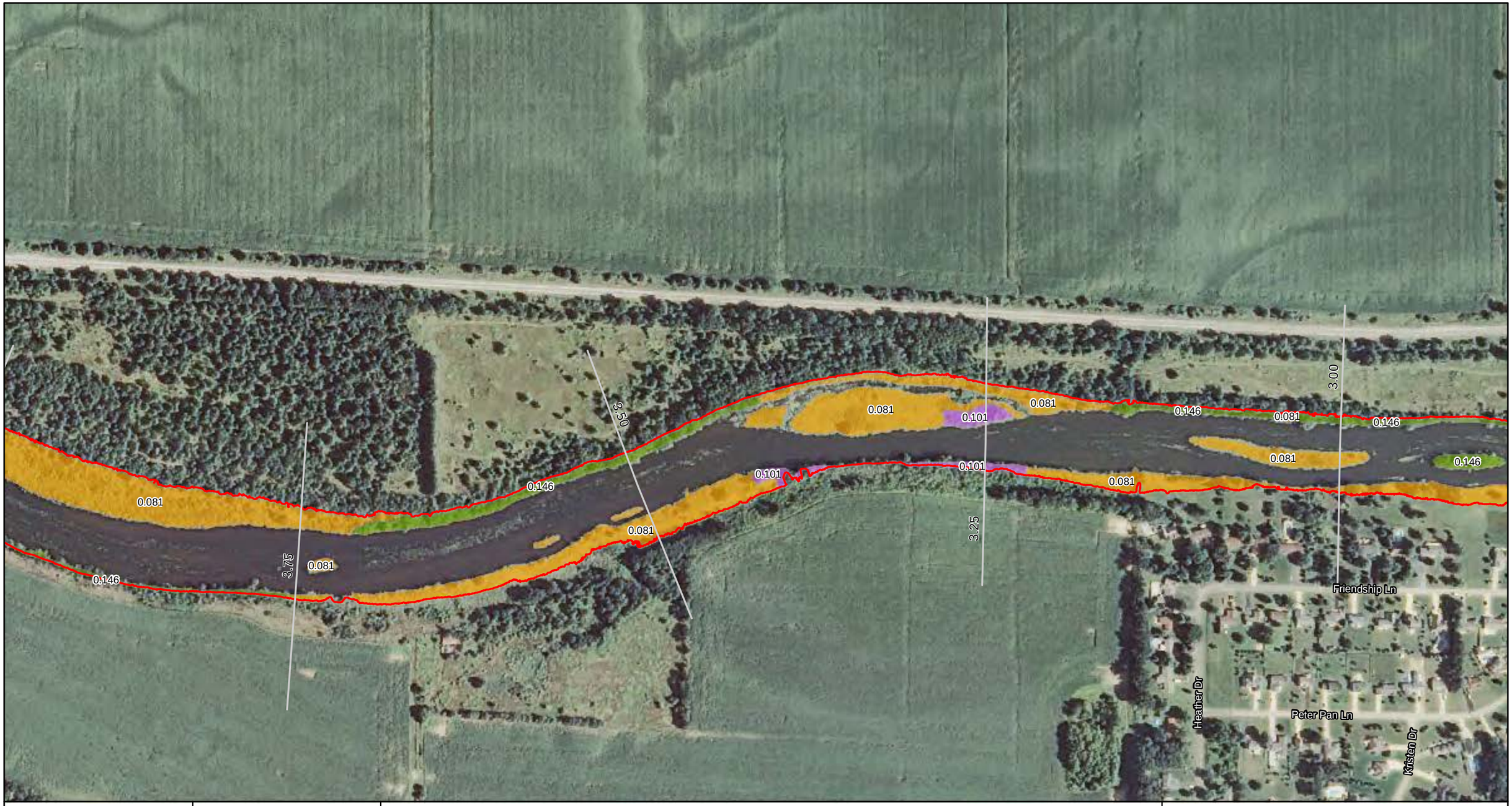
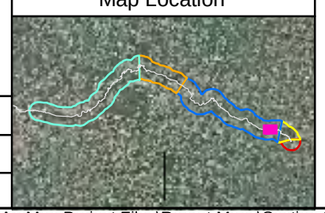
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 02.91 - MP 03.93

SHEET 2 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

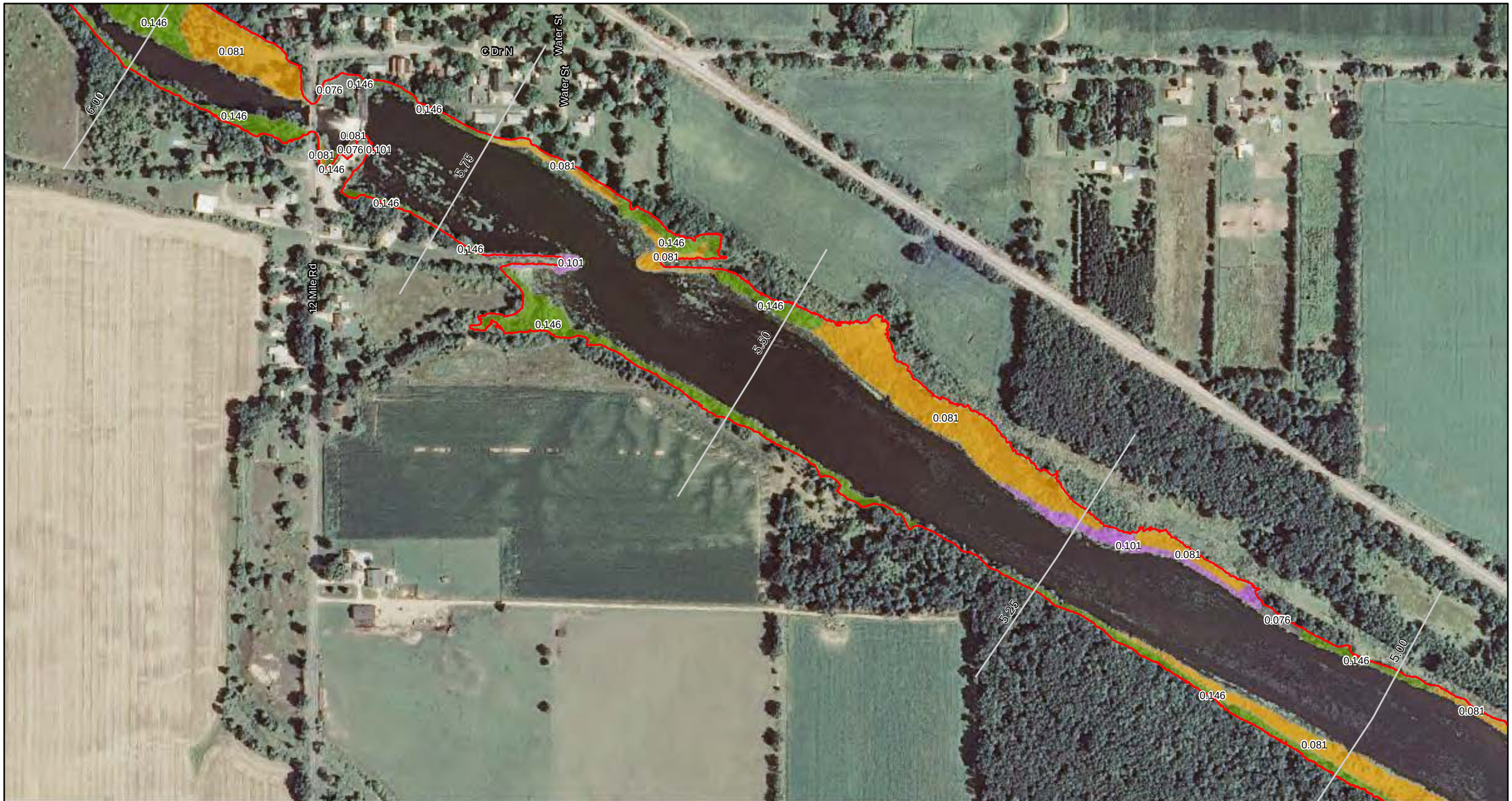
MP 03.93 - MP 04.98

SHEET 3 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Vegetation Categories with Roughness.mxd

Aerial Photography Date: July 2011



Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 03.93 - MP 04.98

SHEET 4 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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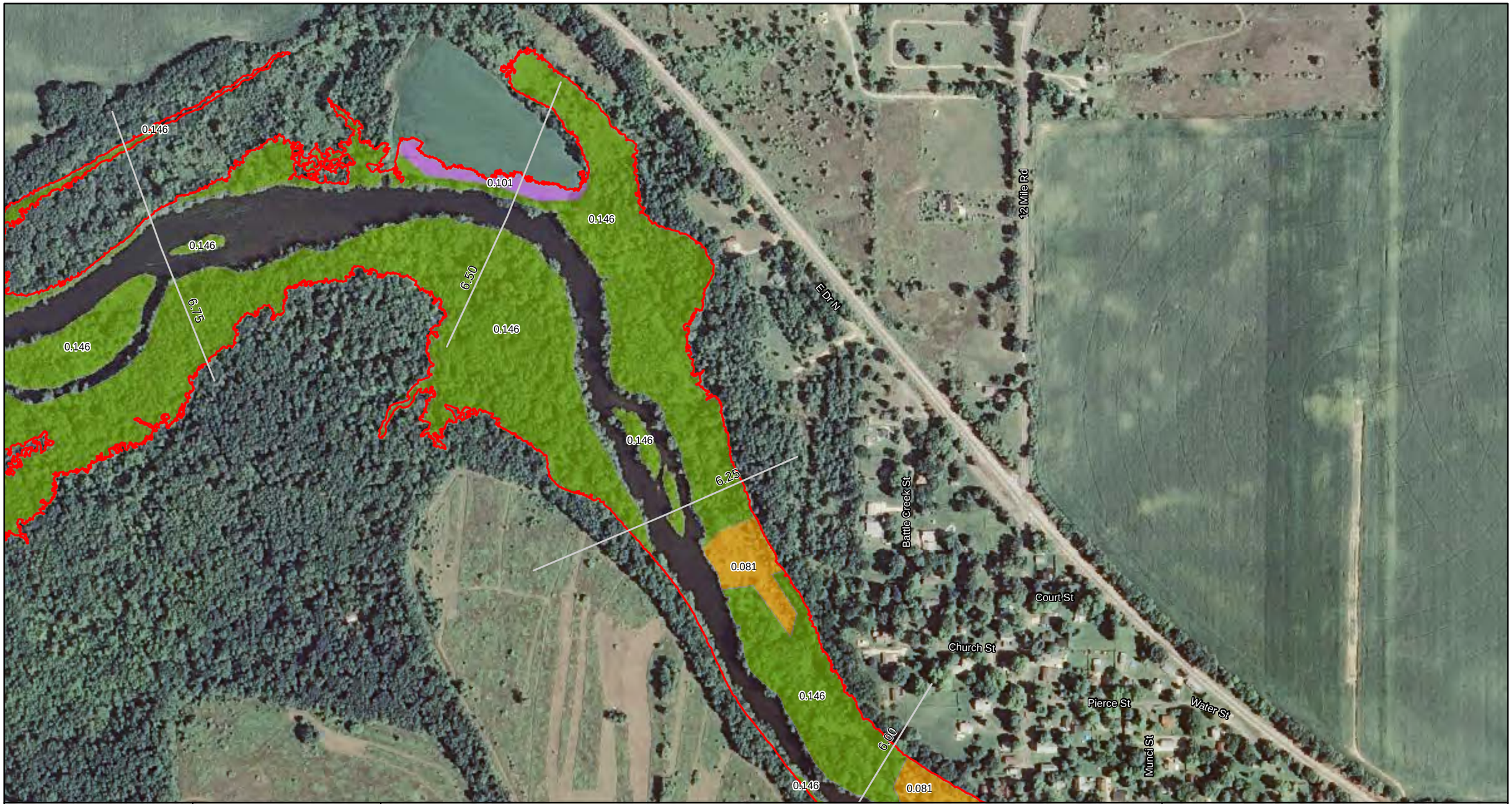
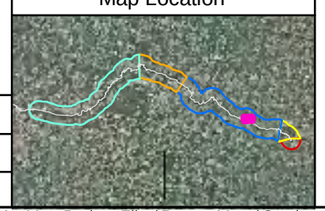
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 06.03 - MP 06.85

SHEET 5 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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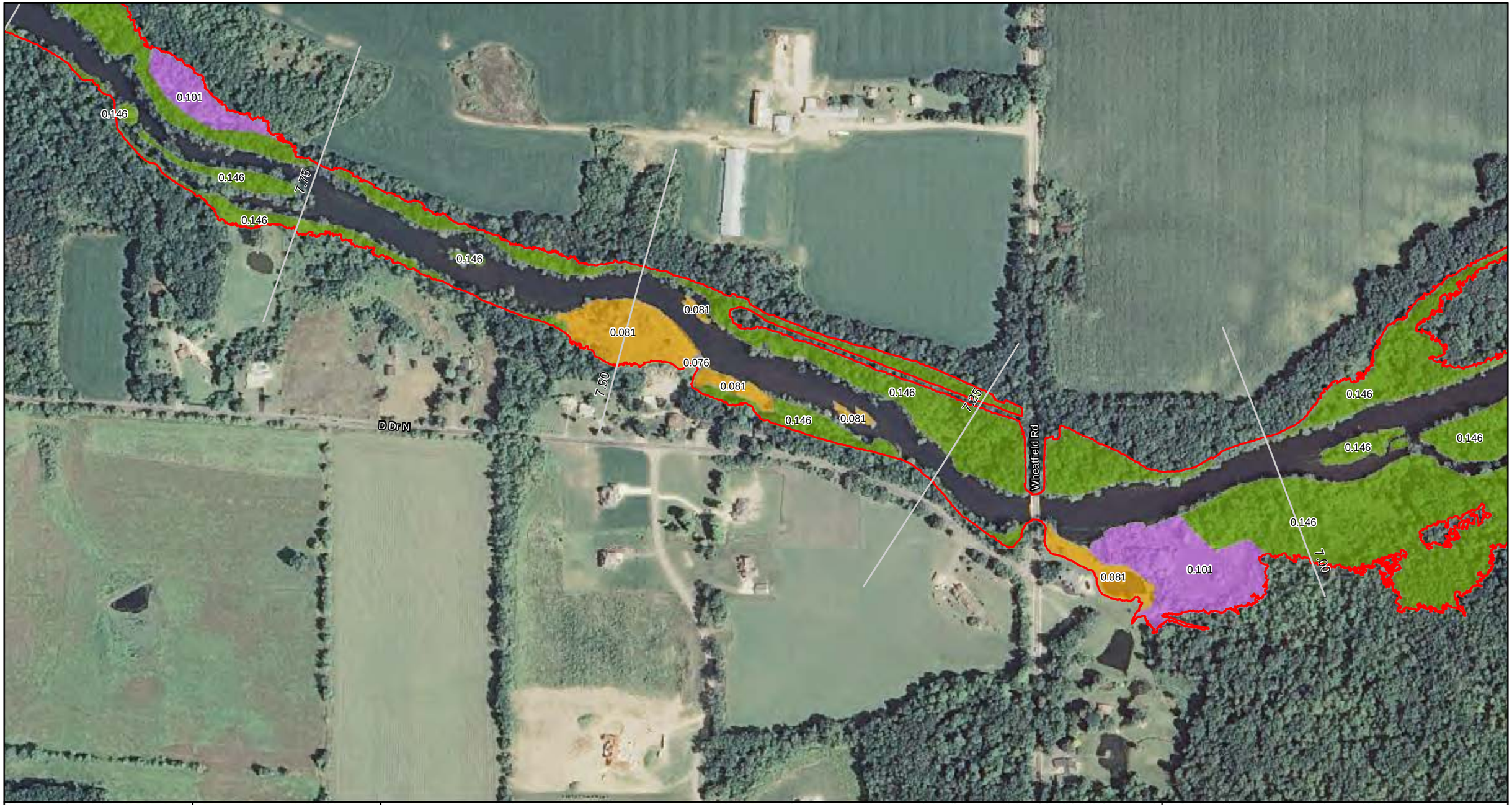
Aerial Photography Date: July 2011



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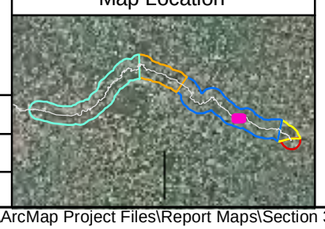

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 06.85 - MP 07.95

SHEET 6 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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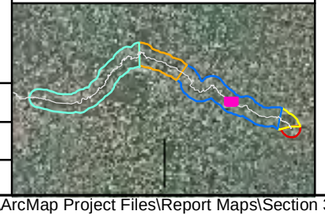
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 07.95 - MP 08.93

SHEET 7 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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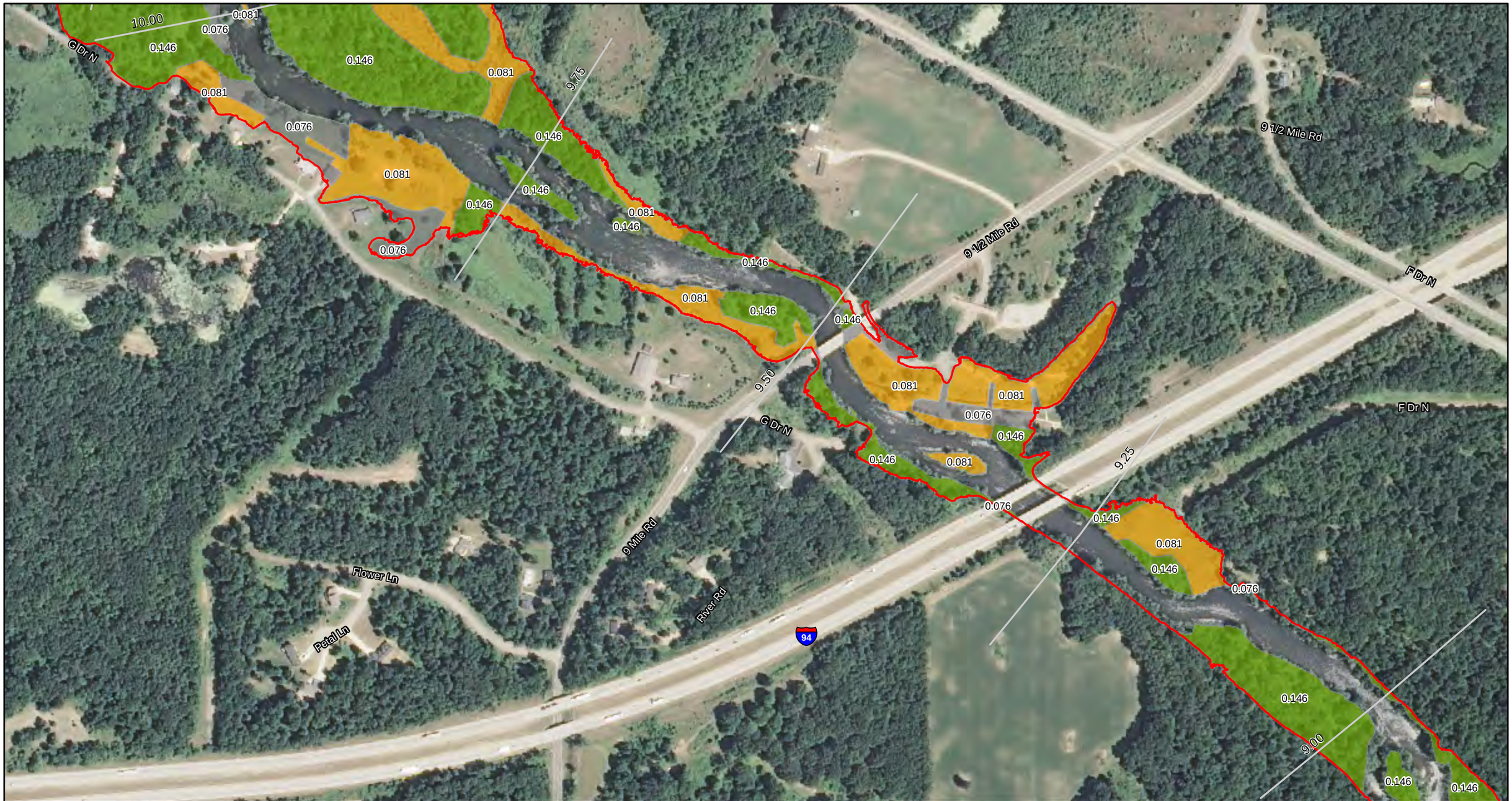
Aerial Photography Date: July 2011



Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 08.93 - MP 10.00

SHEET 8 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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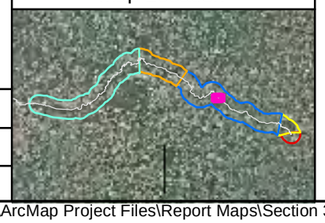
Aerial Photography Date: July 2011

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 10.00 - MP 10.80

SHEET 9 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

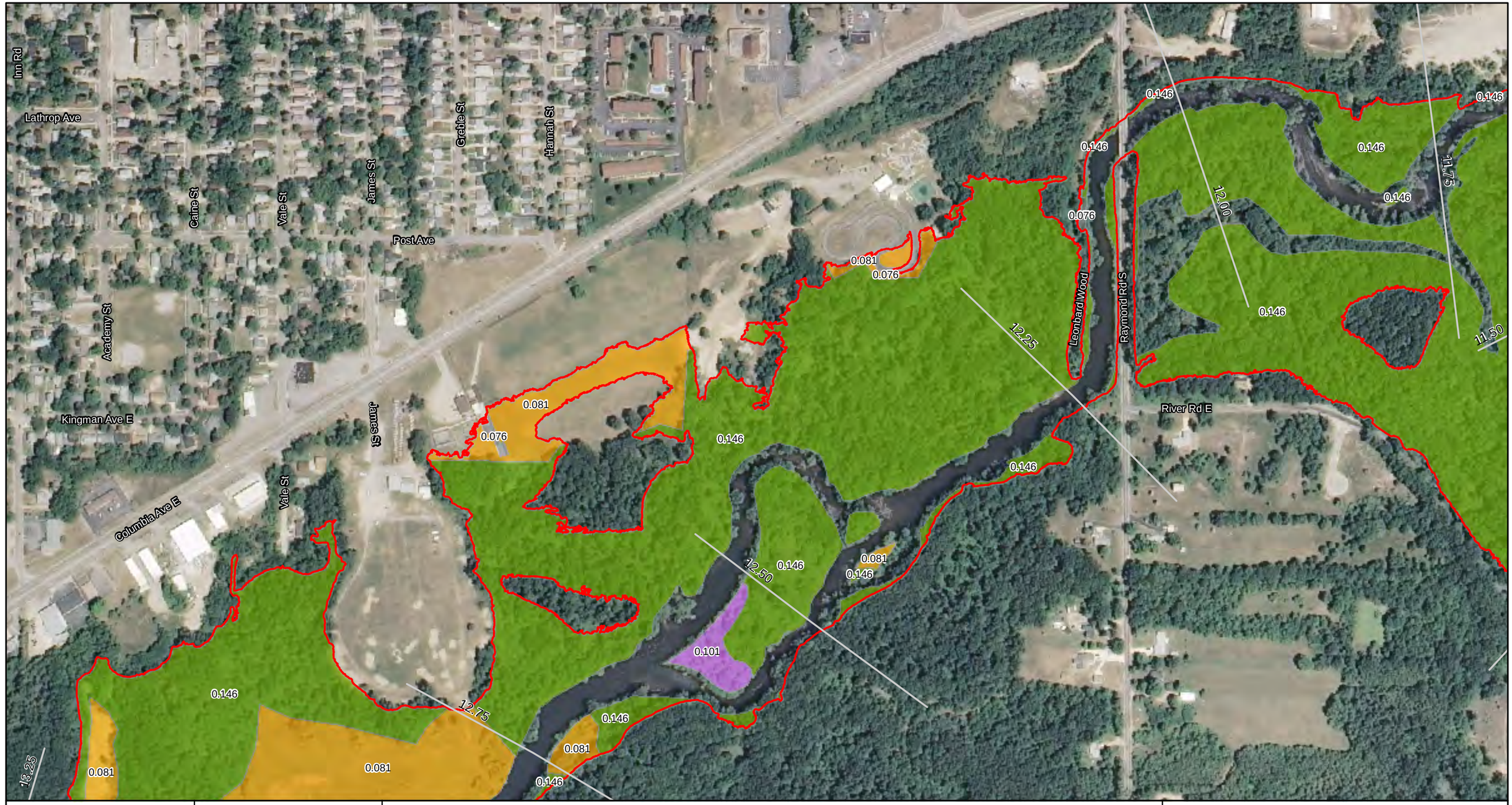
MP 10.80 - MP 11.70

SHEET 10 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

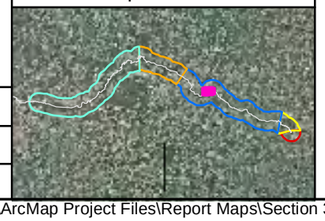
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Vegetation Categories with Roughness.mxd

Aerial Photography Date: July 2011



Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 11.70 - MP 12.77

SHEET 11 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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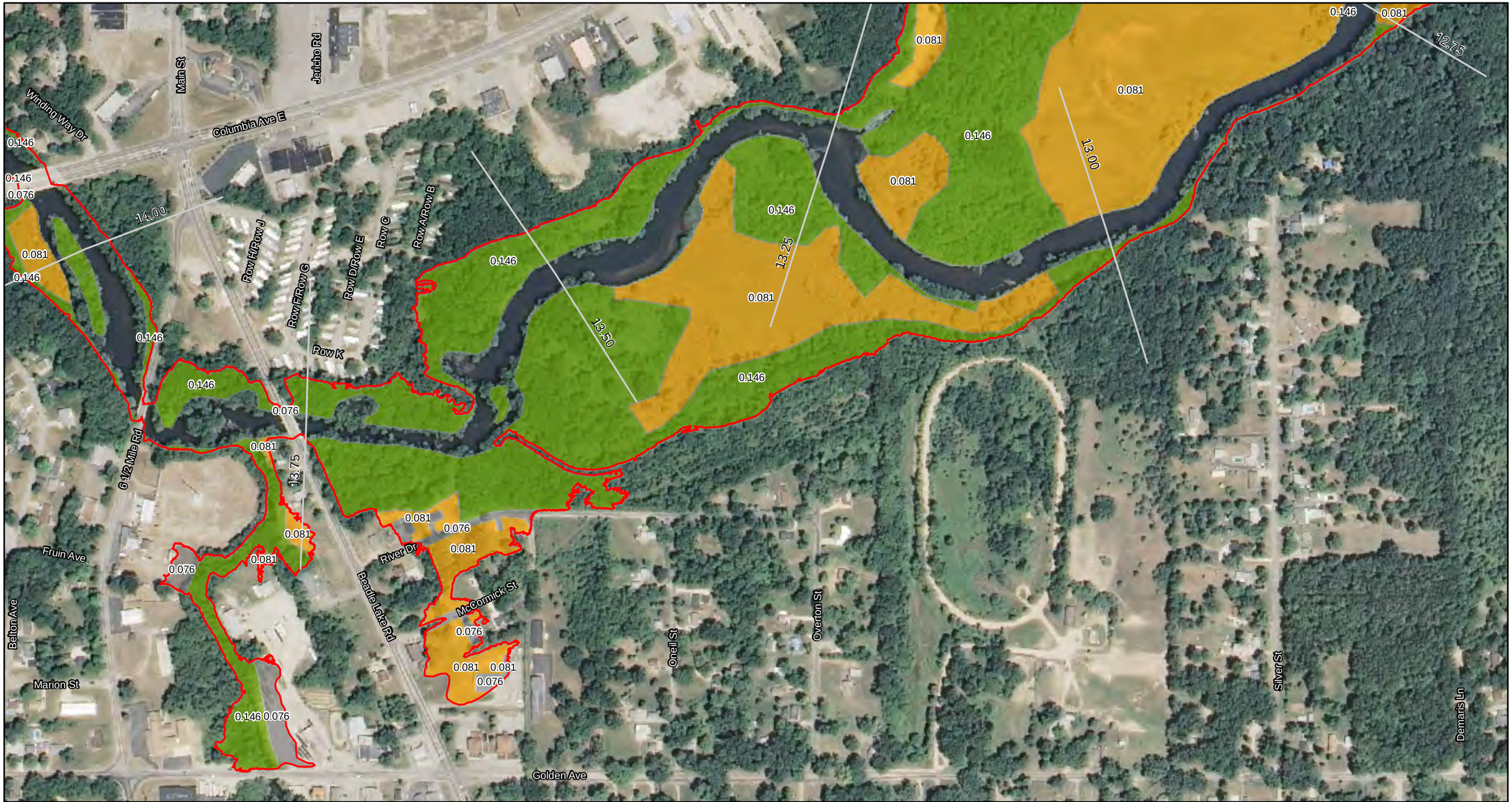
Aerial Photography Date: July 2011



Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 12.77 - MP 14.00

SHEET 12 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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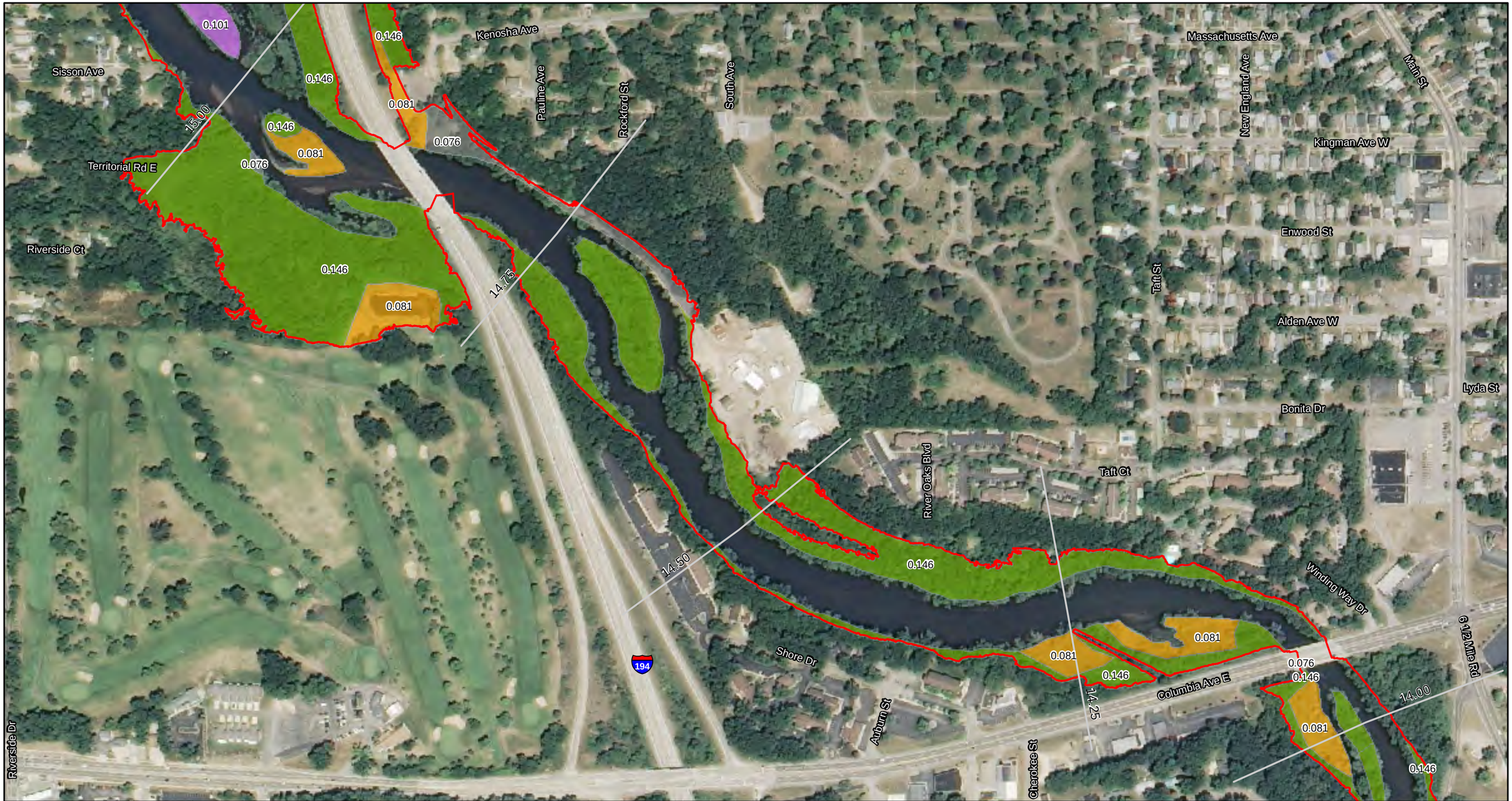
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 14.00 - MP 15.05

SHEET 13 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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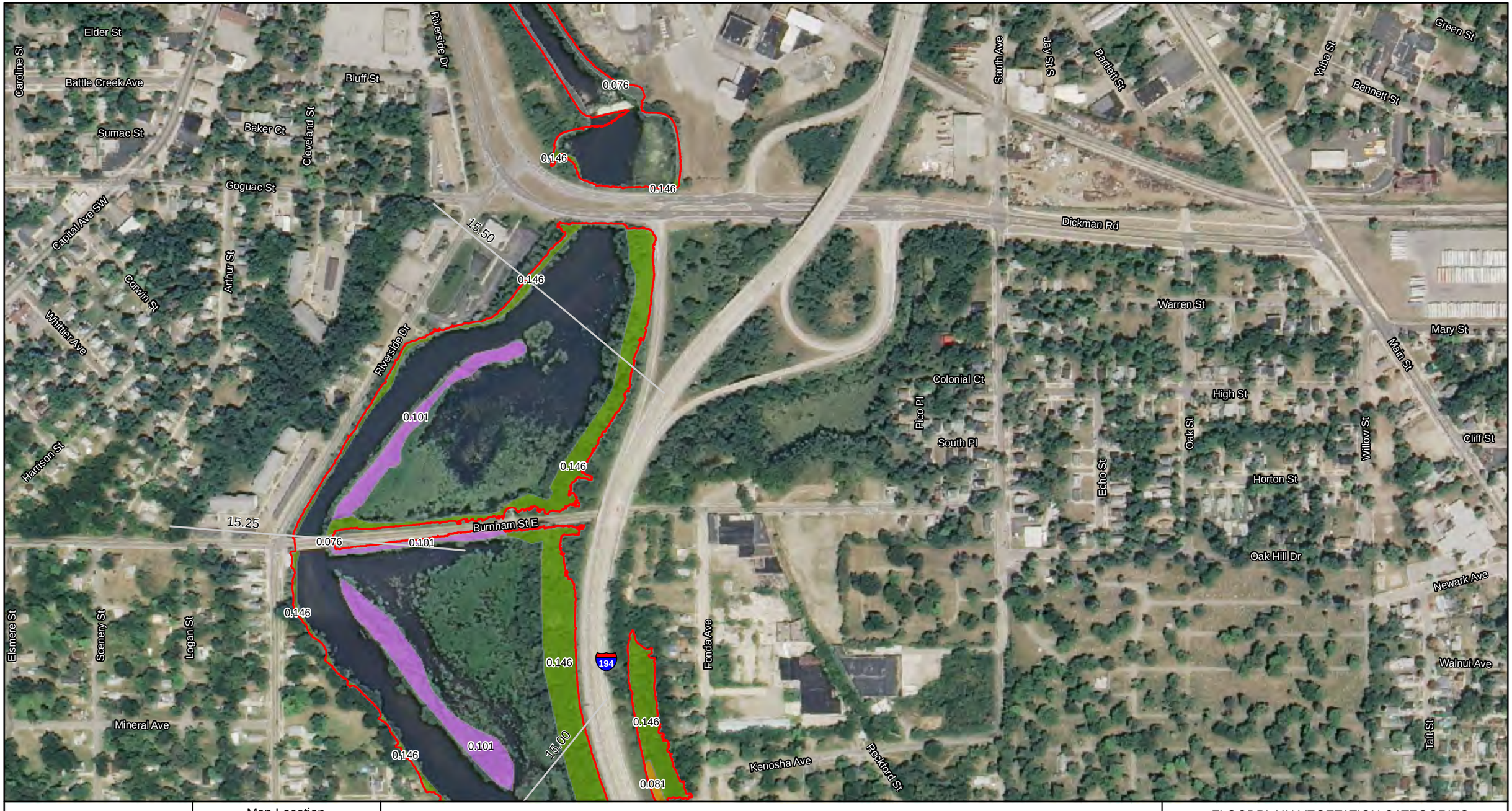
Aerial Photography Date: July 2011



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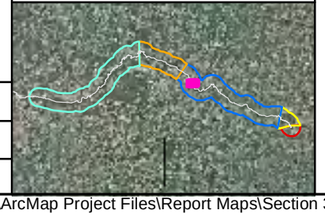

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 15.05 - MP 15.71

SHEET 14 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 15.71 - MP 16.38

SHEET 15 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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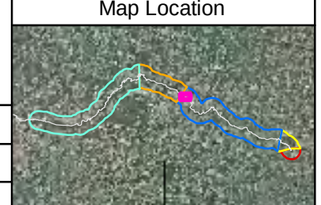
Aerial Photography Date: July 2011

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 16.38 - MP 17.30

SHEET 16 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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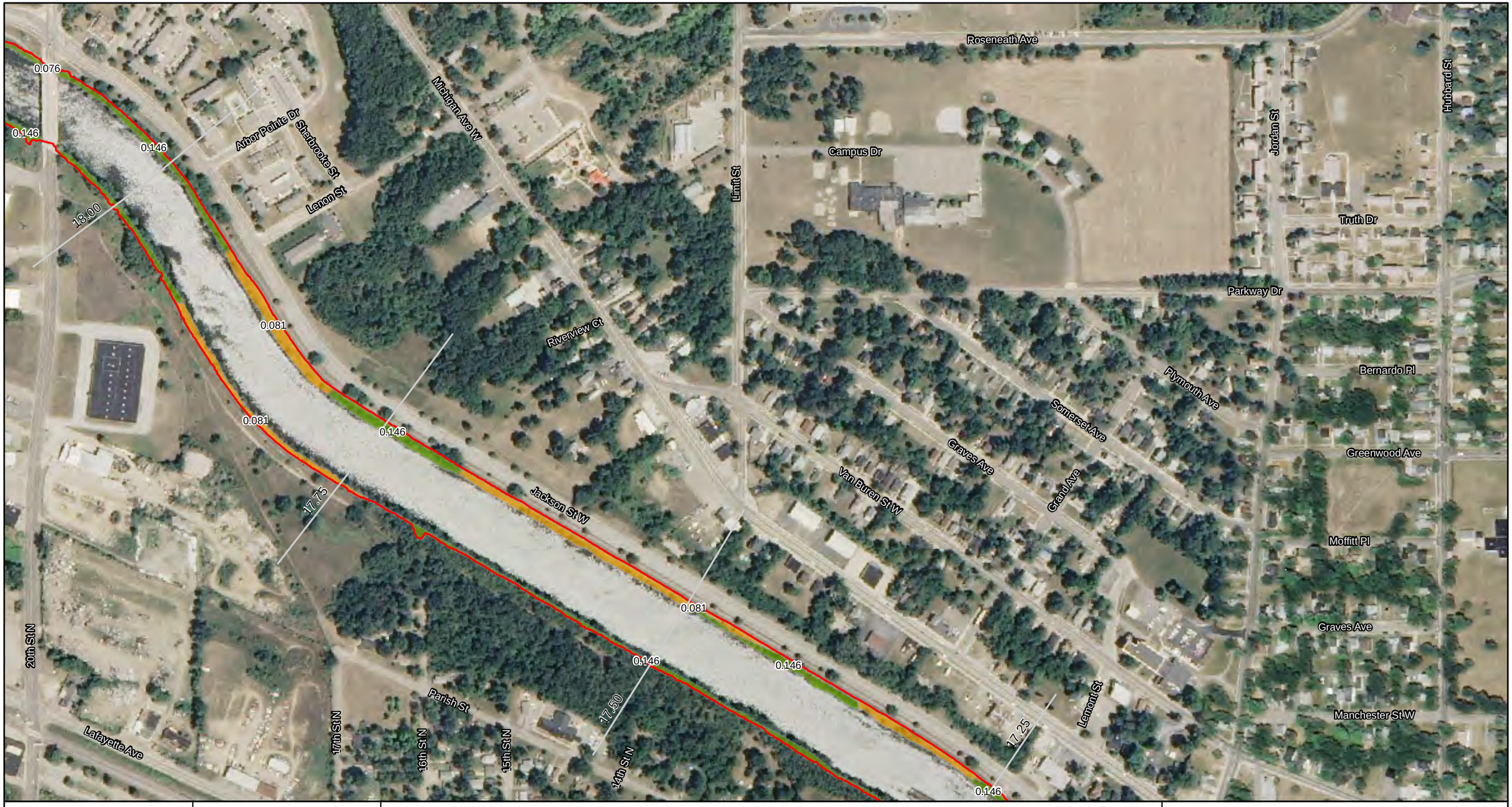
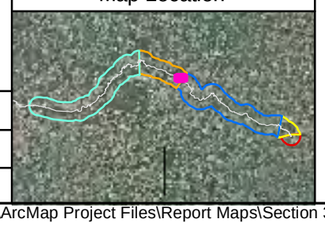
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 17.30 - MP 18.11

SHEET 17 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 17.30 - MP 18.11

SHEET 18 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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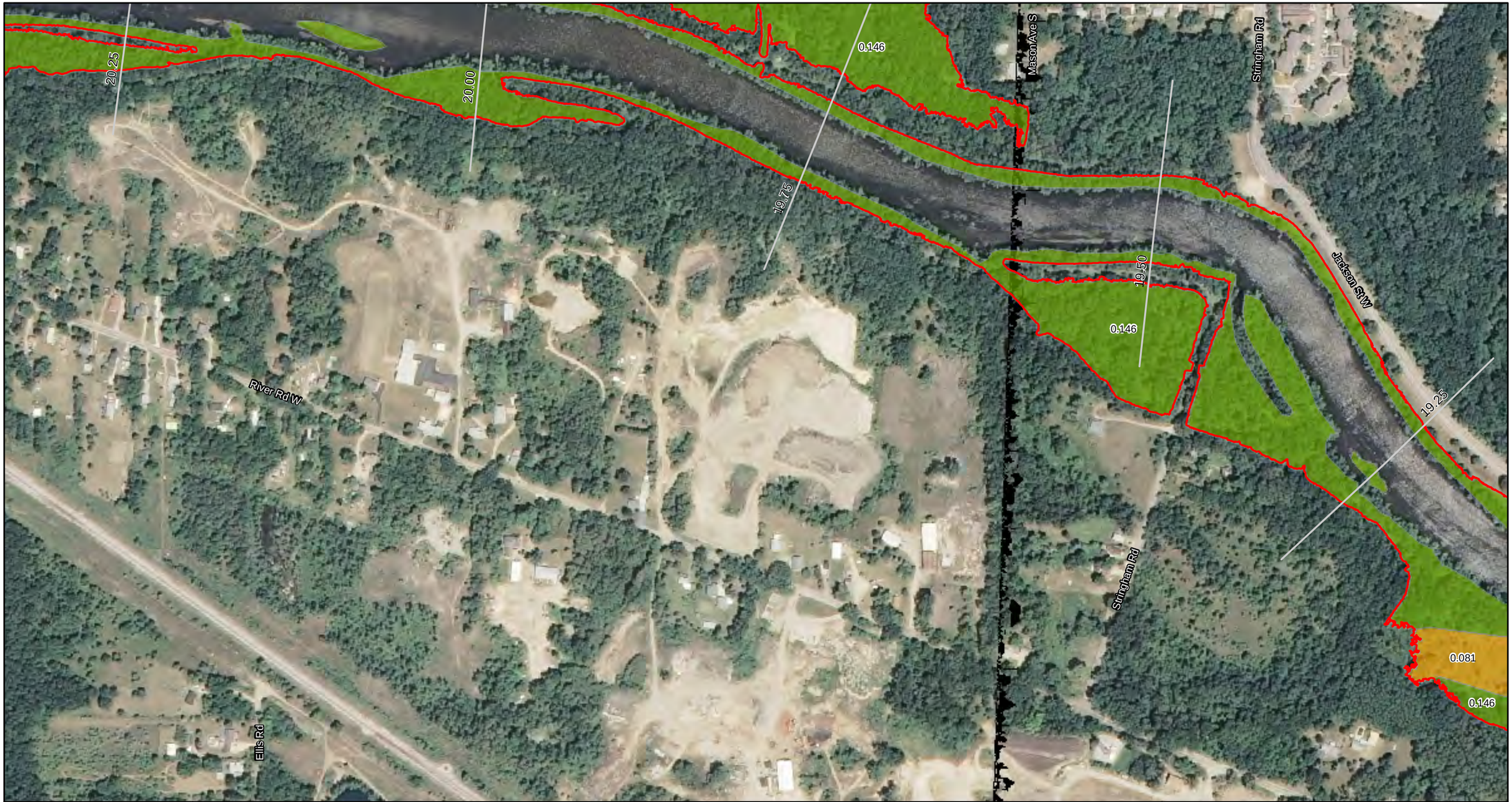
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 19.18 - MP 20.00

SHEET 19 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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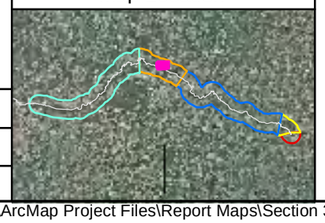
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 20.00 - MP 20.32

SHEET 20 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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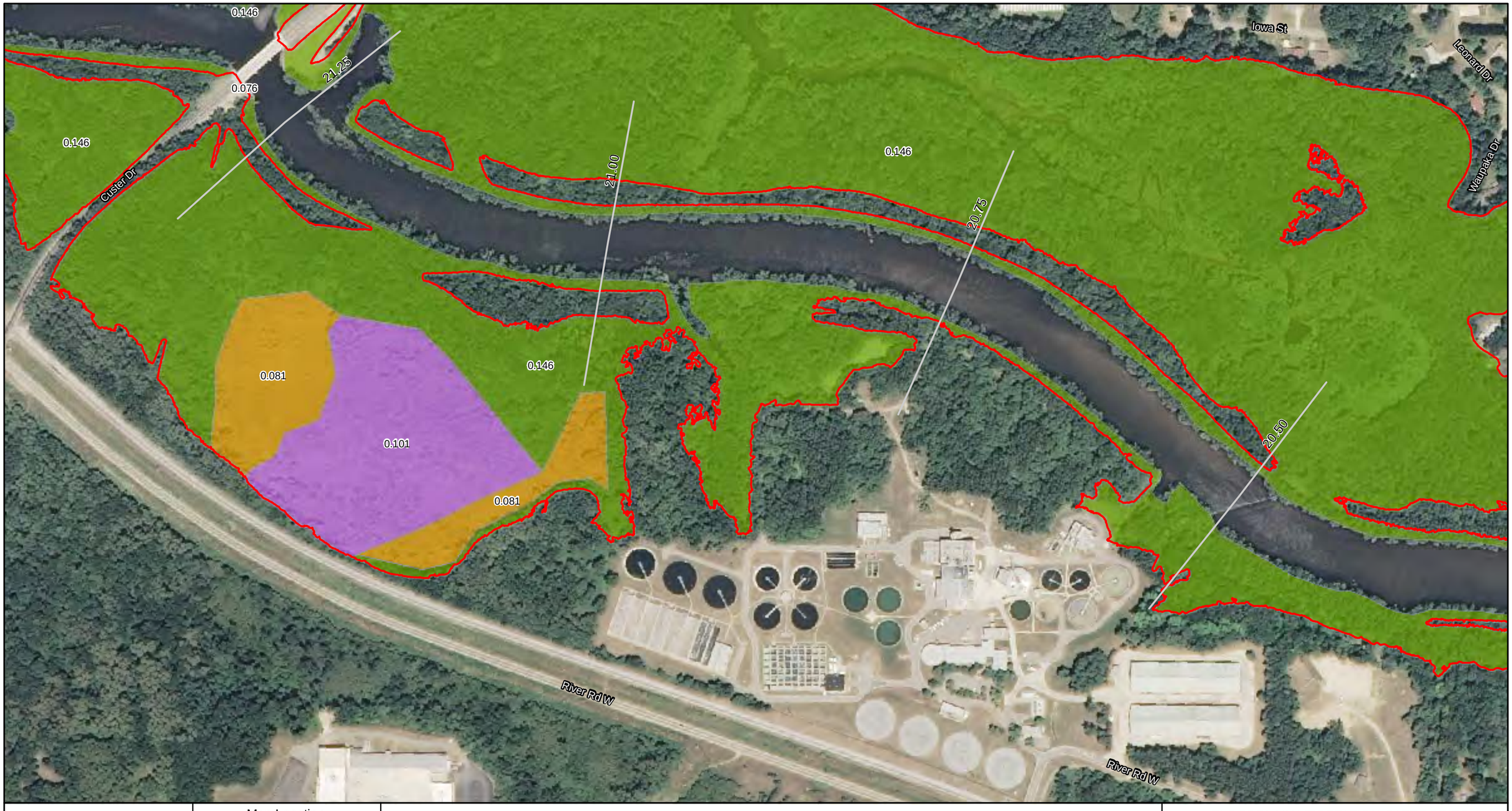
Aerial Photography Date: July 2011



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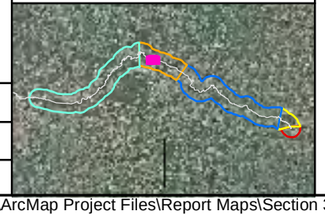

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 20.32 - MP 21.36

SHEET 21 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 21.36 - MP 21.59

SHEET 22 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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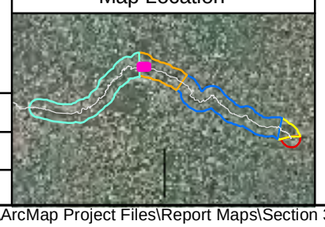
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 21.59 - MP 22.33

SHEET 23 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 22.33 - MP 24.01

SHEET 24 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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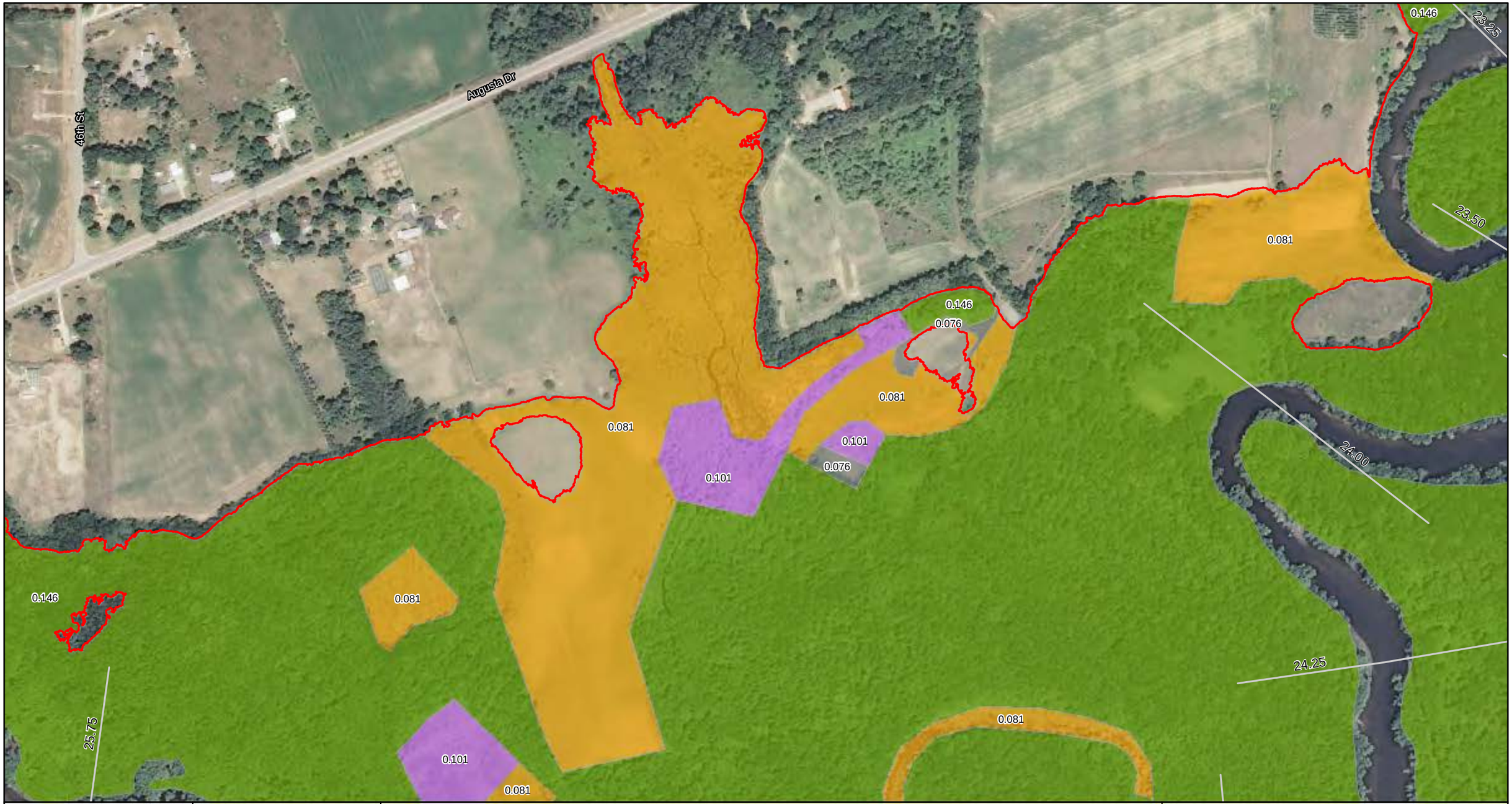
Aerial Photography Date: July 2011



Map Location

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 24.01 - MP 24.33

SHEET 25 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 24.33 - MP 25.79

SHEET 26 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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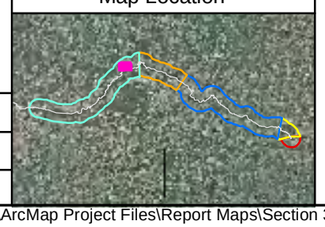
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 25.79 - MP 26.80

SHEET 27 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 26.80 - MP 27.80

SHEET 28 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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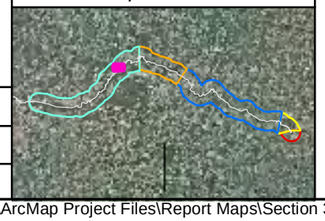
Aerial Photography Date: July 2011

Map Location



Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 27.80NW - MP 28.22NW

SHEET 29 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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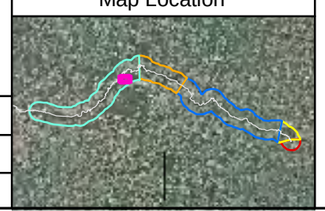
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 27.80SE - MP 28.22SE

SHEET 30 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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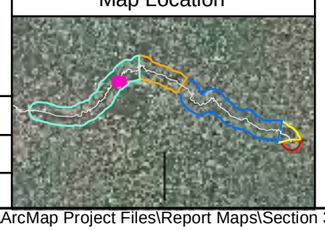
Aerial Photography Date: July 2011

Map Location



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

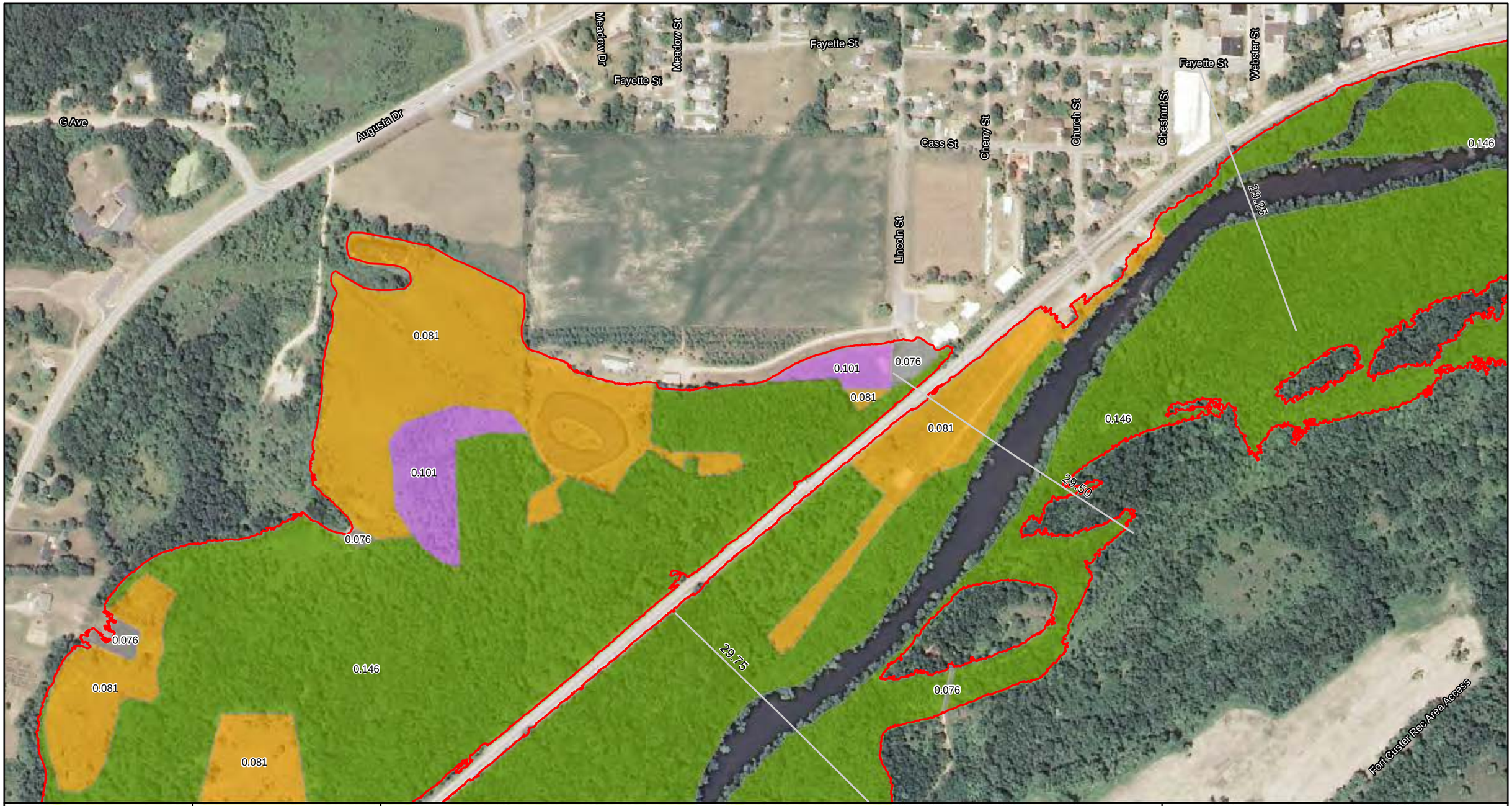
MP 28.22 - MP 29.20

SHEET 31 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Vegetation Categories with Roughness.mxd

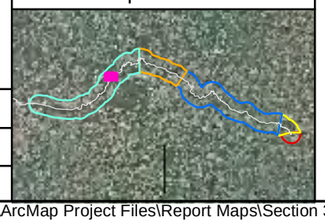
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 29.20 - MP 29.82

SHEET 32 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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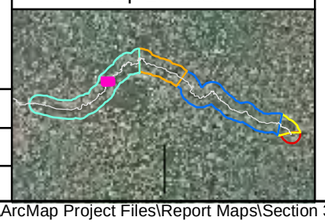
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 29.82 - MP 30.84

SHEET 33 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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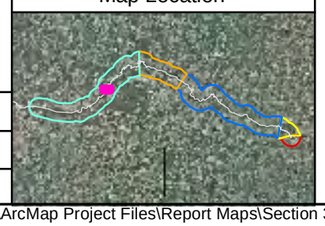
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 30.84 - MP 31.40

SHEET 34 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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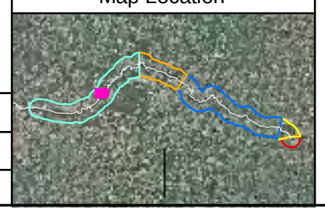
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

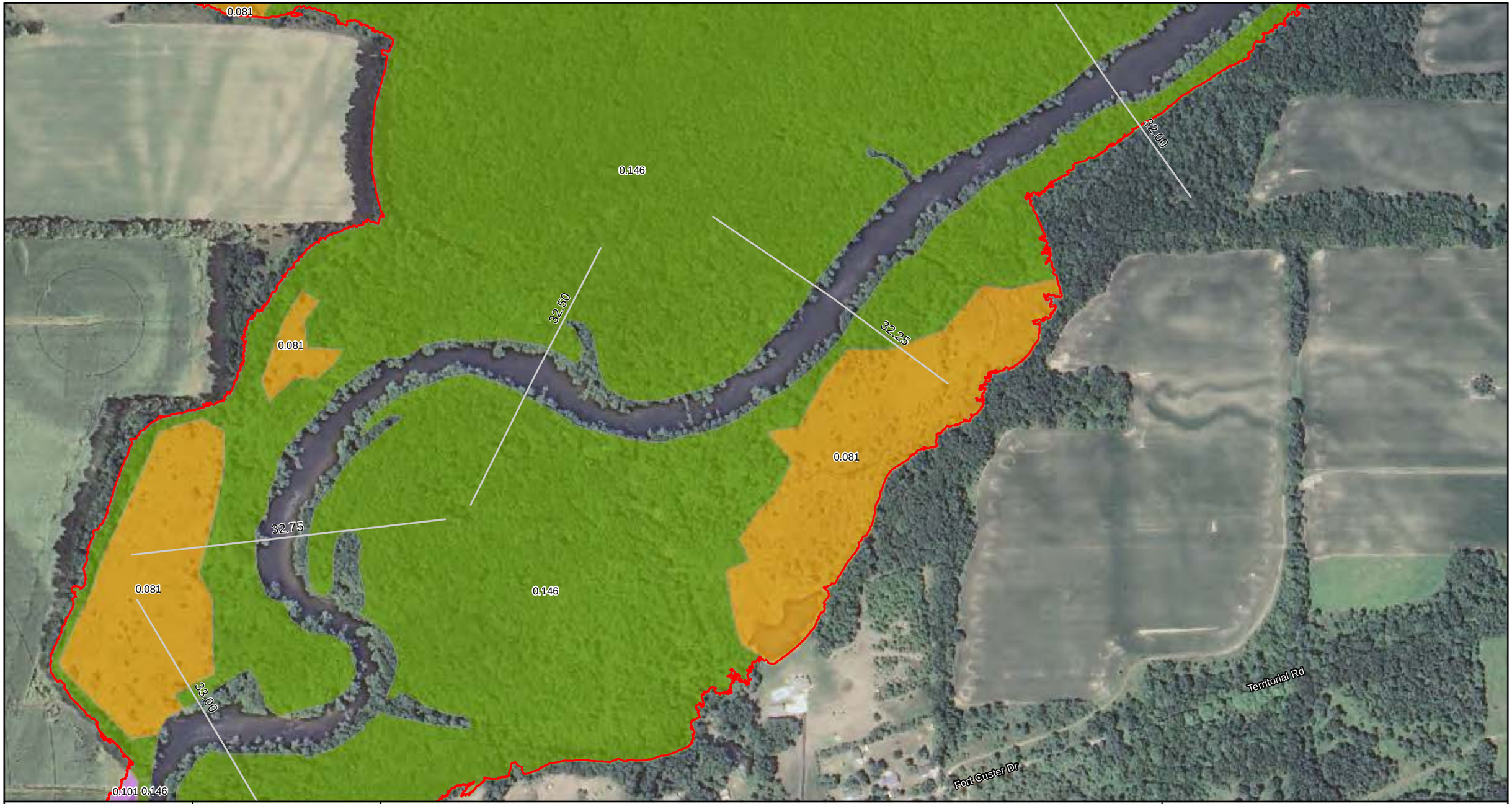
MP 31.40 - MP 31.94

SHEET 35 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Vegetation Categories with Roughness.mxd

Aerial Photography Date: July 2011



Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 31.94 - MP 33.00

SHEET 36 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

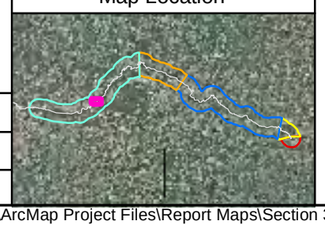
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Vegetation Categories with Roughness.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 33.00 - MP 33.52

SHEET 37 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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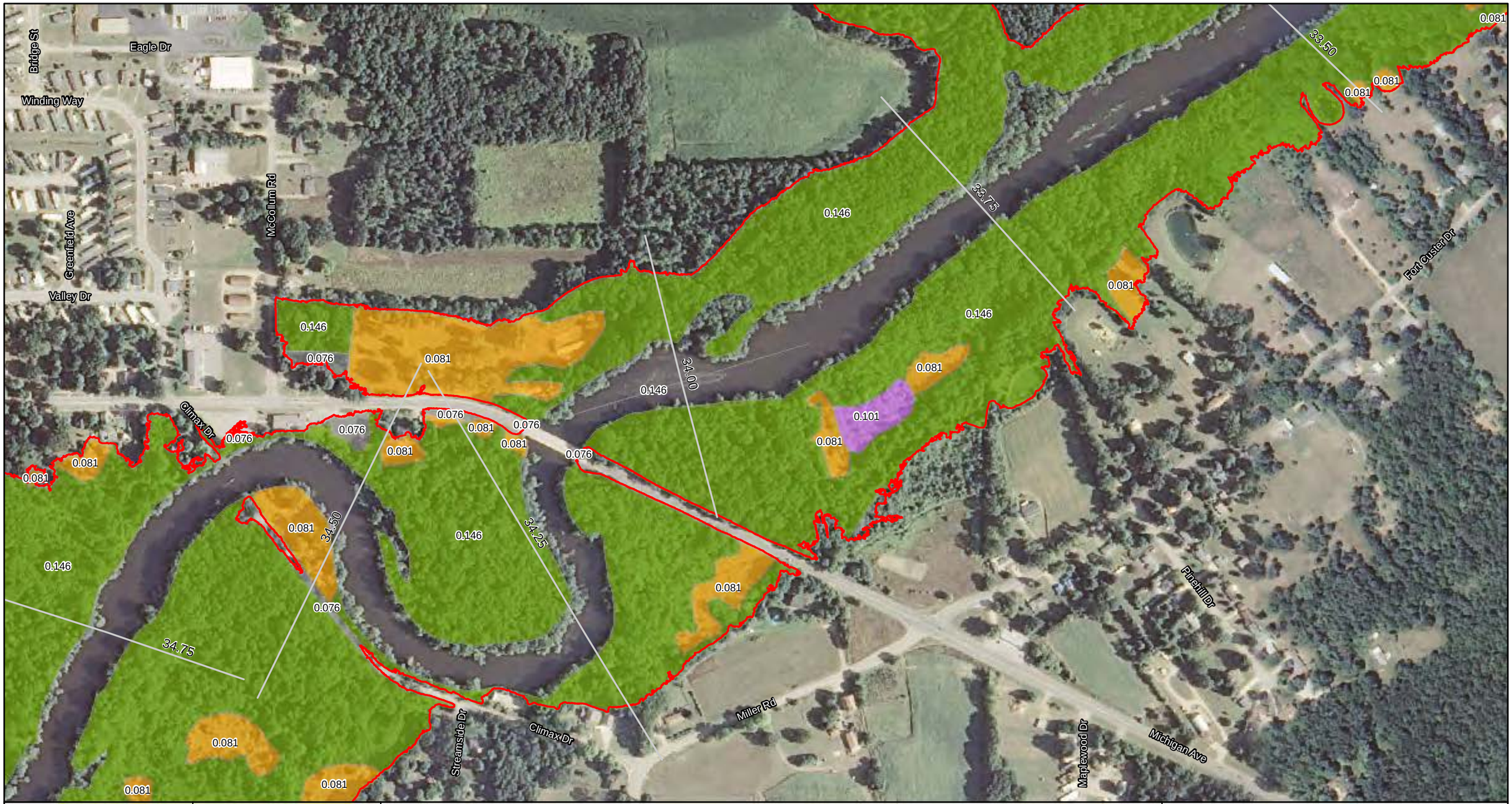
Aerial Photography Date: July 2011



Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

HEC-RAS 100-Year Floodplain

Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

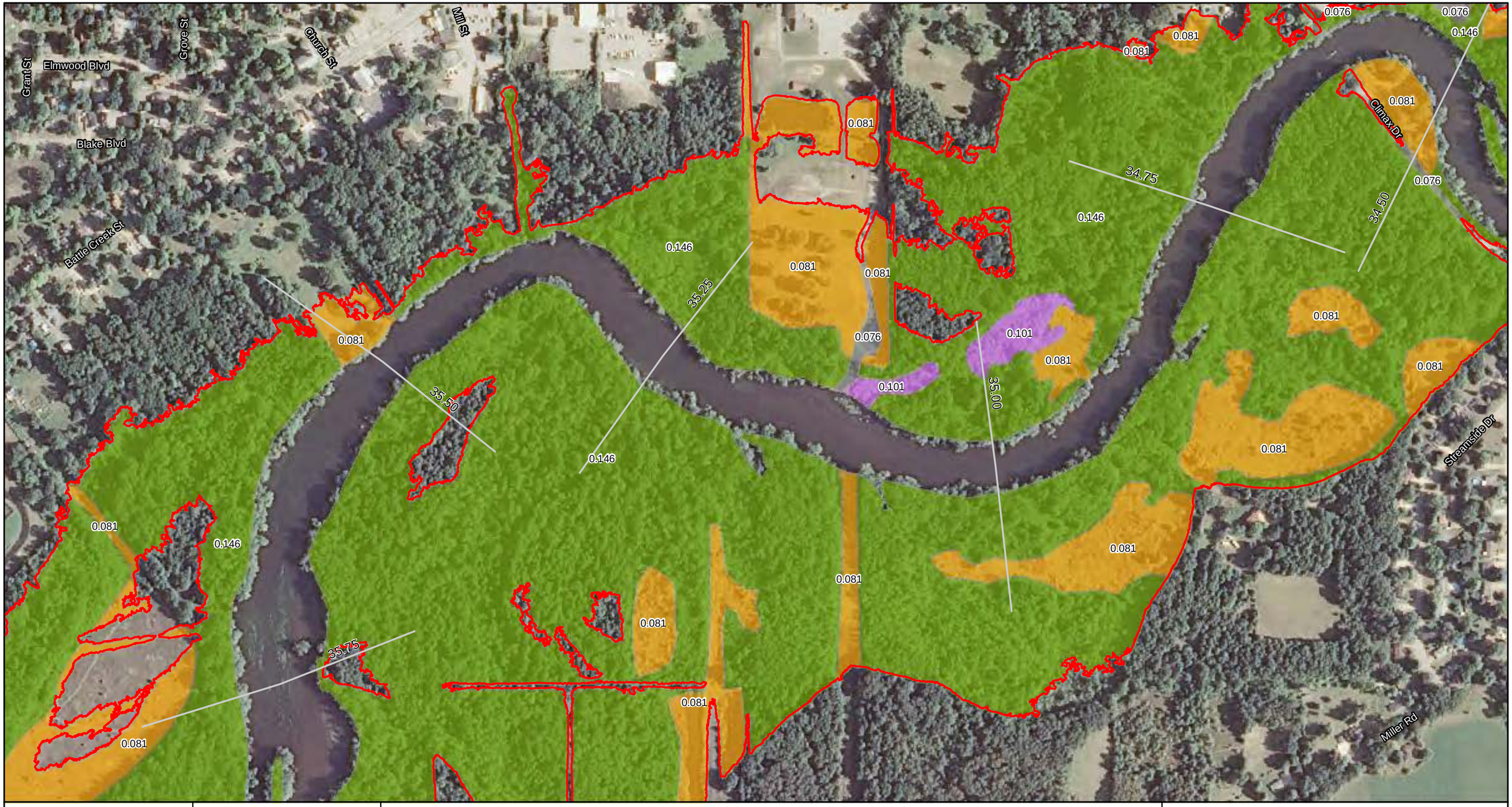
MP 33.52 - MP 34.70

SHEET 38 OF 45

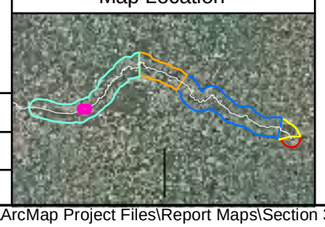
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Vegetation Categories with Roughness.mxd

Aerial Photography Date: July 2011



Map Location



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 34.70 - MP 35.75

SHEET 39 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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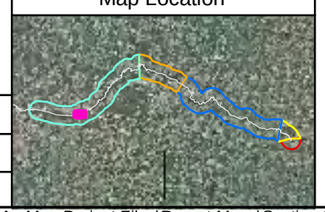
Aerial Photography Date: July 2011

Map Location



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 35.75 - MP 36.75

SHEET 40 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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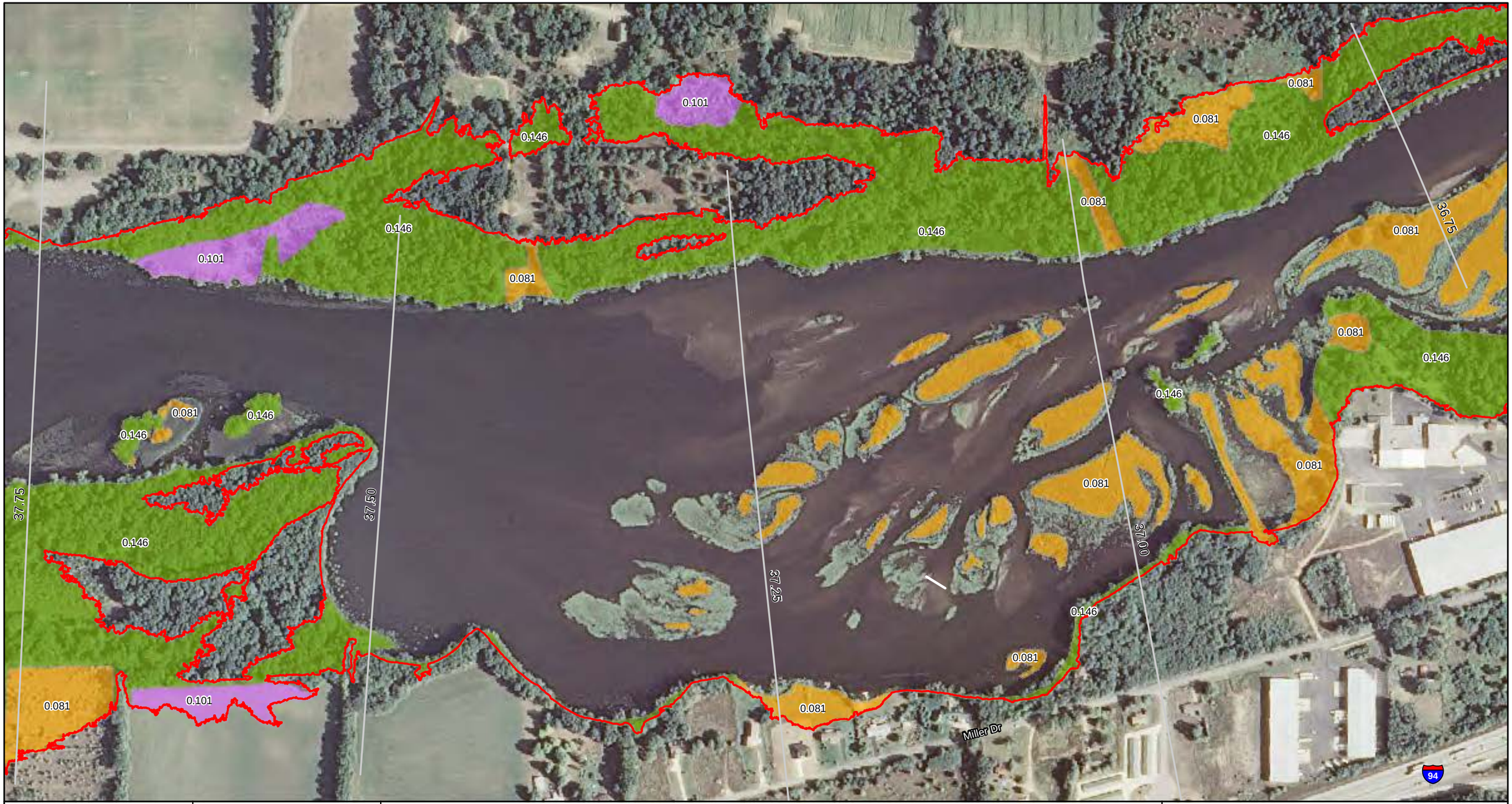
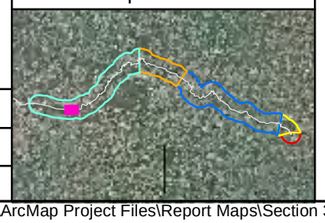
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 36.75 - MP 37.75

SHEET 41 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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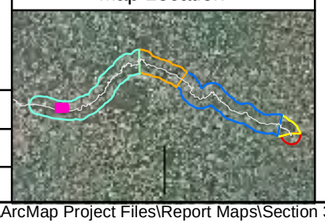
Aerial Photography Date: July 2011

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 37.75N - MP 38.80N

SHEET 42 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

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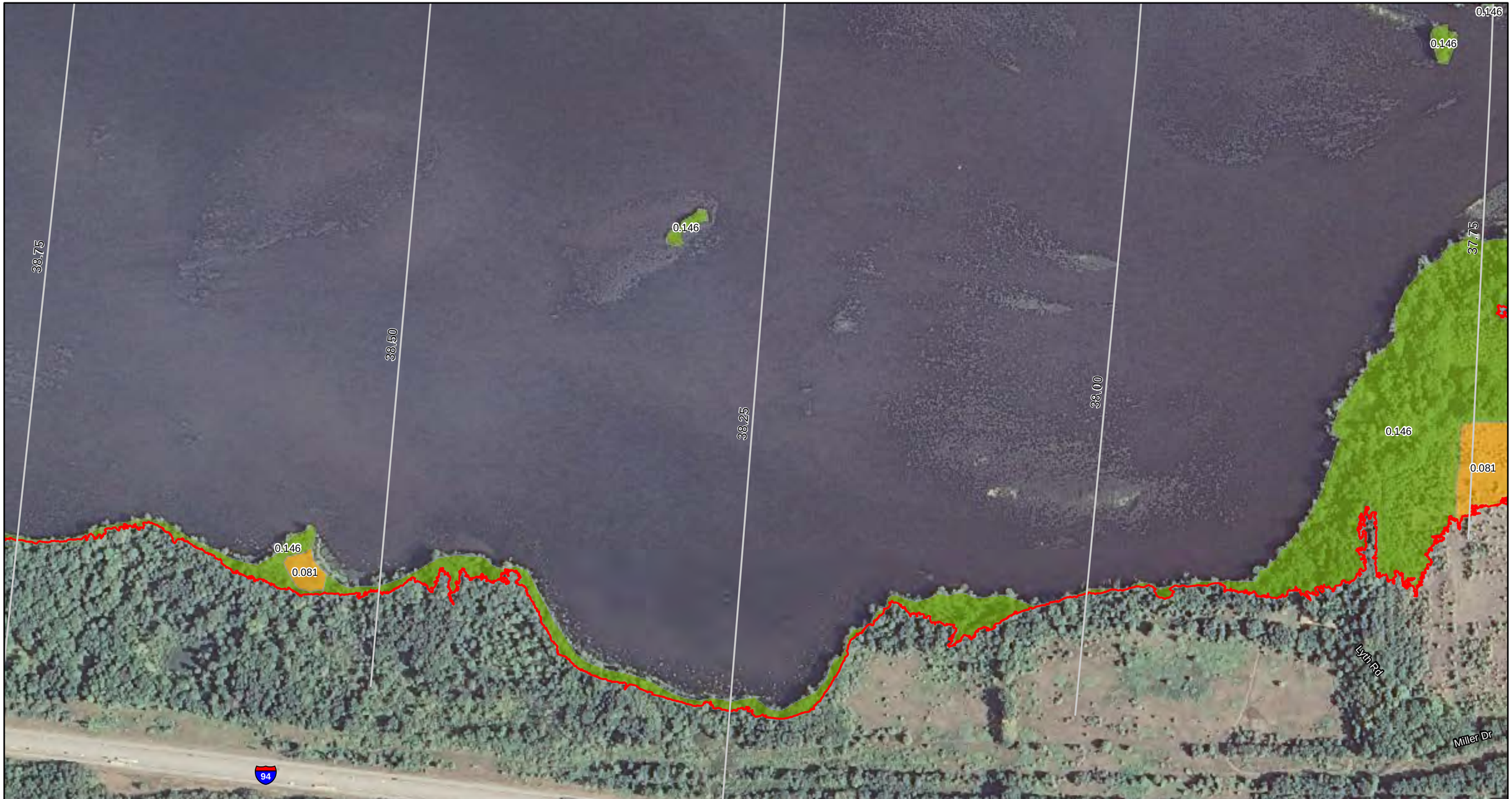
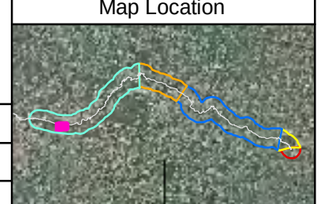
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES WITH ROUGHNESS

MP 37.75S - MP 38.80S

SHEET 43 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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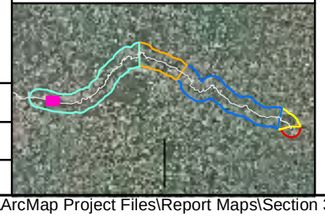
Aerial Photography Date: July 2011

Arden Ave
Morrow St
Elliot Rd
Lawndale Ave
Chene Dr
Consumers Power Dr
0.146
0.146
39.75
39.50
39.25
39.00

Map Location



ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 38.80N - MP 39.95N

SHEET 44 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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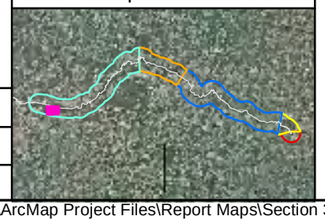
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	MB 3/29/2012
Approved:	BRS 3/29/2012
Project #:	106-4186

Map Location



Vegetation Categories (Label Equals Model Roughness Value)

- Forested
- Grass and Forbs
- Brush or Crops
- Pavement or Bare Ground
- Excavated/Removed

- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN VEGETATION CATEGORIES
WITH ROUGHNESS

MP 38.80S - MP 39.95S

SHEET 45 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

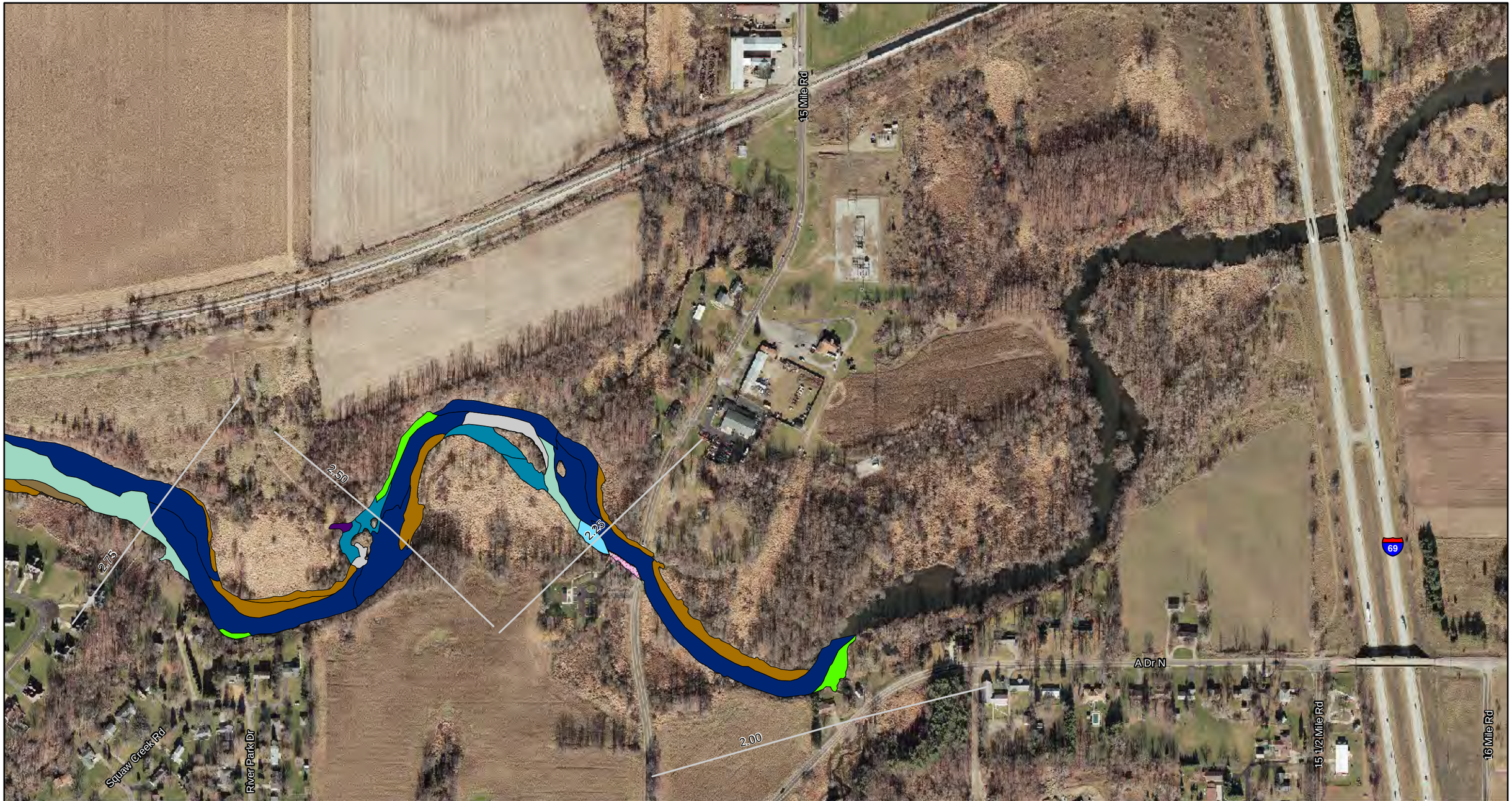
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Vegetation Categories with Roughness.mxd

Aerial Photography Date: July 2011

Figure 3-13

Final Geomorphic Surfaces

Sheets 1 through 48



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 2.00 - MP 2.67

SHEET 1 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

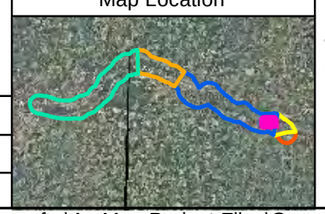
E:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Geo_Surfaces_Final_03202012.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 2.68 - MP 3.54

SHEET 2 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

E:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Geo_Surfaces_Final_03202012.mxd

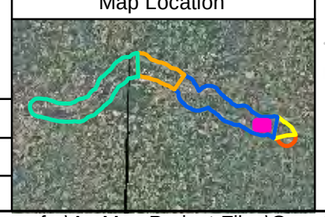
Aerial Photography Date: November 2011

4.50
4.25
4.00
3.75
3.50

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

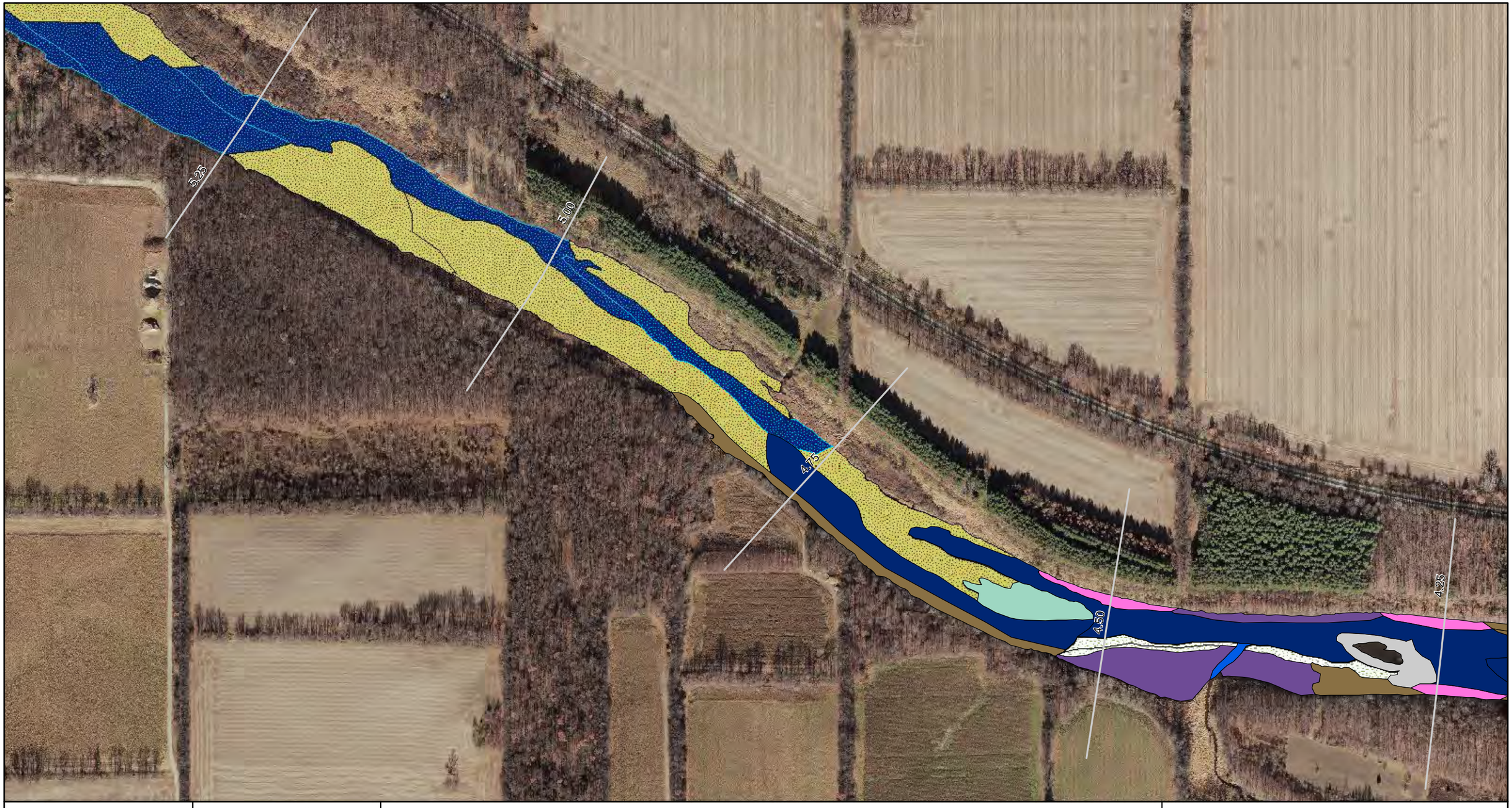
MP 3.54 - MP 4.37

SHEET 3 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

E:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Geo_Surfaces_Final_03202012.mxd

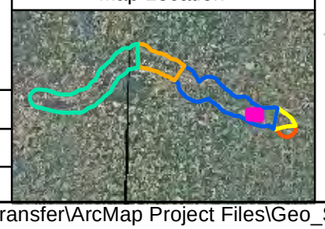
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 4.37 - MP 5.28

SHEET 4 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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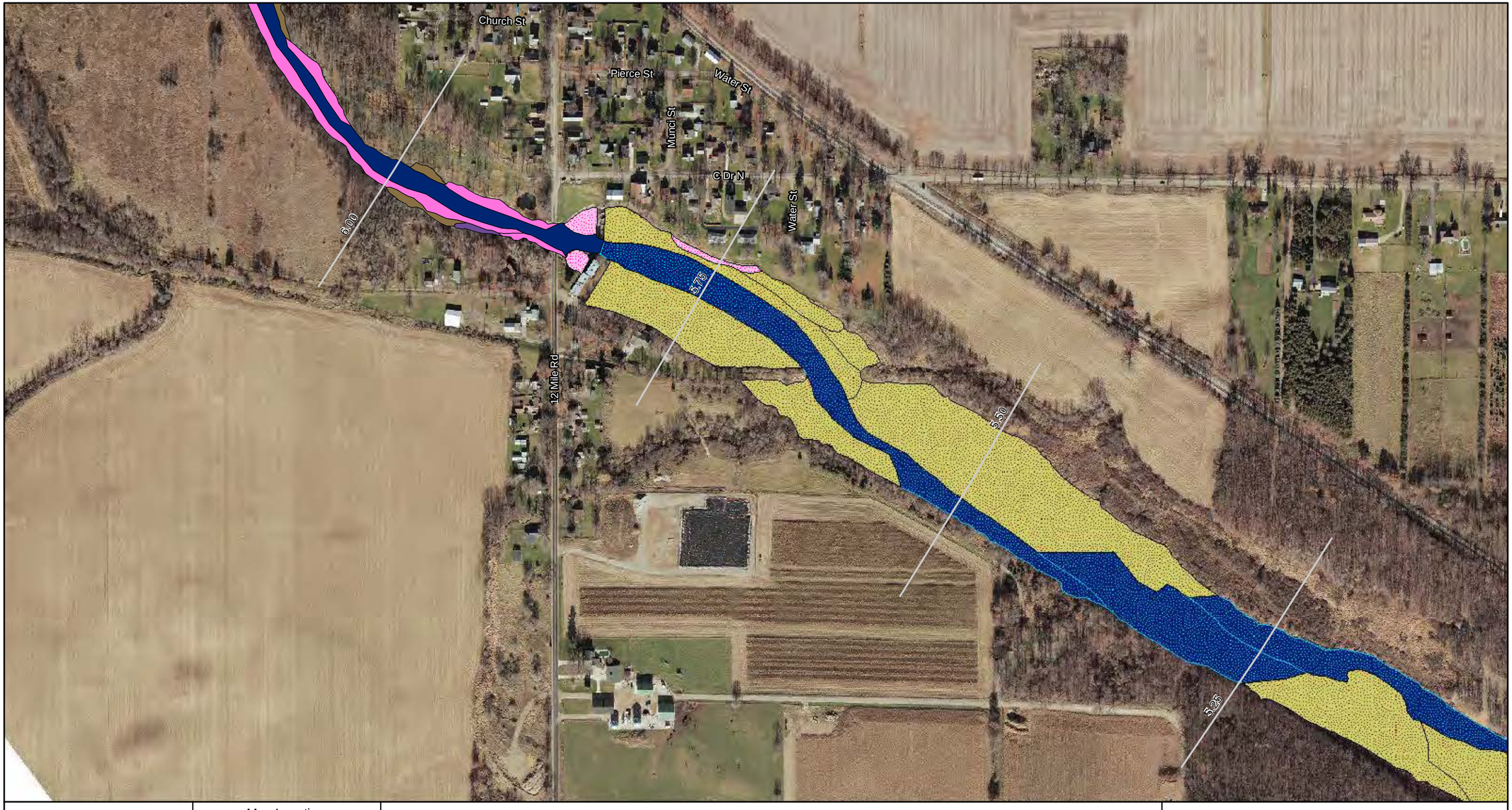
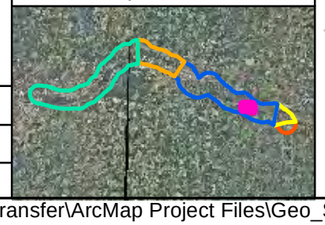
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
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Delta and Lake Surfaces
- Delta Bar
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- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 5.24 - MP 6.09

SHEET 5 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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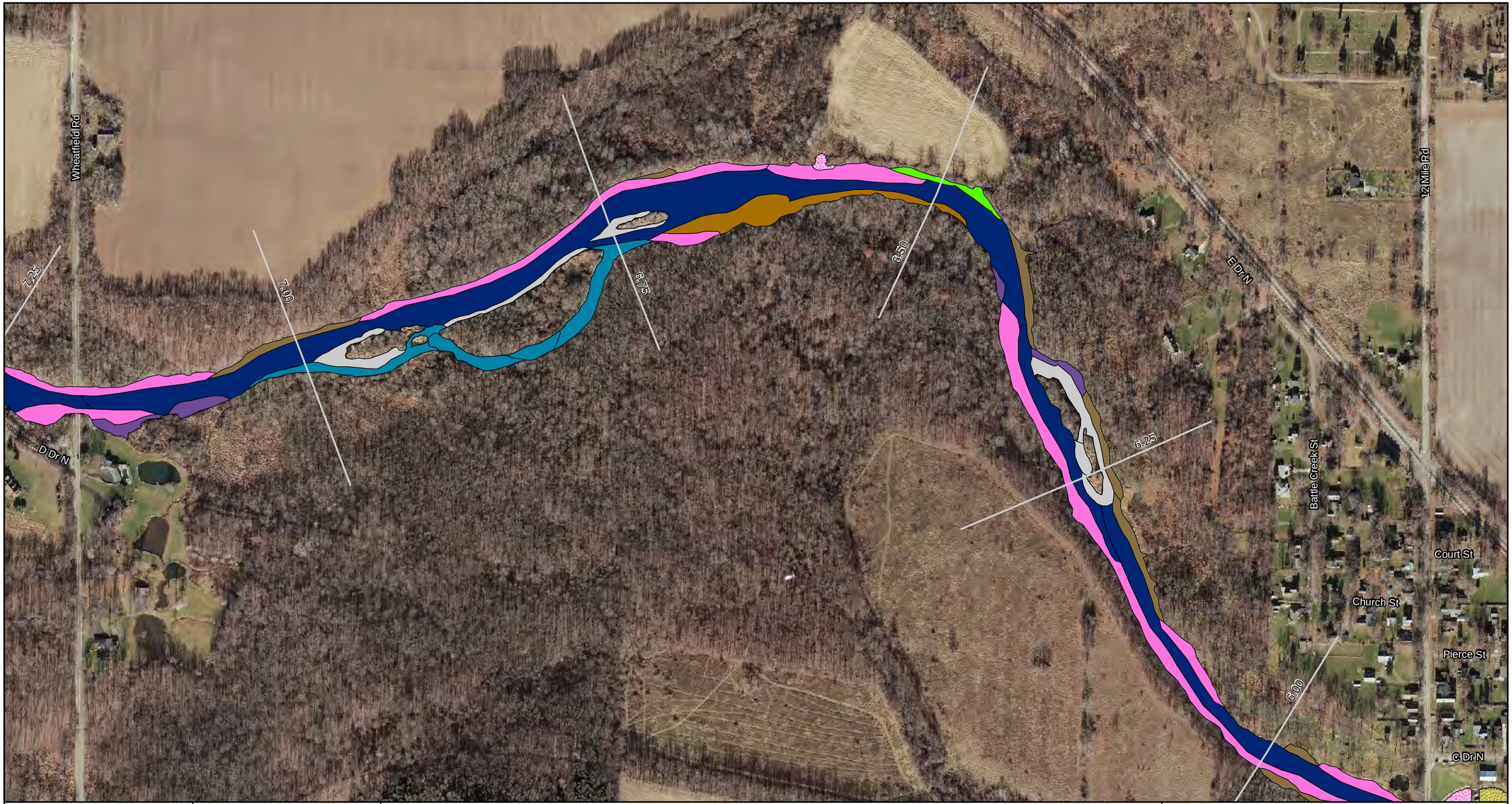
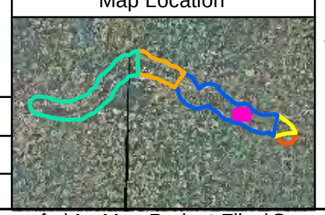
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
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Delta and Lake Surfaces
- Delta Bar
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- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 6.06 - MP 7.08

SHEET 6 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
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- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 7.08 - MP 7.98

SHEET 7 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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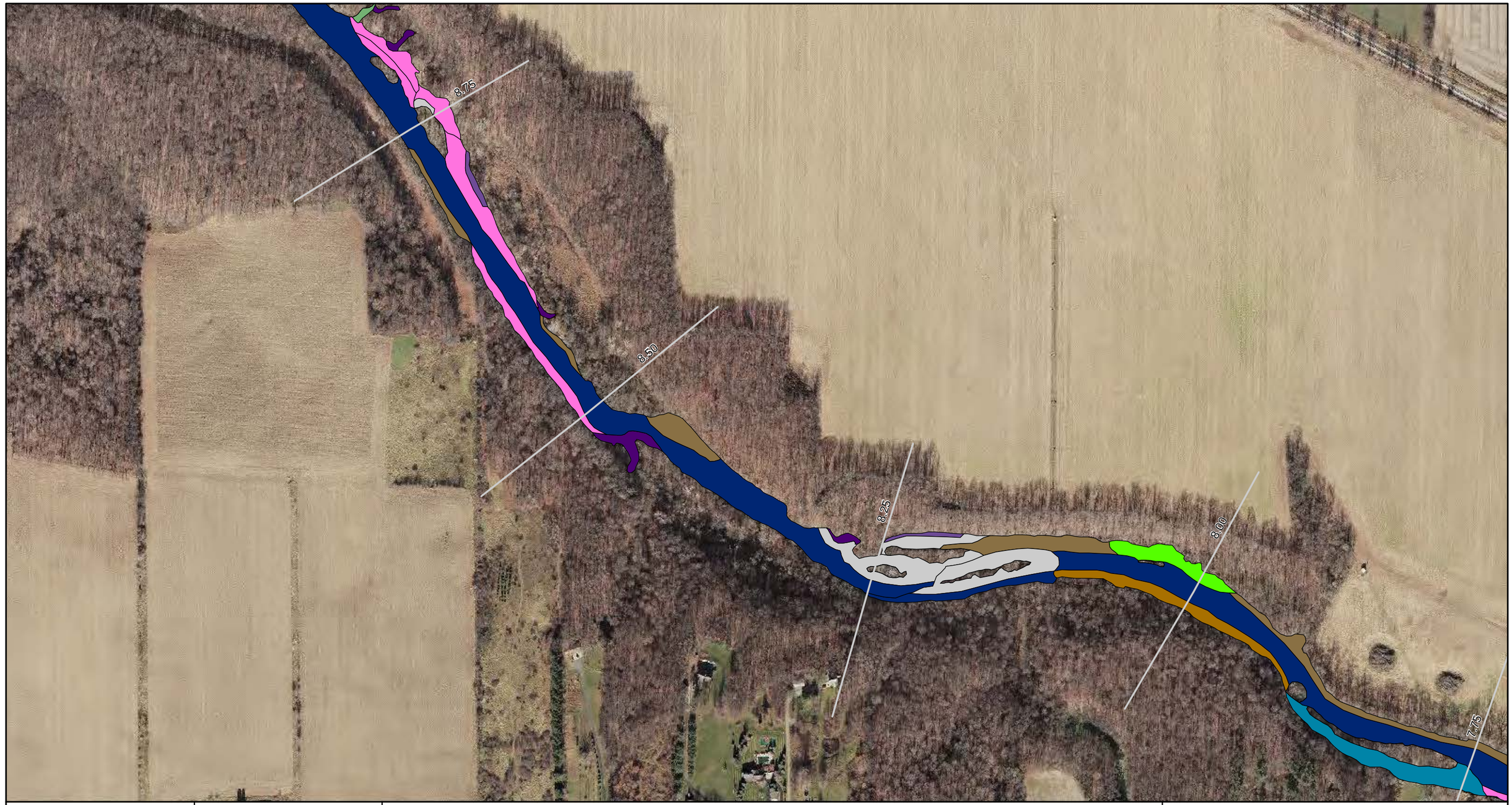
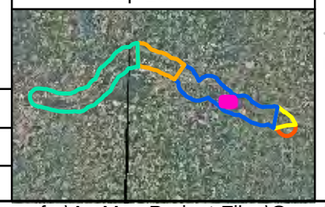
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
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- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 7.92 - MP 8.79

SHEET 8 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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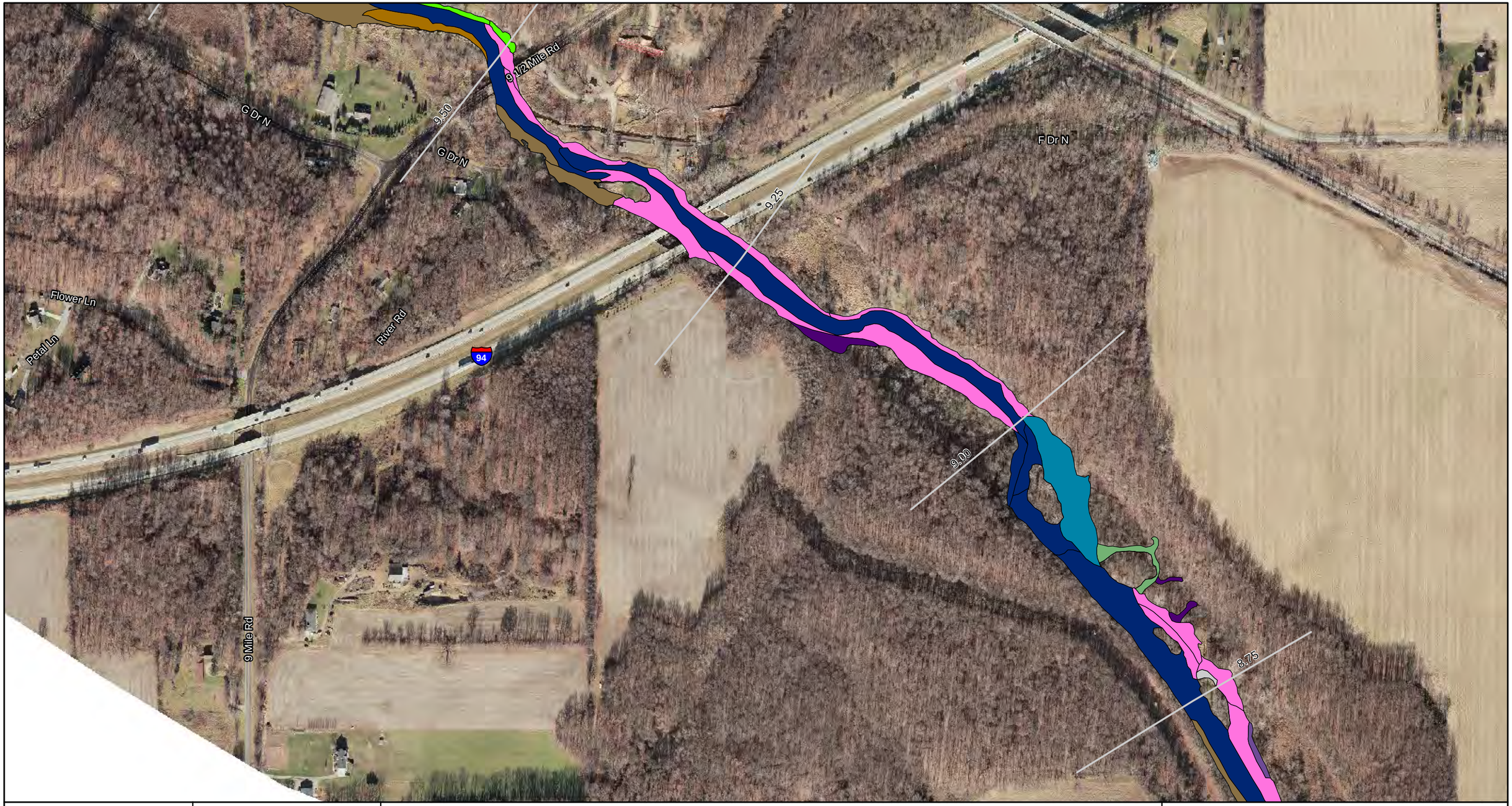
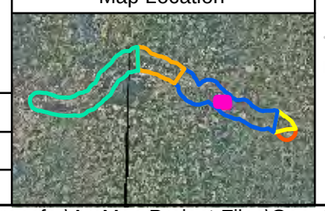
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
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Delta and Lake Surfaces
- Delta Bar
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- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 8.74 - MP 9.48

SHEET 9 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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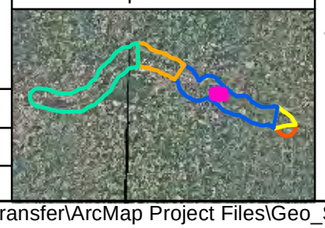
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
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- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 9.46 - MP 10.45

SHEET 10 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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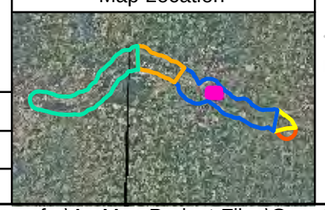
Aerial Photography Date: November 2011

11.25
11.00
10.75
10.50
10.25
Kimball Pines Park Rd
River Rd E
Crosby Dr
Golden Ave

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
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- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500
Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 10.41 - MP 11.03

SHEET 11 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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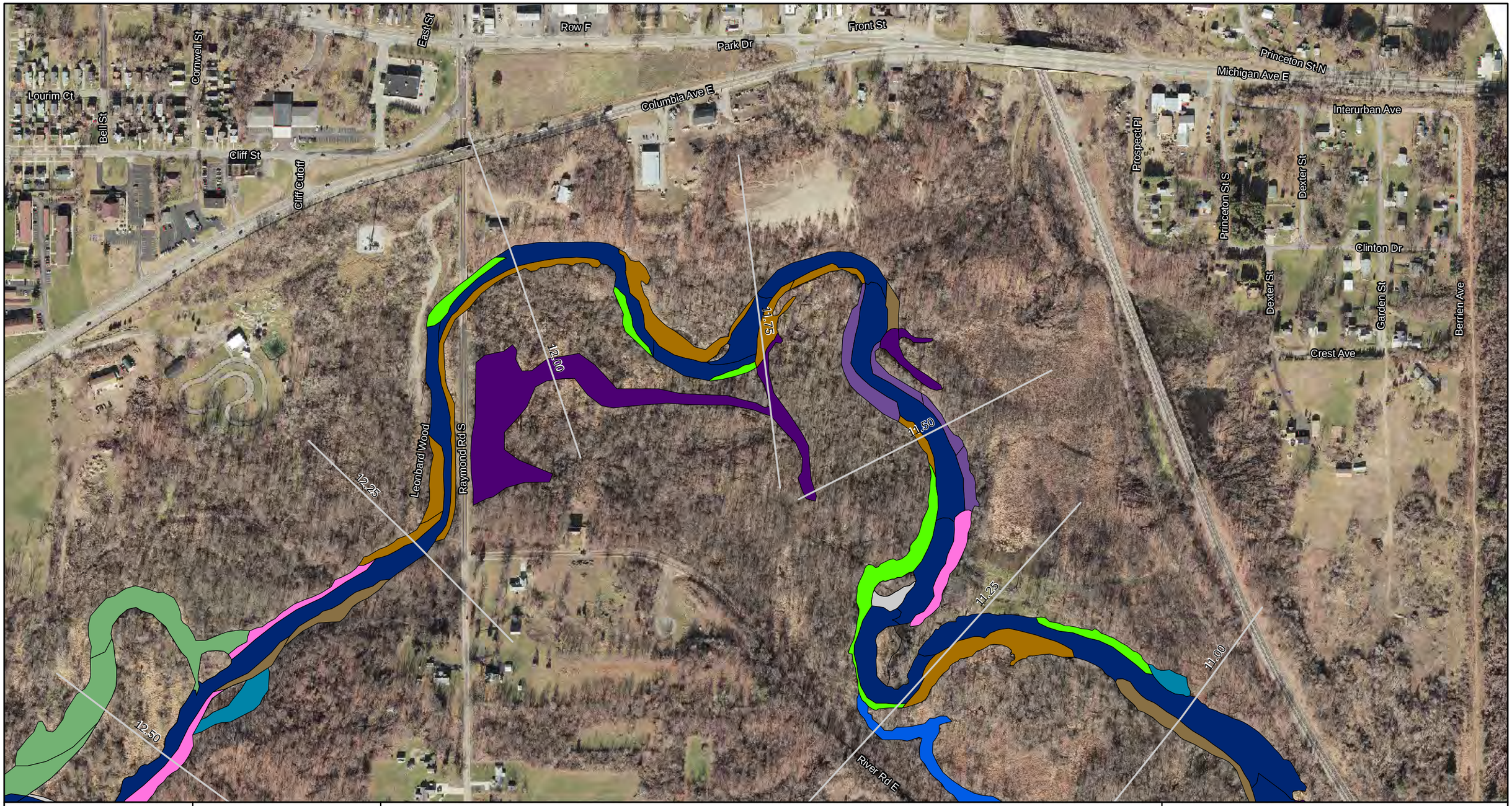
Aerial Photography Date: November 2011



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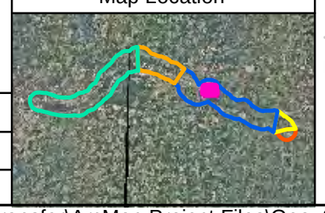

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces

- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces

- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces

- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	JLH 4/17/2012
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Project #:	106-4186

FINAL GEOMORPHIC SURFACES

MP 11.03 - MP 12.44

SHEET 12 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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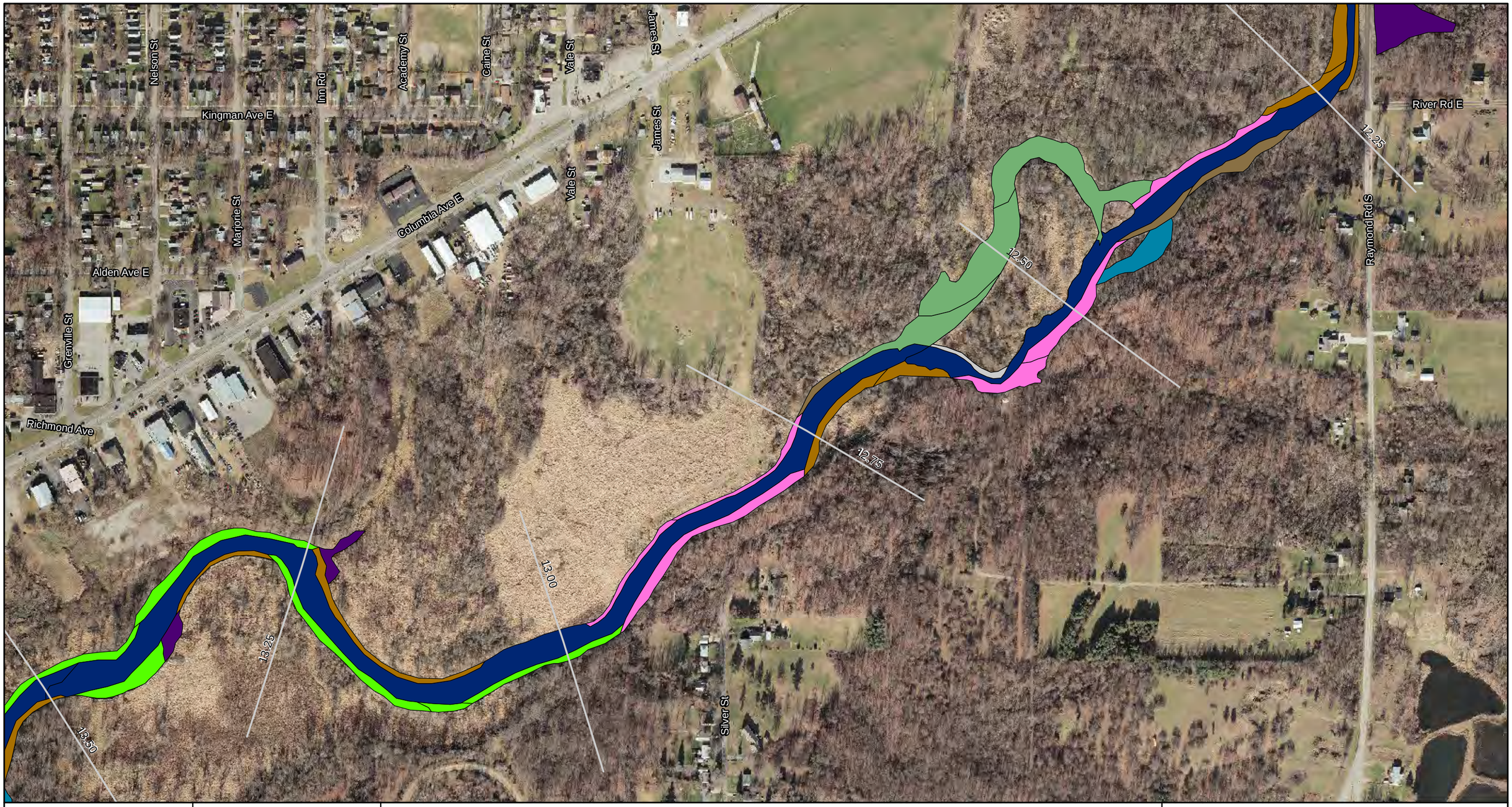
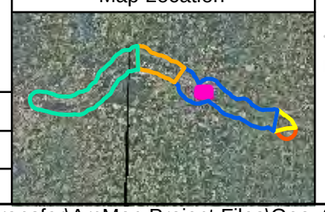
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
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- Tributary

Delta and Lake Surfaces
- Delta Bar
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- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 12.30 - MP 13.33

SHEET 13 OF 48

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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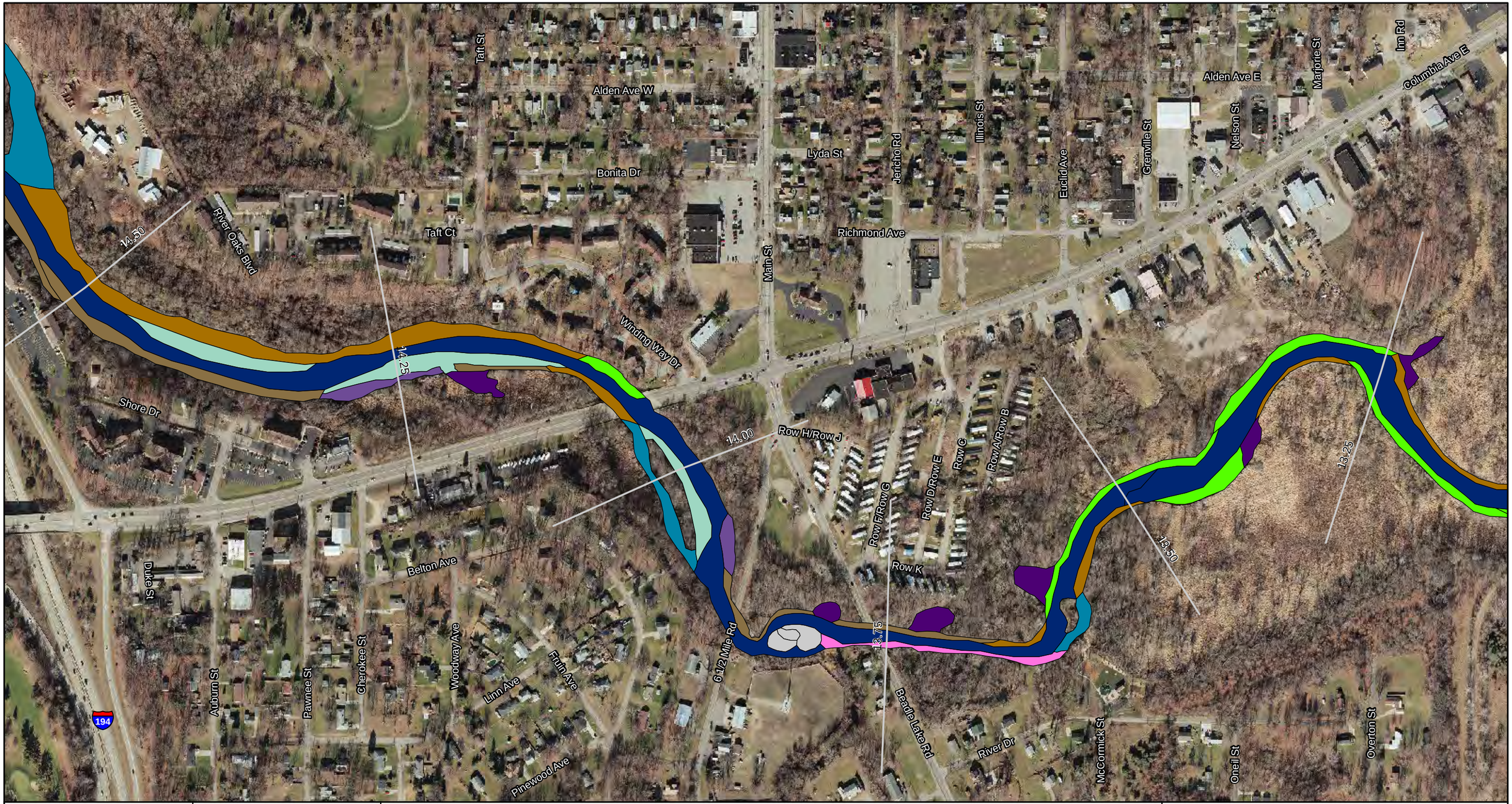
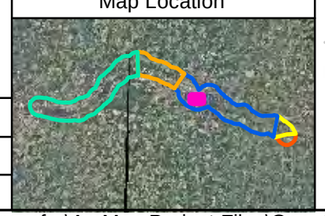
Aerial Photography Date: November 2011



Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces

- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
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- Near Bank Low Energy
- Near Bank Moderate Energy
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Delta and Lake Surfaces

- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces

- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

FINAL GEOMORPHIC SURFACES

MP 13.35 - MP 14.39

SHEET 14 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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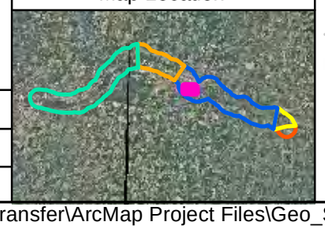
Aerial Photography Date: November 2011

Roe St
Mineral Ave
LaSalle St
Elsmere St
Scenery St
Logan St
Sisson Ave
Fonda Ave
Kenosha Ave
Pauline Ave
Rockford St
South Ave
15.00
Territorial Rd E
Riverside Ct
14.75
Riverside Pkwy
Riverside Dr
Leitch Dr
Marine Dr
Harold St
Foster Ct
Foster Dr
Griffin St
Columbia Ave E
River Oaks Blvd
Taft Ct
14.50
14.25
194
Shore Dr
Auburn St

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
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Delta and Lake Surfaces
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- Distributary Fan
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- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

FINAL GEOMORPHIC SURFACES

MP 14.41 - MP 15.06

SHEET 15 OF 48

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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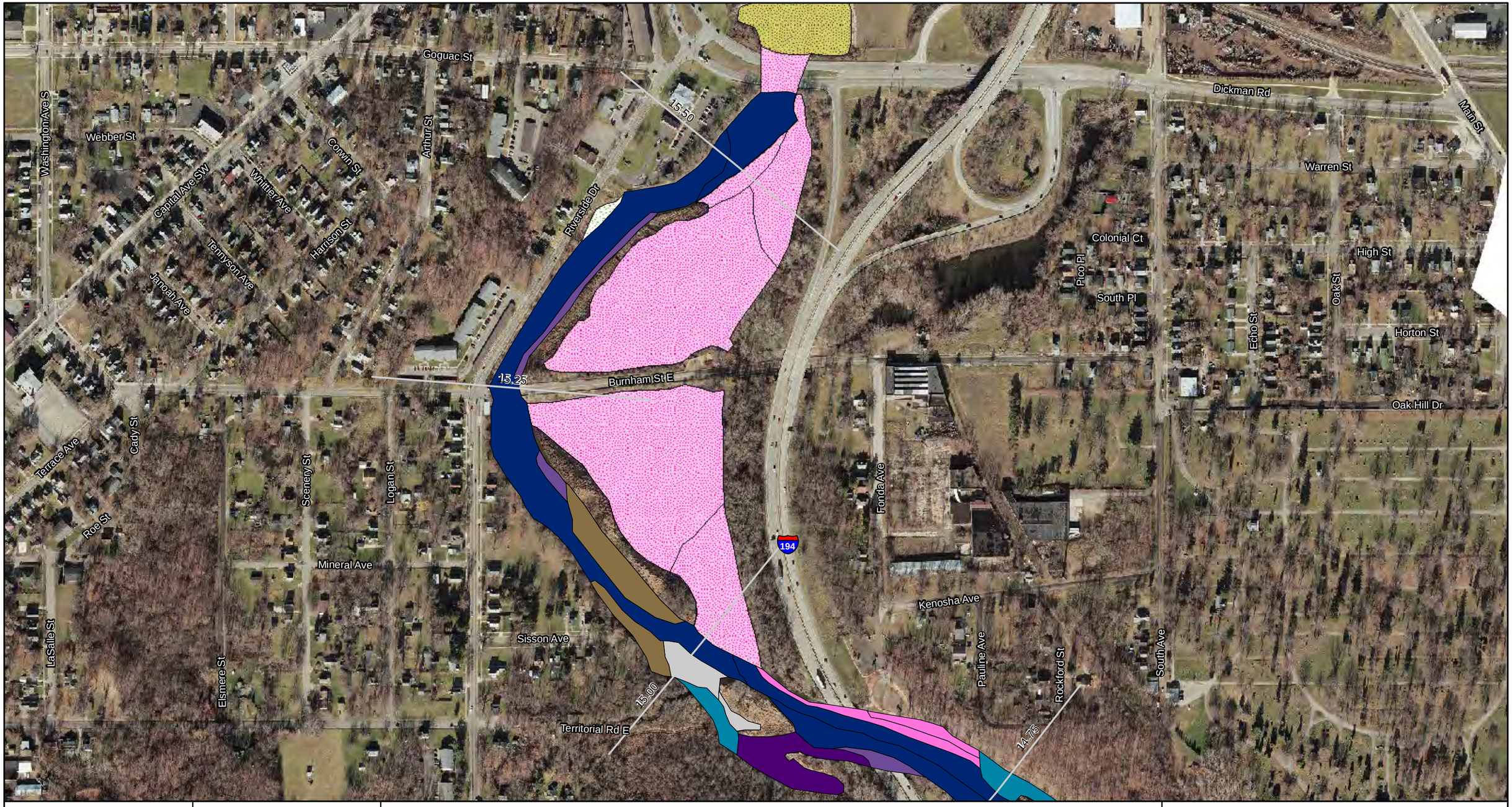
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location

Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
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- Island Deposit
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- Tributary

Delta and Lake Surfaces
- Delta Bar
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- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 14.89 - MP 15.57

SHEET 16 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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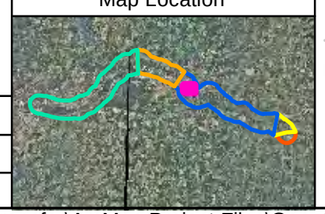
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
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- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
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- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 15.50 - MP 16.07

SHEET 17 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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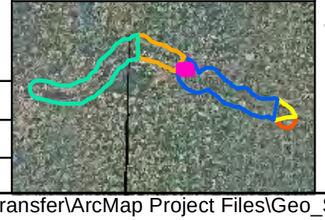
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 16.07 - MP 16.77

SHEET 18 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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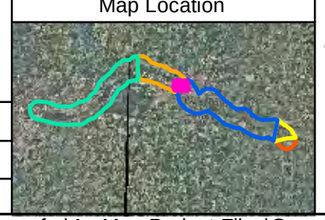
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 16.78 - MP 17.60

SHEET 19 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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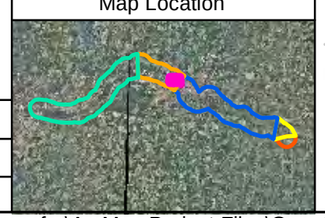
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 17.51 - MP 18.40

SHEET 20 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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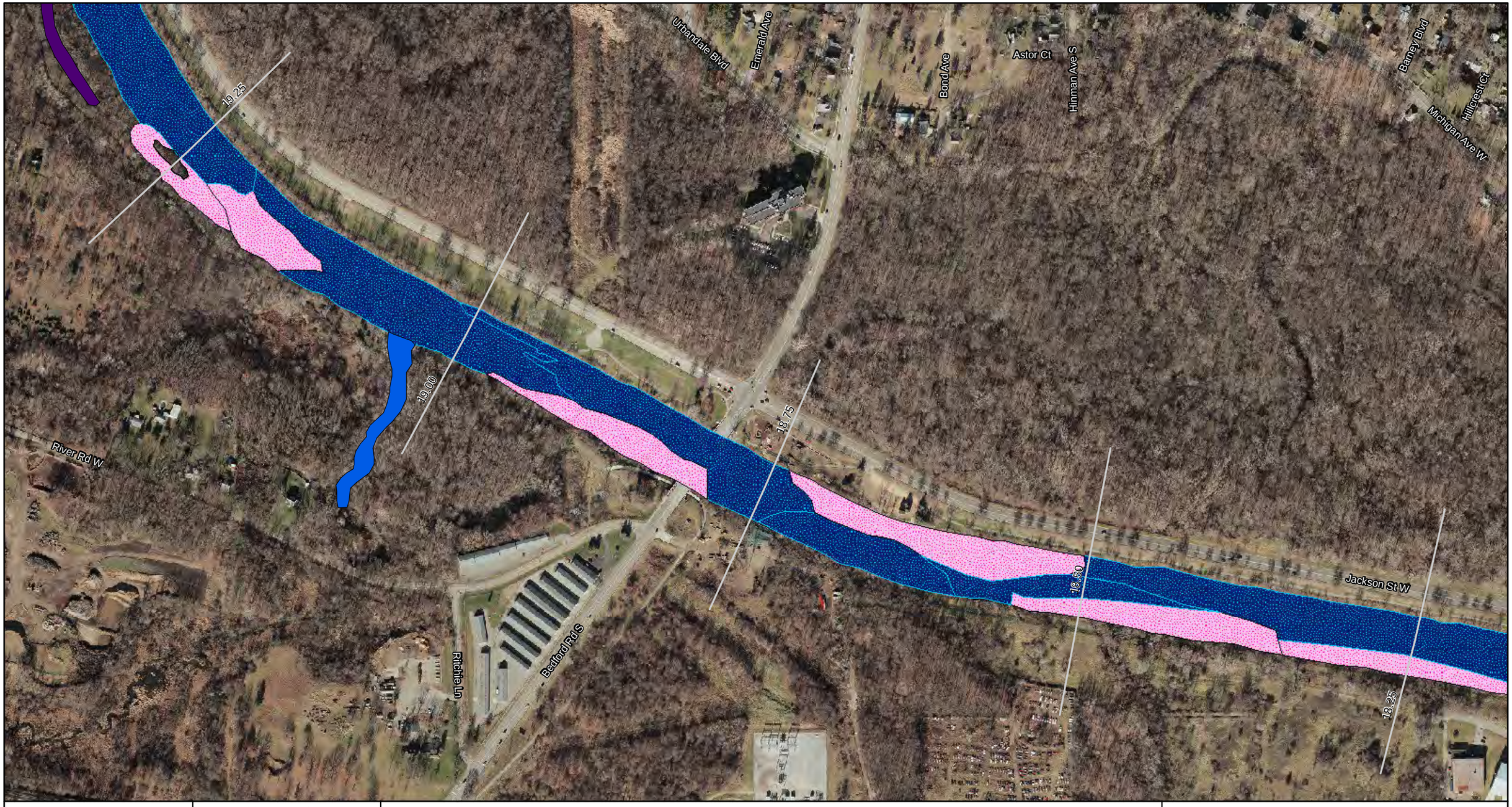
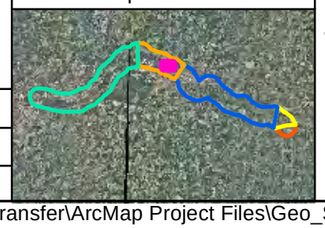
Aerial Photography Date: November 2011



Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
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- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
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- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

FINAL GEOMORPHIC SURFACES

MP 18.37 - MP 19.23

SHEET 21 OF 48

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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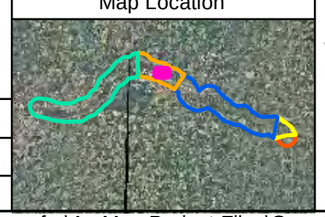
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 19.16 - MP 20.04

SHEET 22 OF 48

ENBRIDGE LINE 6B MP 608
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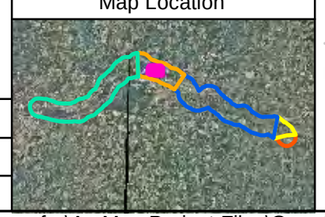
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 20.00 - MP 20.88

SHEET 23 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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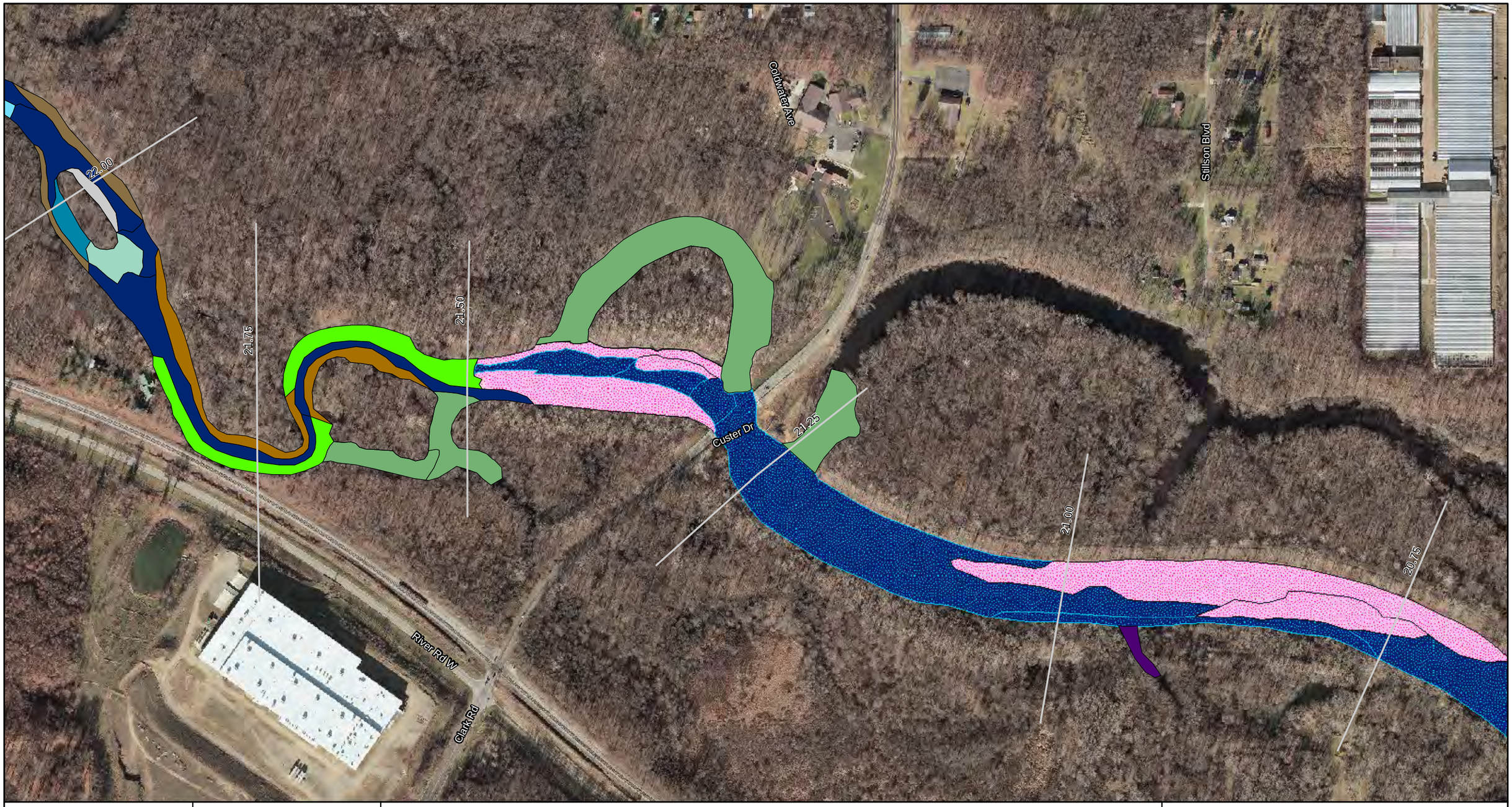
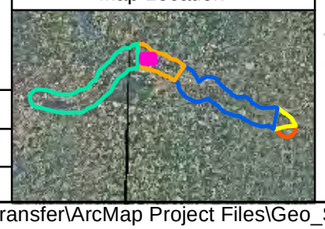
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 20.85 - MP 21.79

SHEET 24 OF 48

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 21.48 - MP 22.35

SHEET 25 OF 48

ENBRIDGE LINE 6B MP 608
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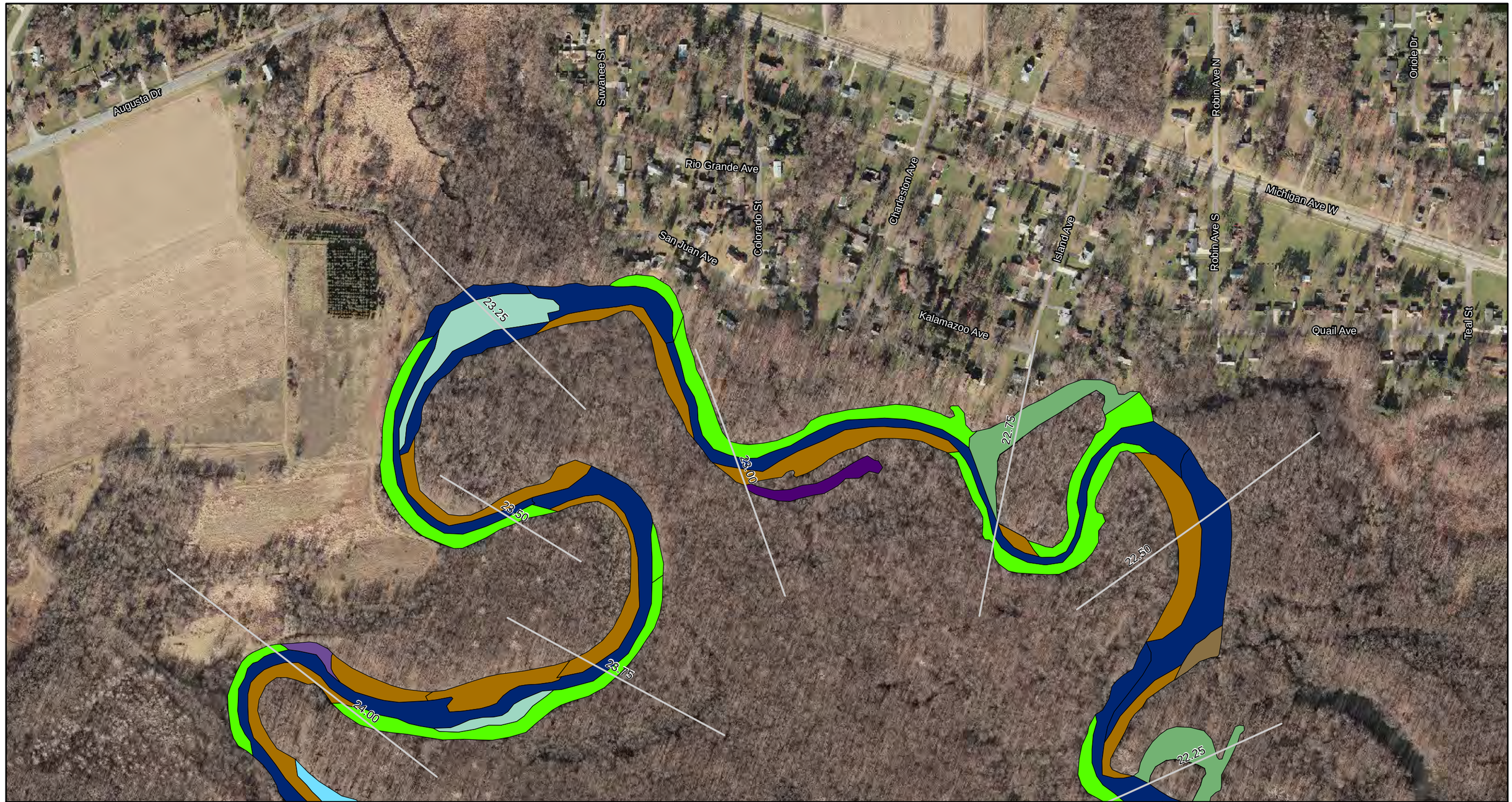
Aerial Photography Date: November 2011



Map Location

Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

FINAL GEOMORPHIC SURFACES

MP 23.34 - MP 24.08

SHEET 26 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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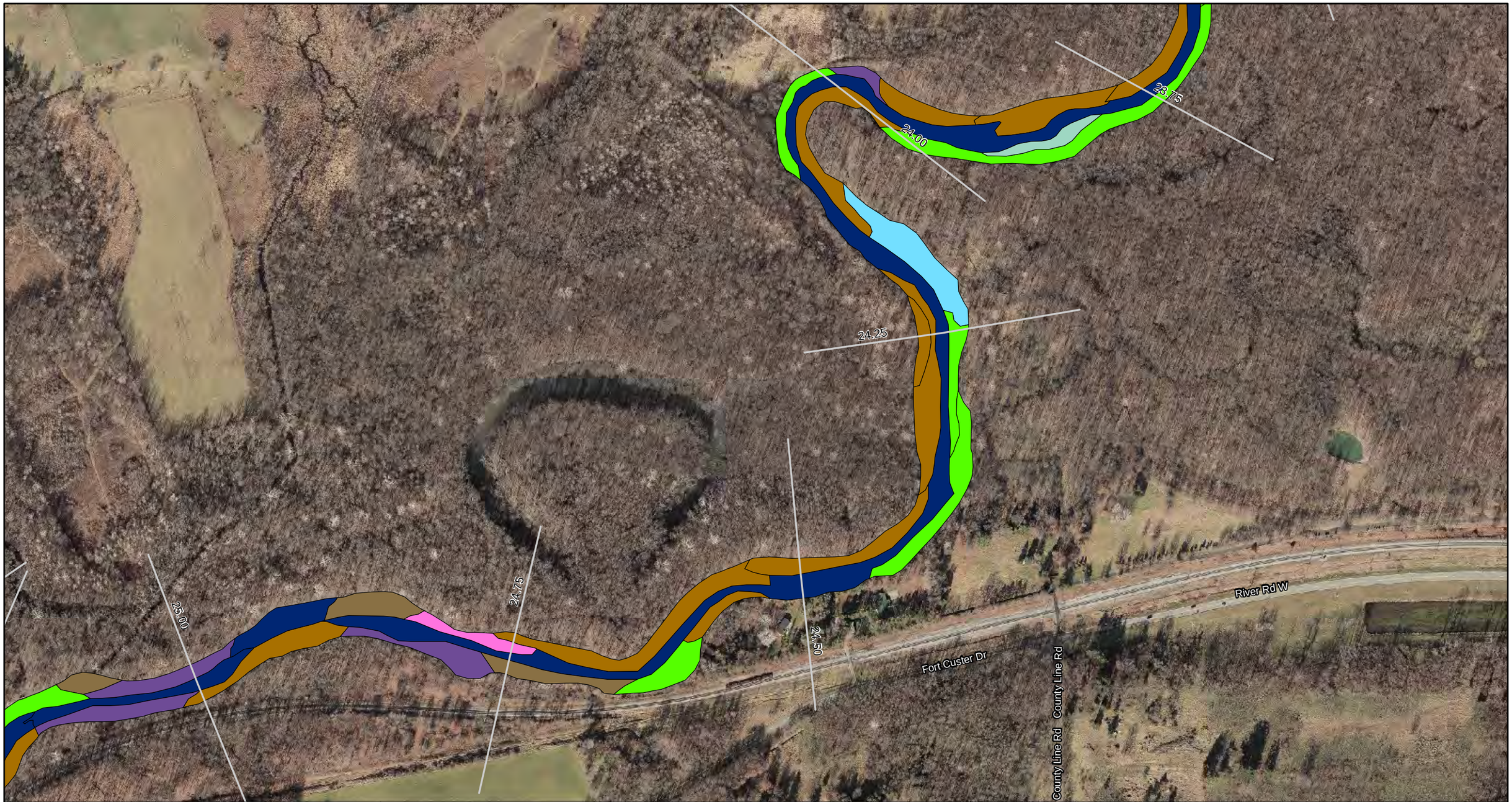
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 23.79 - MP 24.99

SHEET 27 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 24.99 - MP 26.38

SHEET 28 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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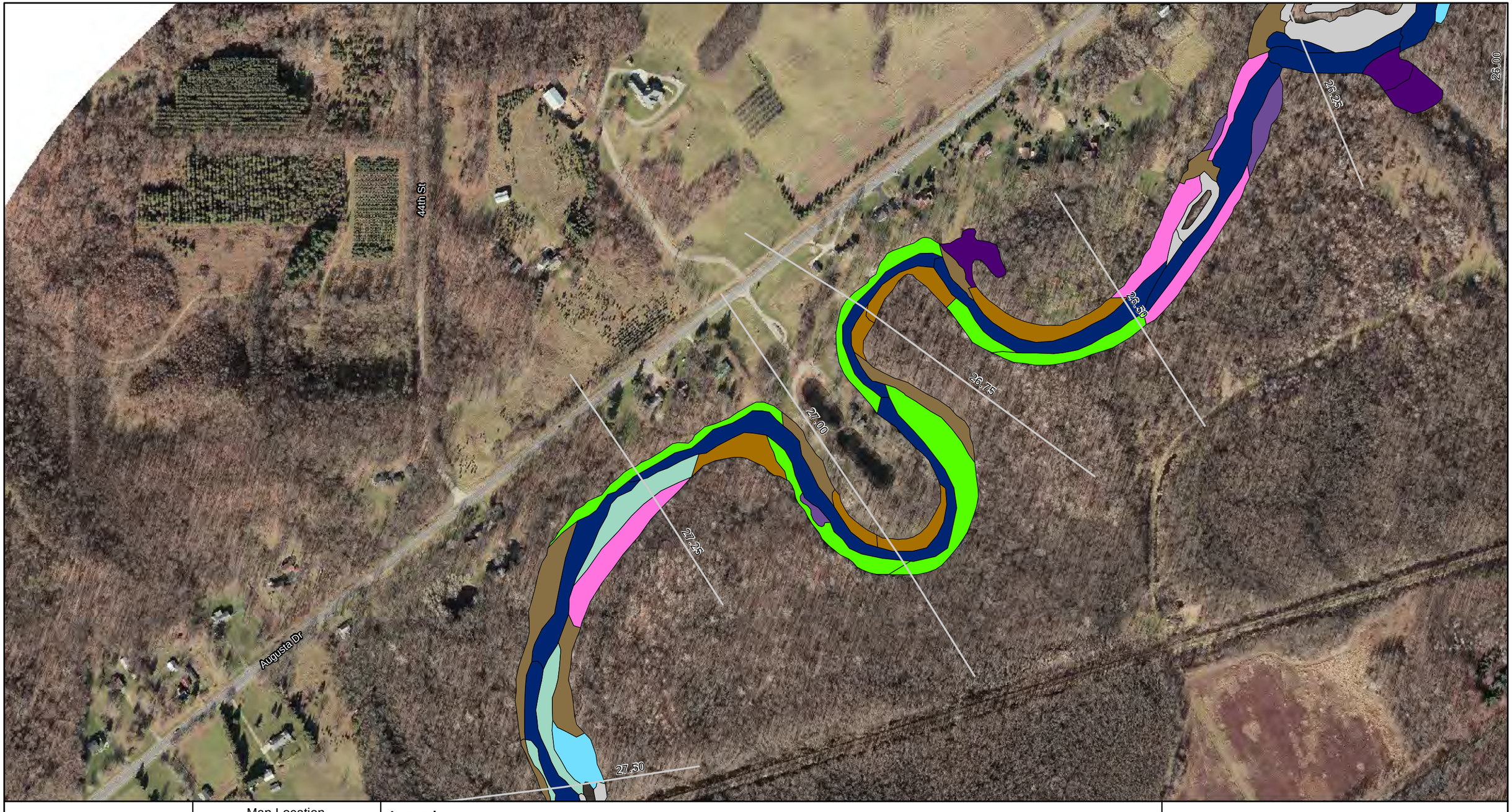

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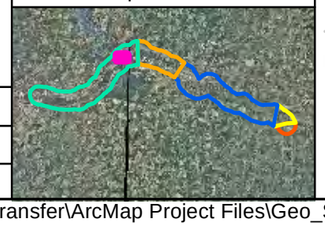

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

FINAL GEOMORPHIC SURFACES

MP 26.34 - MP 27.46

SHEET 29 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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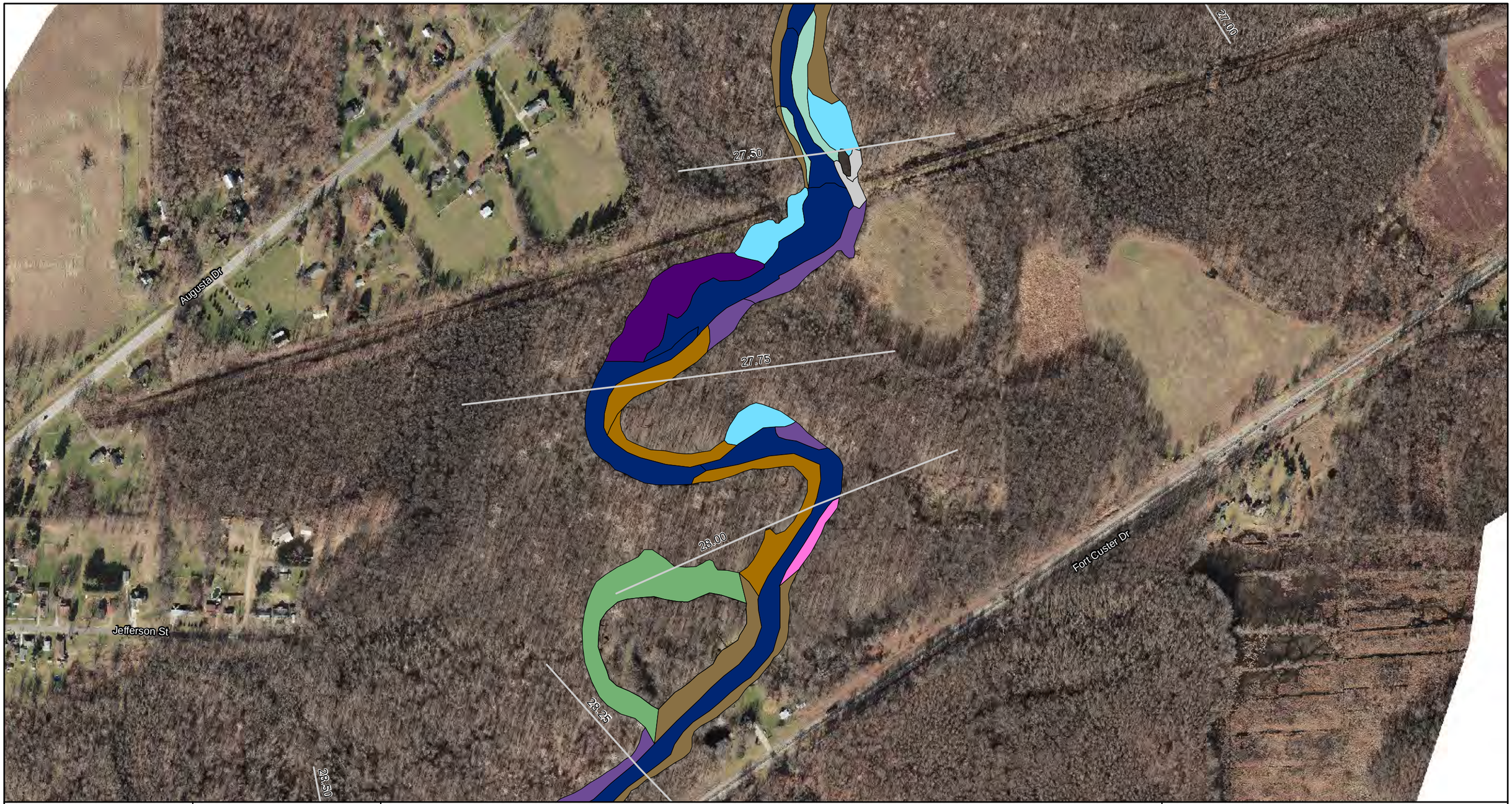
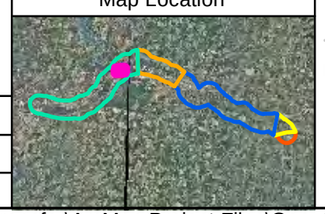
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 27.47 - MP 28.22

SHEET 30 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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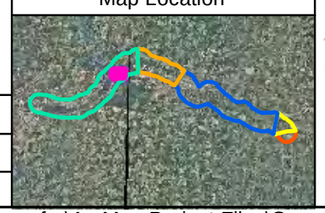
Aerial Photography Date: November 2011

Washington St
Augusta Ave
Convis
Van Buren St
Canal St
Water St
Wayne Ter Berg St
Michigan Ave
Clinton St
Fort Custer Dr
28.50
28.25
28.75
29.00
Augusta Dr
Harmonia Rd
Fort Custer Rec Area Access
Augusta Climax Rd

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
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Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
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- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 28.22 - MP 29.04

SHEET 31 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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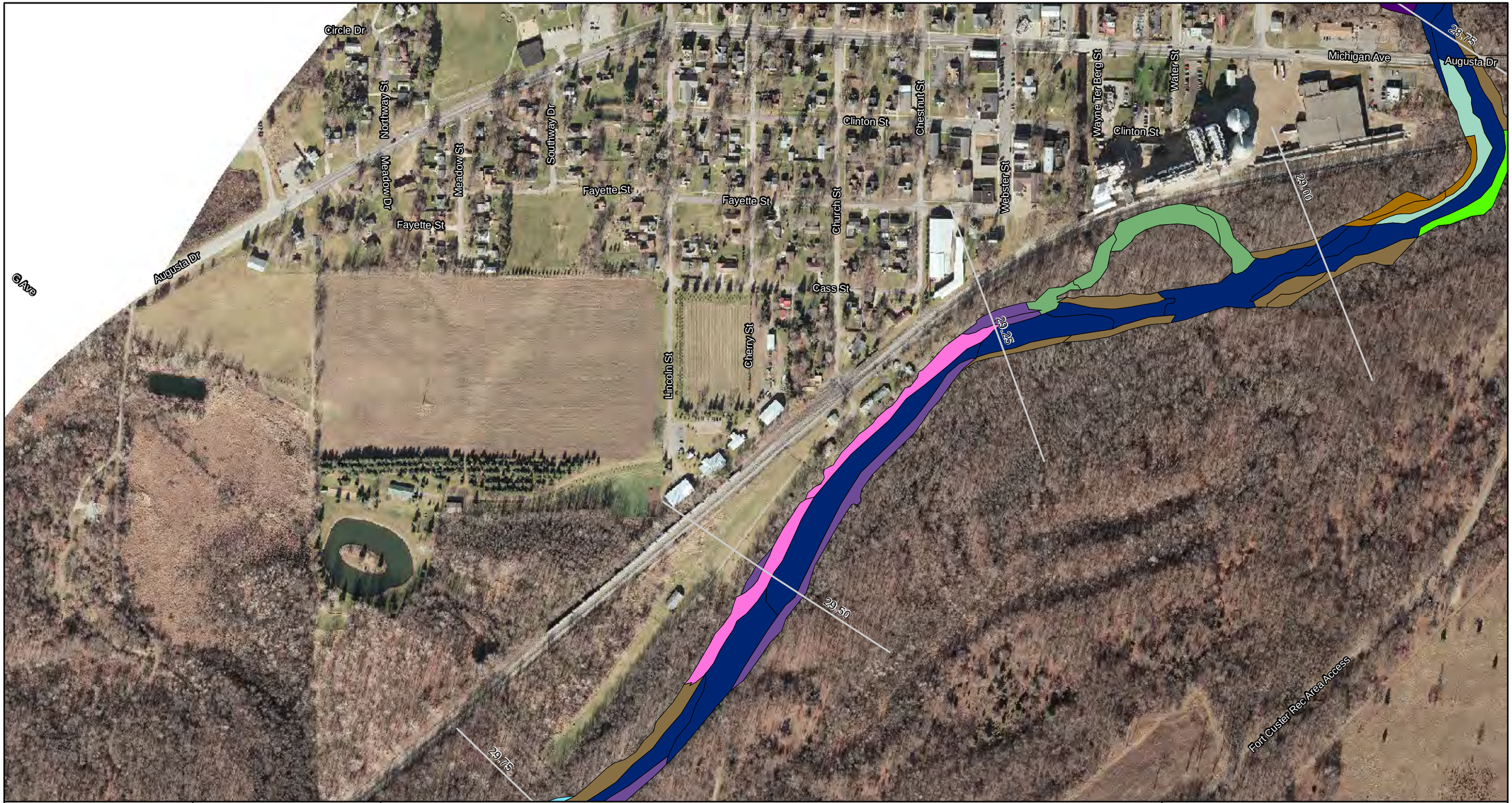
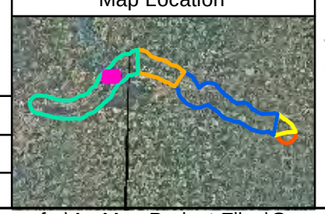
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 29.05 - MP 29.65

SHEET 32 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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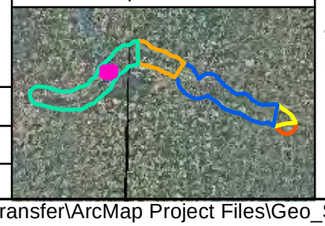
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 29.65 - MP 30.59

SHEET 33 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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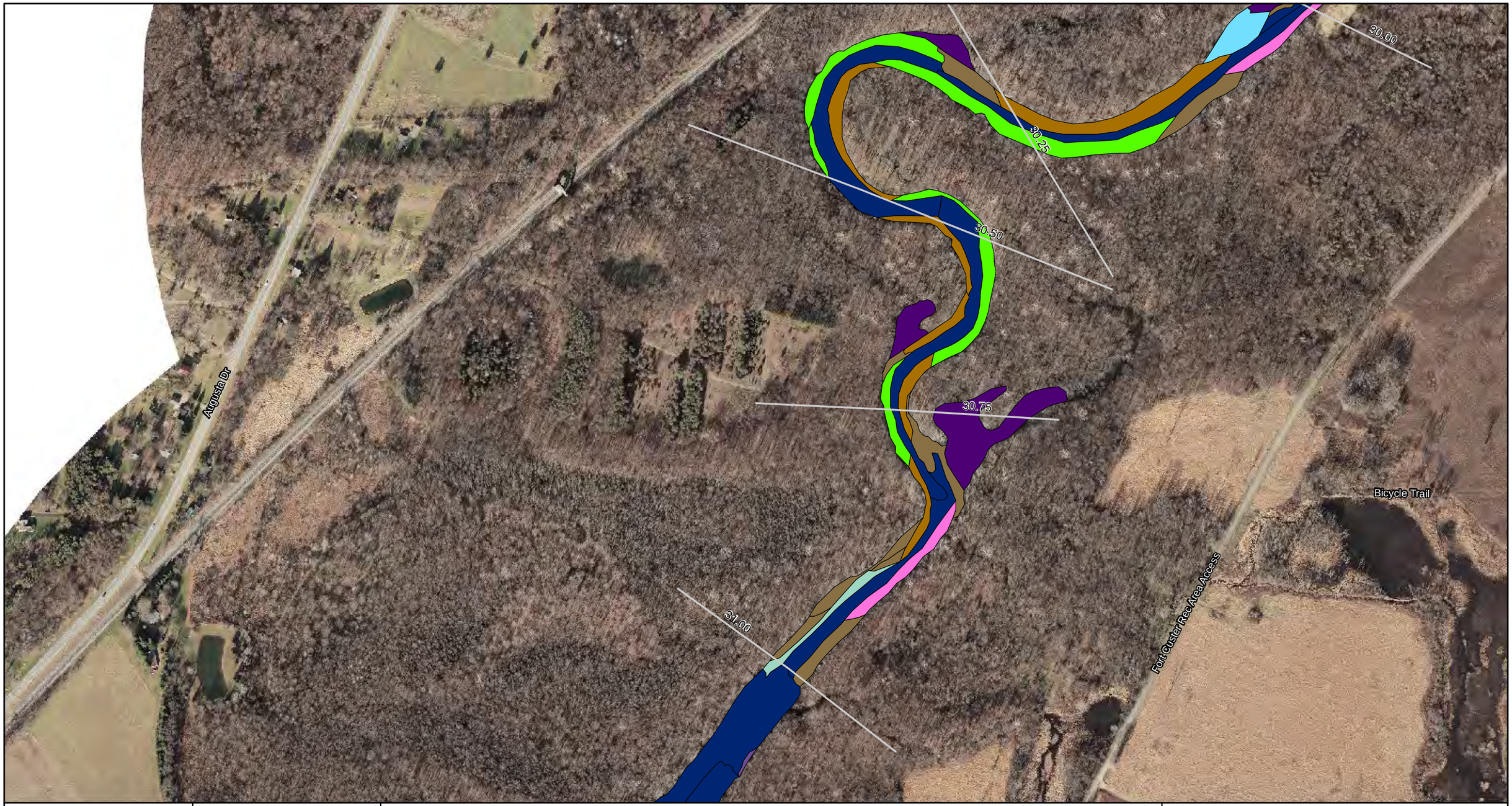
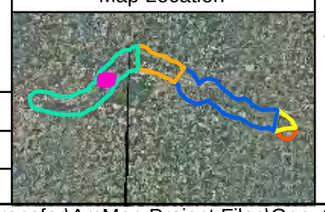
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 30.43 - MP 31.06

SHEET 34 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 31.06 - MP 31.67

SHEET 35 OF 48

ENBRIDGE LINE 6B MP 608
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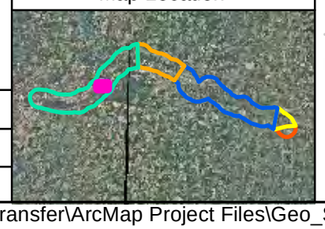
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 31.68 - MP 32.34

SHEET 36 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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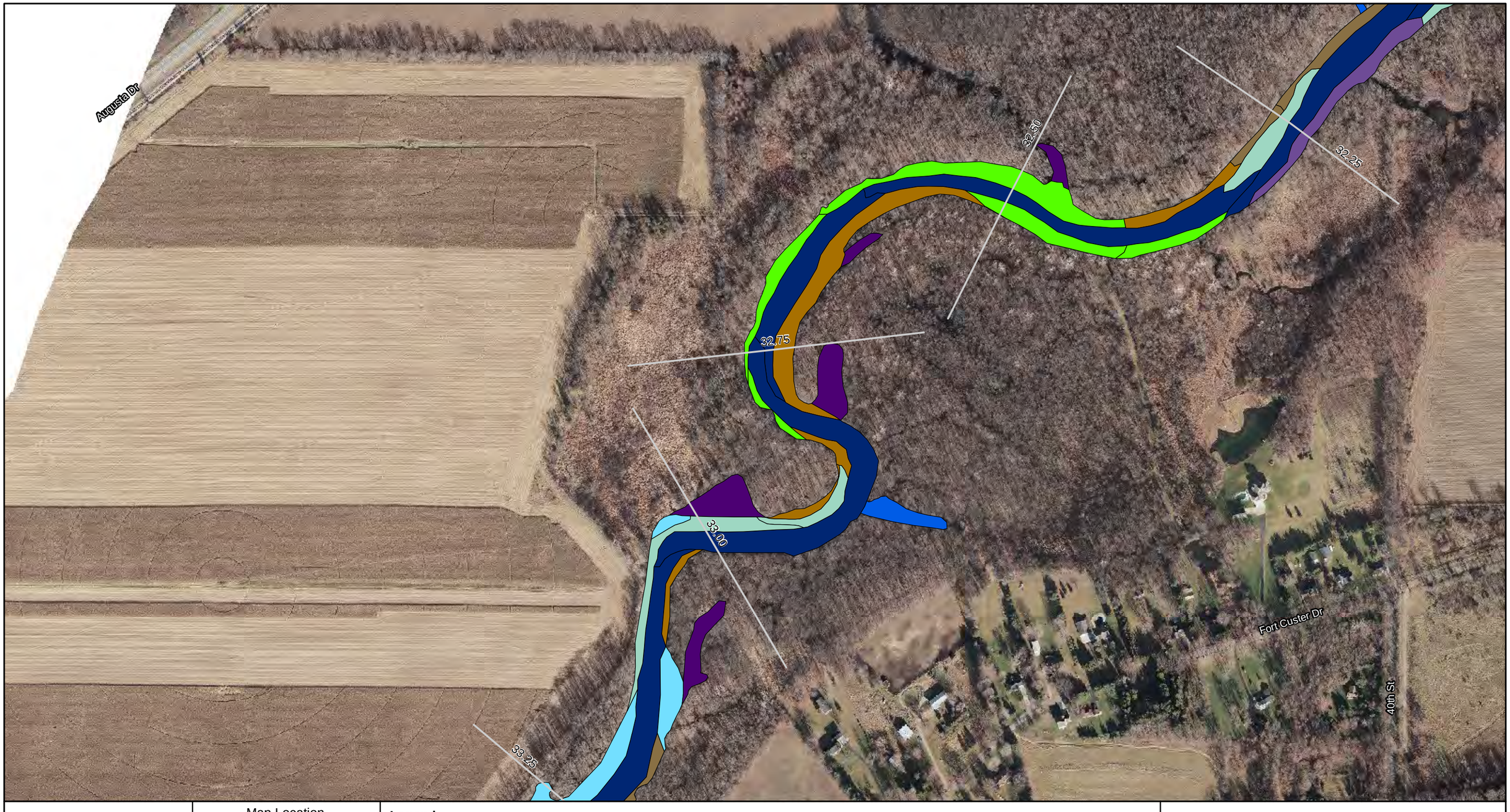
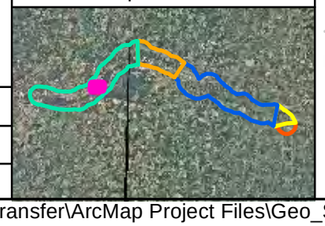
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 32.28 - MP 33.18

SHEET 37 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 33.09 - MP 36.76

SHEET 38 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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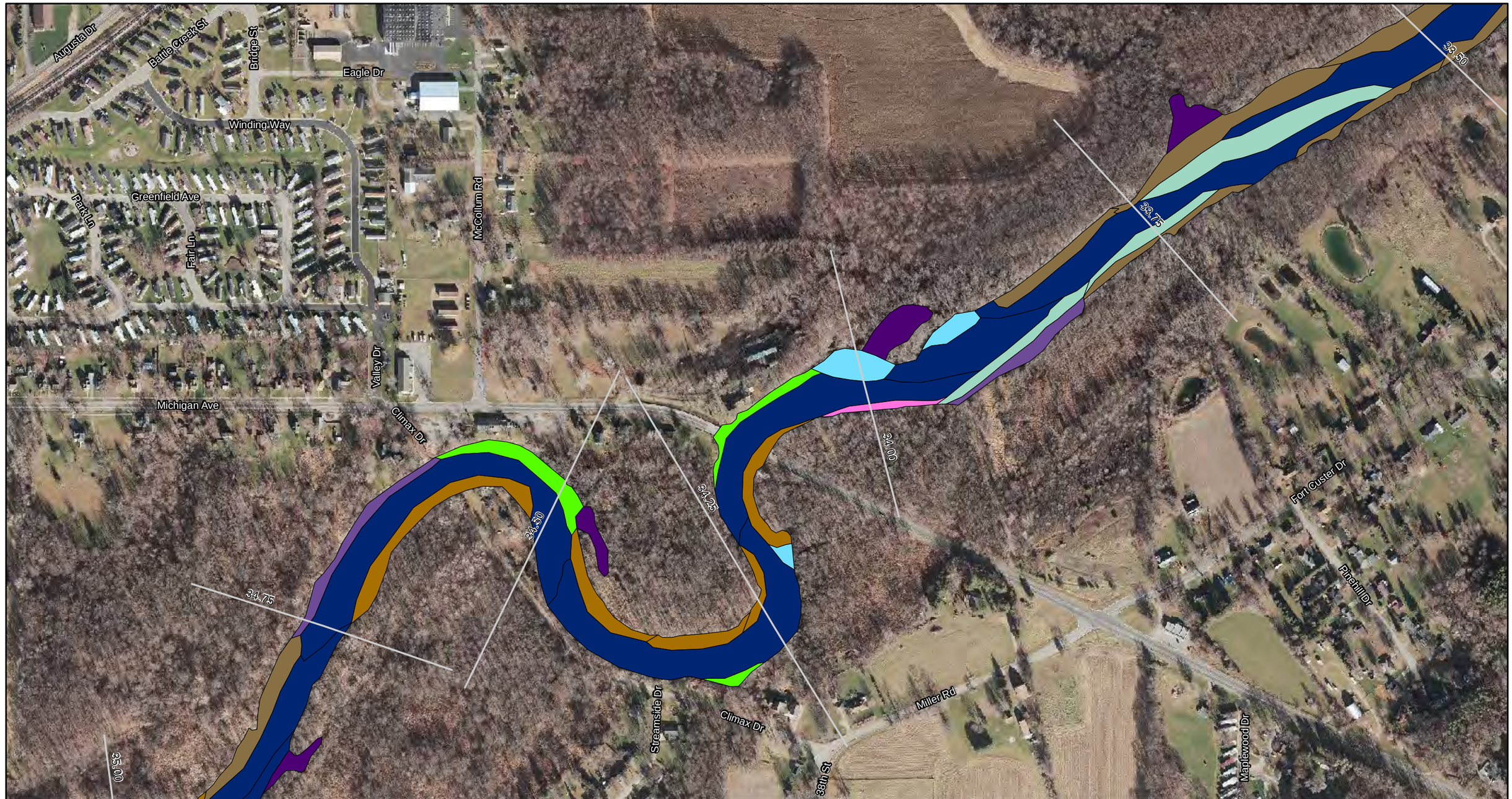
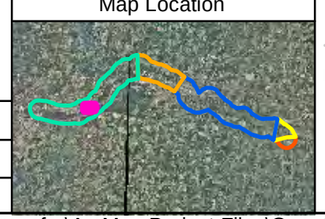
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 33.65 - MP 34.84

SHEET 39 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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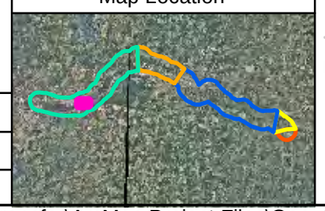
Aerial Photography Date: November 2011

Blake Blvd
Grove St
Toland St
Battle Creek St
Climax Dr
Streamside Dr
Miller Rd
34.75
34.50
35.25
35.50
35.00
35.75
36.00

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500
Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 34.78 - MP 35.91

SHEET 40 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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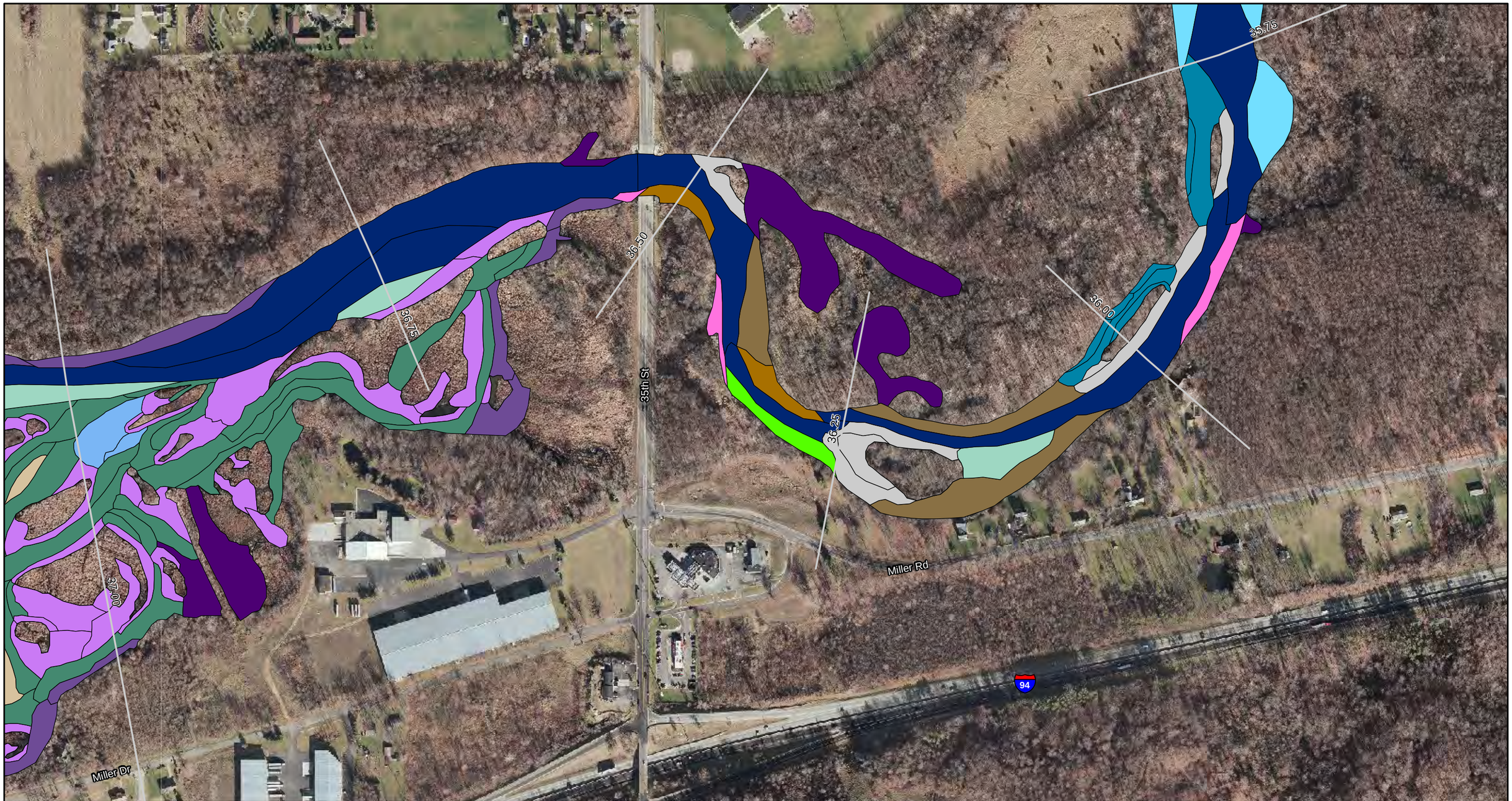
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 35.80 - MP 36.90

SHEET 41 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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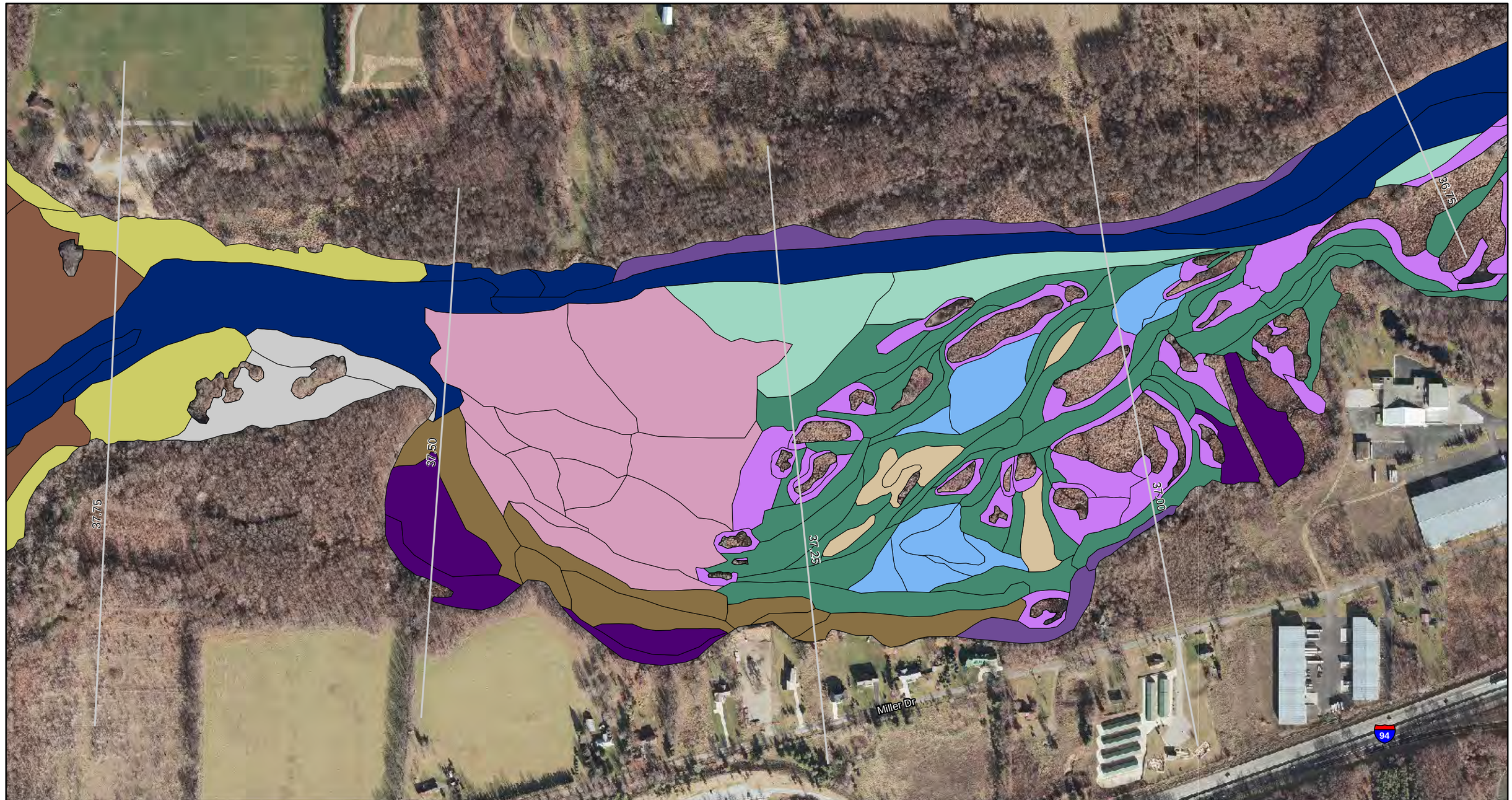
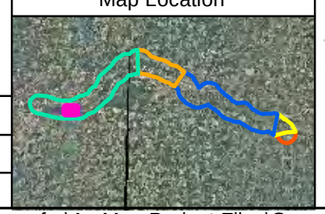
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 36.88 - MP 37.70

SHEET 42 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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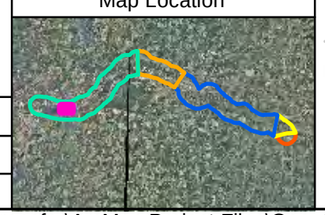
Aerial Photography Date: November 2011

38.25
38.00
37.75
37.50
37.25

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 37.40 - MP 38.20

SHEET 43 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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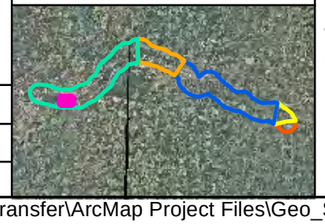
Aerial Photography Date: November 2011

38.25
38.00
37.75
37.50
37.25
Lyth Rd
Miller Dr
Galesburg Rest Area
33rd St
94

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 37.41 - MP 38.21

SHEET 44 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

E:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Geo_Surfaces_Final_03202012.mxd

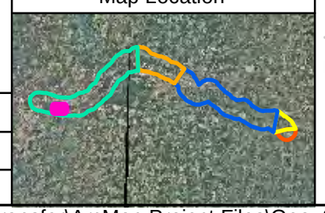
Aerial Photography Date: November 2011

39.00
38.75
38.50
38.25
38.00
Cleneagle Dr
94

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

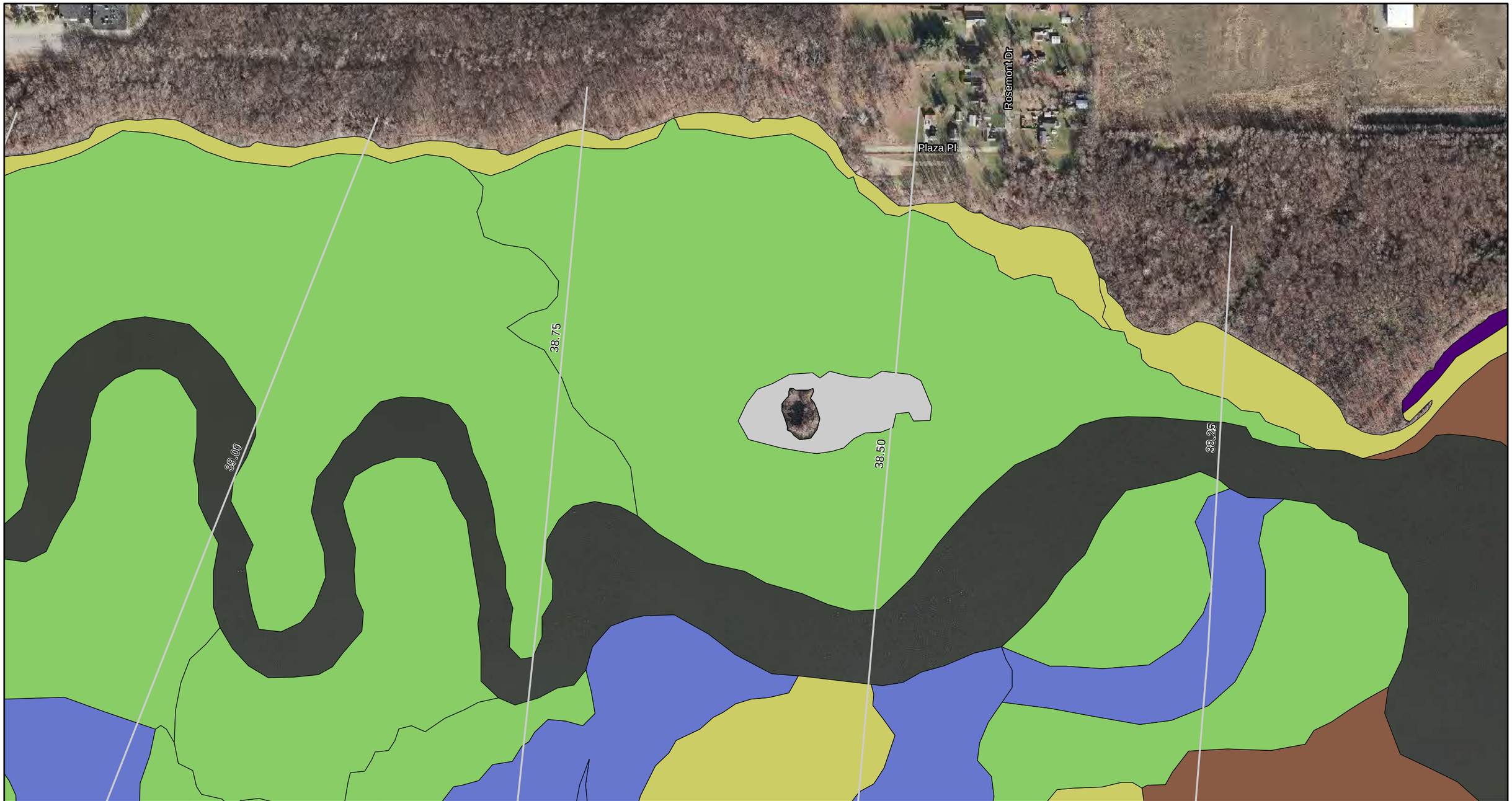
MP 38.21 - MP 39.00

SHEET 45 OF 48

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

E:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Geo_Surfaces_Final_03202012.mxd

Aerial Photography Date: November 2011



Map Location

Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

FINAL GEOMORPHIC SURFACES

MP 38.20 - MP 39.01

SHEET 46 OF 48

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

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Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location

Legend

- Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 39.01 - MP 39.86

SHEET 47 OF 48

ENBRIDGE LINE 6B MP 608
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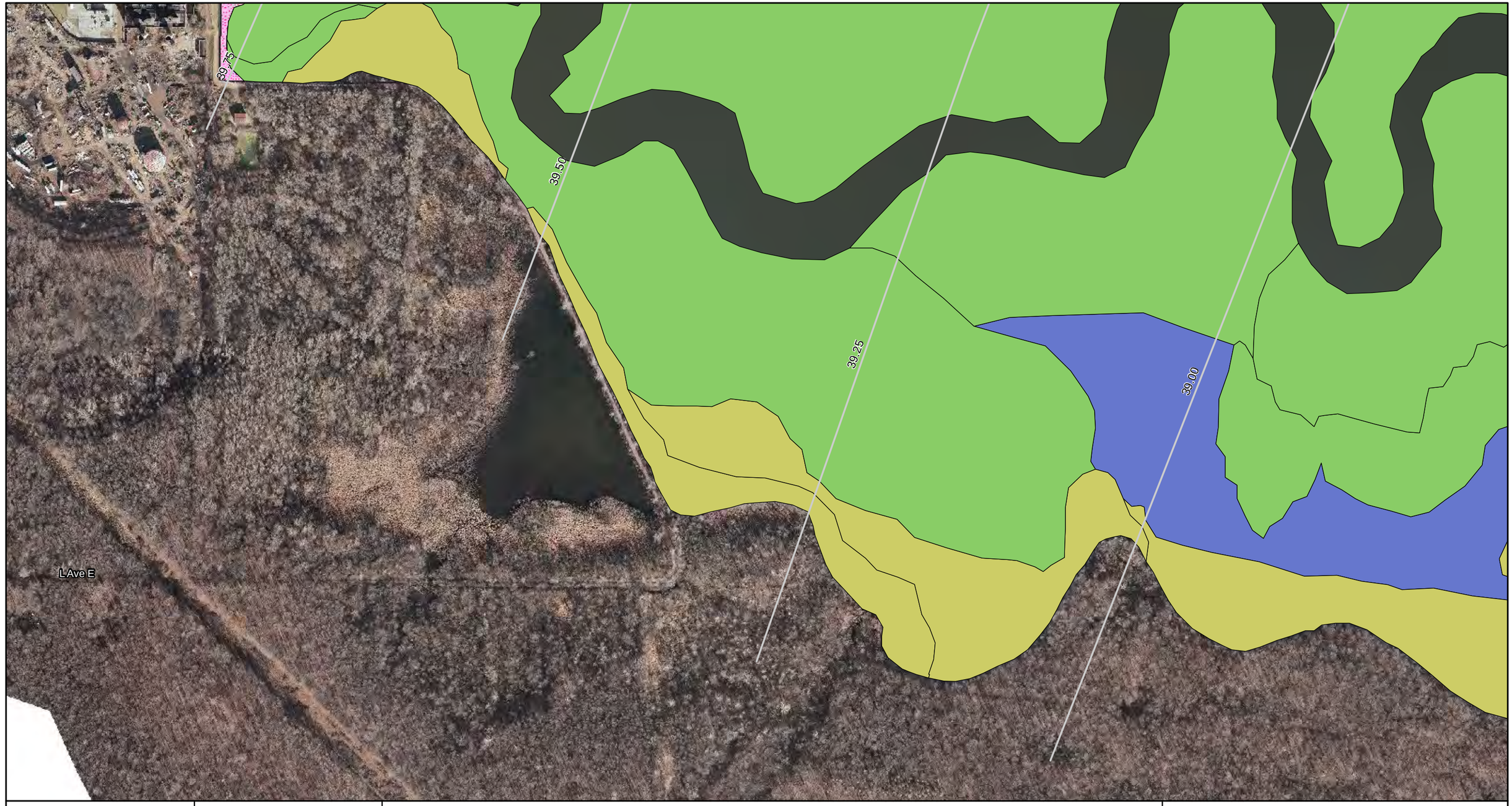
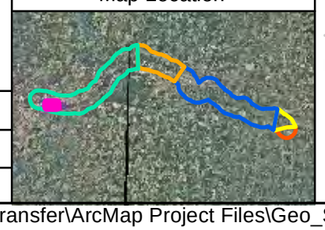
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	JLH 4/17/2012
Approved:	DBR 4/17/2012
Project #:	106-4186

Map Location



Legend

Quarter Mile Grid Segment

Fluvial Surfaces
- Backwater
- Cut Bank
- Cutoff Channel
- Increased Channel Width
- Island
- Island Deposit
- Mid-Channel Bar
- Near Bank High Energy
- Near Bank Low Energy
- Near Bank Moderate Energy
- Oxbow
- Point Bar
- Thalweg
- Tributary

Delta and Lake Surfaces
- Delta Bar
- Delta Island Deposit
- Distributary Channel
- Distributary Fan
- Former Floodplain
- Former Oxbow
- Lake Fan
- Low Energy Deposit
- Remnant Terrace

Anthropogenic Surfaces
- Anthropogenic Deposit
- Anthropogenic Silt Curtain
- Anthropogenic Thalweg
- Dam Deposit
- Engineered Channel

N

0 125 250 500

Scale in Feet

FINAL GEOMORPHIC SURFACES

MP 39.01 - MP 39.88

SHEET 48 OF 48

ENBRIDGE LINE 6B MP 608
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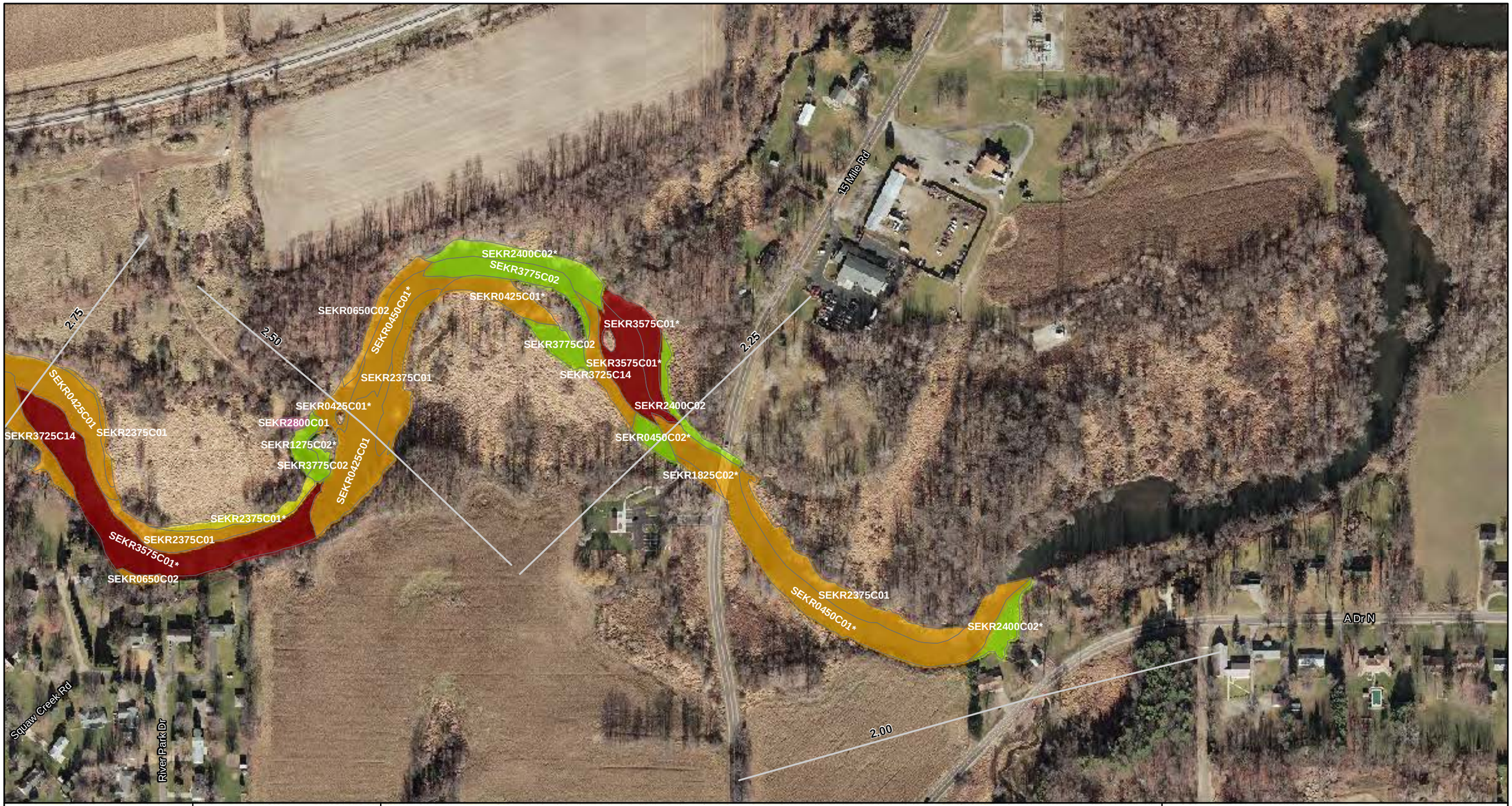
Aerial Photography Date: November 2011

Figure 3-14

Geomorphic Polygons By Bed Type With Assigned Cores (All 110 Cores Used)

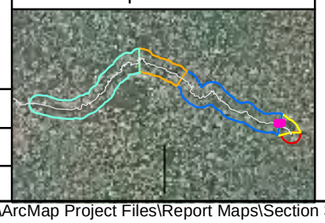
Sheets 1 through 56



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 01.95 - MP 02.75

SHEET 1 OF 56

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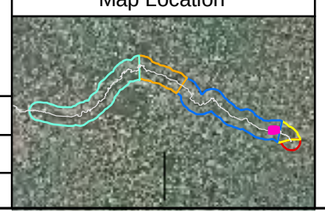
Aerial Photography Date: November 2011

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
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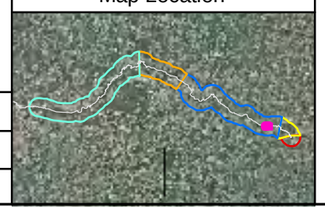
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
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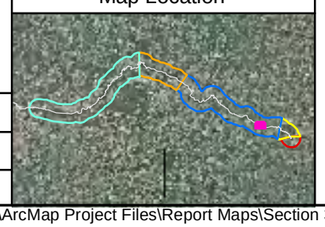
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 04.15 - MP 05.00

SHEET 4 OF 56

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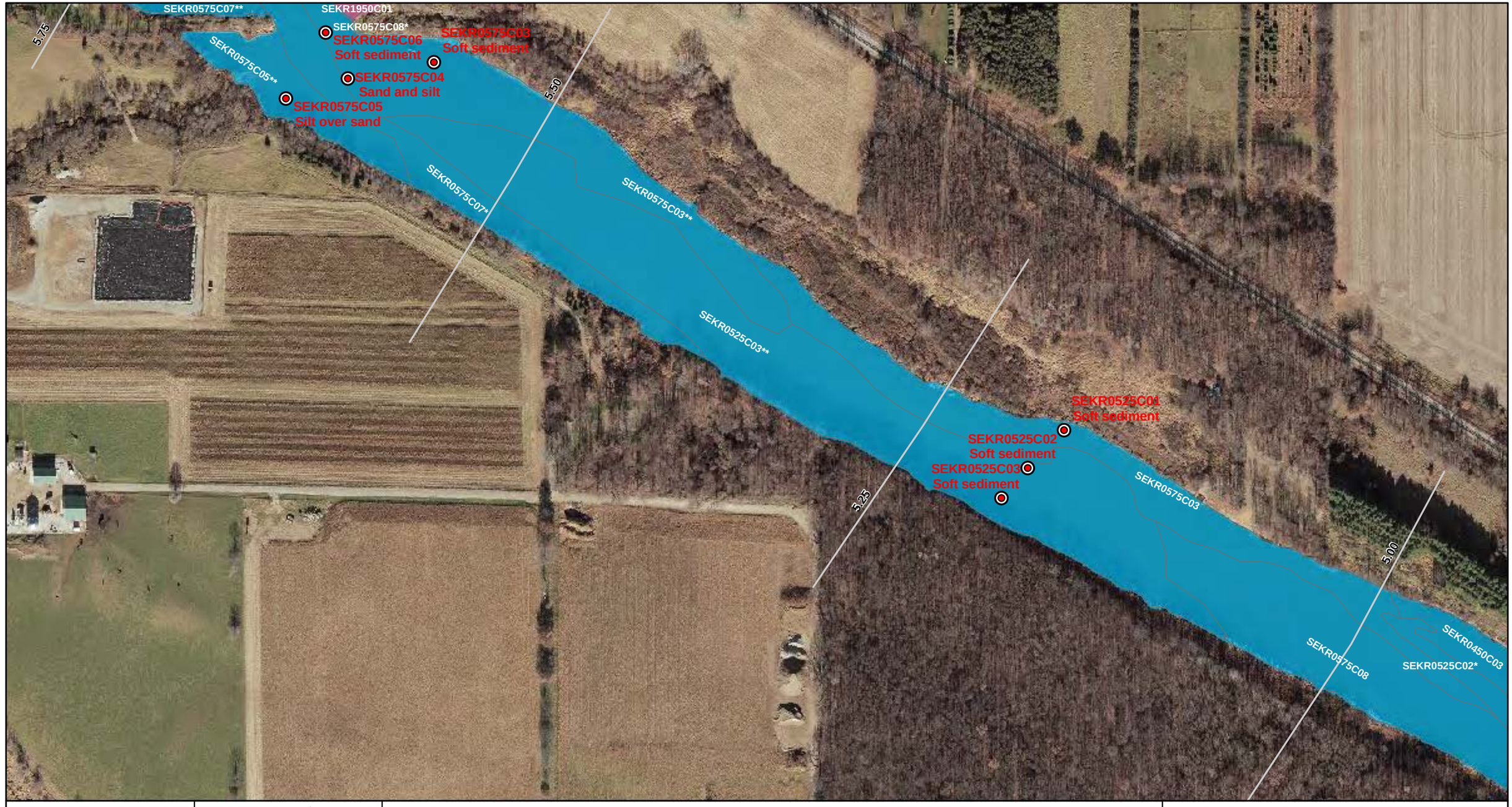
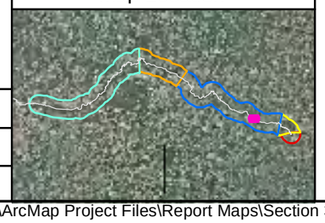
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
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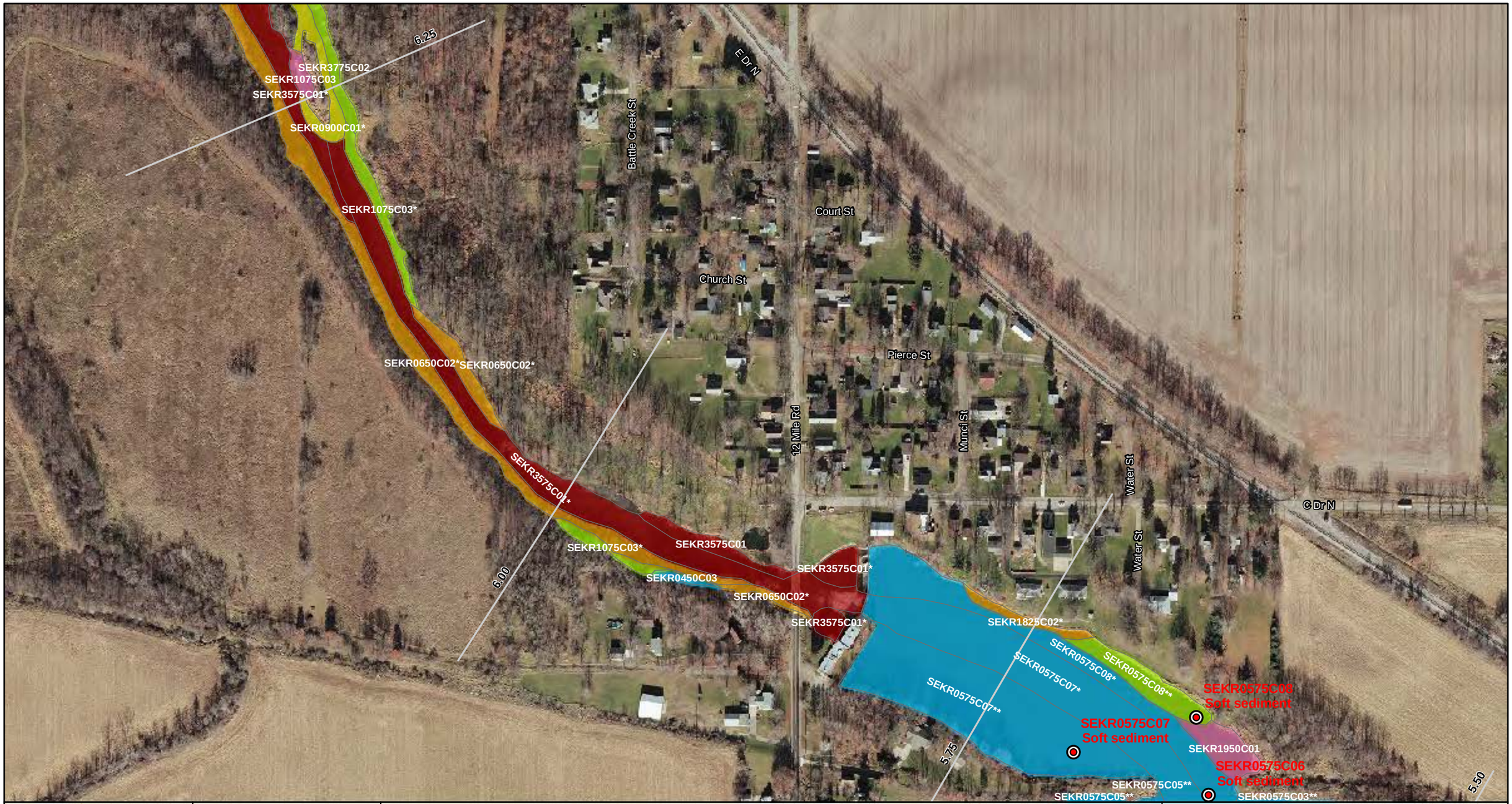

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Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
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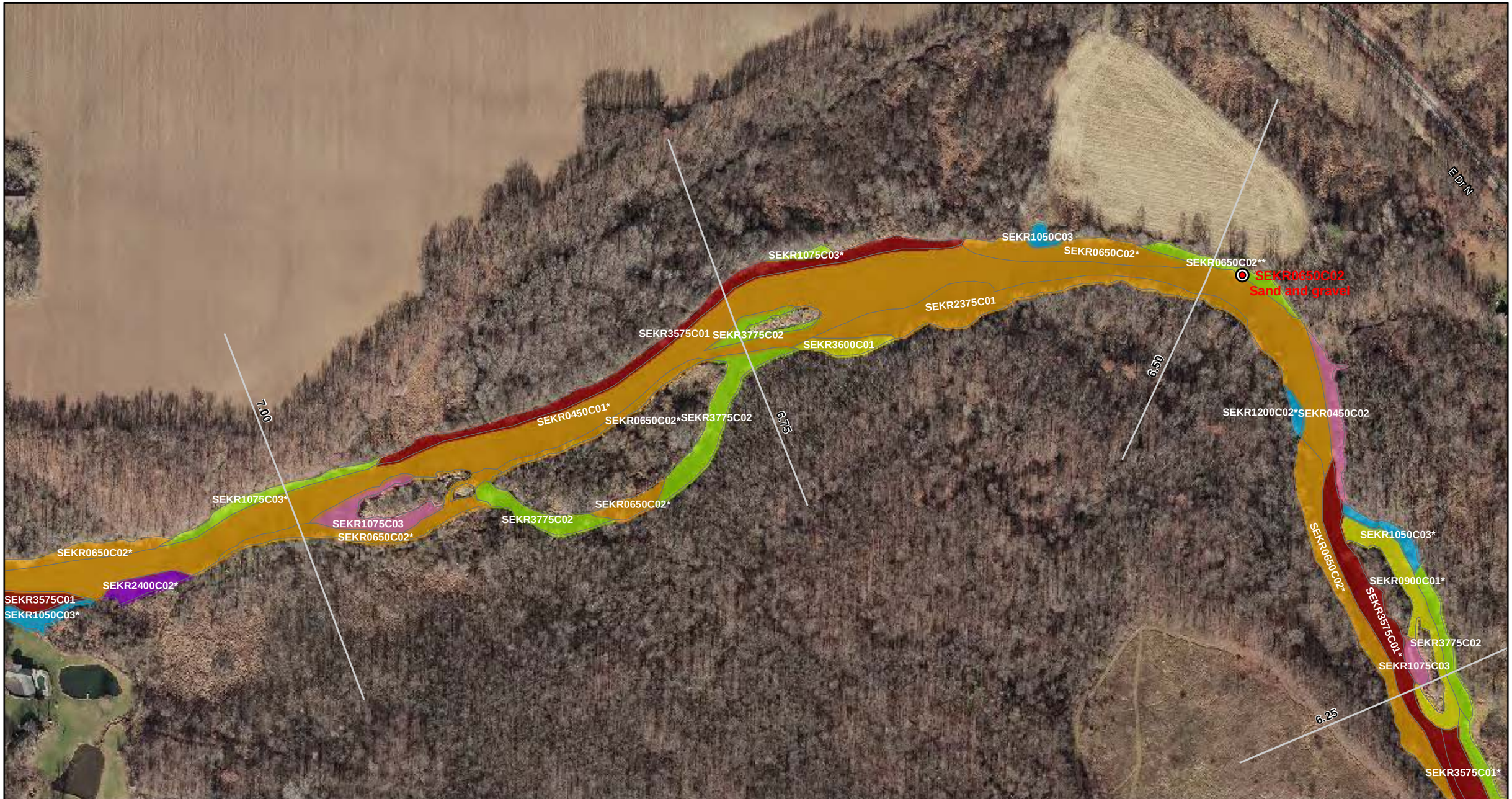
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
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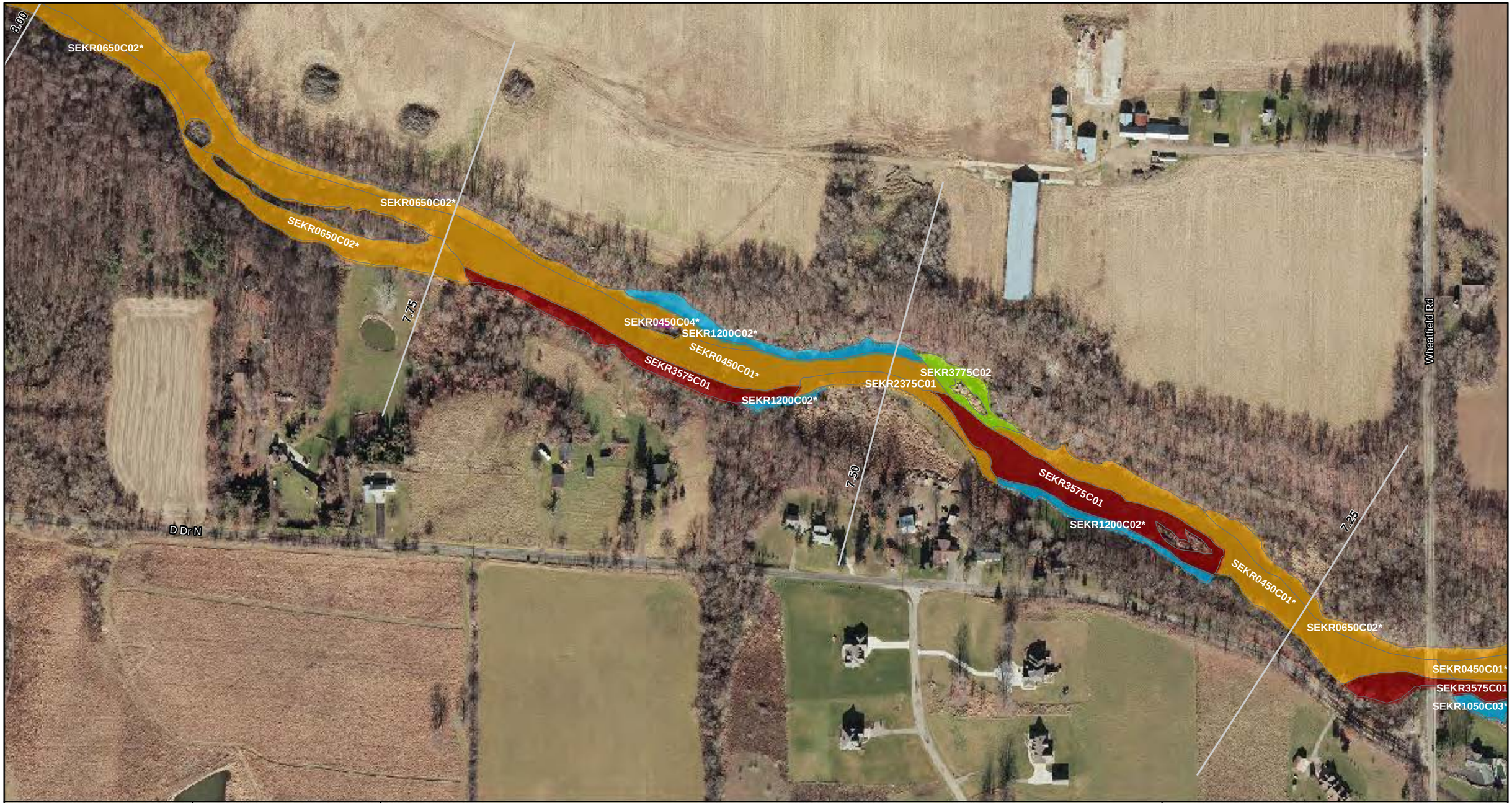
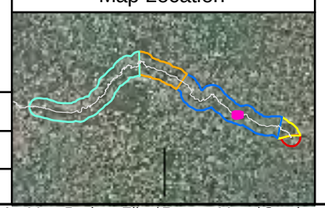
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 07.15 - MP 07.95

SHEET 8 OF 56

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Aerial Photography Date: November 2011

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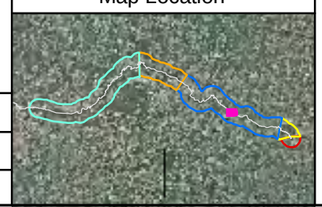
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons

- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500

Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
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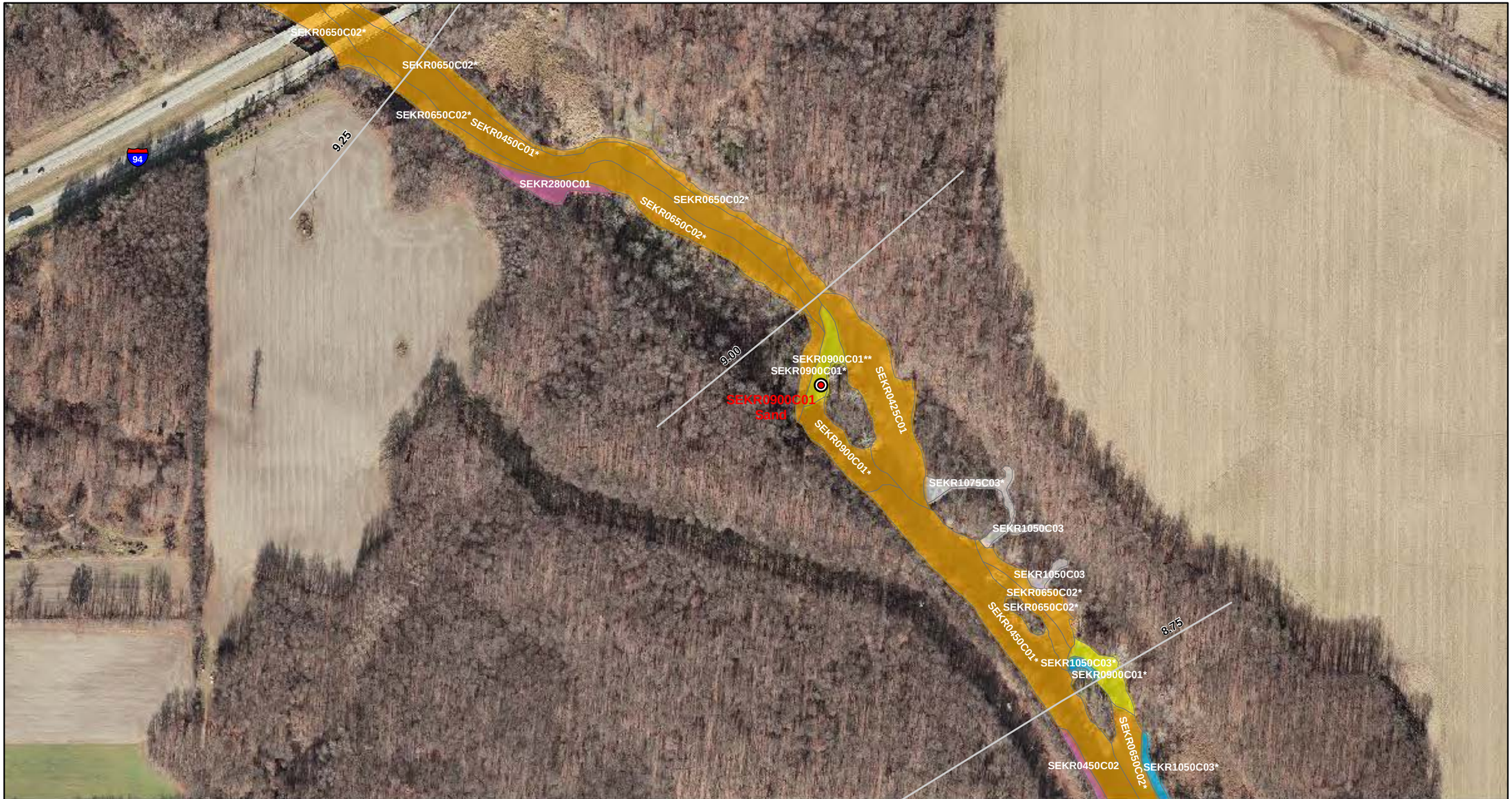
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
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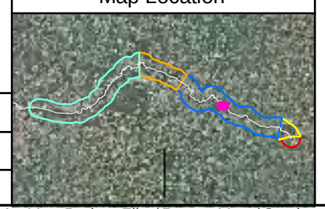
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
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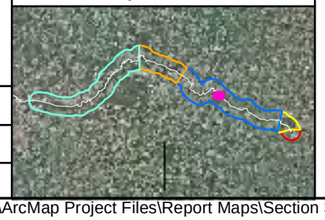
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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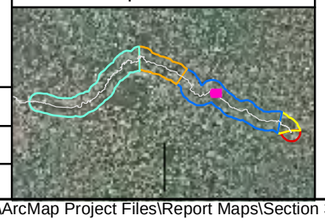
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
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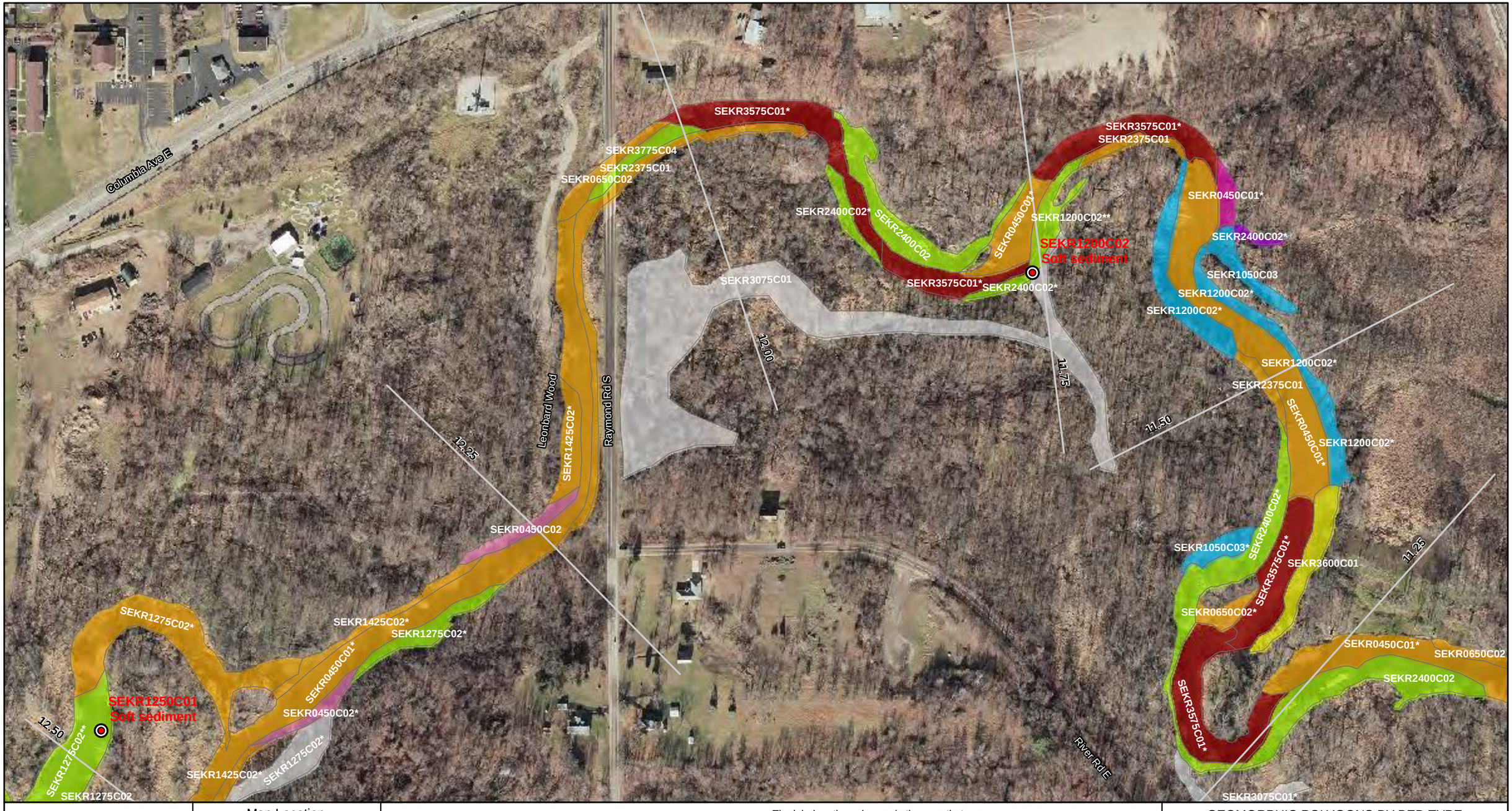
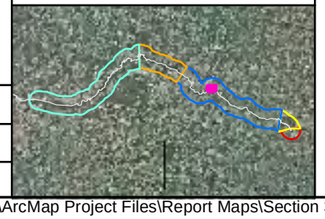
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 110.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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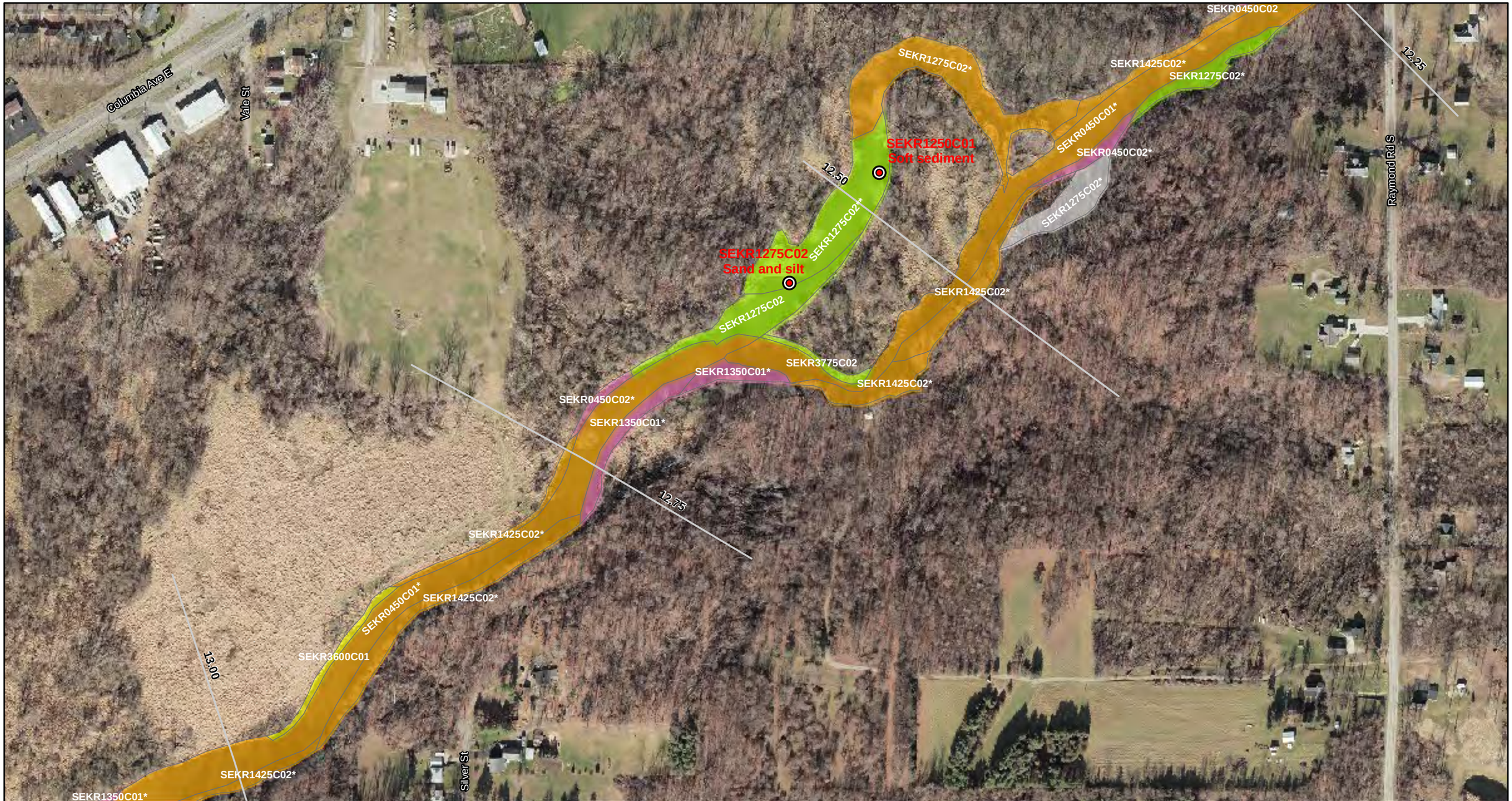
Aerial Photography Date: November 2011



Map Location

Legend

HDM Core

Geomorphic Polygons

- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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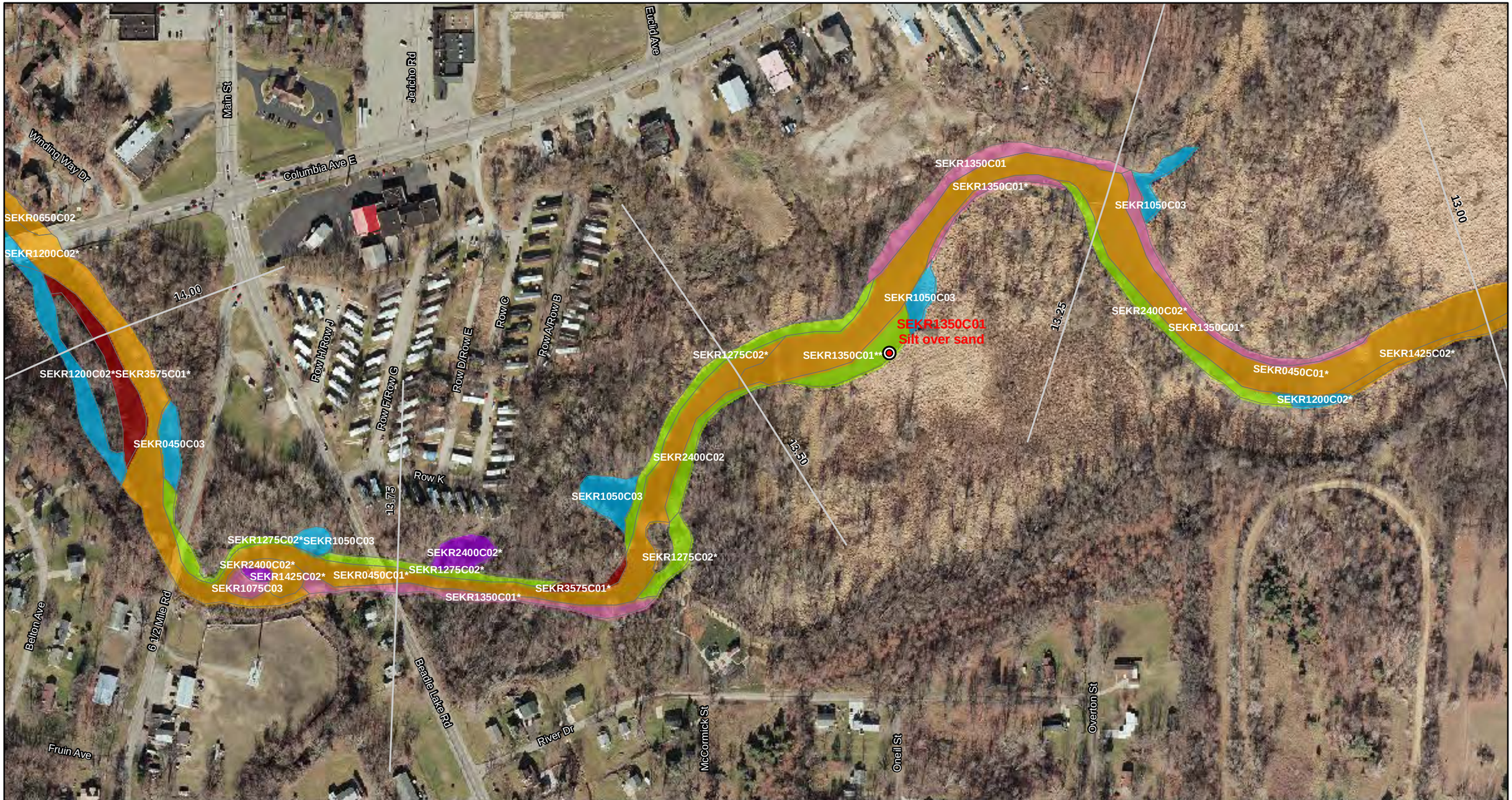
Aerial Photography Date: November 2011



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Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
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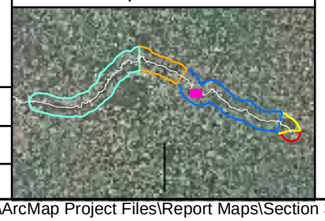
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core

Geomorphic Polygons

- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500

Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
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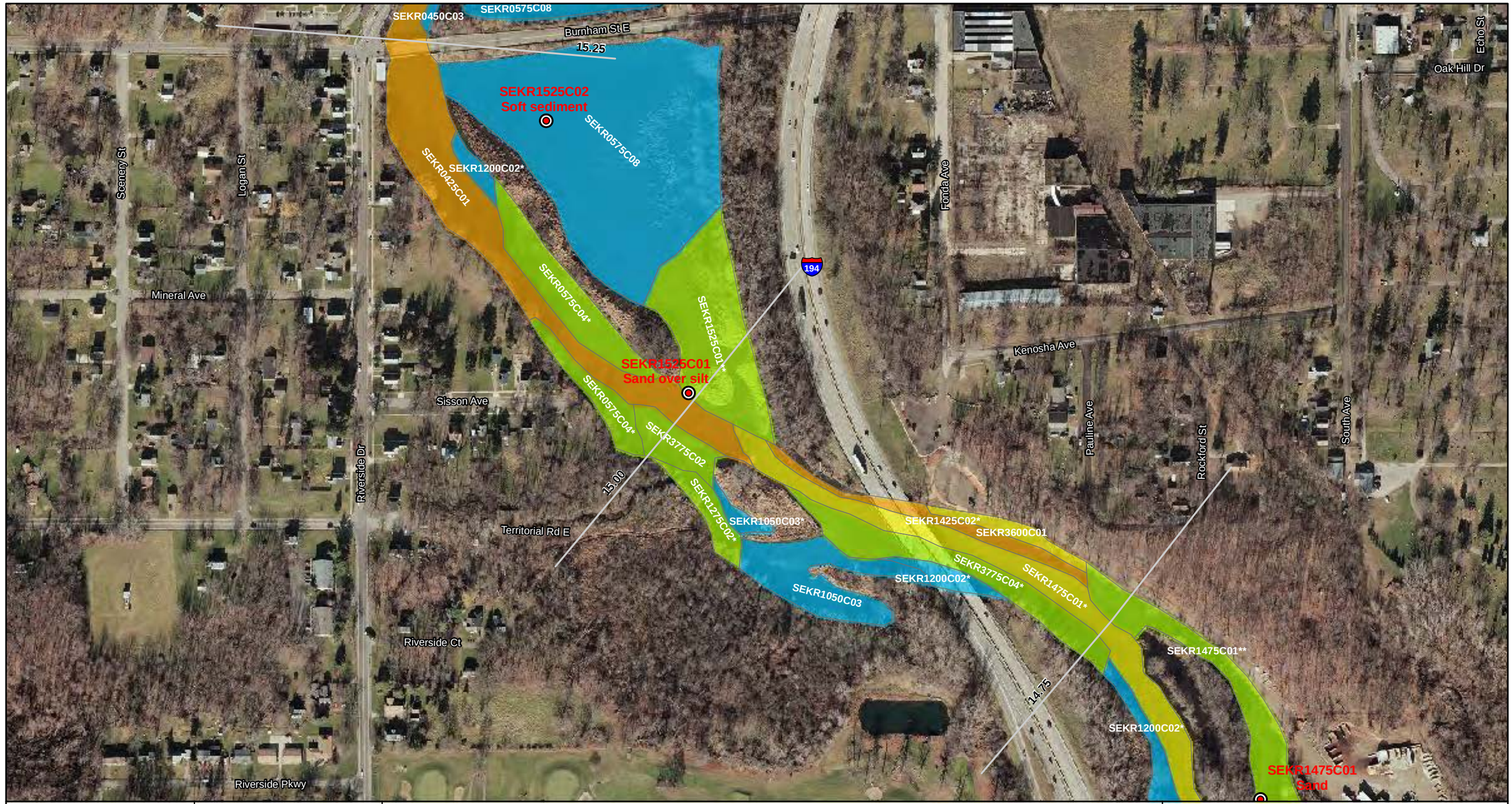
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 110.mxd

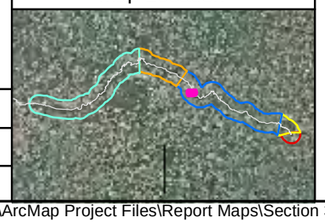
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
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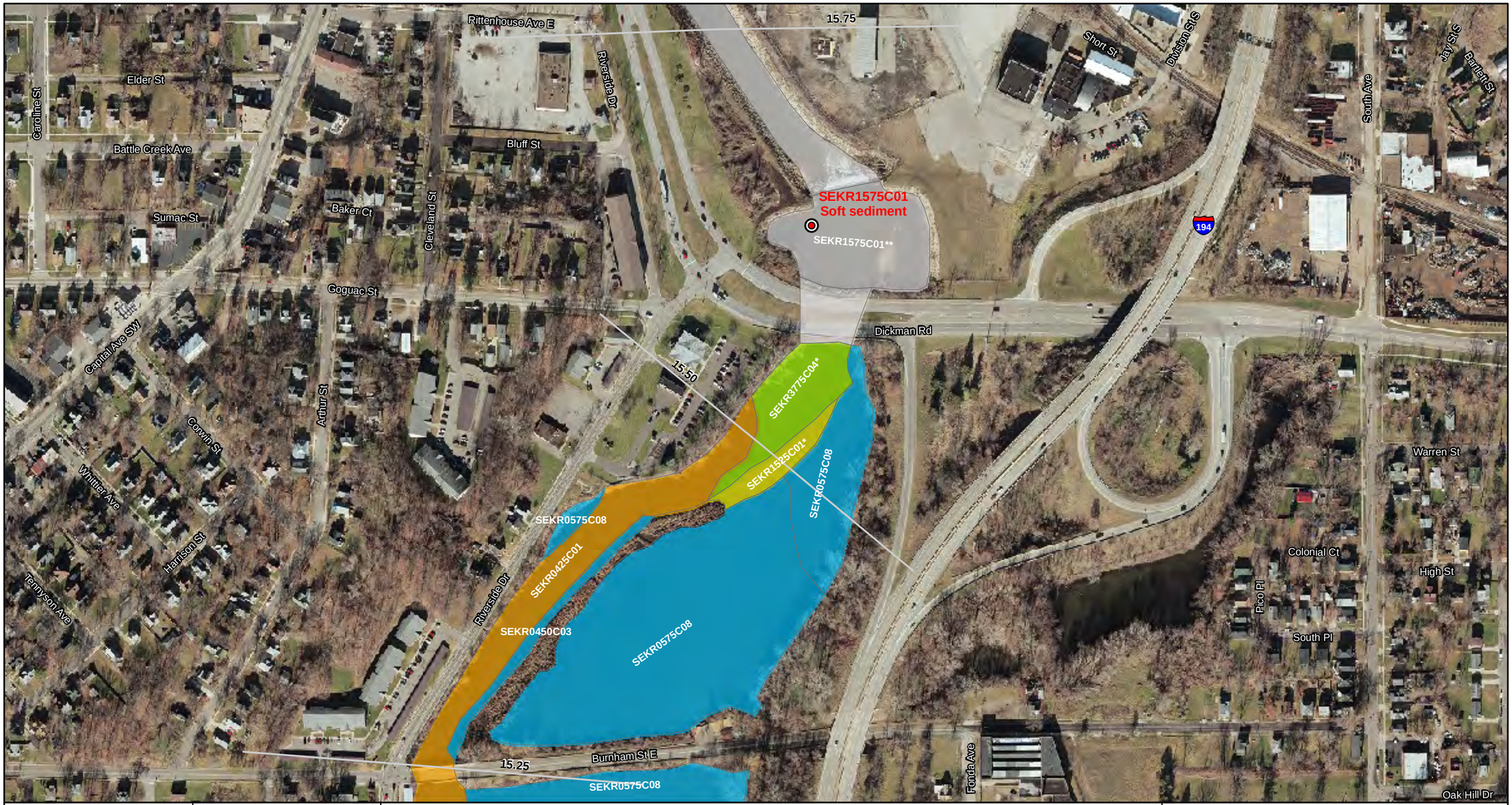
Aerial Photography Date: November 2011



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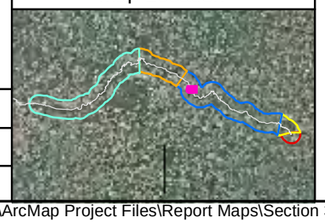
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons

- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500

Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
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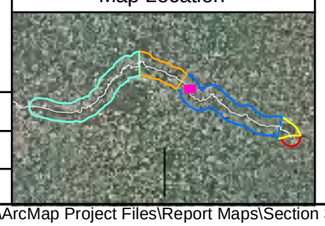
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

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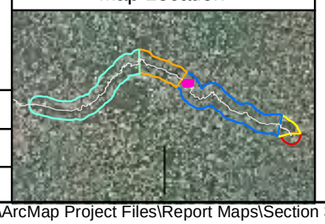
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
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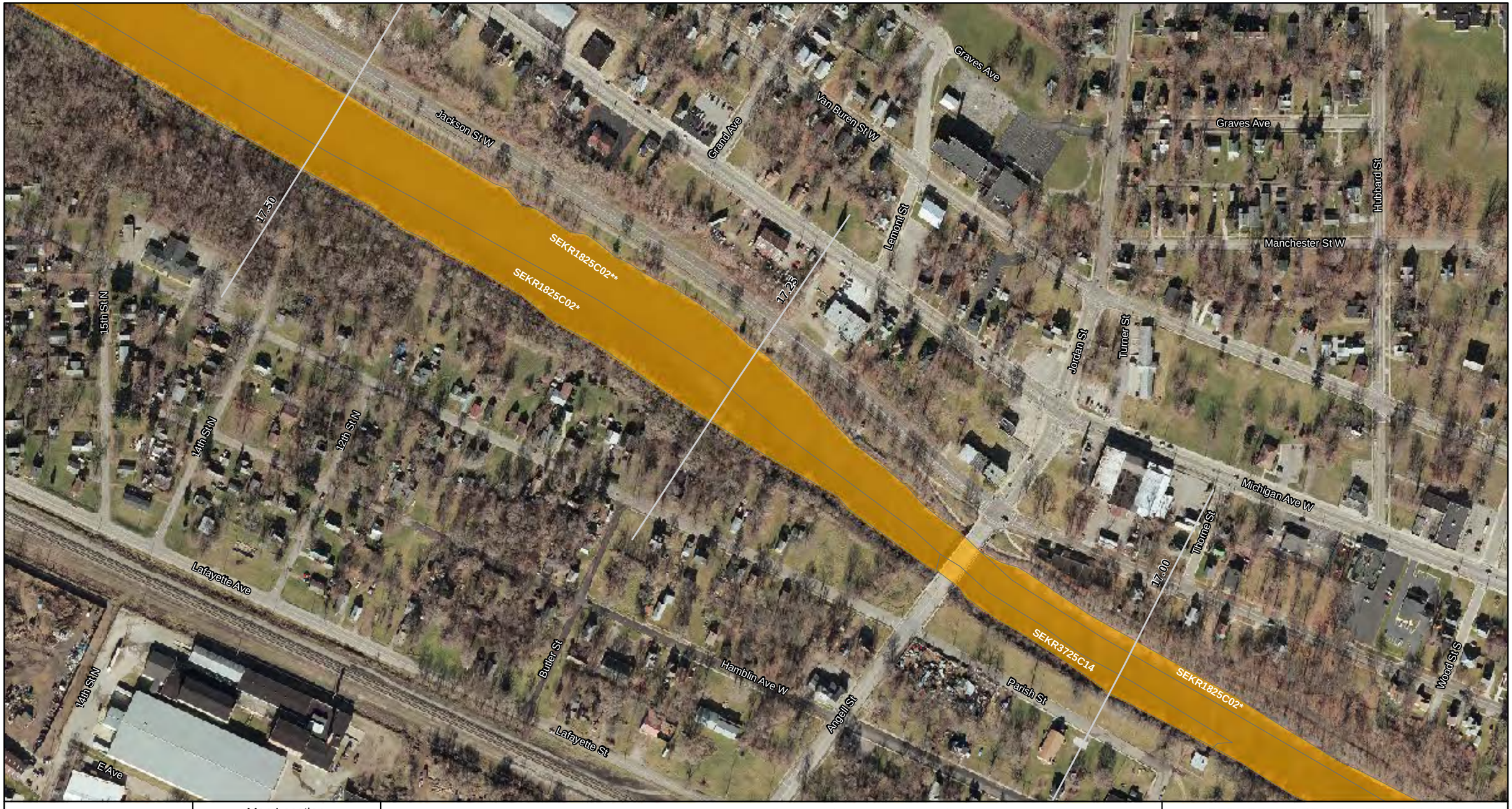
Aerial Photography Date: November 2011



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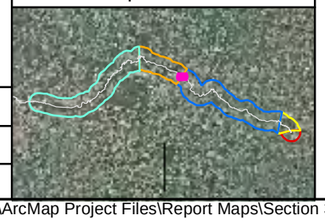
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500

Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
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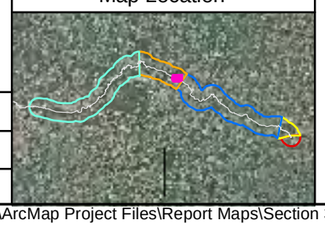
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
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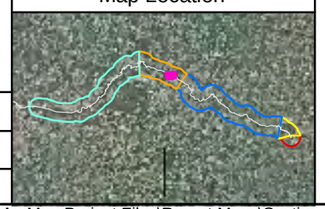
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
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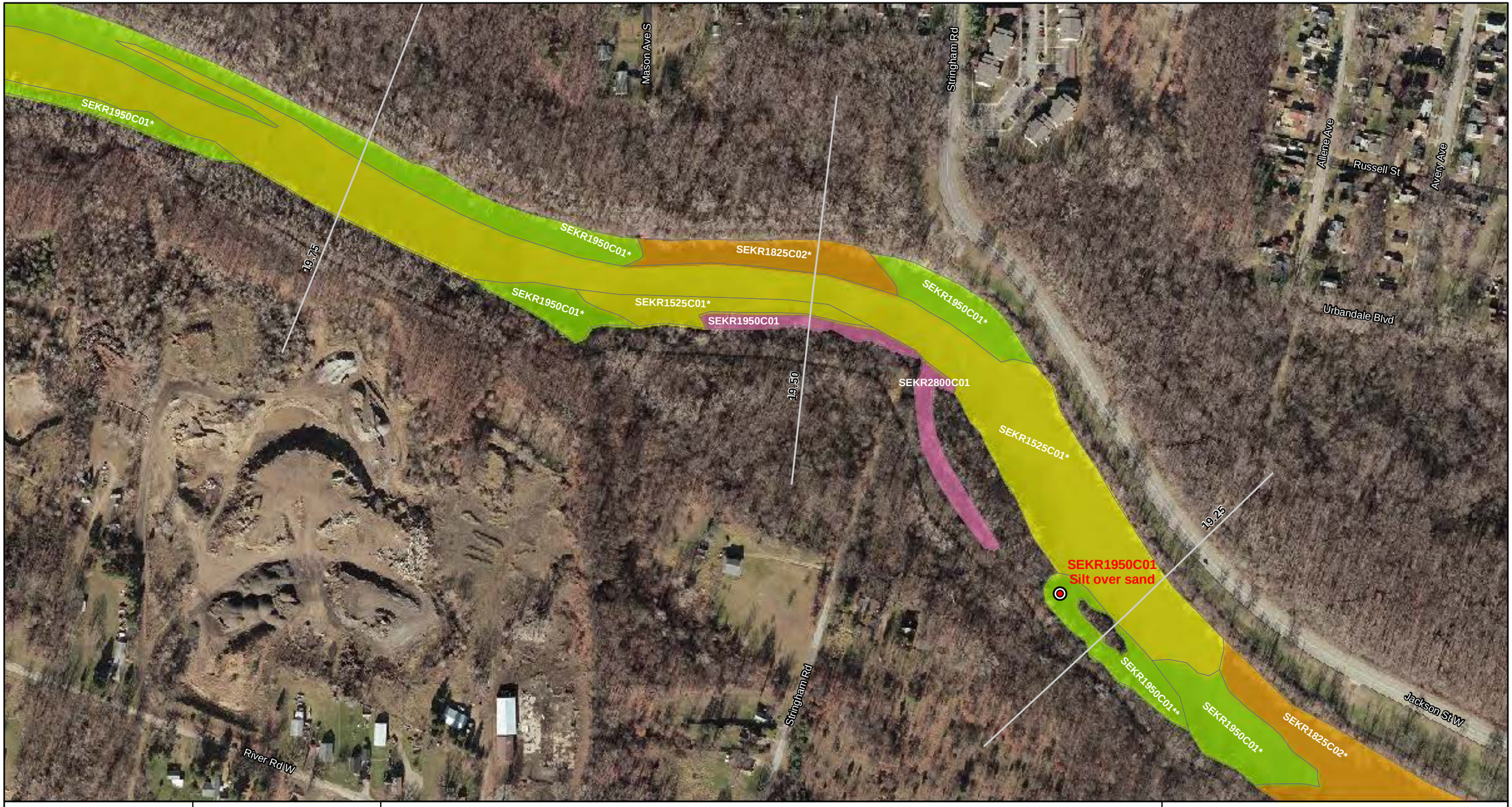
Aerial Photography Date: November 2011



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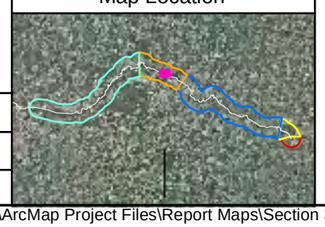
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
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  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
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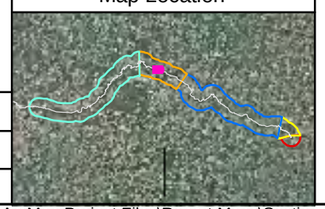
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
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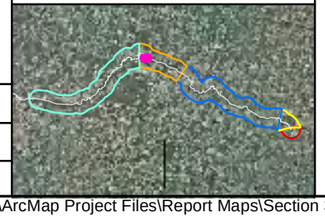
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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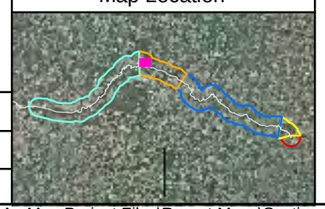
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

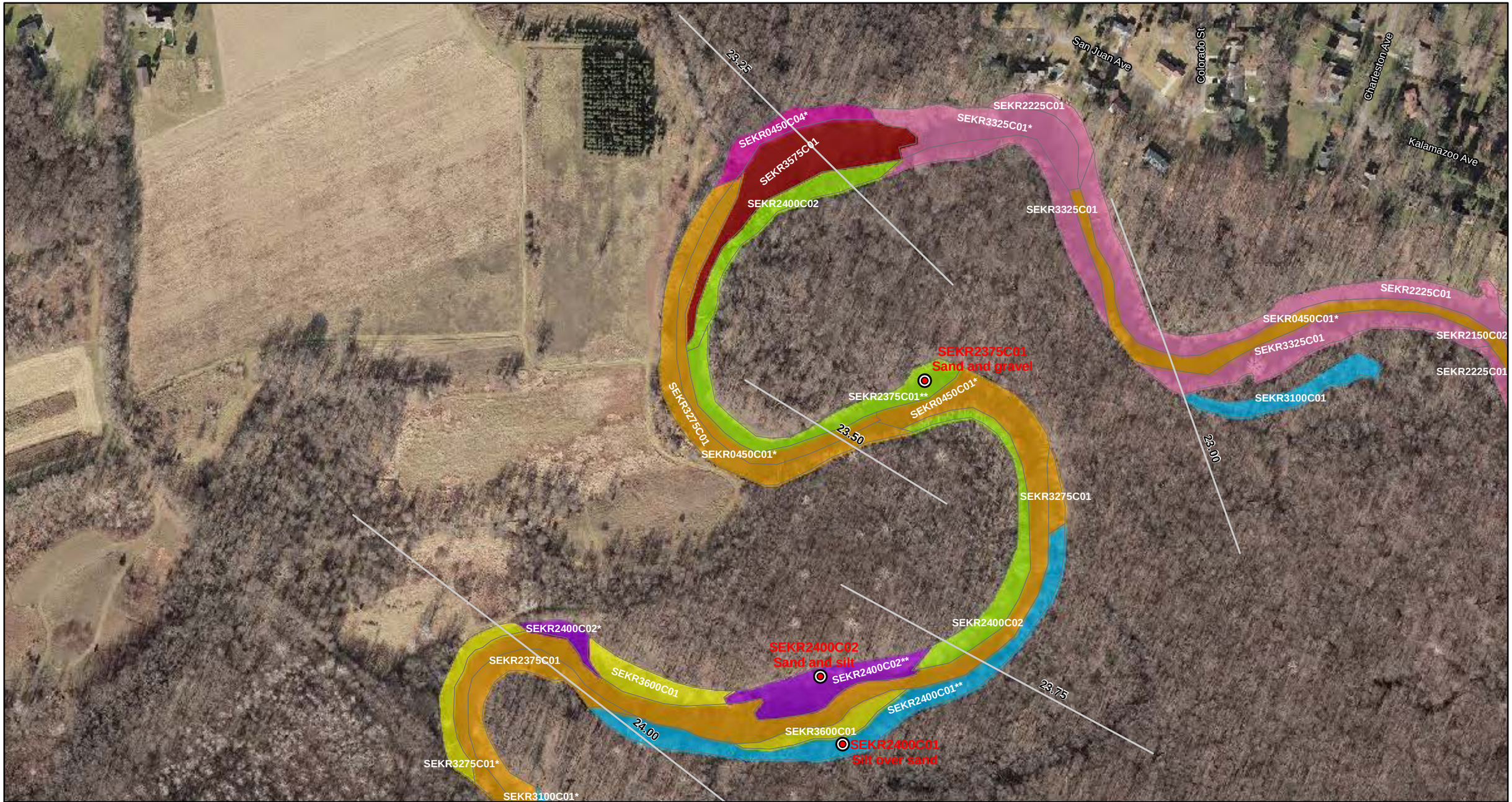
MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 110.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
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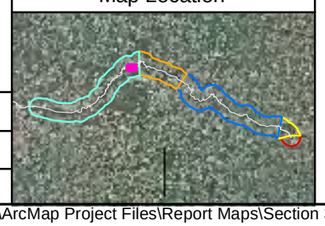
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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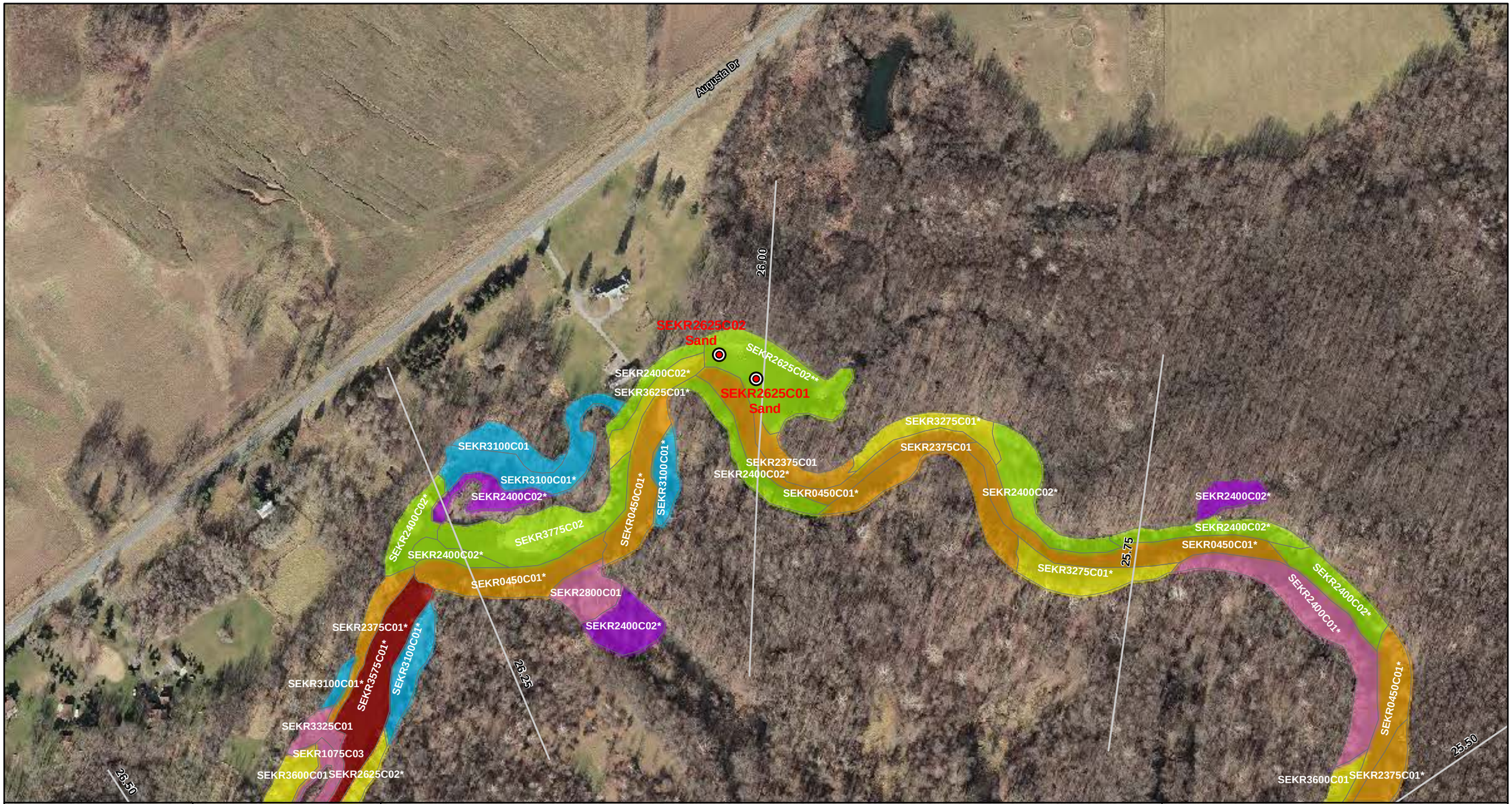
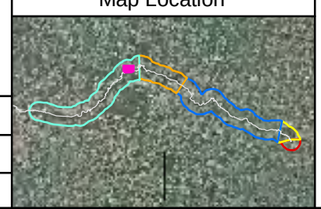
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
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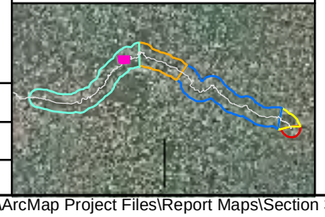
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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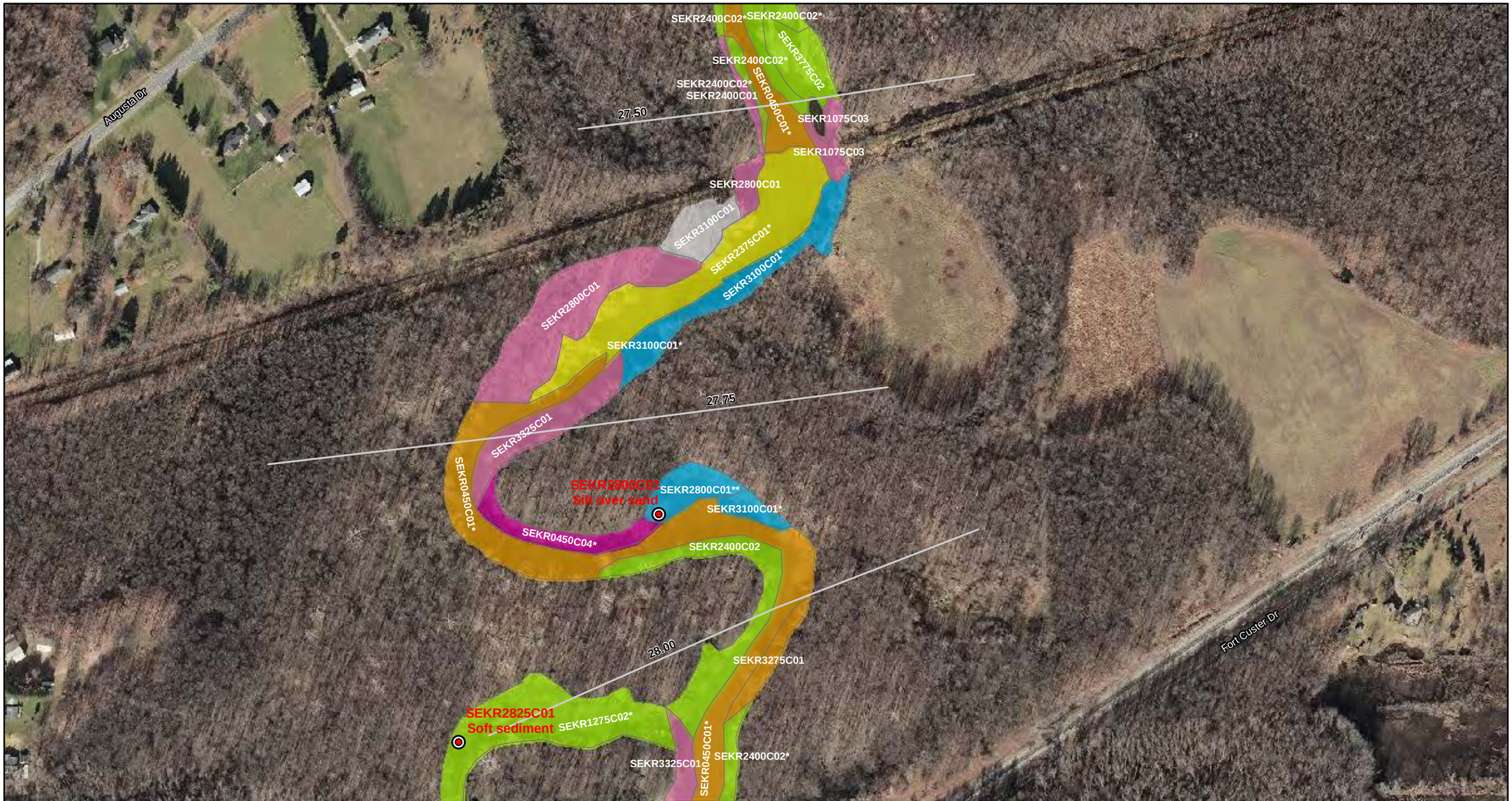
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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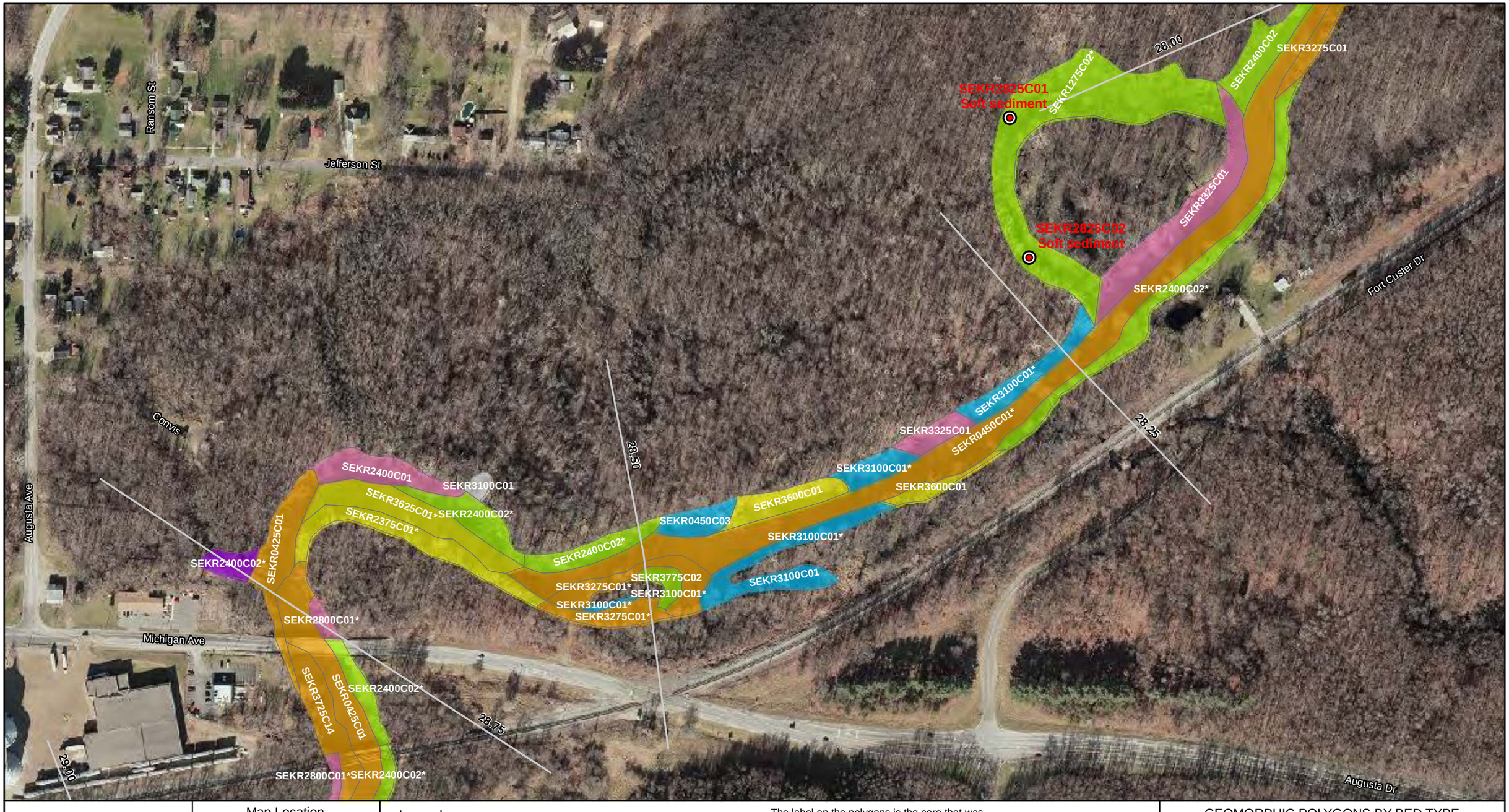
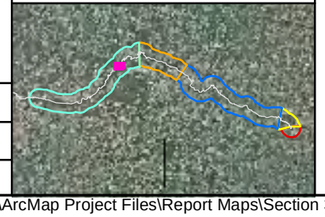
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
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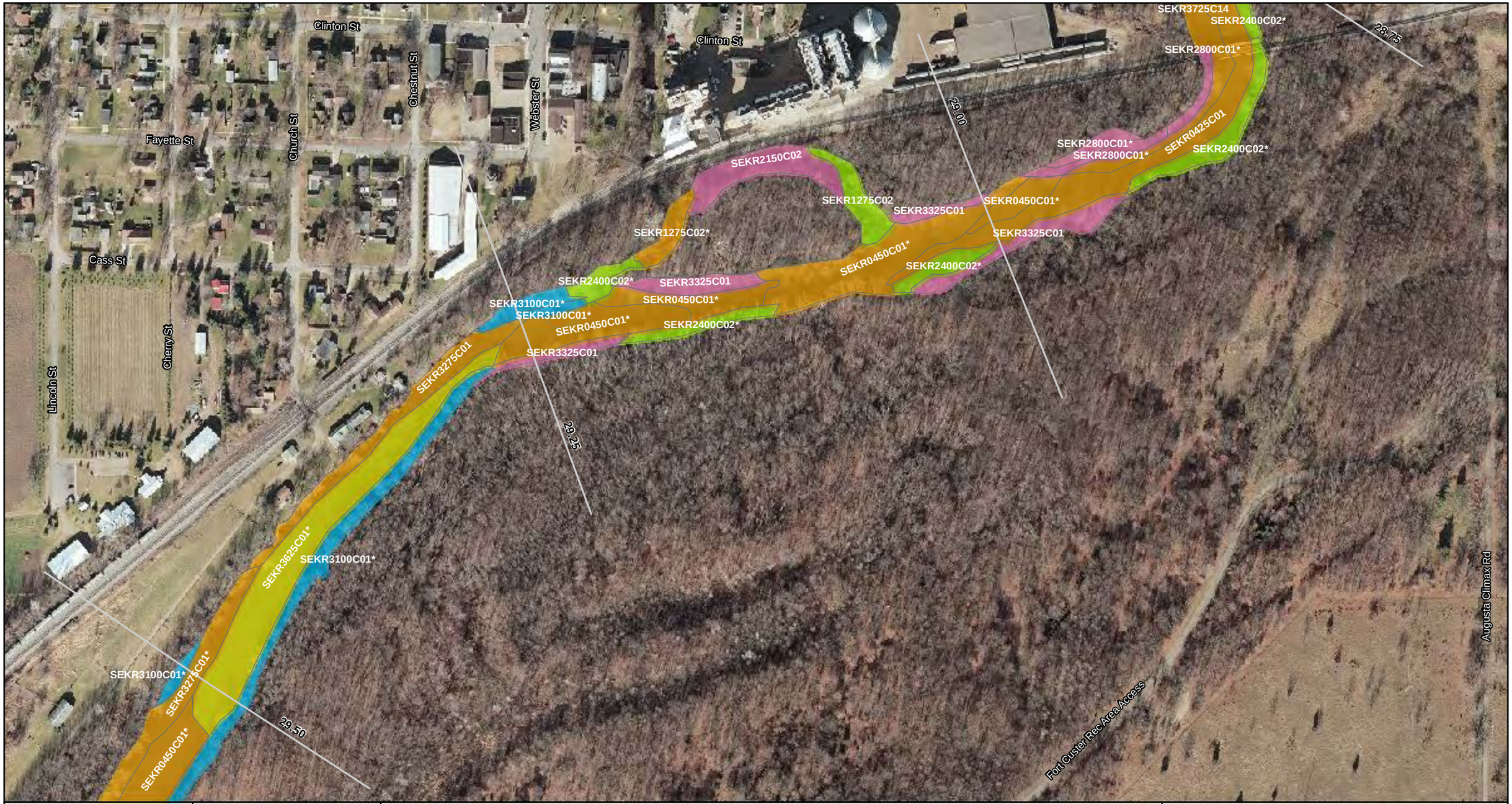
Aerial Photography Date: November 2011



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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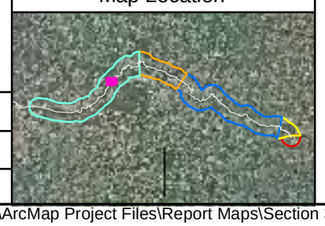
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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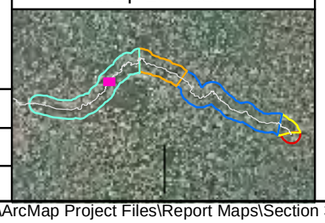
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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N

0 125 250 500

Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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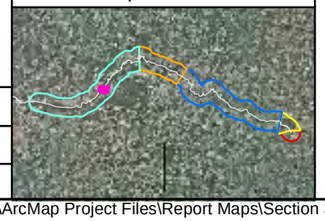
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 31.65 - MP 32.25

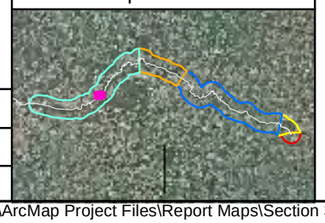
SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 110.mxd

Aerial Photography Date: November 2011

Map Location



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Legend

HDM Core

Geomorphic Polygons

- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500

Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

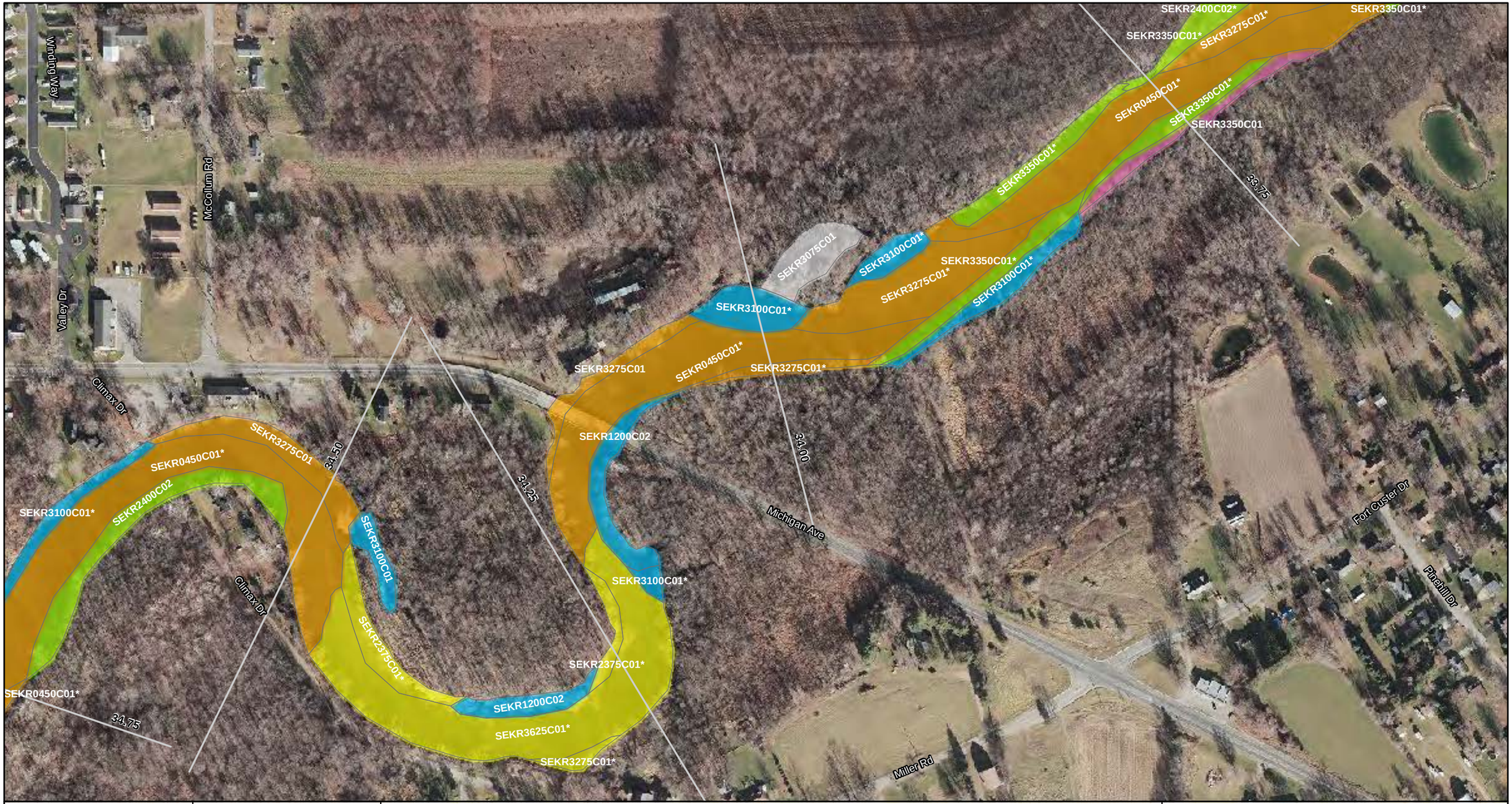
MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 110.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

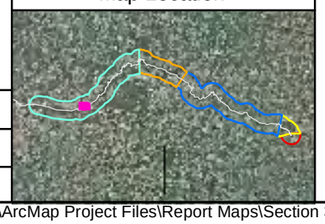
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 110.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
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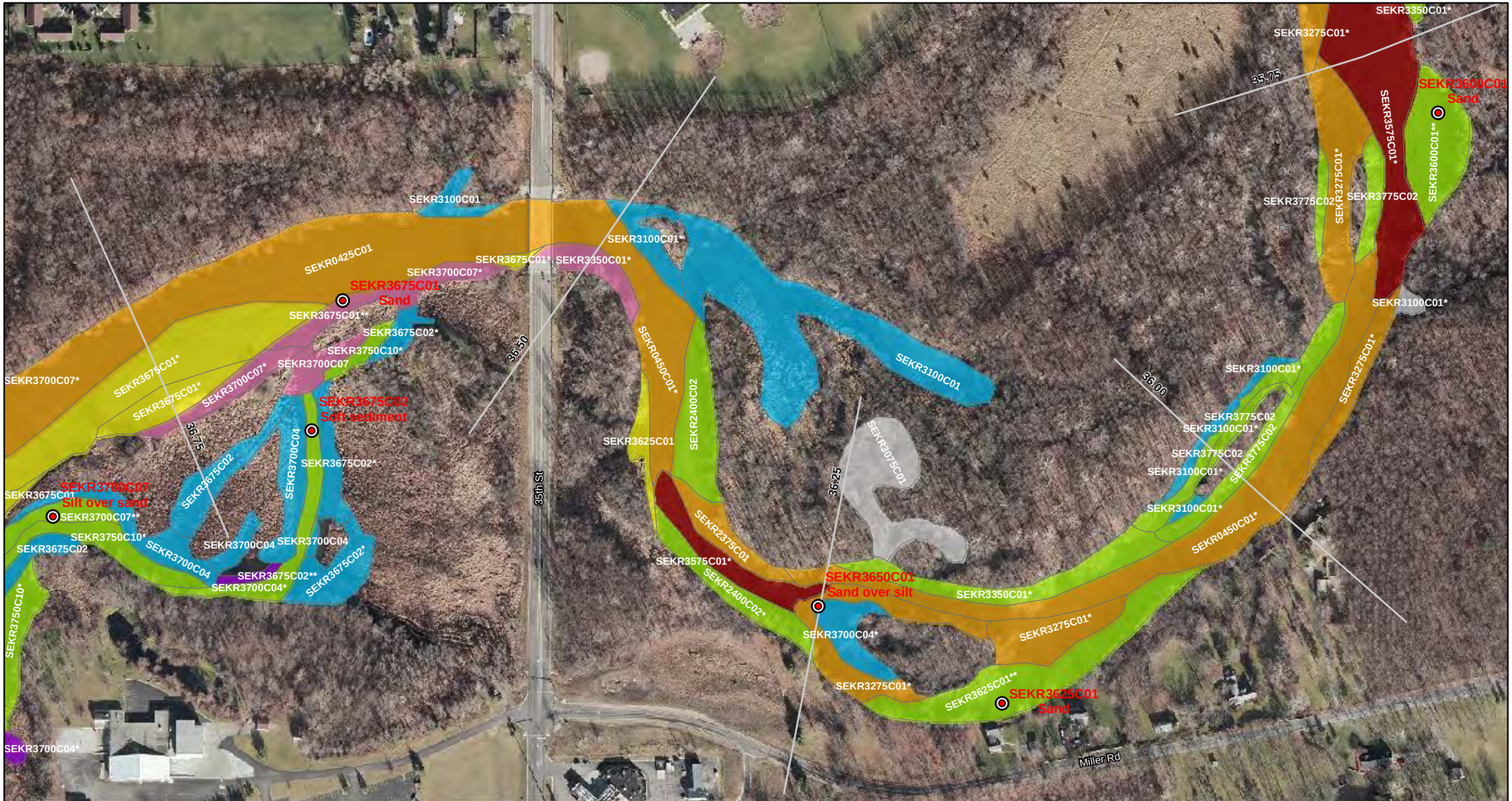
Aerial Photography Date: November 2011



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Project #:	106-4186

Map Location

Legend

- HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
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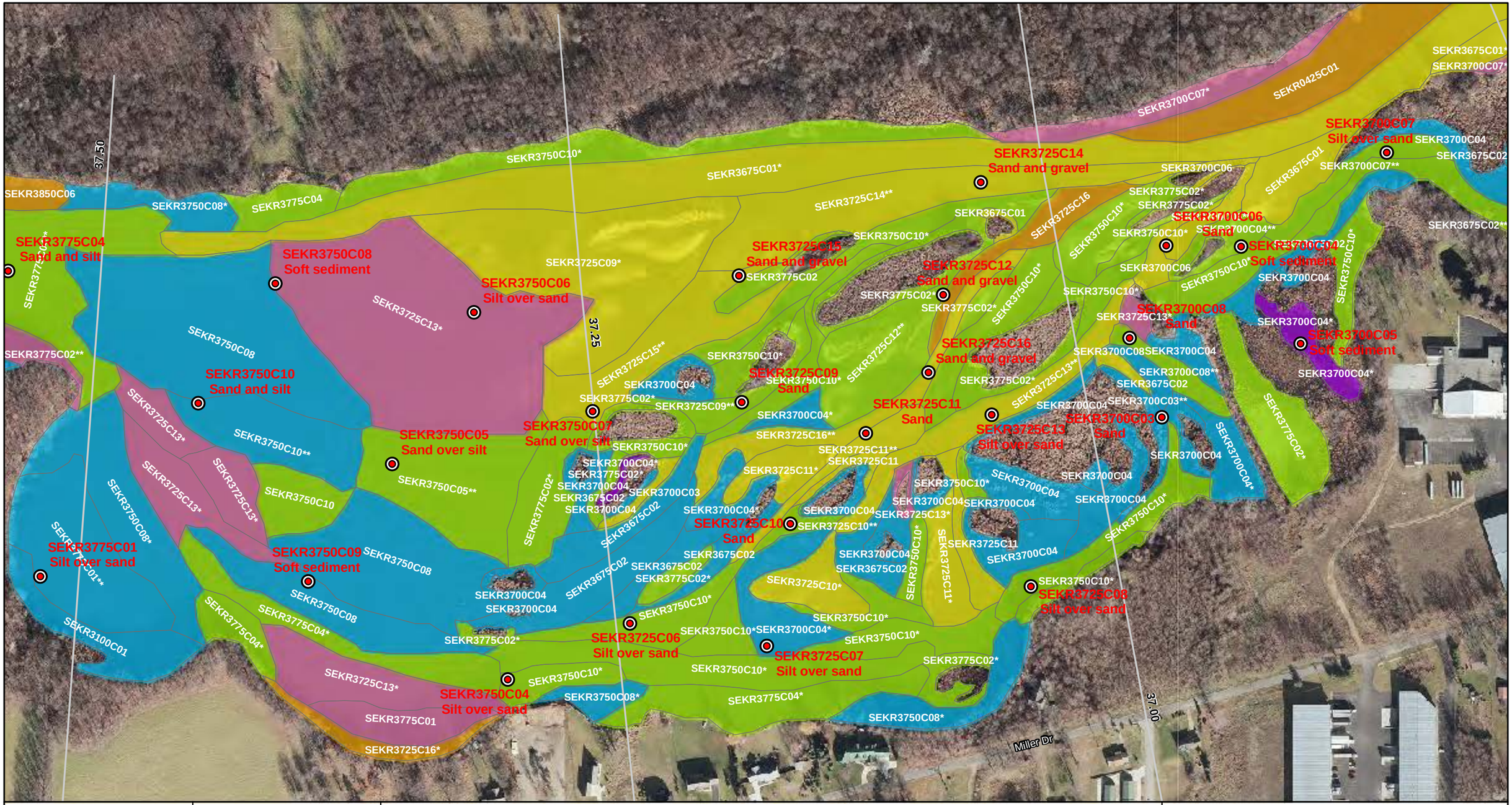
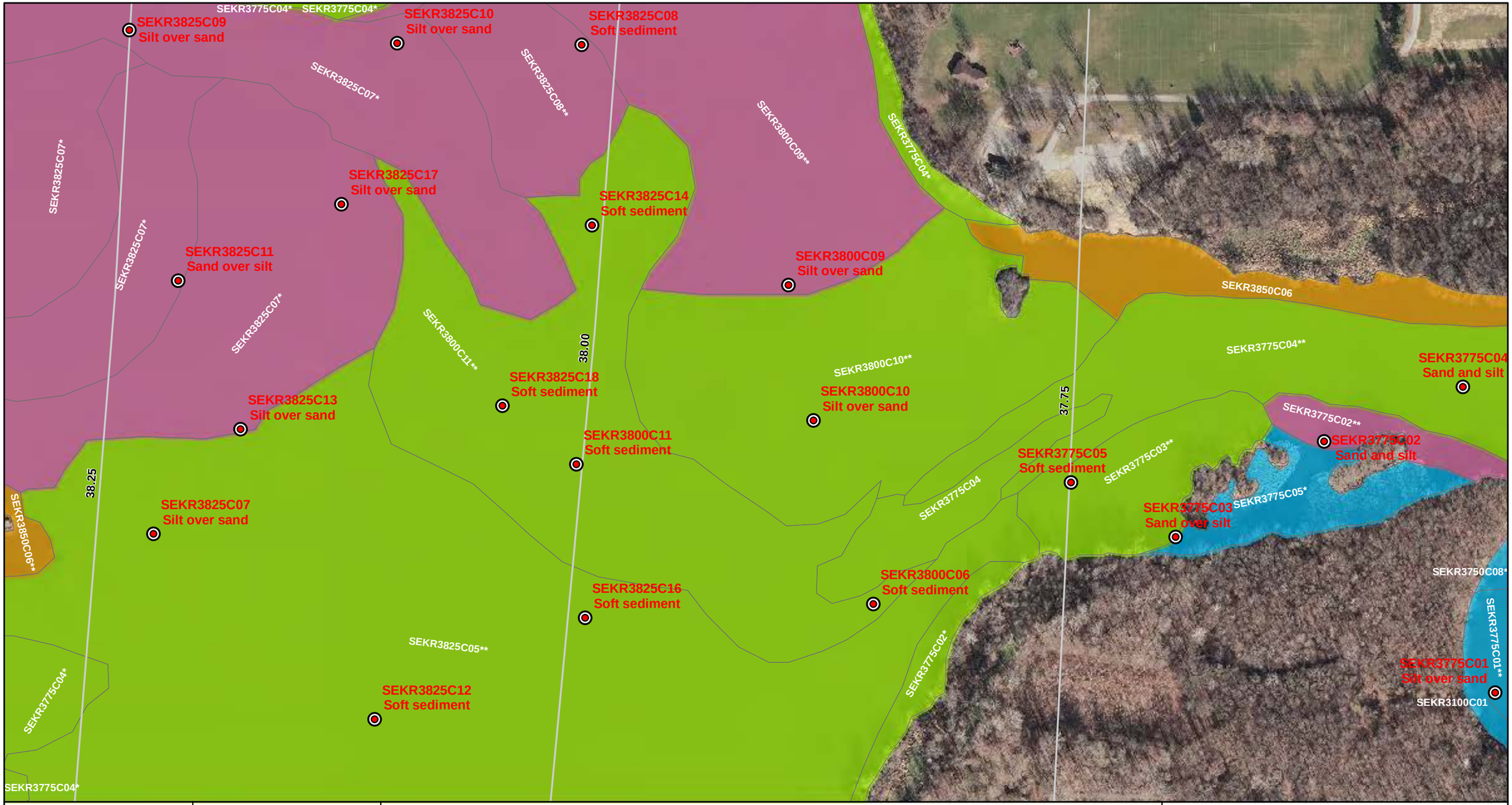
Aerial Photography Date: November 2011


37.50
37.25
37.00
Miller Dr
SEKR3775C04
Sand and silt
SEKR3750C08
Soft sediment
SEKR3750C06
Silt over sand
SEKR3750C10
Sand and silt
SEKR3750C05
Sand over silt
SEKR3750C07
Sand over silt
SEKR3775C01
Silt over sand
SEKR3750C09
Soft sediment
SEKR3750C04
Silt over sand
SEKR3725C14
Sand and gravel
SEKR3725C15
Sand and gravel
SEKR3725C12
Sand and gravel
SEKR3725C16
Sand and gravel
SEKR3725C09
Sand
SEKR3725C11
Sand
SEKR3725C13
Silt over sand
SEKR3725C10
Sand
SEKR3725C06
Silt over sand
SEKR3725C07
Silt over sand
SEKR3725C08
Silt over sand
SEKR3700C07
Silt over sand
SEKR3700C06
Sand
SEKR3700C04
Soft sediment
SEKR3700C08
Sand
SEKR3700C05
Soft sediment
SEKR3700C03
Sand
SEKR3850C06
SEKR3750C08*
SEKR3775C04
SEKR3675C01*
SEKR3750C10*
SEKR3725C14**
SEKR3675C01
SEKR3725C16
SEKR3750C10*
SEKR3775C02*
SEKR3775C02*
SEKR3775C02*
SEKR3700C06
SEKR3675C01
SEKR0425C01
SEKR3700C07*
SEKR3675C01*
SEKR3700C07
SEKR3700C04
SEKR3675C02
SEKR3700C07**
SEKR3675C02**
SEKR3700C04**
SEKR3700C02
SEKR3750C10*
SEKR3700C04
SEKR3700C04*
SEKR3700C08
SEKR3700C04
SEKR3700C08**
SEKR3675C02
SEKR3700C03**
SEKR3700C04
SEKR3700C04*
SEKR3775C02*
SEKR3725C13*
SEKR3750C10**
SEKR3725C13*
SEKR3725C13*
SEKR3750C08*
SEKR3750C10
SEKR3750C05**
SEKR3775C02*
SEKR3700C04
SEKR3675C02
SEKR3700C04
SEKR3700C03
SEKR3675C02
SEKR3700C04*
SEKR3725C10**
SEKR3675C02
SEKR3675C02
SEKR3675C02
SEKR3775C02*
SEKR3700C04
SEKR3700C04
SEKR3725C10*
SEKR3750C10*
SEKR3725C11*
SEKR3700C04
SEKR3675C02
SEKR3725C11*
SEKR3750C10*
SEKR3750C10*
SEKR3750C08
SEKR3775C01**
SEKR3750C08
SEKR3750C08
SEKR3775C04*
SEKR3100C01
SEKR3775C04*
SEKR3725C13*
SEKR3775C01
SEKR3725C16*
SEKR3775C02*
SEKR3750C10*
SEKR3750C08*
SEKR3750C10*
SEKR3750C10*
SEKR3750C10*
SEKR3700C04*
SEKR3750C10*
SEKR3750C10*
SEKR3775C02*
SEKR3775C04*
SEKR3750C08*
SEKR3750C08*
SEKR3725C10*
SEKR3725C11*
SEKR3750C10*
SEKR3725C08
Silt over sand
SEKR3775C02*
SEKR3775C02*
SEKR3775C02*



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Drawn:	BRS 3/29/2012
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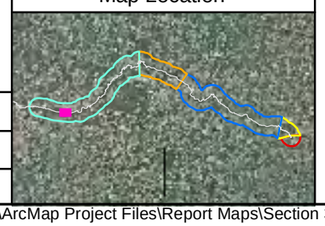
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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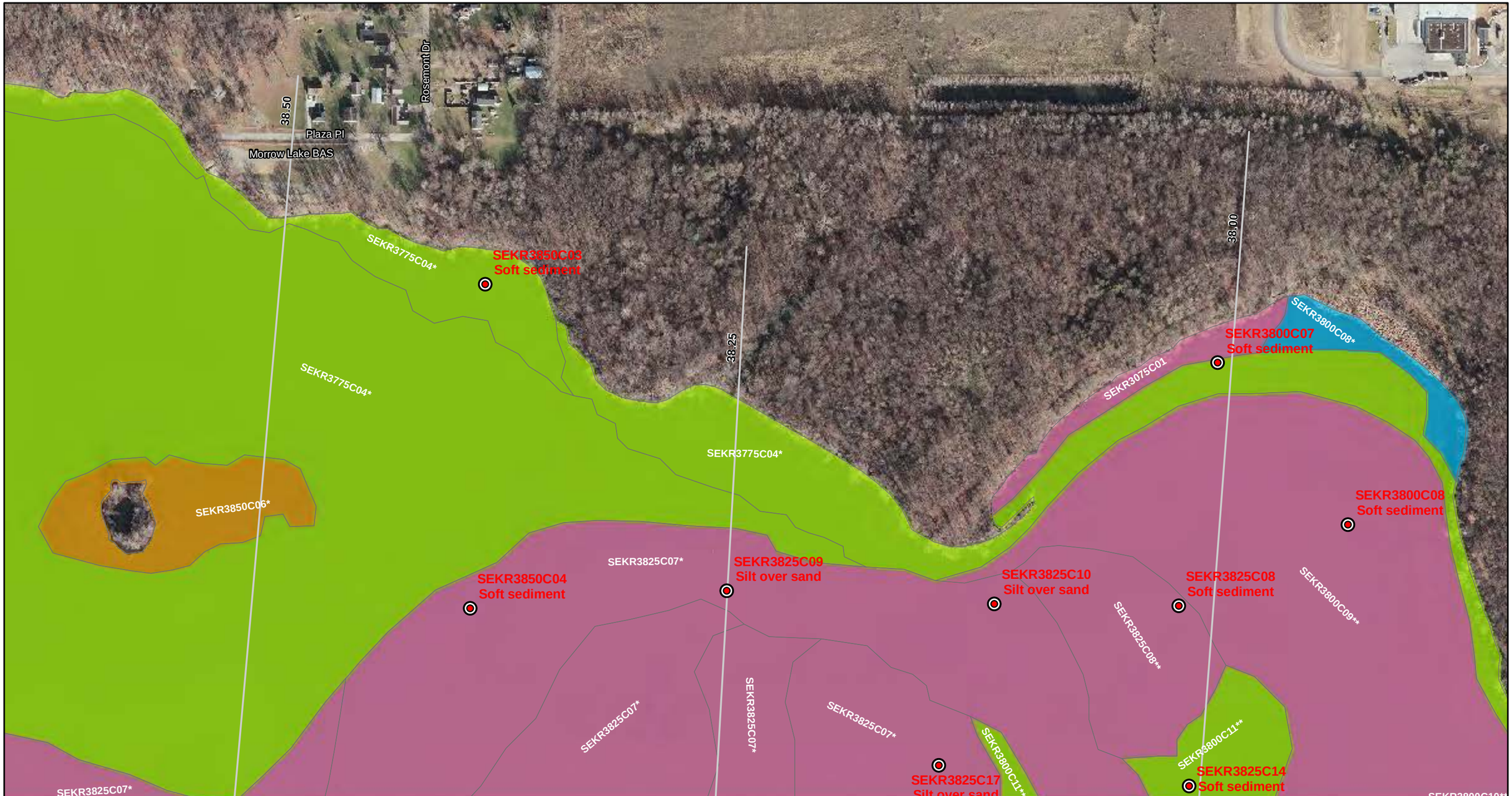
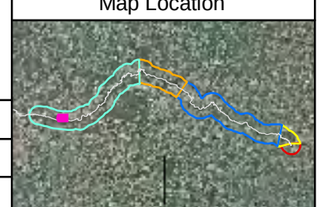
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core

Geomorphic Polygons

- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown
- Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
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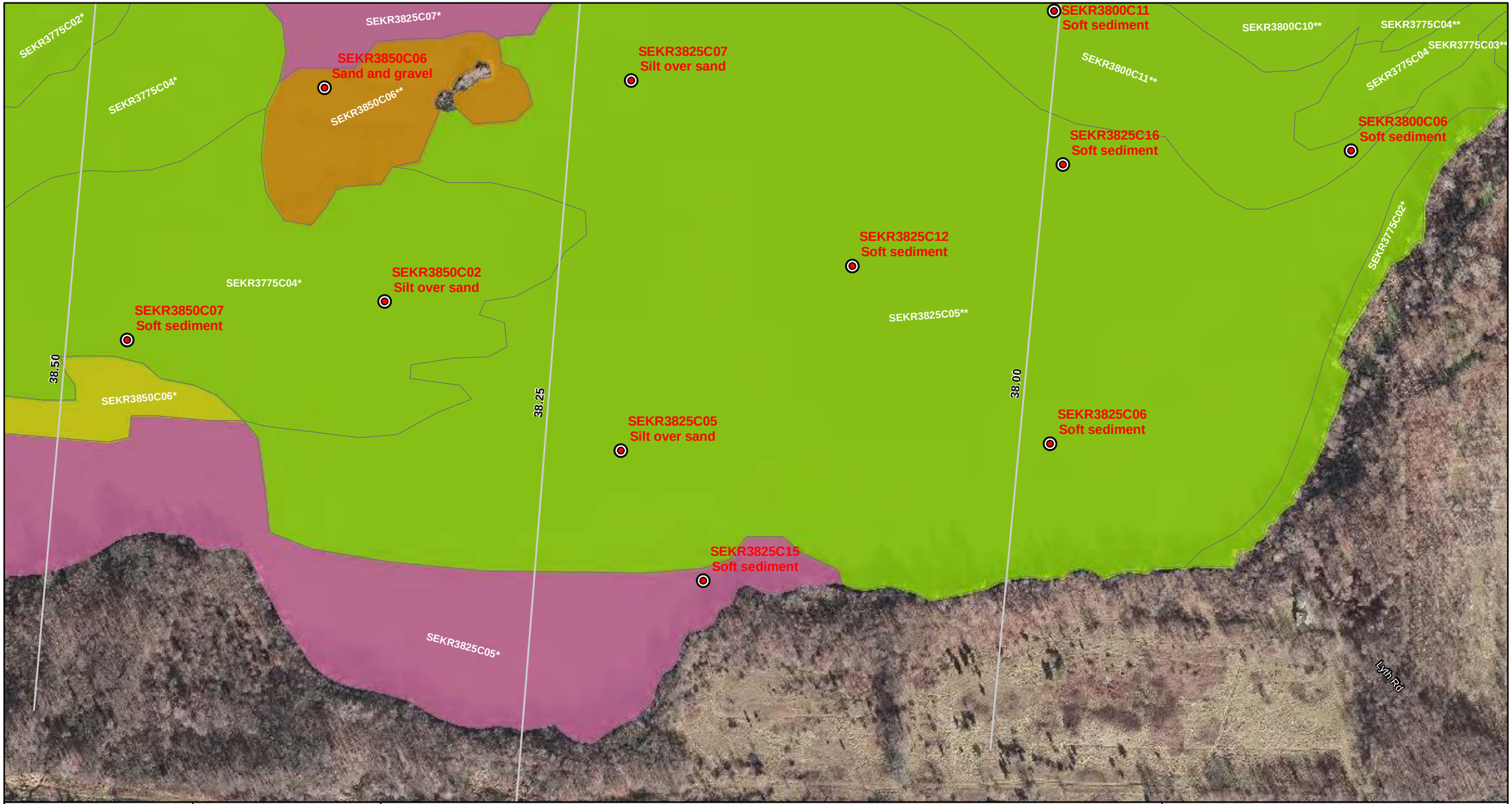
Aerial Photography Date: November 2011



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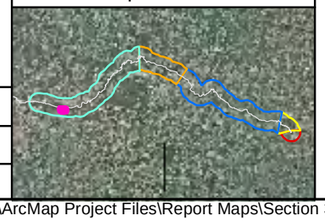
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

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Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
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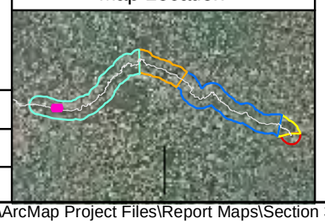
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

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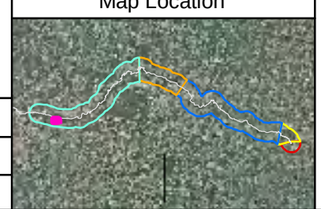
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons

- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500

Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

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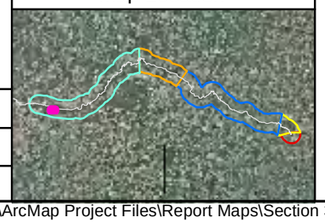
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
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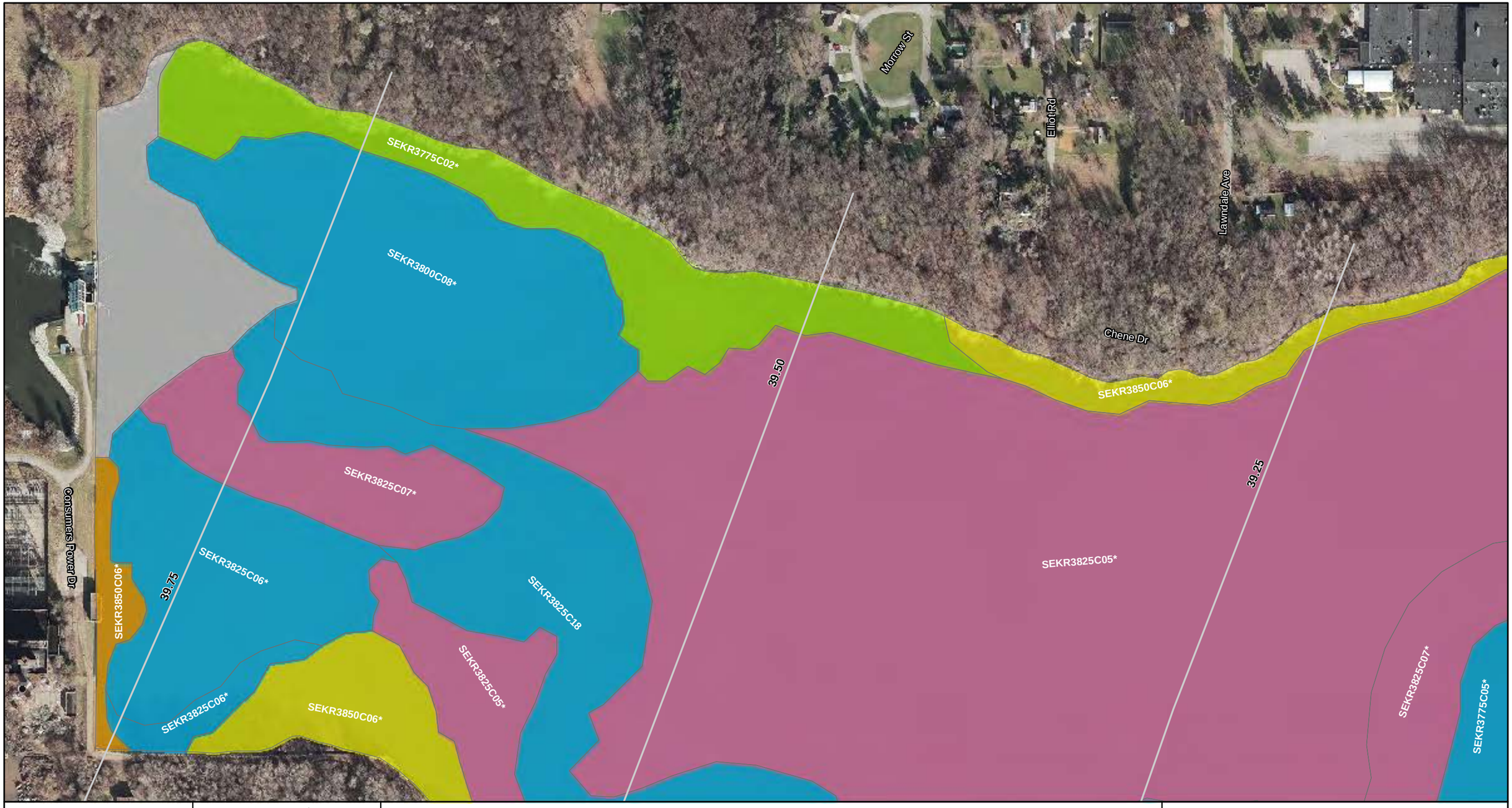
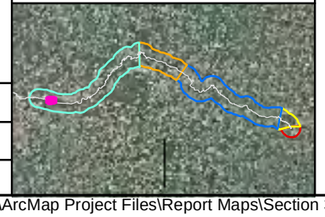


ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (ALL 110 CORES USED)

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
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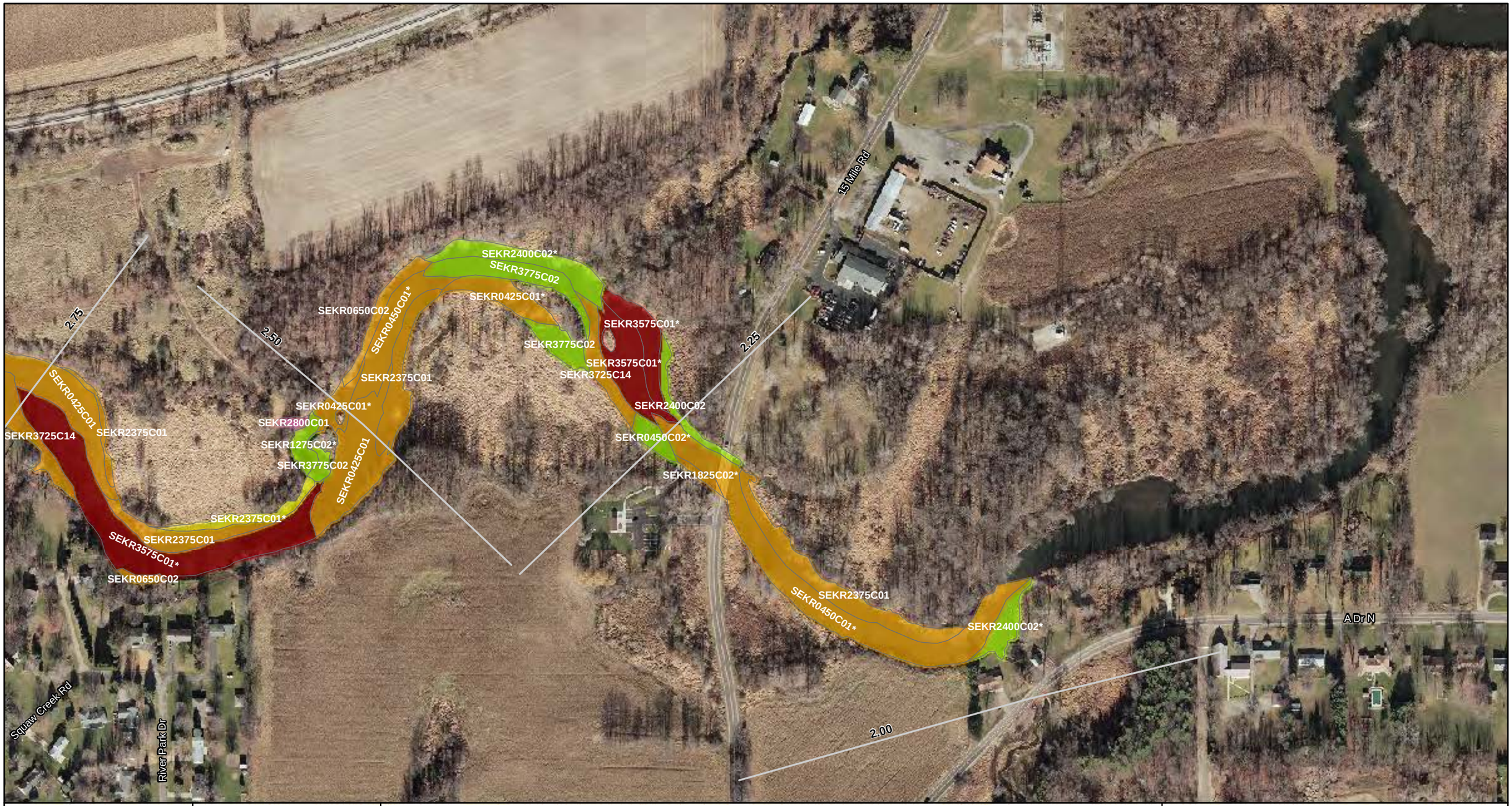
Aerial Photography Date: November 2011

Figure 3-15

Geomorphic Polygons By Bed Type With Assigned Cores (78 Core Subset Used)

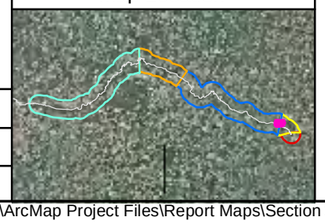
Sheets 1 through 56



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
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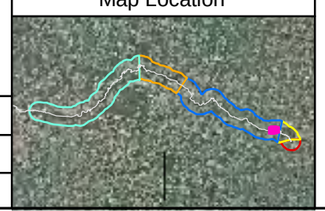
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
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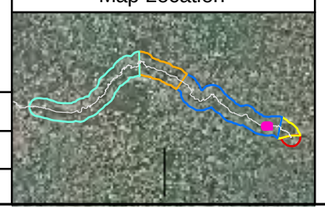
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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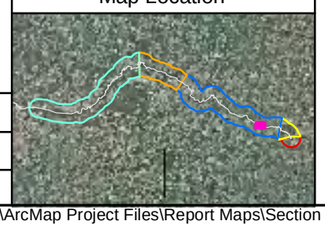
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

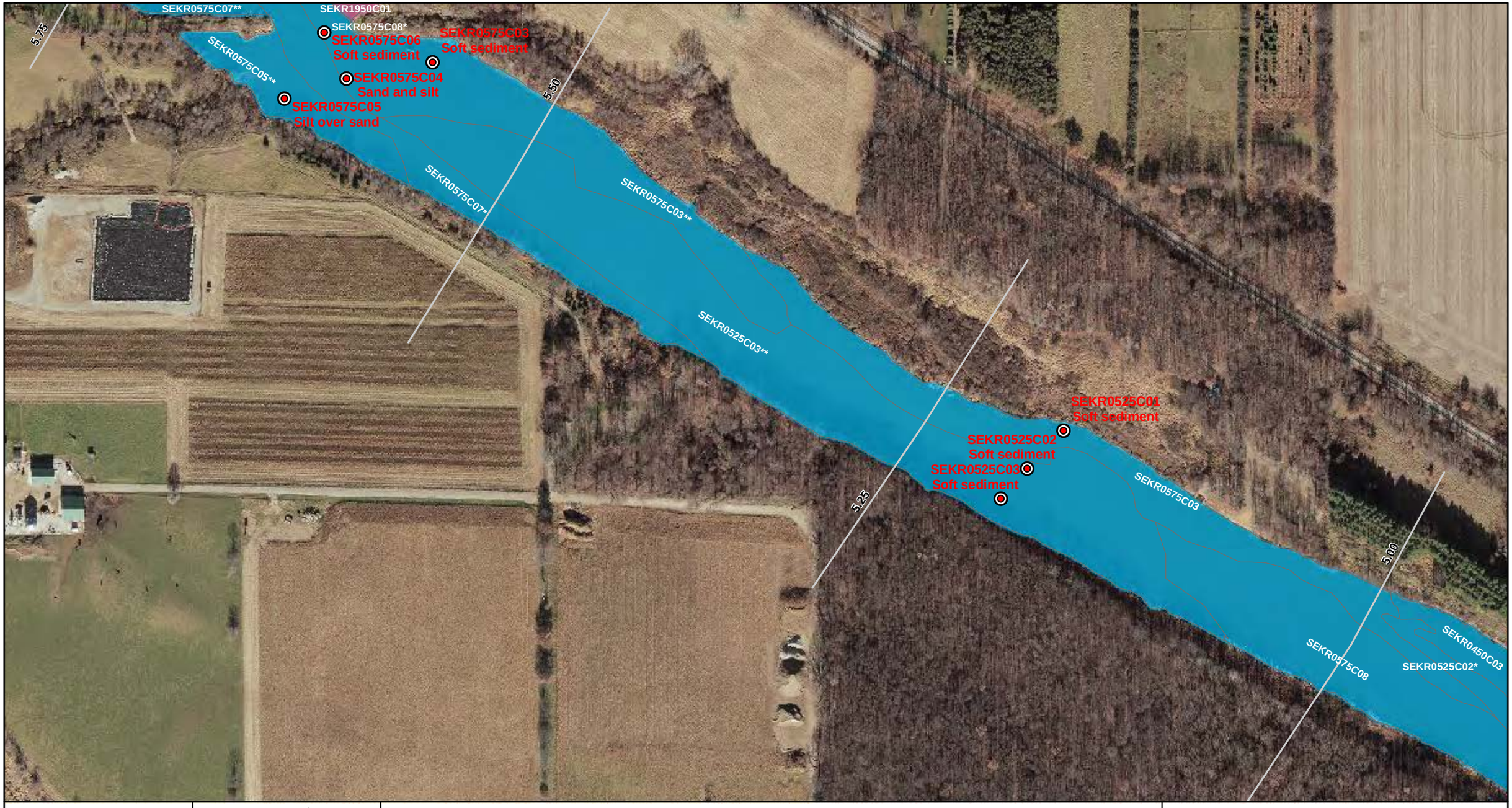
MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 78.mxd

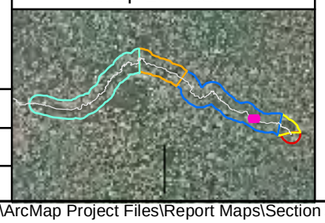
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
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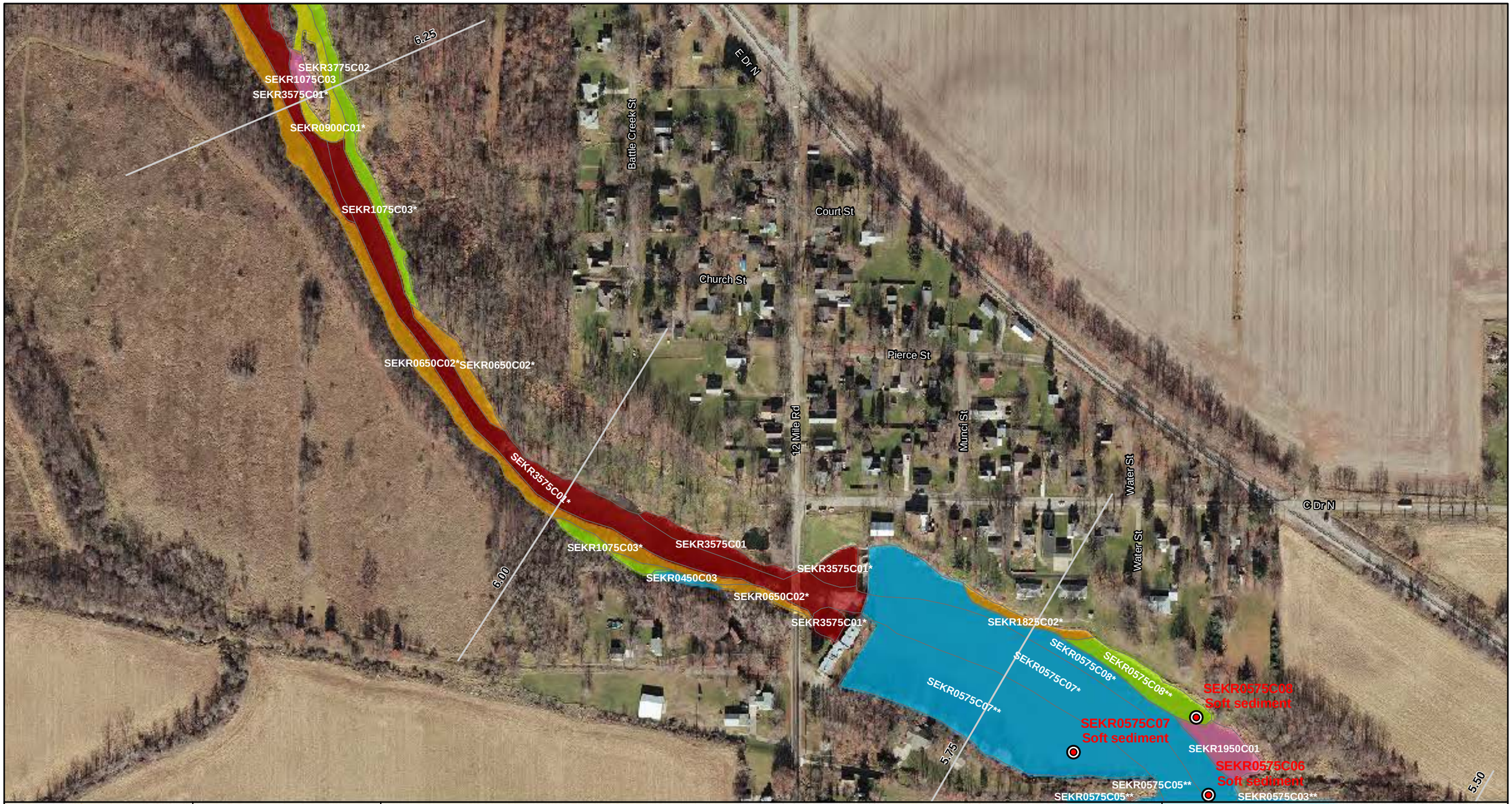
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 78.mxd

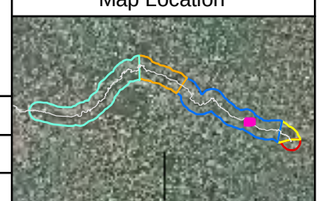
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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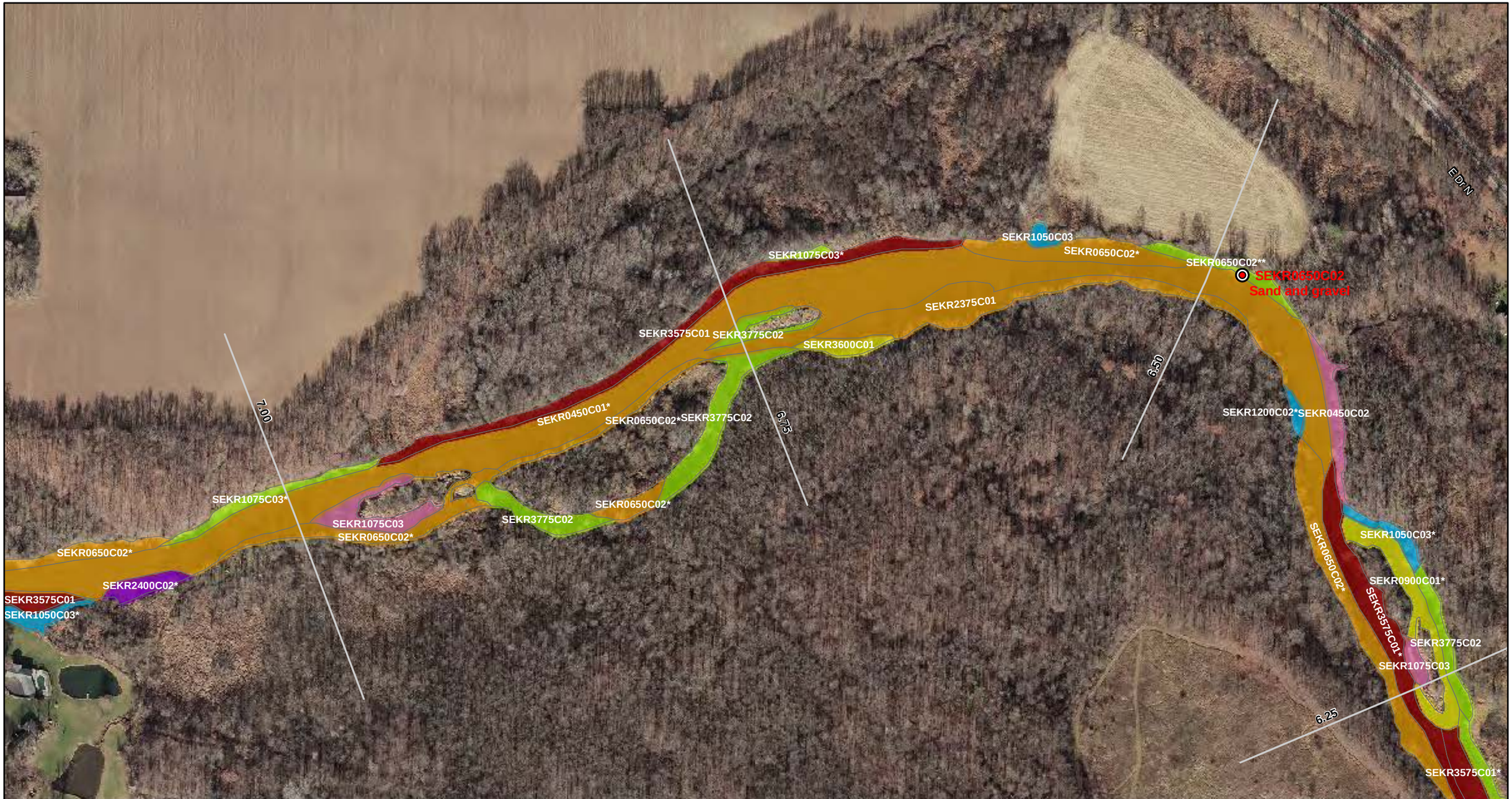
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
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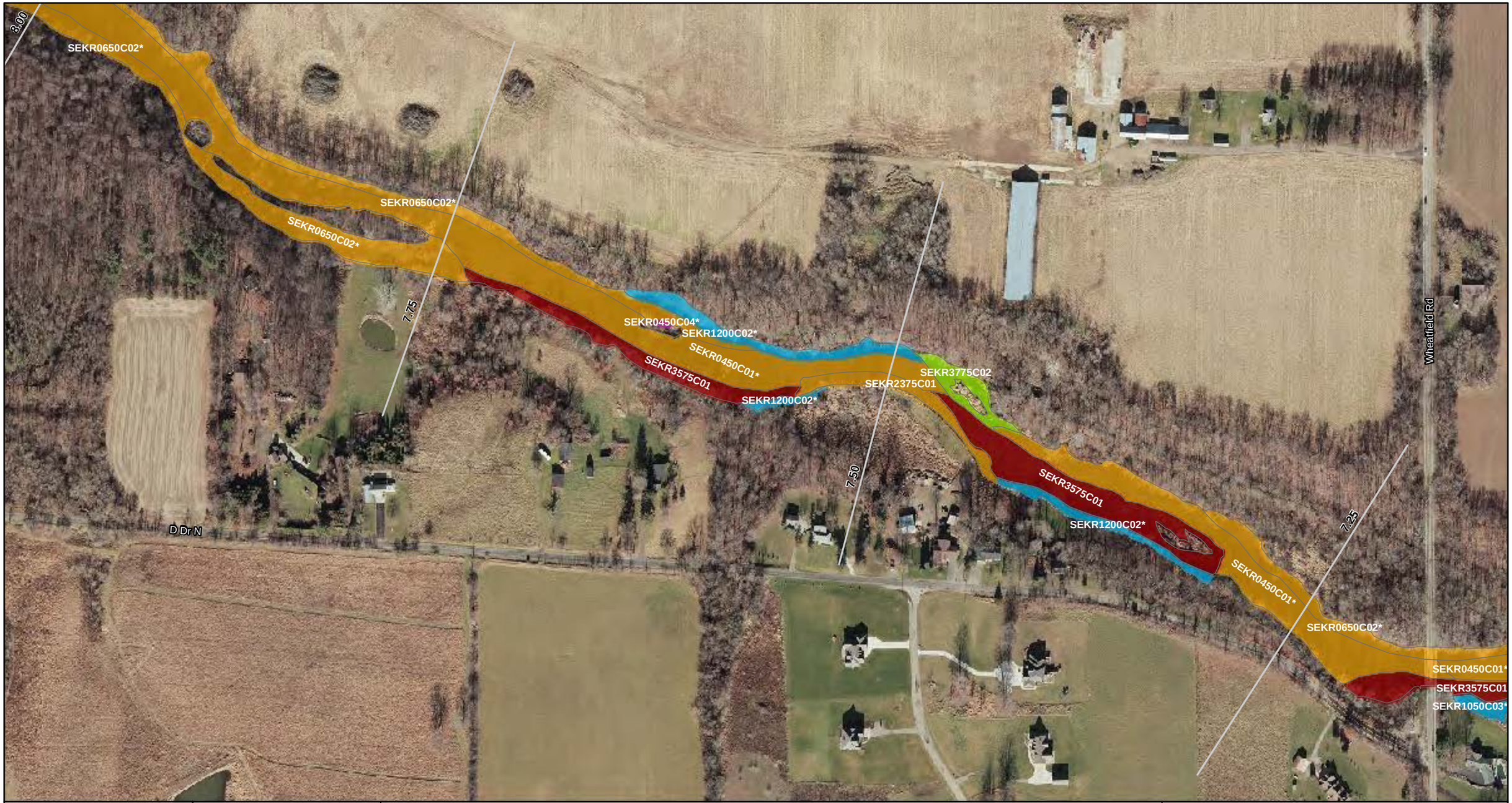
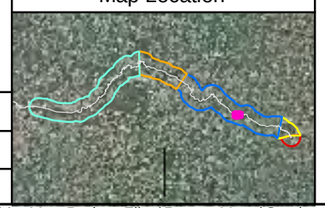
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
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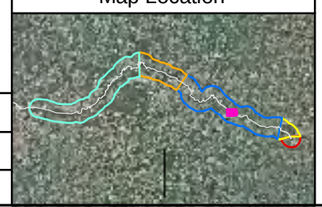
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
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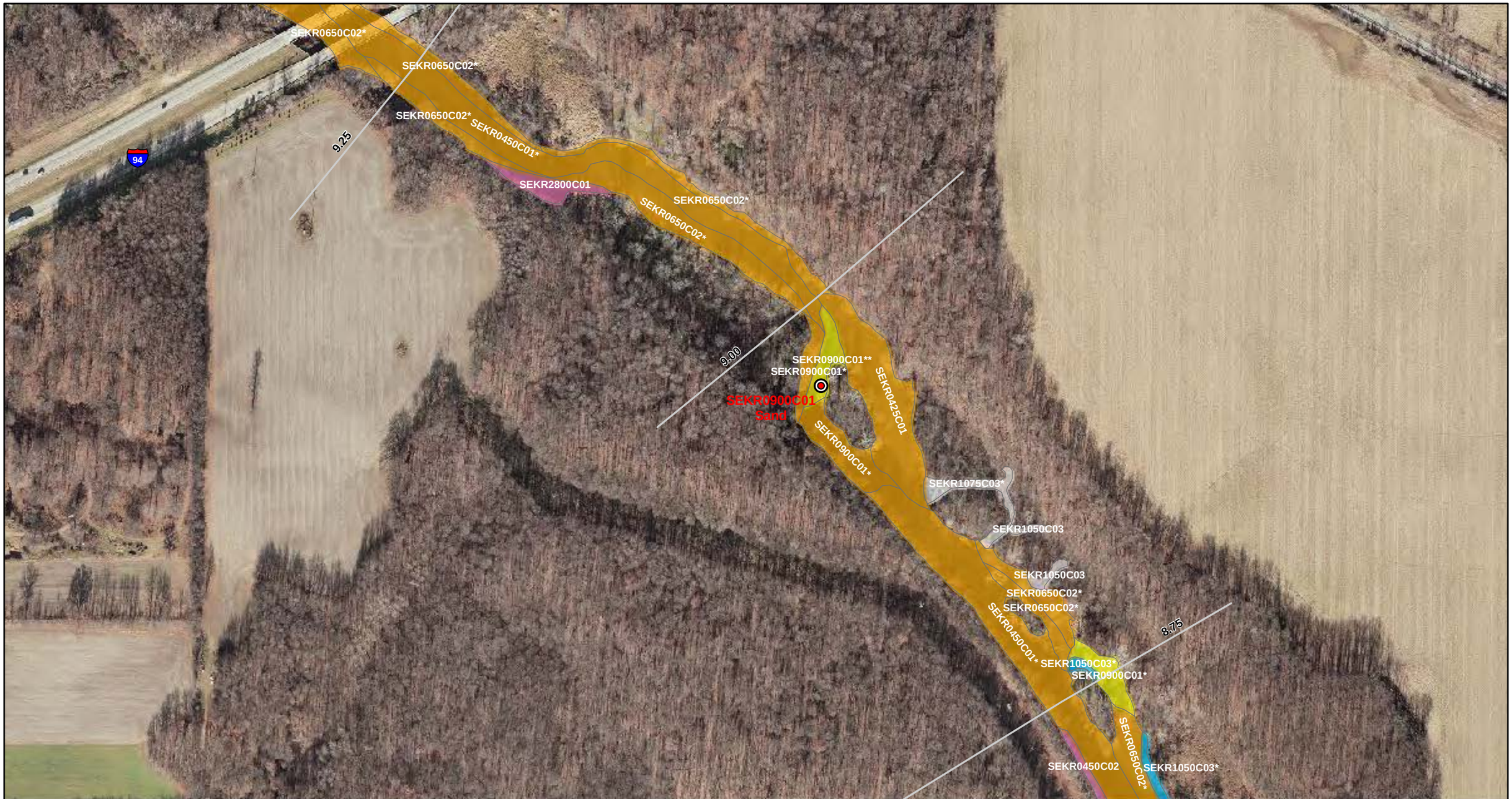
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
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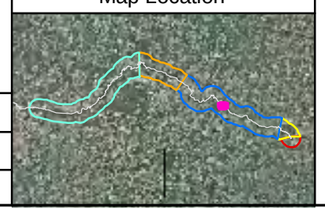
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
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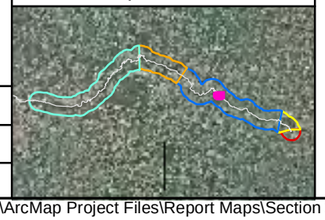
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
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  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
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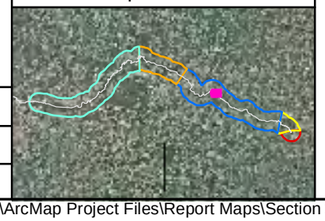
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
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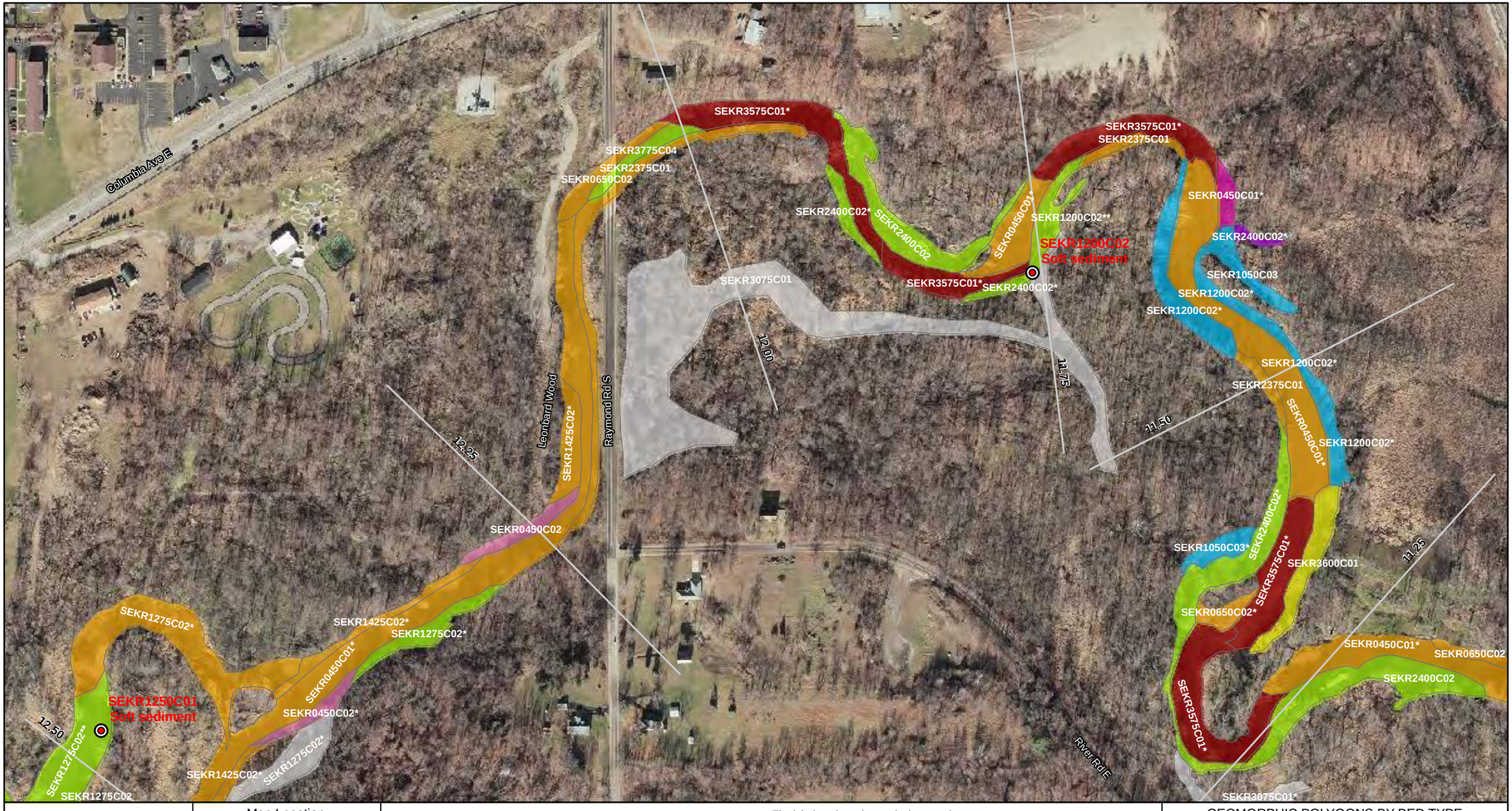
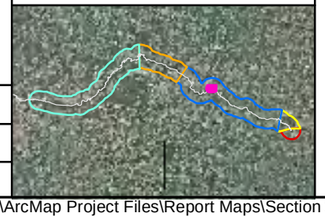
Aerial Photography Date: November 2011



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
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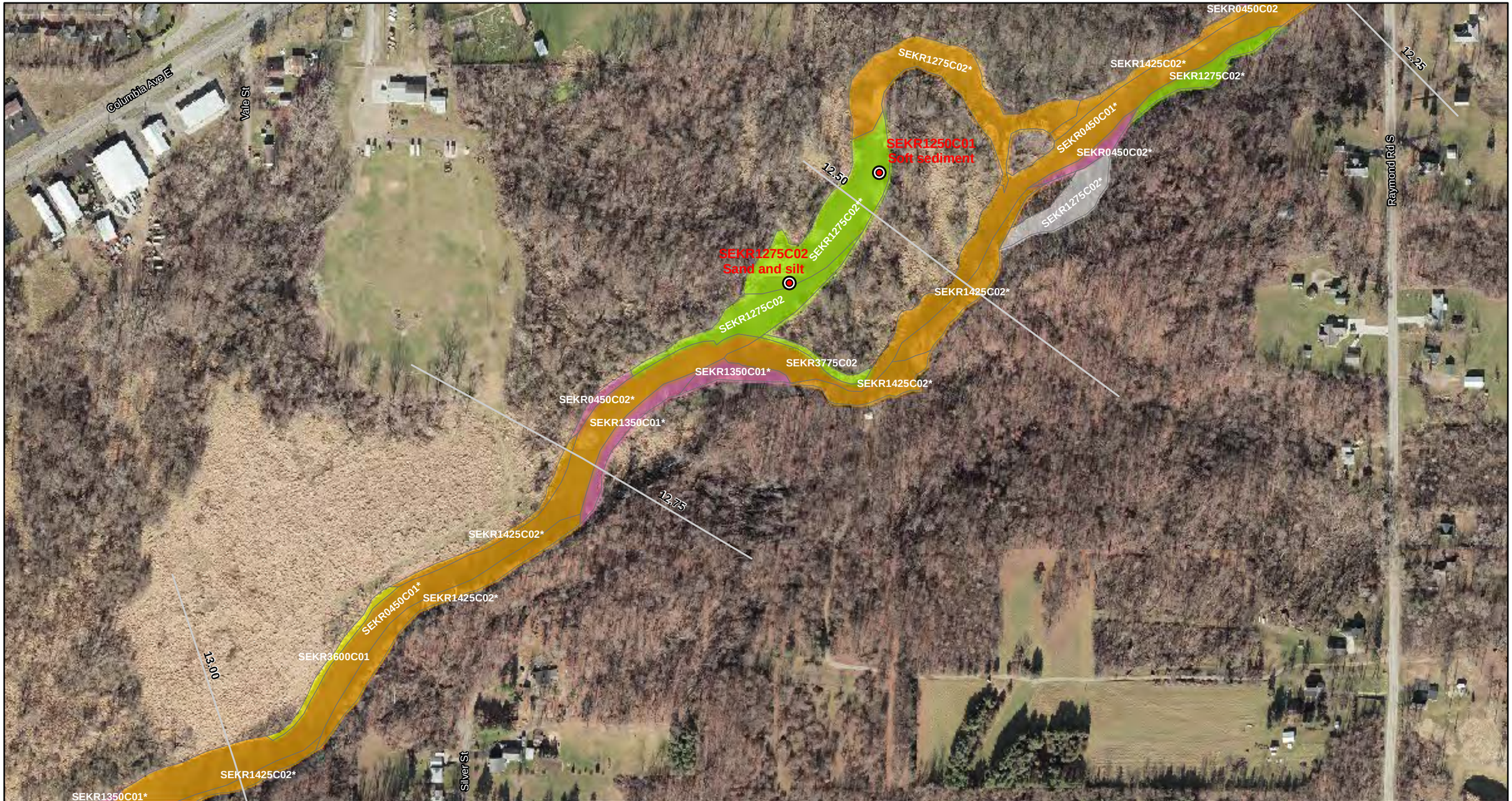
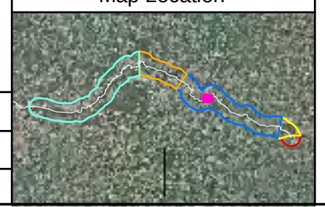
Aerial Photography Date: November 2011



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
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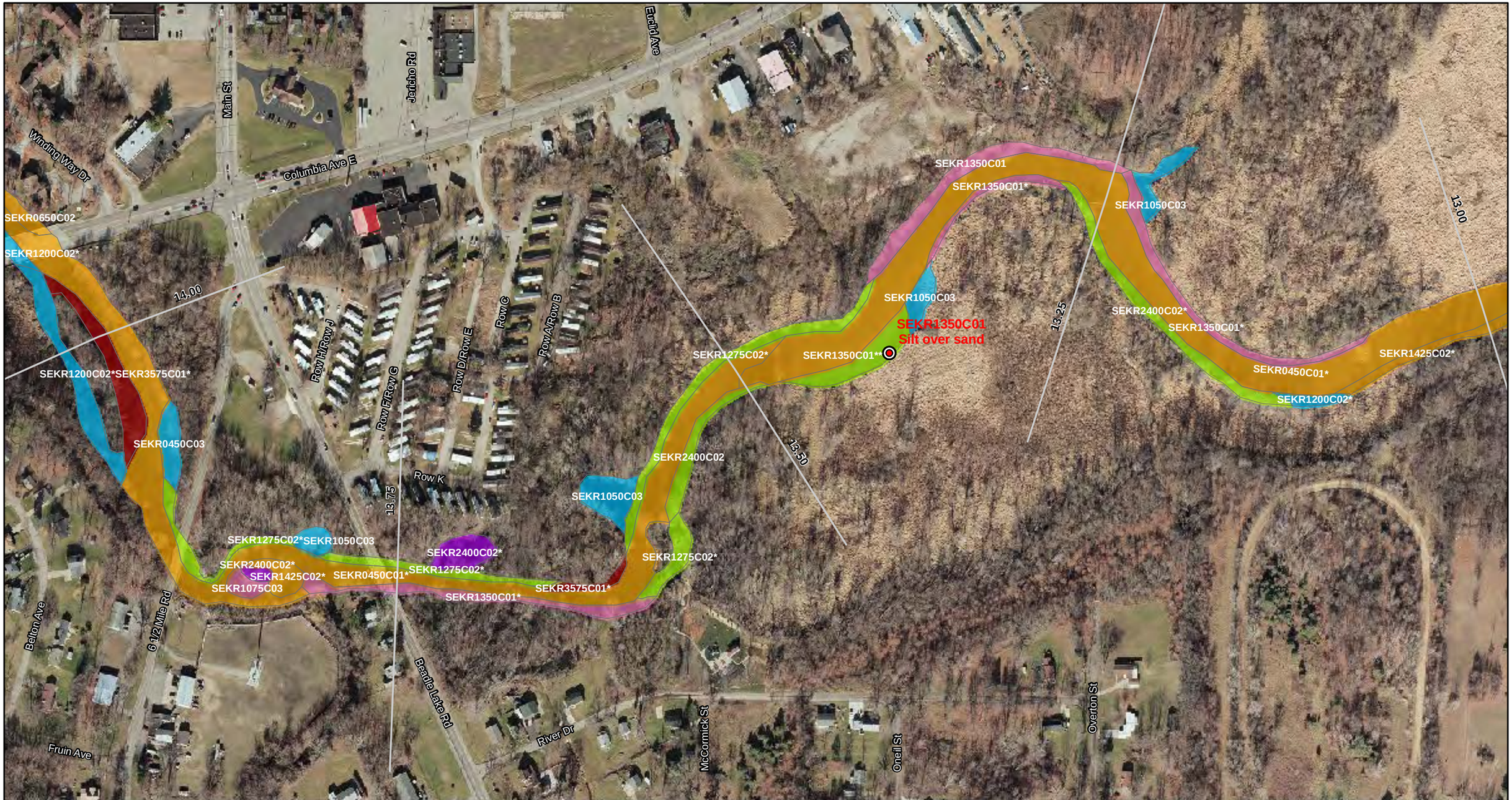
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 78.mxd

Aerial Photography Date: November 2011



Map Location

Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
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N

0 125 250 500
Scale in Feet

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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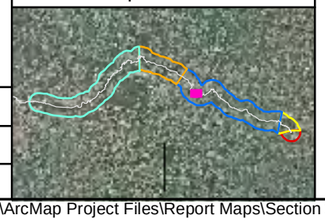
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

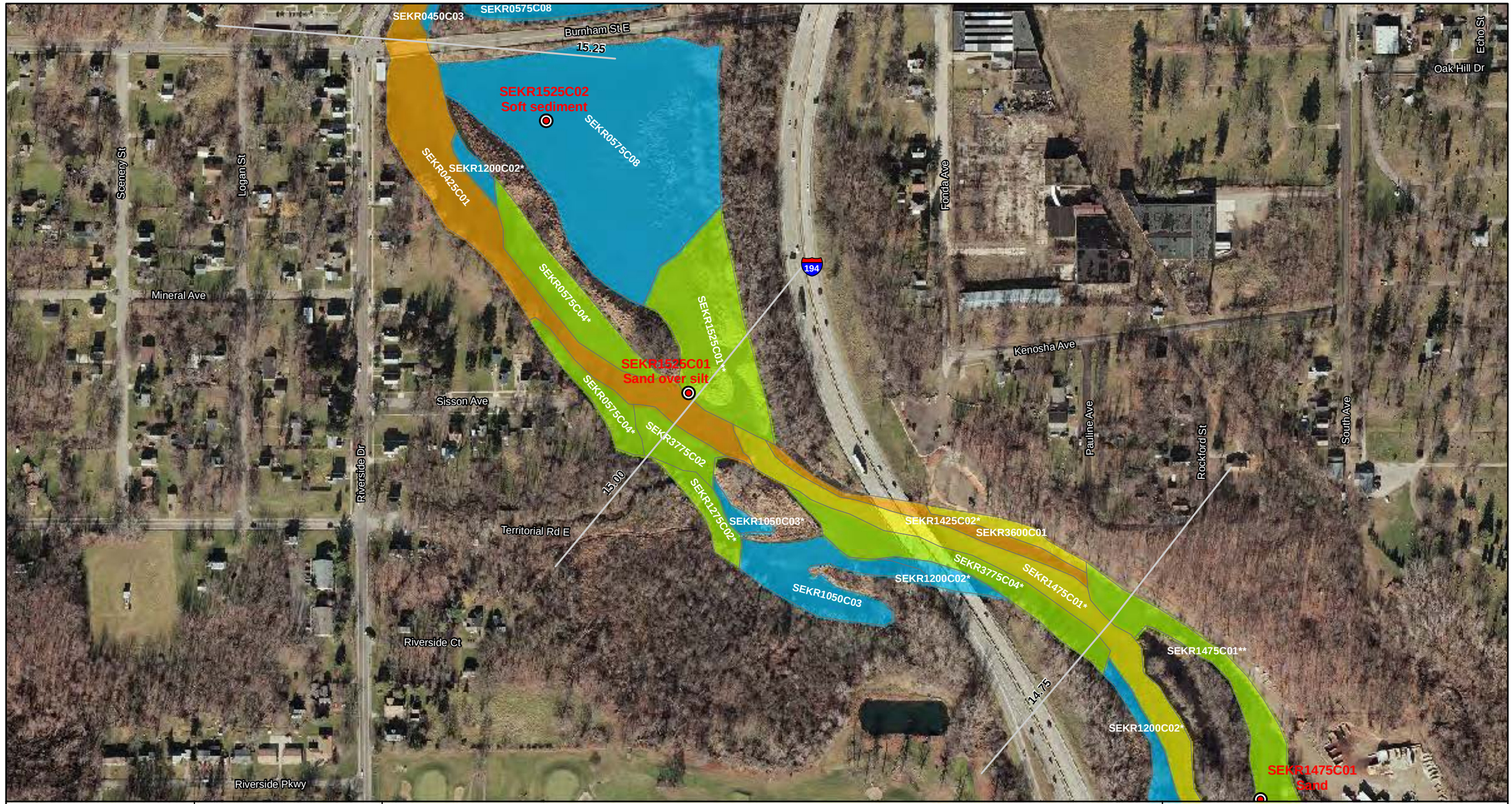
MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 78.mxd

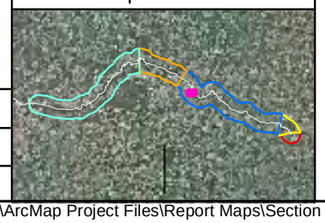
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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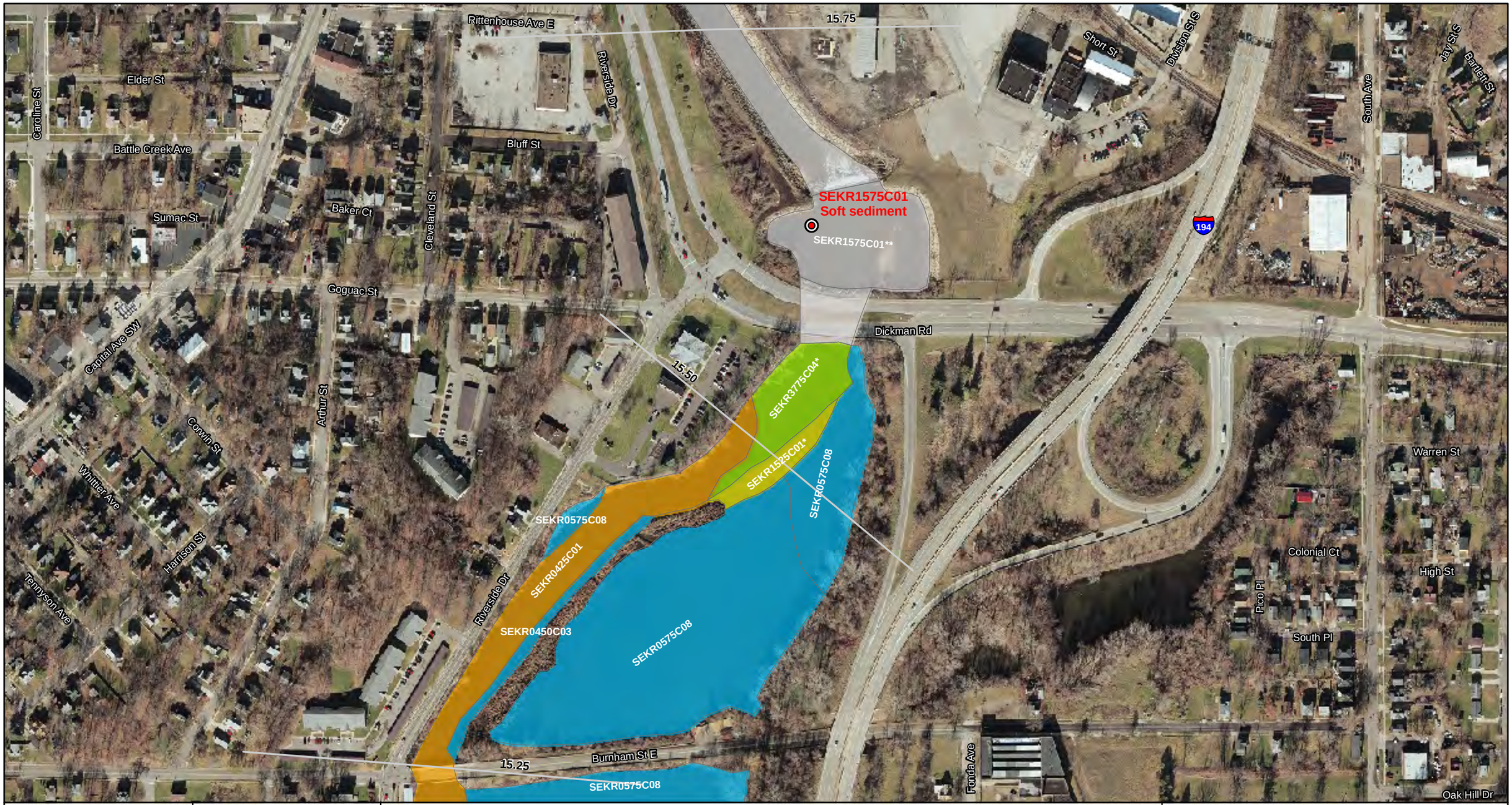
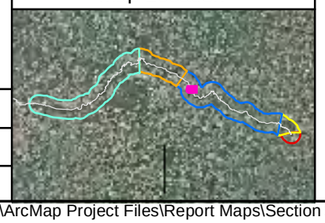
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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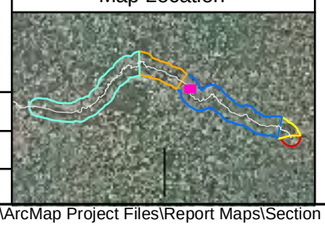
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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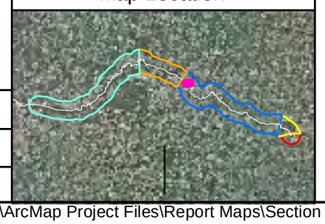
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
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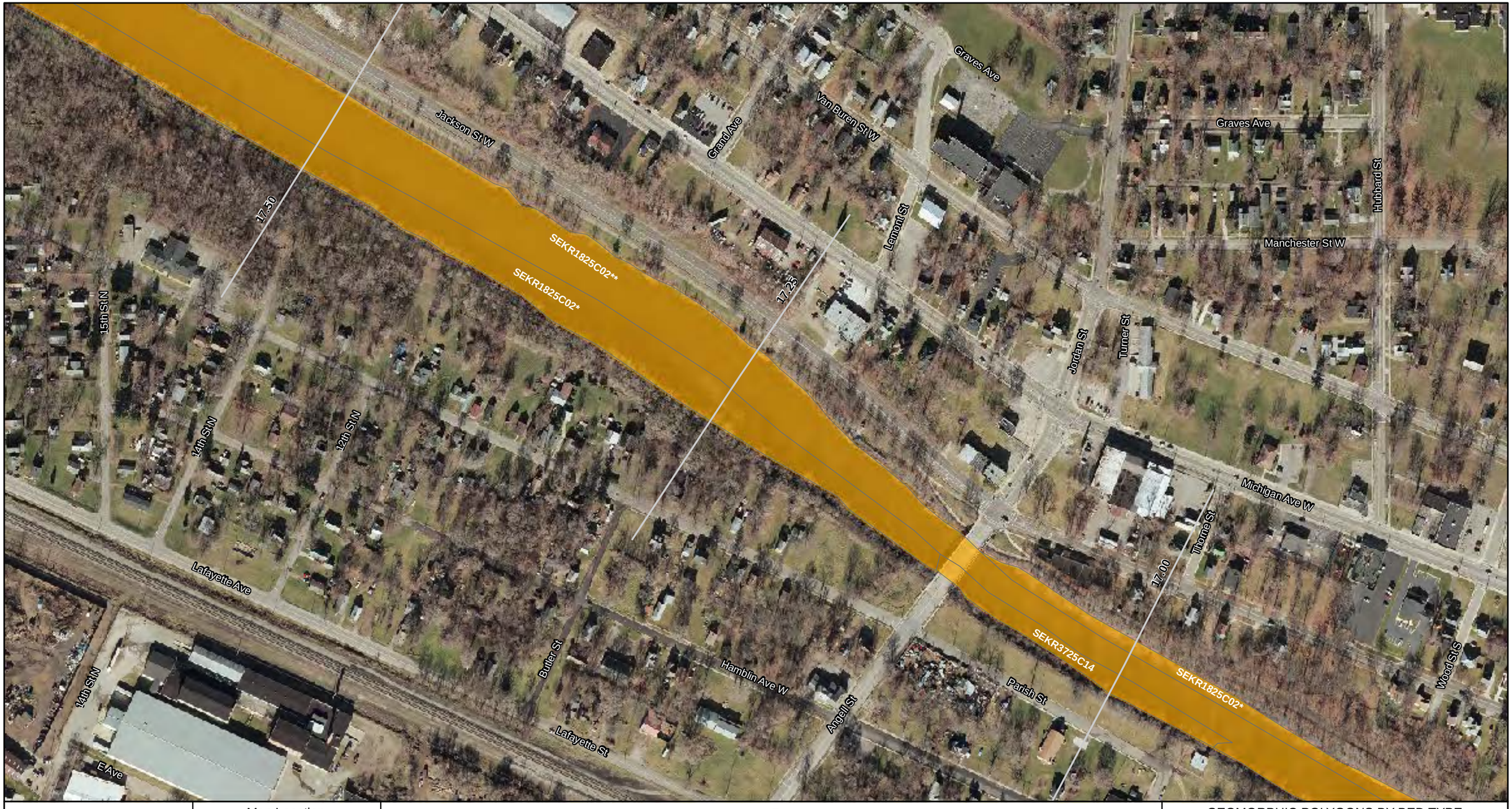
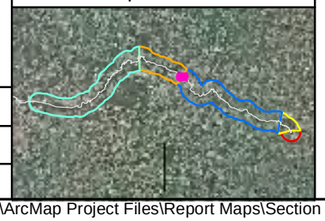
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500

Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
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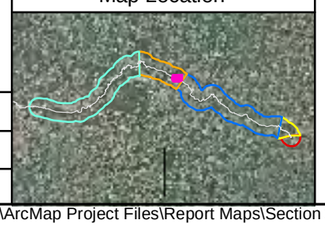
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
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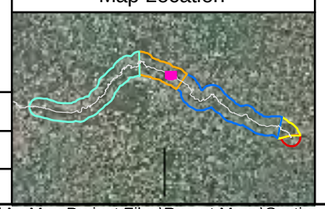
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
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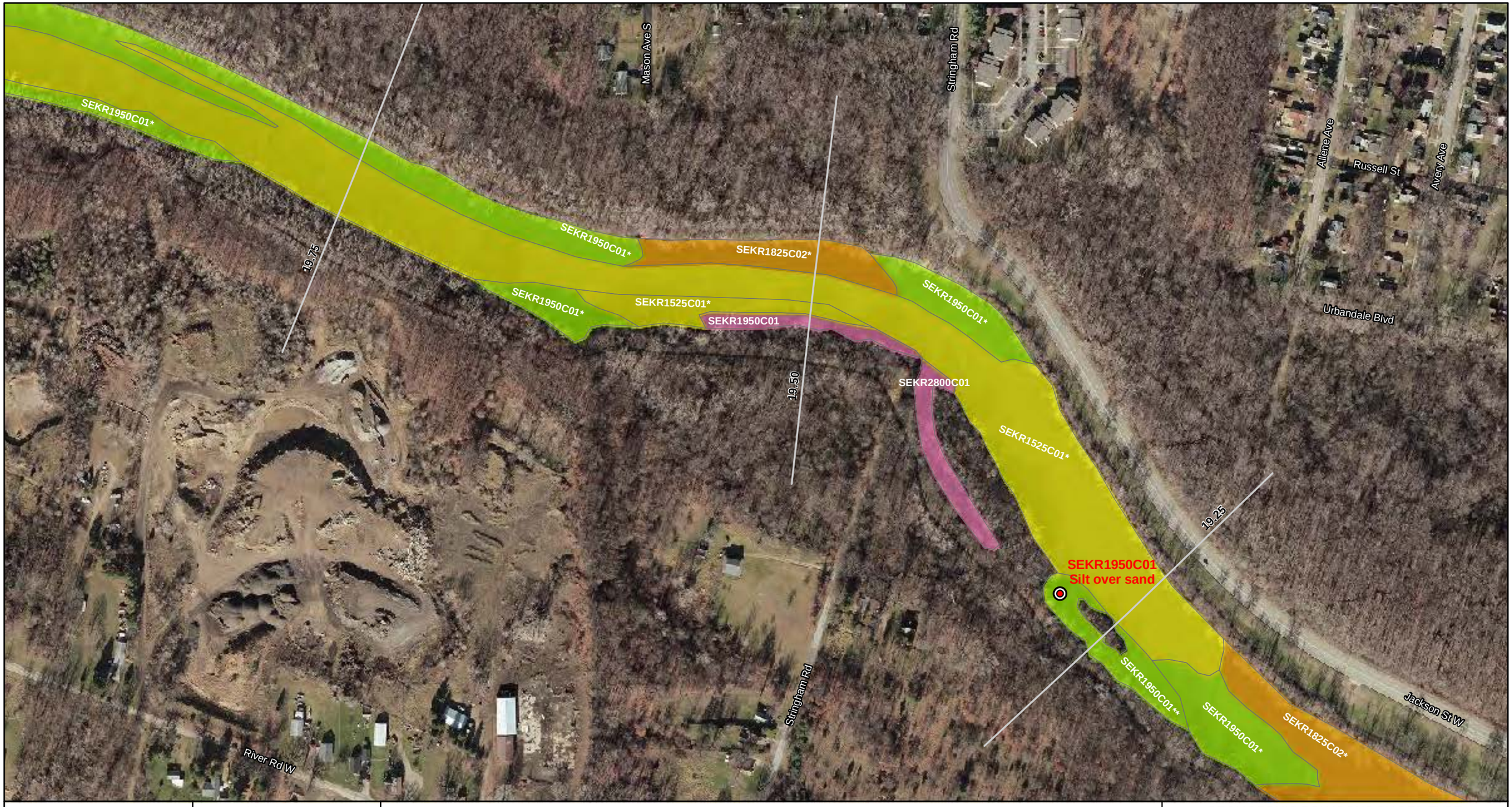
Aerial Photography Date: November 2011



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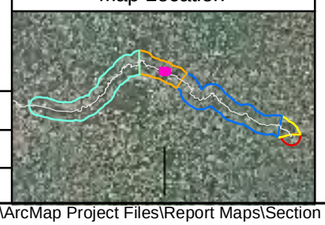
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
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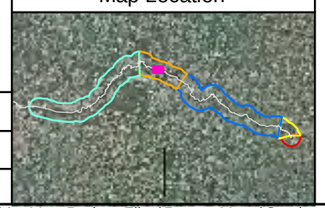
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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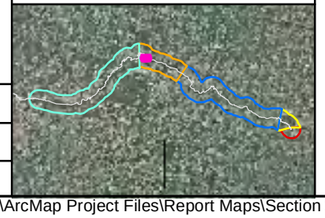
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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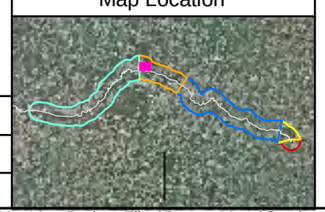
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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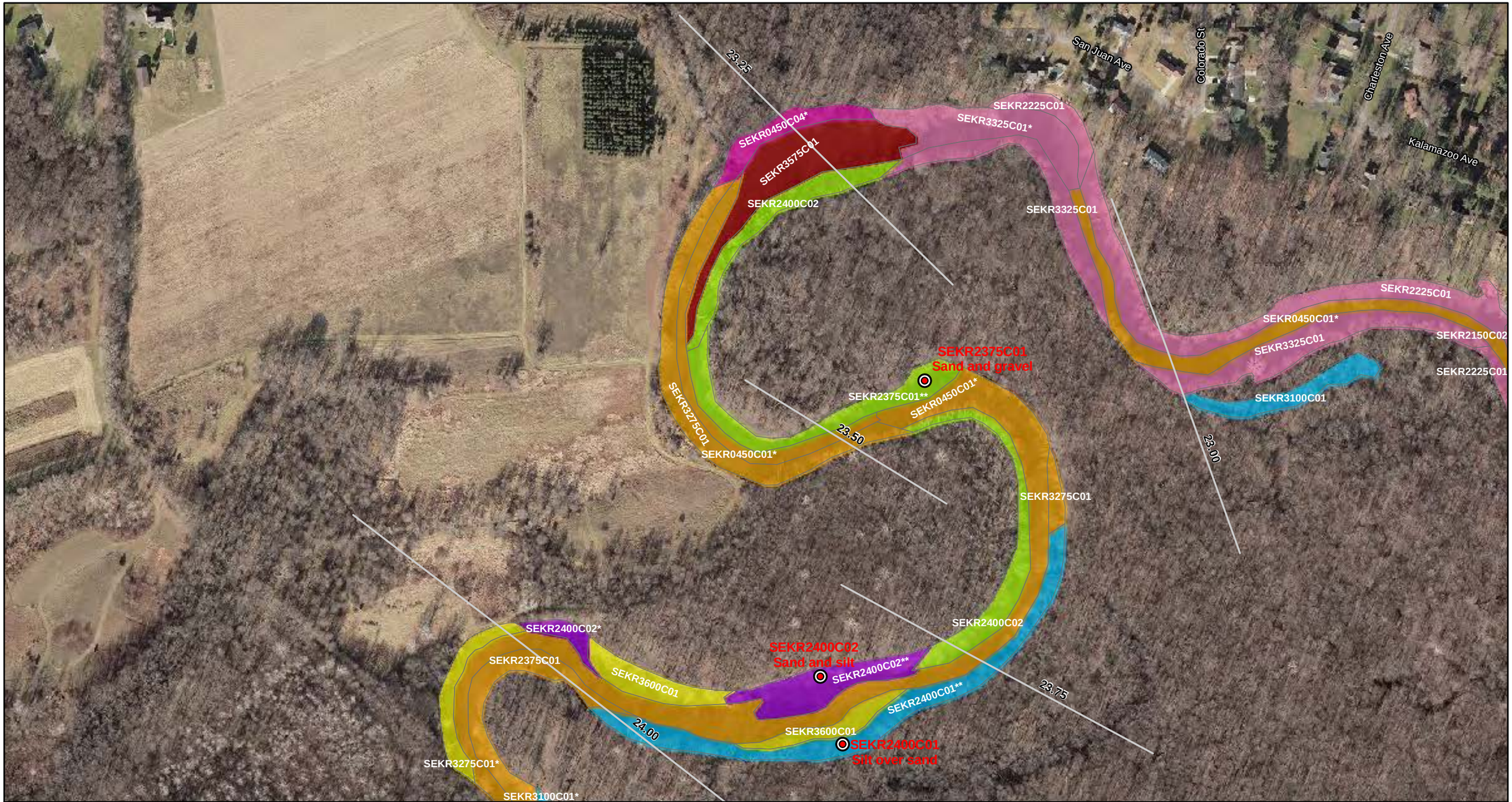
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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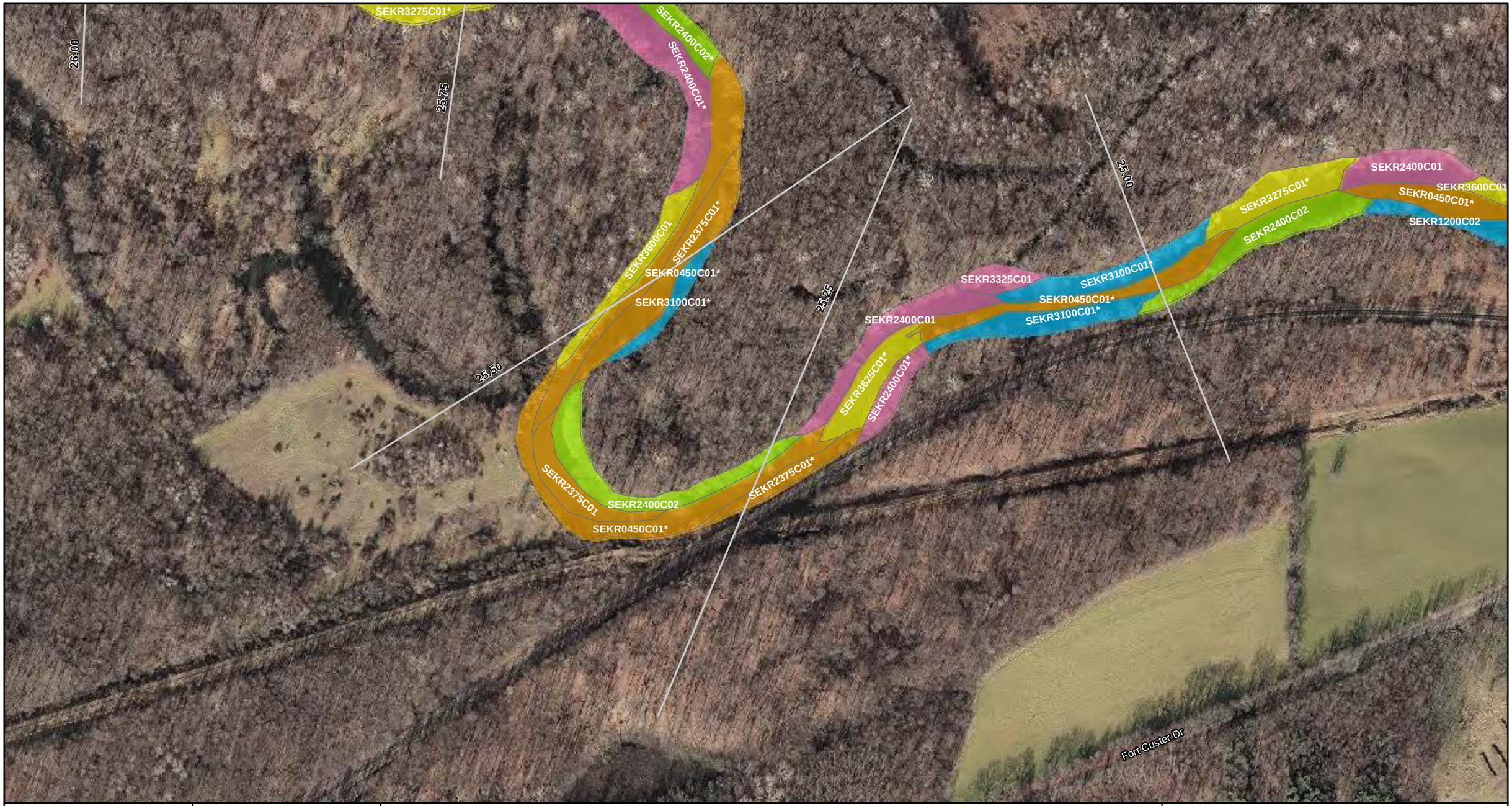
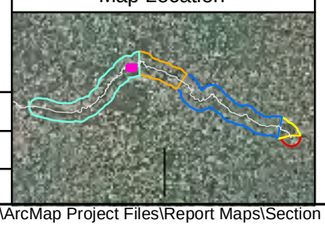
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

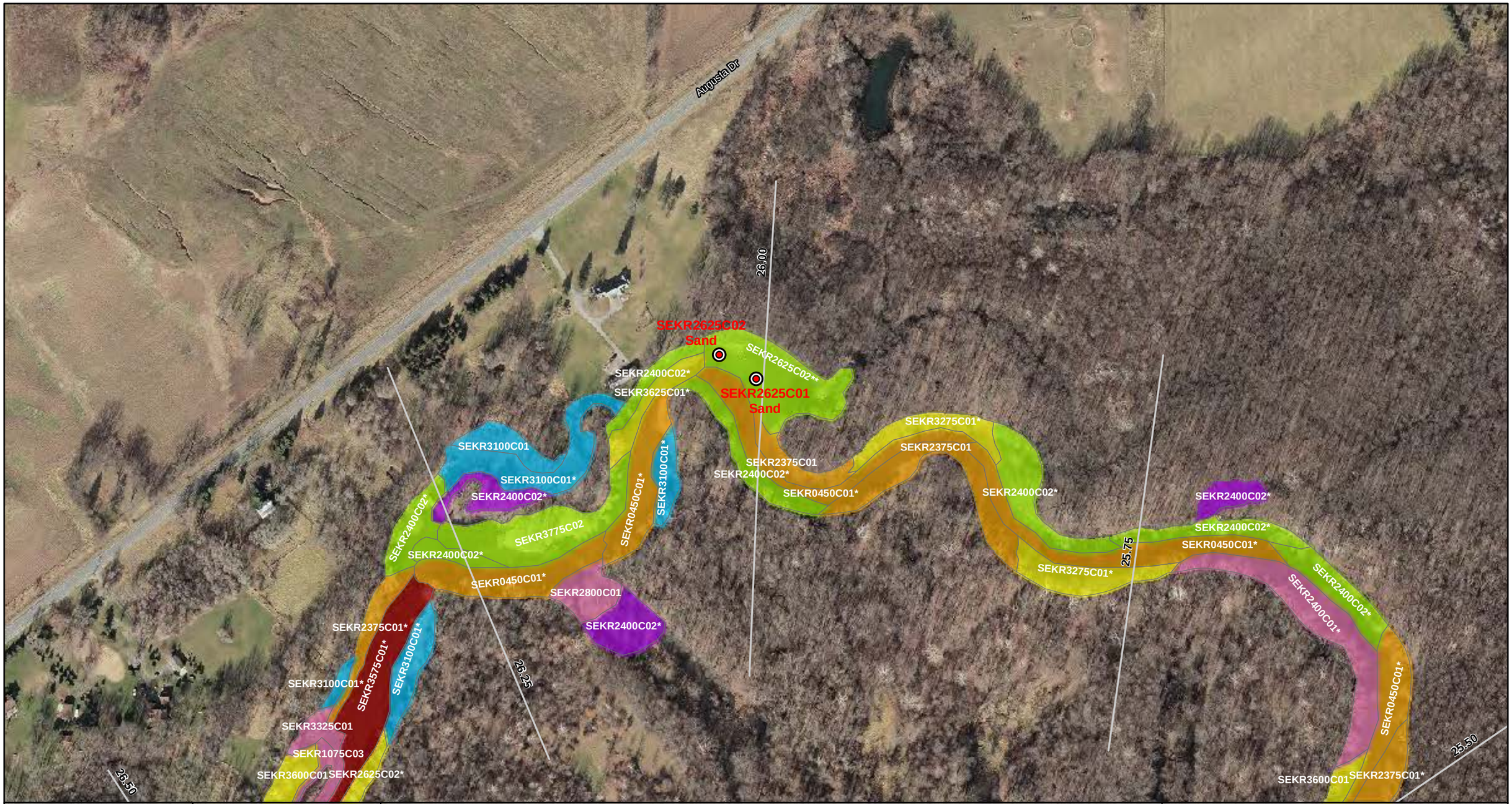
MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 78.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

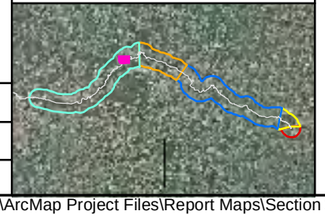
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 78.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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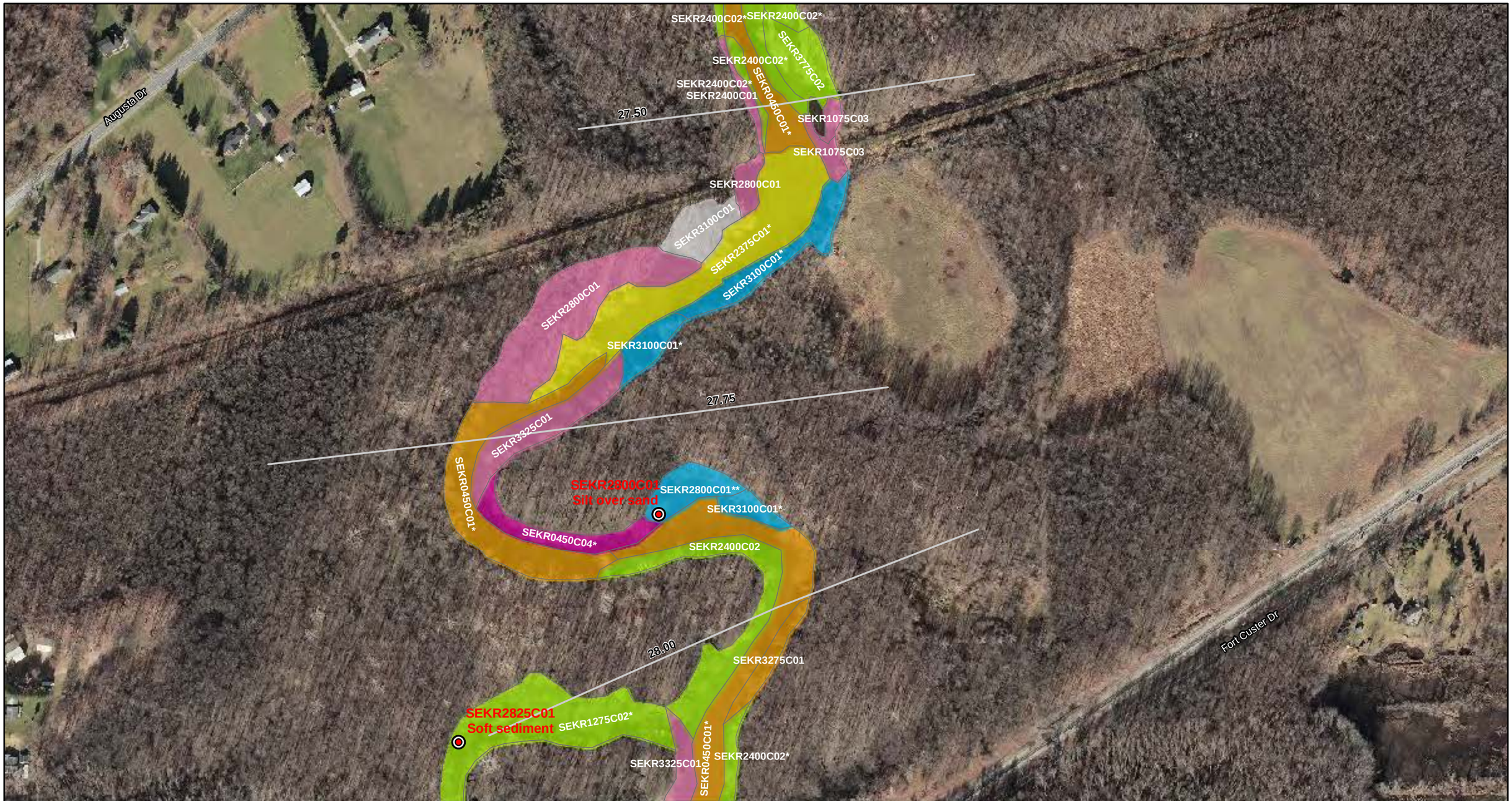
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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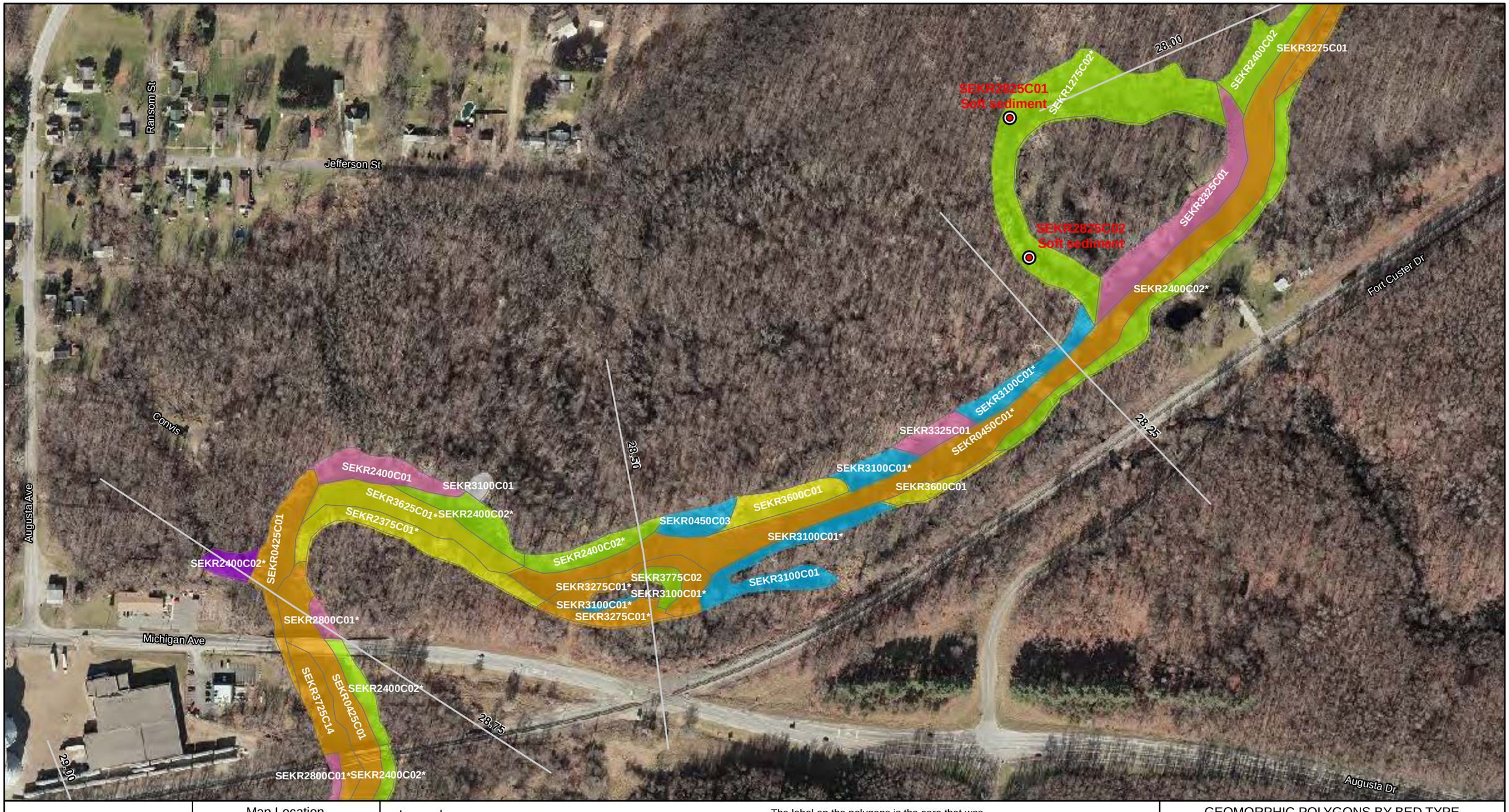
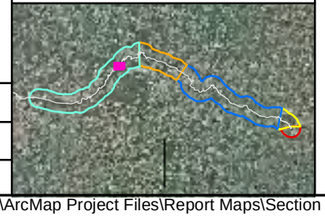
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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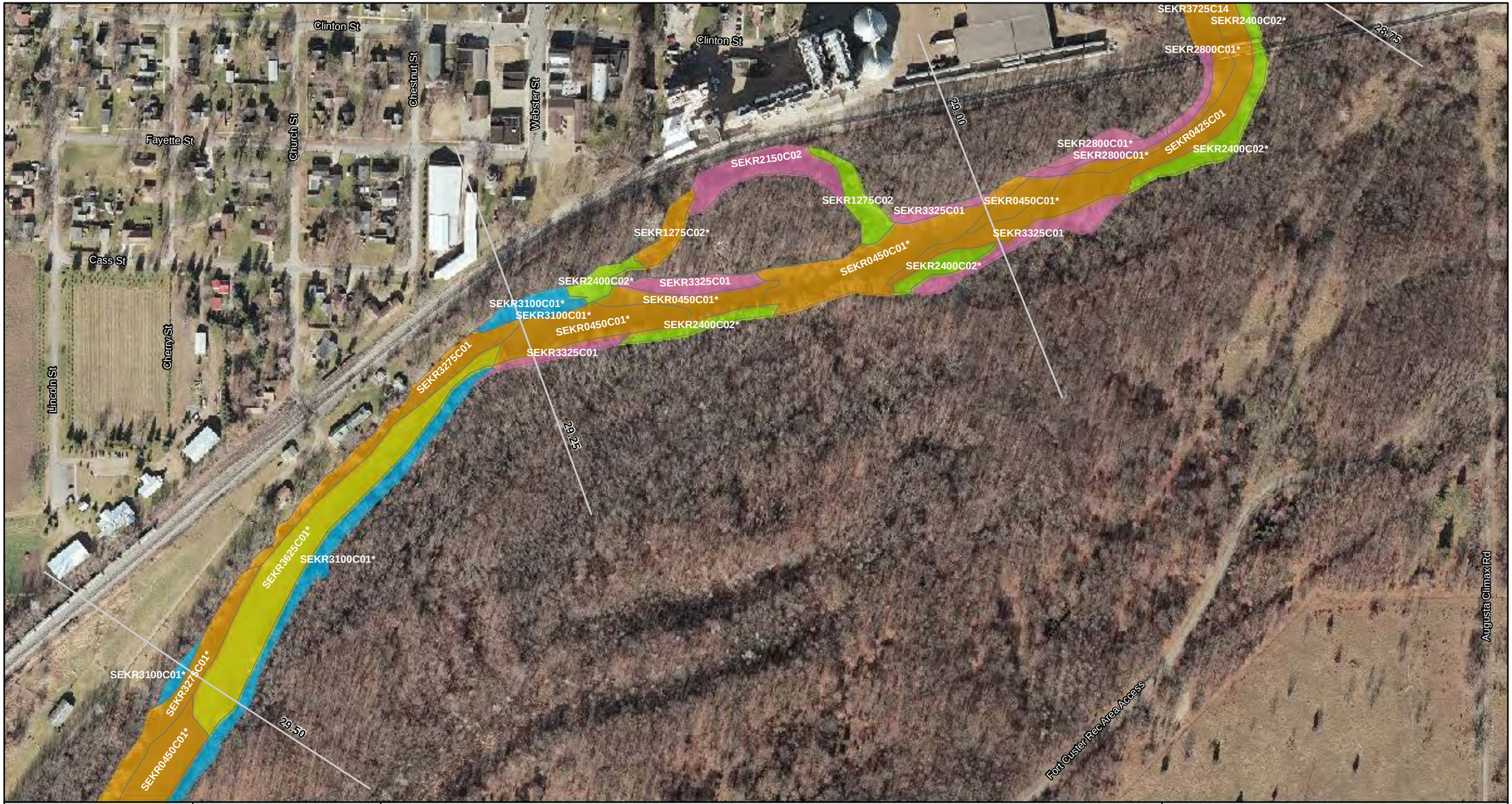
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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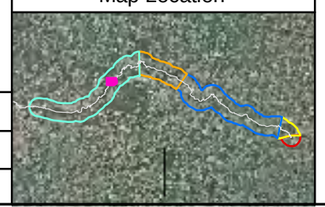
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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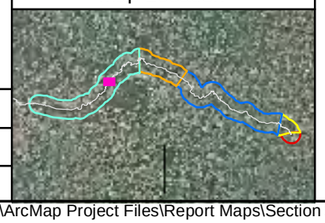
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
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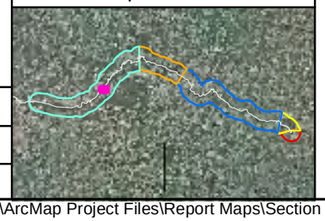
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
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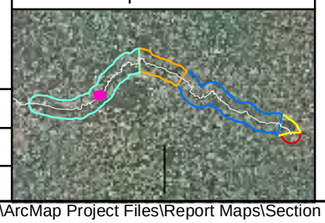
Aerial Photography Date: November 2011

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
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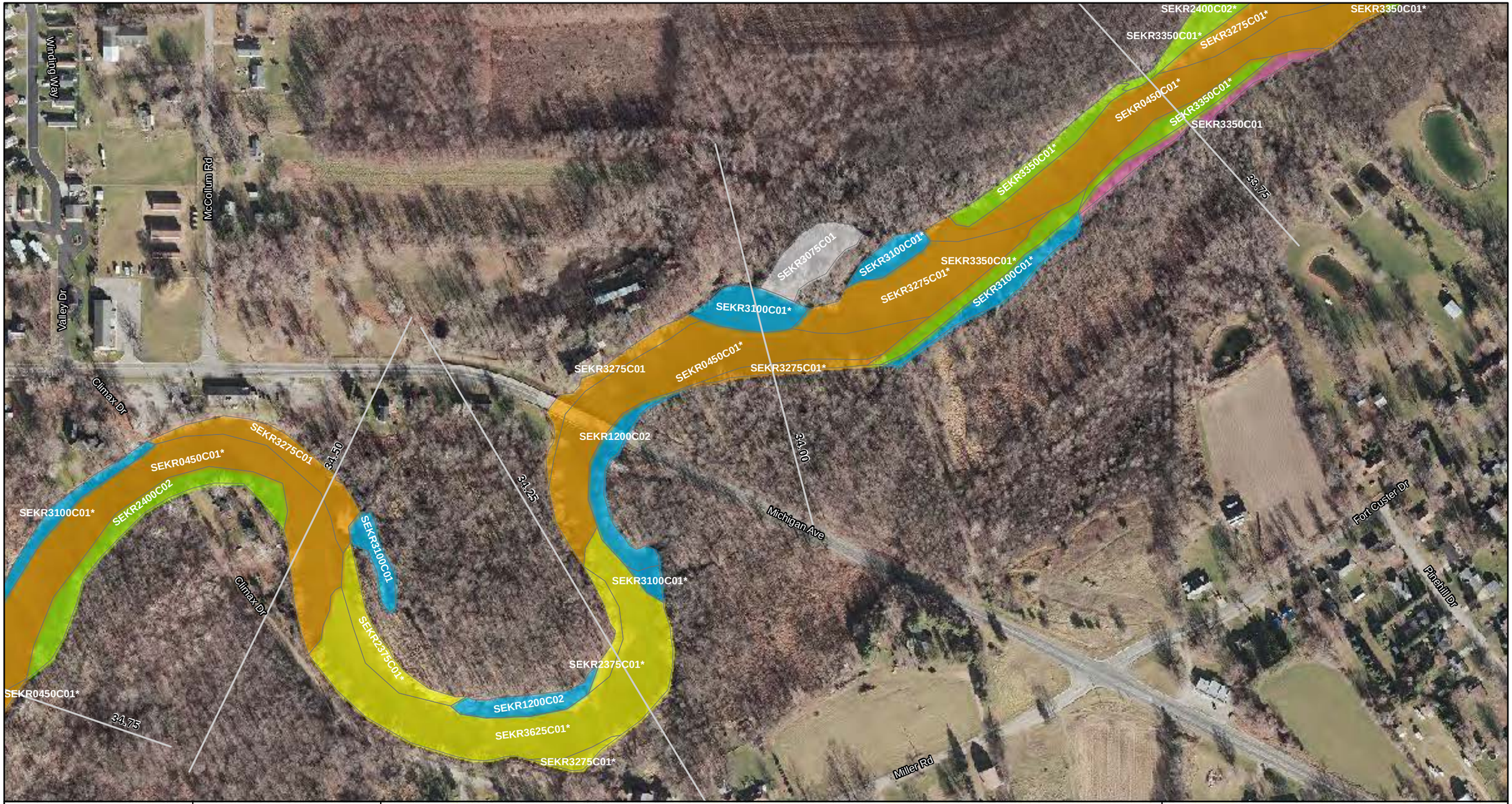
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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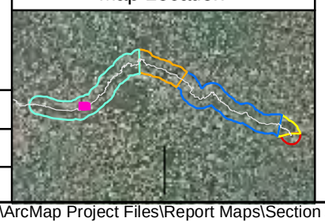
Aerial Photography Date: November 2011

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

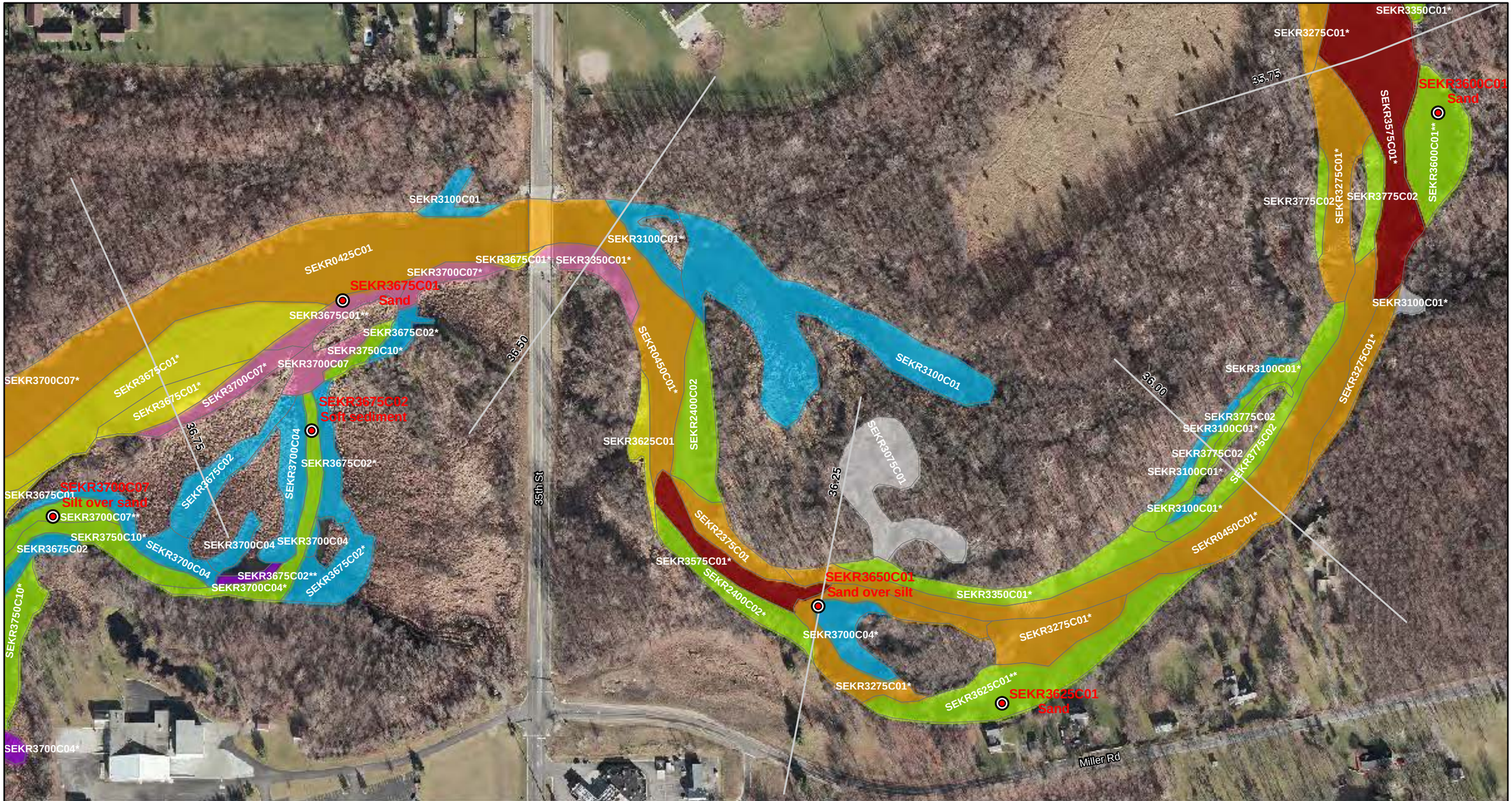
MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 78.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
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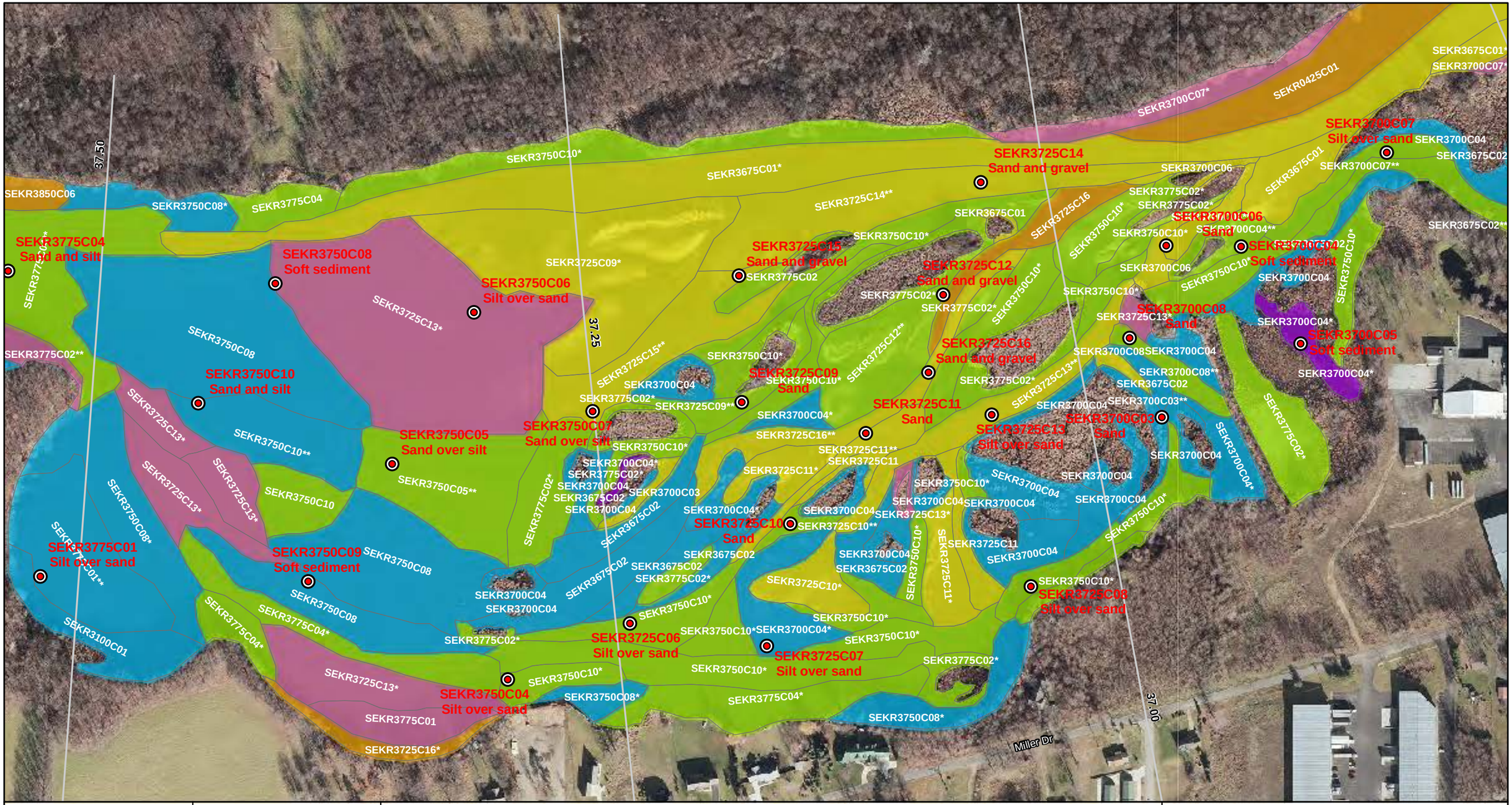
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 78.mxd

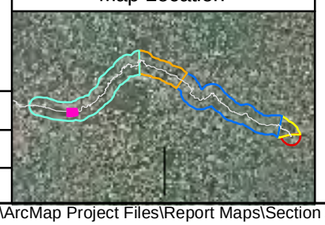
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

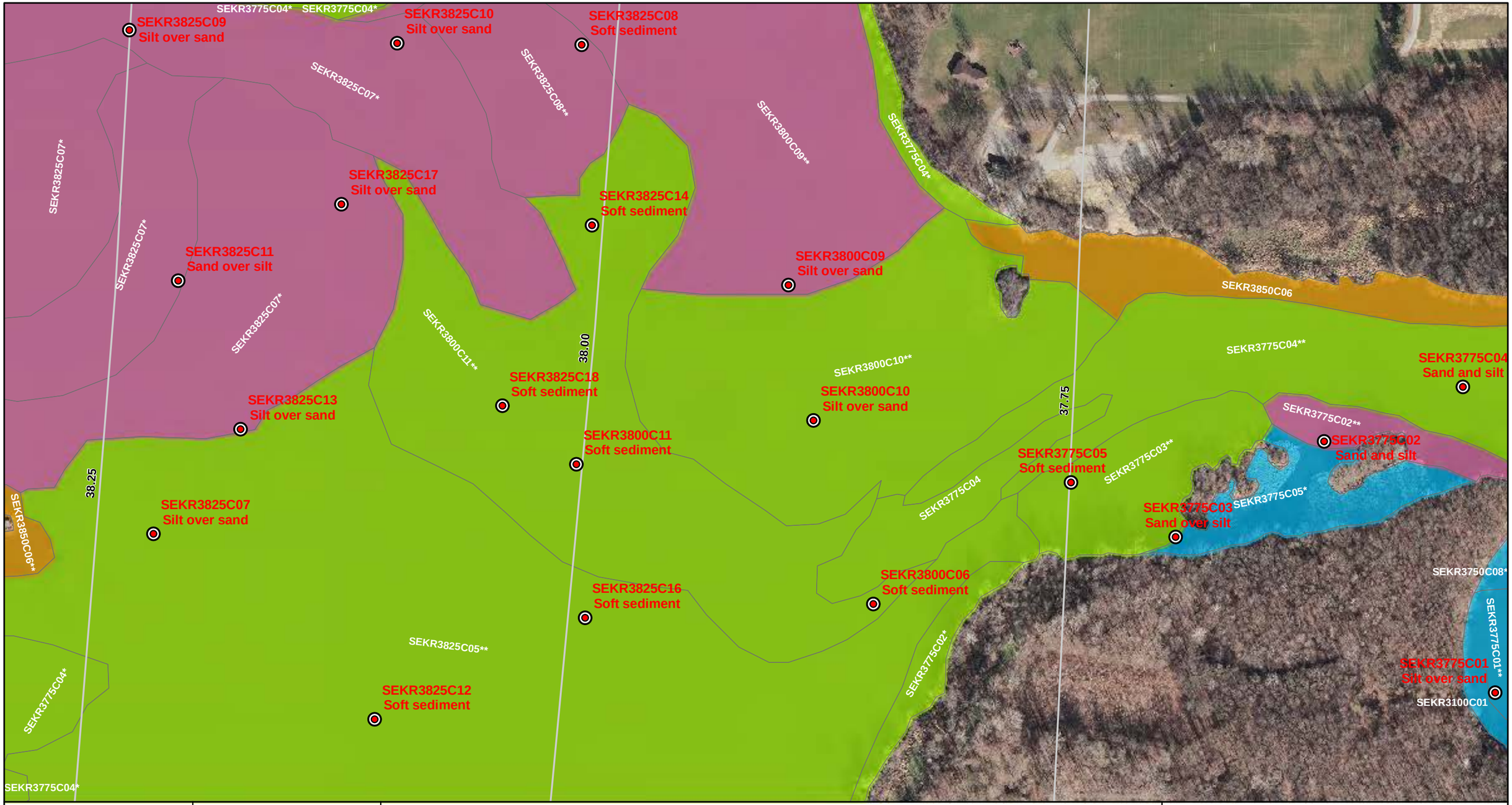
MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

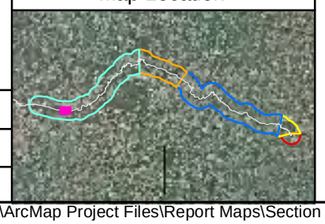
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 78.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

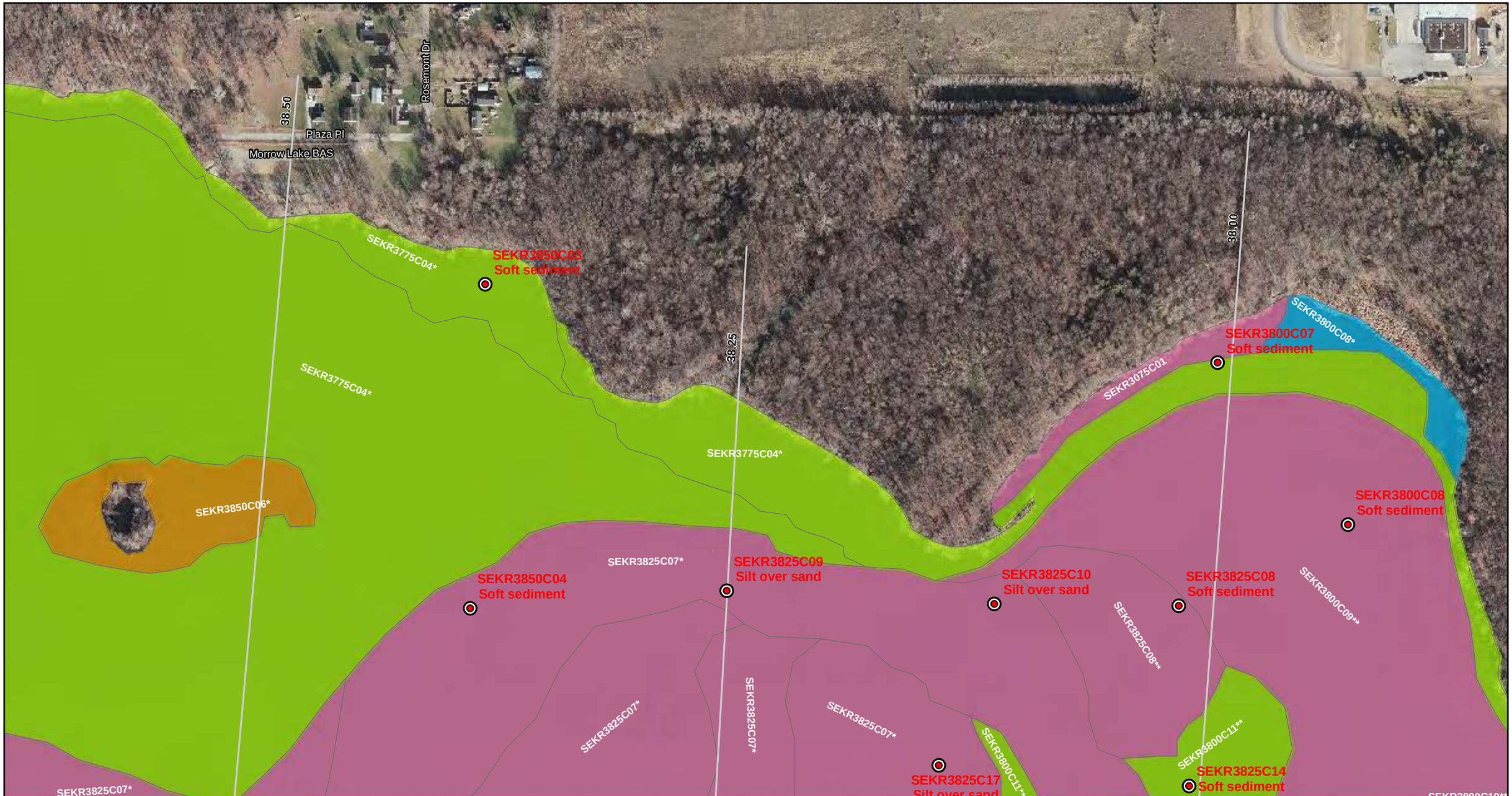
MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Core Assignment 78.mxd

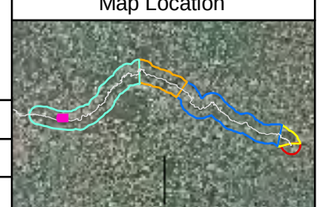
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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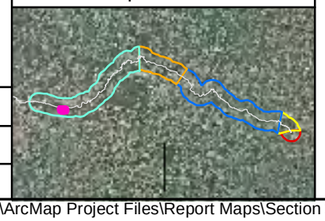
Aerial Photography Date: November 2011

SEKR3775C02*
SEKR3825C07*
SEKR3850C06
Sand and gravel
SEKR3775C04*
SEKR3850C06**
SEKR3825C07
Silt over sand
SEKR3800C11
Soft sediment
SEKR3800C10**
SEKR3775C04**
SEKR3775C03**
SEKR3775C04
SEKR3800C11**
SEKR3825C16
Soft sediment
SEKR3800C06
Soft sediment
SEKR3825C12
Soft sediment
SEKR3775C04*
SEKR3850C02
Silt over sand
SEKR3775C02*
SEKR3850C07
Soft sediment
SEKR3825C05**
38.50
38.25
38.00
SEKR3850C06*
SEKR3825C05
Silt over sand
SEKR3825C06
Soft sediment
SEKR3825C15
Soft sediment
SEKR3825C05*
Lyth Rd

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

- HDM Core
- Geomorphic Polygons
  - Gravel and Larger
  - Sand and Gravel
  - Sand
  - Sand and Silt
  - Sand over Silt
  - Silt over Sand
  - Soft Sediment
  - Organic
  - Unknown
- Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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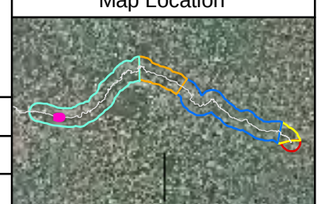
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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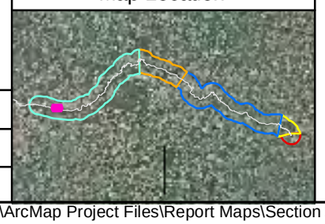
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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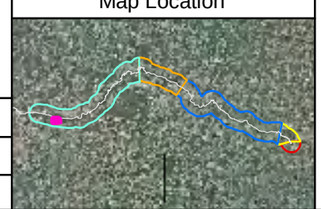
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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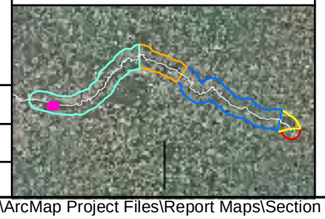
Aerial Photography Date: November 2011

SEKR3850C06*
SEKR3825C05*
SEKR3825C05*
SEKR3825C07*
SEKR3825C07*
SEKR3825C05*
39.50
SEKR3825C18
SEKR3775C05*
39.00
SEKR3825C18
39.25
SEKR3825C05*
SEKR3825C07*
SEKR3850C06*
SEKR3825C07*
SEKR3775C02*
SEKR3825C05*
SEKR3850C06*

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

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* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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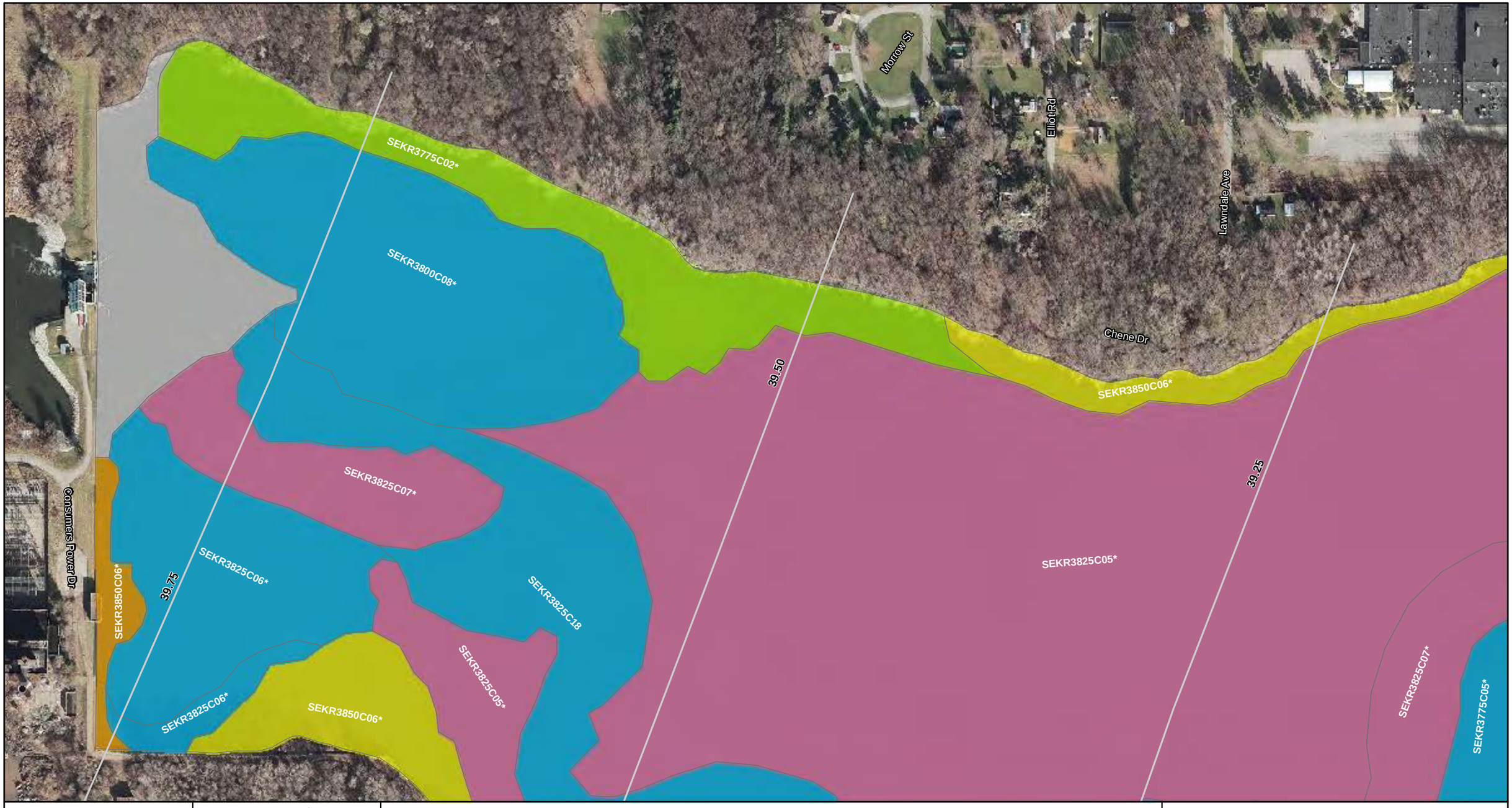
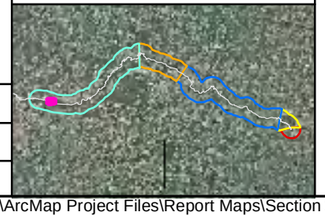
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

HDM Core

Geomorphic Polygons
- Gravel and Larger
- Sand and Gravel
- Sand
- Sand and Silt
- Sand over Silt
- Silt over Sand
- Soft Sediment
- Organic
- Unknown

Quarter Mile Grid Segment

HDM = Hydrodynamic Model

The label on the polygons is the core that was used for bulk density and texture assignments.

No asterisk = Core with same fluvial setting and sediment category assigned (typically the nearest core).
* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 125 250 500
Scale in Feet

GEOMORPHIC POLYGONS BY BED TYPE
WITH ASSIGNED CORES (78 CORE SUBSET USED)

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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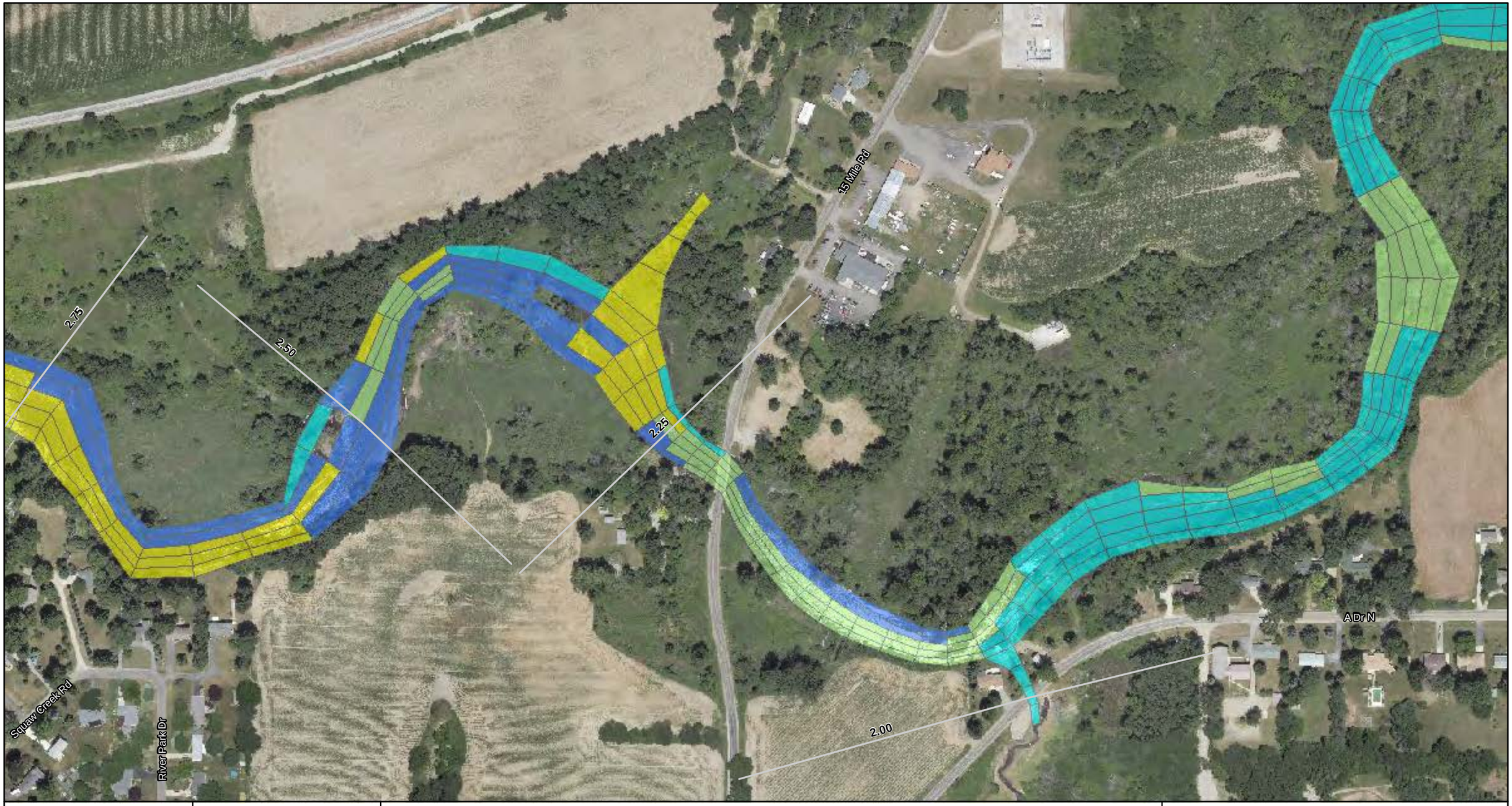
Aerial Photography Date: November 2011

Figure 3-16

Riverine Grid: Percent Sand

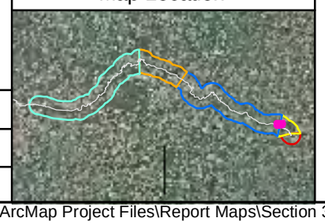
Sheets 1 through 56



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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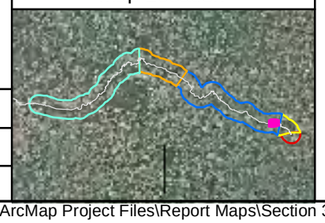
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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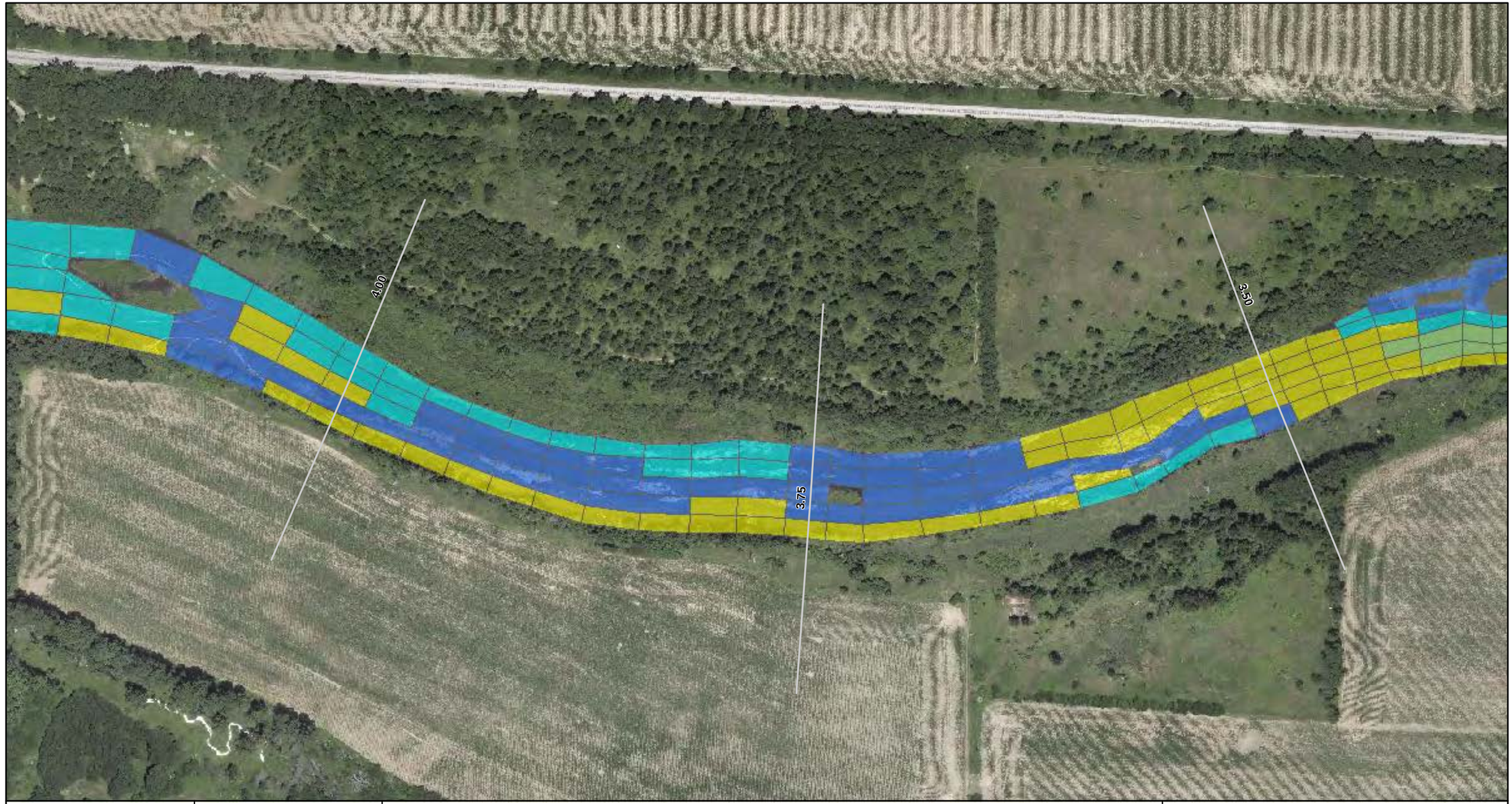
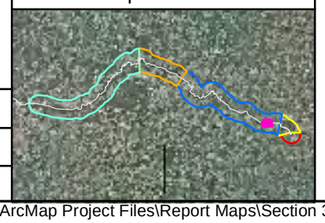
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

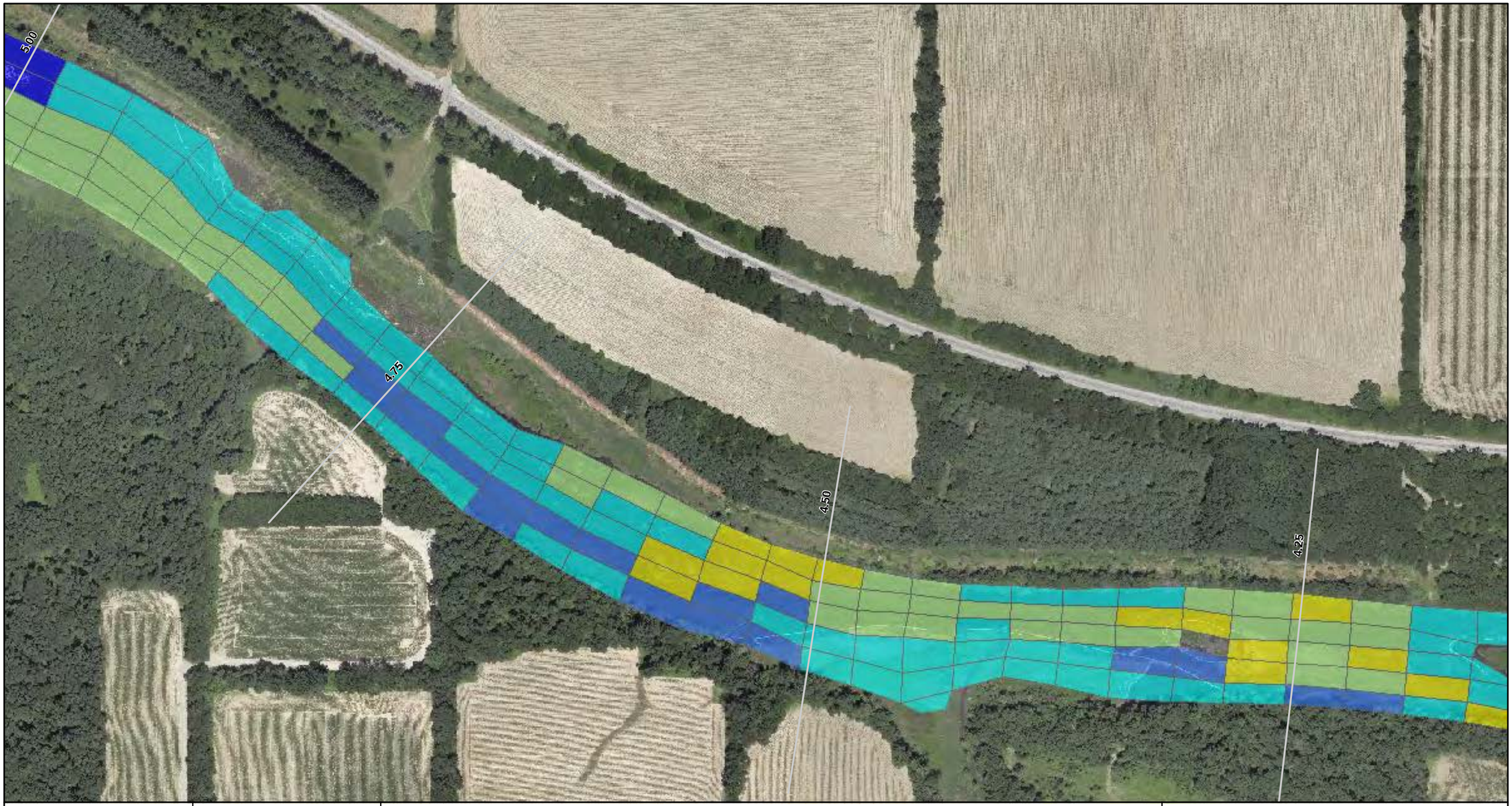
MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

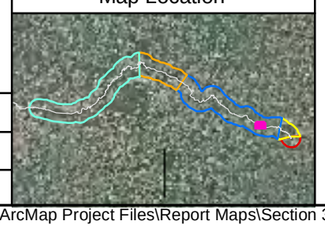
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500
Scale in Feet

RIVERINE GRID: PERCENT SAND

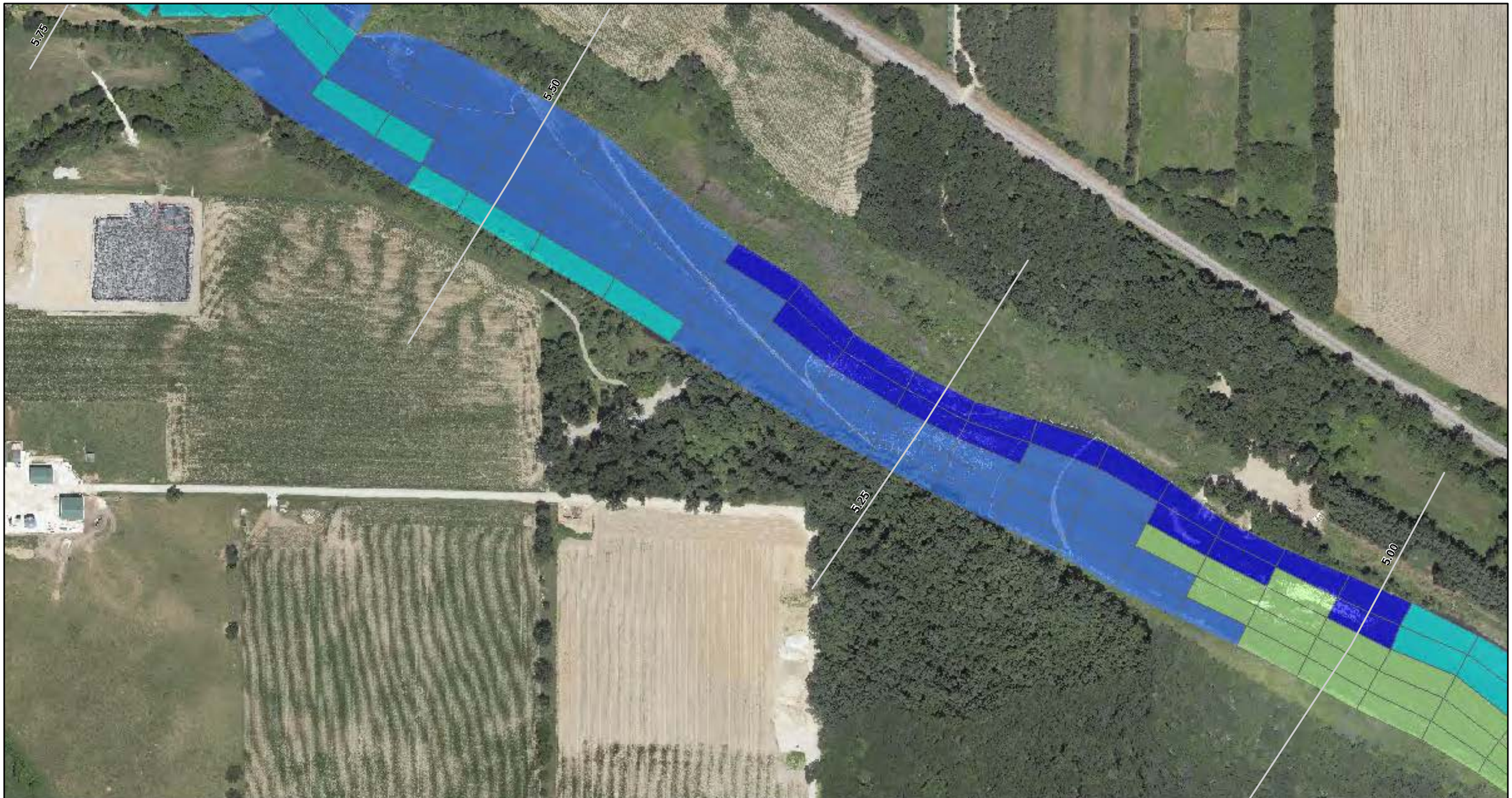
MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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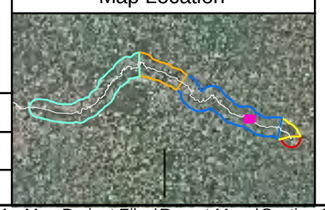
Aerial Photography Date: July 2011

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

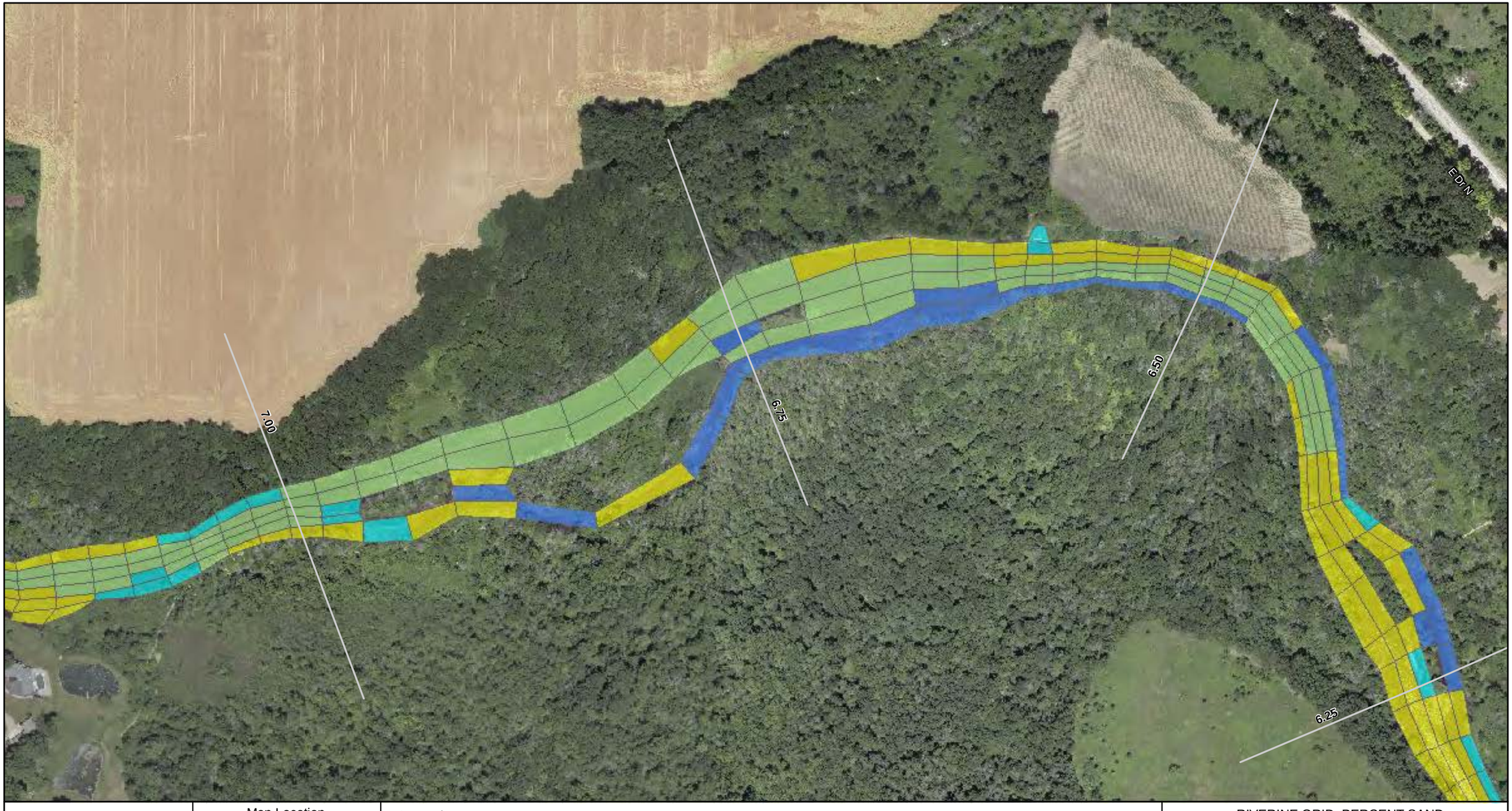
MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

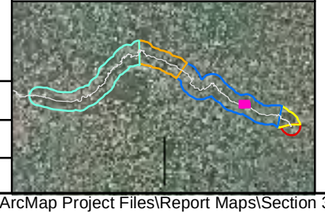
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

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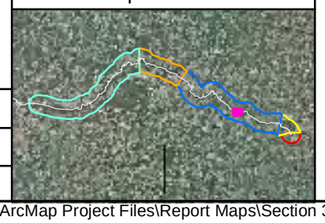
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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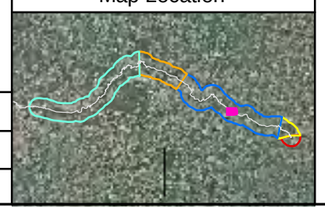
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

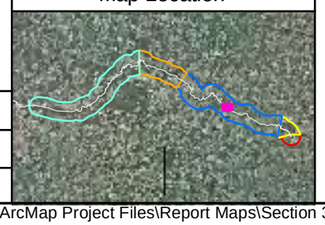
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

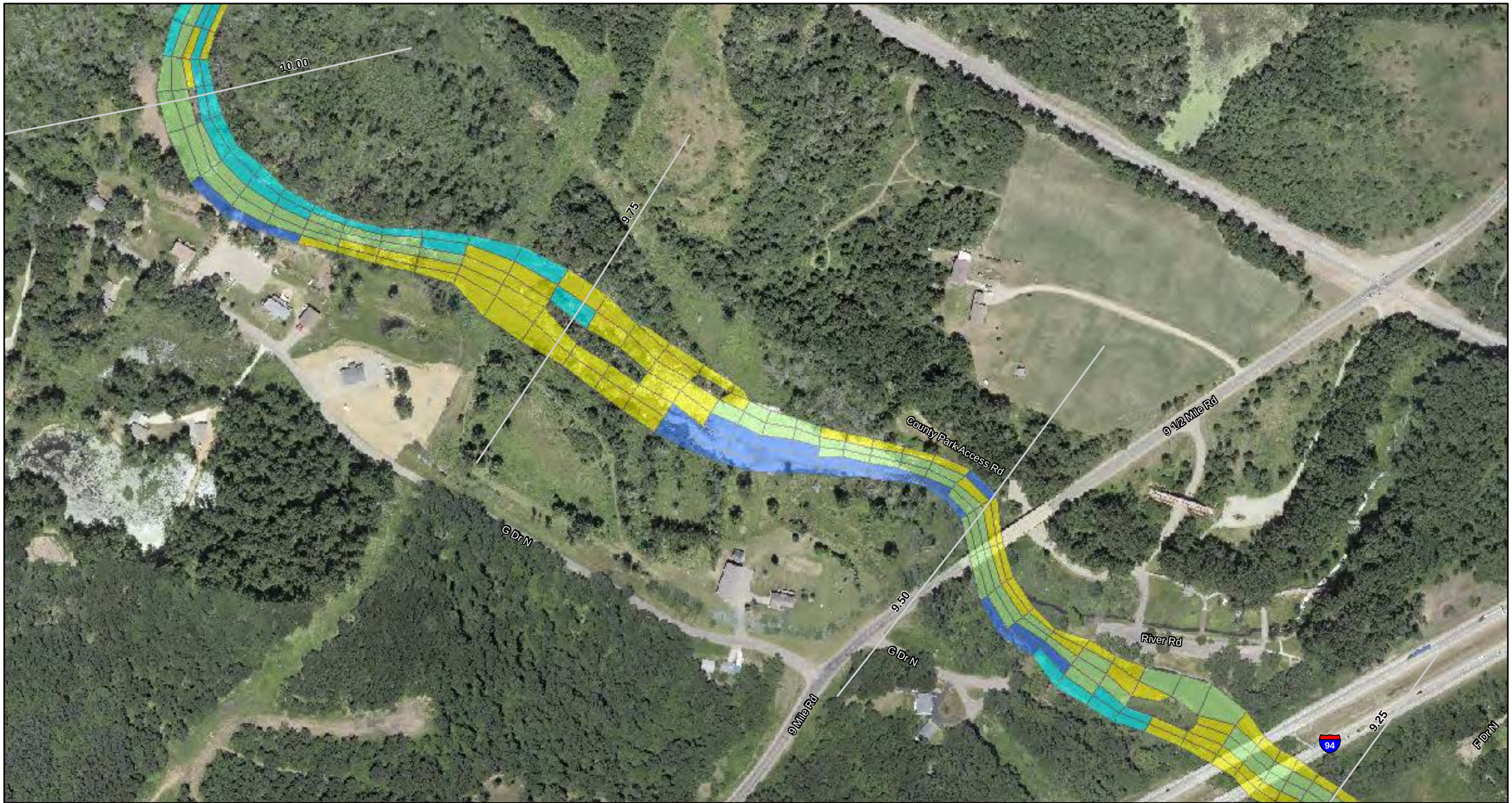
MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

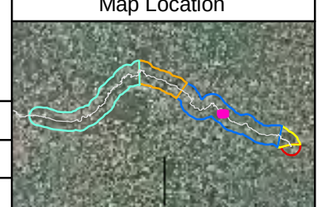
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

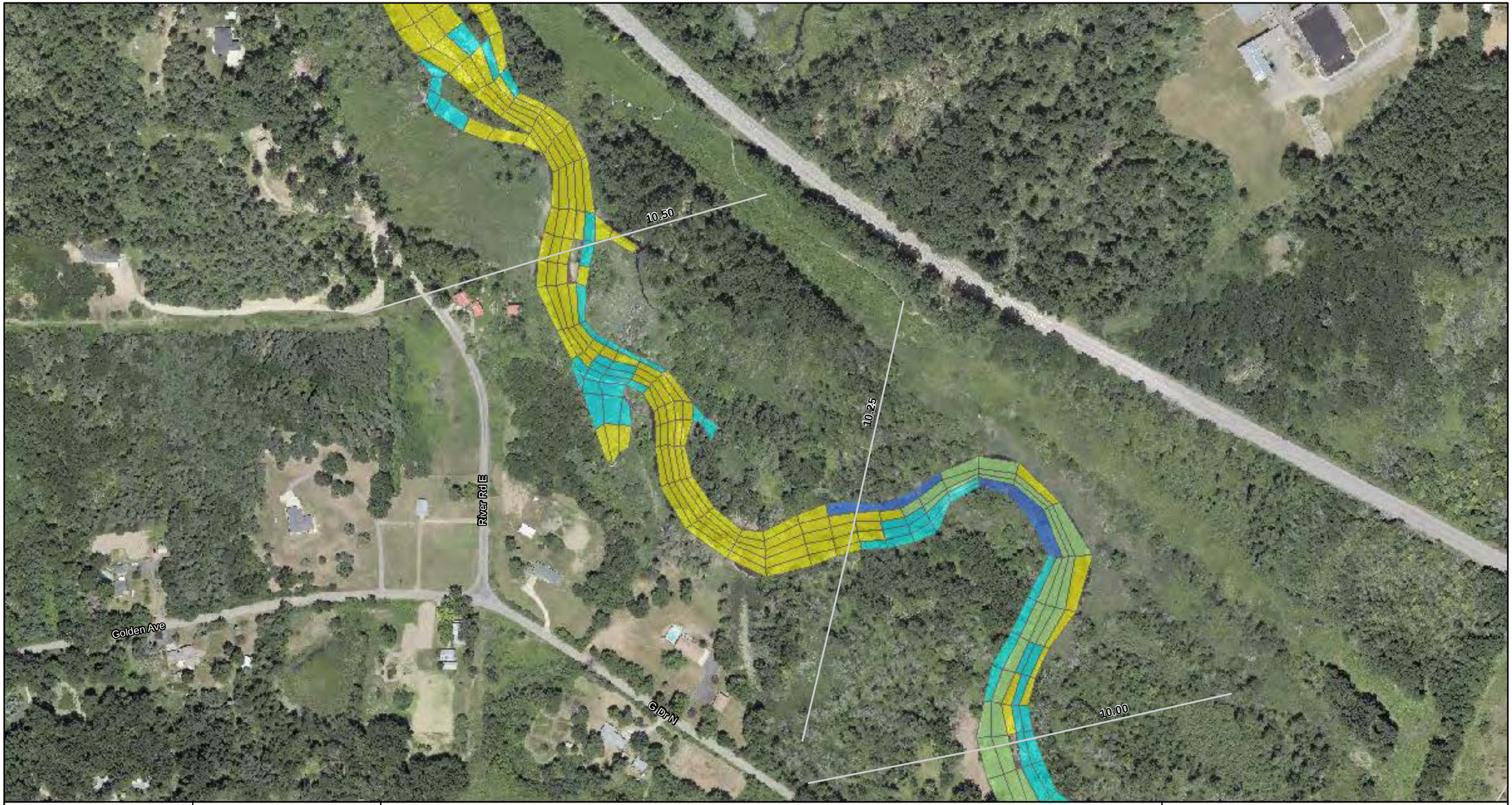
MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

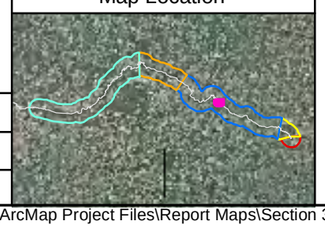
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

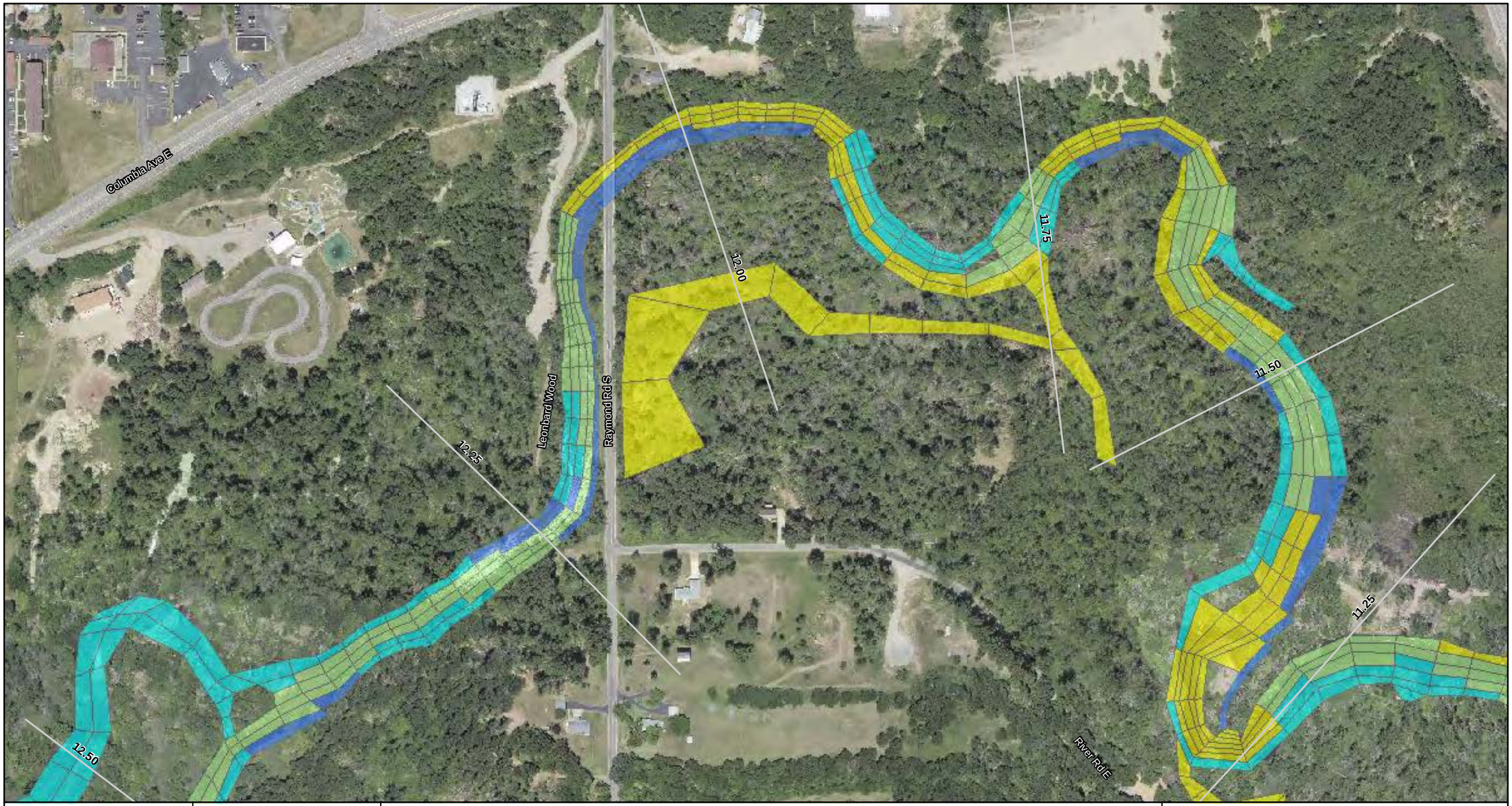
MP 10.60 - MP 11.40

SHEET 13 OF 56

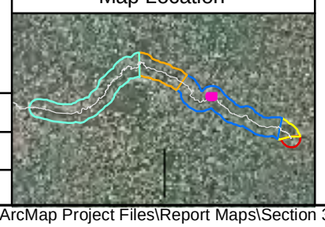
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500
Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 11.10 - MP 12.45

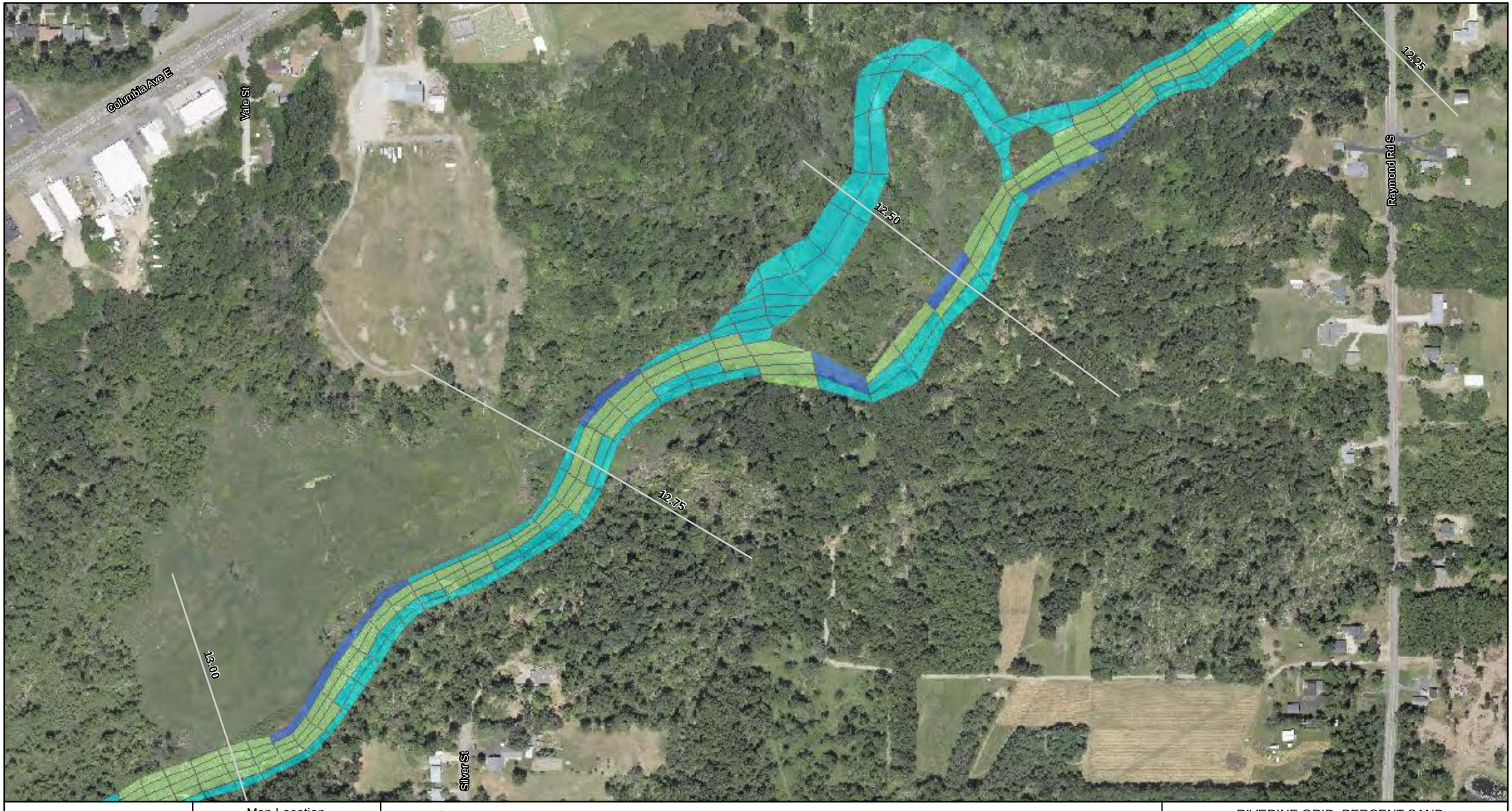
SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

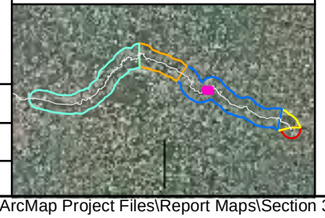
Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

RIVERINE GRID: PERCENT SAND

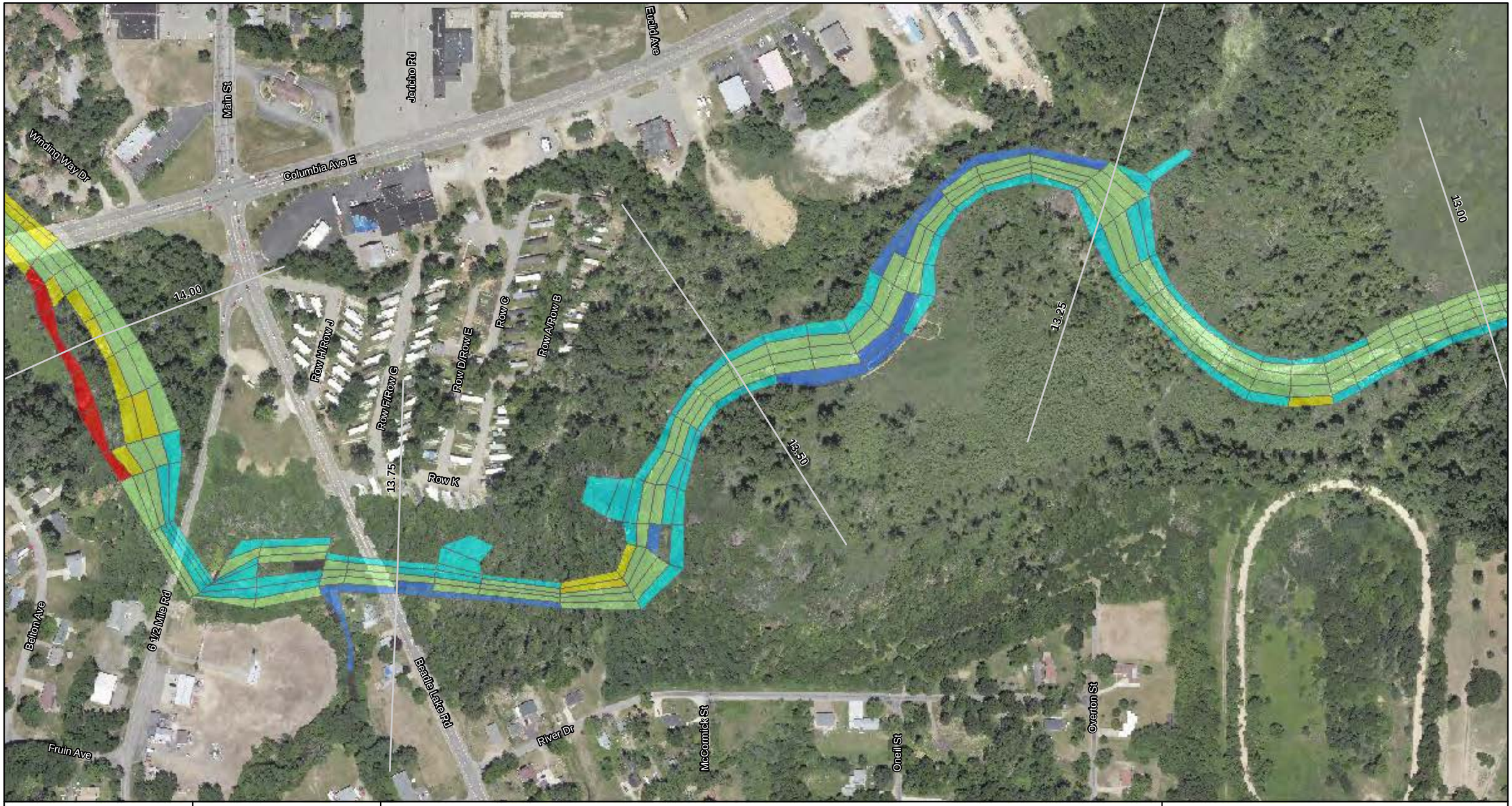
MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

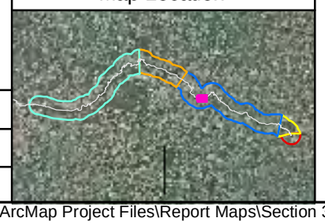
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

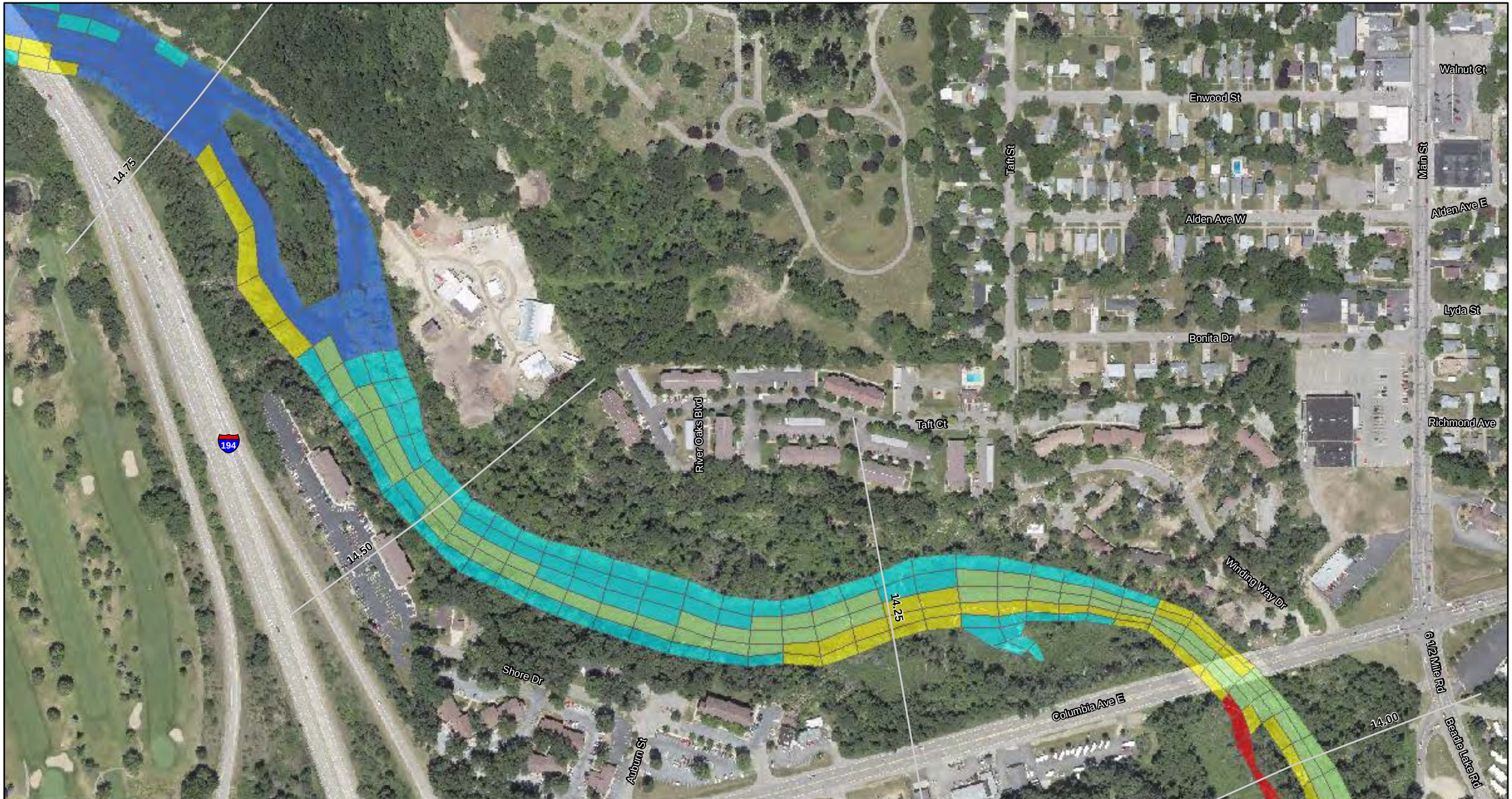
MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand

- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

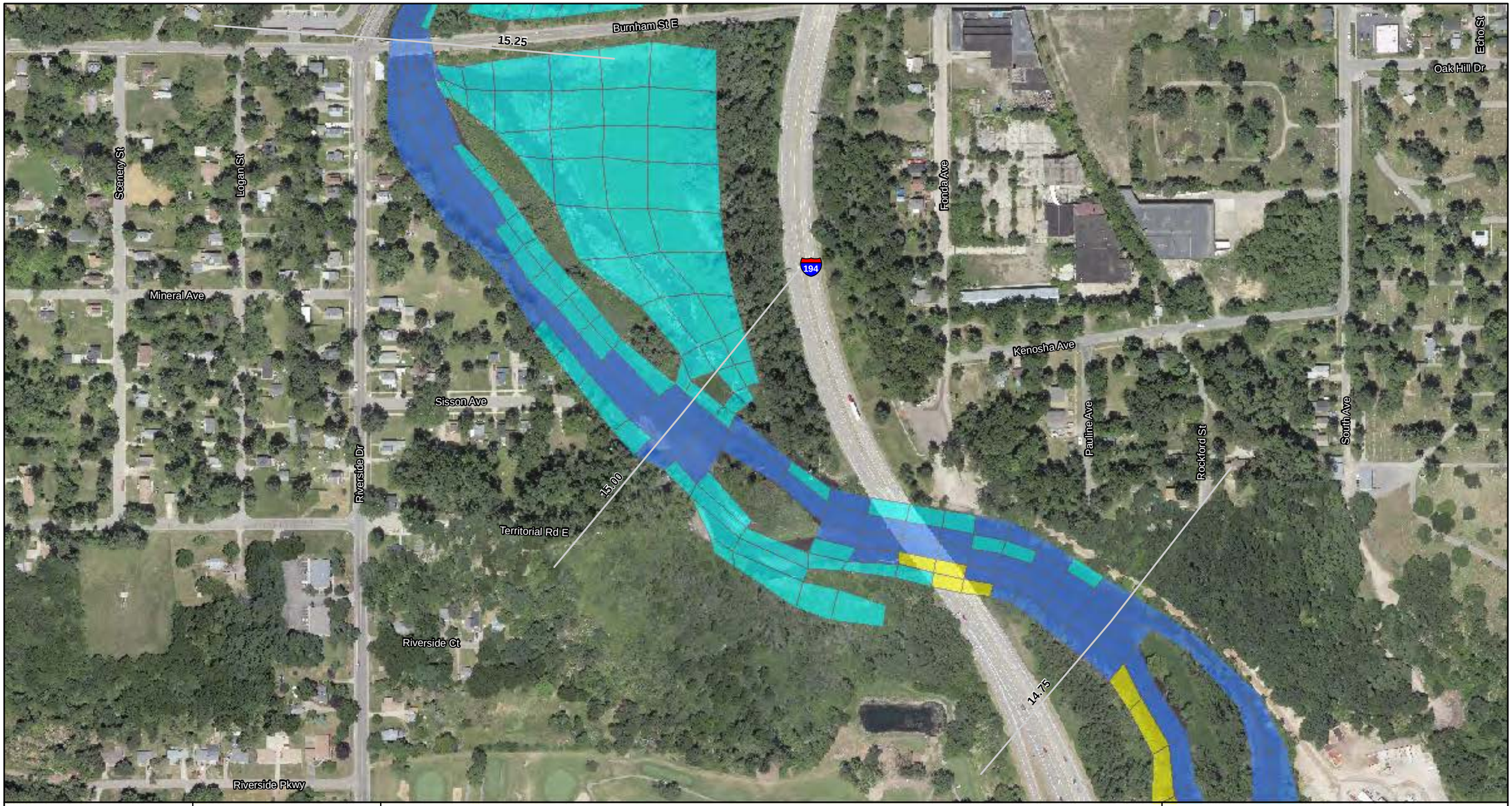
MP 14.00 - MP 14.85

SHEET 17 OF 56

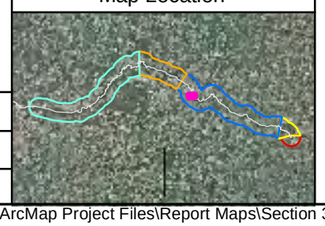
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



Map Location



Legend

% Sand

- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

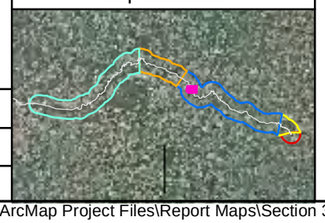
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

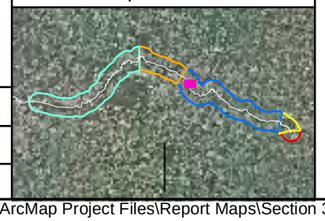
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand

- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

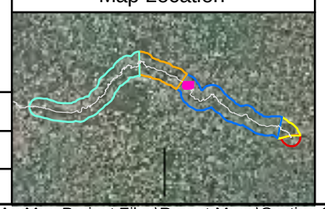
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand

- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

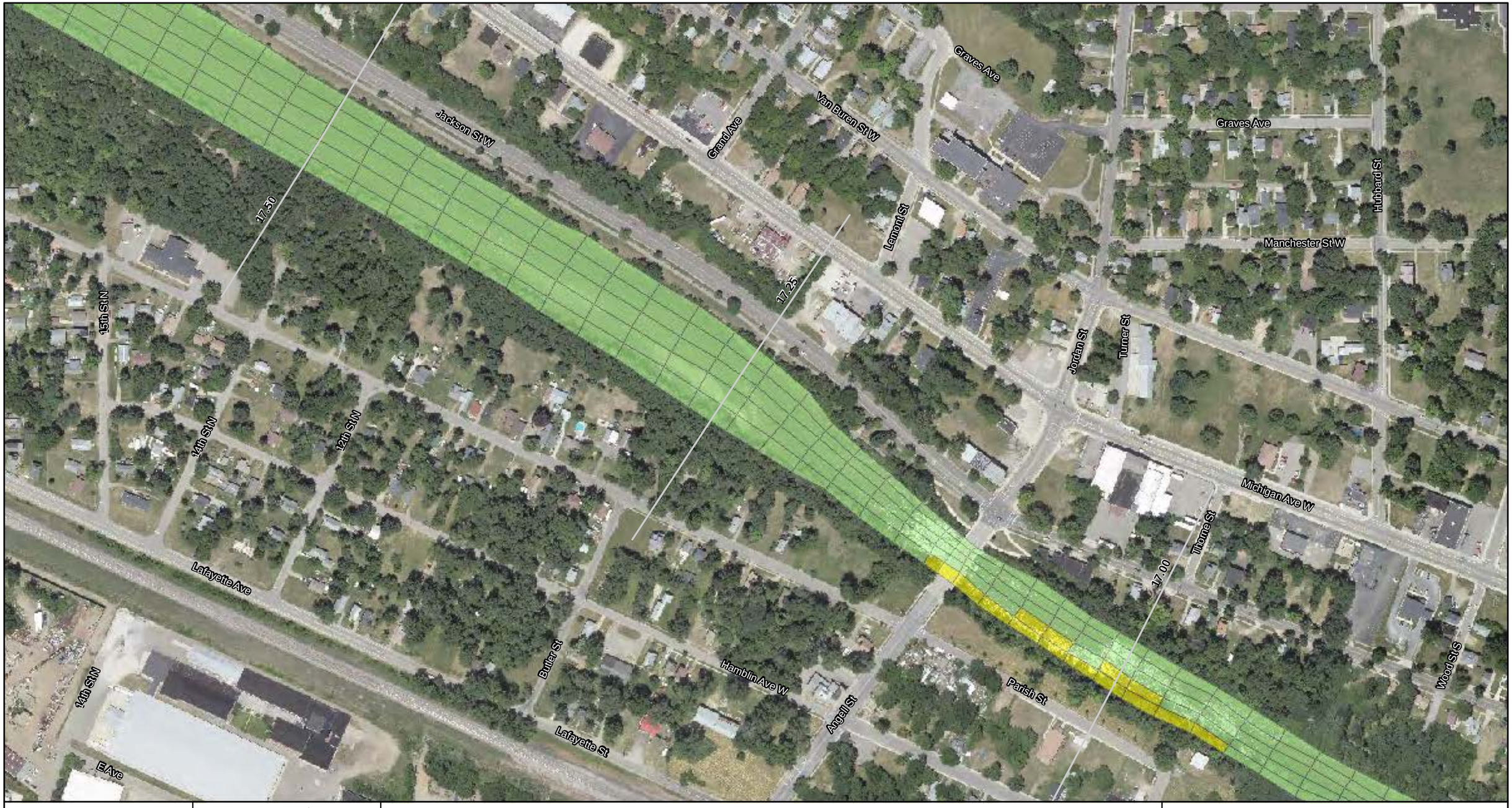
MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

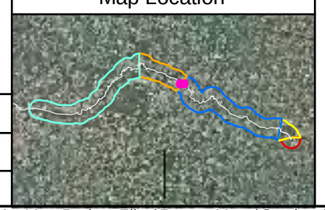
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand

- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

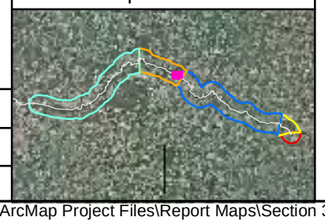
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

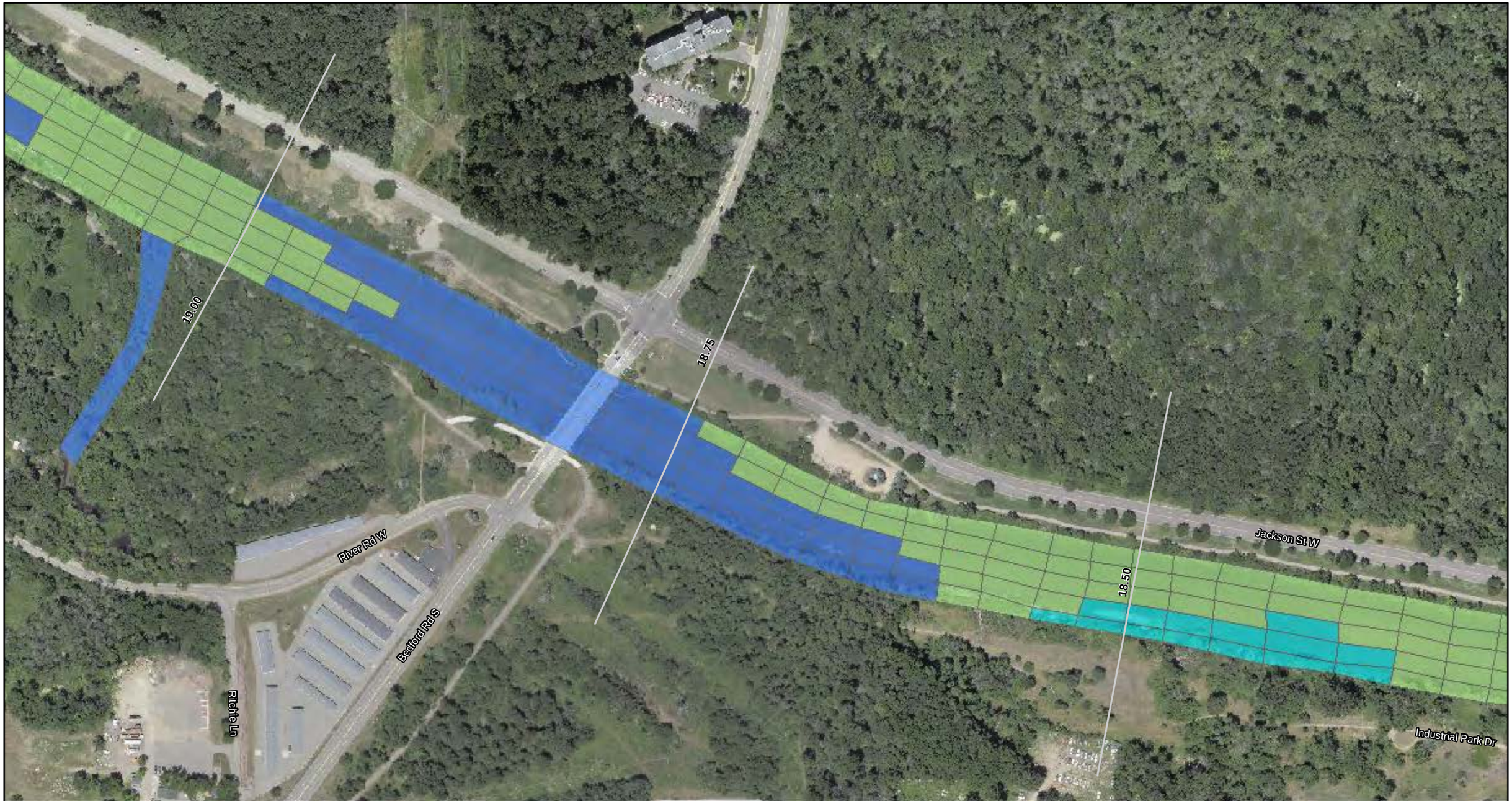
MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

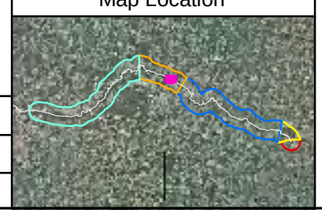
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

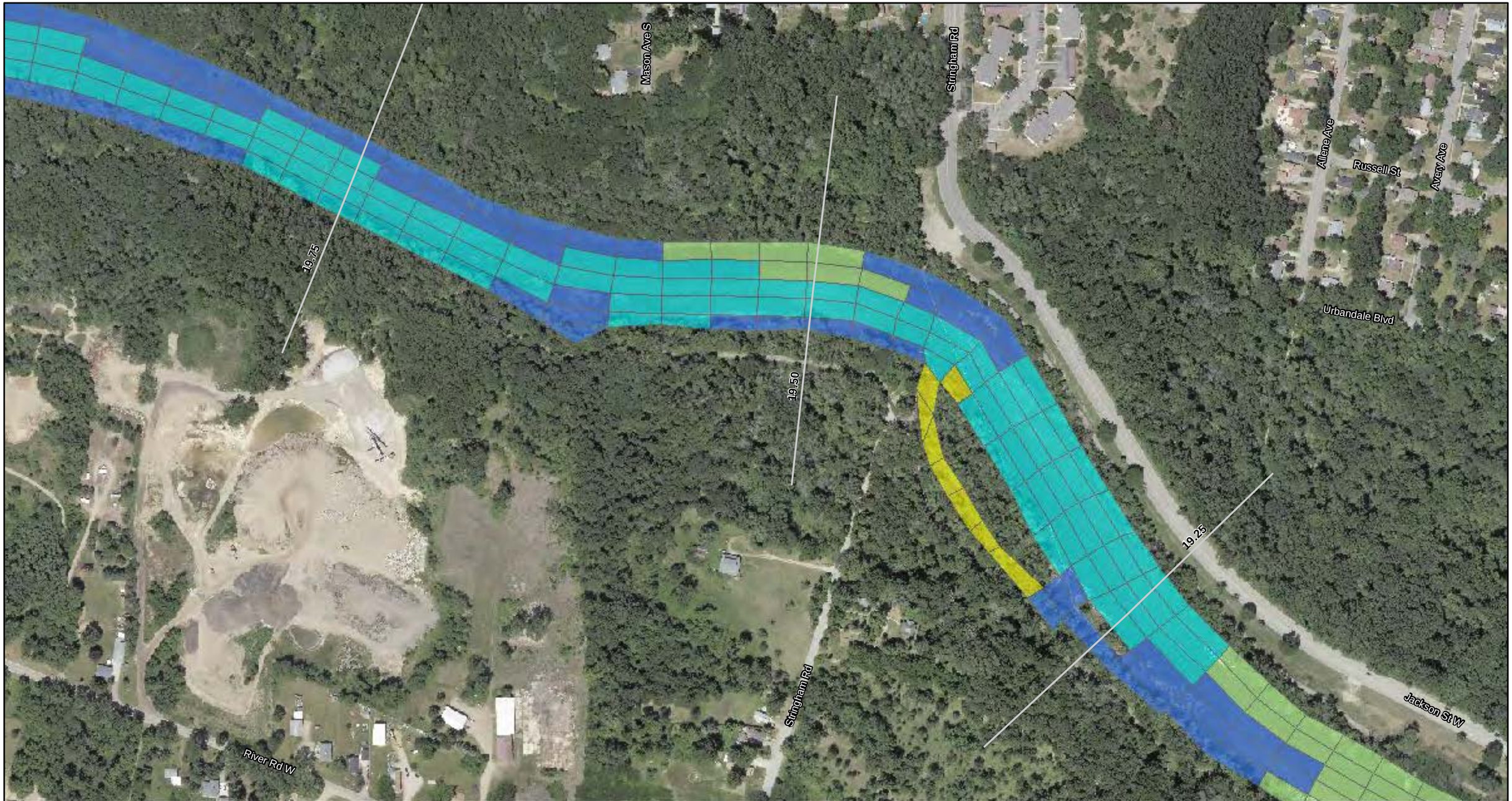
MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

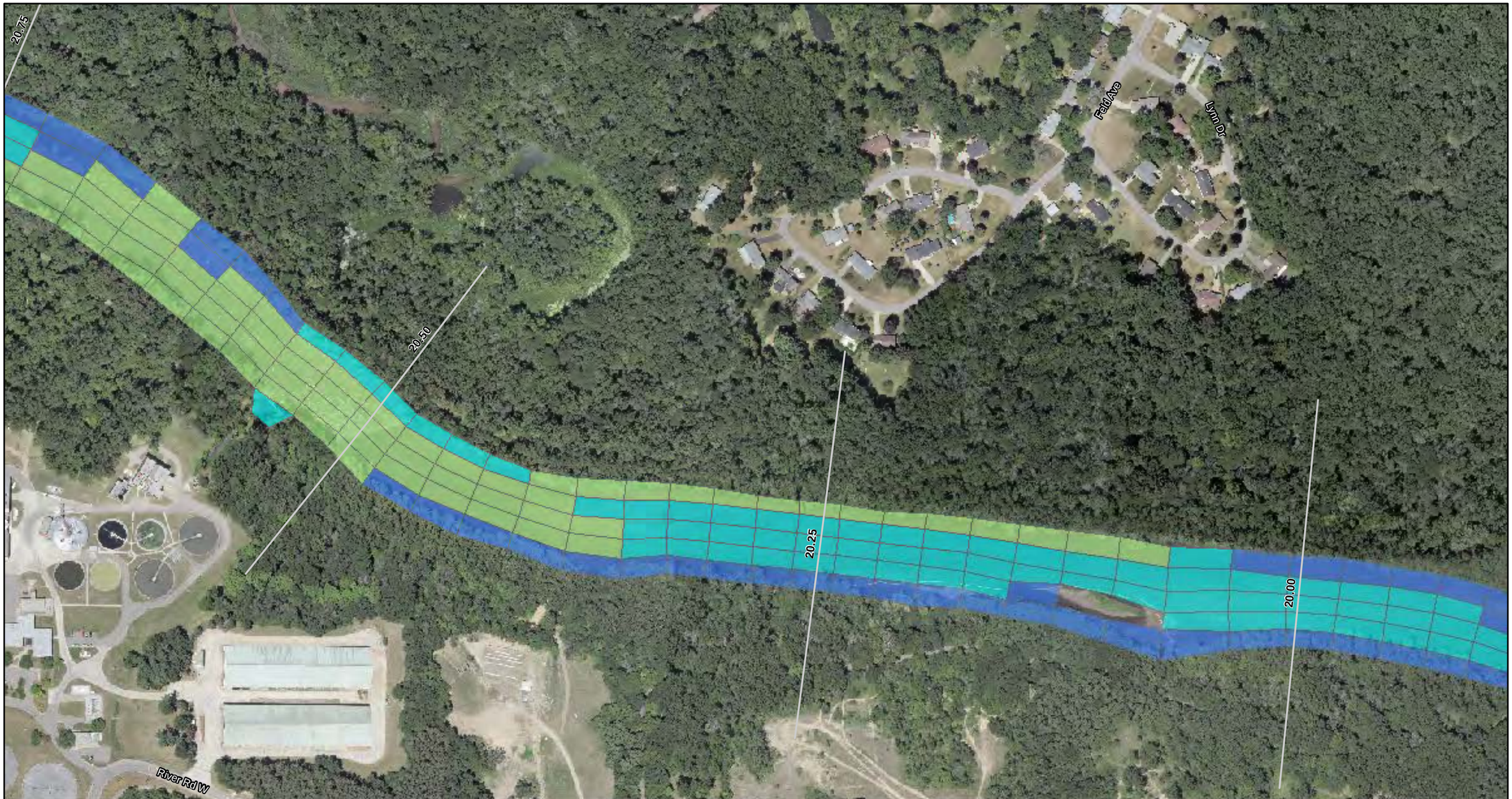
MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

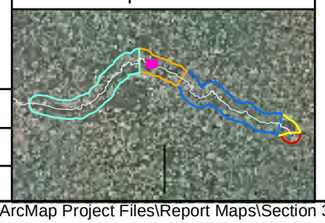
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

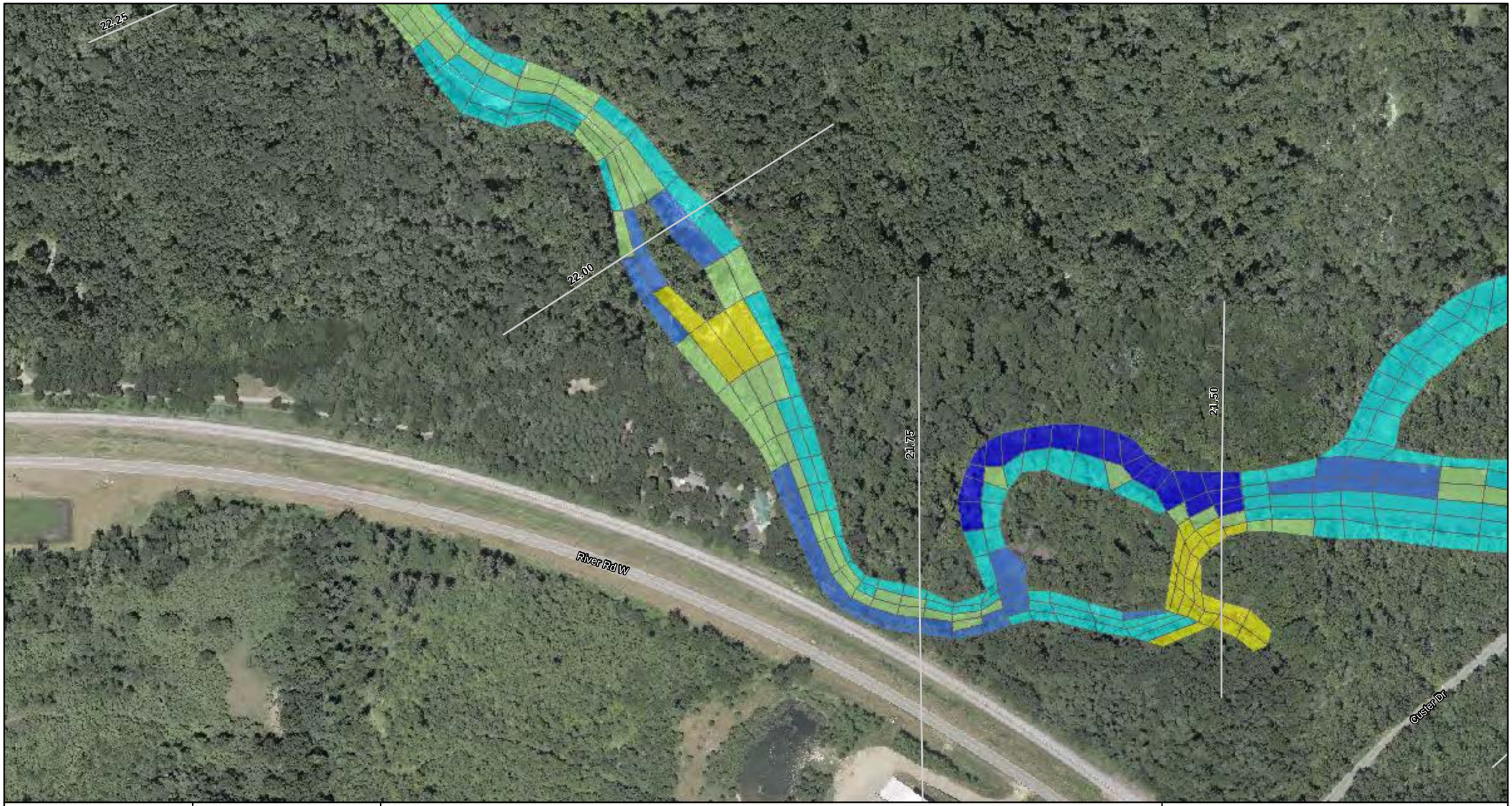
MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

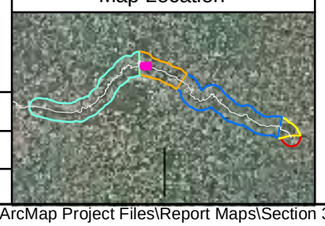
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500
Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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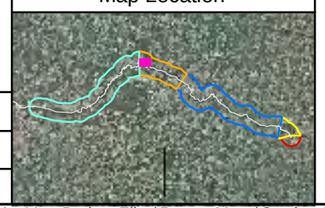
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

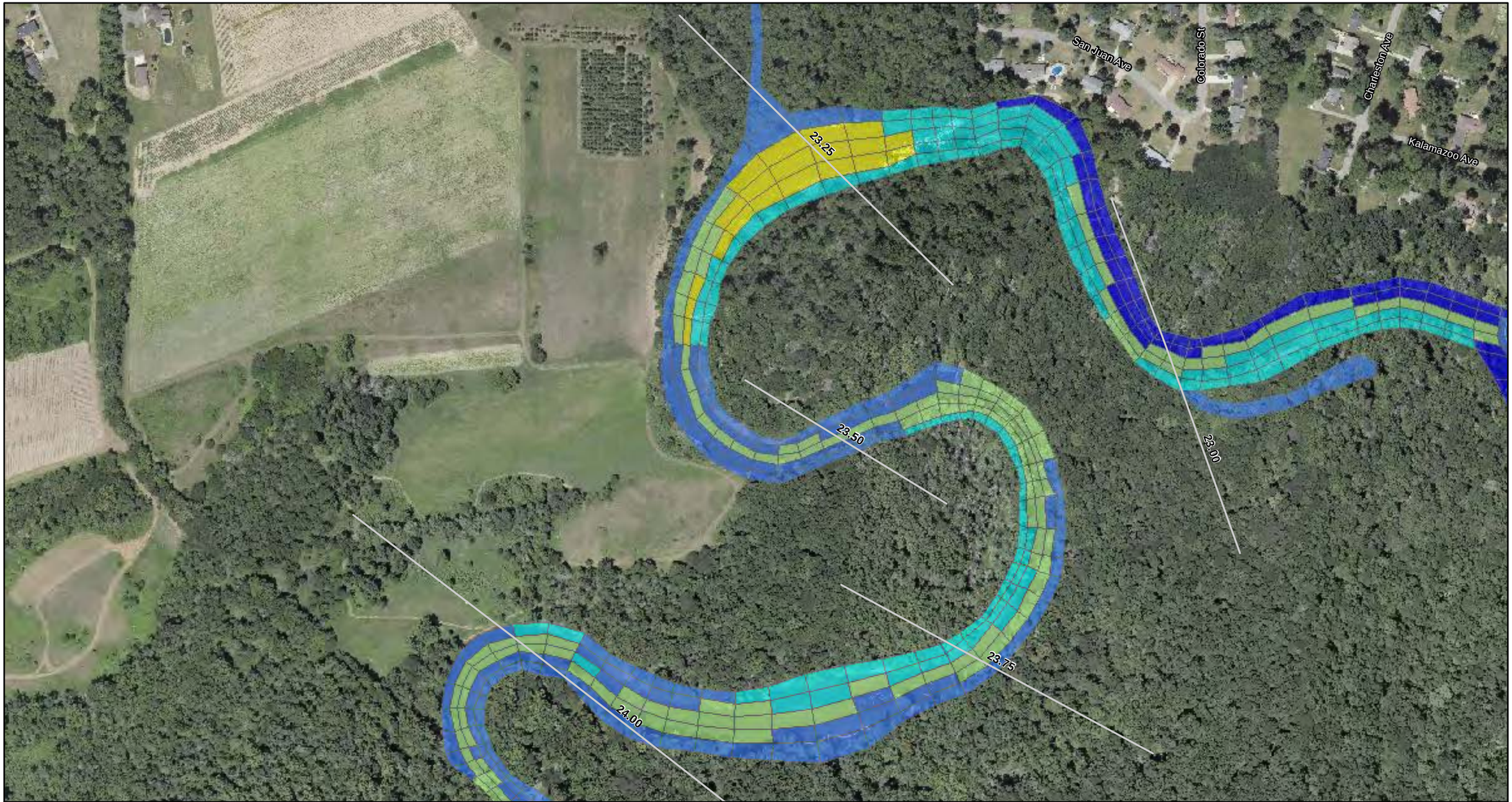
MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

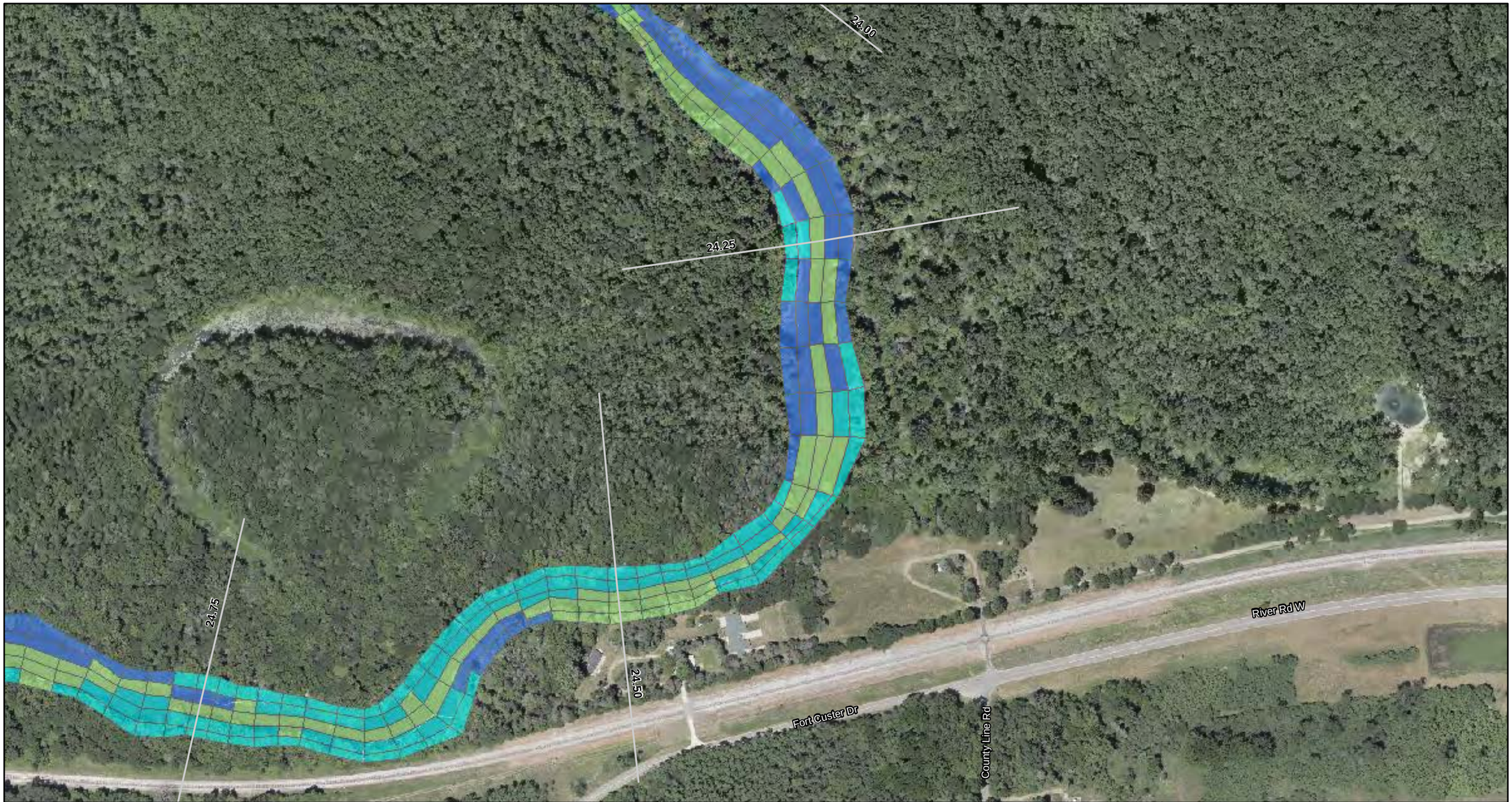
MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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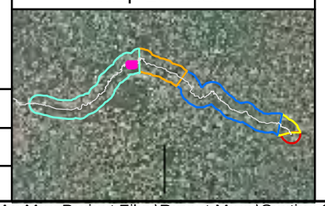
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

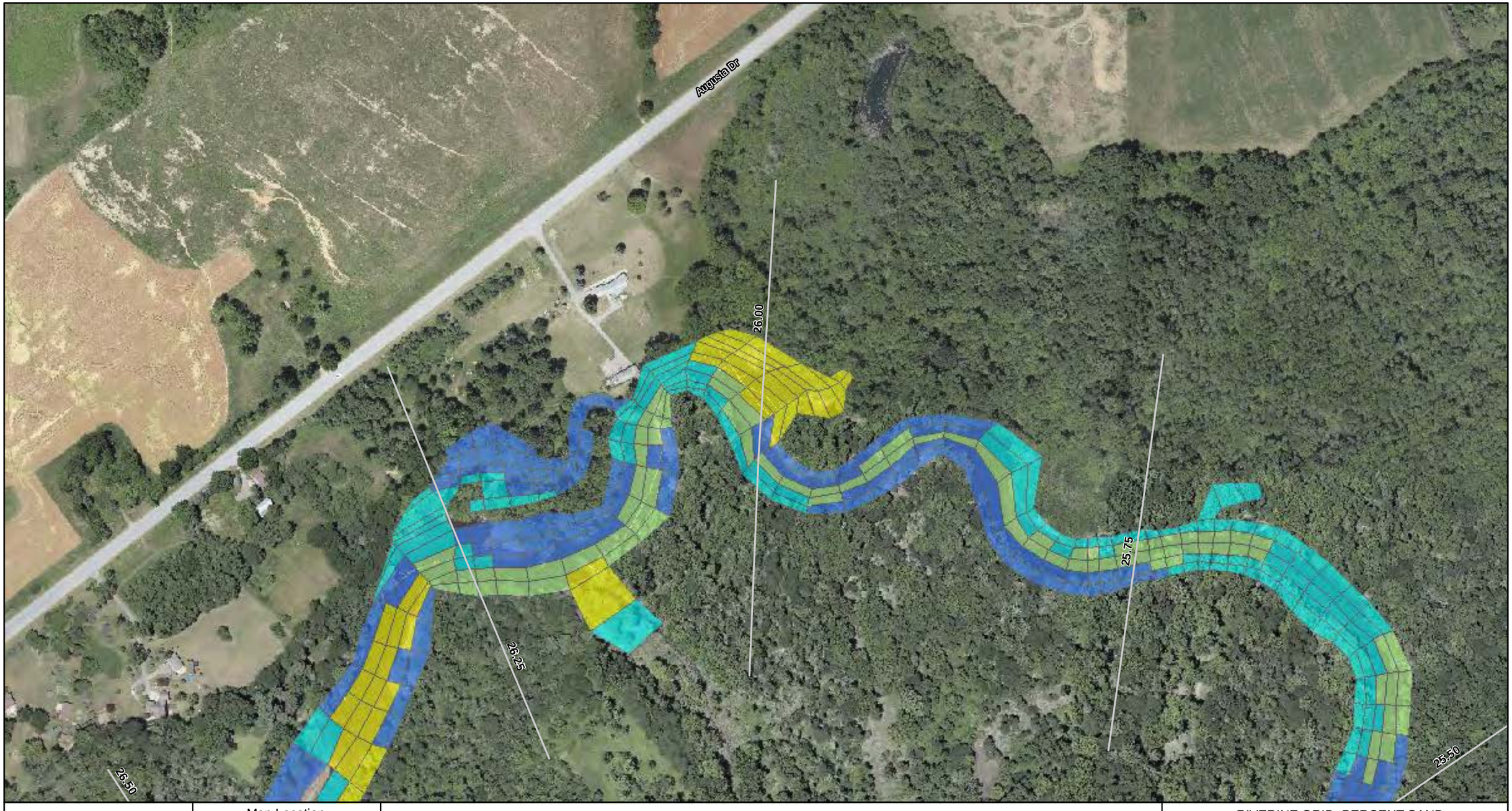
MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

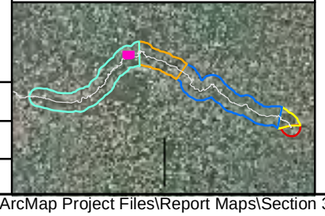
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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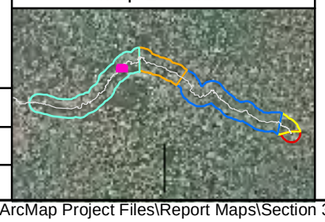
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

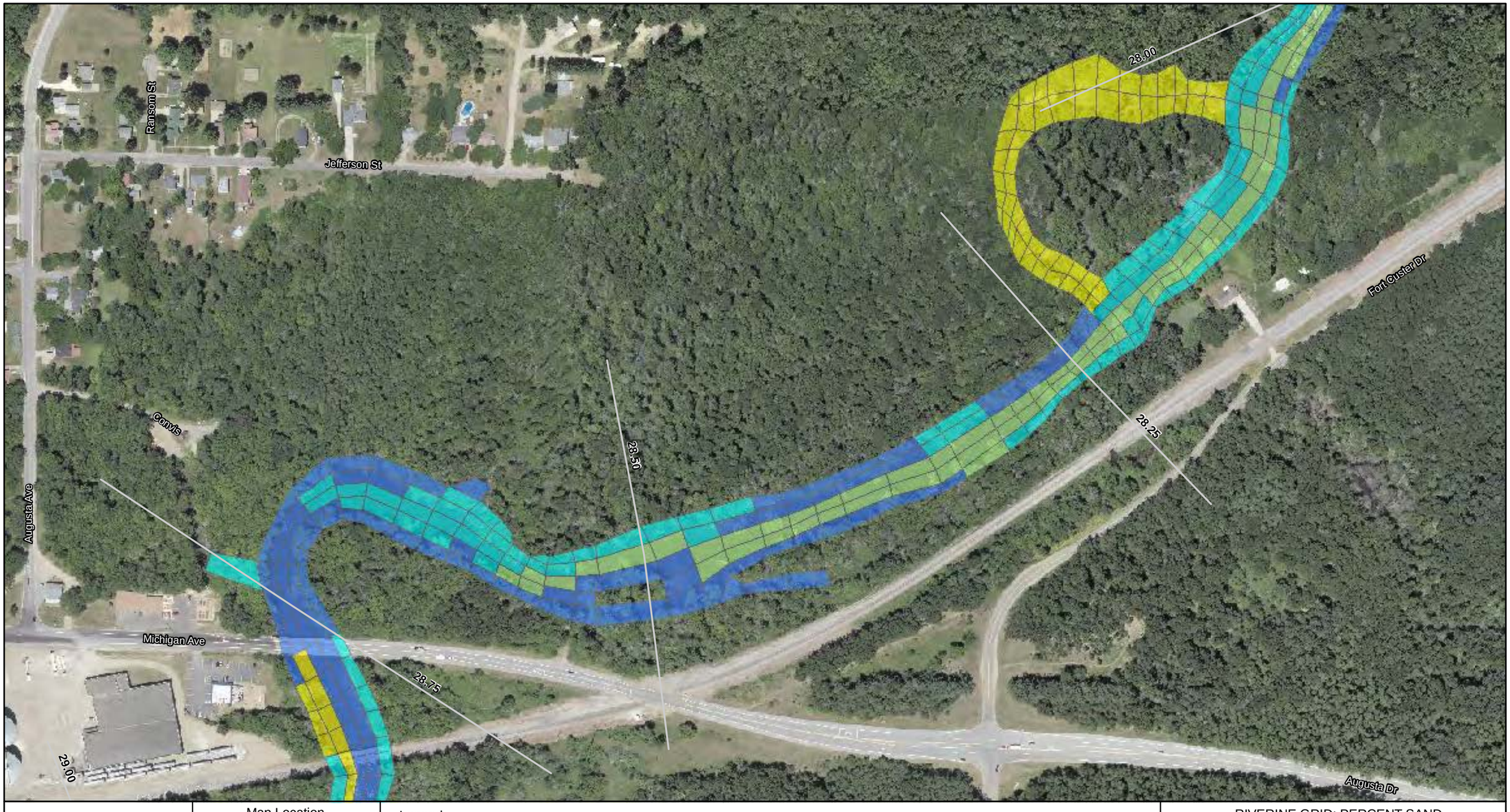
MP 27.45 - MP 28.10

SHEET 35 OF 56

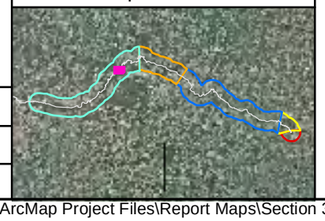
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

RIVERINE GRID: PERCENT SAND

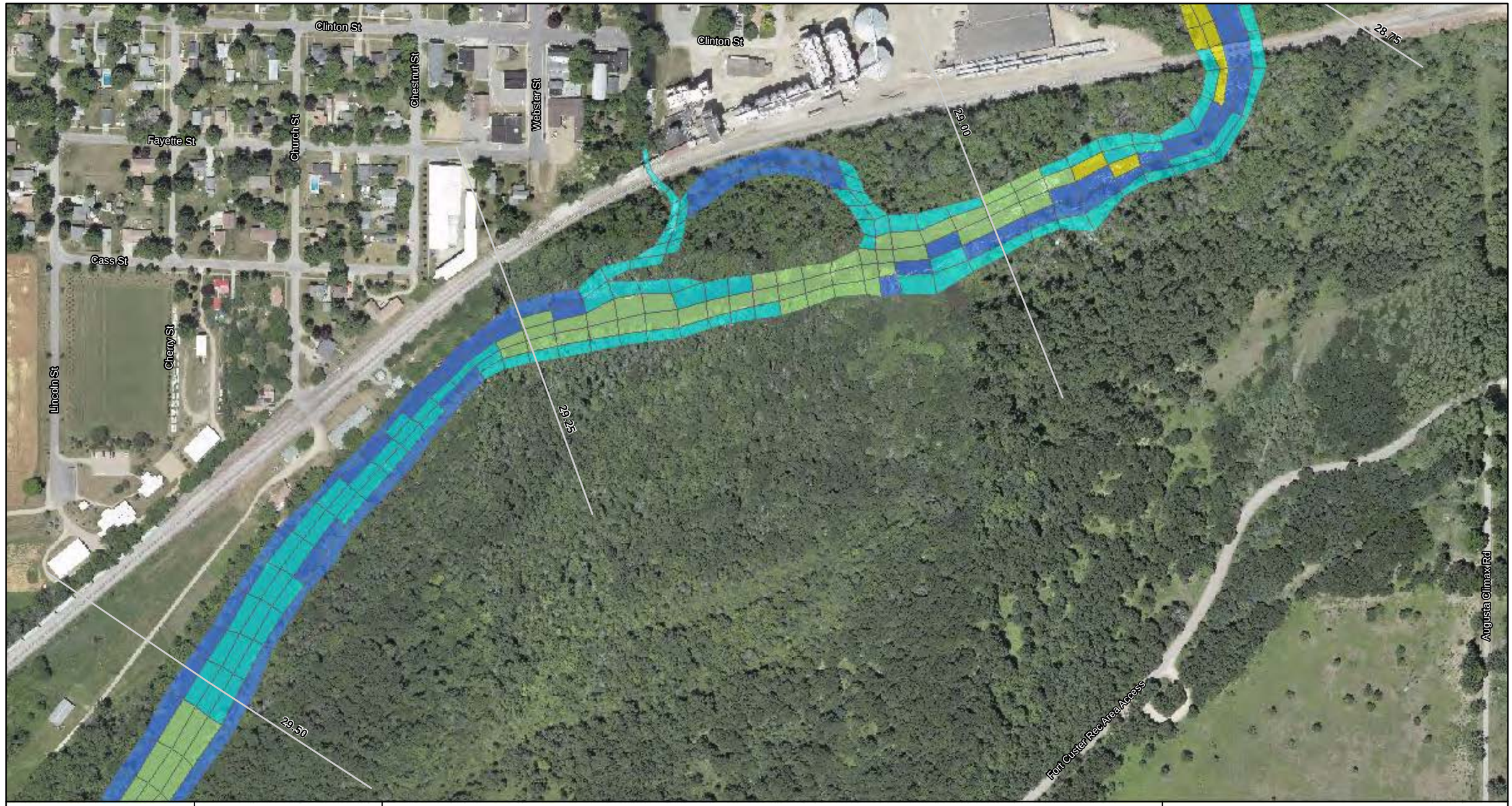
MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

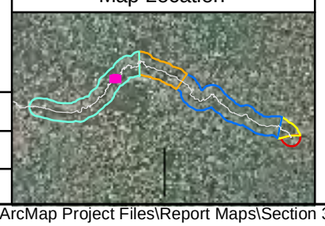
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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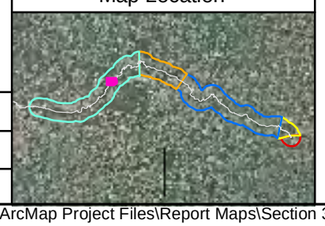
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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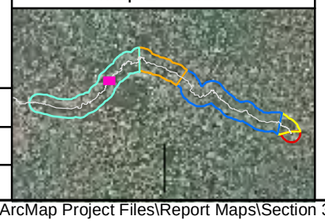
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

30.75

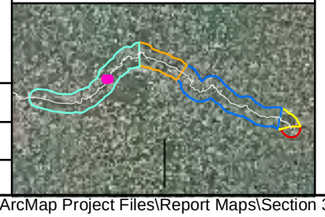
31.00

31.25

Bicycle Trail

Fort Custer Rec Area Access

Map Location



Legend

% Sand

- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

RIVERINE GRID: PERCENT SAND

MP 30.75 - MP 31.25

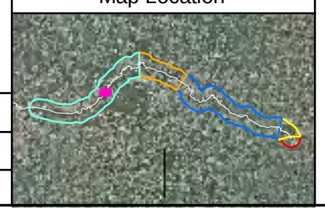
SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500
Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

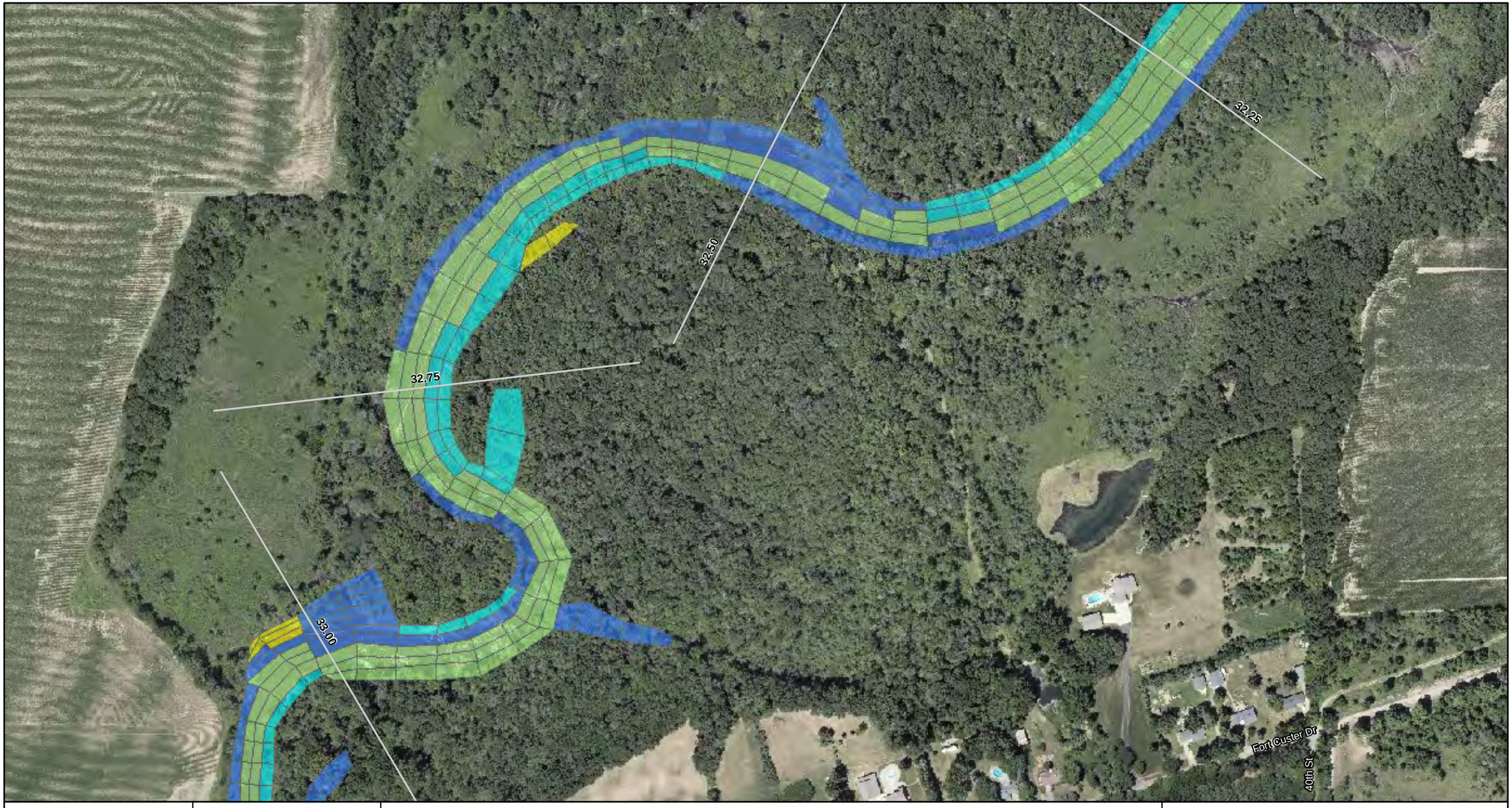
MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

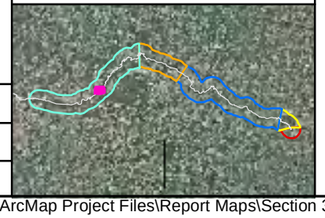
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

33.00
33.25
33.50
33.75
Fort Custer Dr

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500
Scale in Feet

RIVERINE GRID: PERCENT SAND

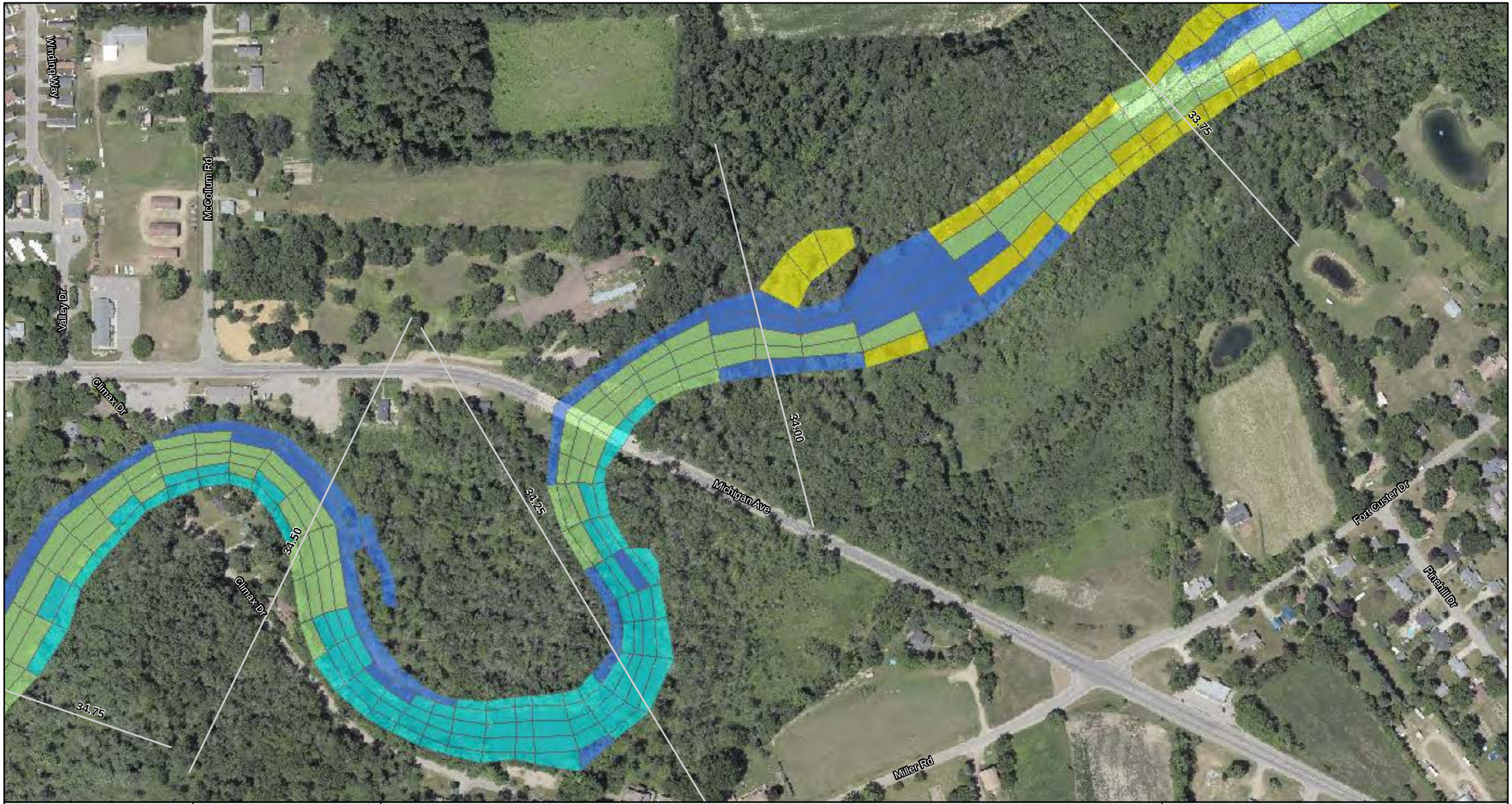
MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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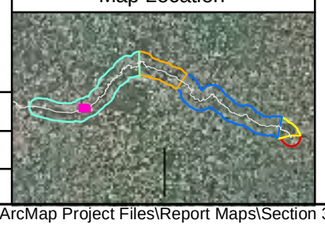
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

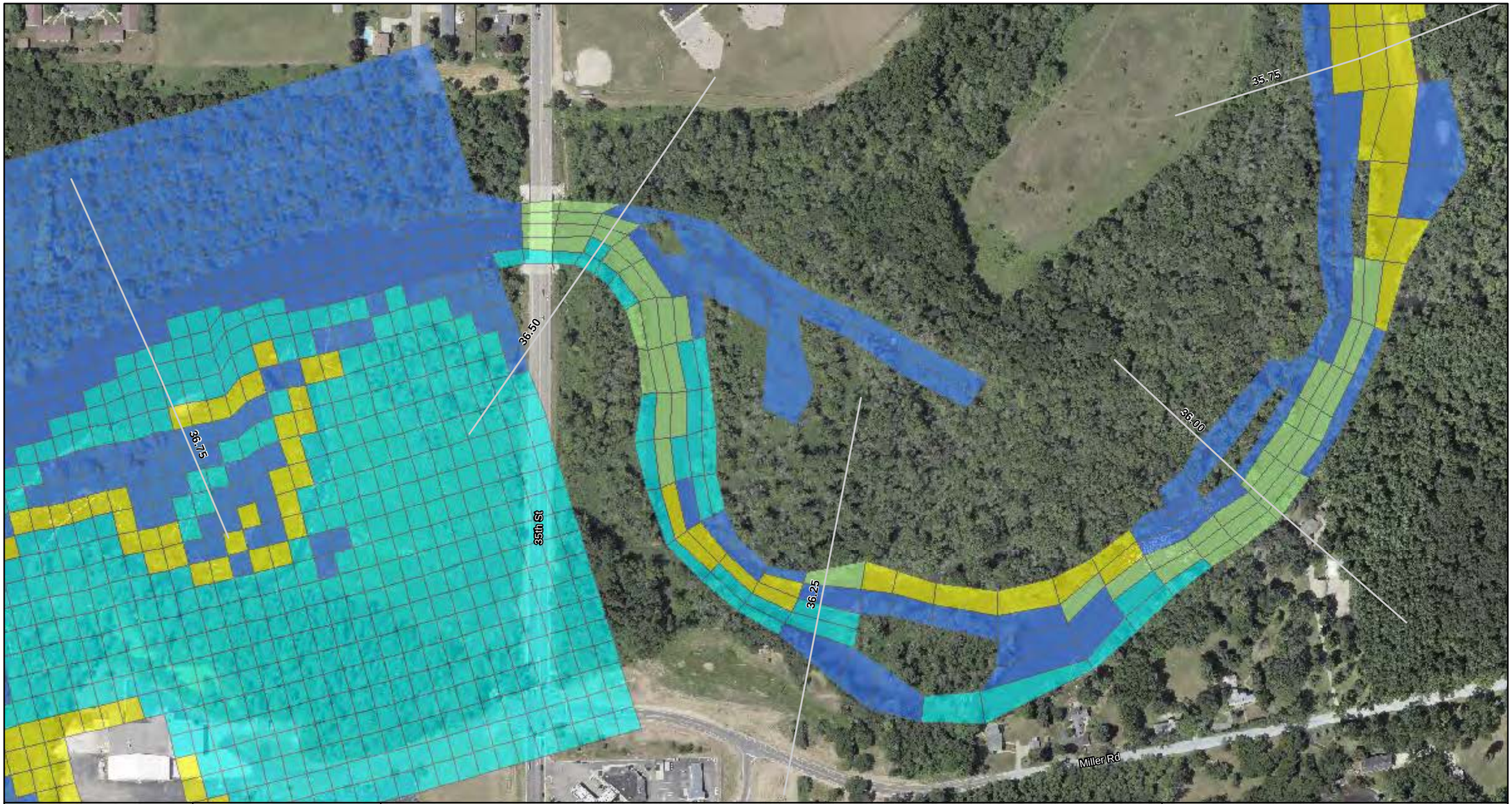
MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

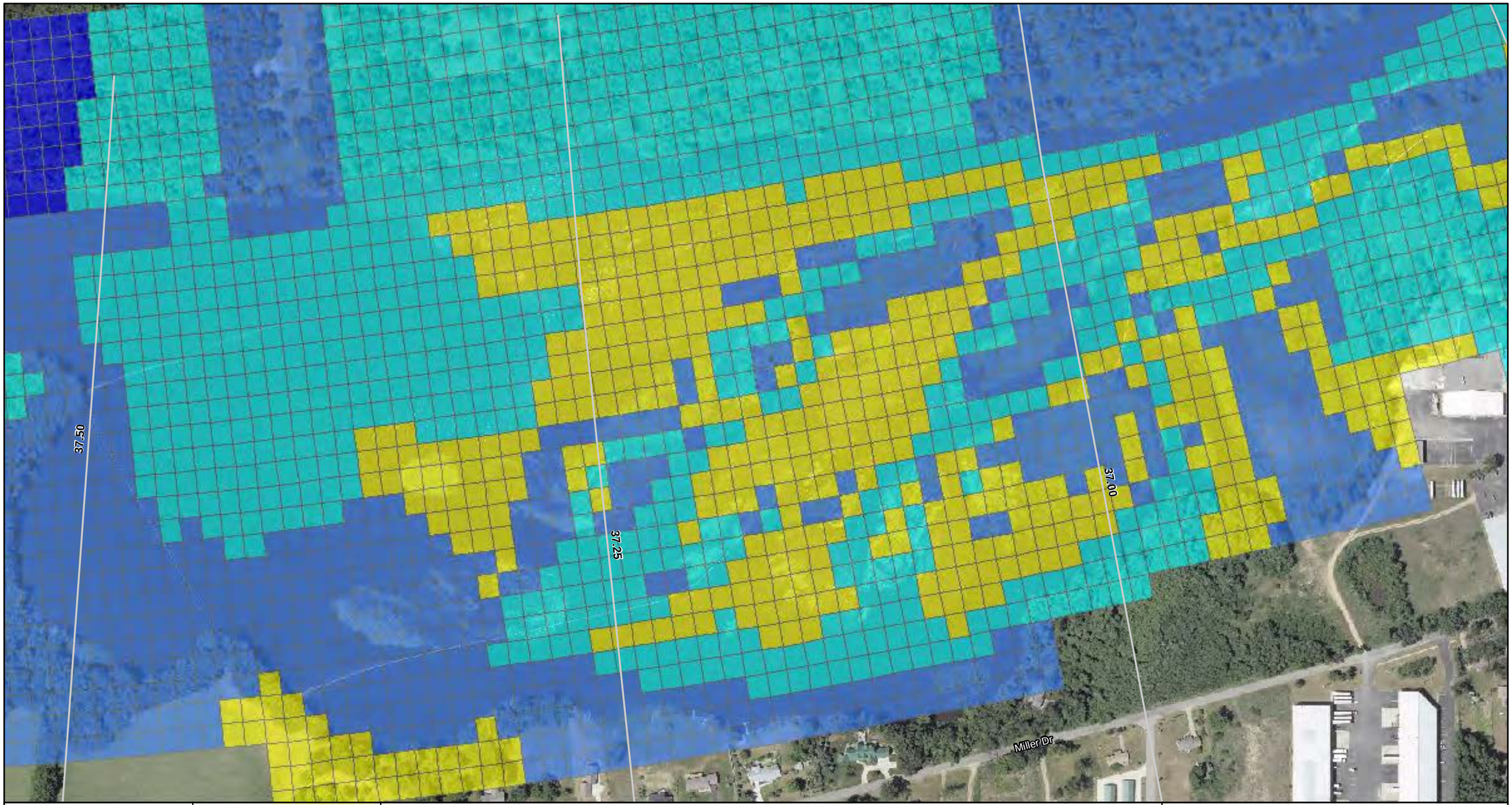
MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

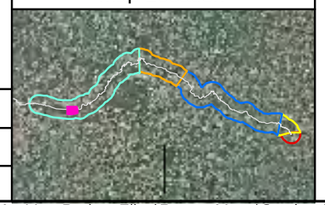
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

38.25

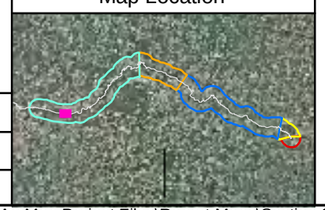
38.00

37.75

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand

- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

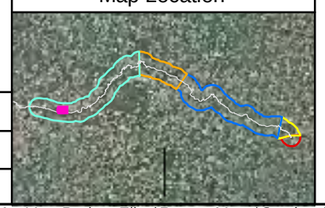
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

38.50

38.25

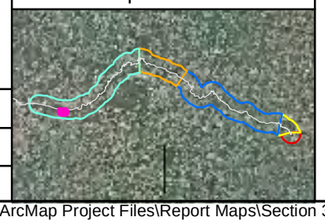
38.00

Lyth Rd

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand

- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

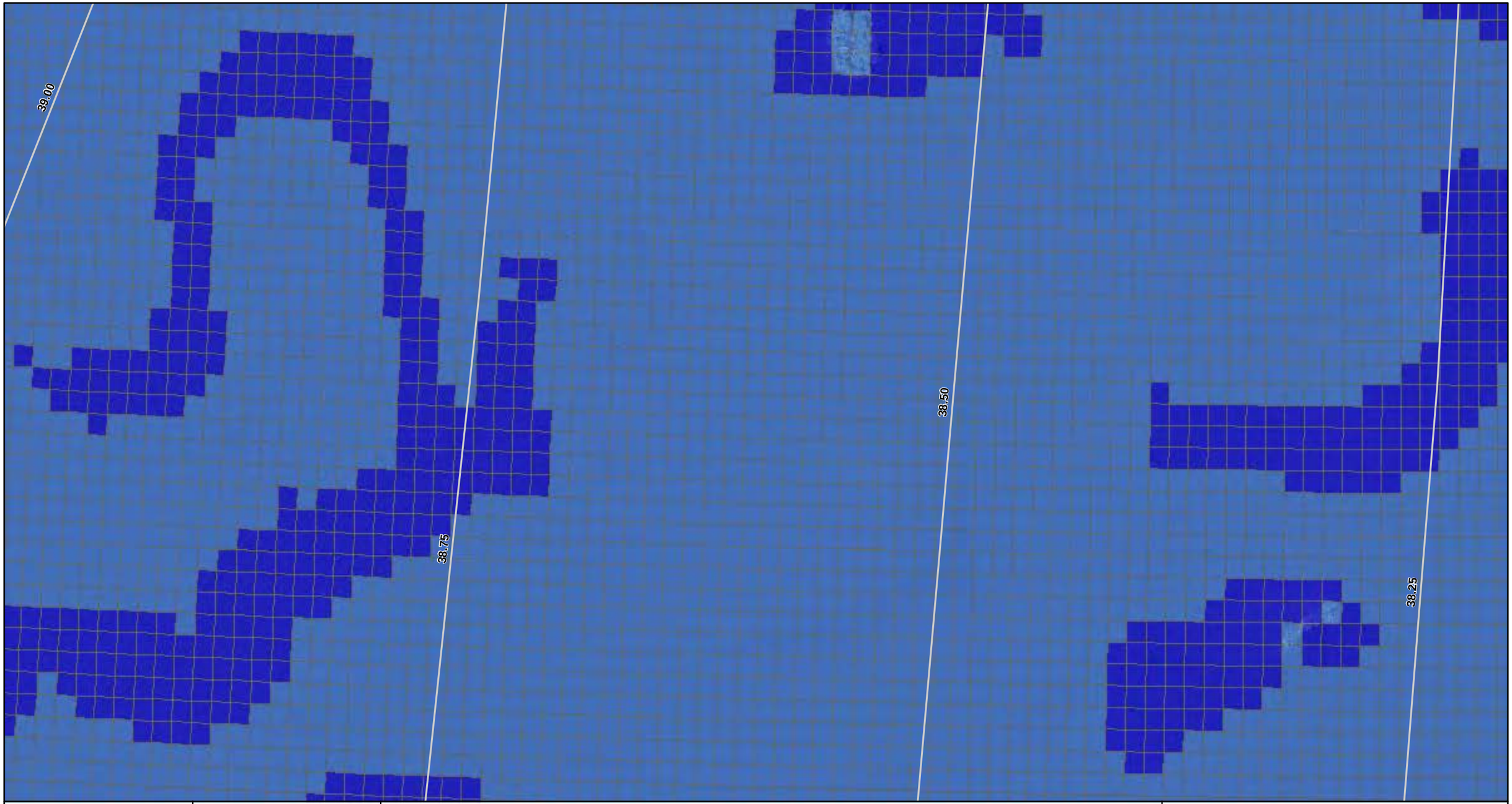
MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

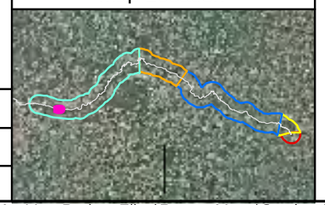
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

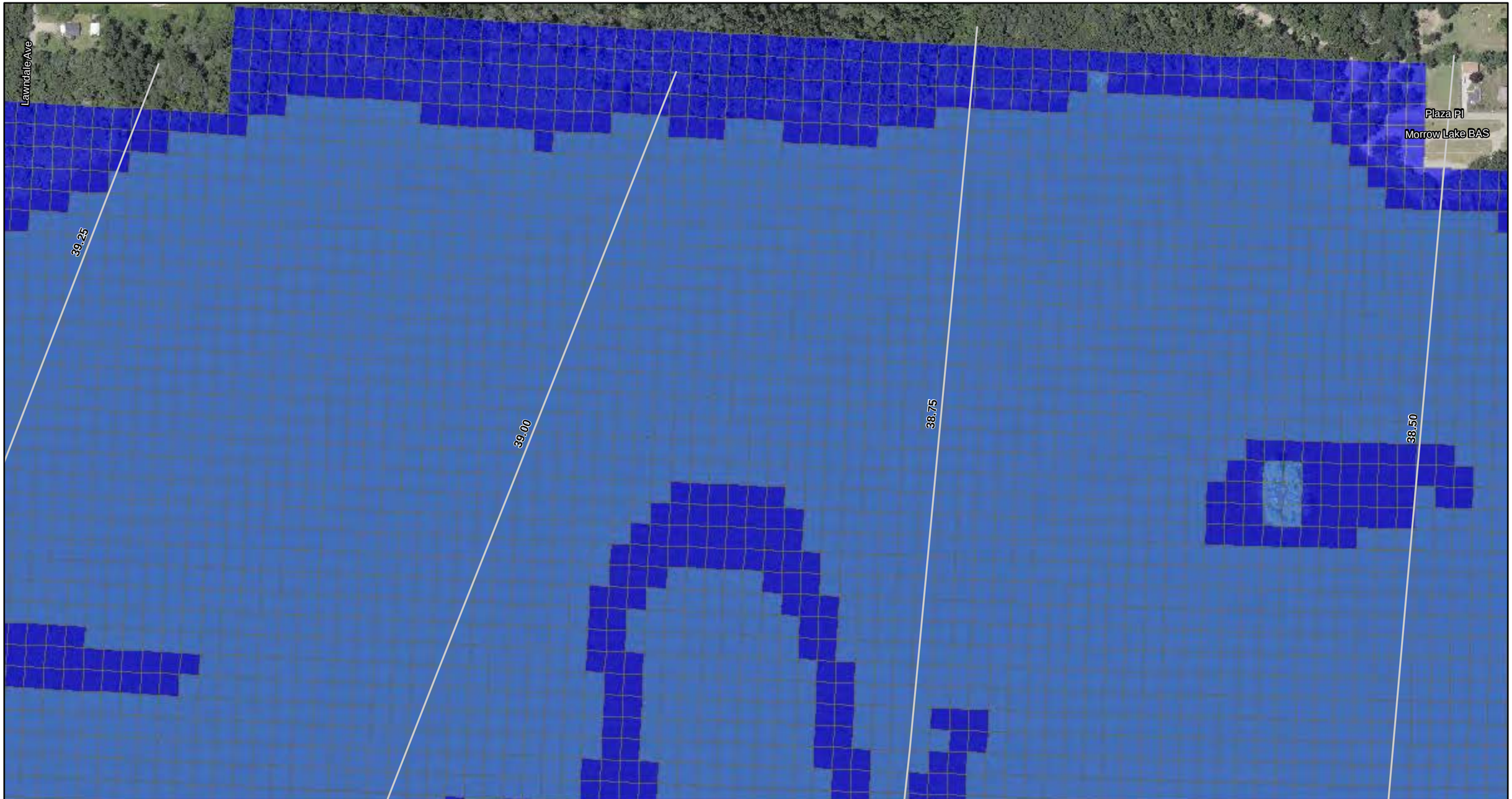
MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

Aerial Photography Date: July 2011

39.25

39.00

38.75

38.50

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

% Sand

- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

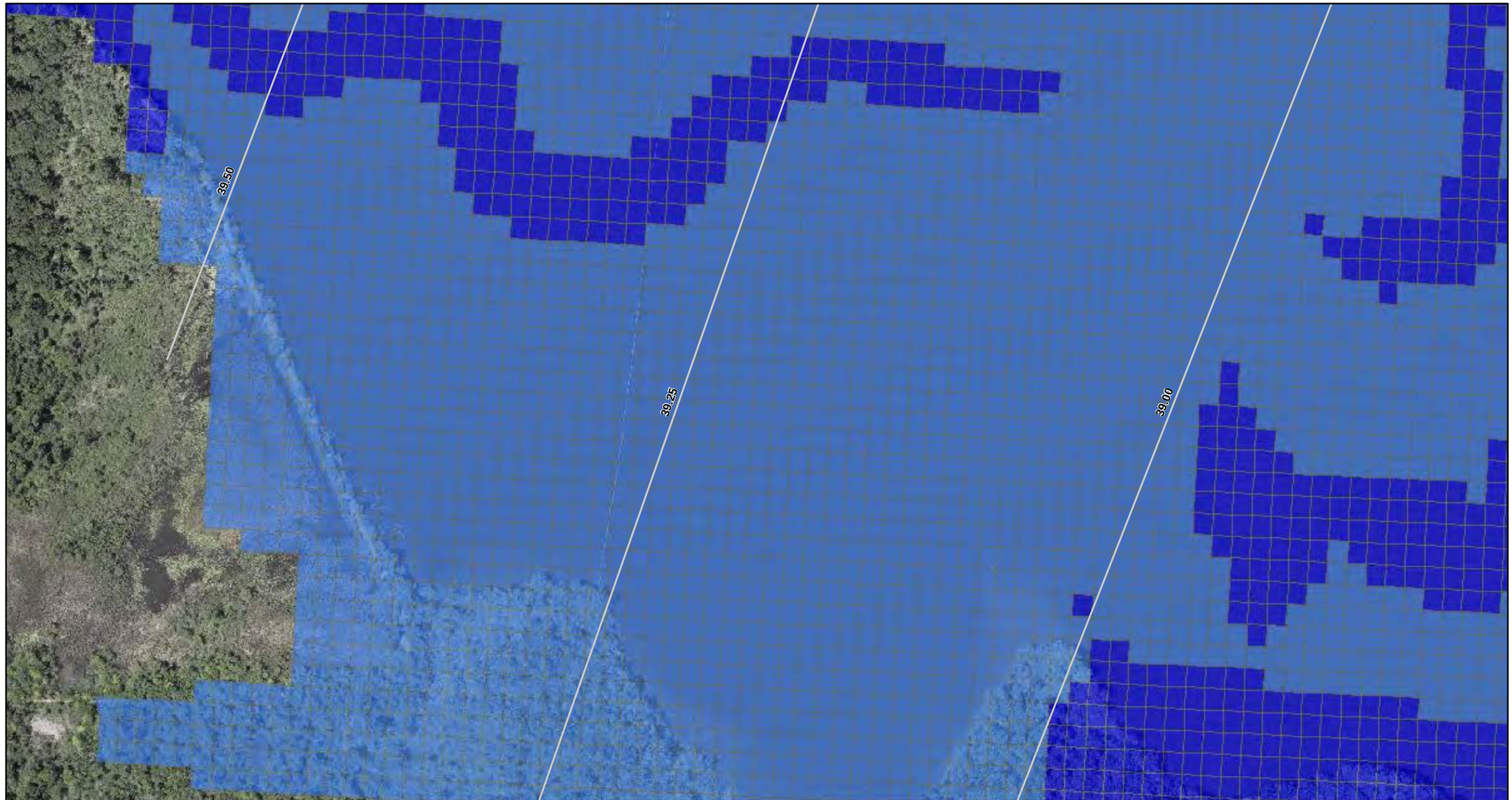
MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

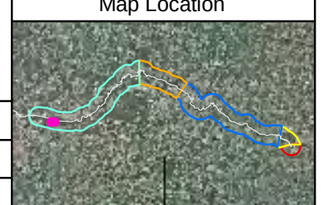
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model Percent Sand Input.mxd

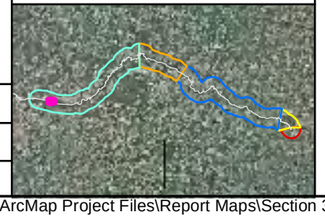
Aerial Photography Date: July 2011

Morrow St
Elliot Rd
Lawndale Ave
Chene Dr
39.50
39.25
39.75
Consumers Power Dr

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand
- <20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70+ %

Quarter Mile Grid Segment

% = Percent

N

0 125 250 500

Scale in Feet

RIVERINE GRID: PERCENT SAND

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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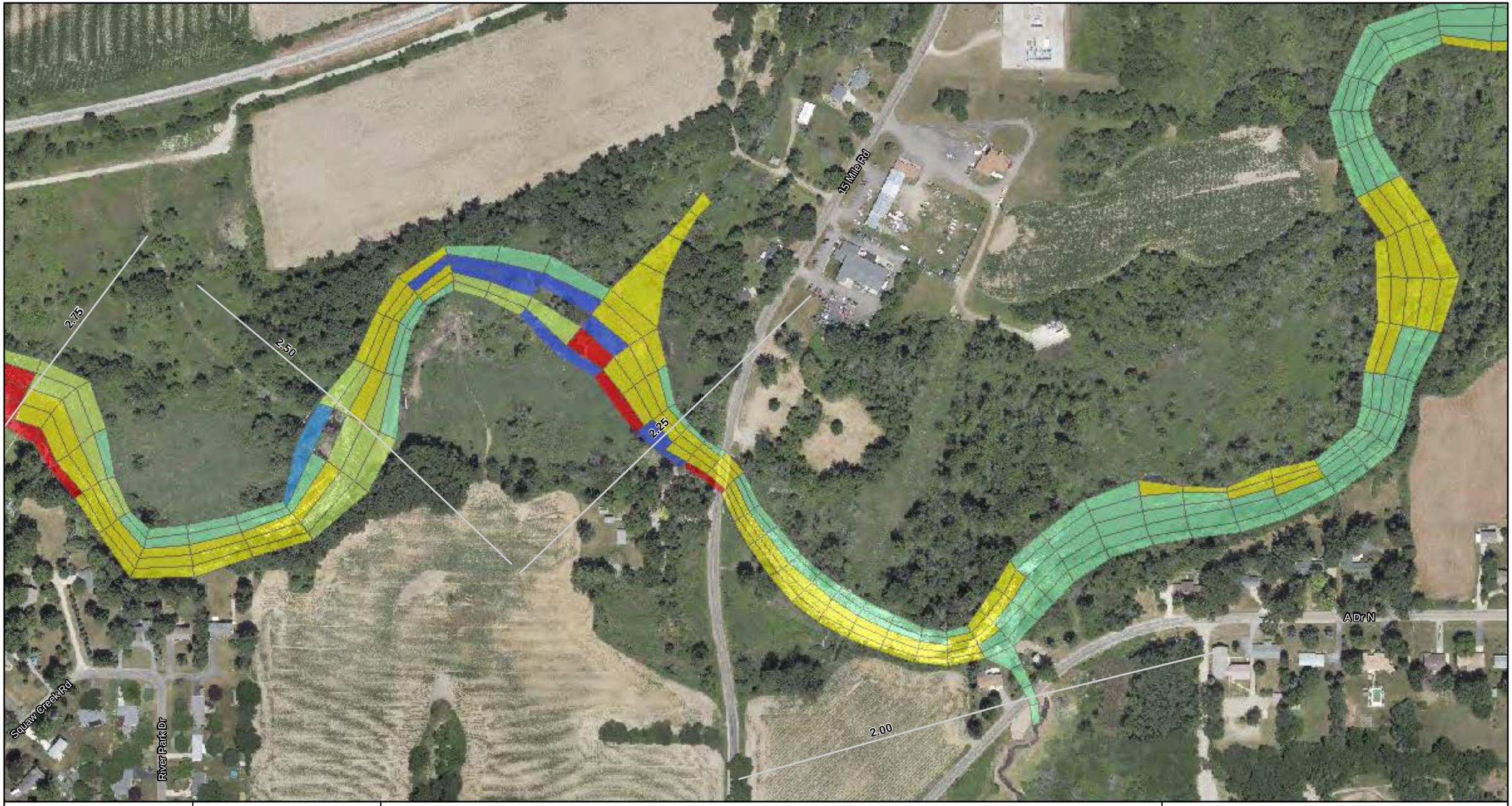
Aerial Photography Date: July 2011

Figure 3-17

Riverine Grid: Wet Bulk Density

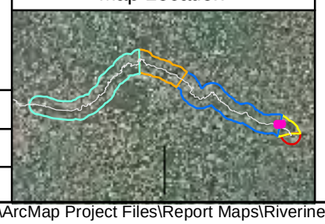
Sheets 1 through 56



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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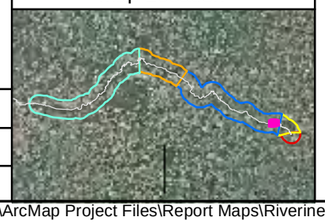
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

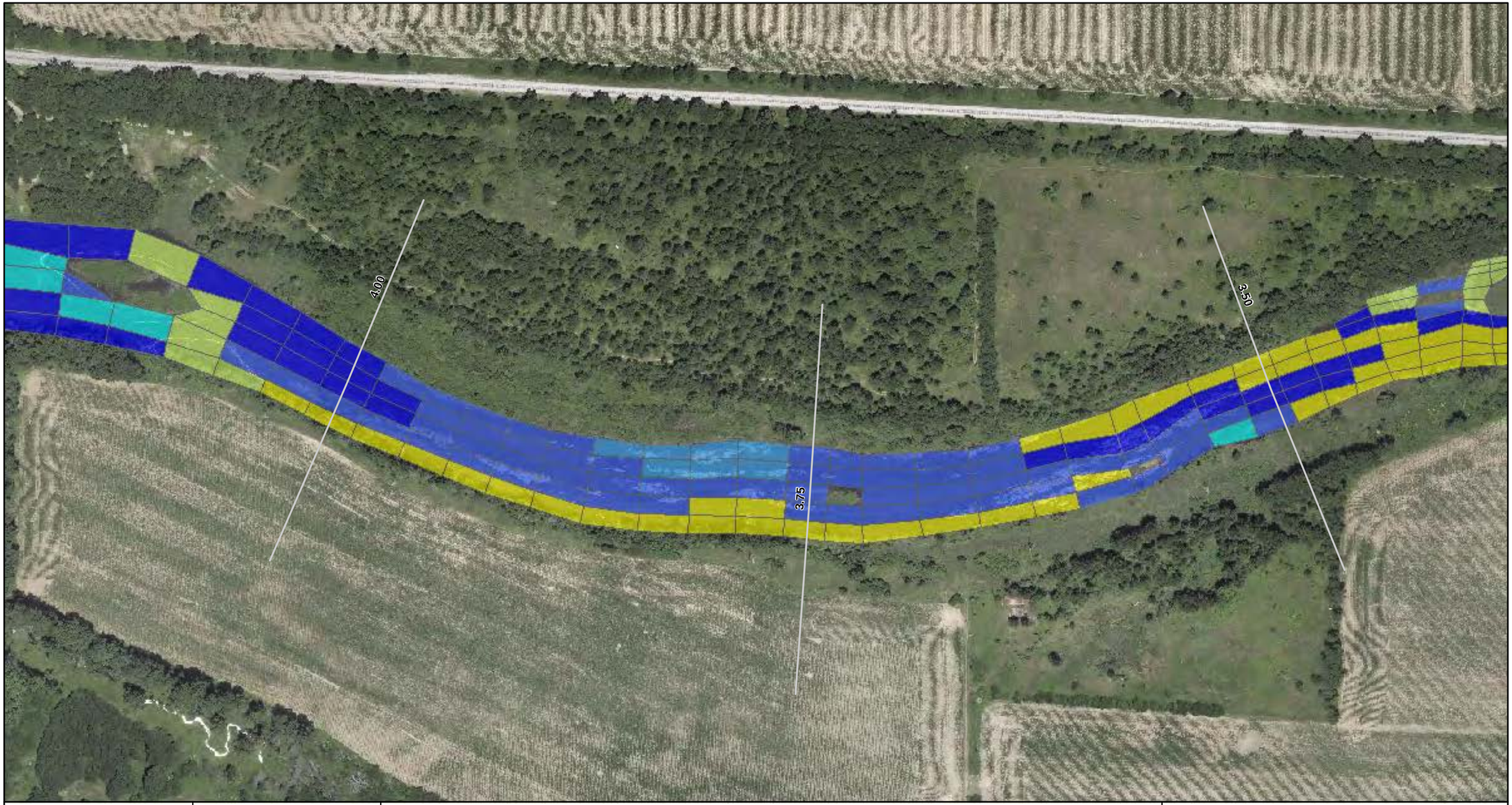
MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

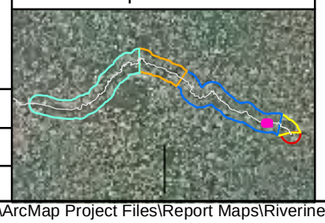
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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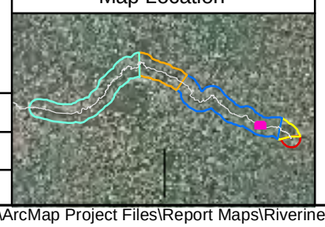
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

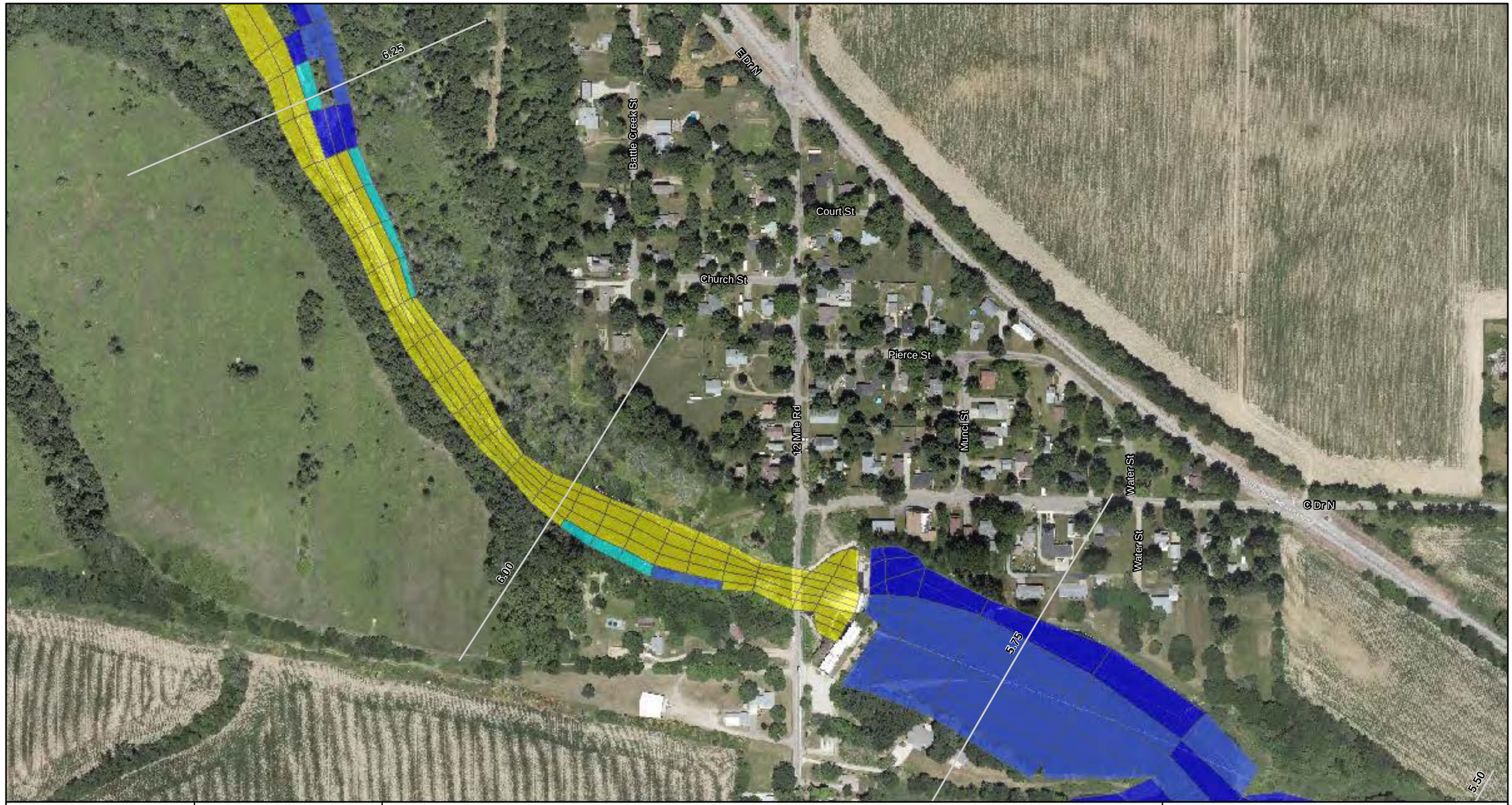
MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

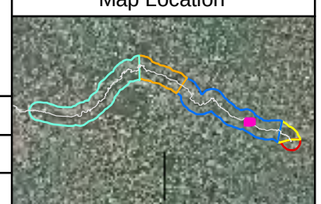
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

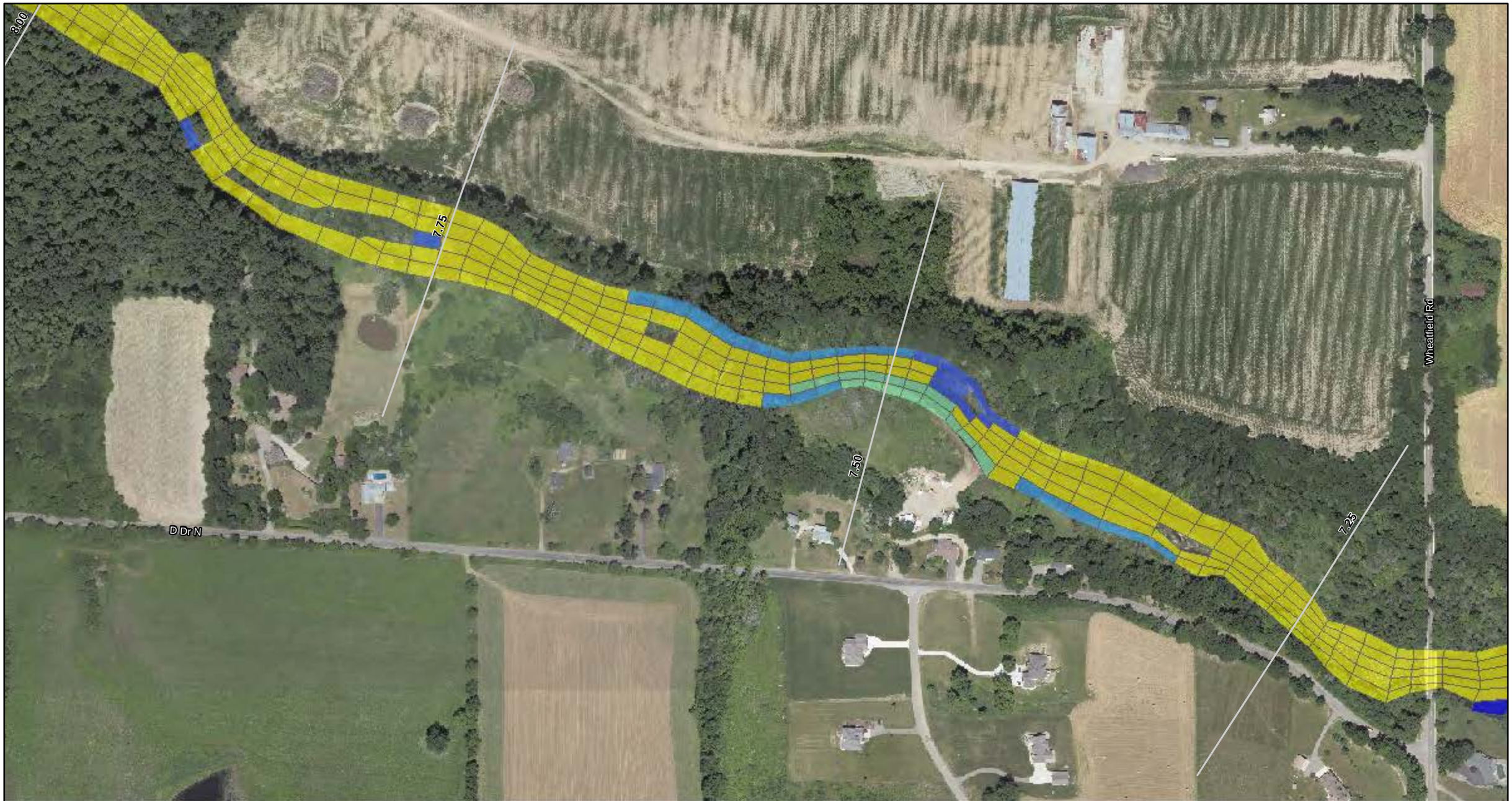
MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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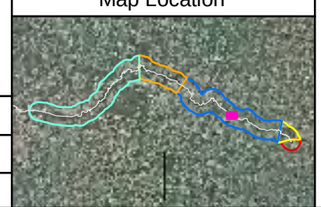
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

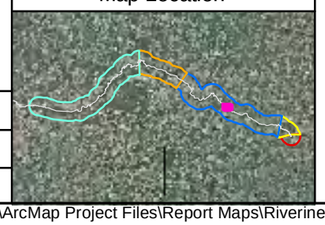
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

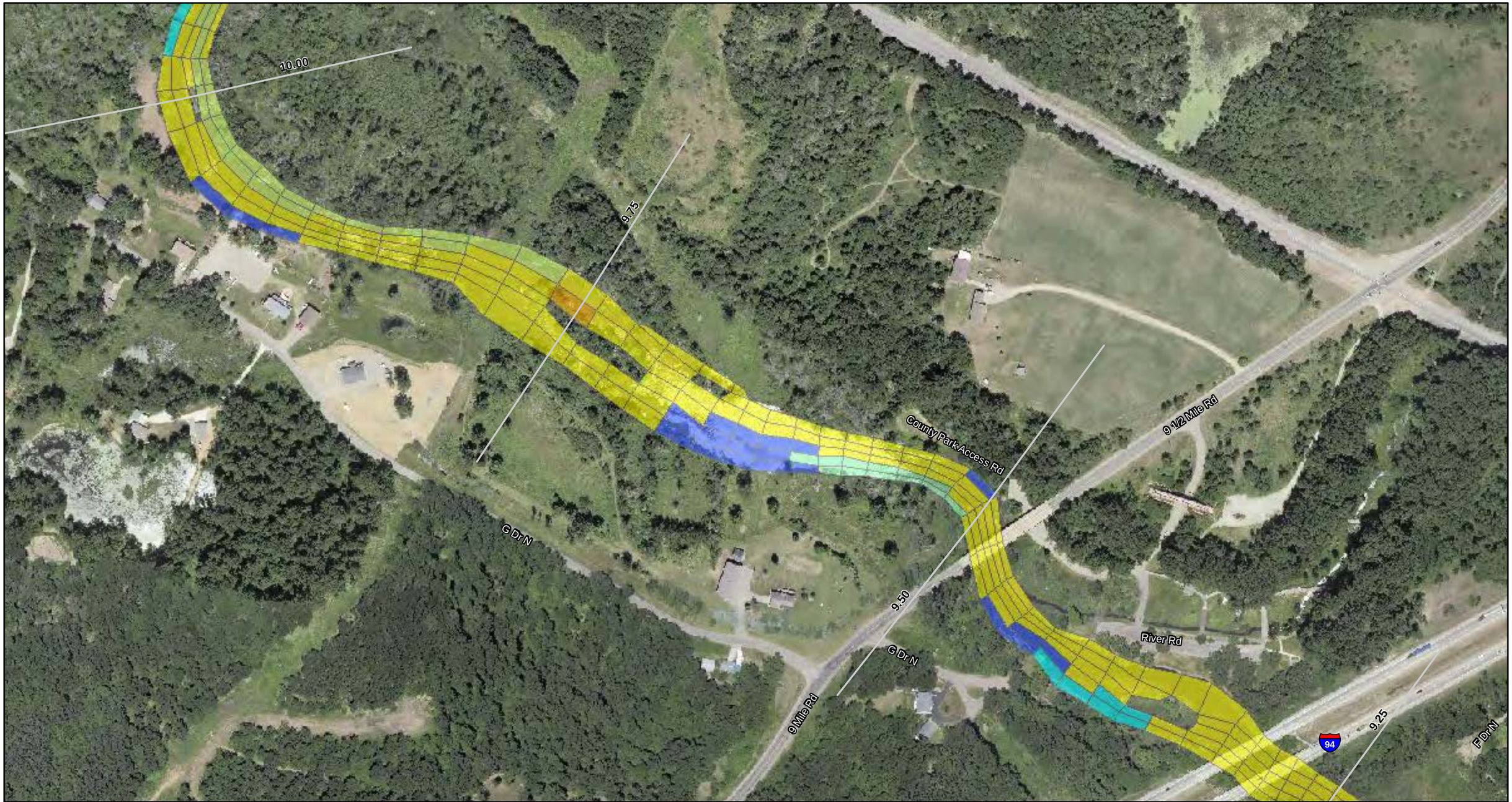
MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

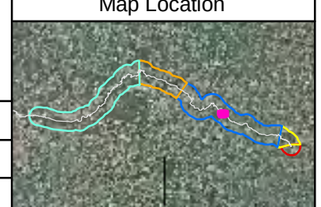
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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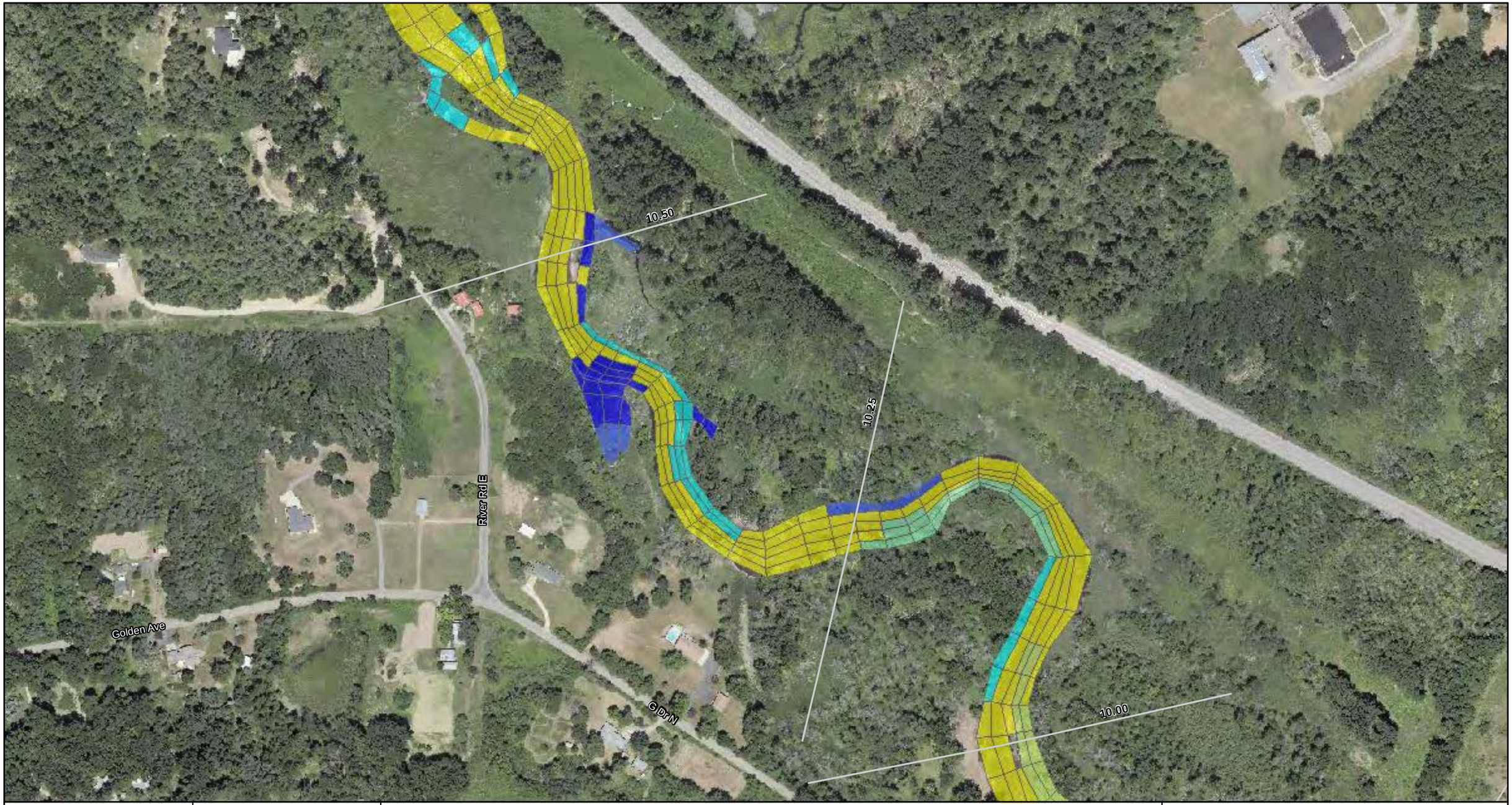
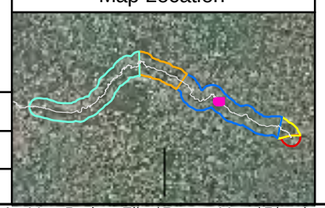
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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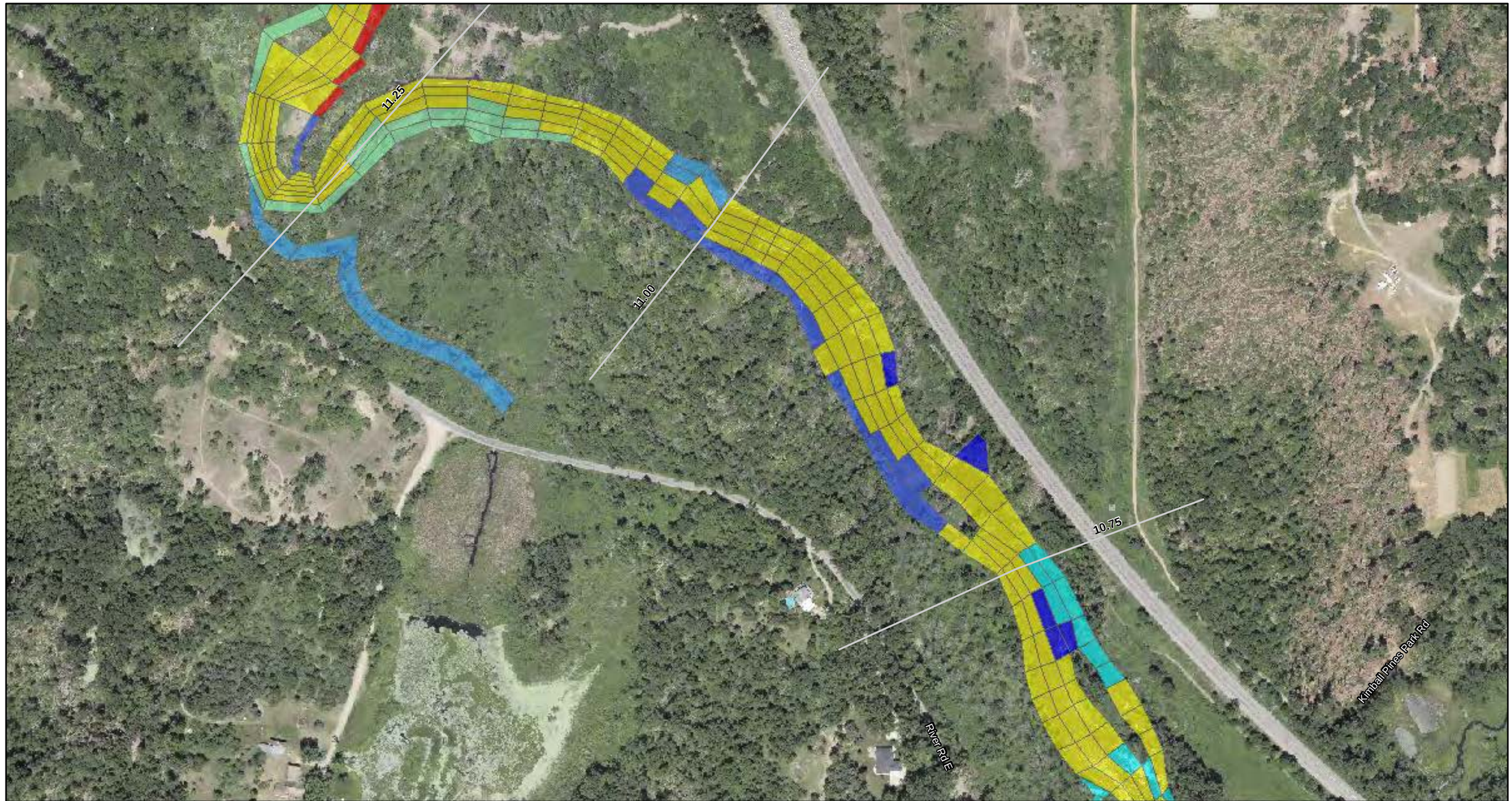
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

Columbia Ave E

Leonard Wood

Raymond Rd S

River Rd E

12.50

12.25

12.00

11.75

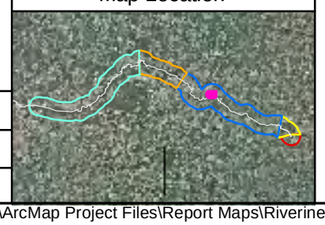
11.50

11.25

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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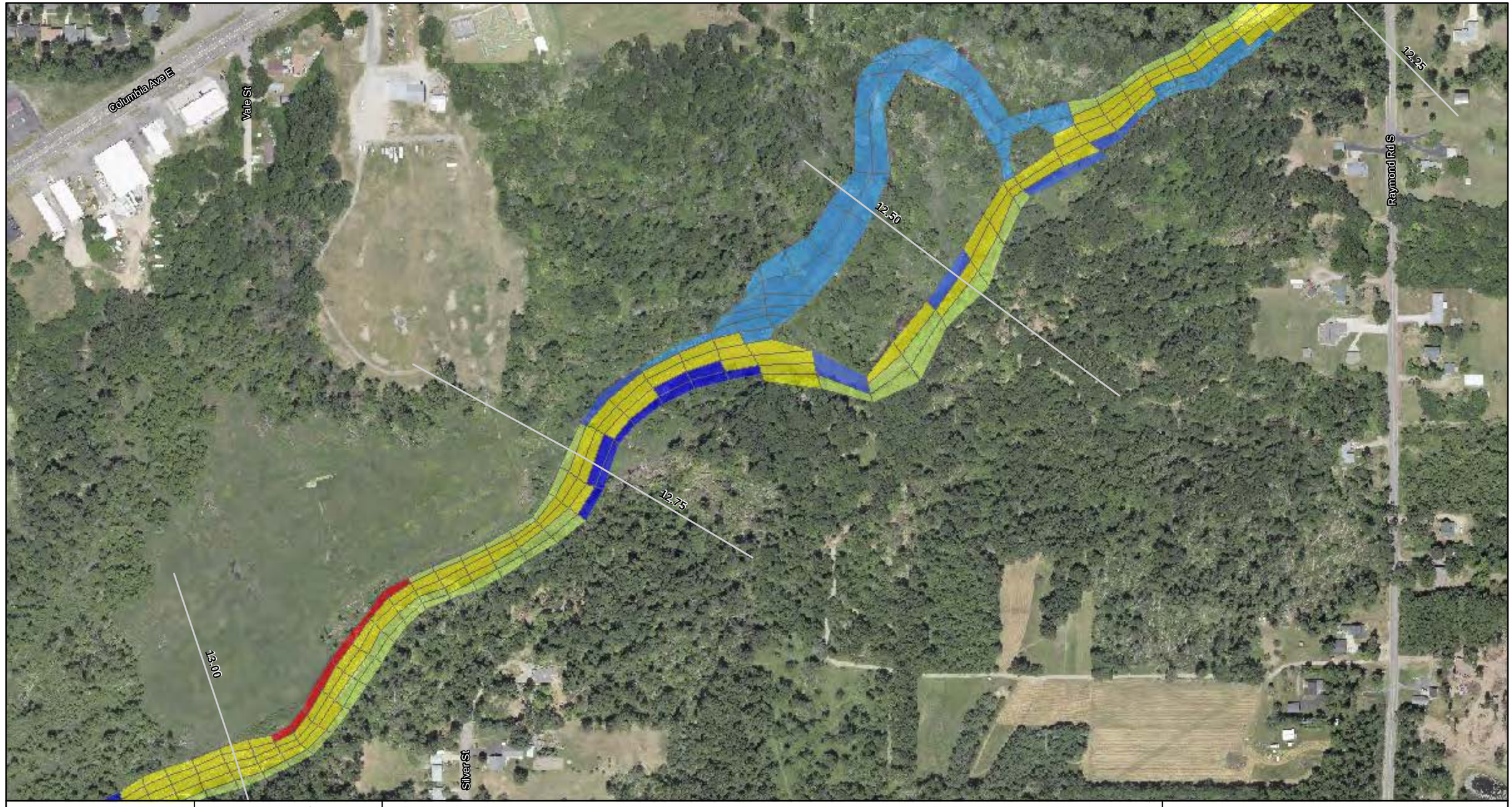
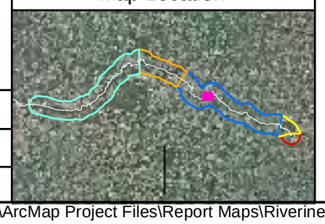
Aerial Photography Date: July 2011



Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

RIVERINE GRID: WET BULK DENSITY

MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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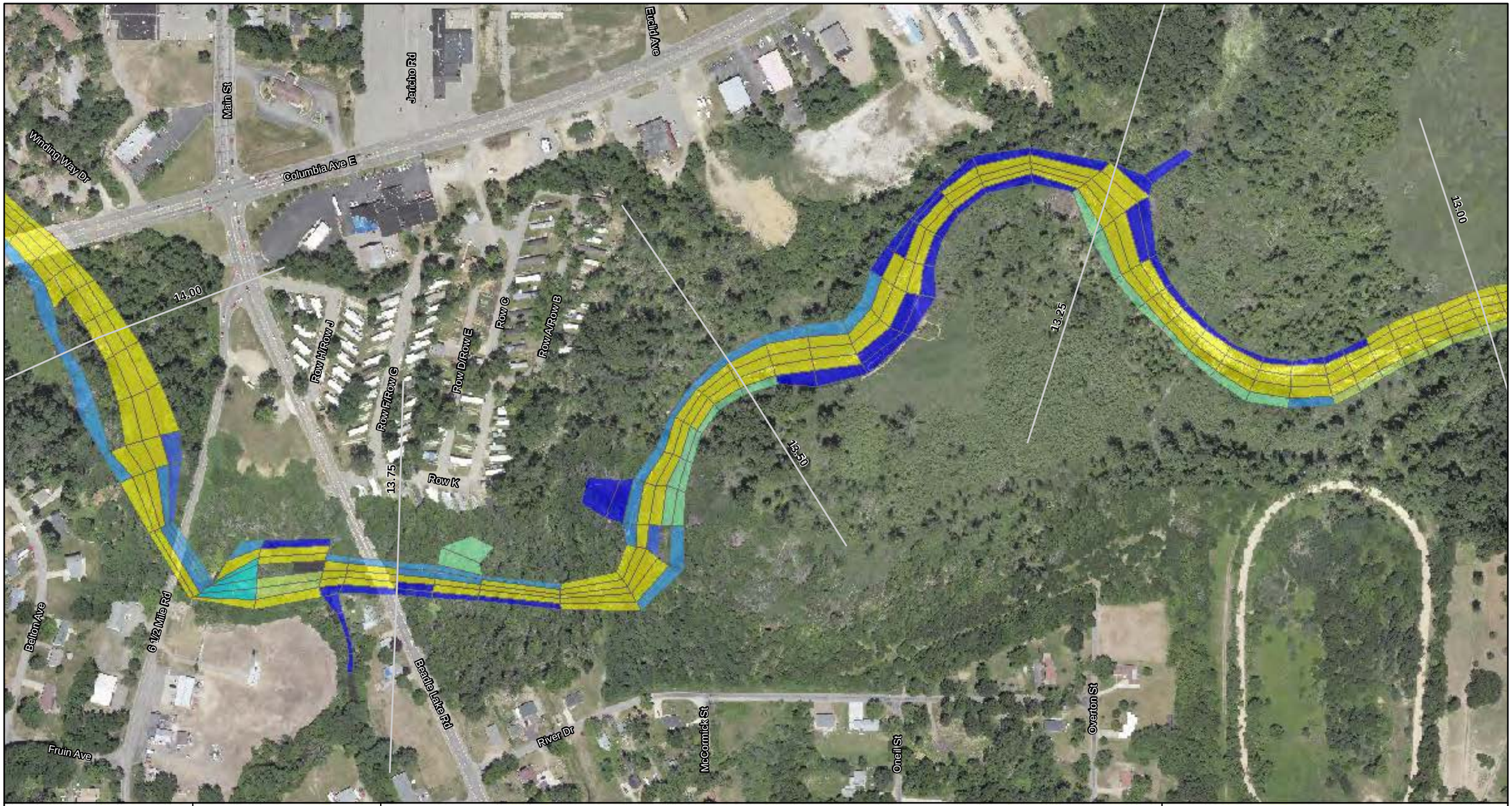
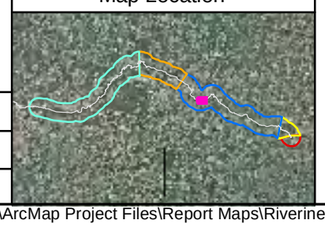
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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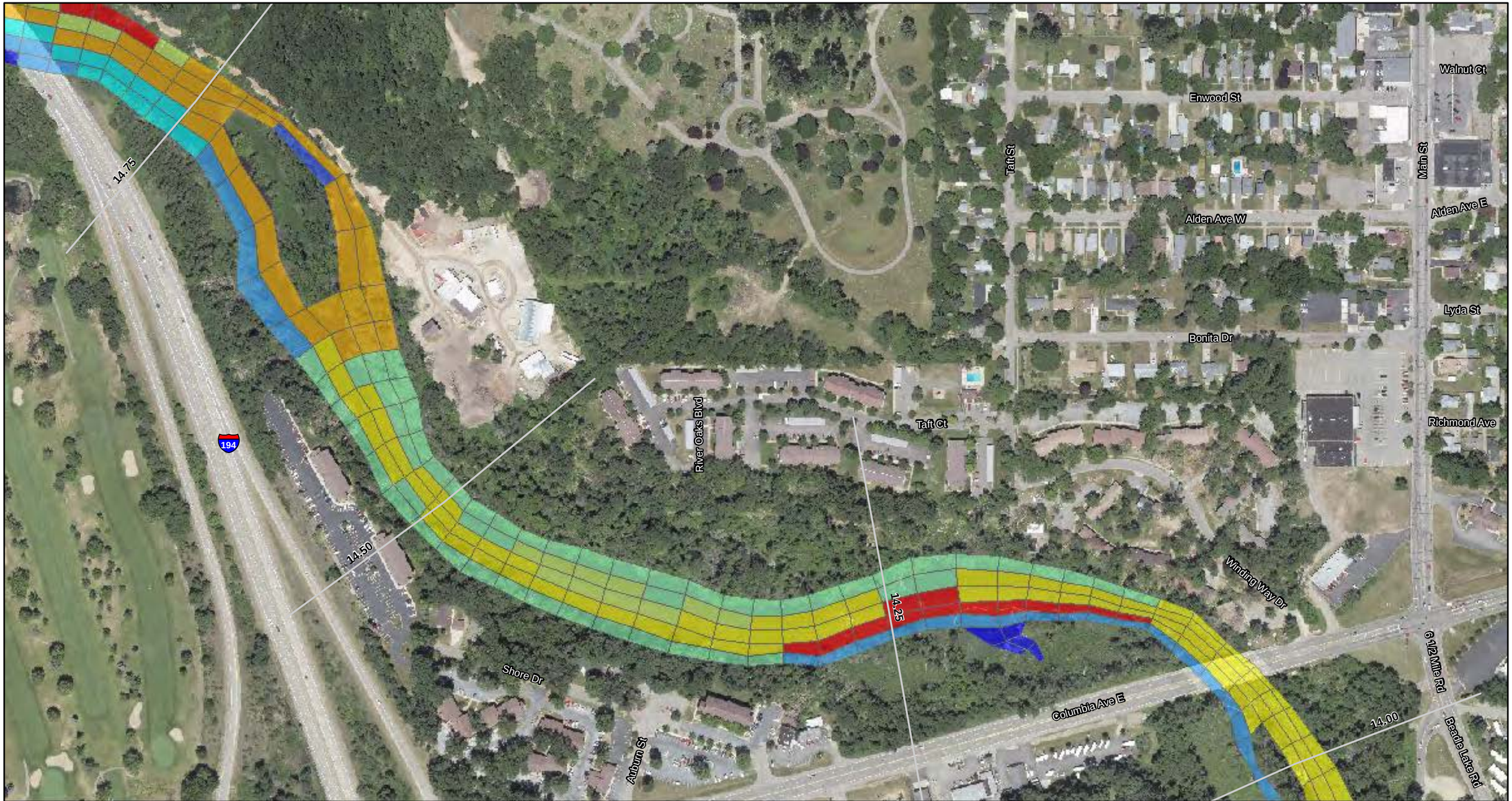
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

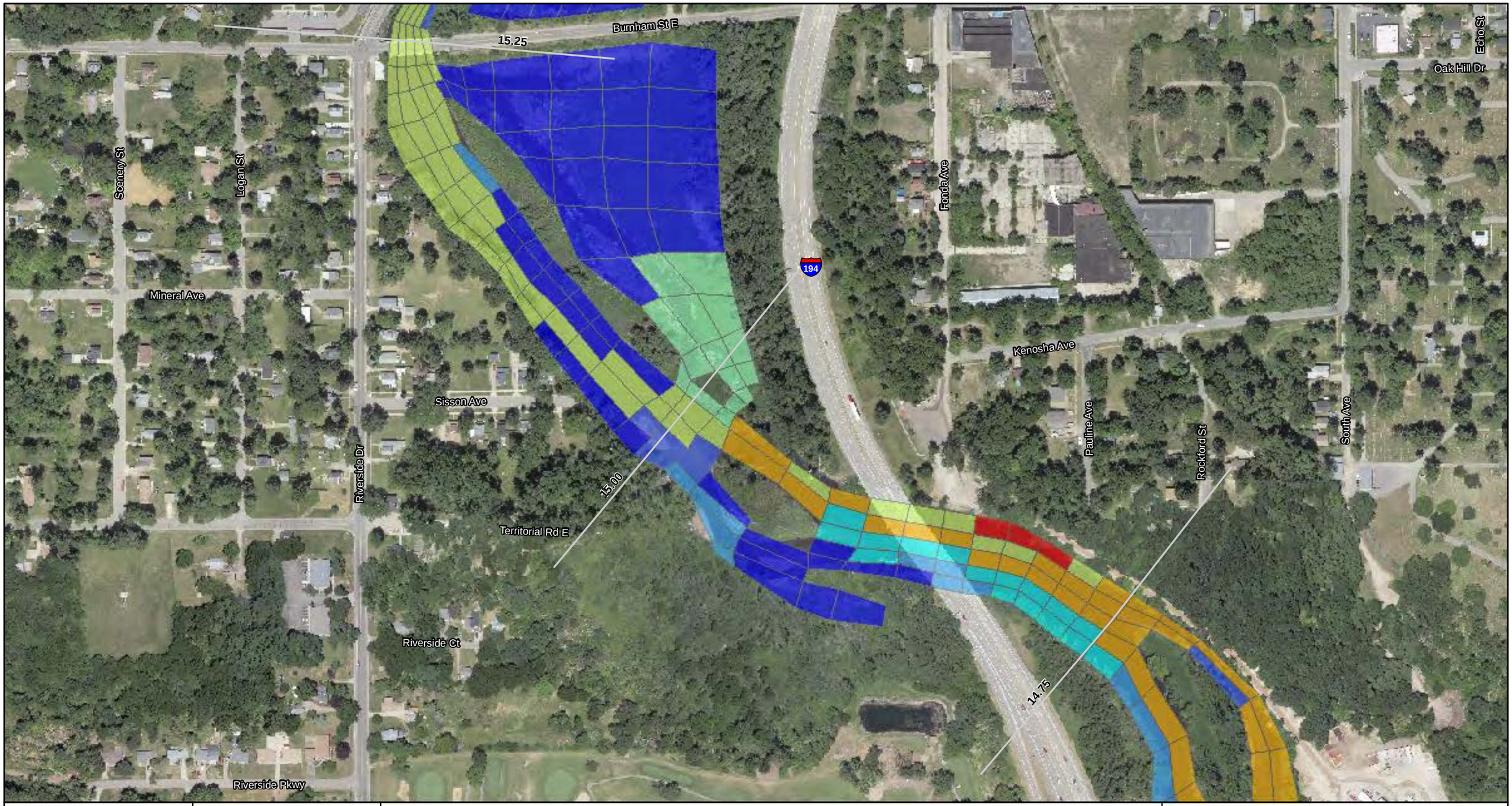
MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

Aerial Photography Date: July 2011



Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

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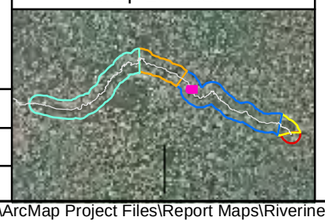
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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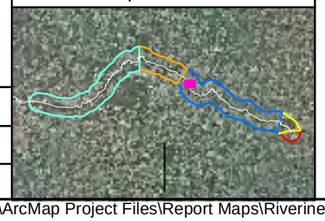
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

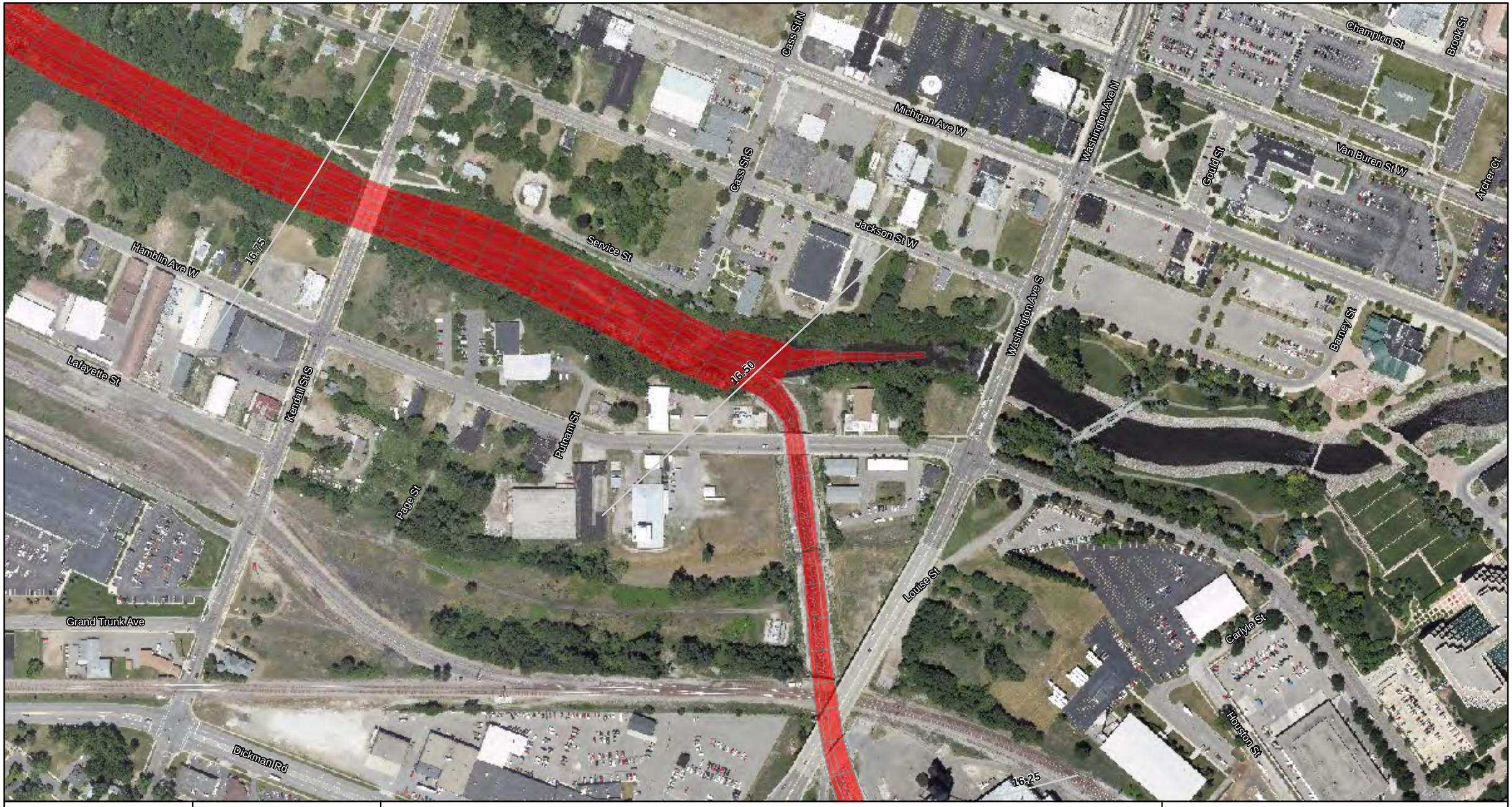
MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

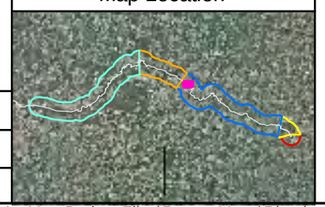
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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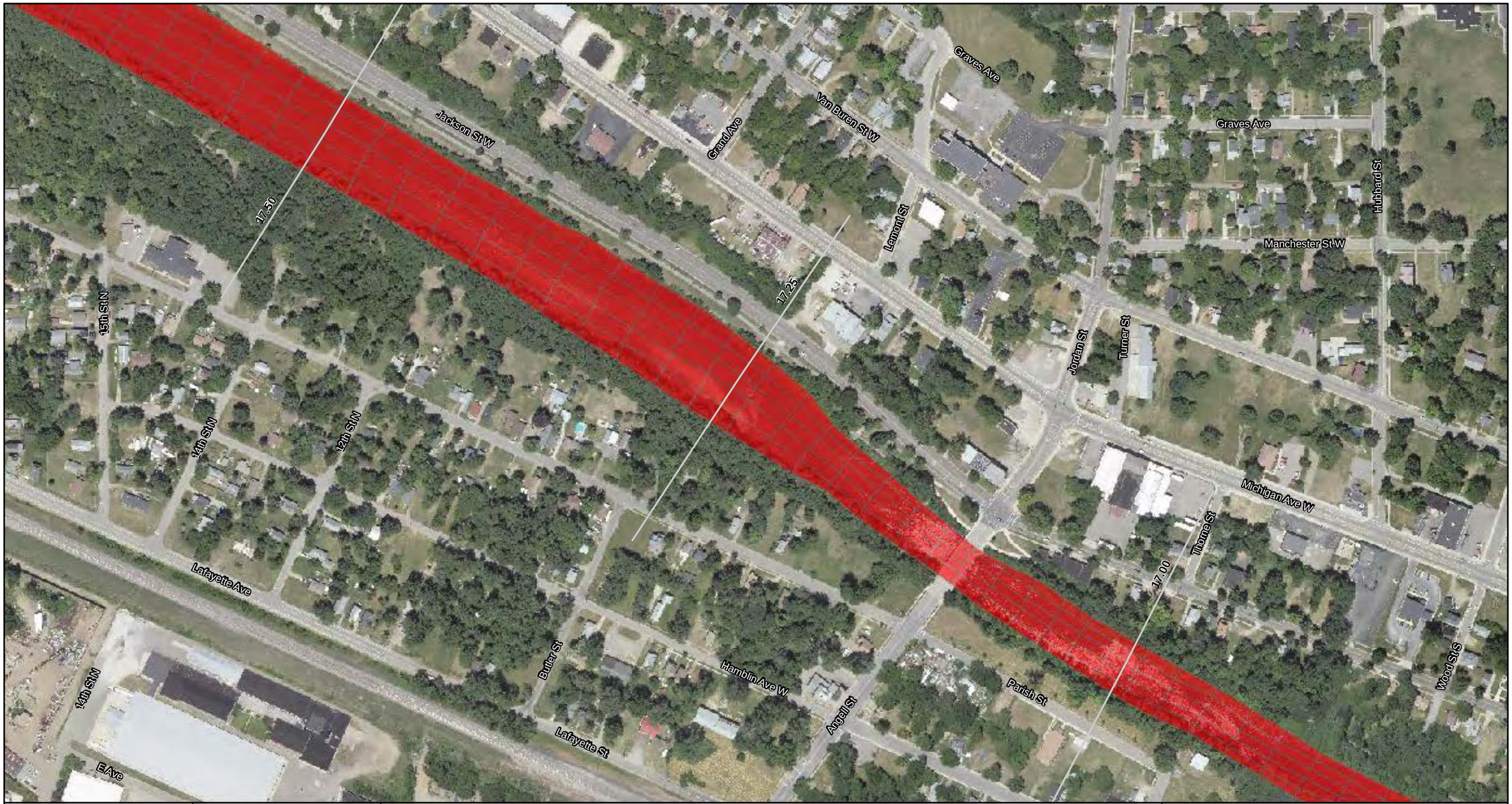
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

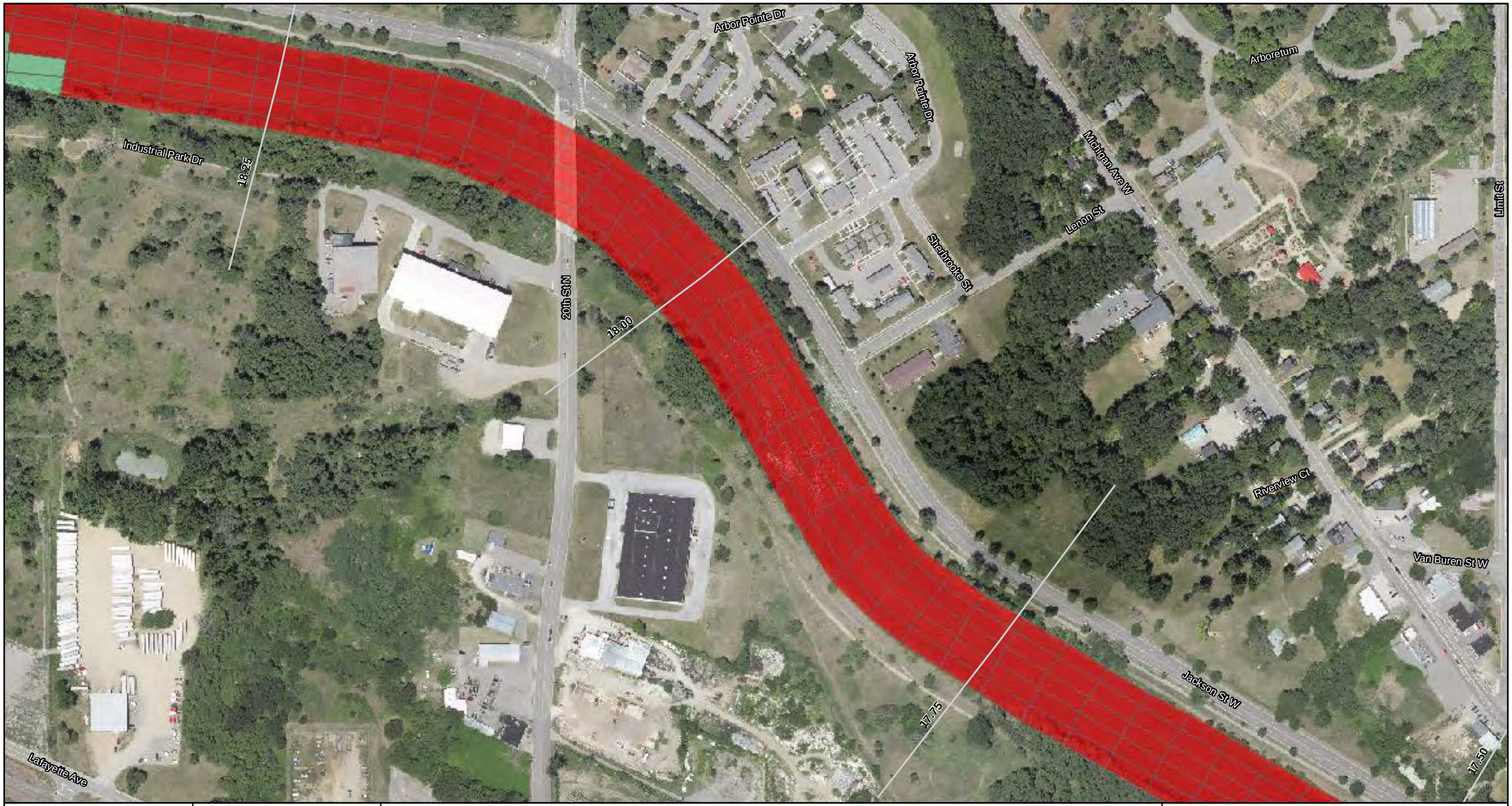
MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

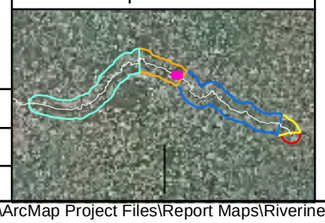
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

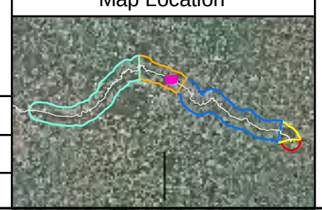
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

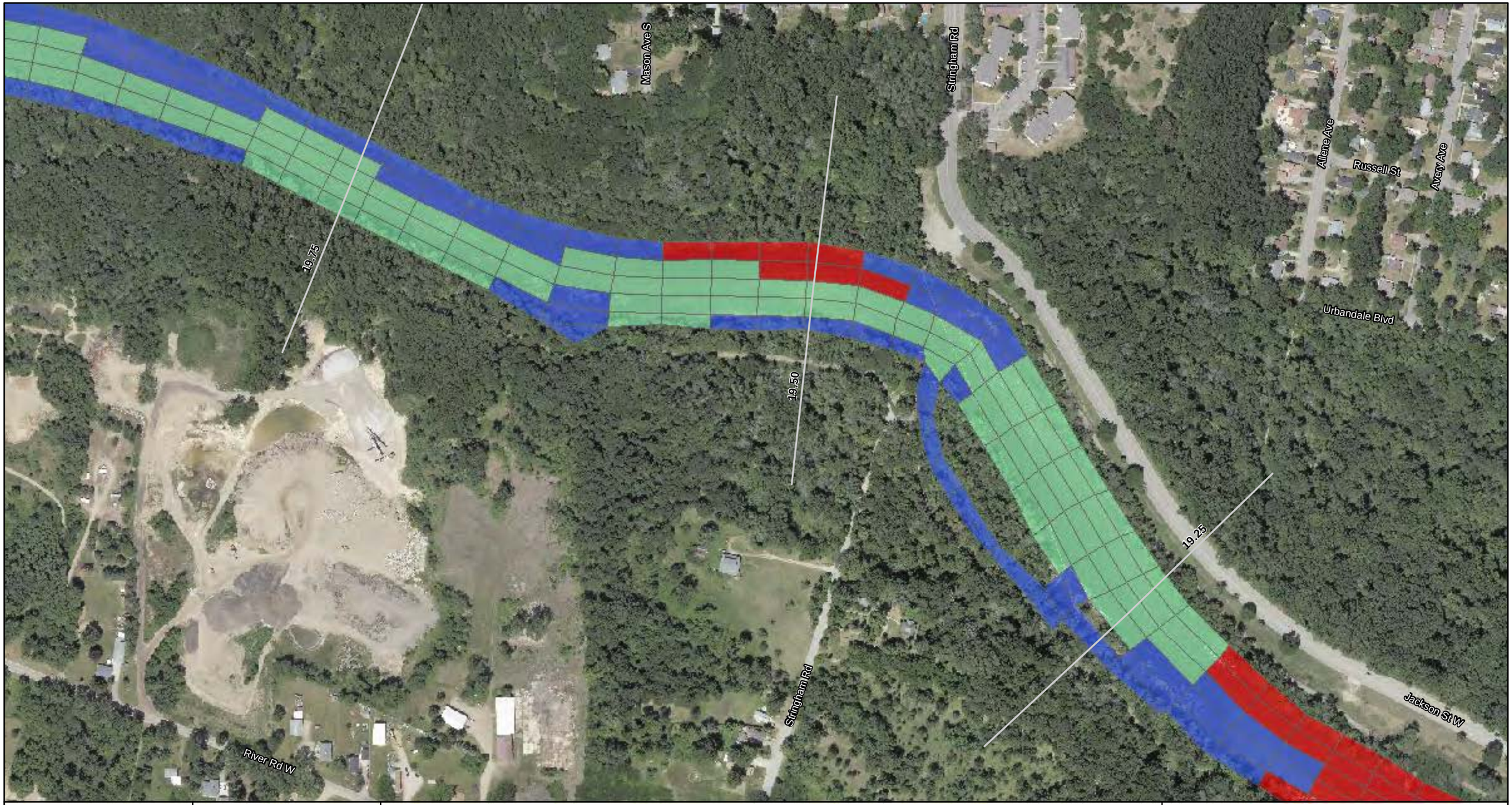
MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

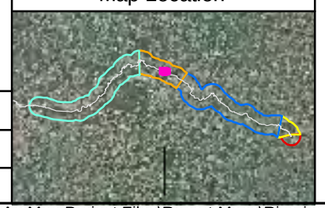
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
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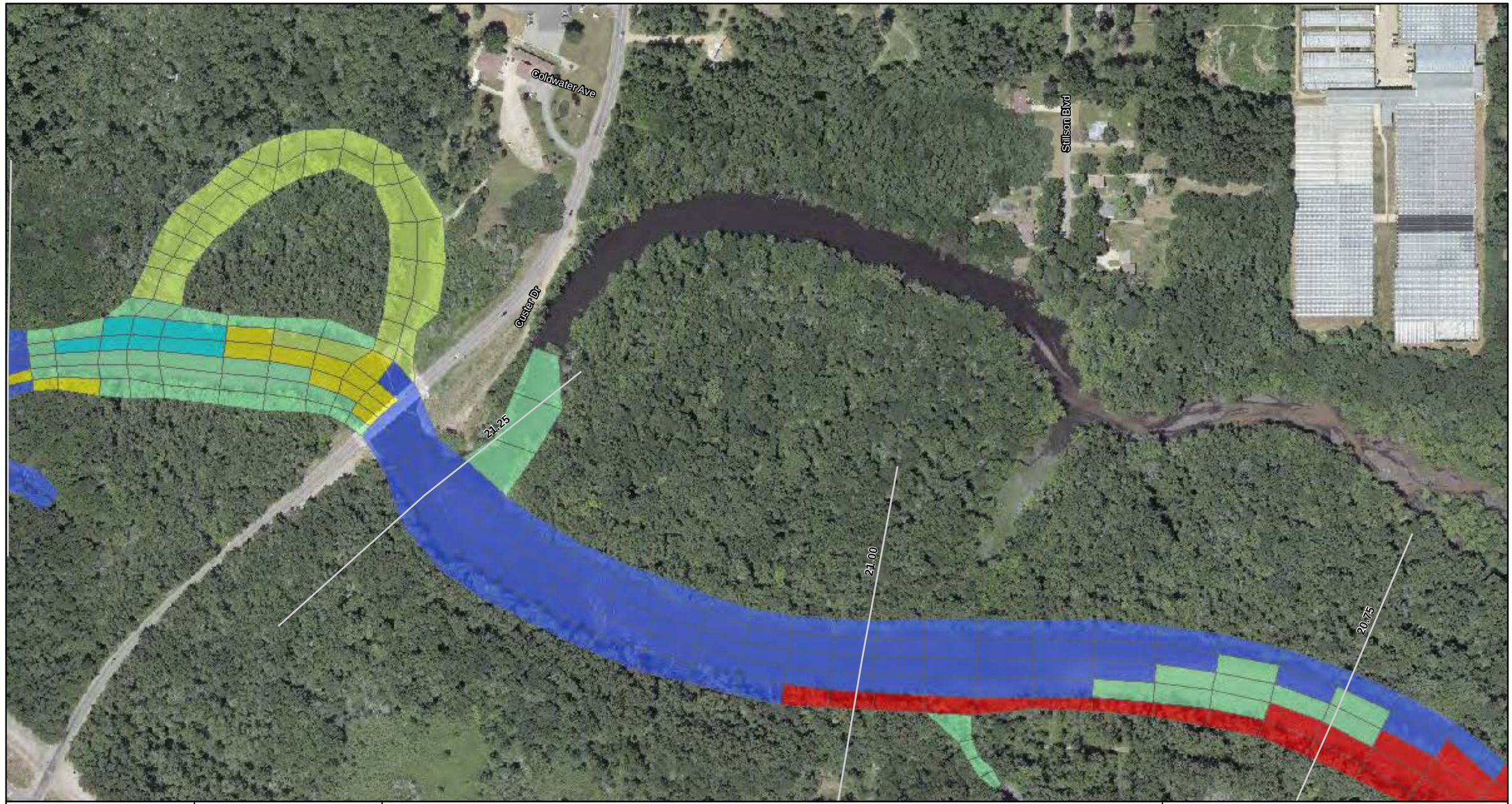
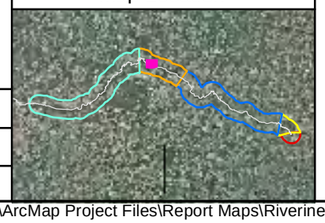
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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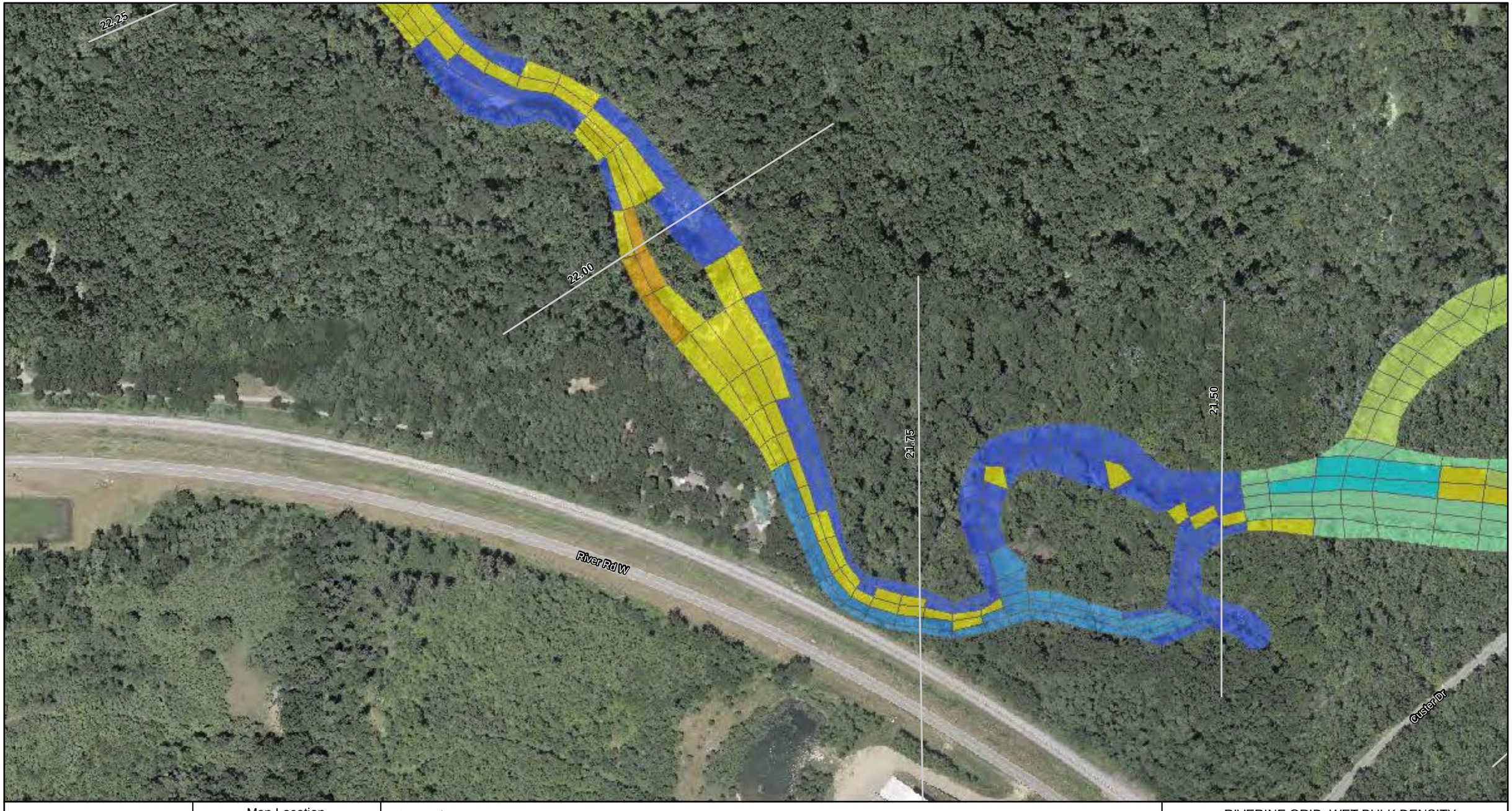
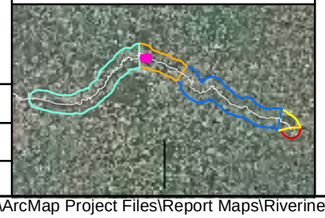
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
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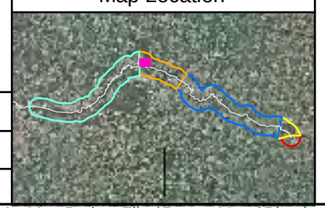
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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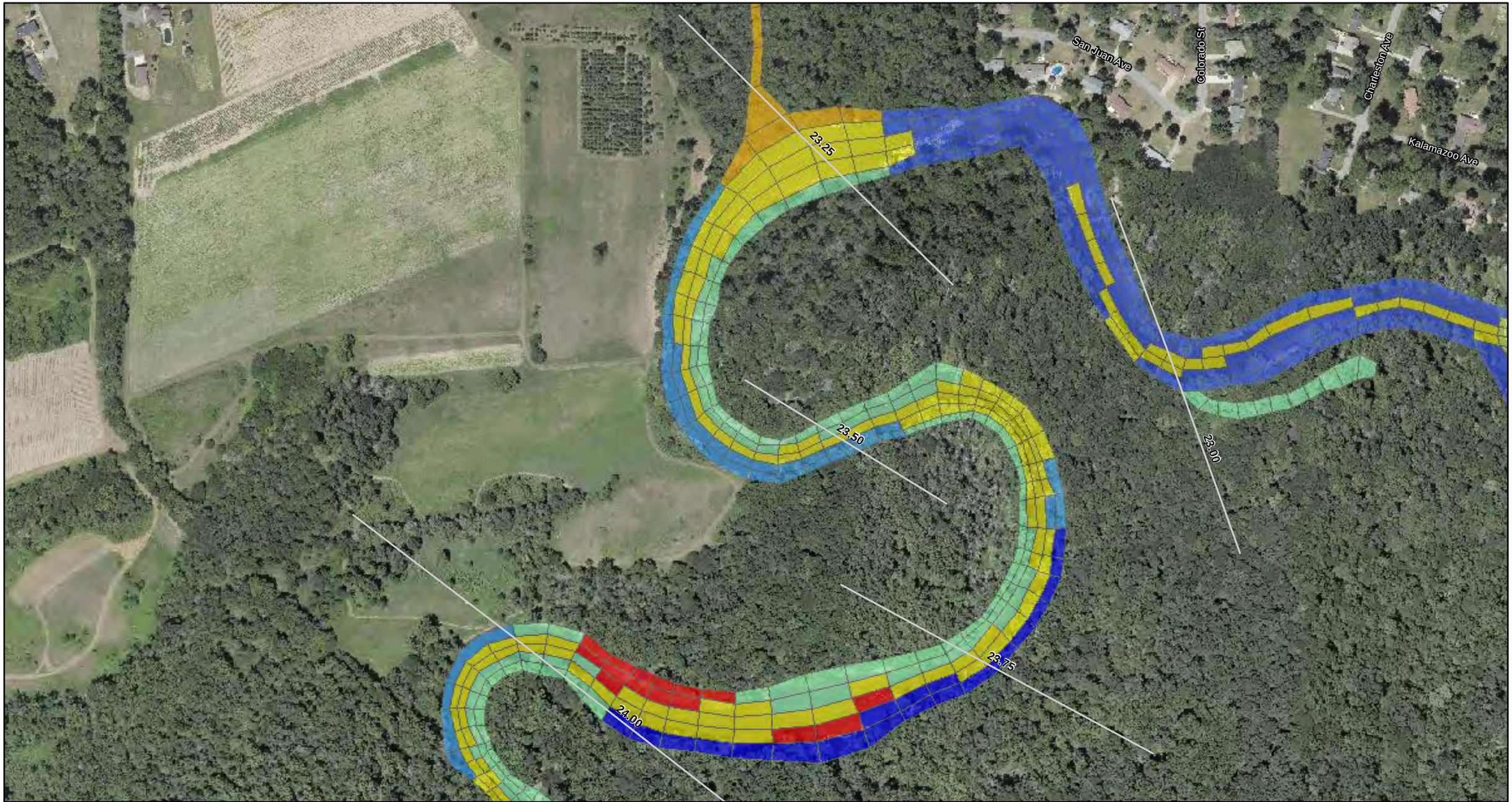
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: July 2011

24.00

24.25

24.75

24.50

River Rd W

Fort Custer Dr

County Line Rd

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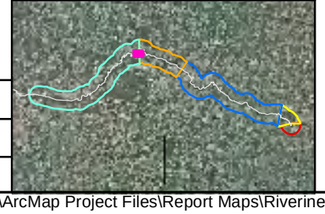
Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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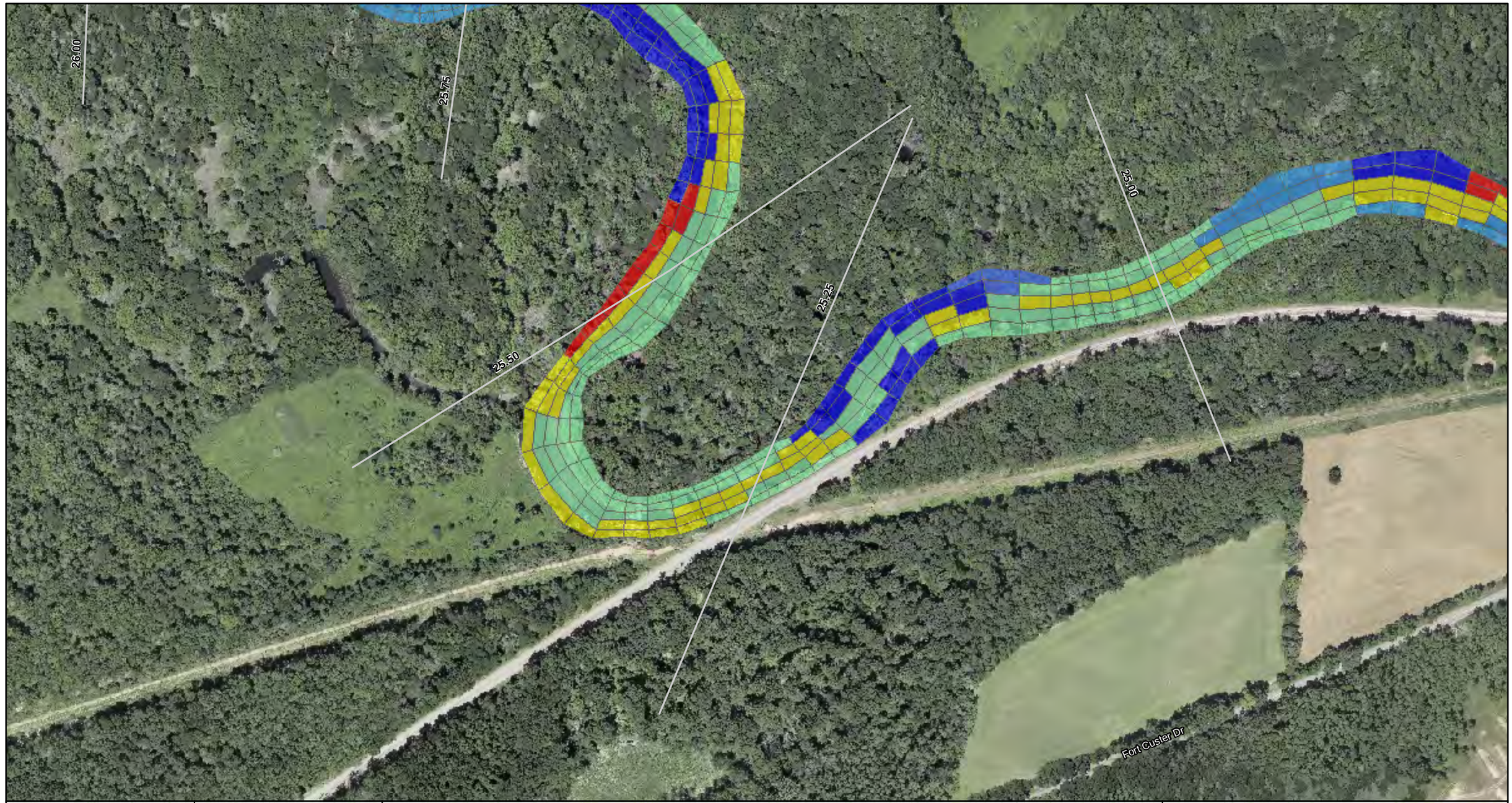
Aerial Photography Date: July 2011



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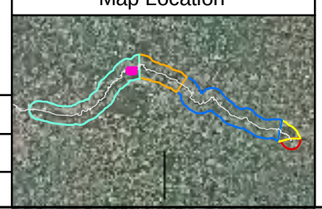
Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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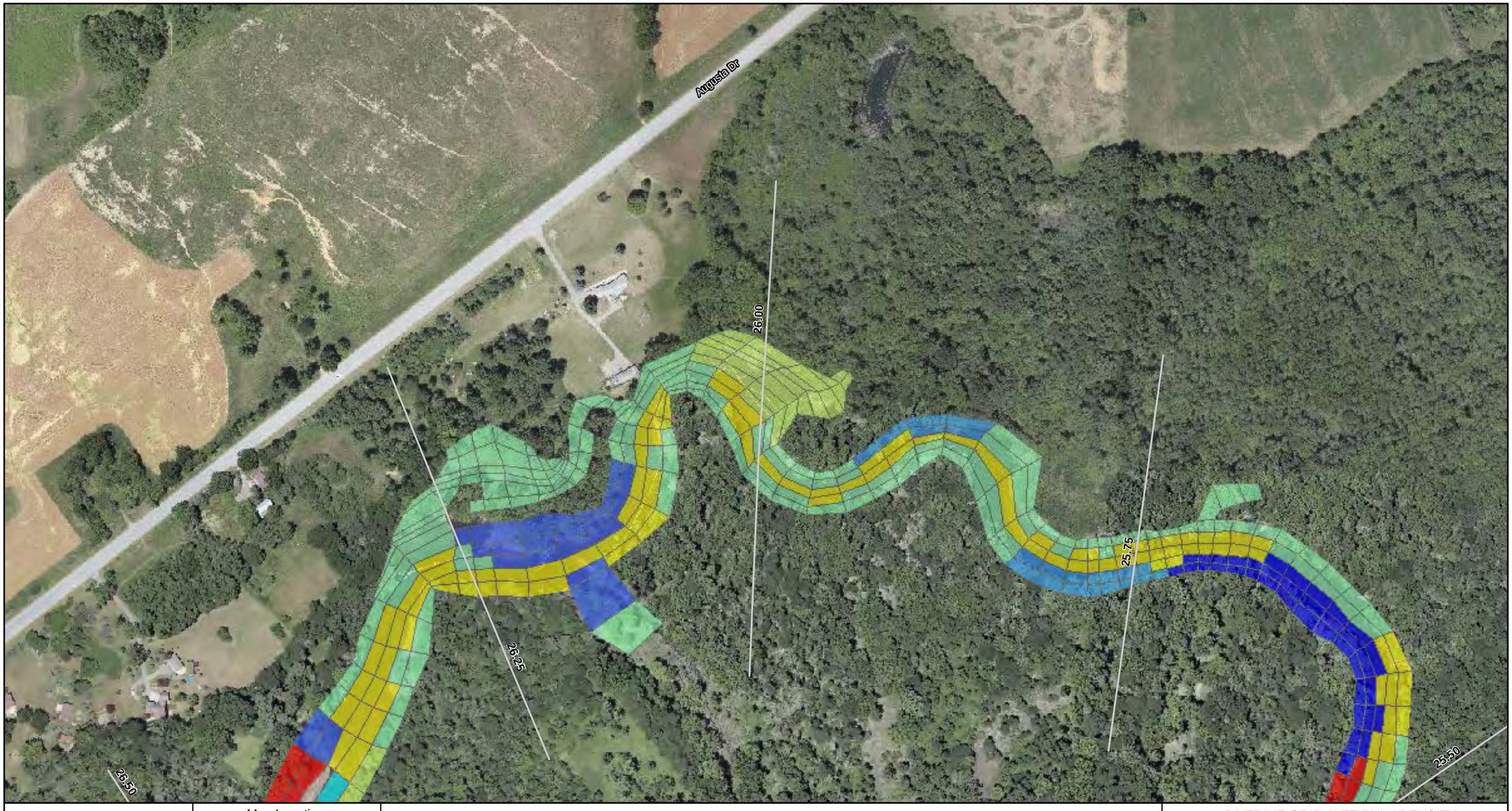
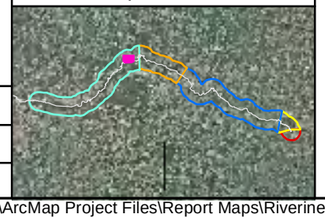
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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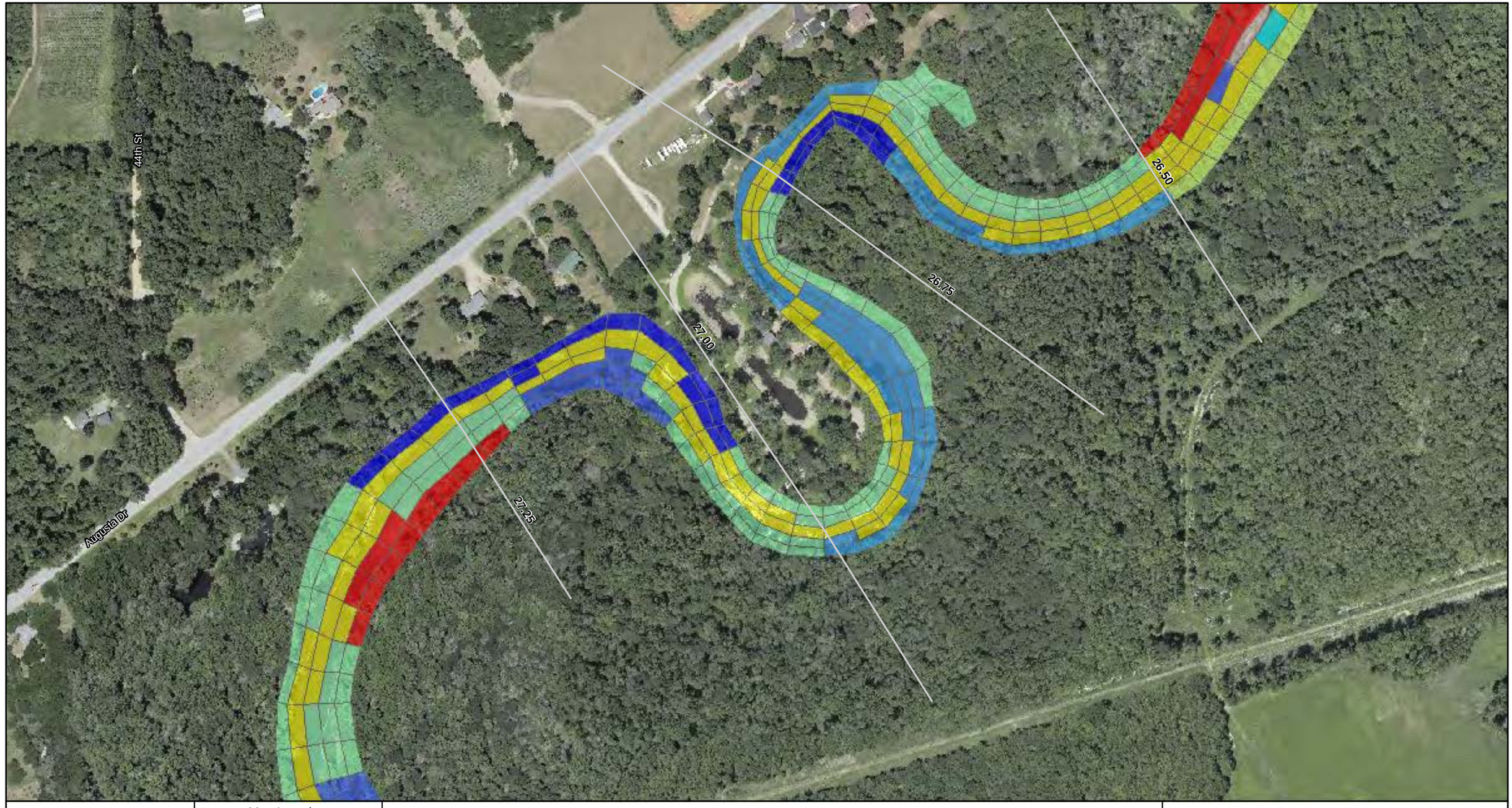
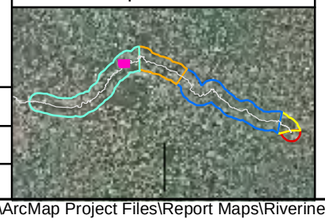
Aerial Photography Date: July 2011



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
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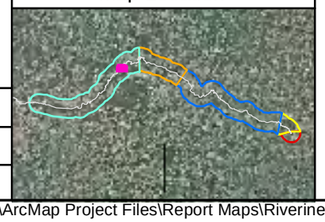
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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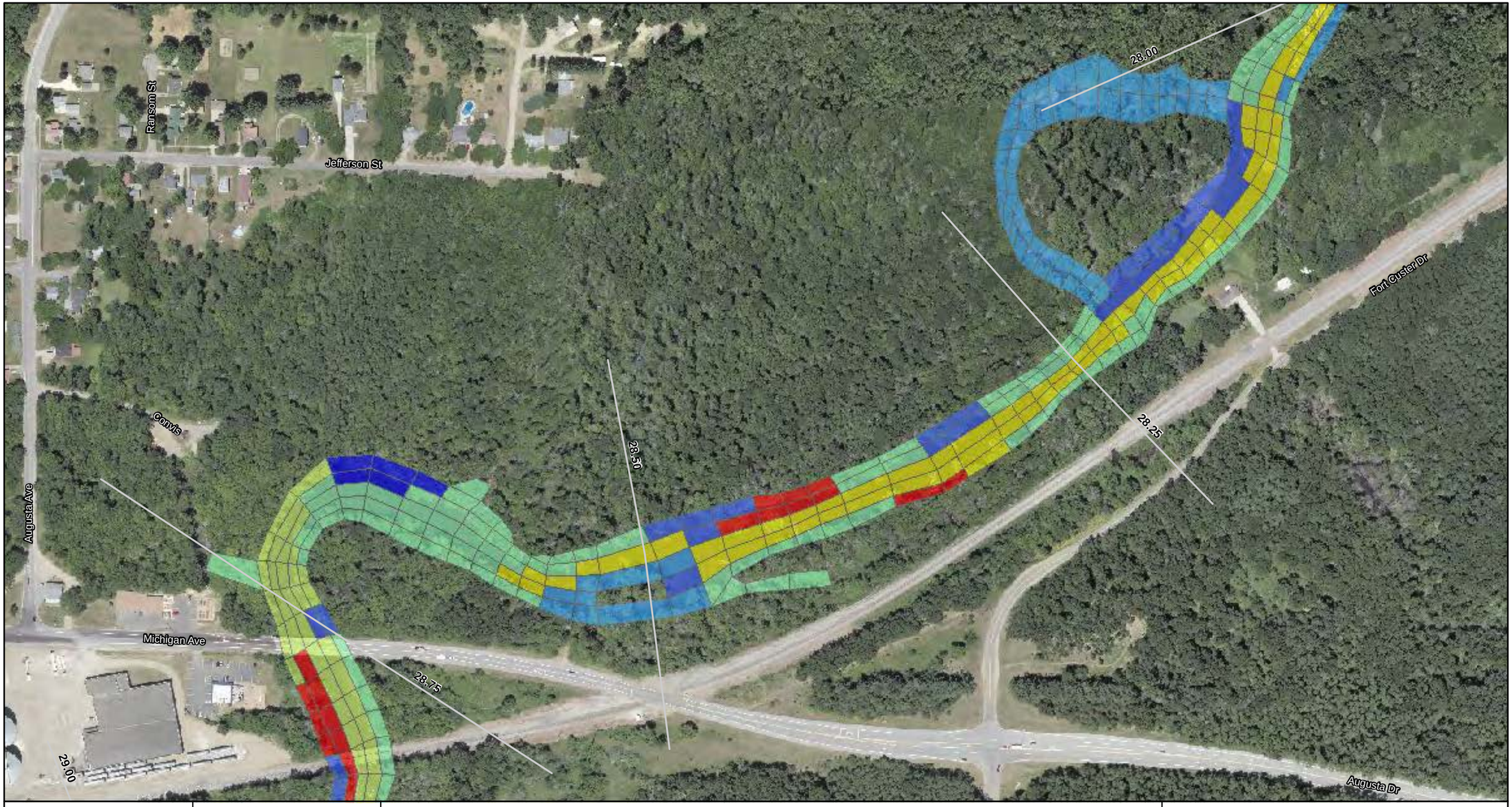
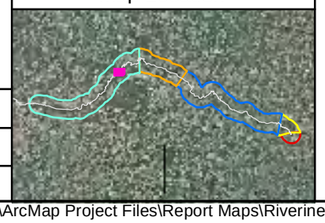
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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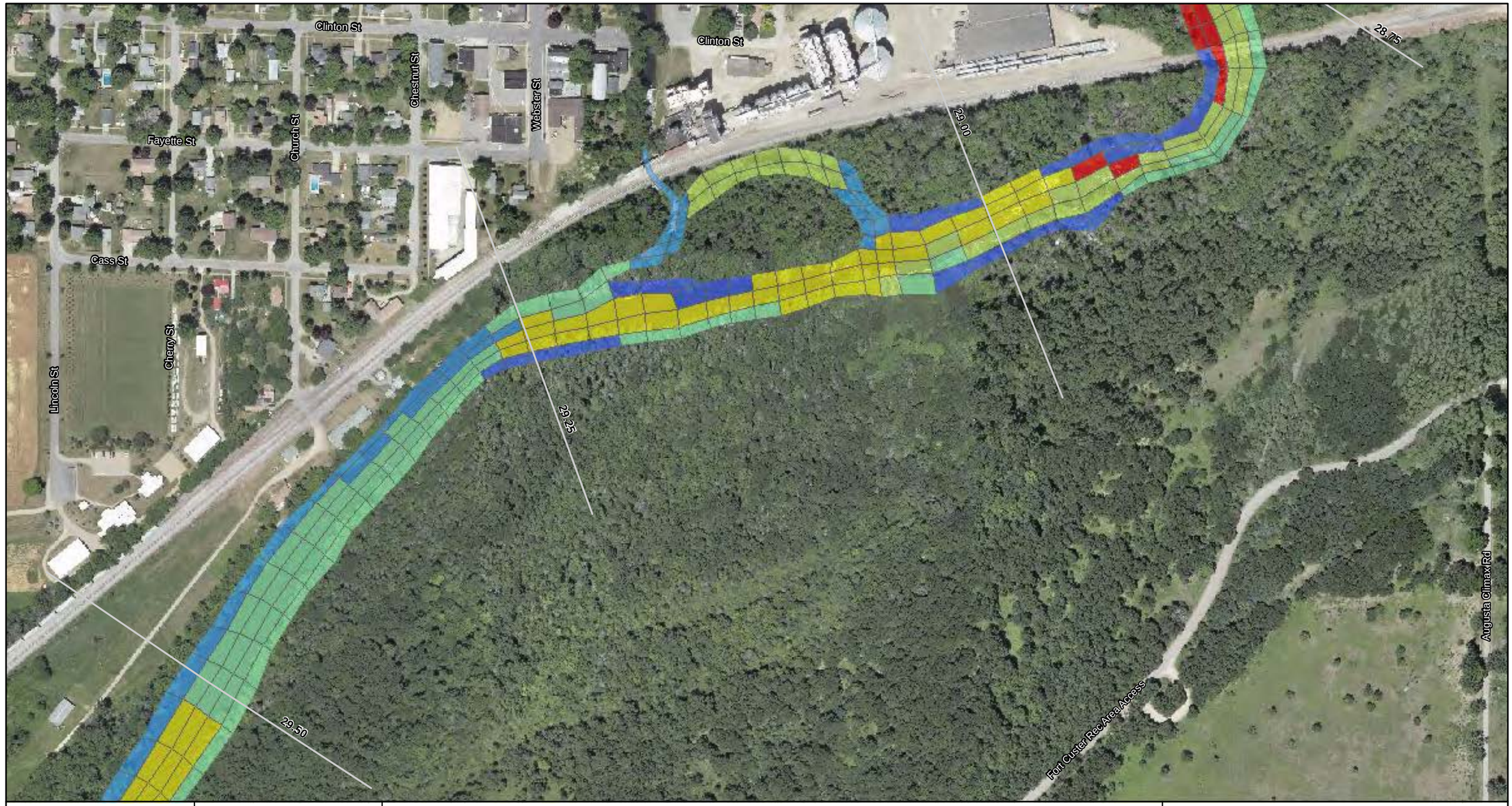
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 28.85 - MP29.55

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ENBRIDGE LINE 6B MP 608
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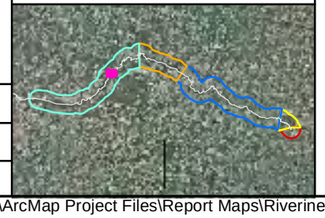
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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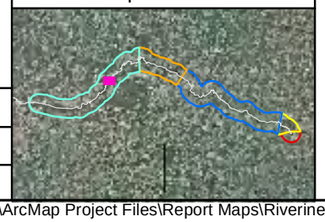
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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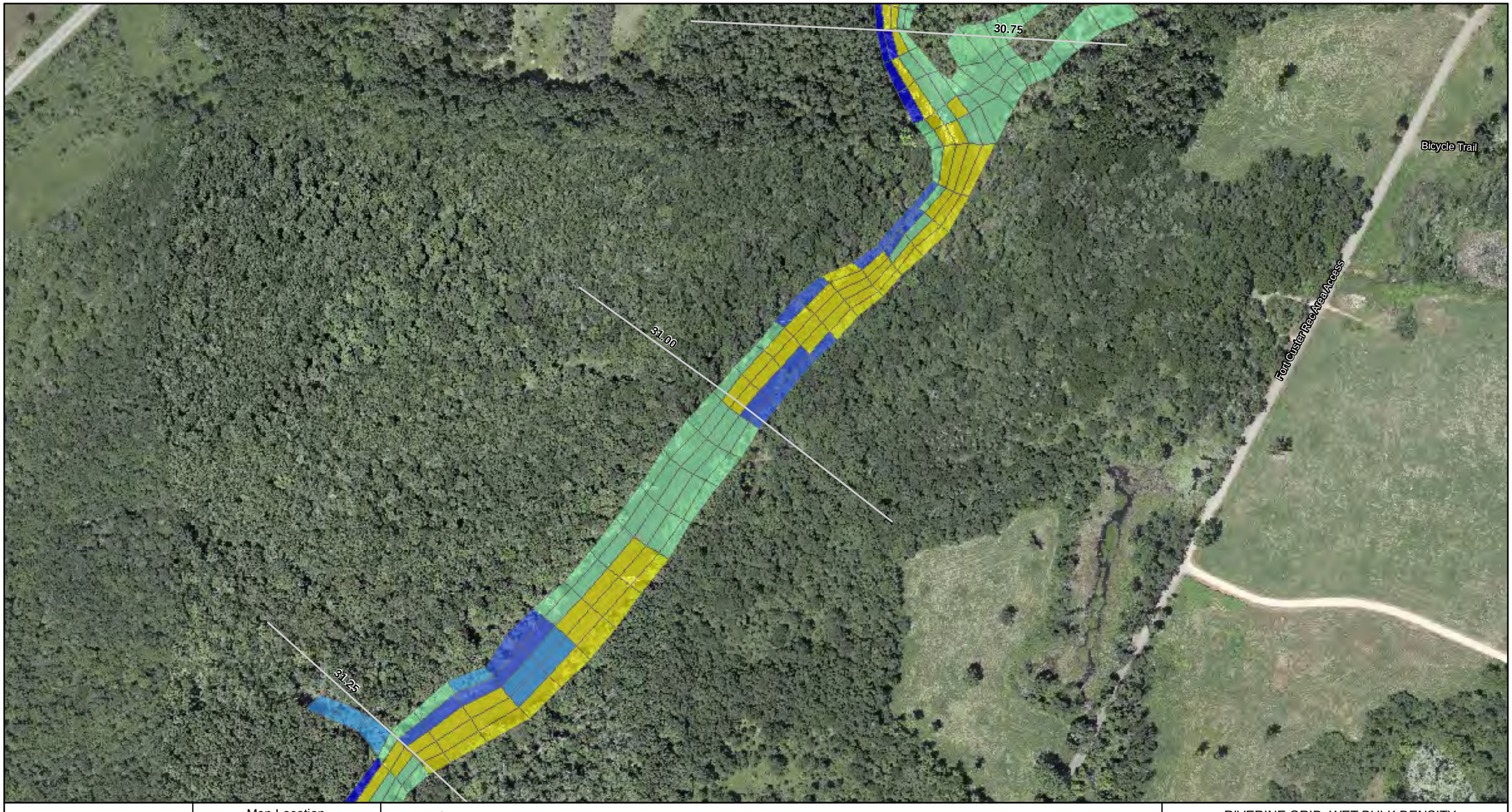
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

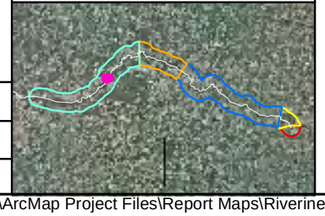
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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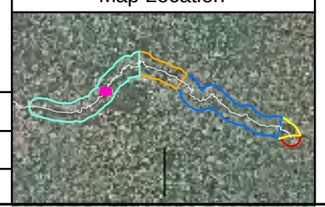
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

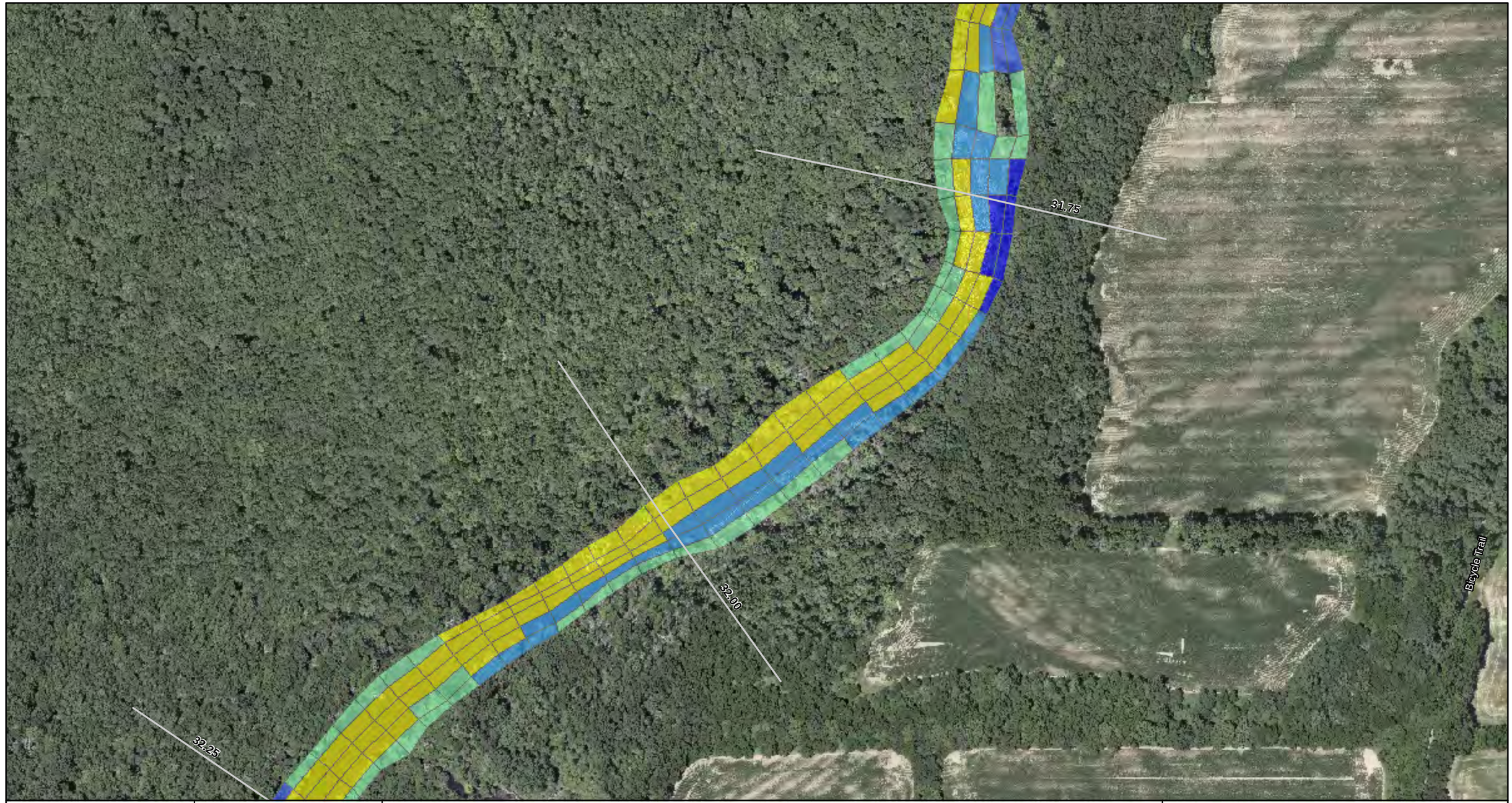
MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

Aerial Photography Date: July 2011



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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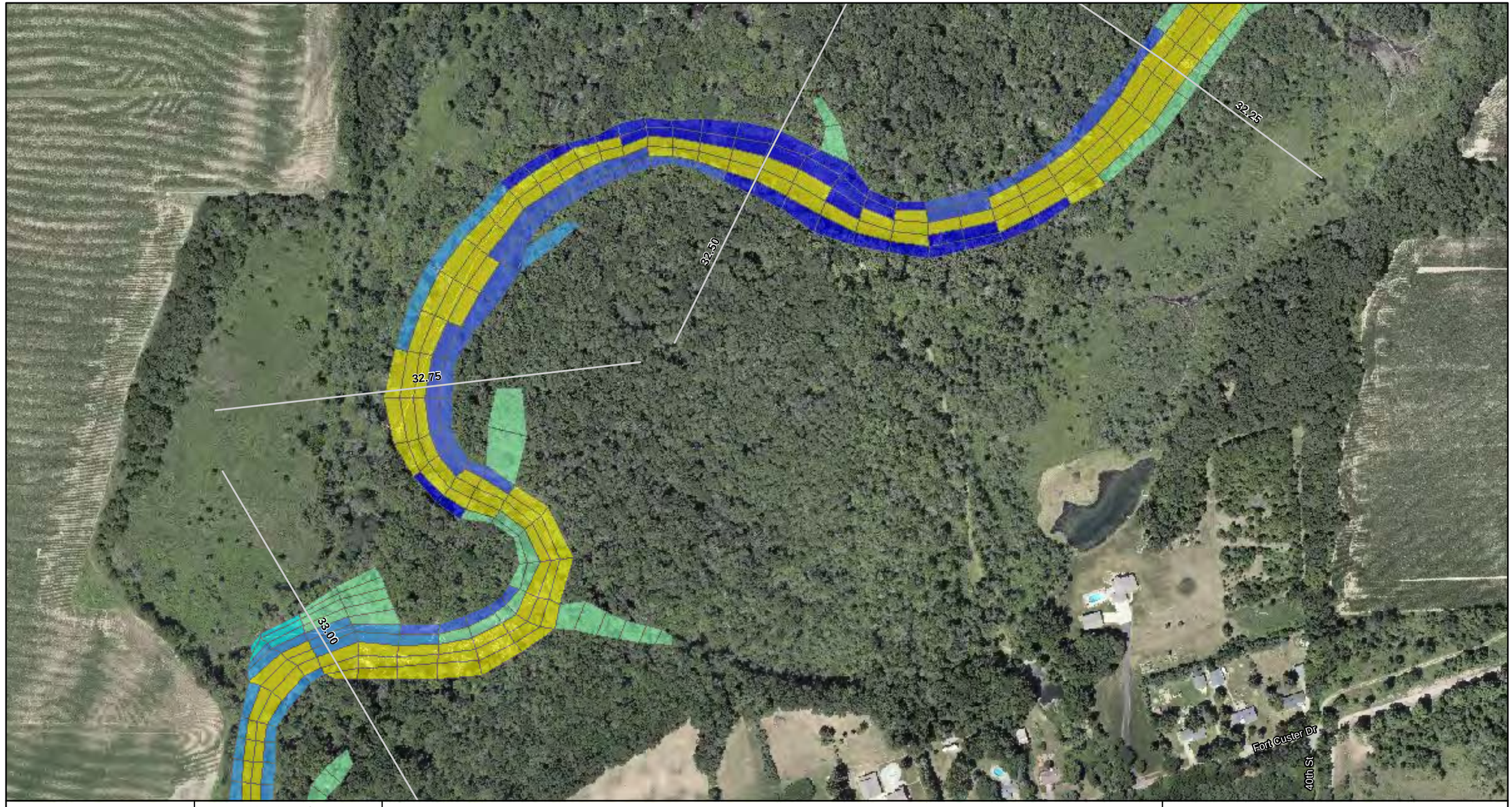
Aerial Photography Date: July 2011



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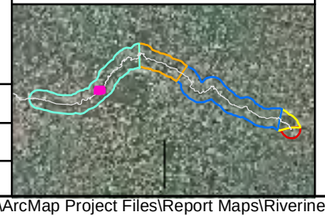
Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: July 2011

33.00
33.25
33.50
33.75
Fort Custer Dr

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Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

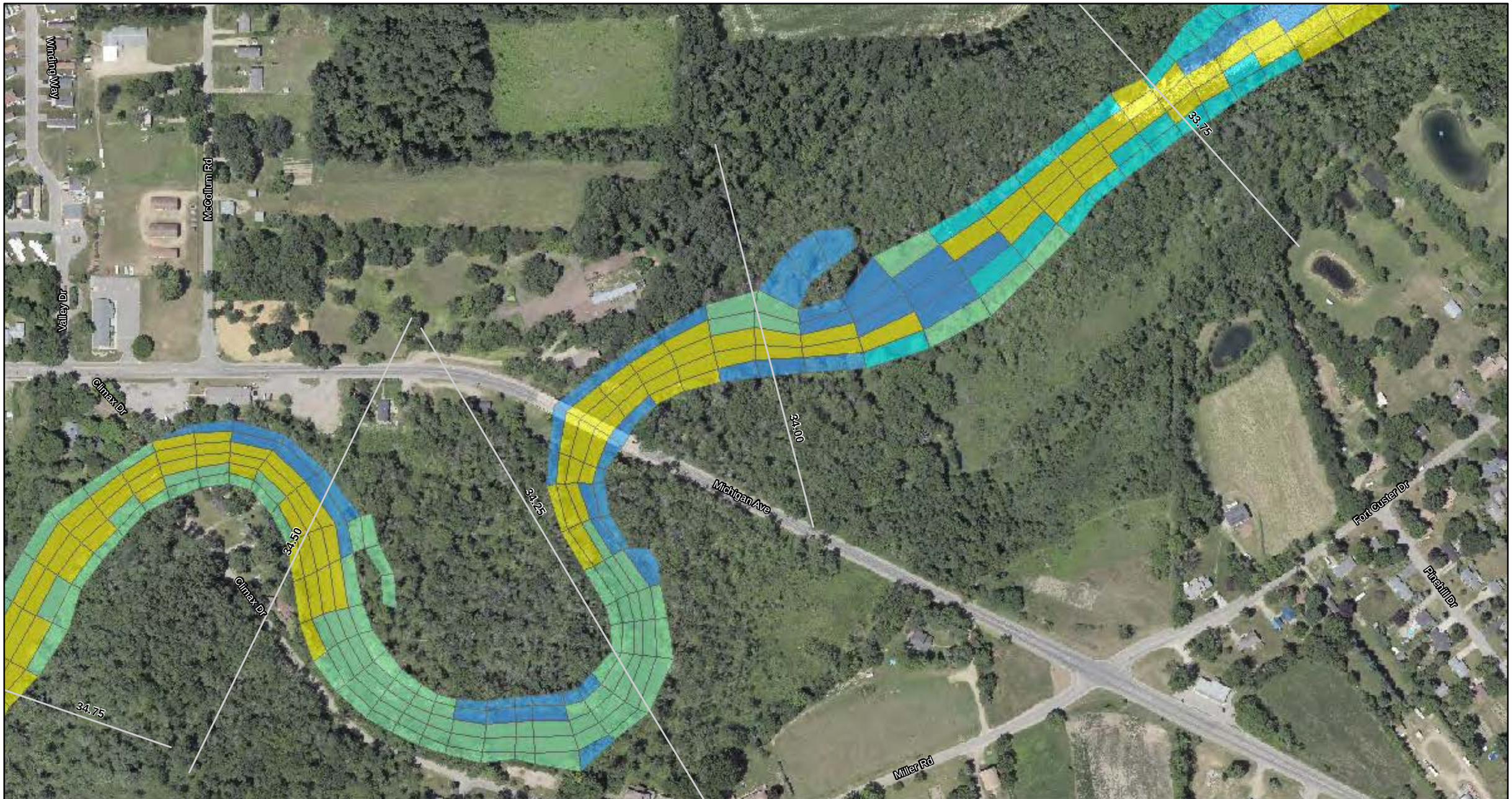
MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

Aerial Photography Date: July 2011



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Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 33.10 - MP 33.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

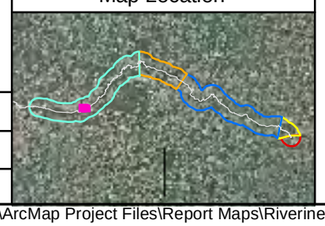
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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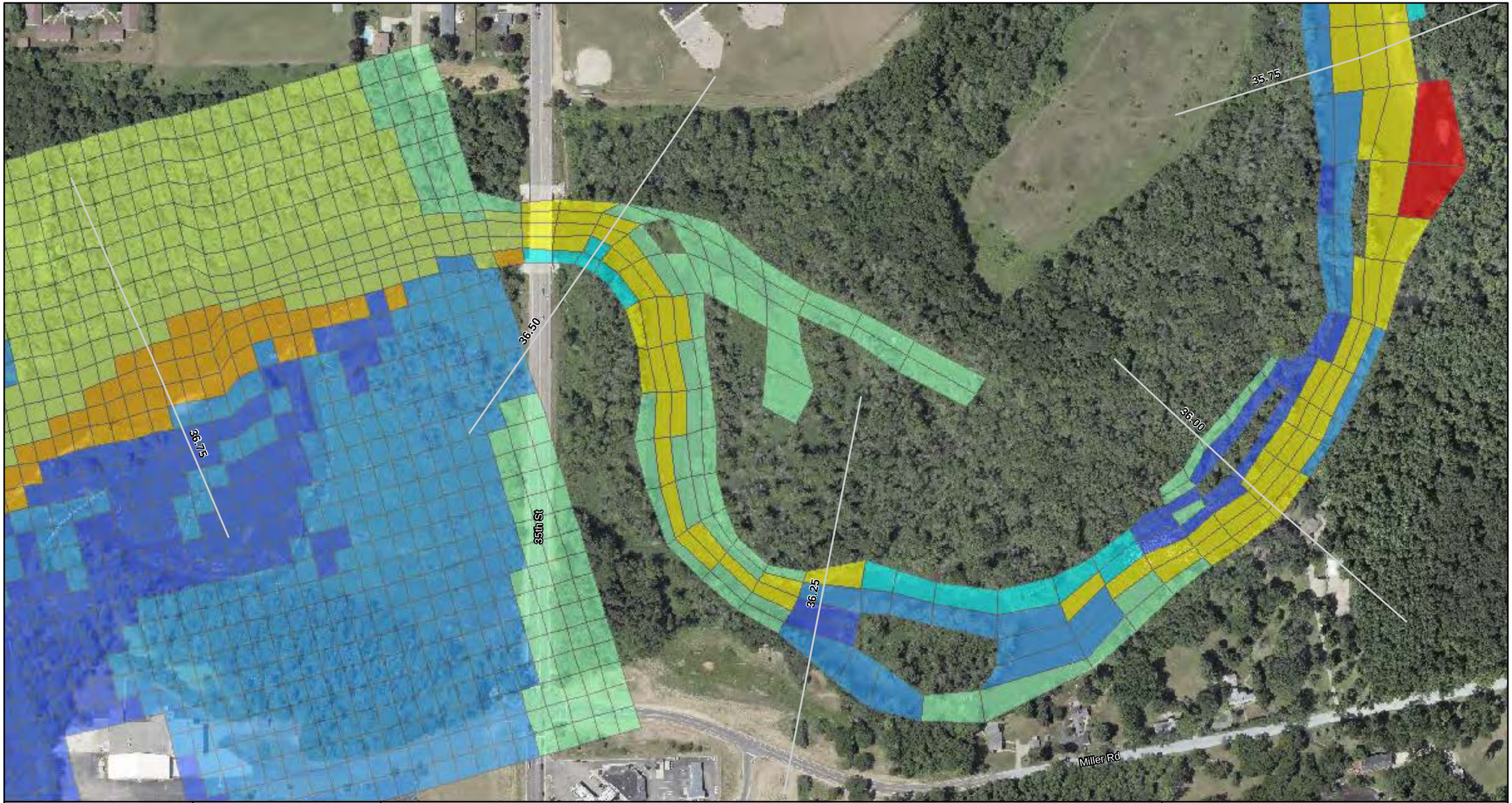
Aerial Photography Date: July 2011



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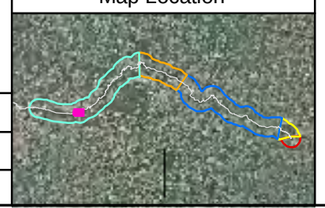
Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
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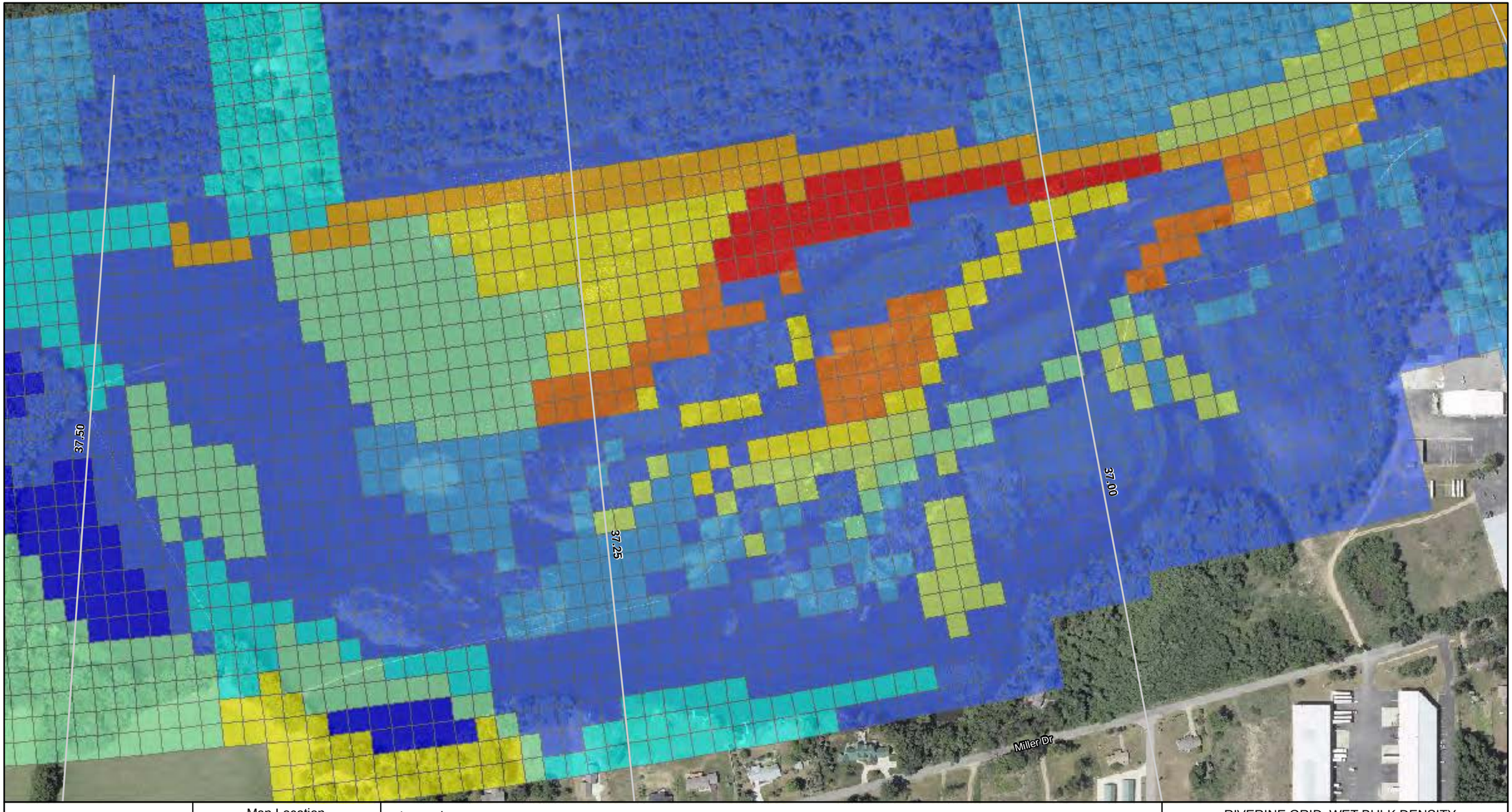
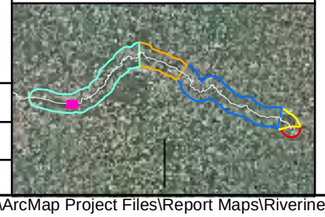
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

38.25

38.00

37.75

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
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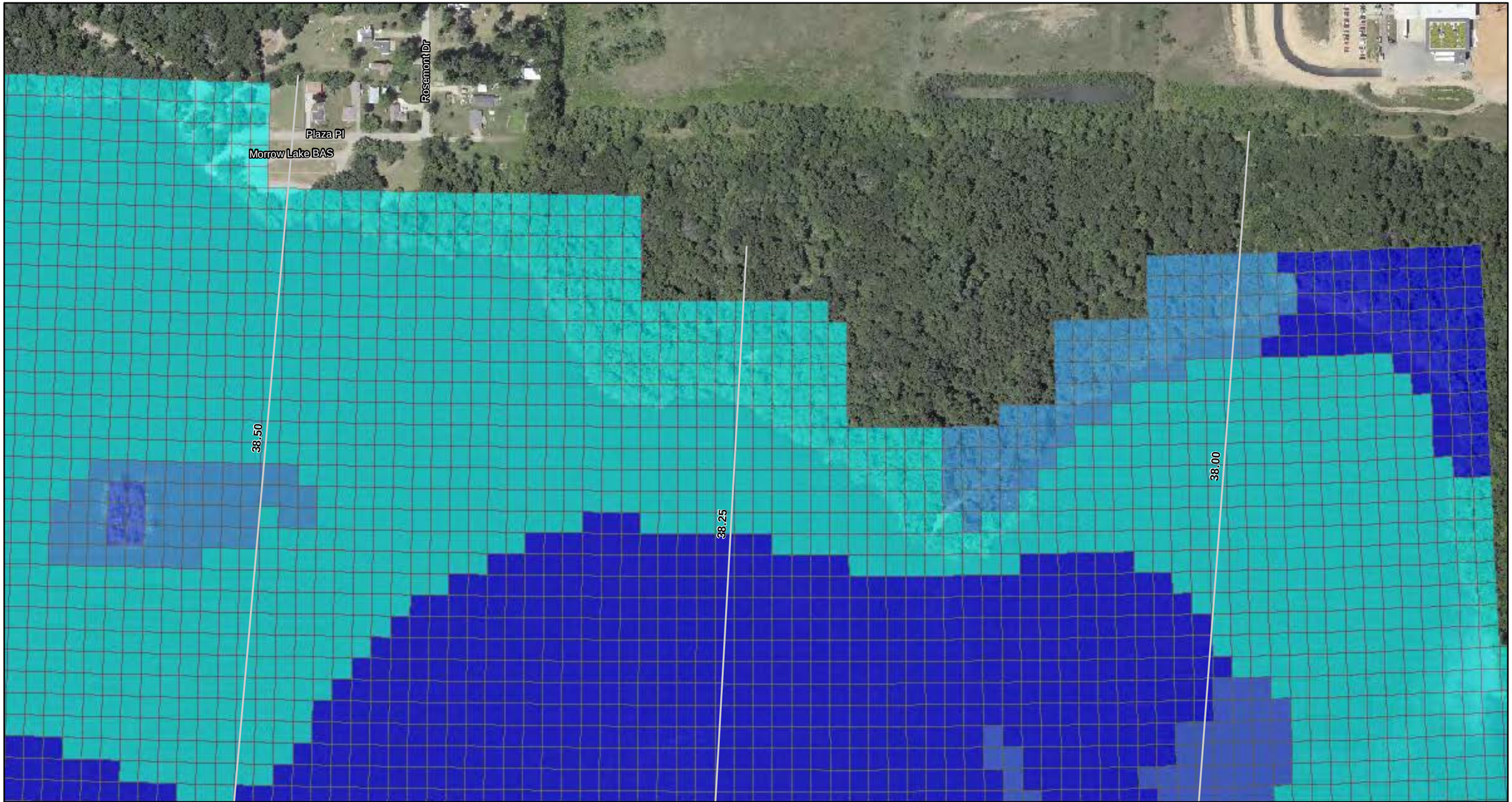
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

Aerial Photography Date: July 2011

38.50

38.25

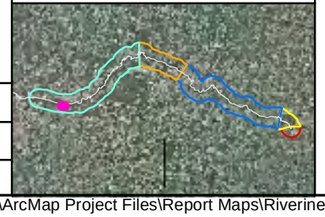
38.00

Lyth Rd

ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

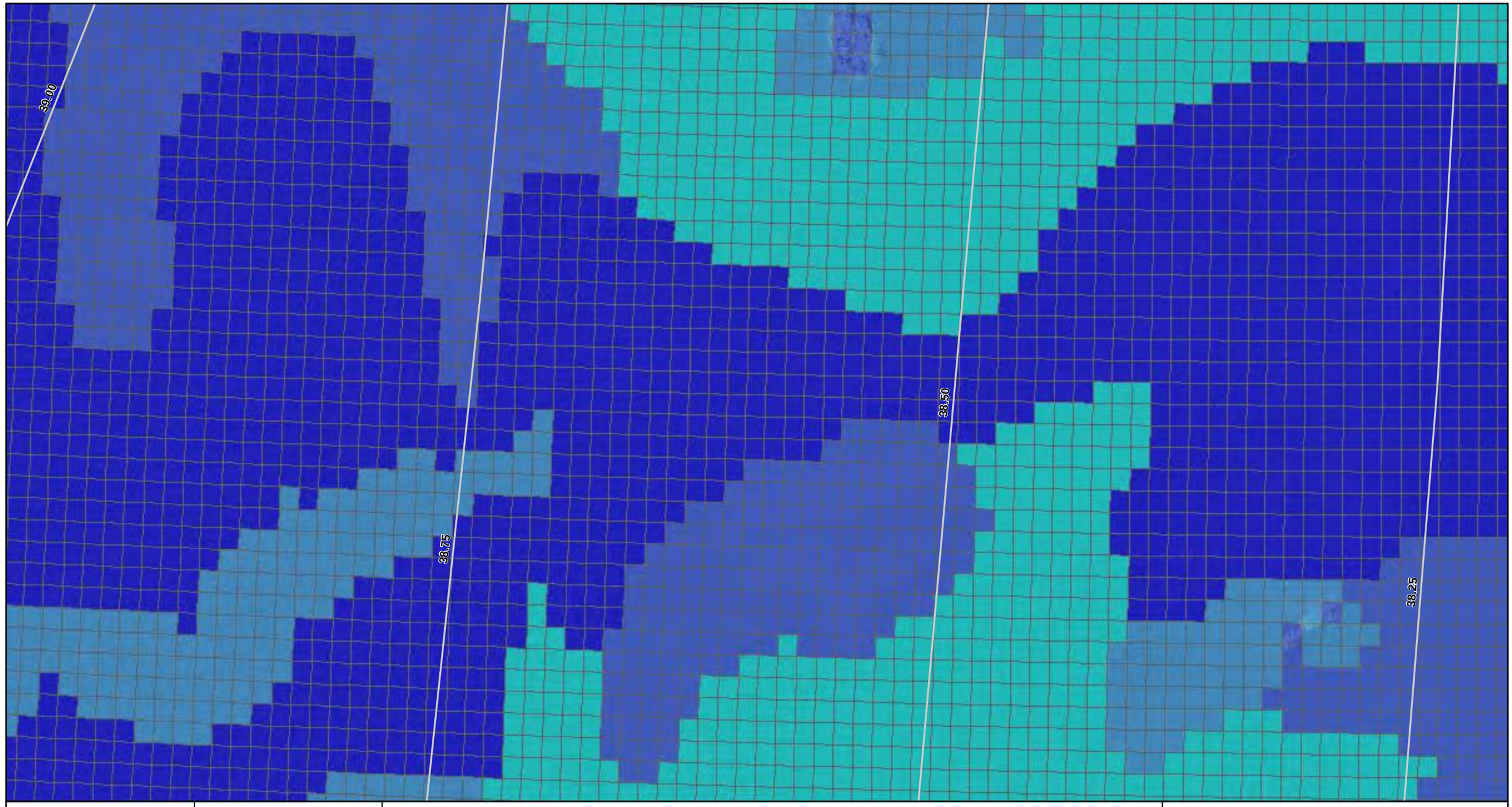
MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

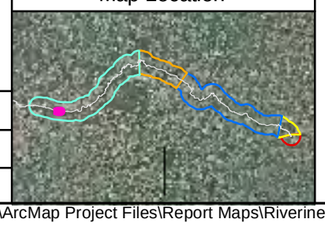
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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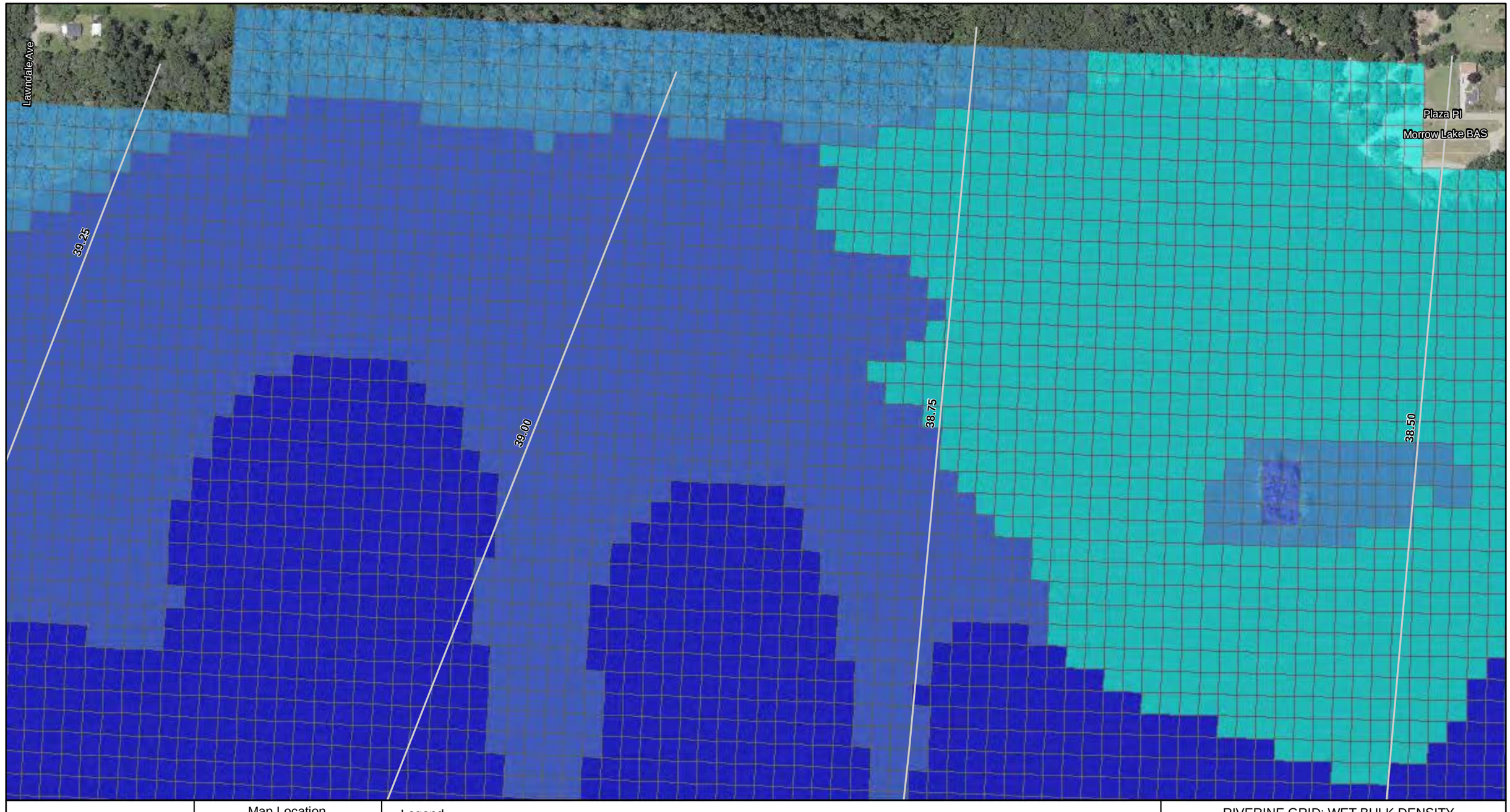
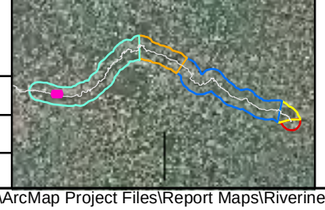
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

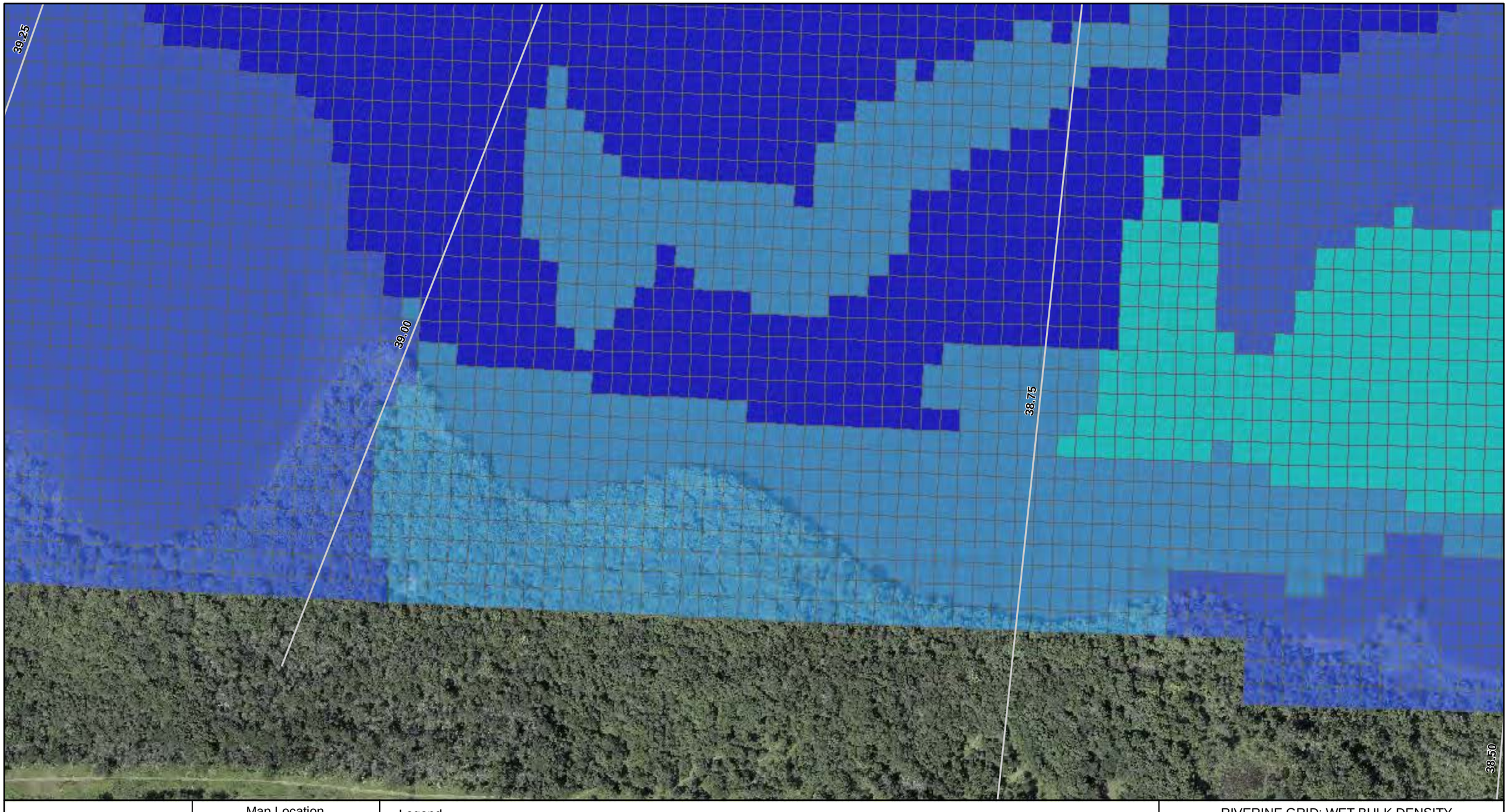
MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

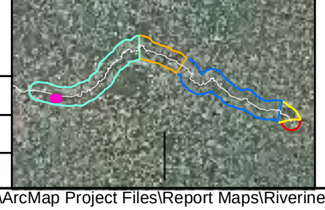
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

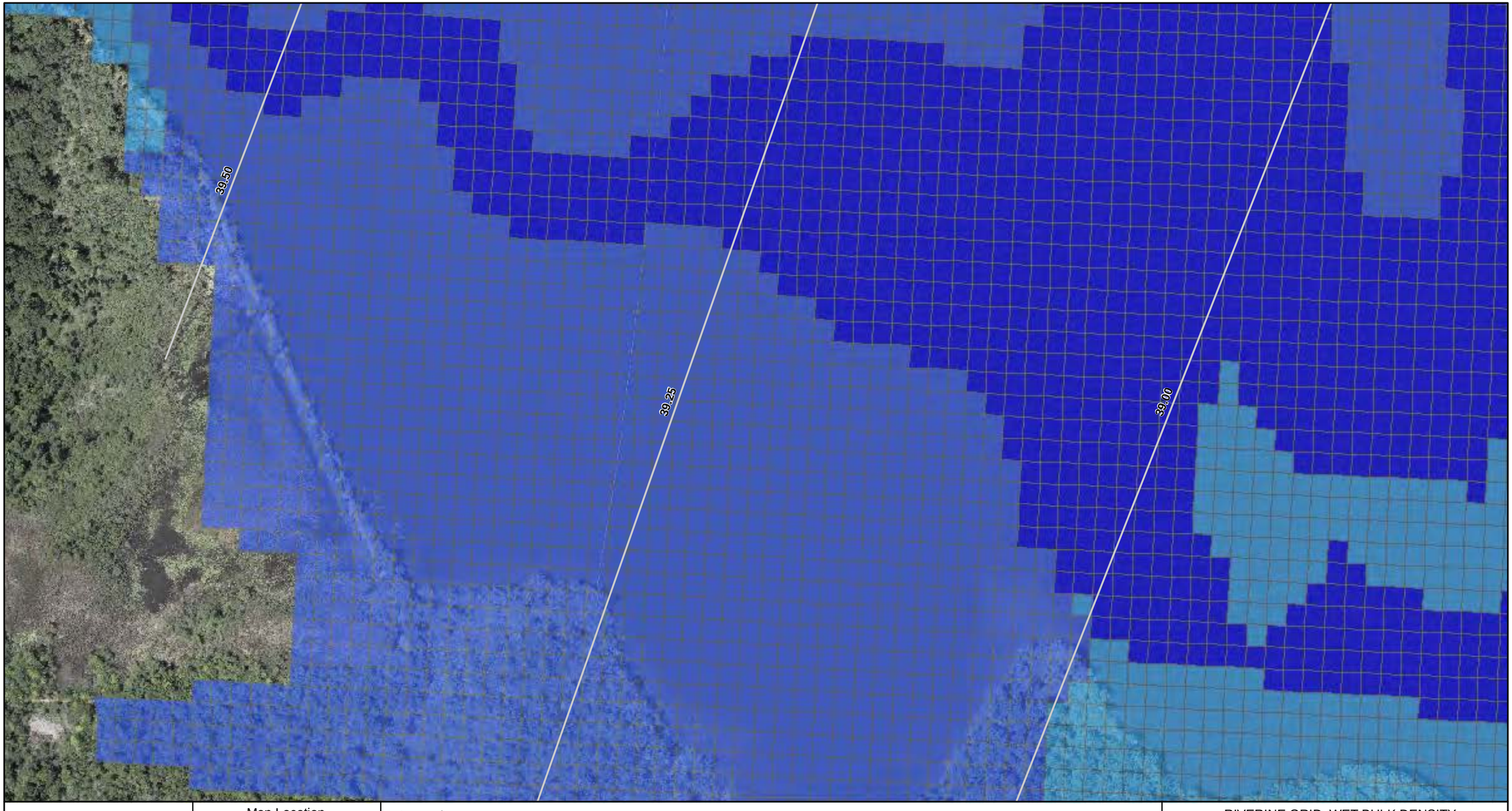
MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Riverine Model WBD Input.mxd

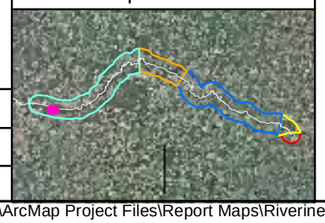
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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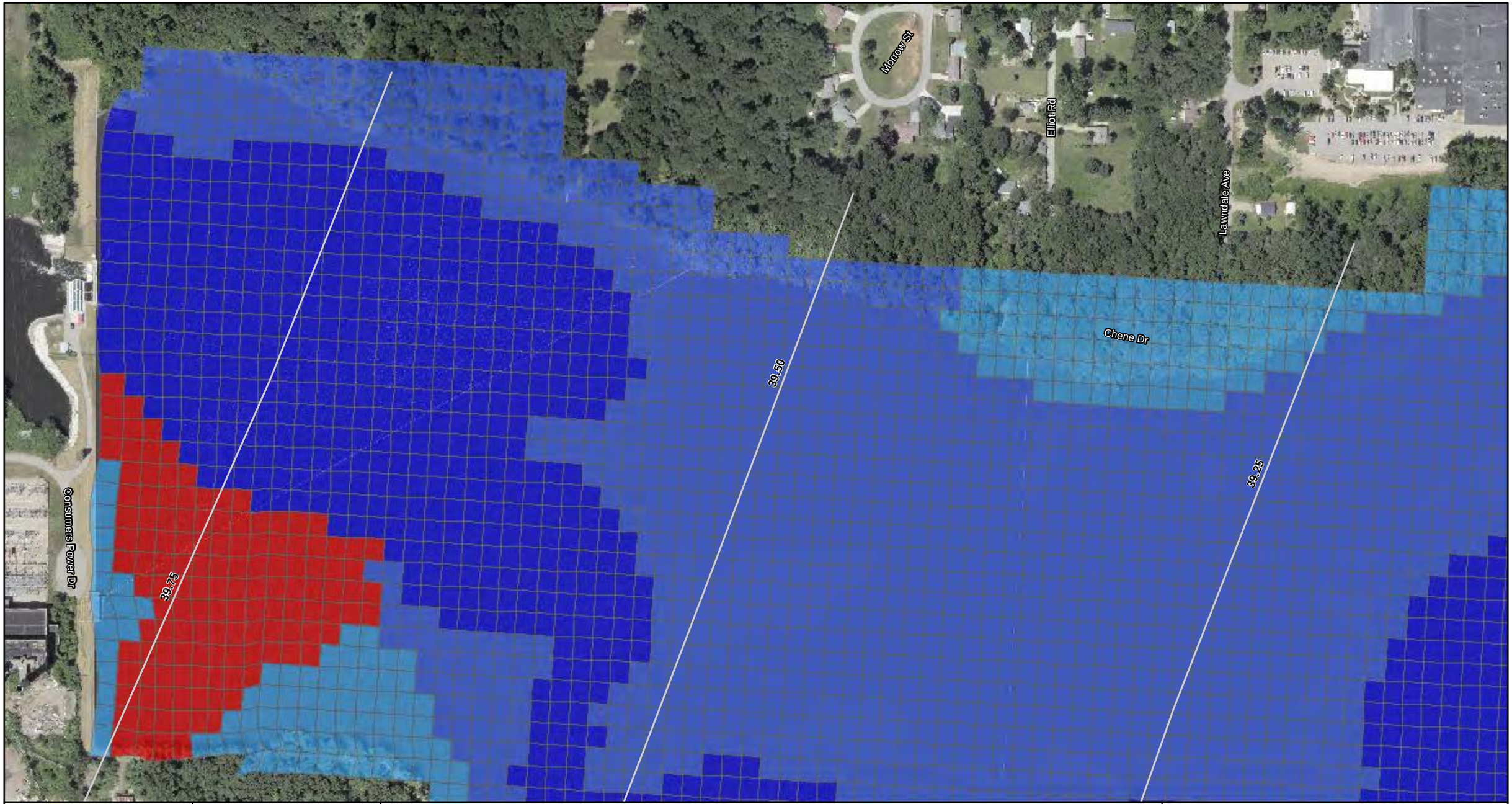
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Wet Bulk Density (g/cm3)

- 1.000001 - 1.100000
- 1.100001 - 1.200000
- 1.200001 - 1.300000
- 1.300001 - 1.400000
- 1.400001 - 1.500000
- 1.500001 - 1.600000
- 1.600001 - 1.700000
- 1.700001 - 1.800000
- 1.800001 - 1.900000
- 1.900001 - 2.000000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: WET BULK DENSITY

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
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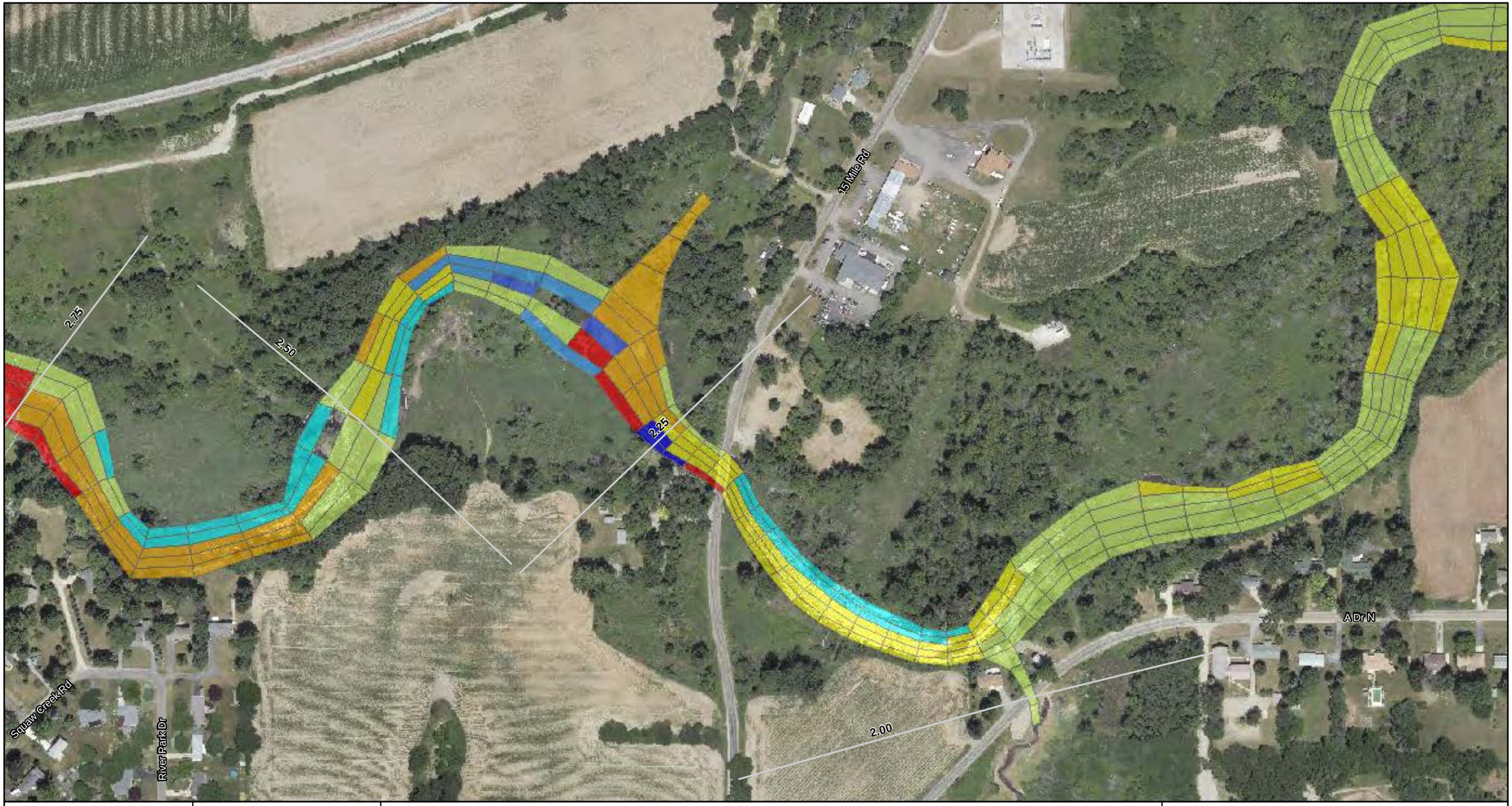
Aerial Photography Date: July 2011

Figure 3-18

Riverine Grid: Dry Bulk Density

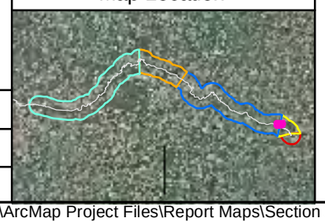
Sheets 1 through 56



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
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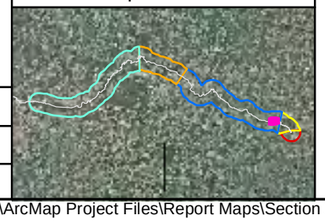
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
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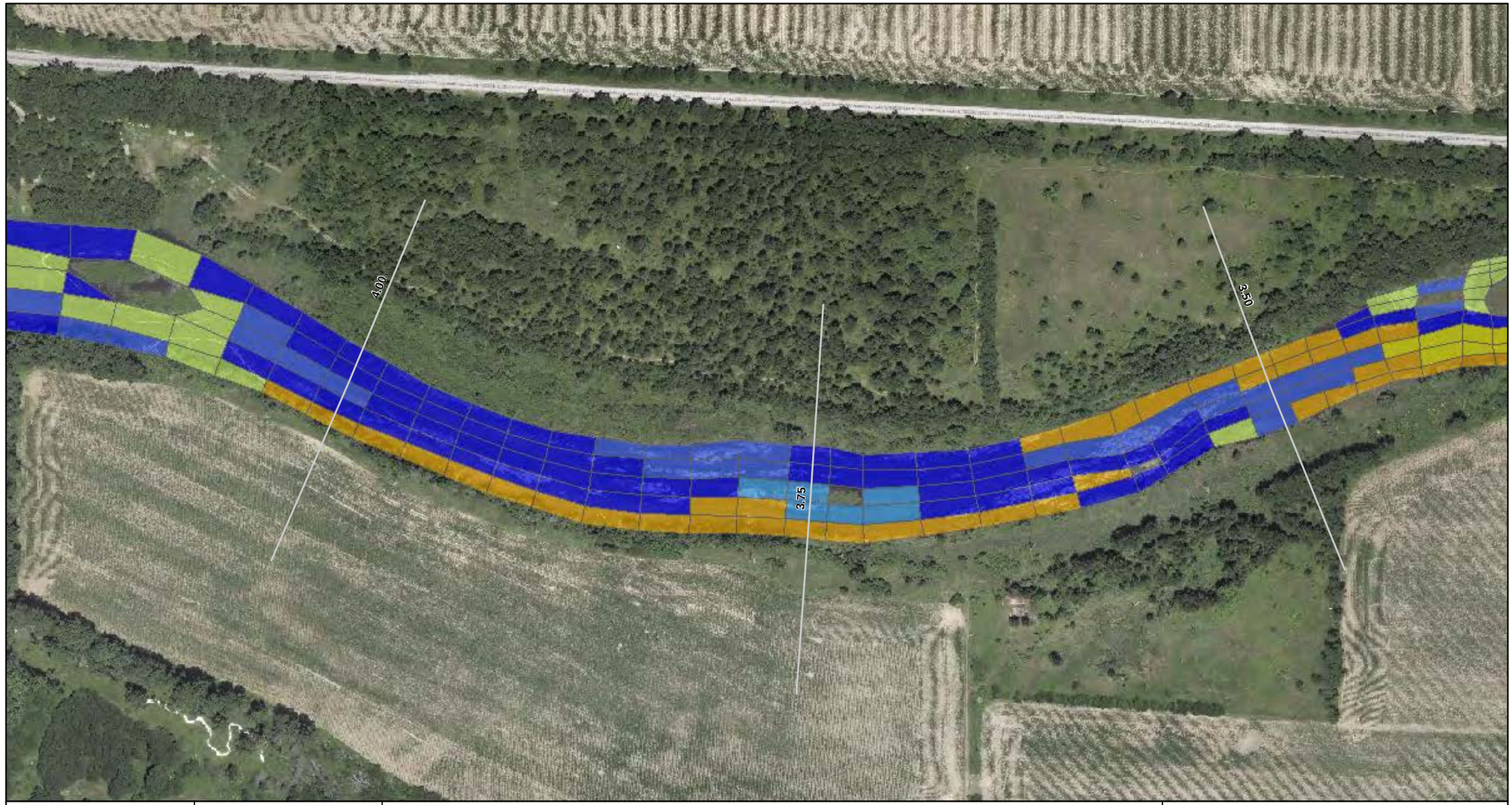
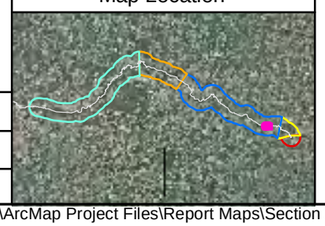
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
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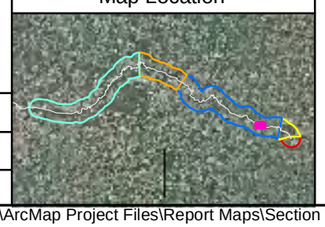
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
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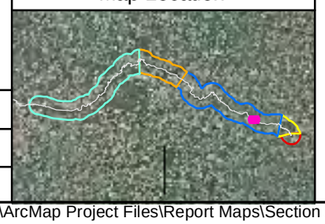
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
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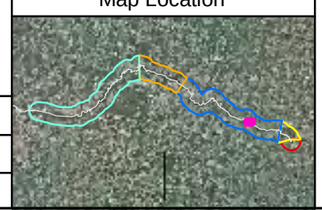
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
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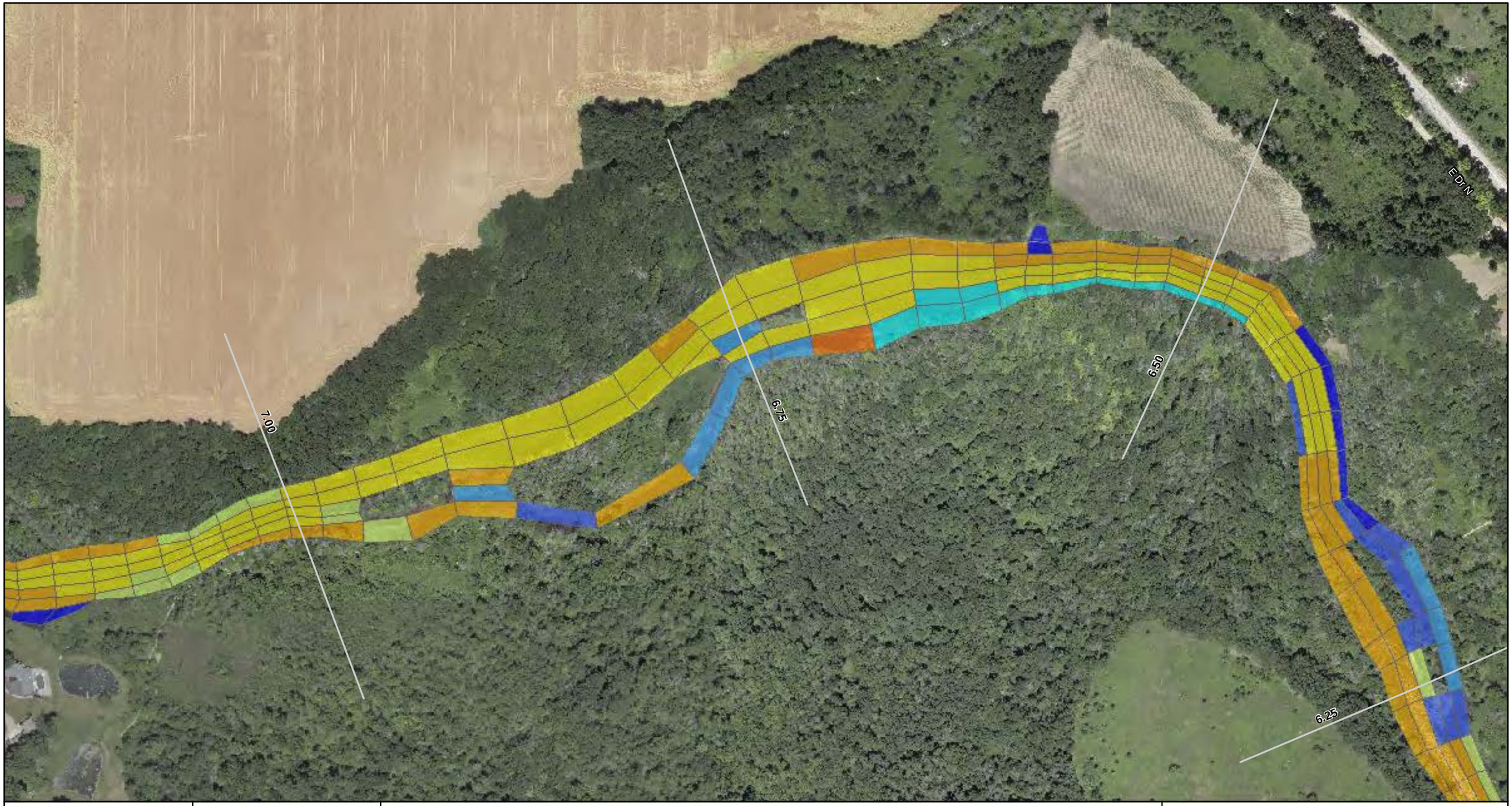
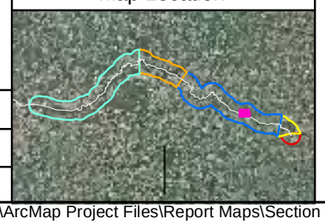
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
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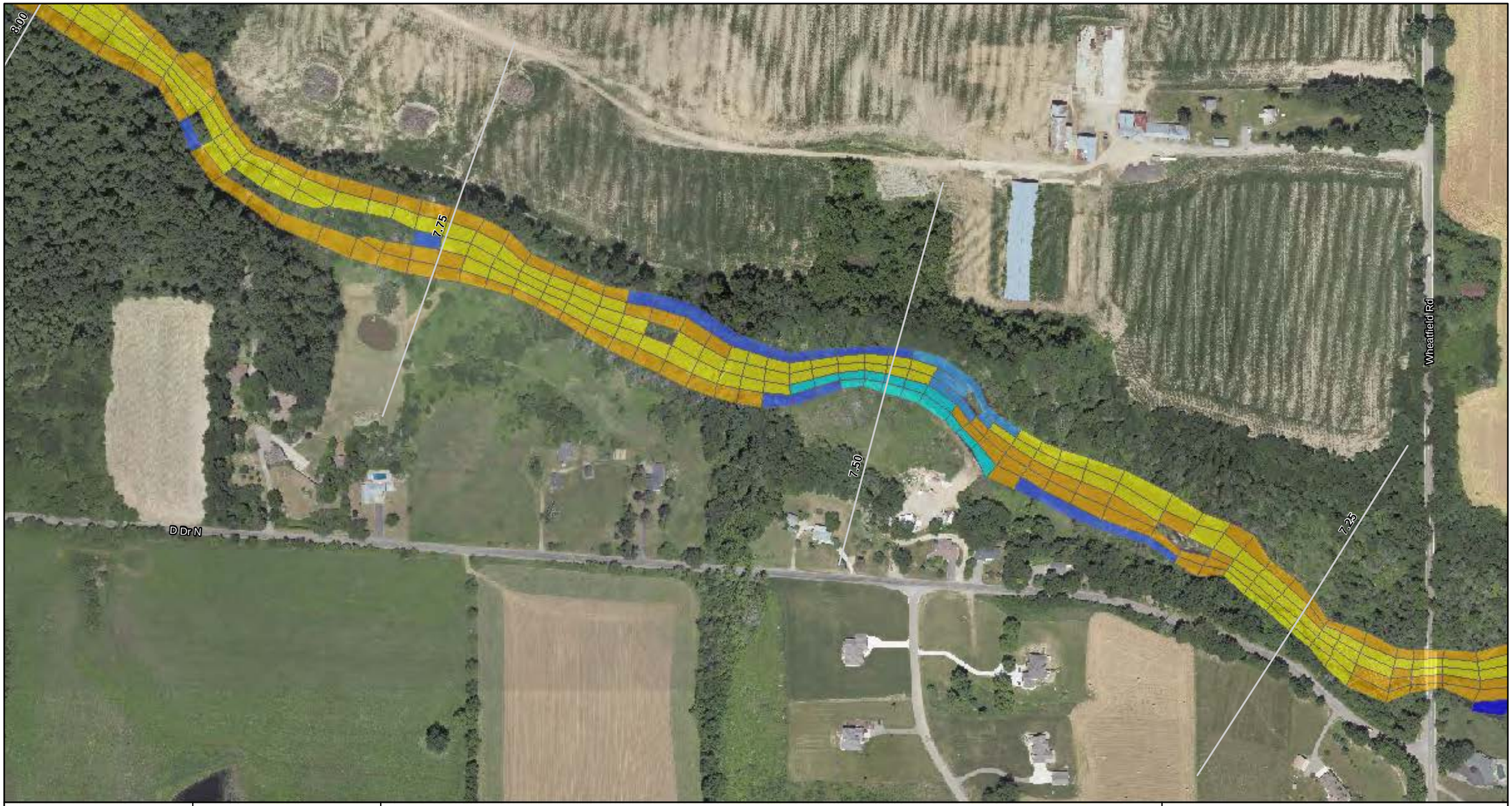
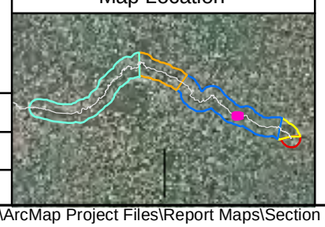
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
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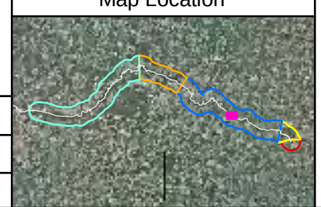
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
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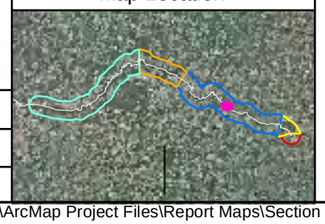
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: July 2011

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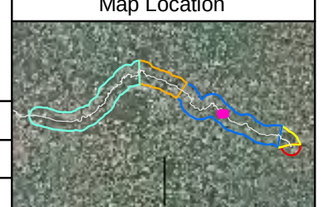
Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
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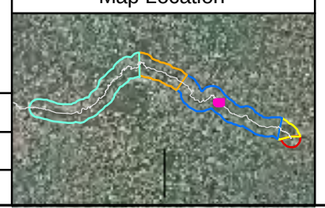
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
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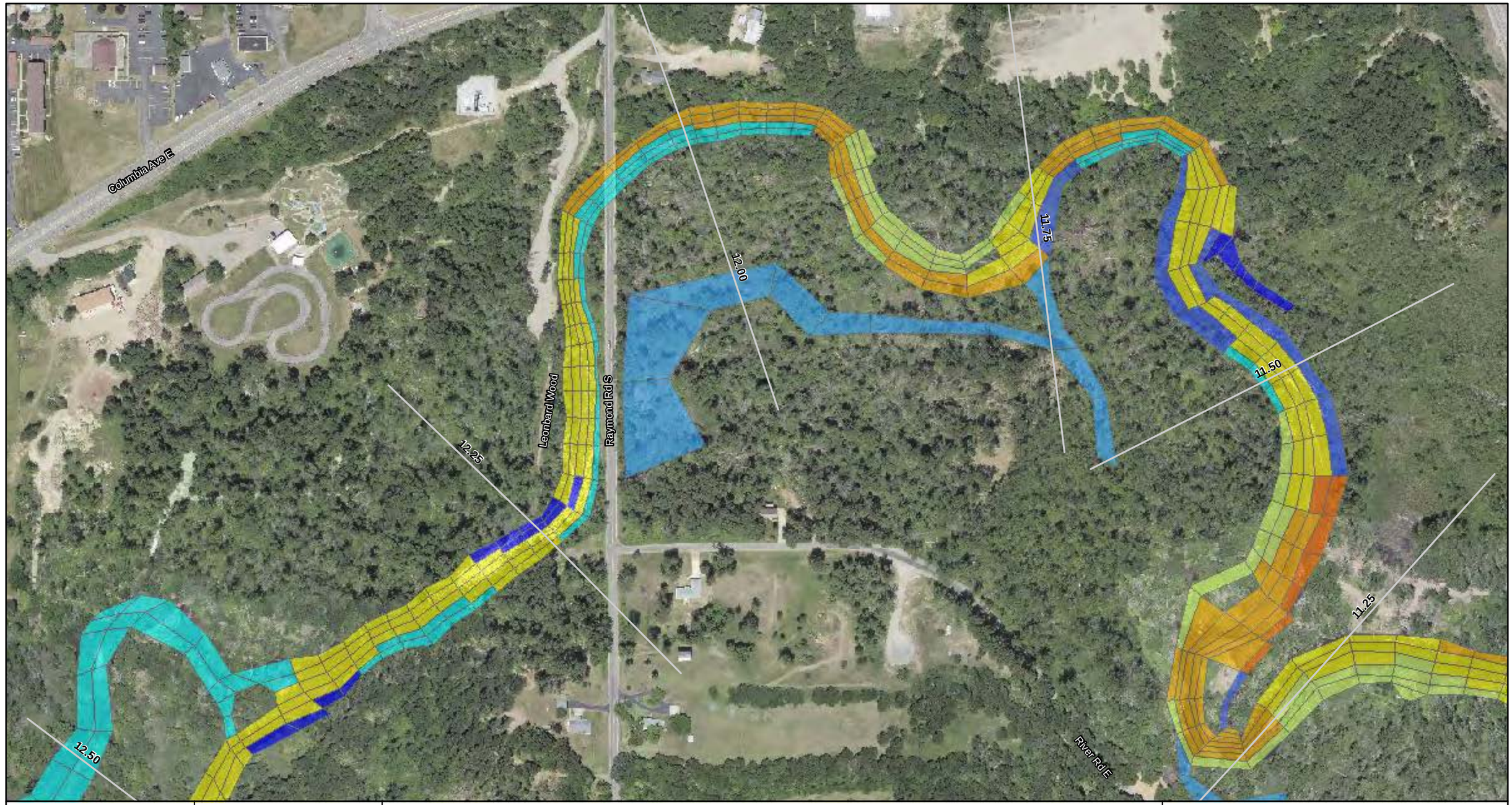
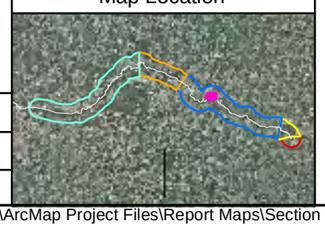
Aerial Photography Date: July 2011



Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

RIVERINE GRID: DRY BULK DENSITY

MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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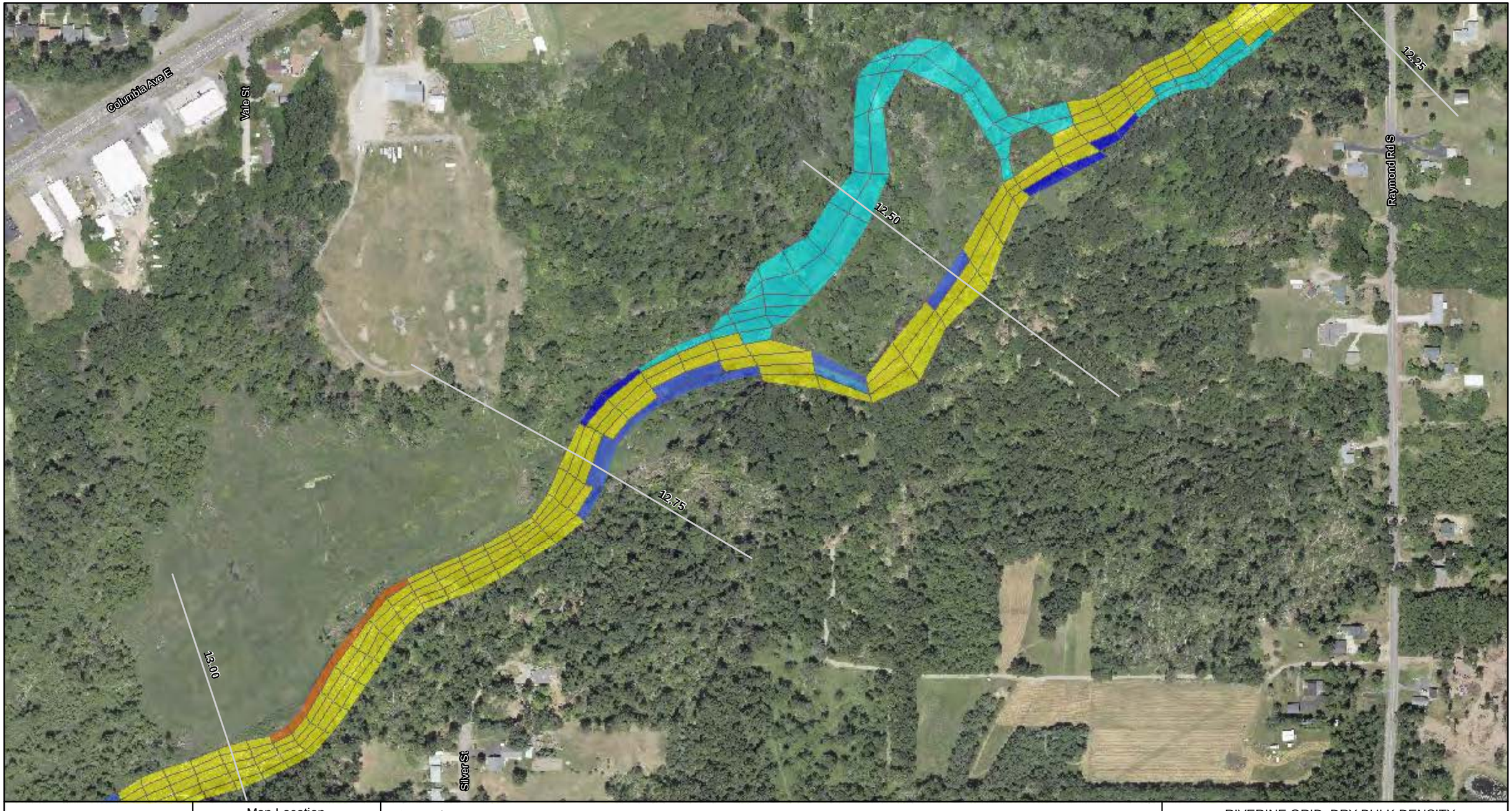
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model DBD Input.mxd

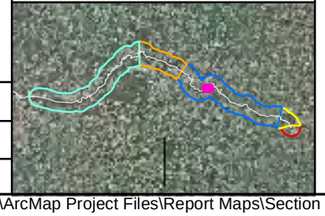
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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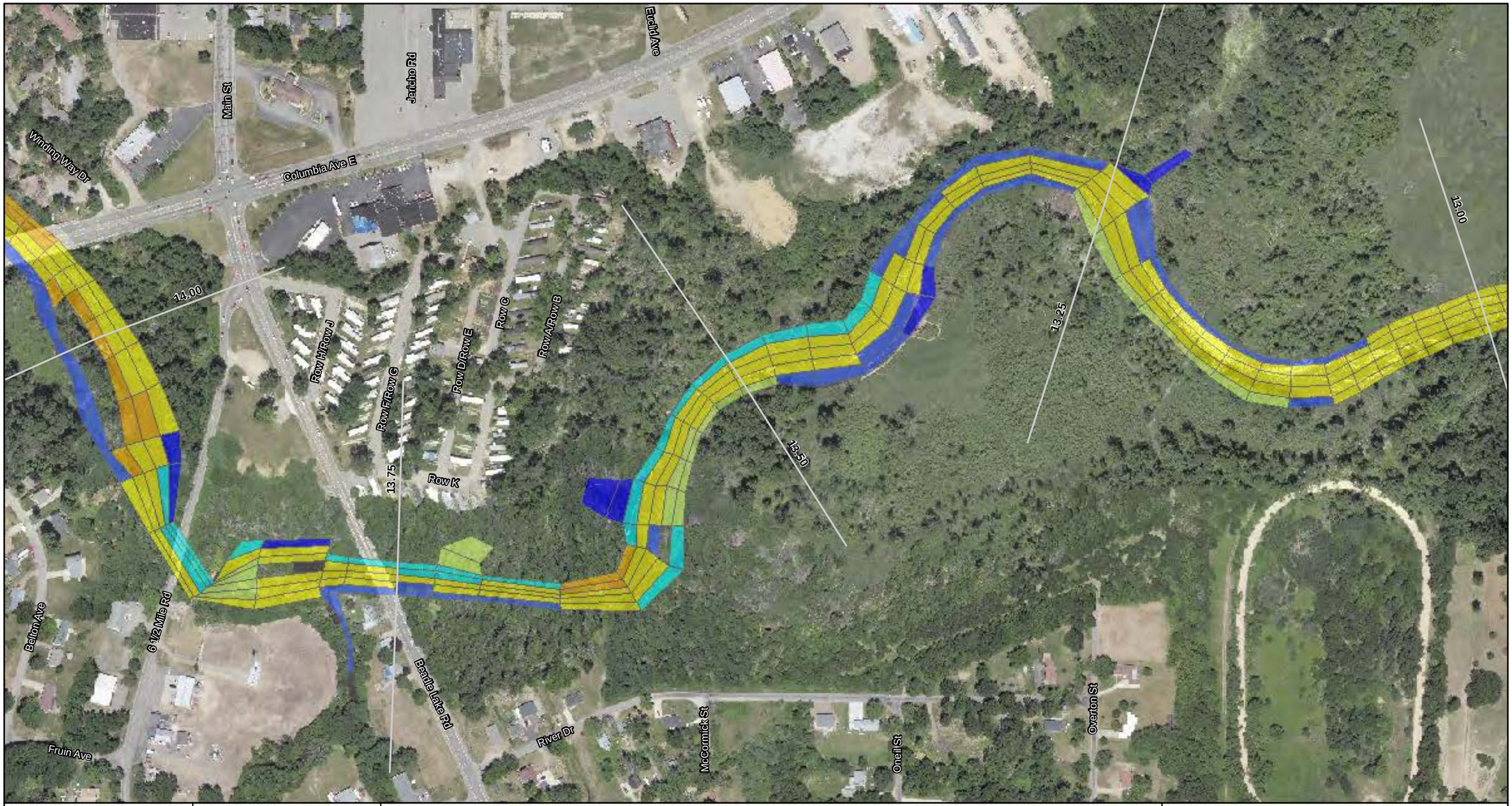
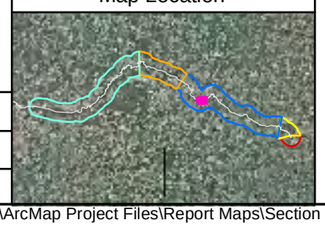
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
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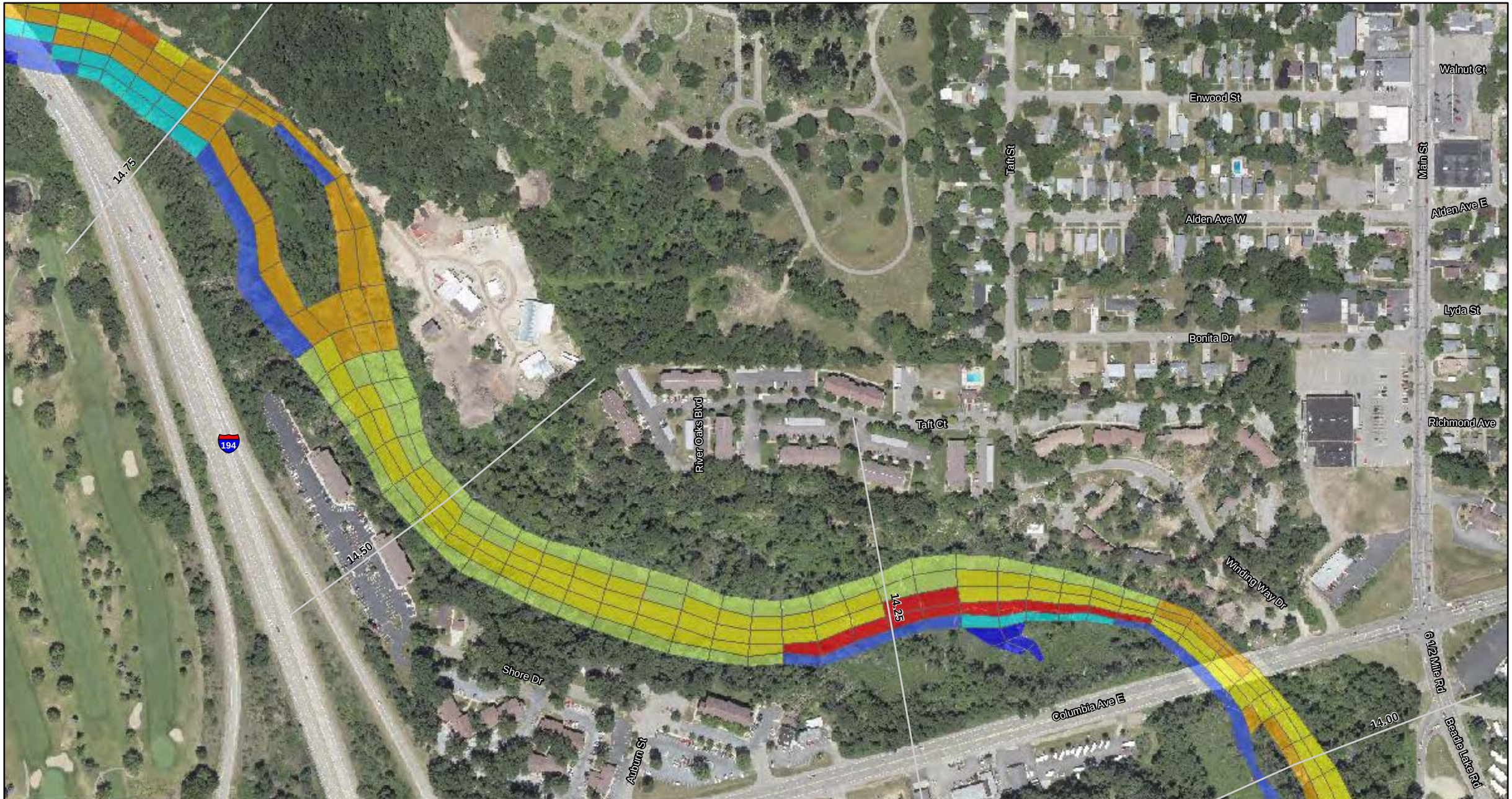
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
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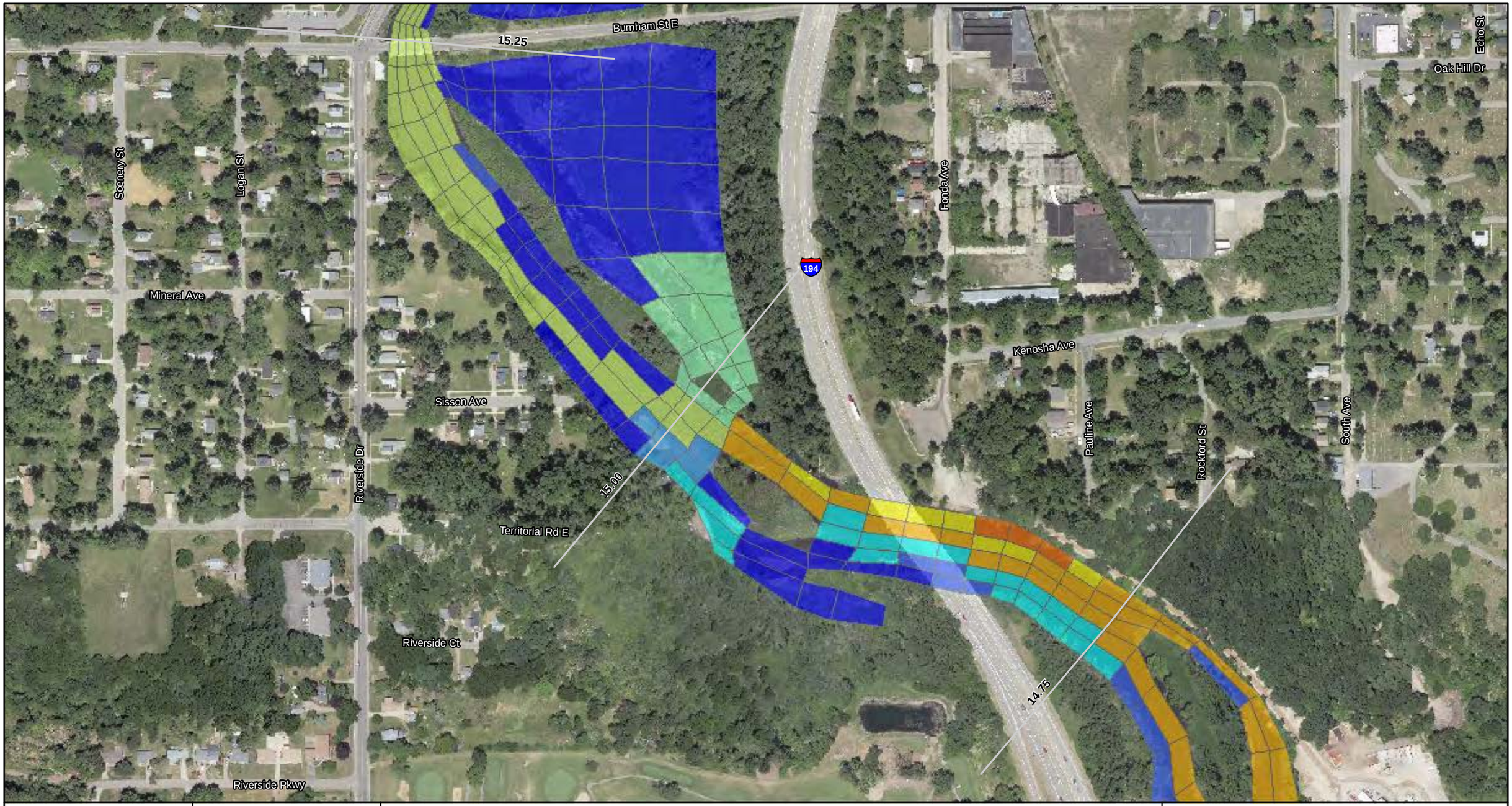
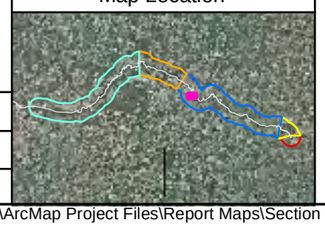
Aerial Photography Date: July 2011



Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
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Drawn:	BRS 3/29/2012
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Project #:	106-4186

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Aerial Photography Date: July 2011

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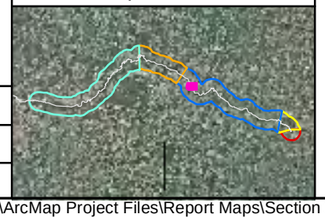
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: July 2011

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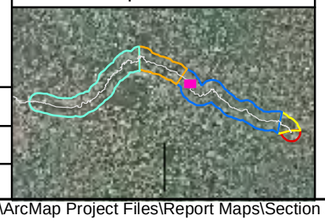
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
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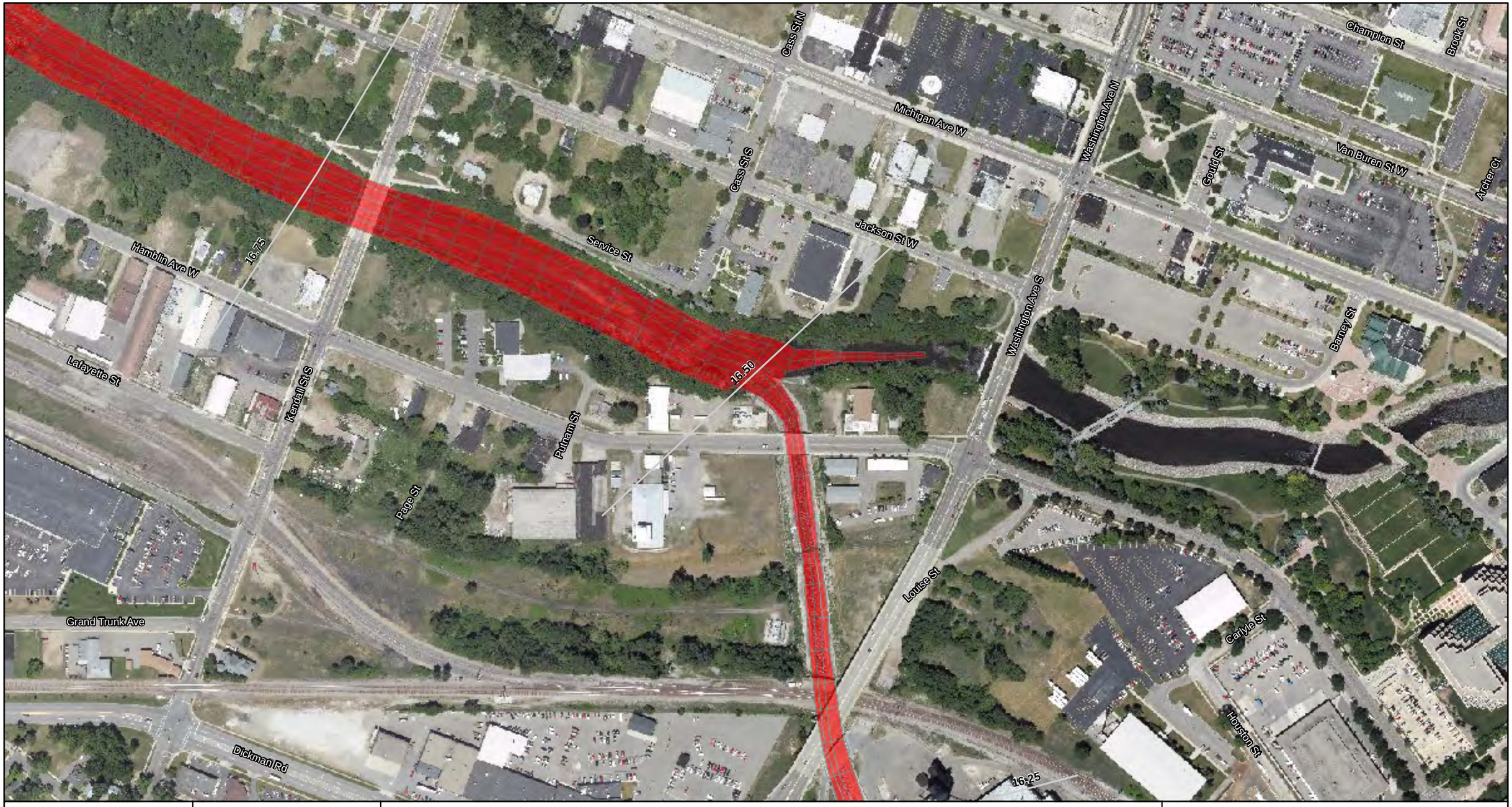
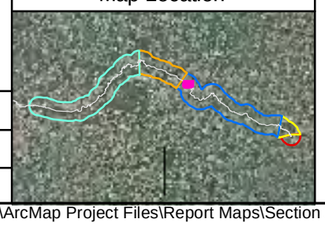
Aerial Photography Date: July 2011



Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
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Drawn:	BRS	3/29/2012
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Project #:	106-4186	

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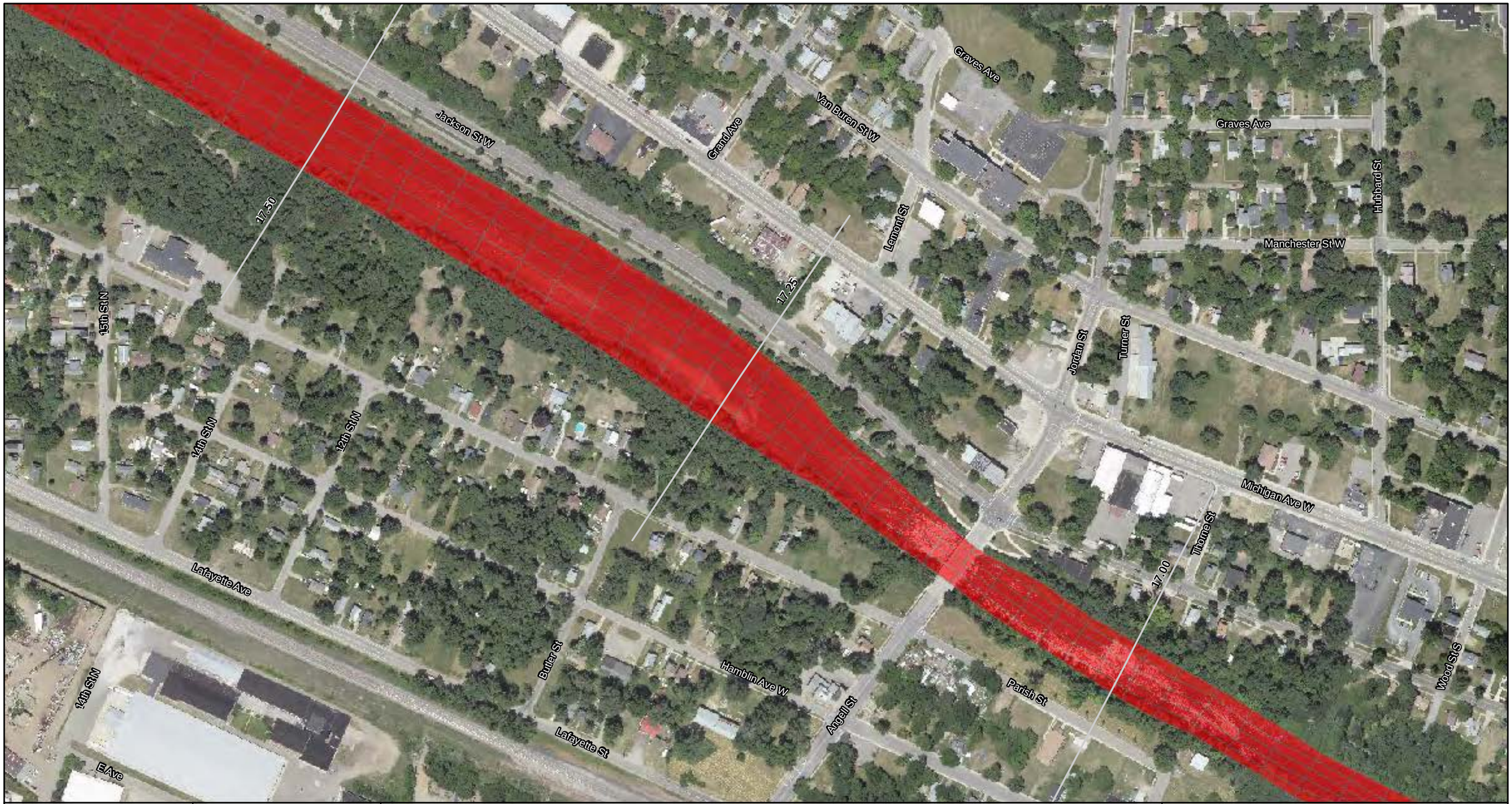
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
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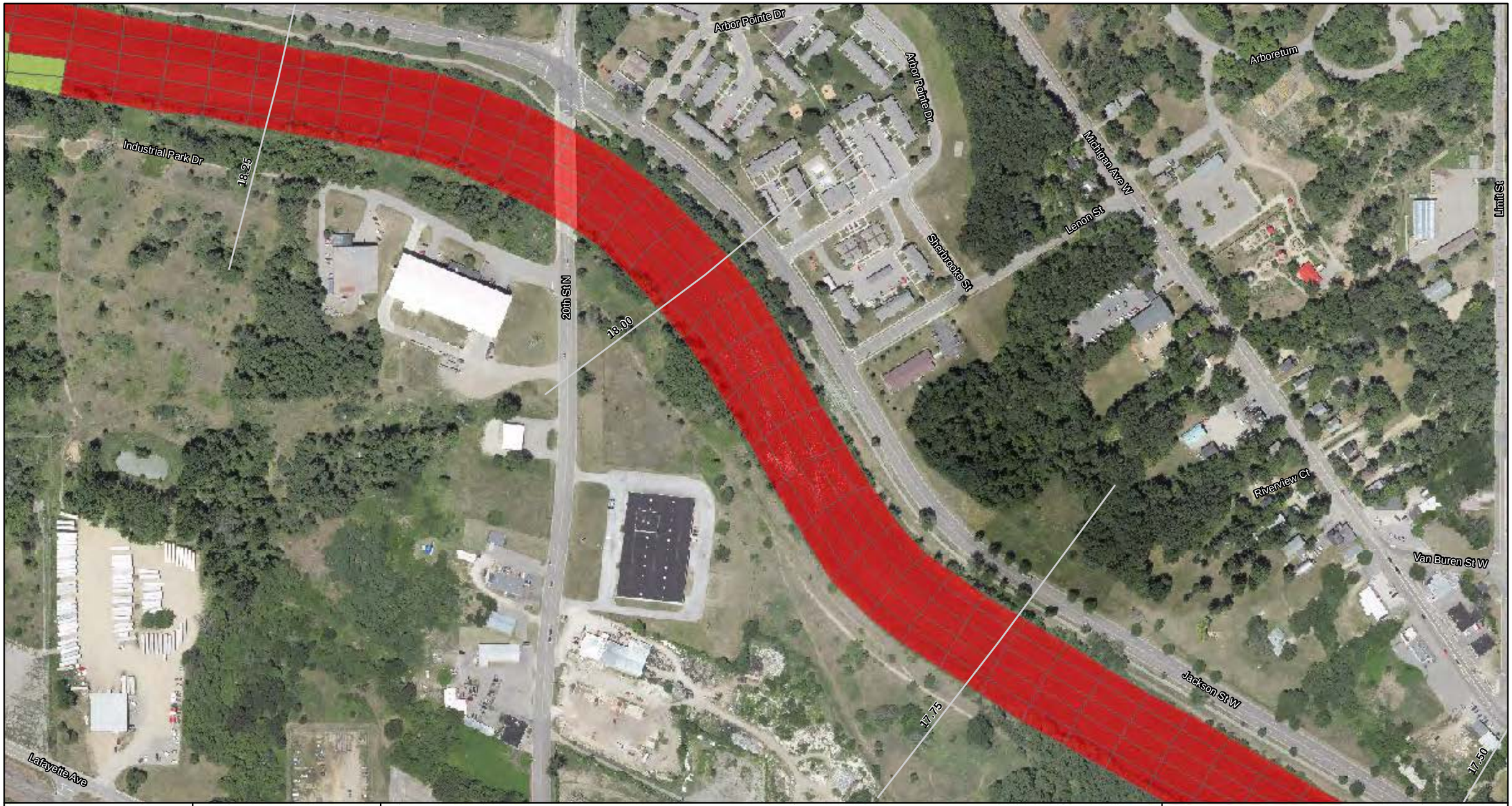
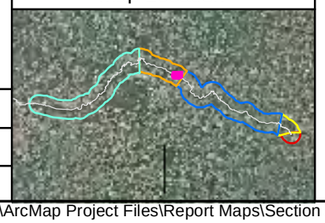
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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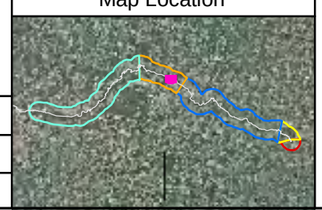
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
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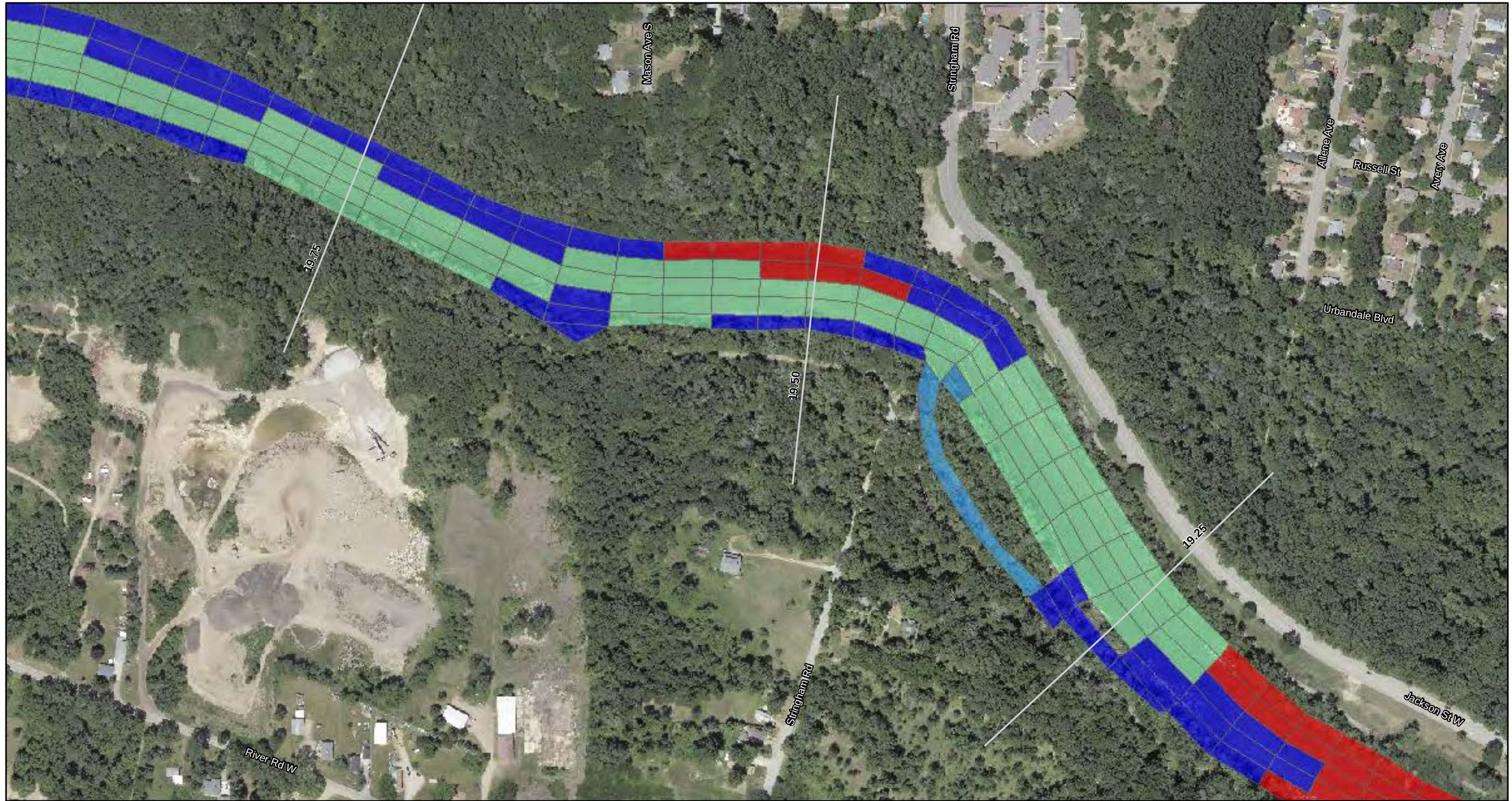
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: July 2011

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
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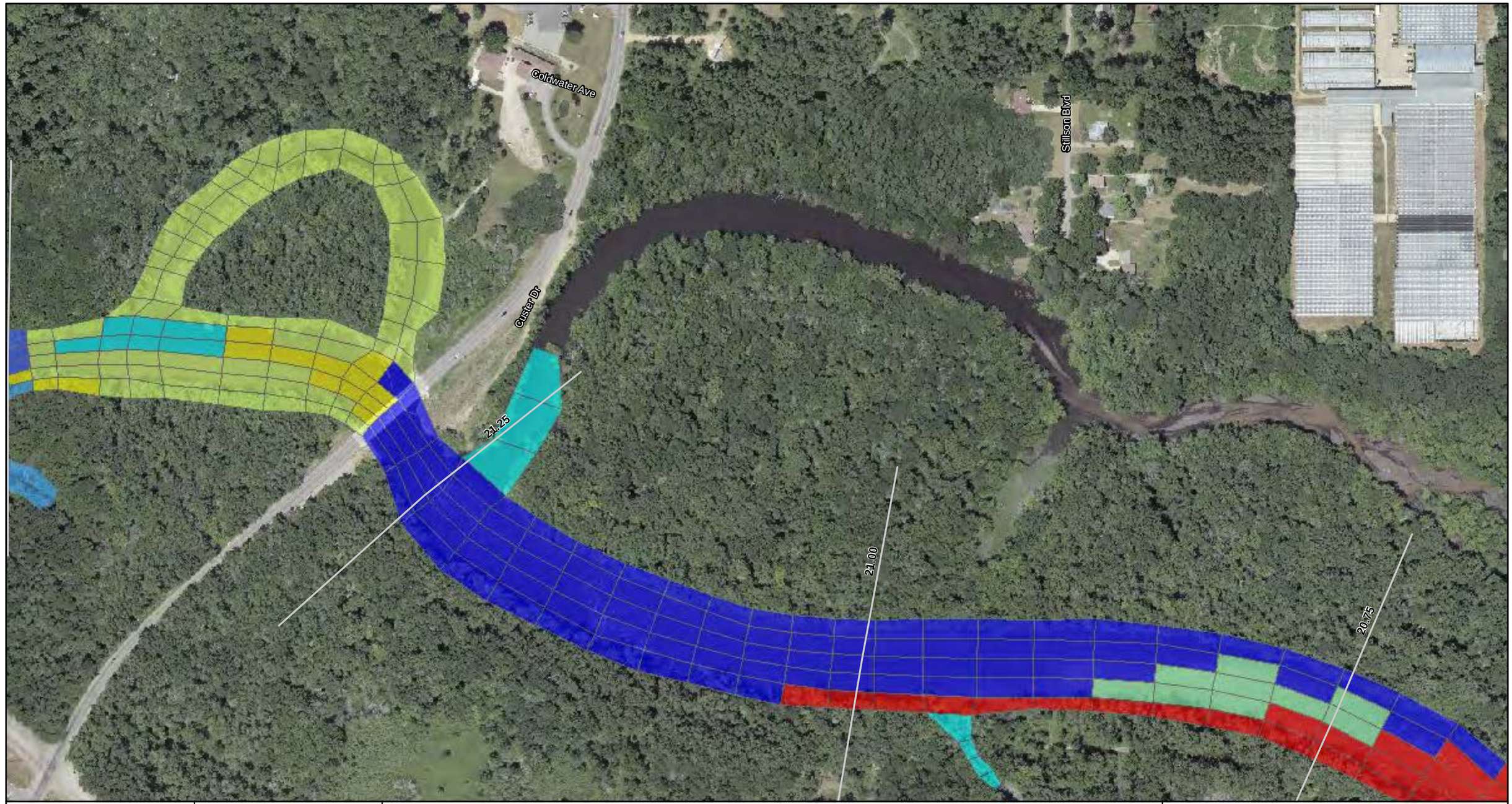
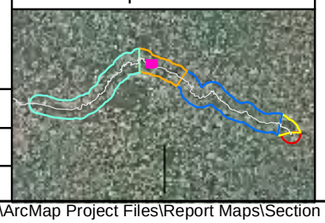
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
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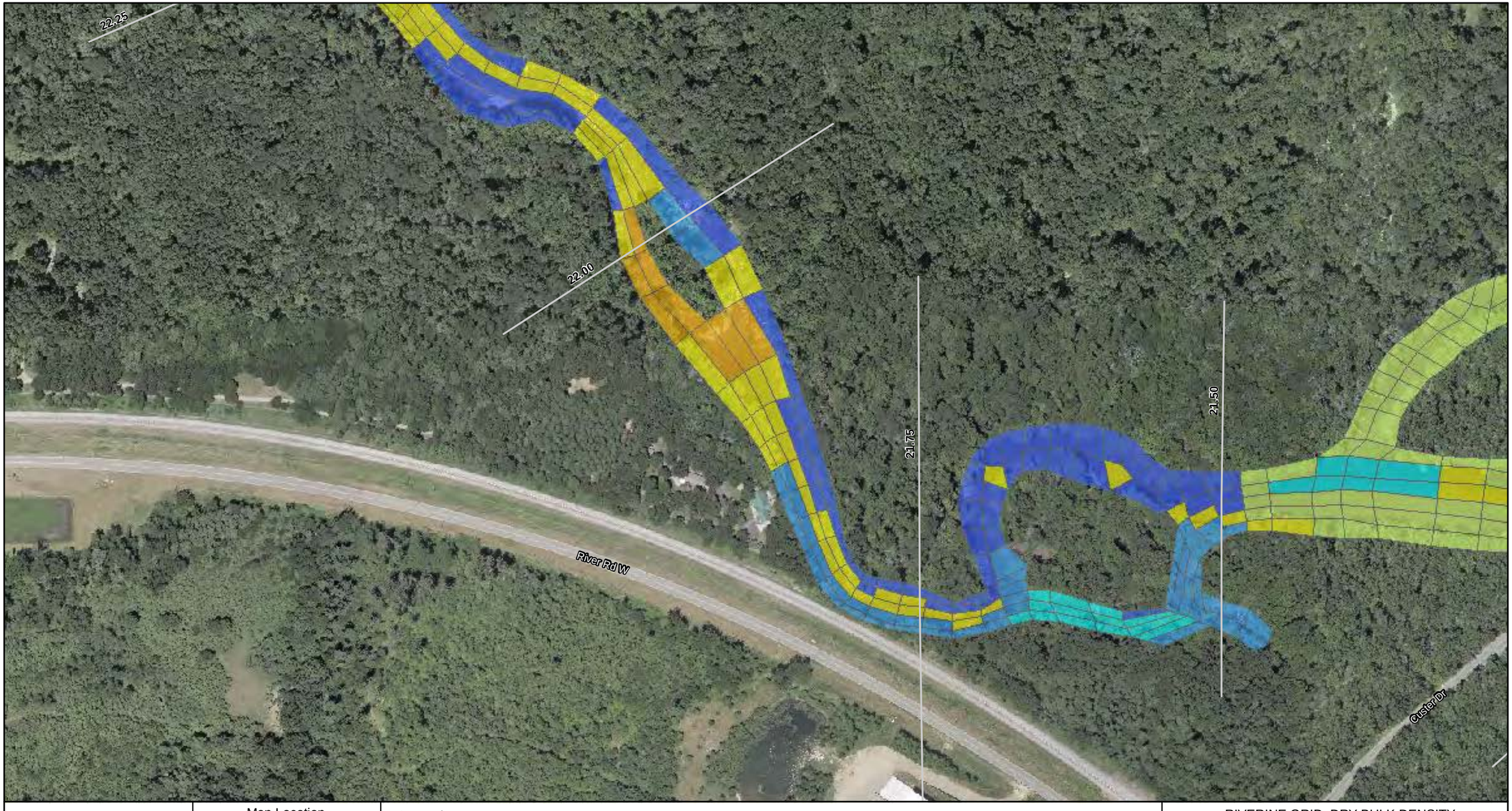
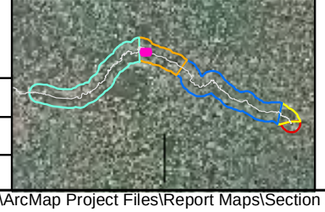
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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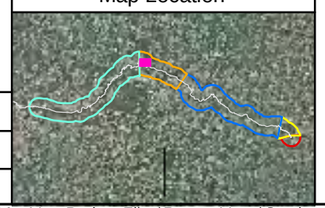
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

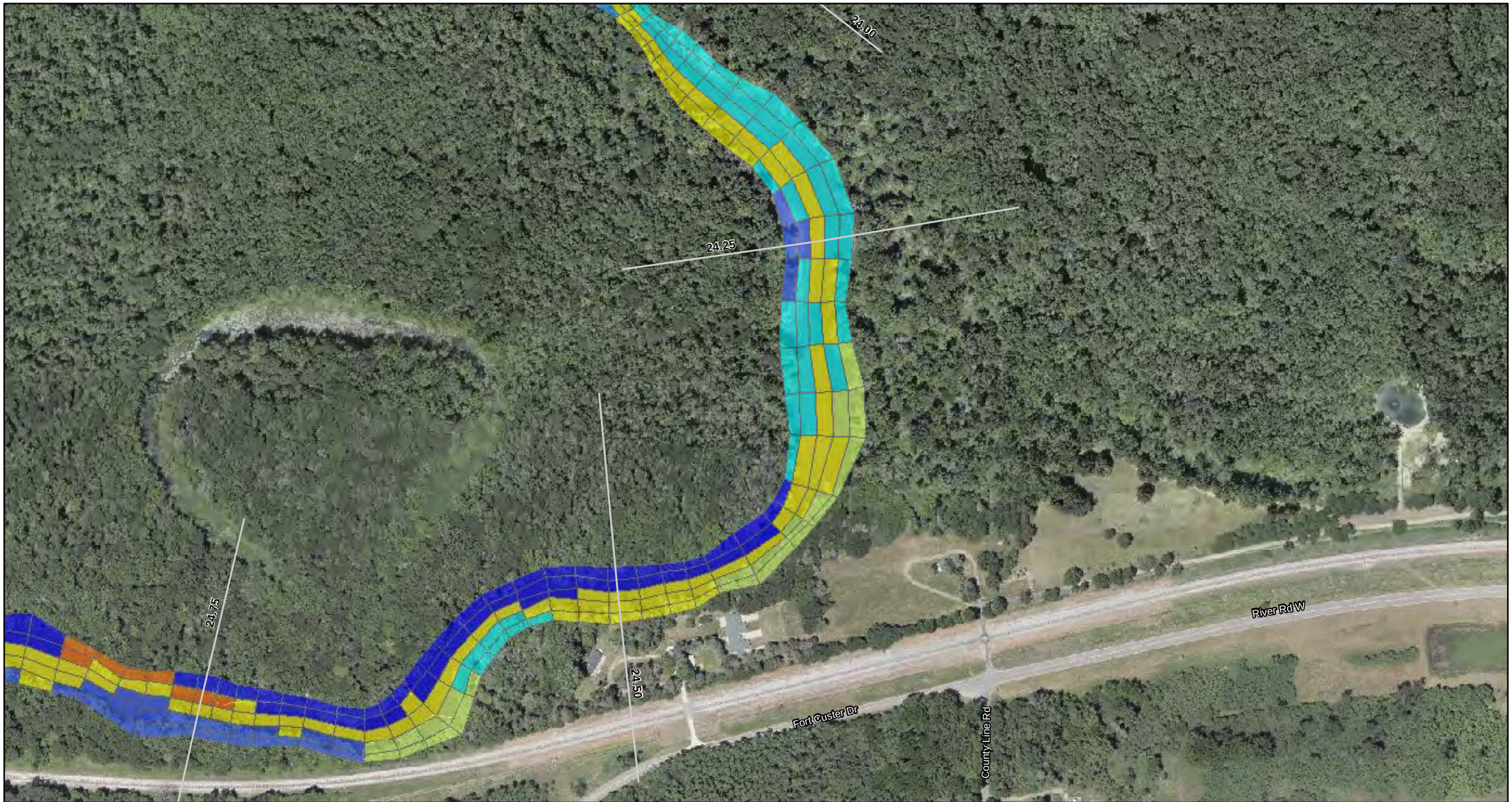
MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model DBD Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

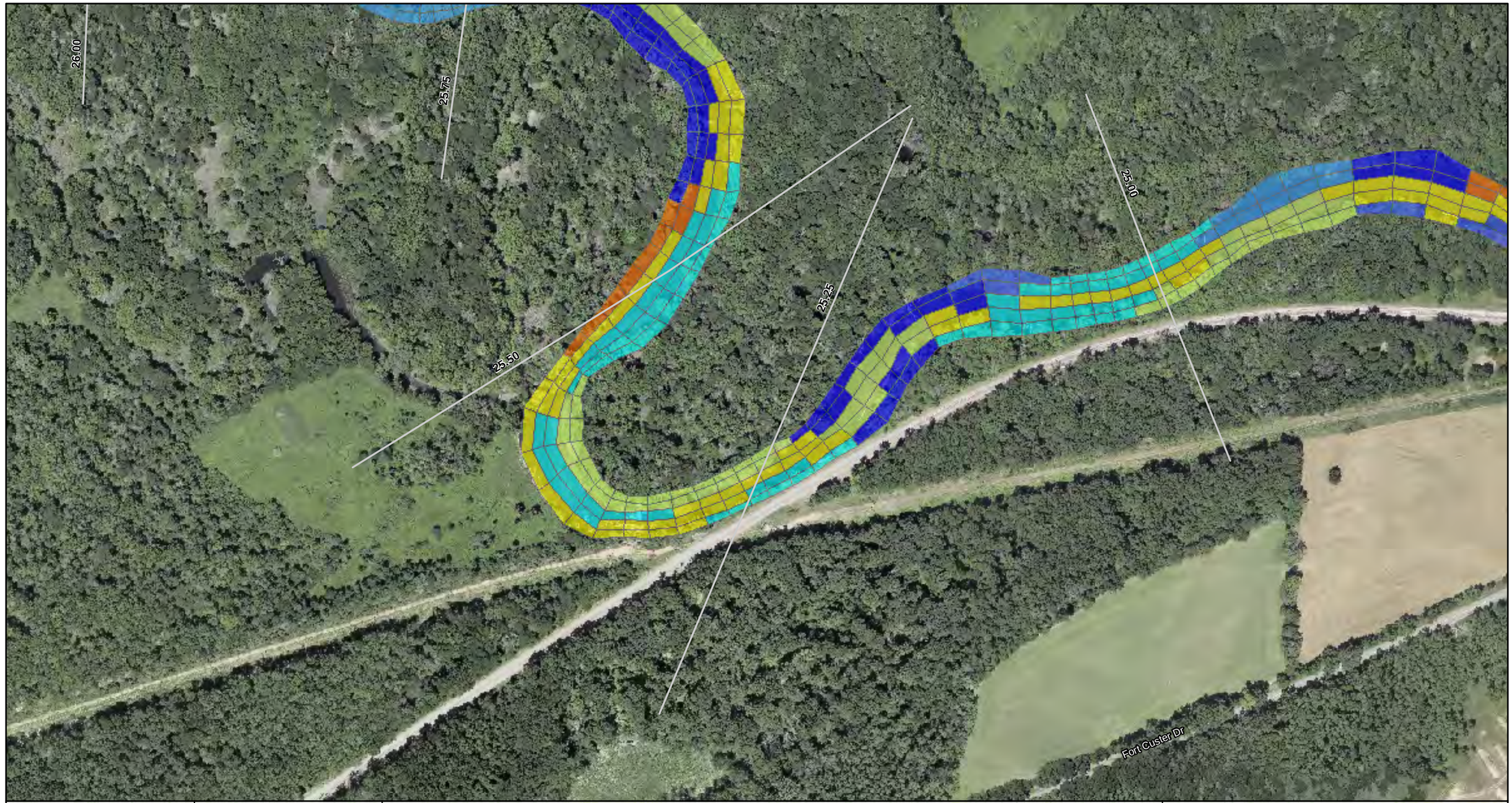
MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model DBD Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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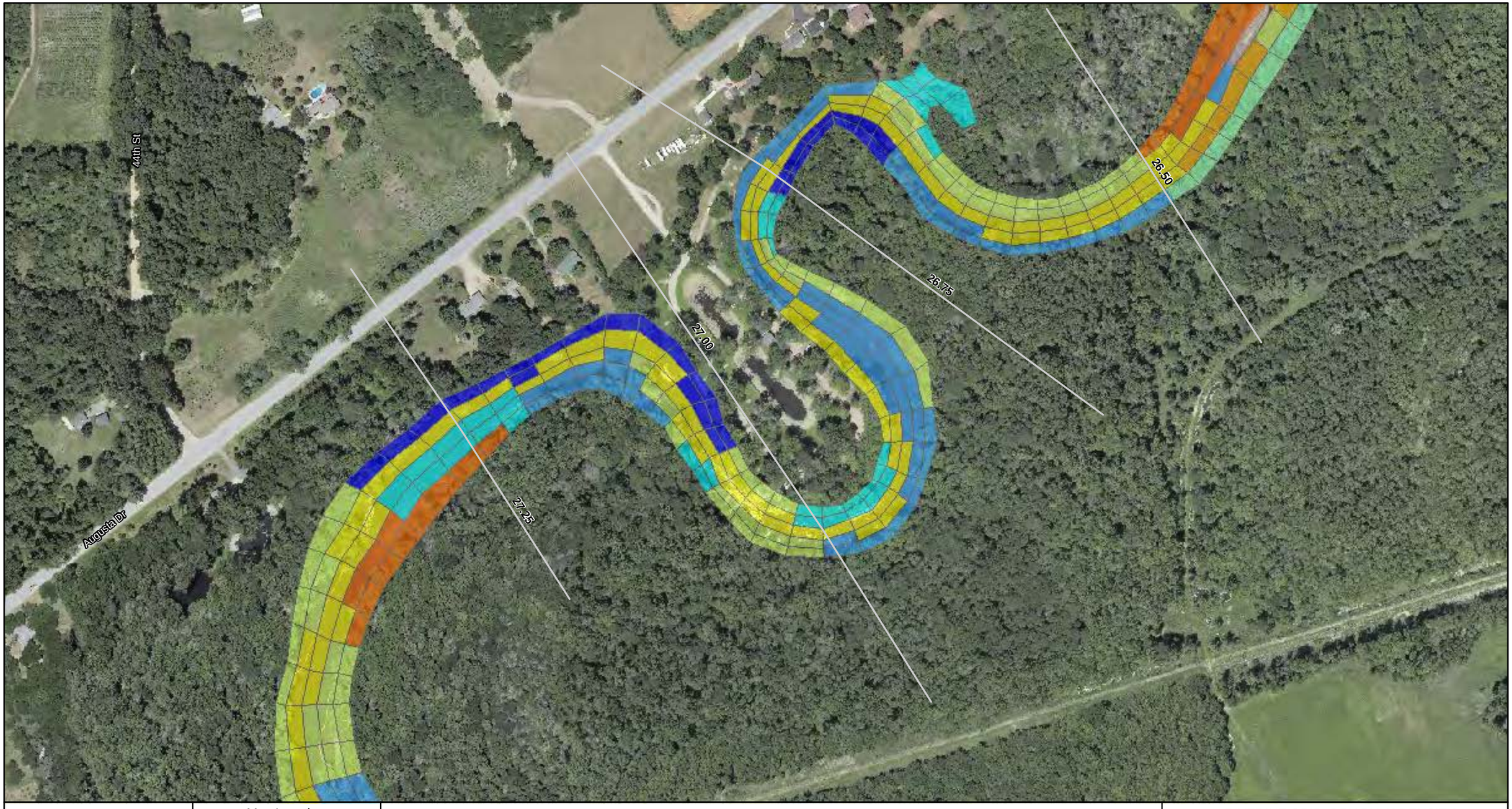
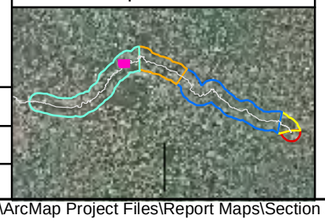
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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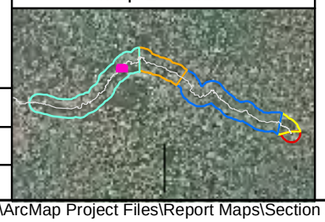
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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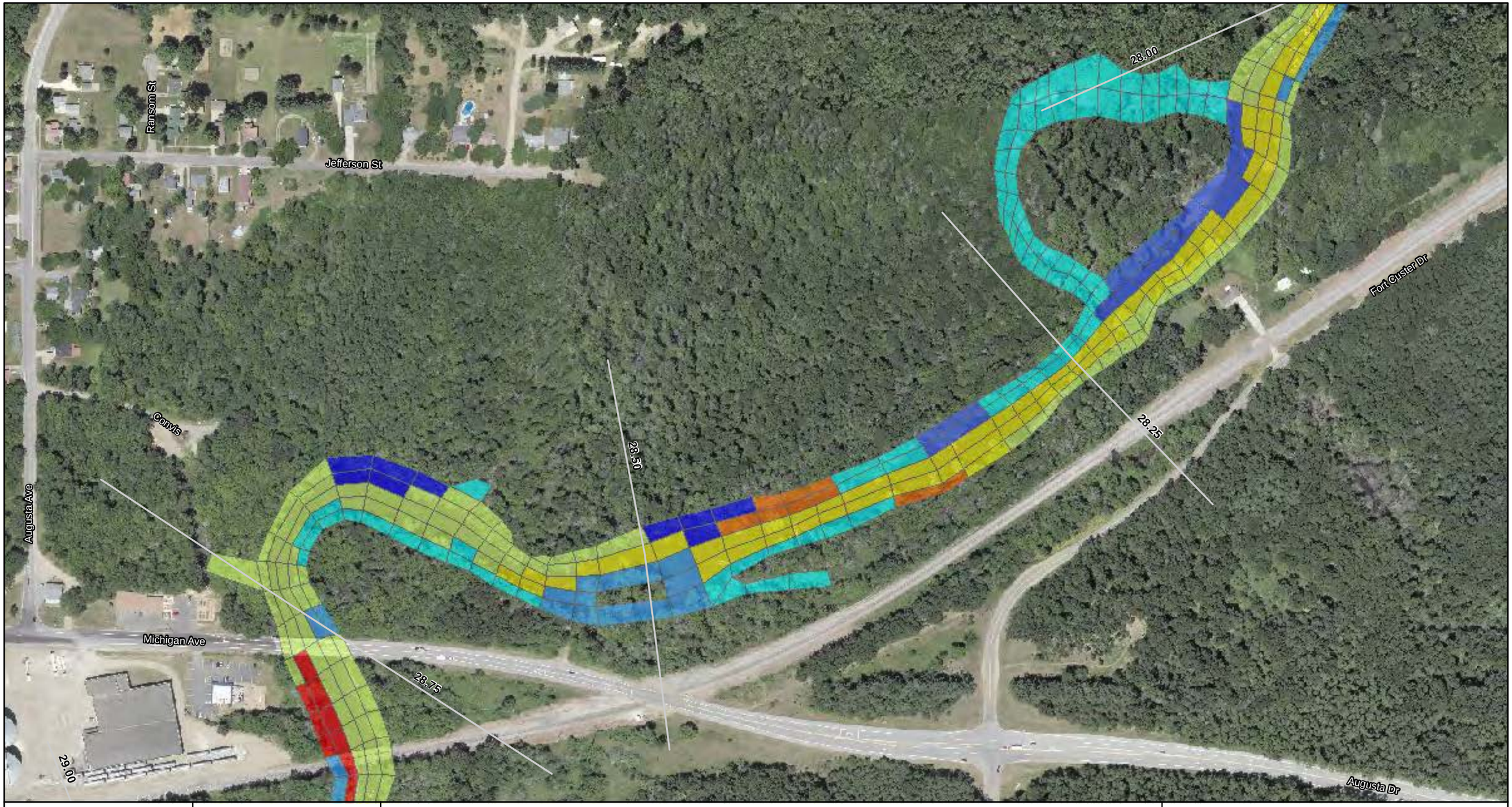
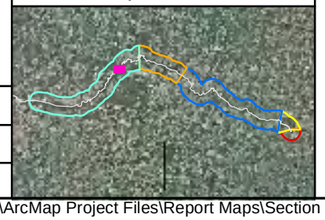
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

29.50
29.75
30.00
30.25
Fort Custer Rec Area Service
Fort Custer Rec Area Access

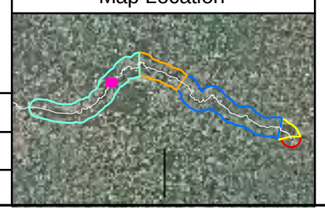
ENBRIDGE

Drawn: BRS 3/29/2012

Approved: DBR 3/29/2012

Project #: 106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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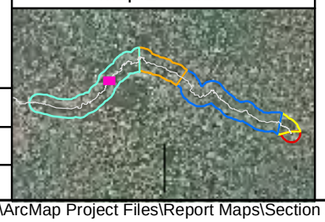
Aerial Photography Date: July 2011

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

30.75

31.00

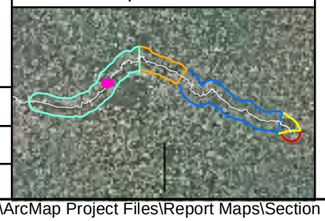
31.25

Bicycle Trail

Fort Custer Rec Area Access

ENBRIDGE	
Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 30.75 - MP 31.25

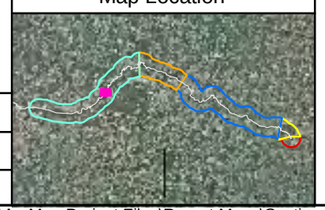
SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model DBD Input.mxd

Aerial Photography Date: July 2011

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 31.25 - MP 31.70

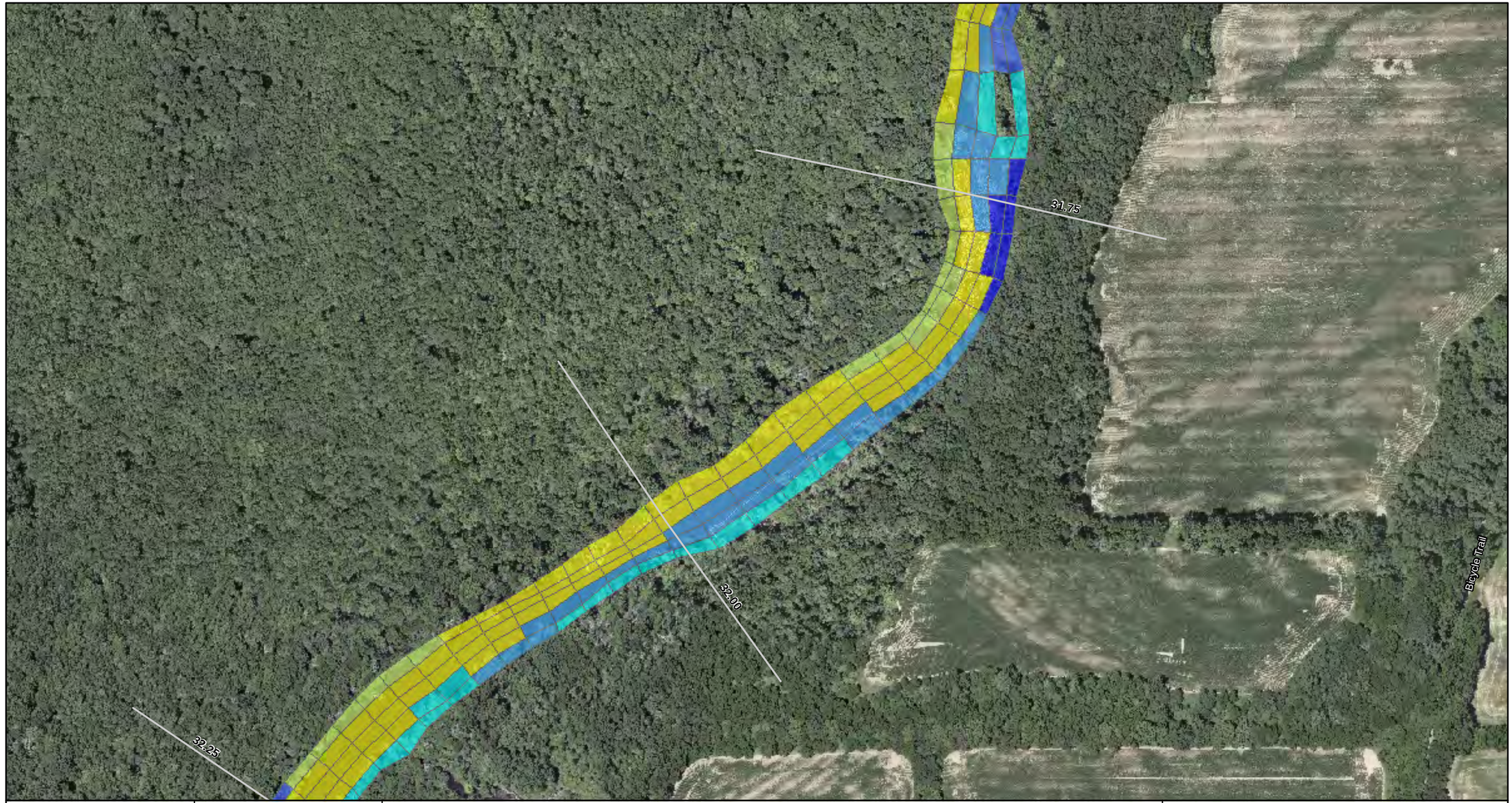
SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model DBD Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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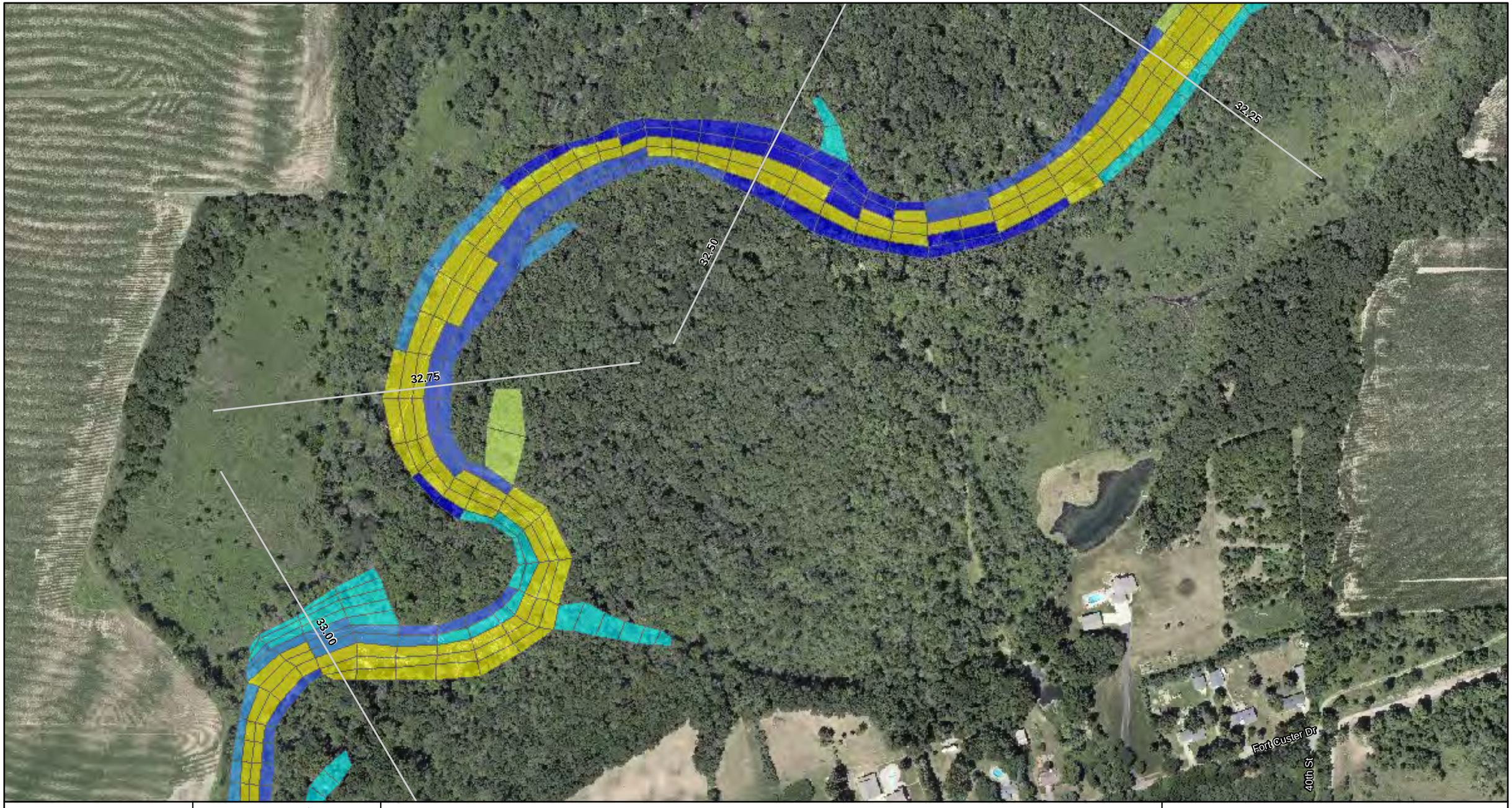
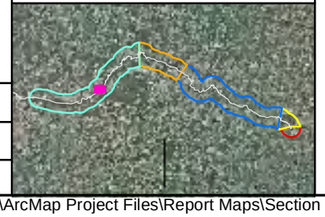
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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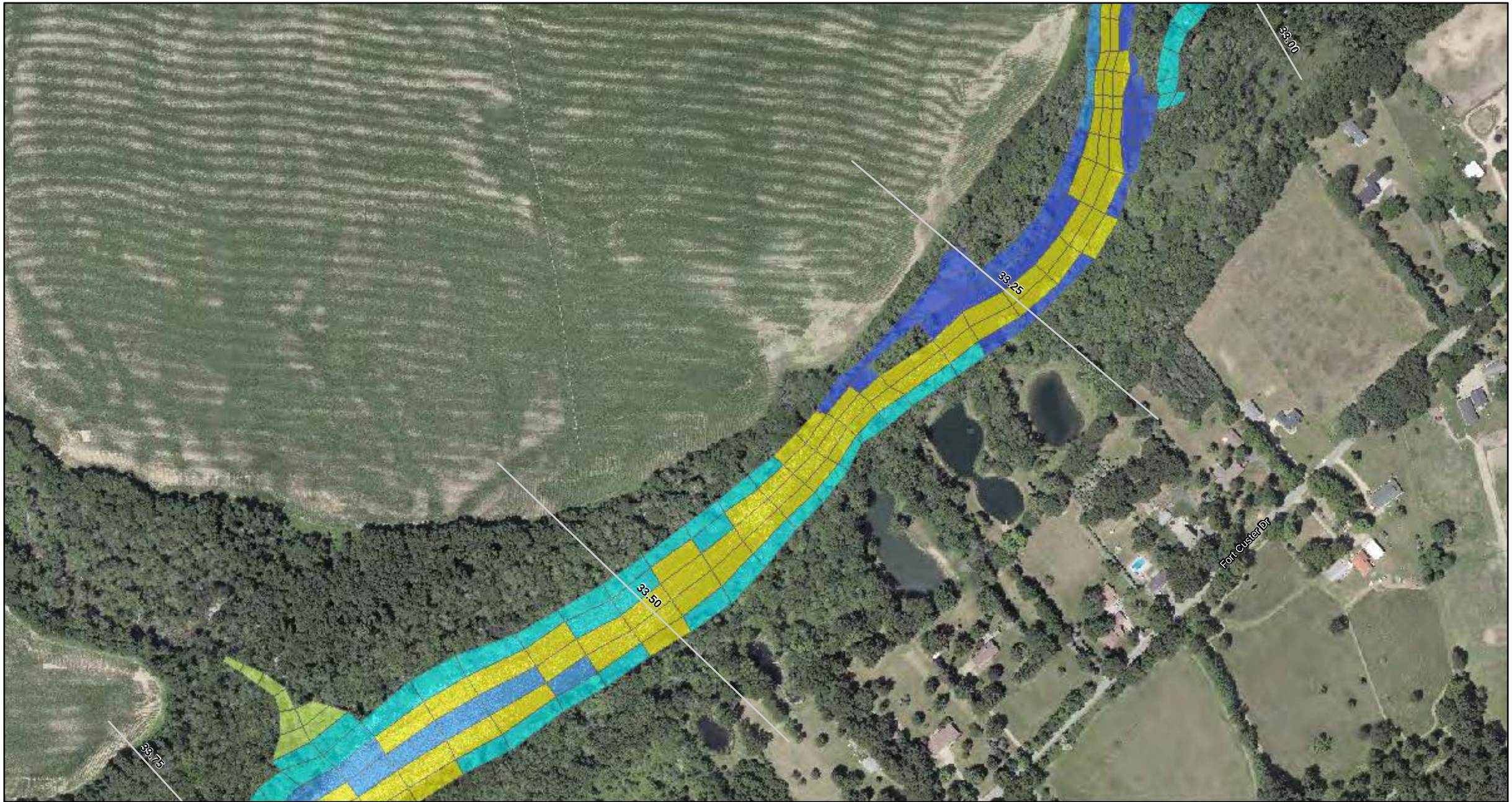
Aerial Photography Date: July 2011



Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

RIVERINE GRID: DRY BULK DENSITY

MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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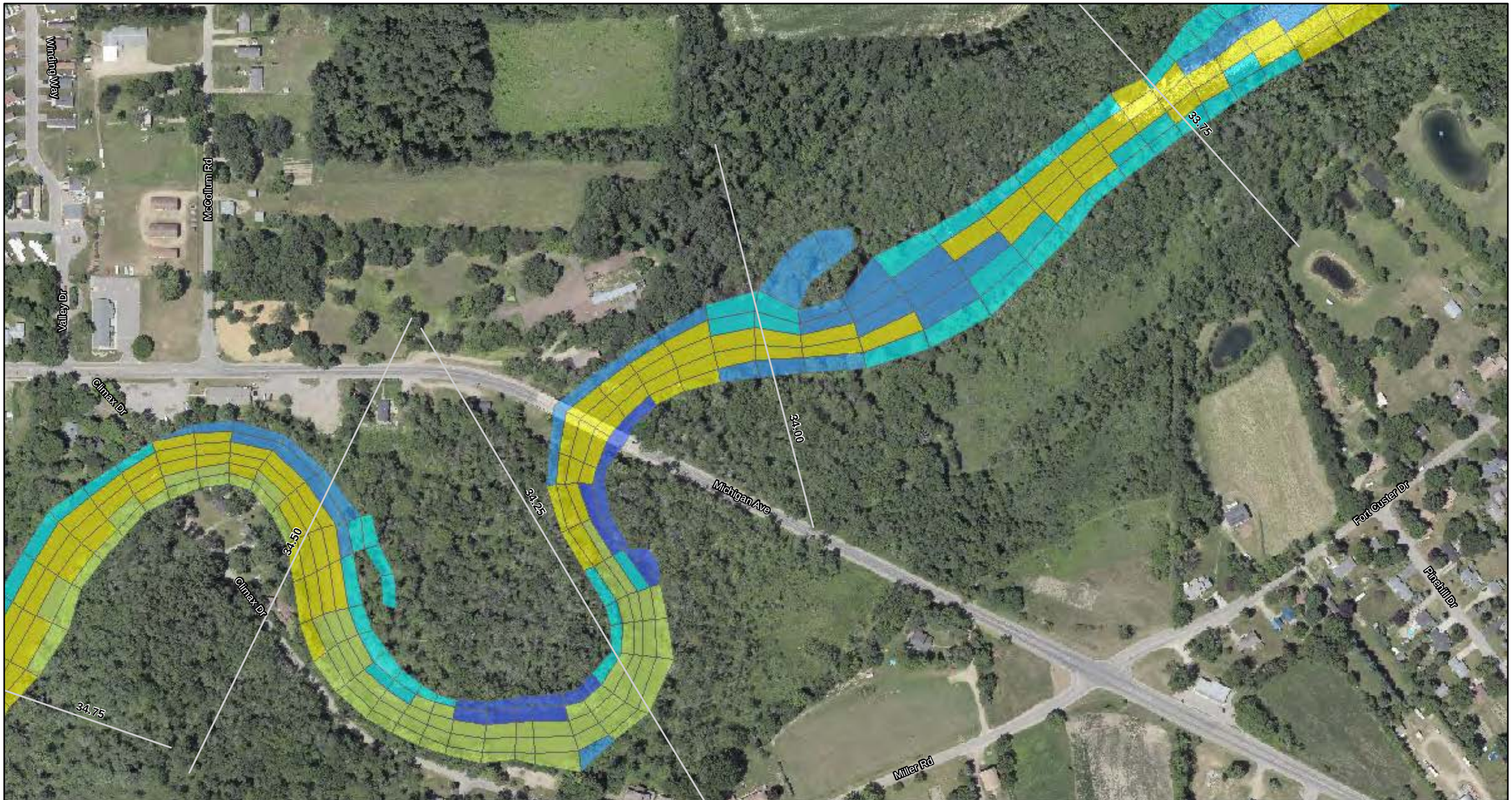
Aerial Photography Date: July 2011



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

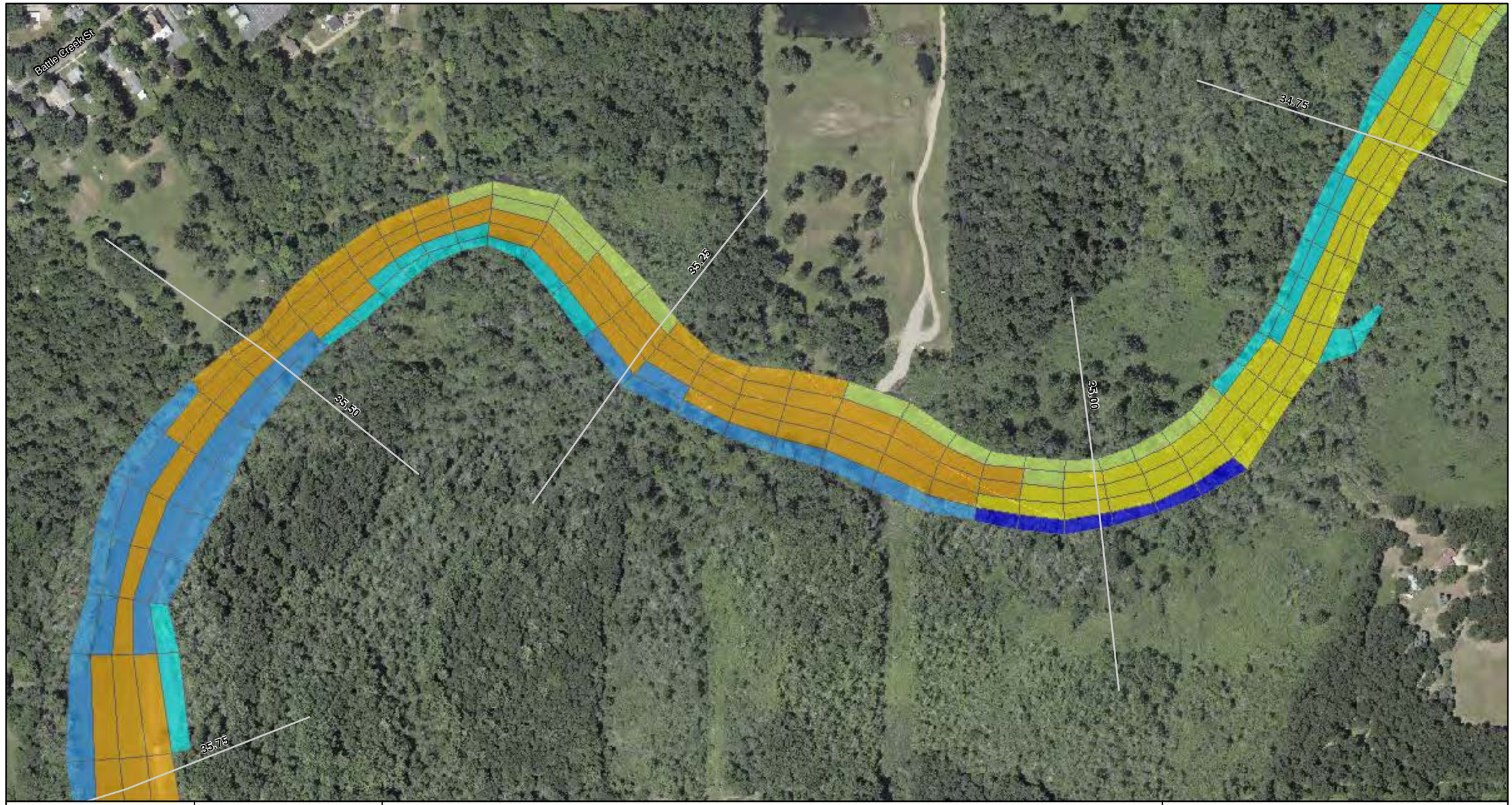
MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model DBD Input.mxd

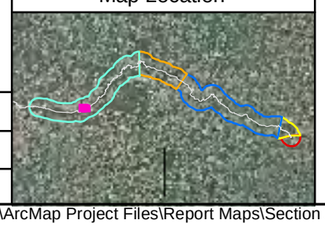
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

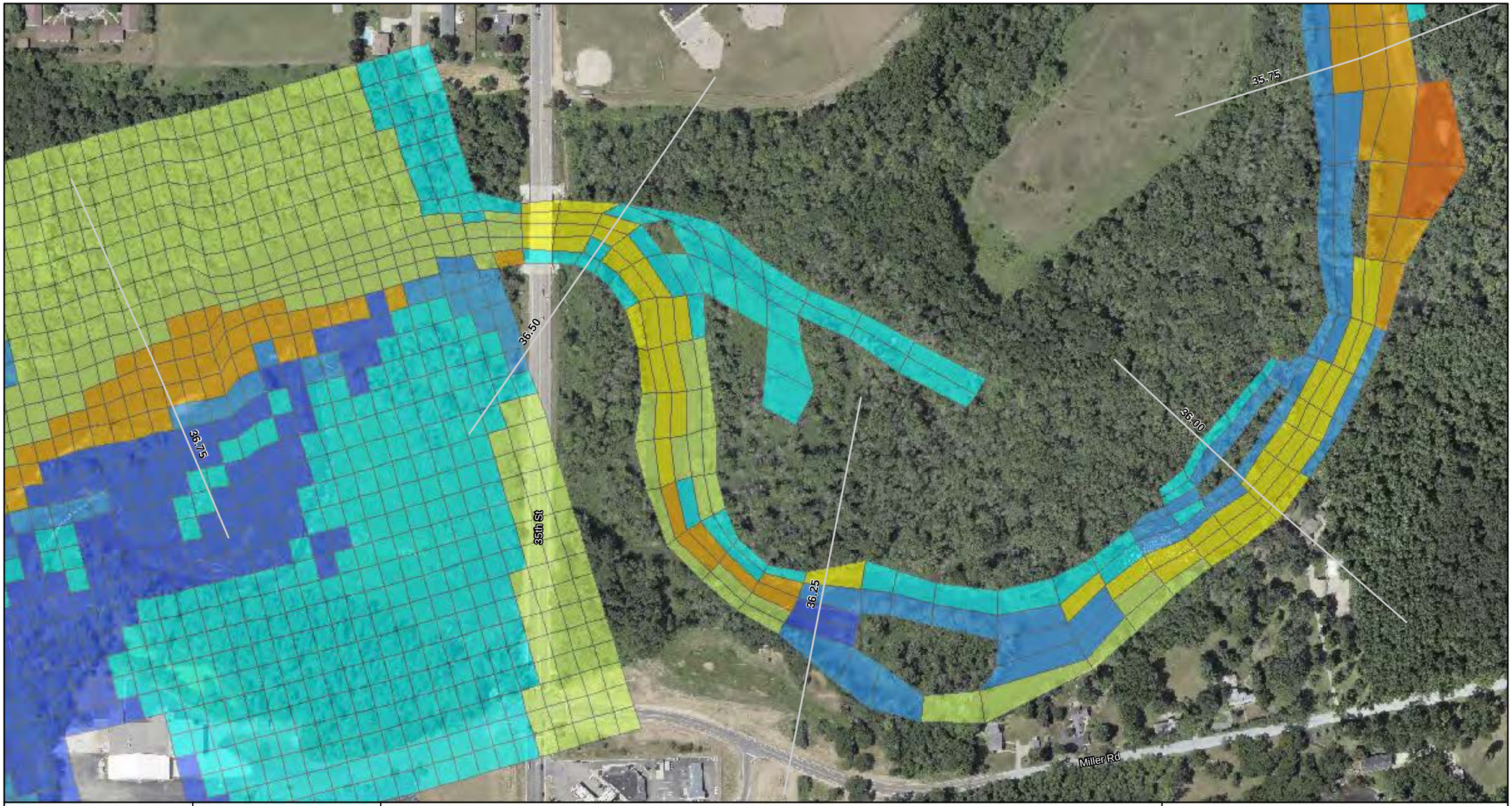
MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model DBD Input.mxd

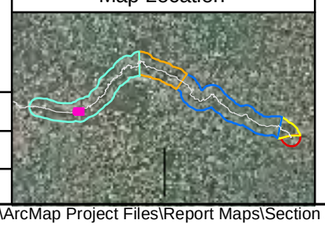
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model DBD Input.mxd

Aerial Photography Date: July 2011

37.50

37.25

37.00

Miller Dr

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: July 2011

38.25

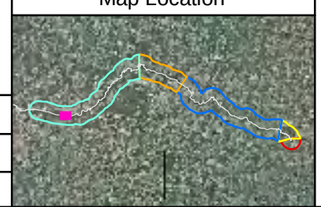
38.00

37.75

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
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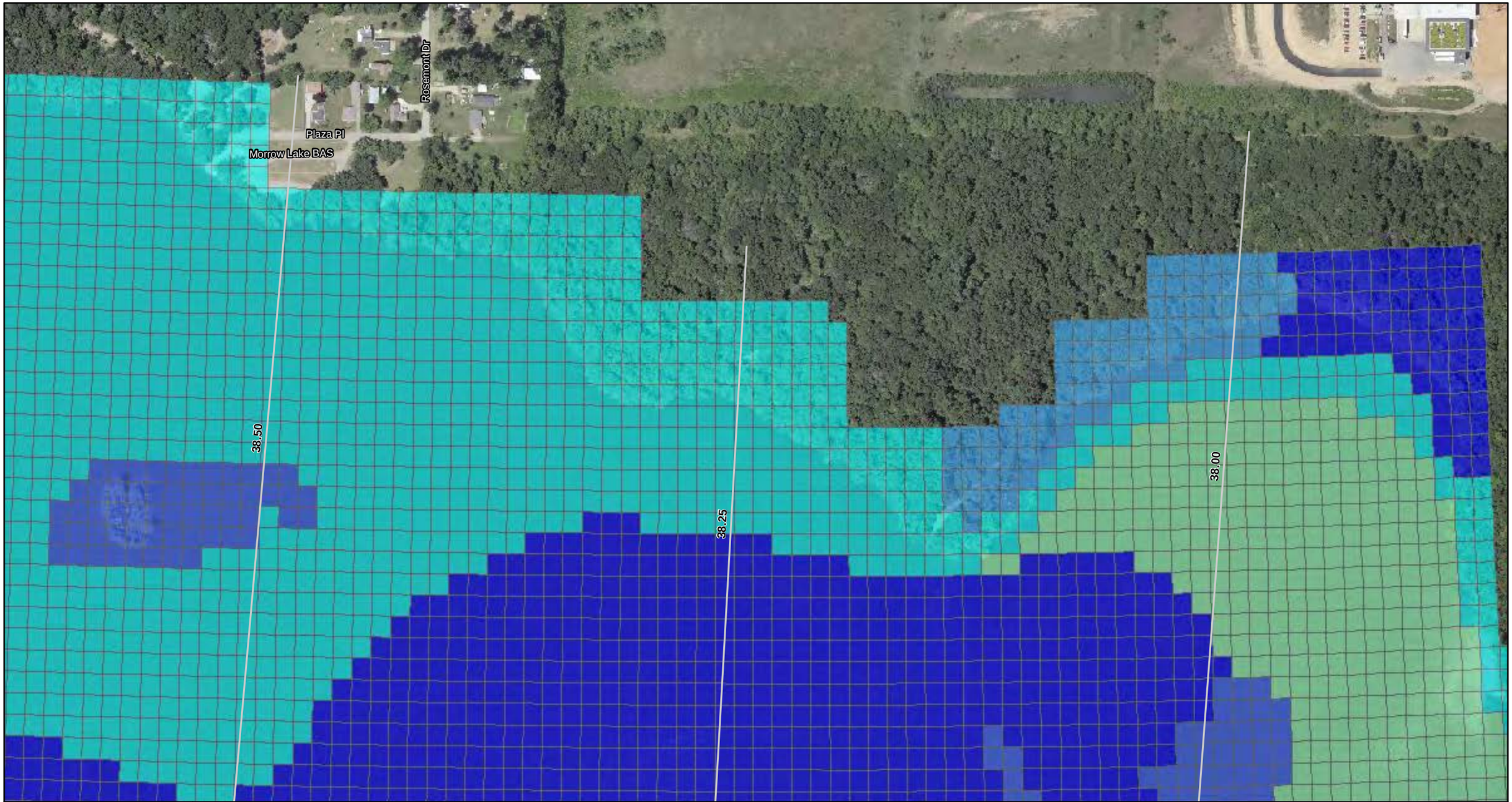
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Riverine Model DBD Input.mxd

Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July 2011

38.50

38.25

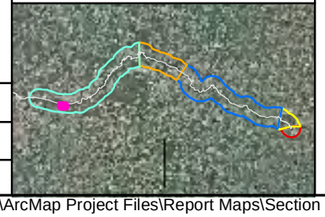
38.00

Lyth Rd

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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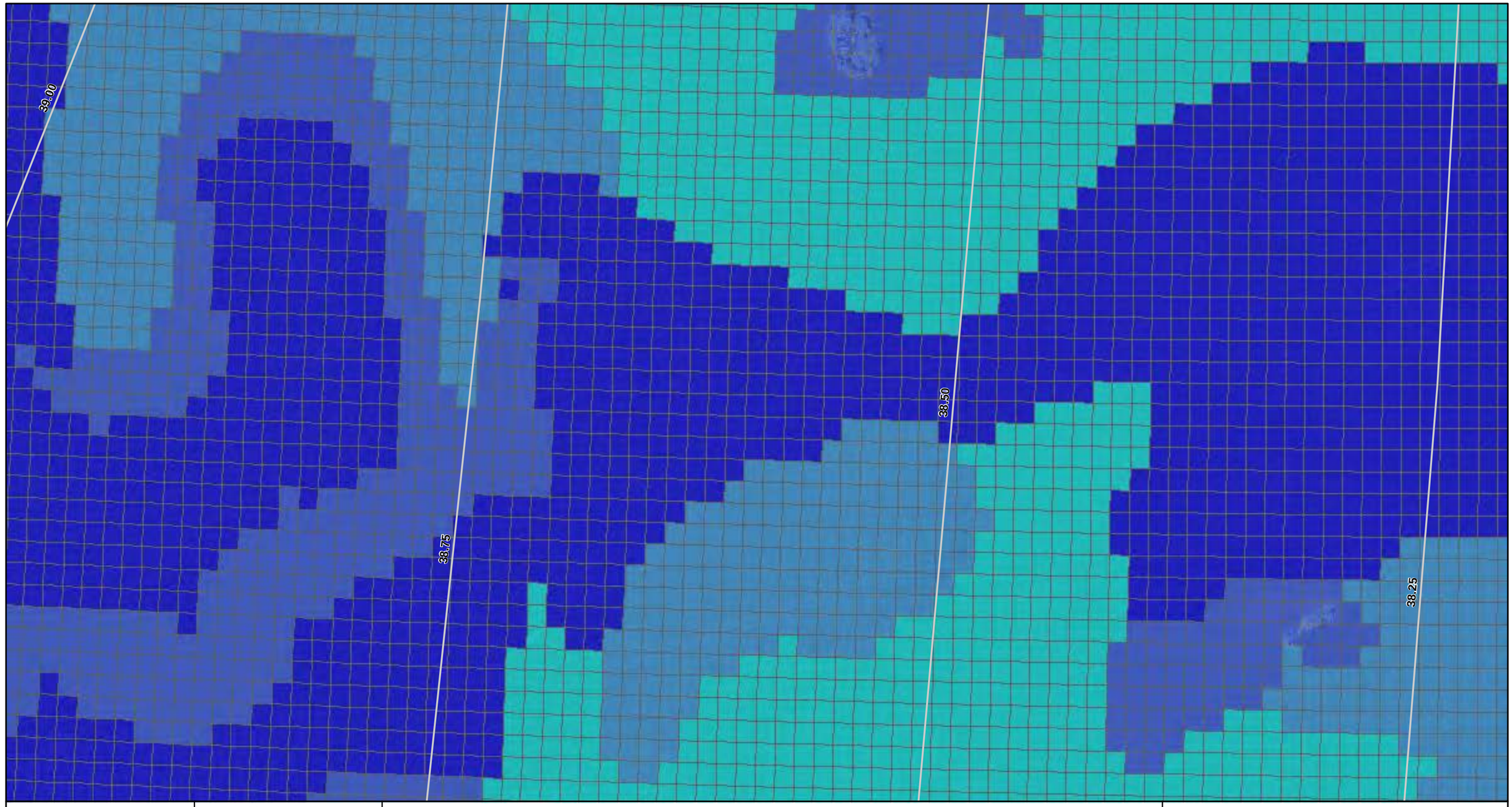
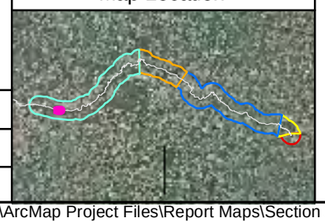
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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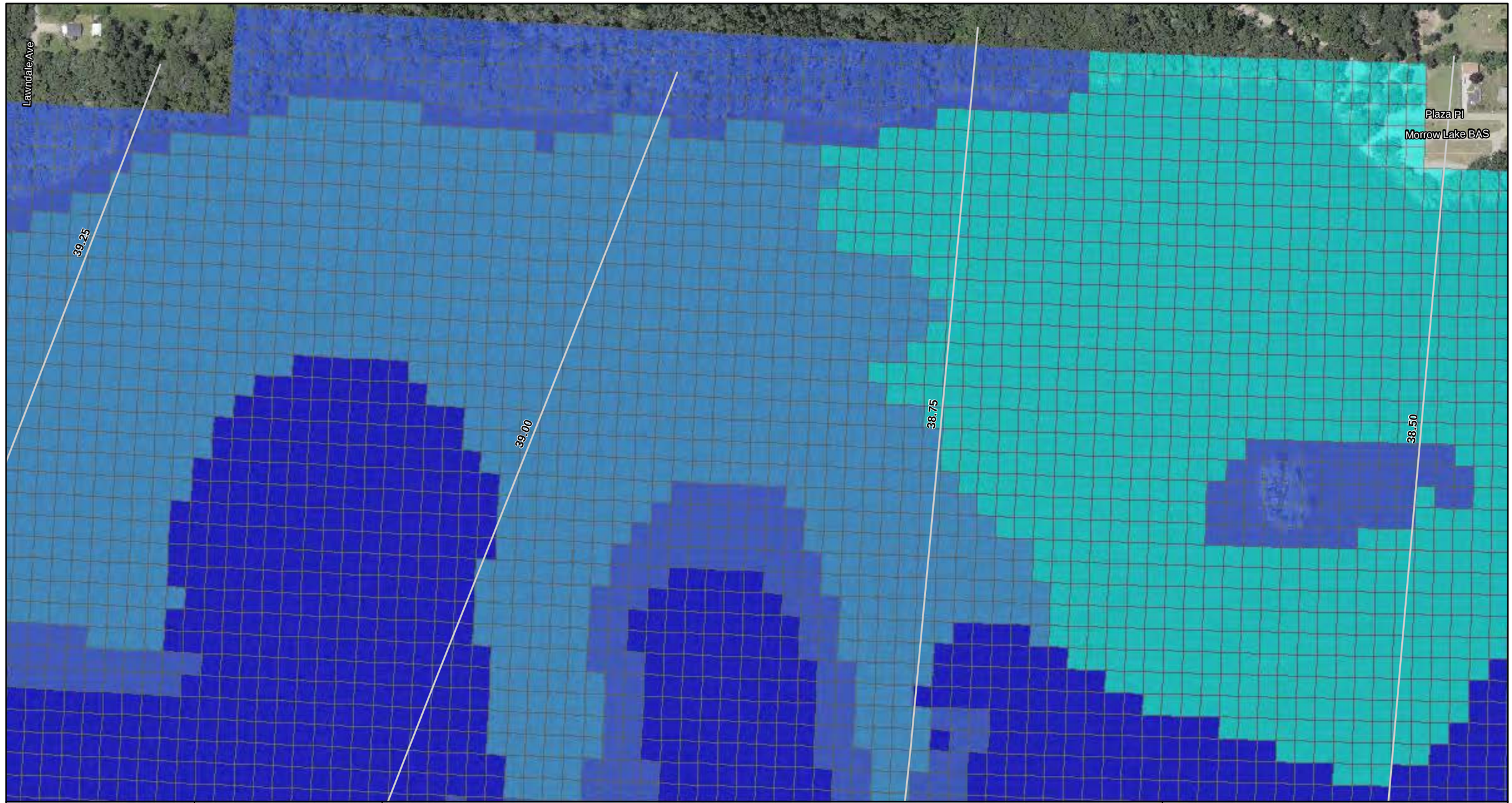
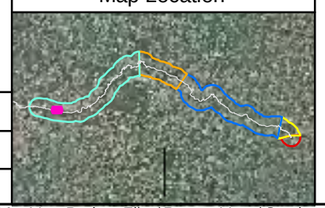
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: July 2011

39.25

39.00

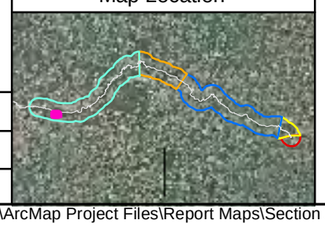
38.75

38.50

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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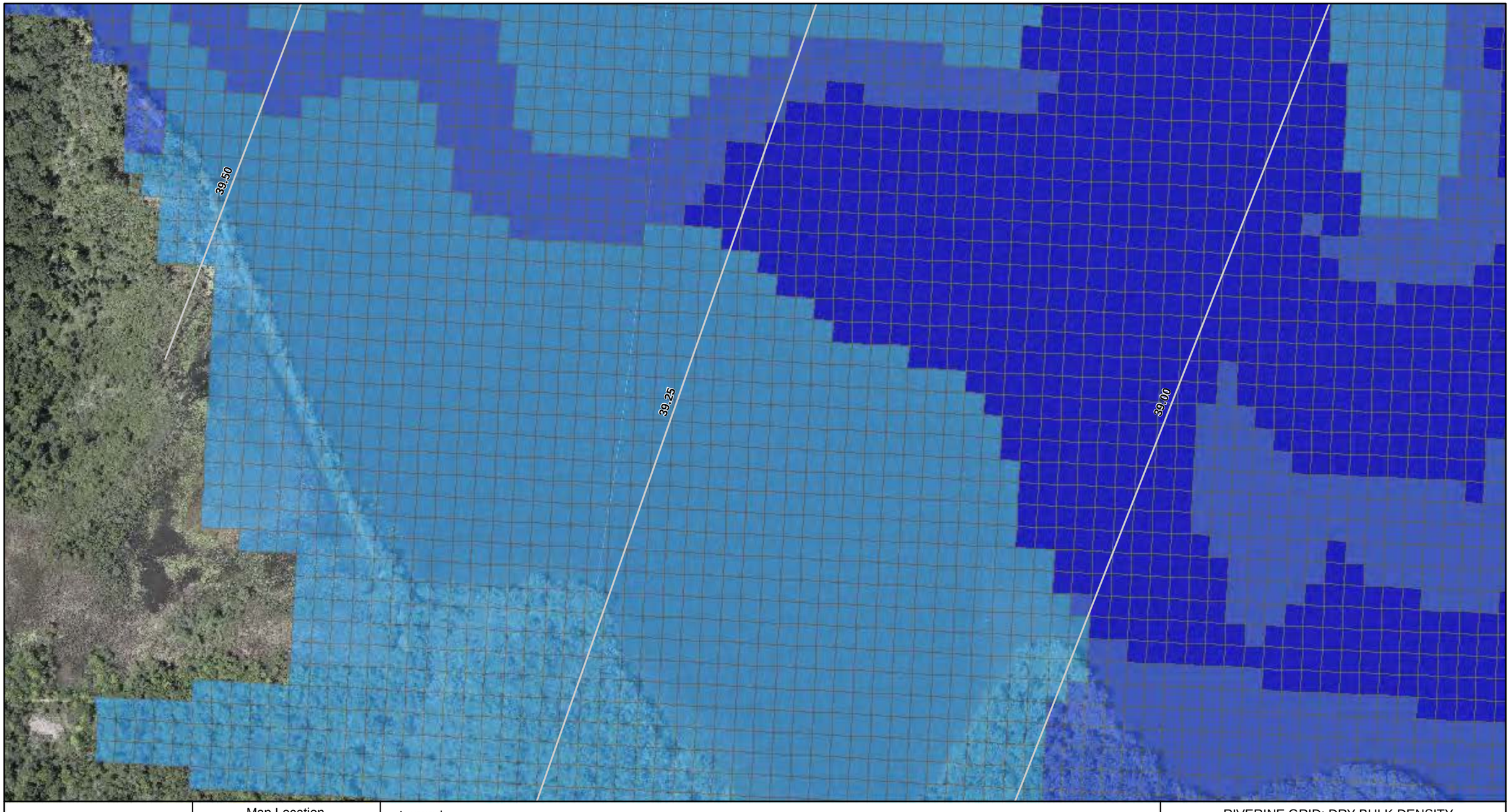
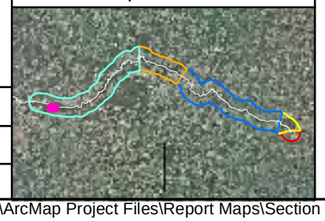
Aerial Photography Date: July 2011



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 38.50 - MP 39.25S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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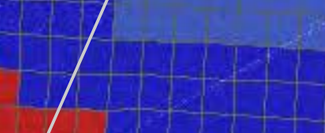
Aerial Photography Date: July 2011

Morrow St
Elliot Rd
Lawndale Ave
Chene Dr
39.50
39.25
39.75
Consumers Power Dr

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.400001
- 0.400001 - 0.550000
- 0.550001 - 0.700000
- 0.700001 - 0.850000
- 0.850001 - 1.000000
- 1.000001 - 1.150000
- 1.150001 - 1.300000
- 1.300001 - 1.450000
- 1.450001 - 1.600000
- 1.600001 - 1.750000

Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 125 250 500

Scale in Feet

RIVERINE GRID: DRY BULK DENSITY

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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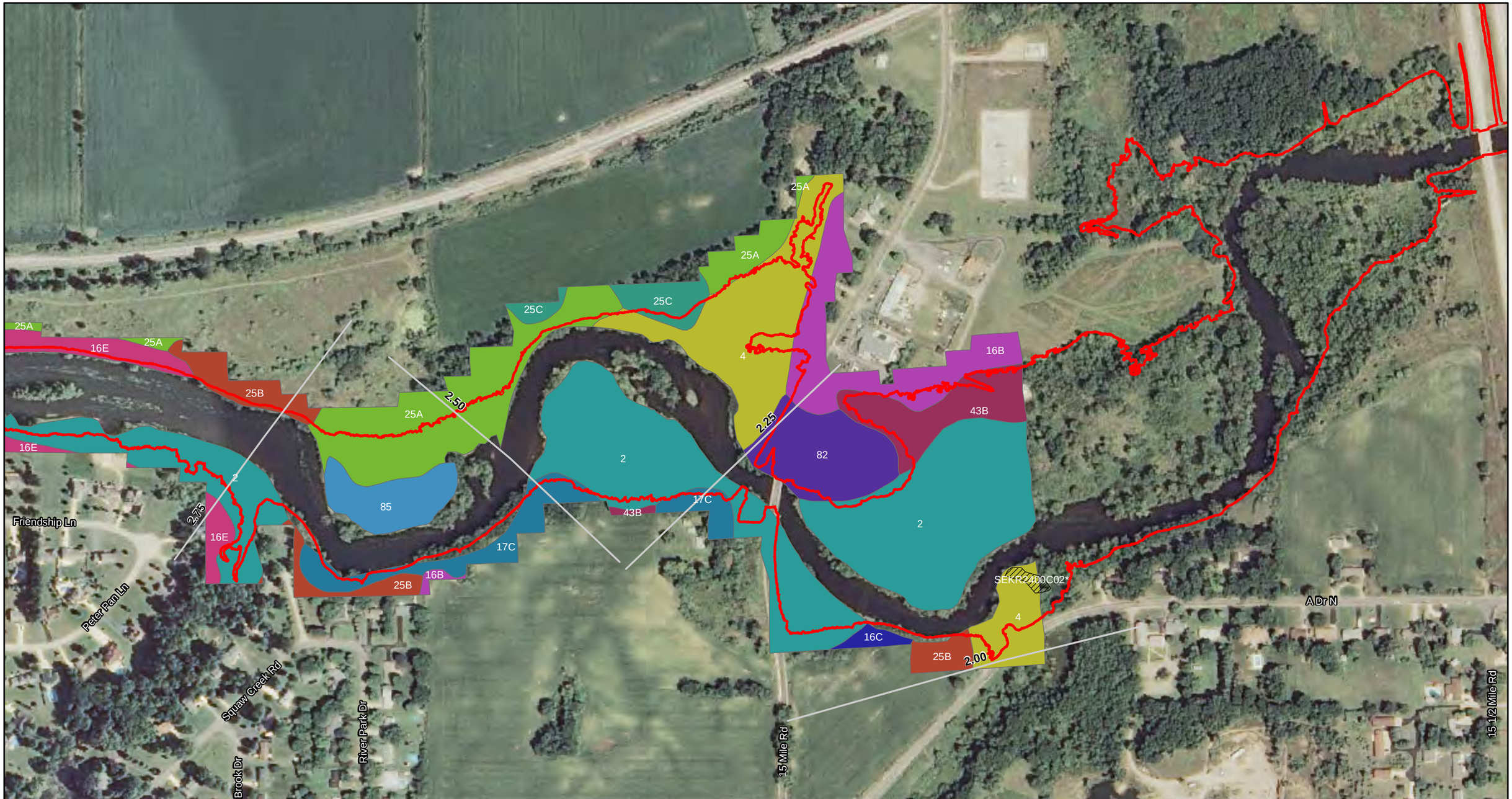
Aerial Photography Date: July 2011

Figure 3-19

Floodplain Grid: Core Assignments & SSURGO Map Units

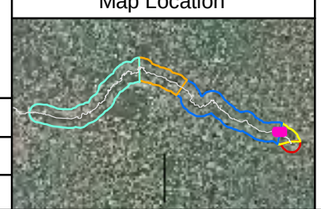
Sheets 1 through 45



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

SSURGO = Soil Survey Geographic Database

The labels on the overbank standing water areas are the cores used for bulk density and texture assignments.

* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

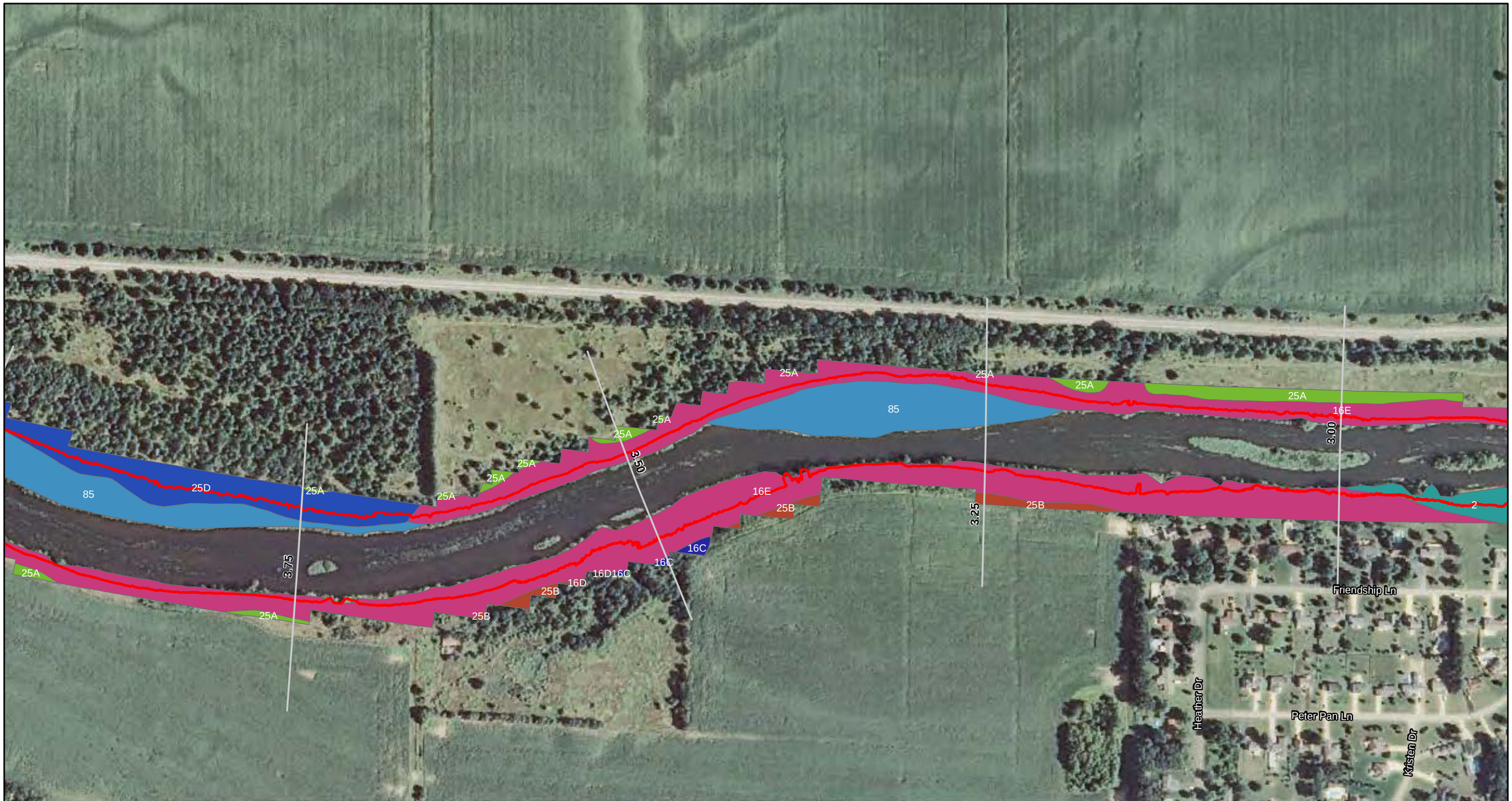
MP 01.88 - MP 02.91

SHEET 1 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Overbank Core Assignment with Map Units.mxd

Aerial Photography Date: July & August 2009



Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)

Overbank Standing Water Areas

HEC-RAS 100-Year Floodplain

Quarter Mile Grid Segment

SSURGO = Soil Survey Geographic Database

The labels on the overbank standing water areas are the cores used for bulk density and texture assignments.

* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 02.91 - MP 03.93

SHEET 2 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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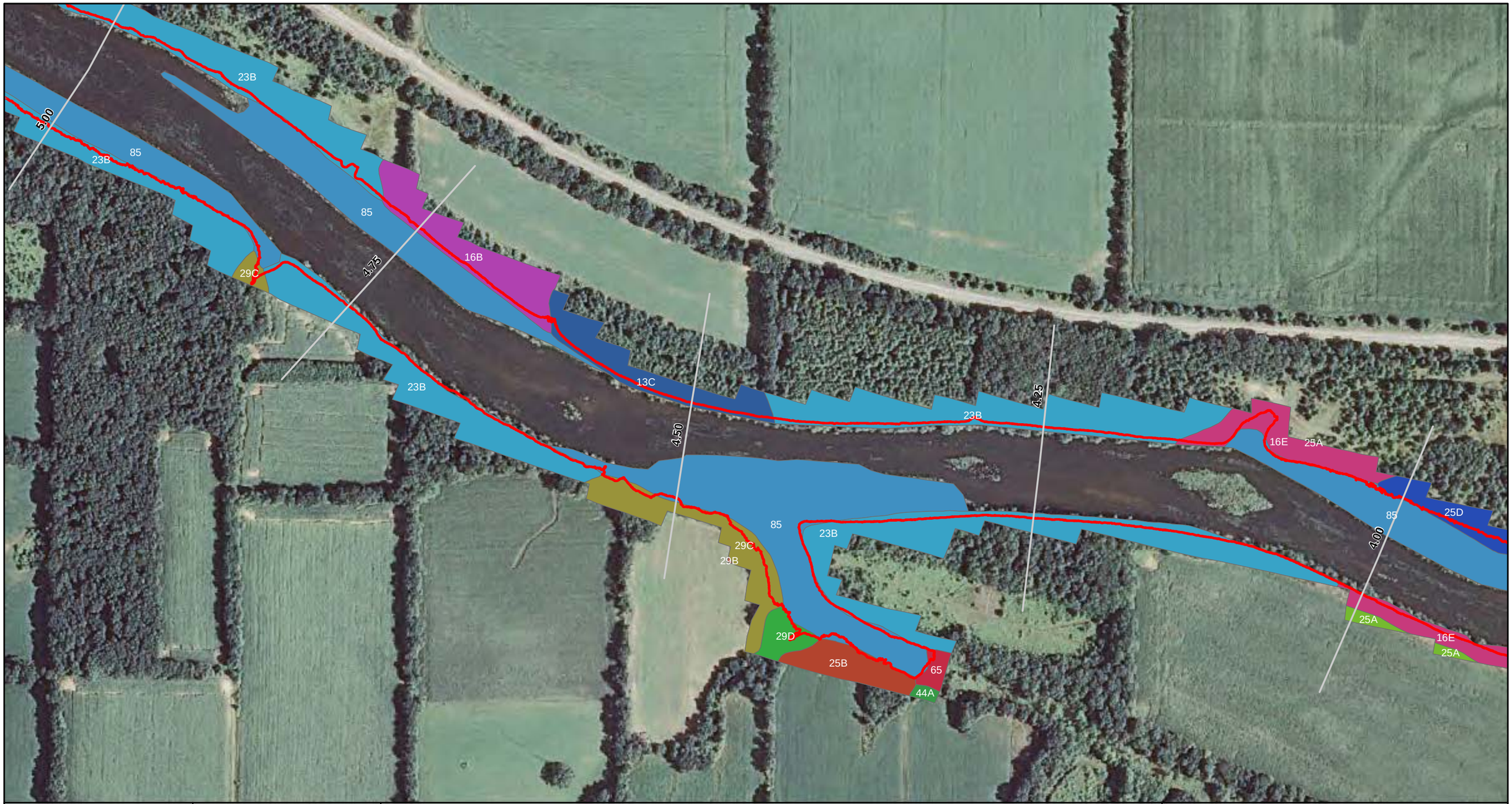
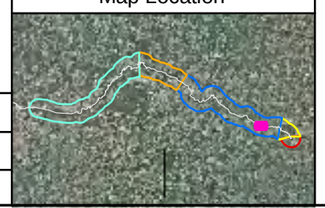
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

SSURGO = Soil Survey Geographic Database

The labels on the overbank standing water areas are the cores used for bulk density and texture assignments.

* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 03.93 - MP 04.98

SHEET 3 OF 45

ENBRIDGE LINE 6B MP 608
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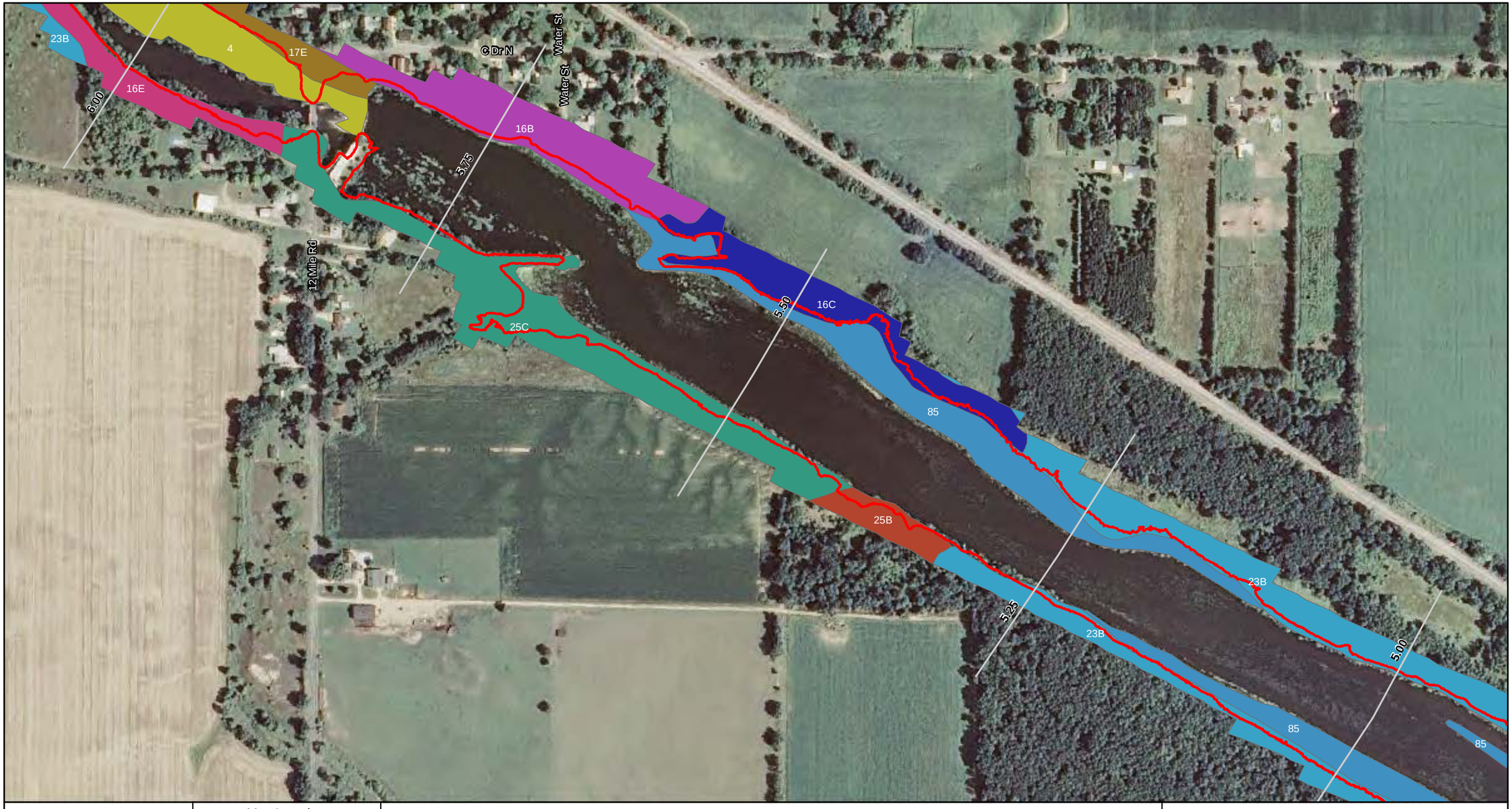
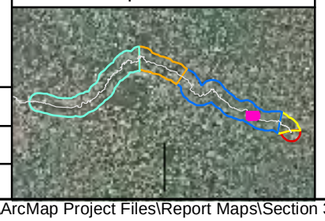
Aerial Photography Date: July & August 2009



Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

SSURGO = Soil Survey Geographic Database

The labels on the overbank standing water areas are the cores used for bulk density and texture assignments.

* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 04.98 - MP 06.03

SHEET 4 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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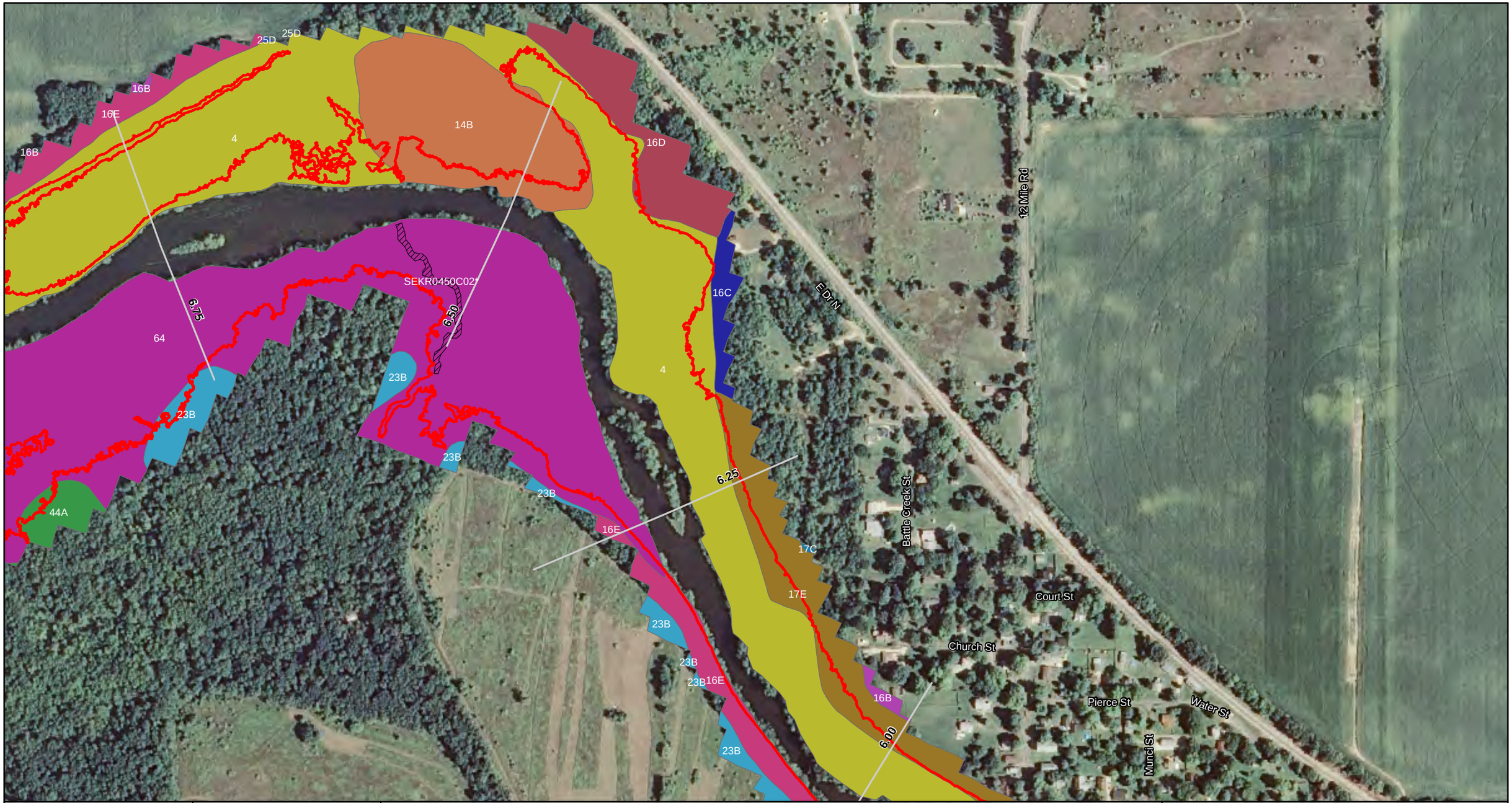
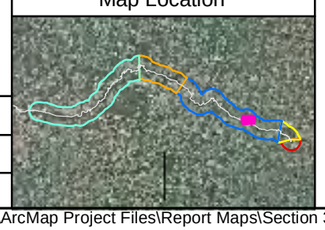
Aerial Photography Date: July & August 2009



Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

SSURGO = Soil Survey Geographic Database

The labels on the overbank standing water areas are the cores used for bulk density and texture assignments.

* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

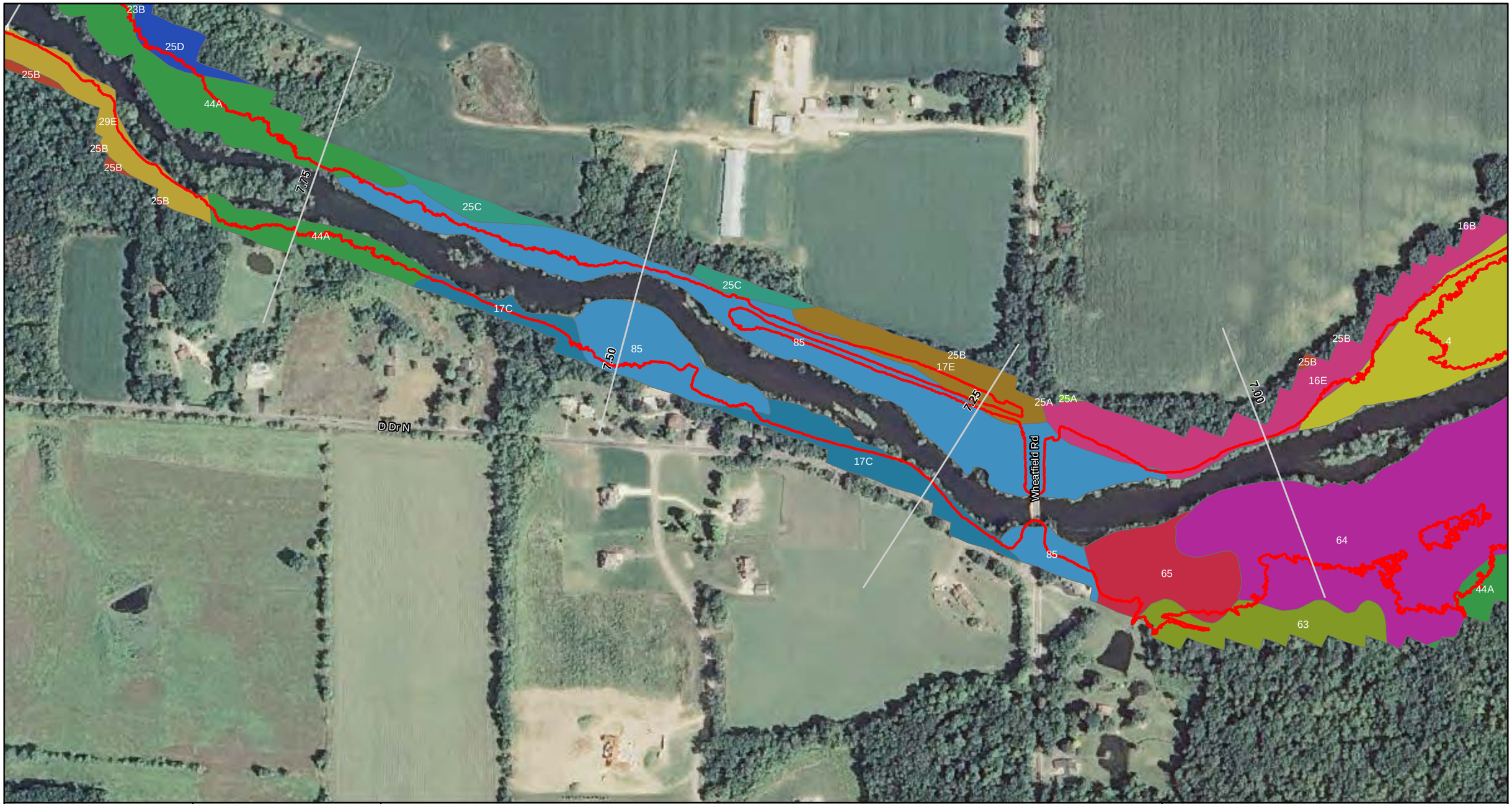
MP 06.03 - MP 06.85

SHEET 5 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Overbank Core Assignment with Map Units.mxd

Aerial Photography Date: July & August 2009



Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

SSURGO = Soil Survey Geographic Database

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 06.85 - MP 07.95

SHEET 6 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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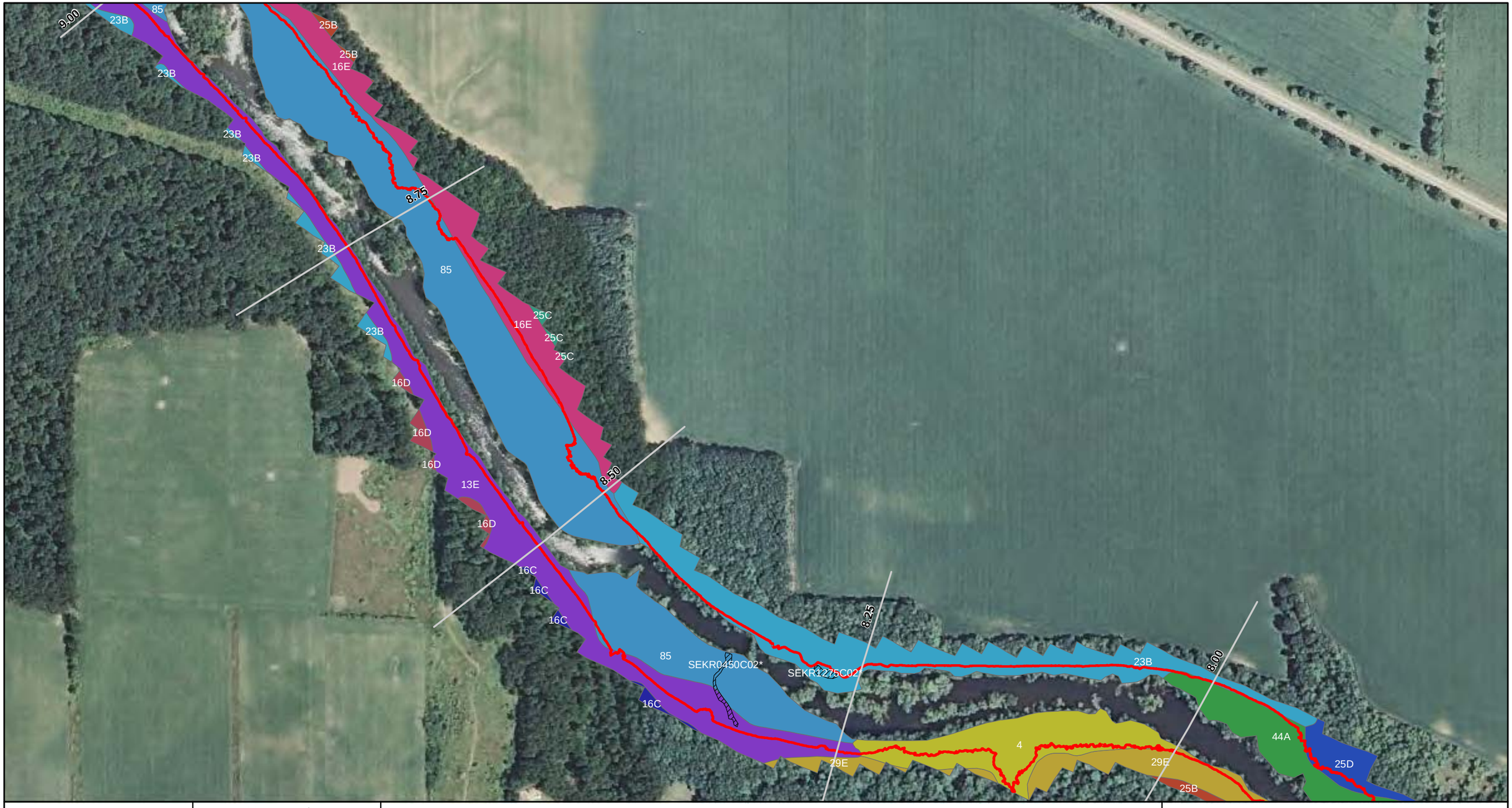
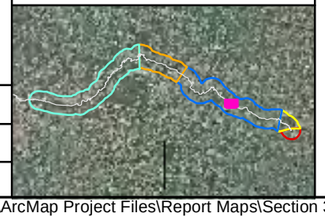
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 07.95 - MP 08.93

SHEET 7 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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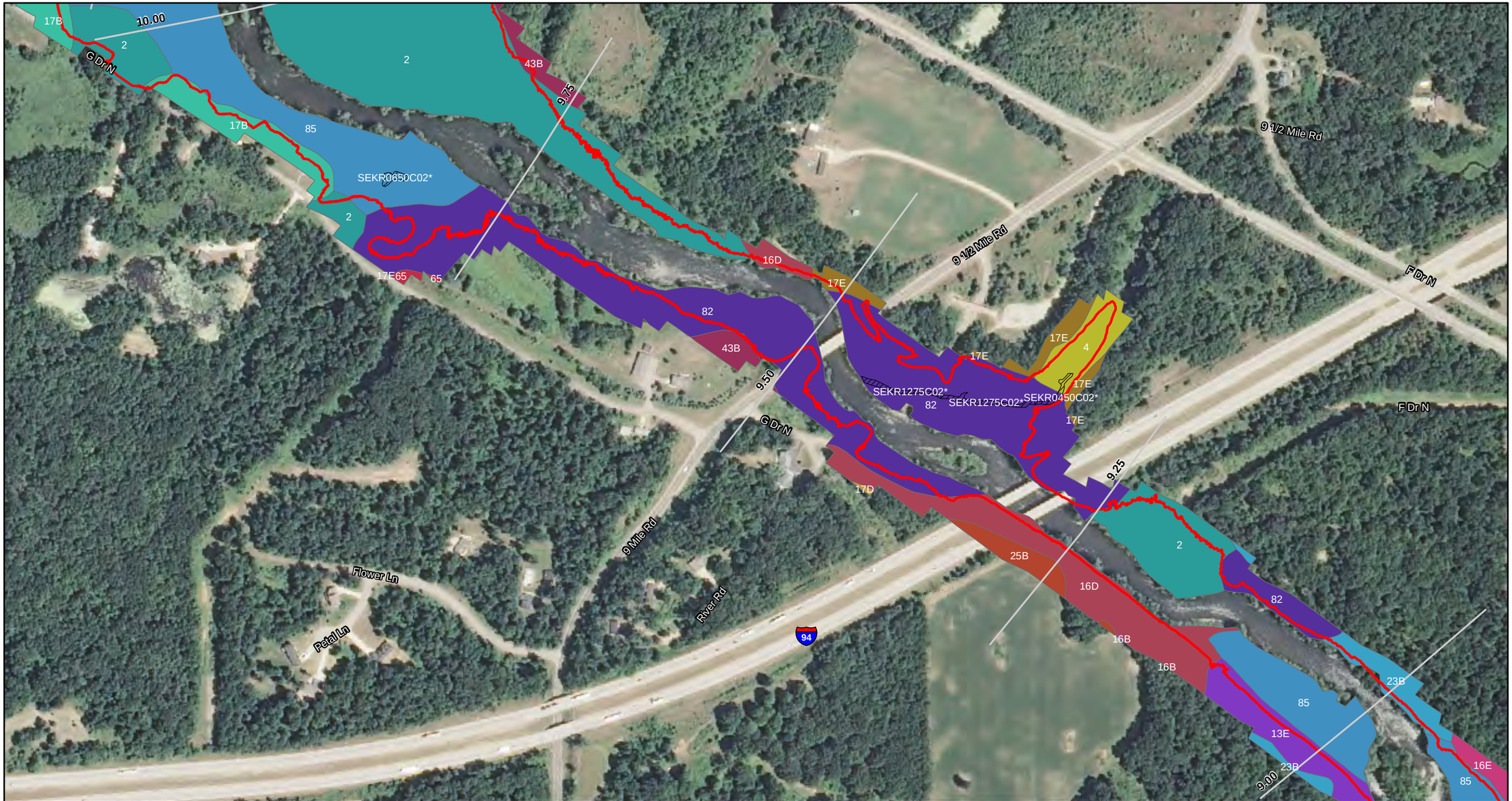
Aerial Photography Date: July & August 2009



Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
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Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 08.93 - MP 10.00

SHEET 8 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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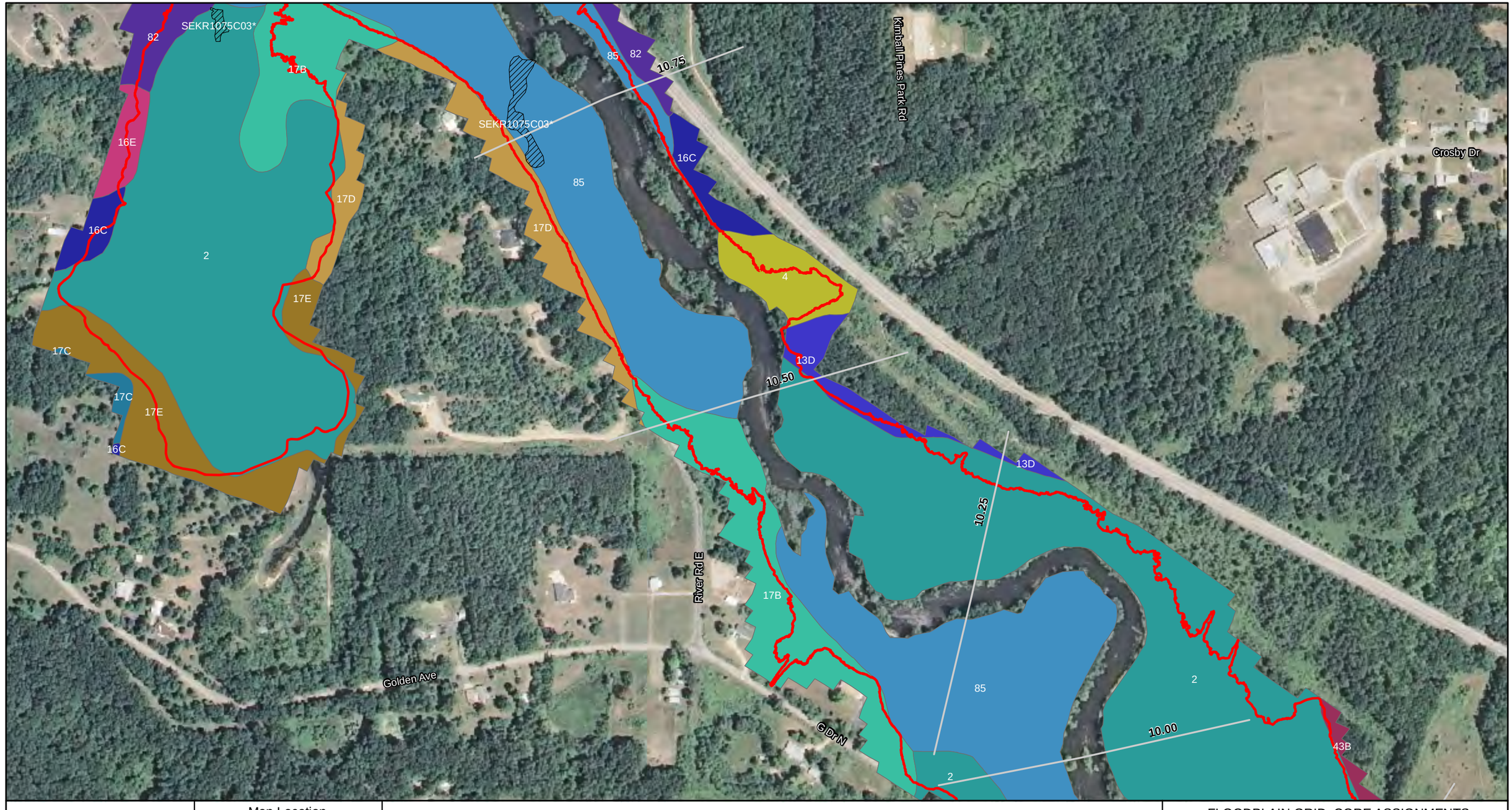
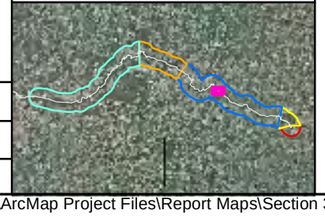
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



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Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 10.00 - MP 10.80

SHEET 9 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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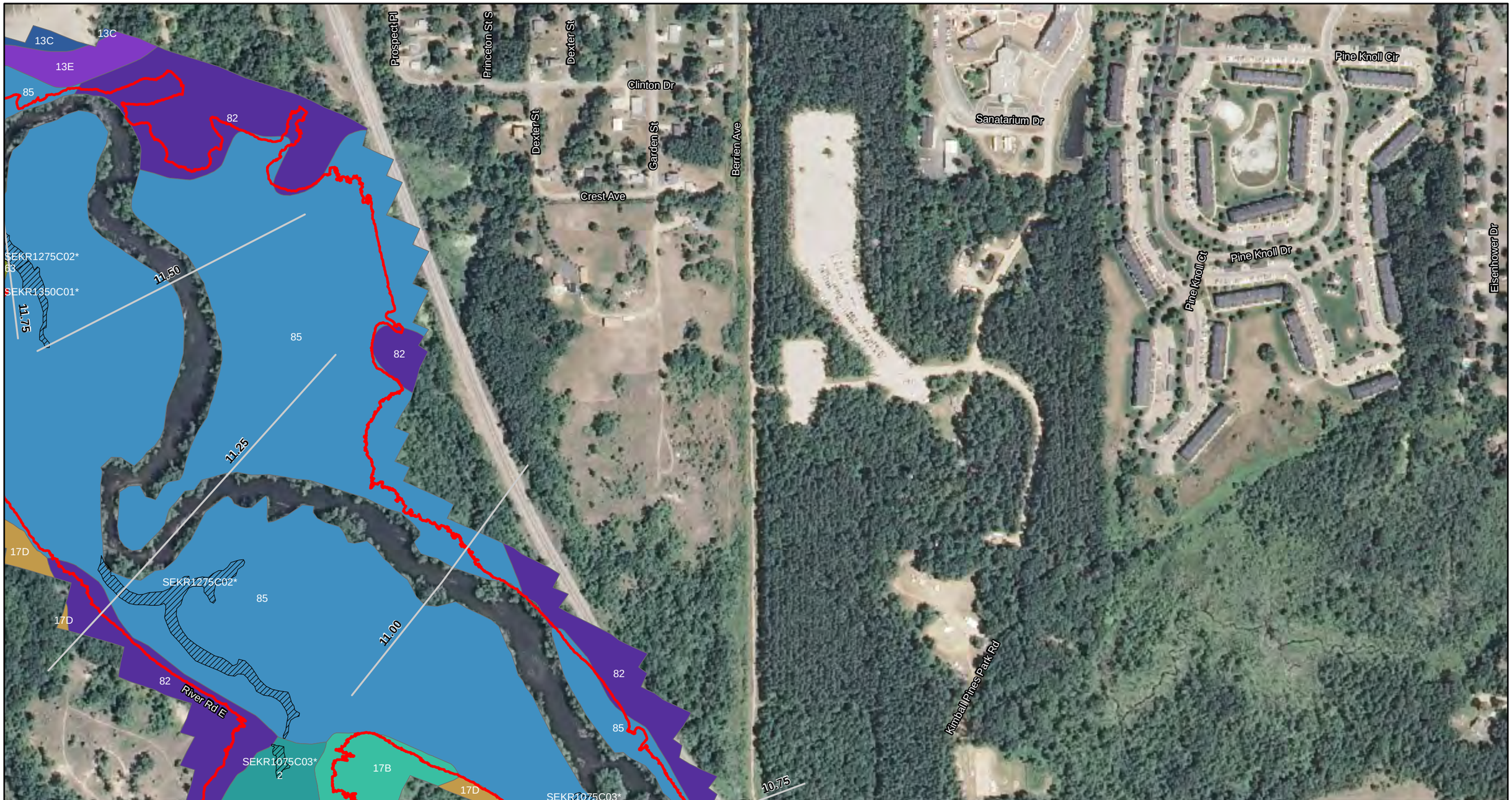

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 10.80 - MP 11.70

SHEET 10 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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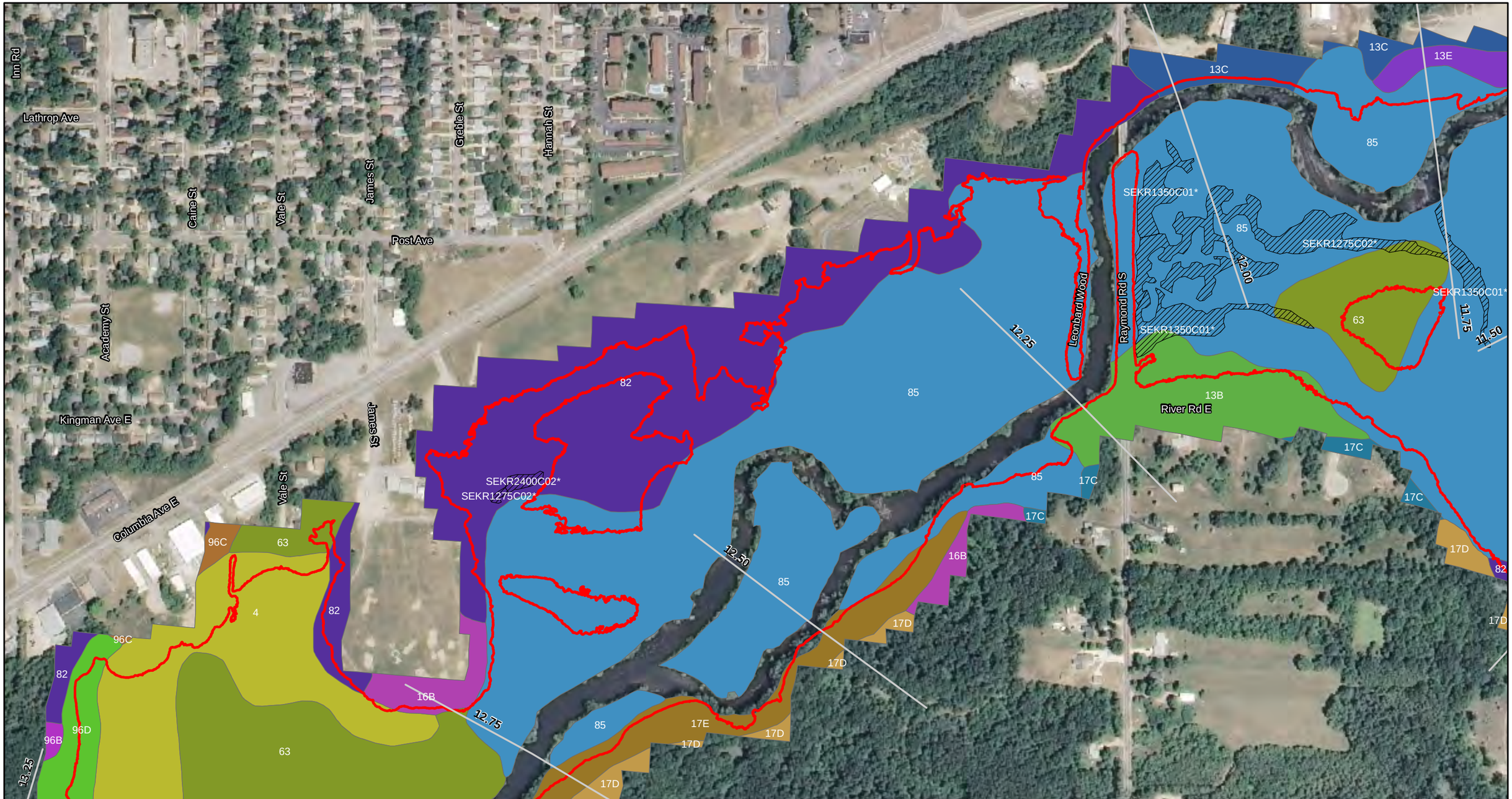
Aerial Photography Date: July & August 2009



Map Location

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 11.70 - MP 12.77

SHEET 11 OF 45

ENBRIDGE LINE 6B MP 608
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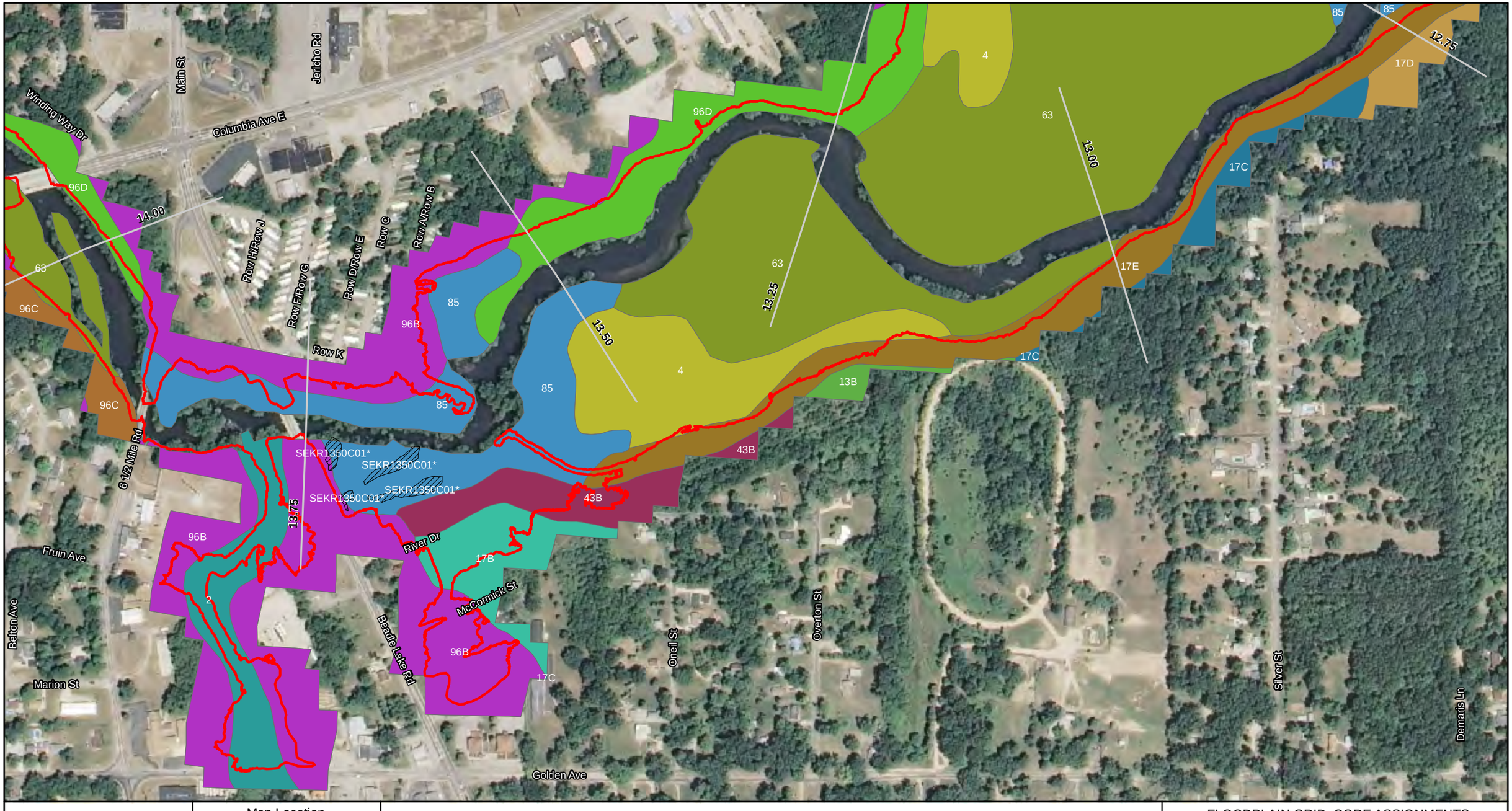
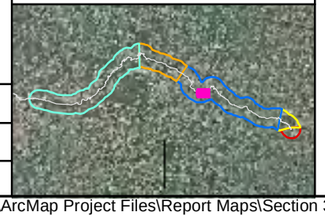
Aerial Photography Date: July & August 2009



Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 12.77 - MP 14.00

SHEET 12 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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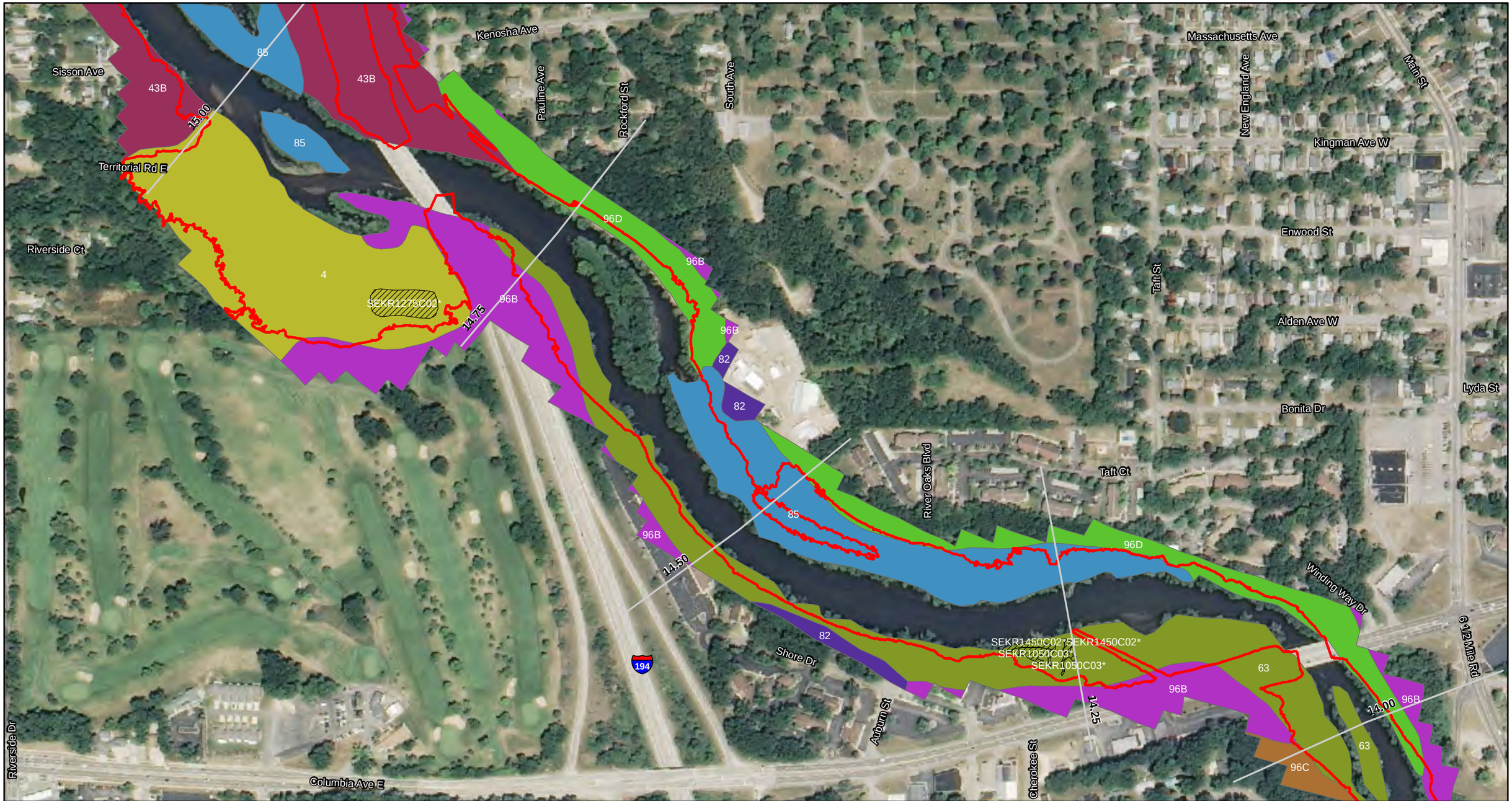
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 14.00 - MP 15.05

SHEET 13 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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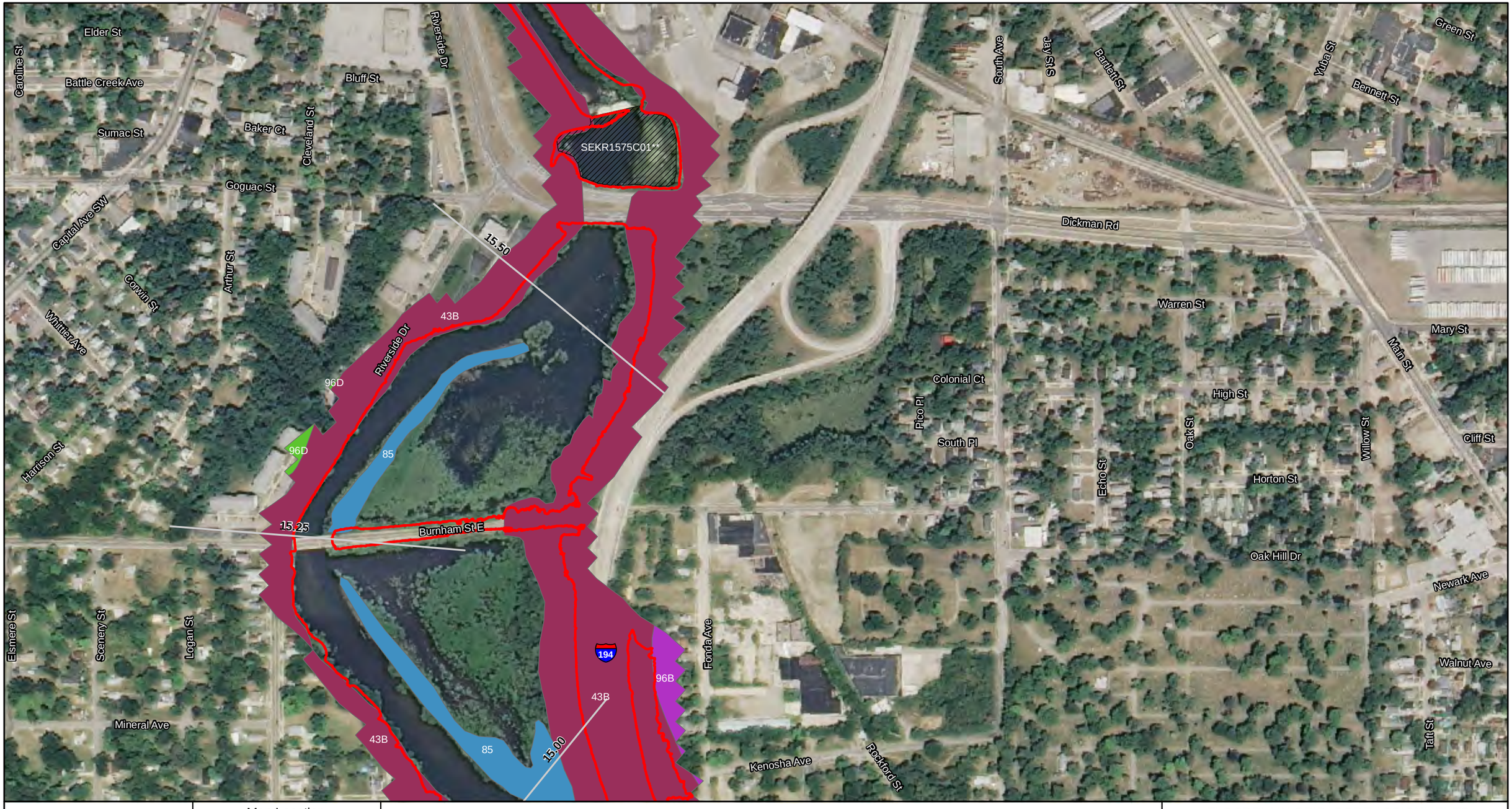
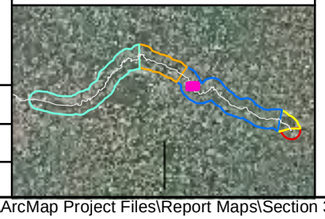
Aerial Photography Date: July & August 2009



Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 15.05 - MP 15.71

SHEET 14 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 15.71 - MP 16.38

SHEET 15 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 16.38 - MP 17.30

SHEET 16 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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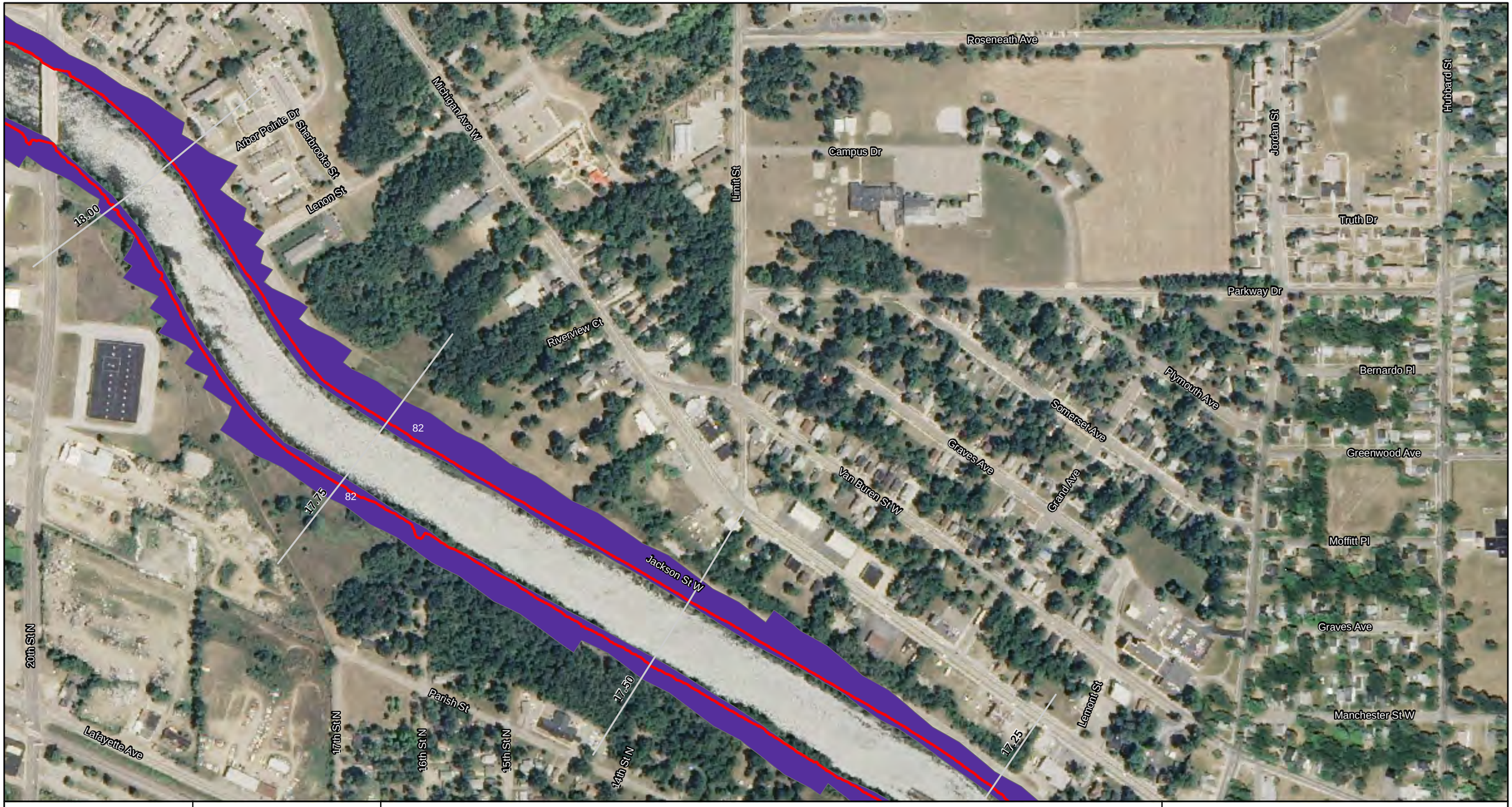
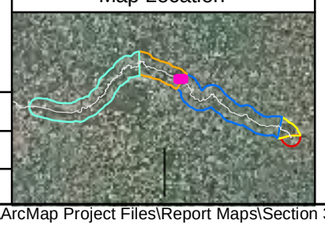


ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



- SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
- Overbank Standing Water Areas
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

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N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 17.30 - MP 18.11

SHEET 17 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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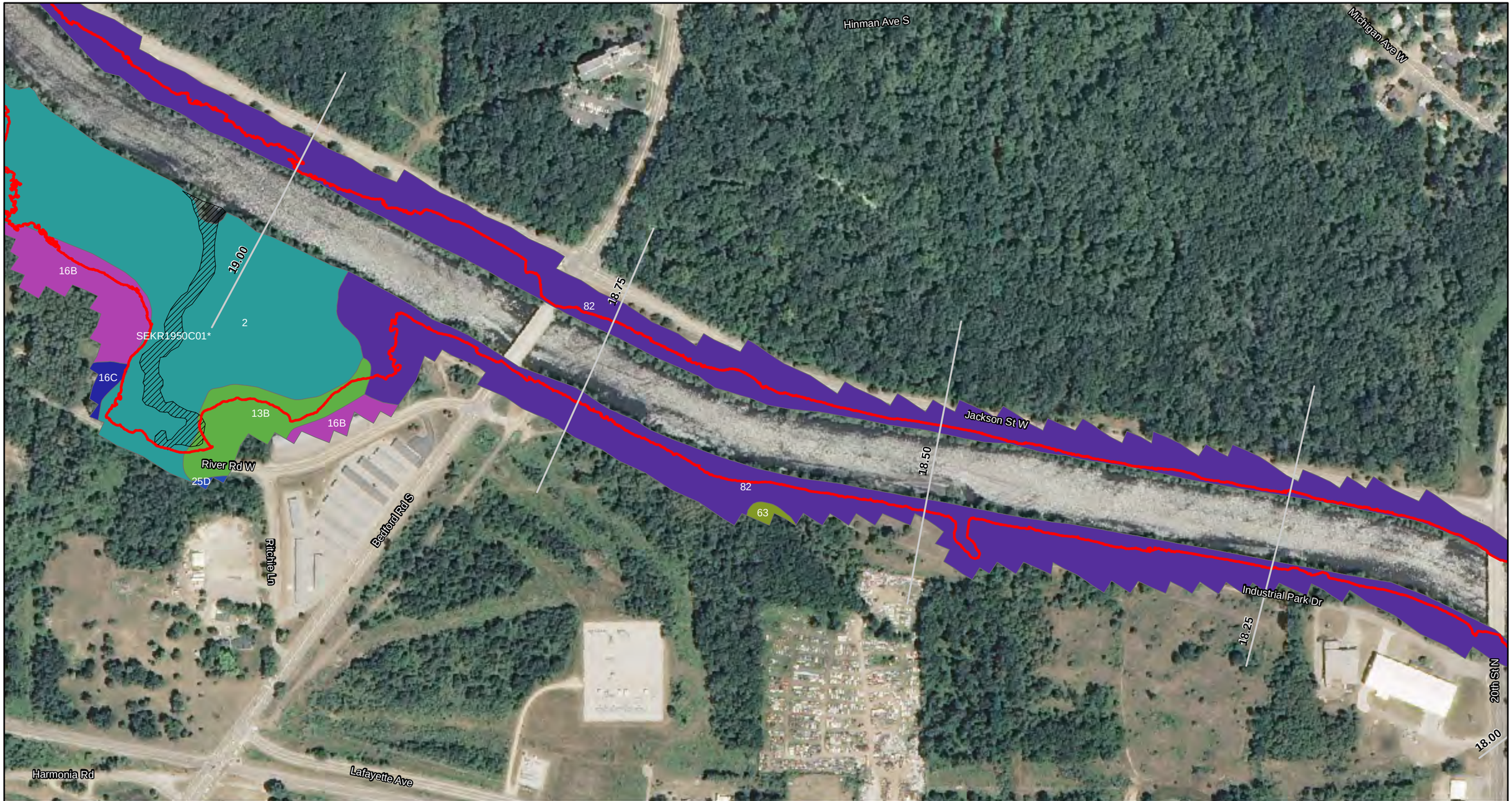
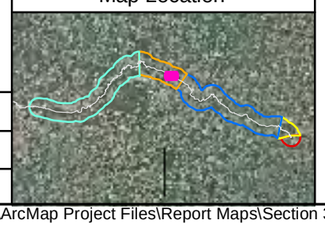


Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 18.11 - MP 19.18

SHEET 18 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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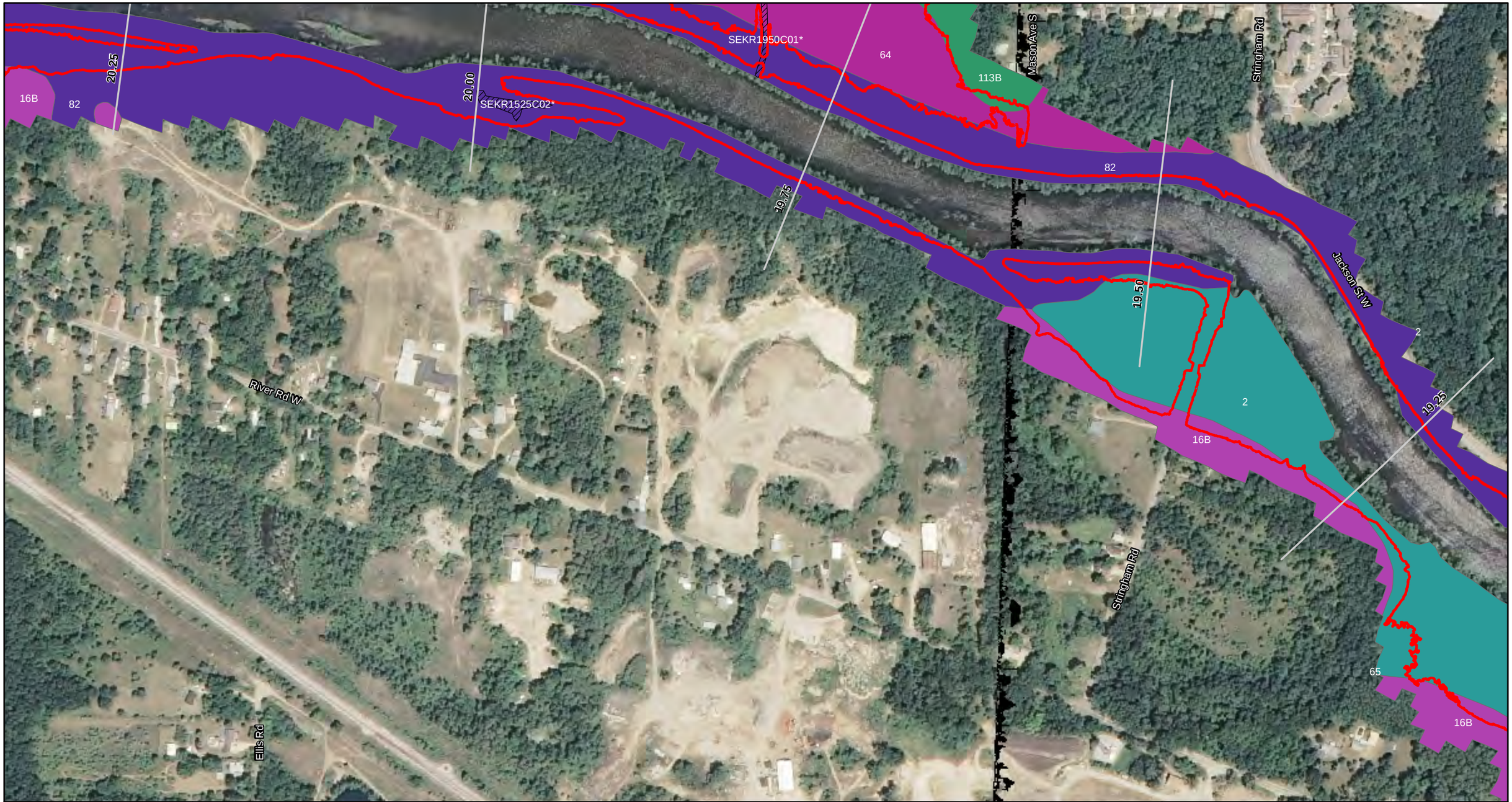

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 19.18 - MP 20.00

SHEET 19 OF 45

ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

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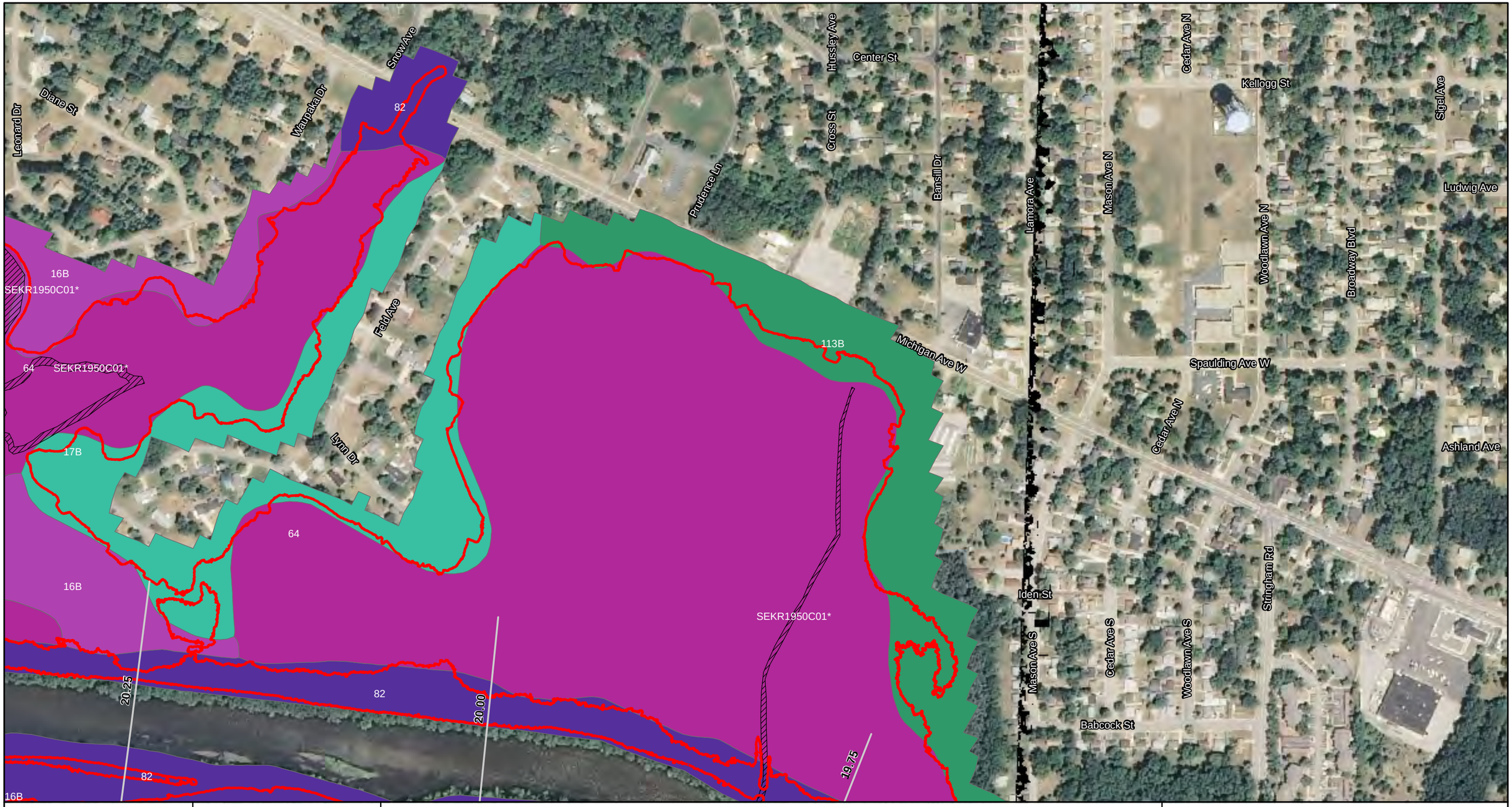
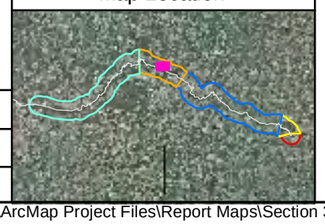


Map Location



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HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 20.00 - MP 20.32

SHEET 20 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

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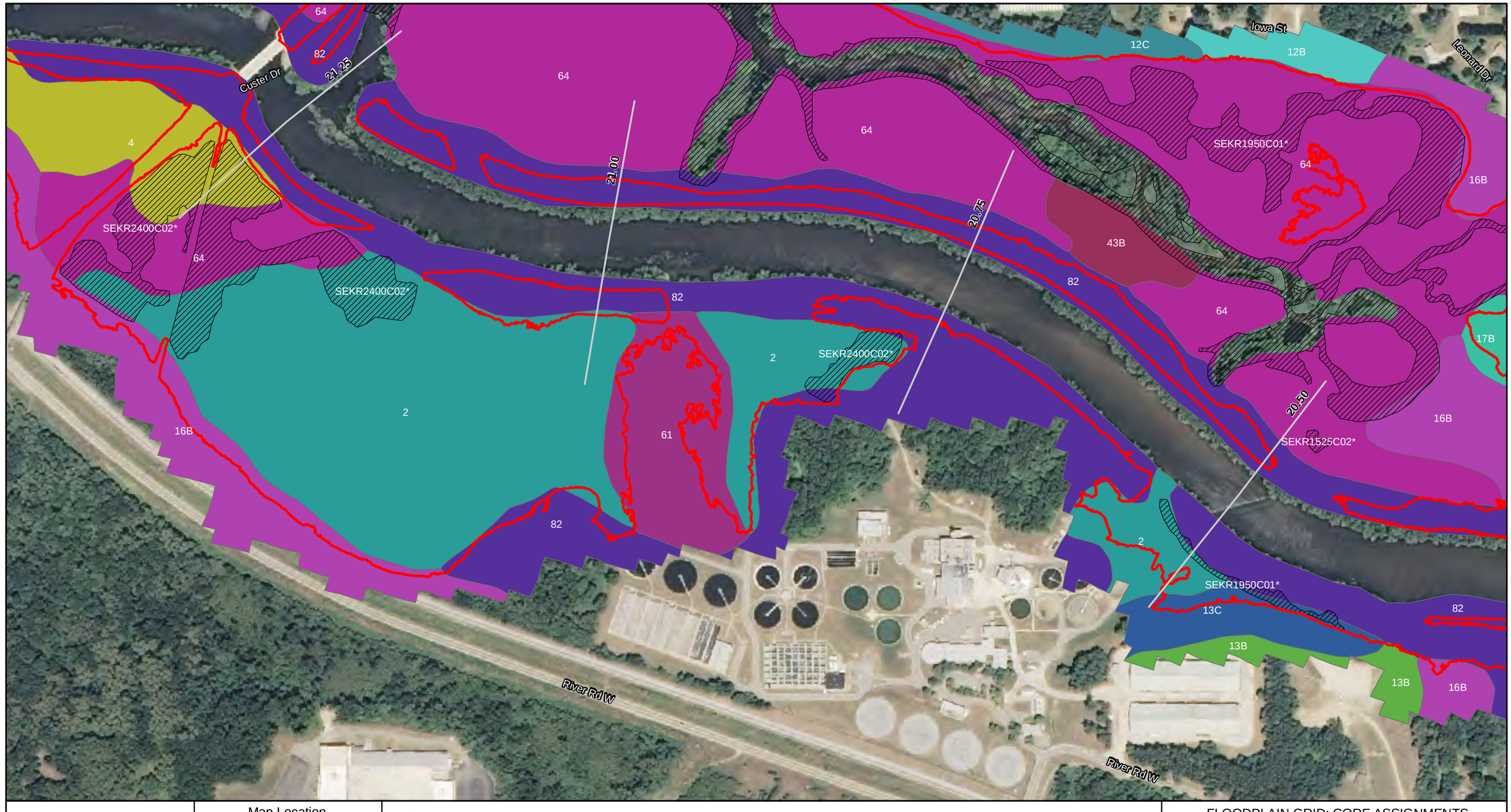
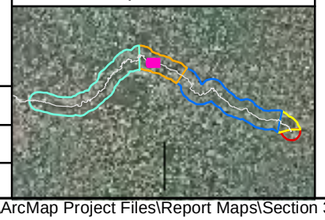
Aerial Photography Date: July & August 2009



Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 20.32 - MP 21.36

SHEET 21 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

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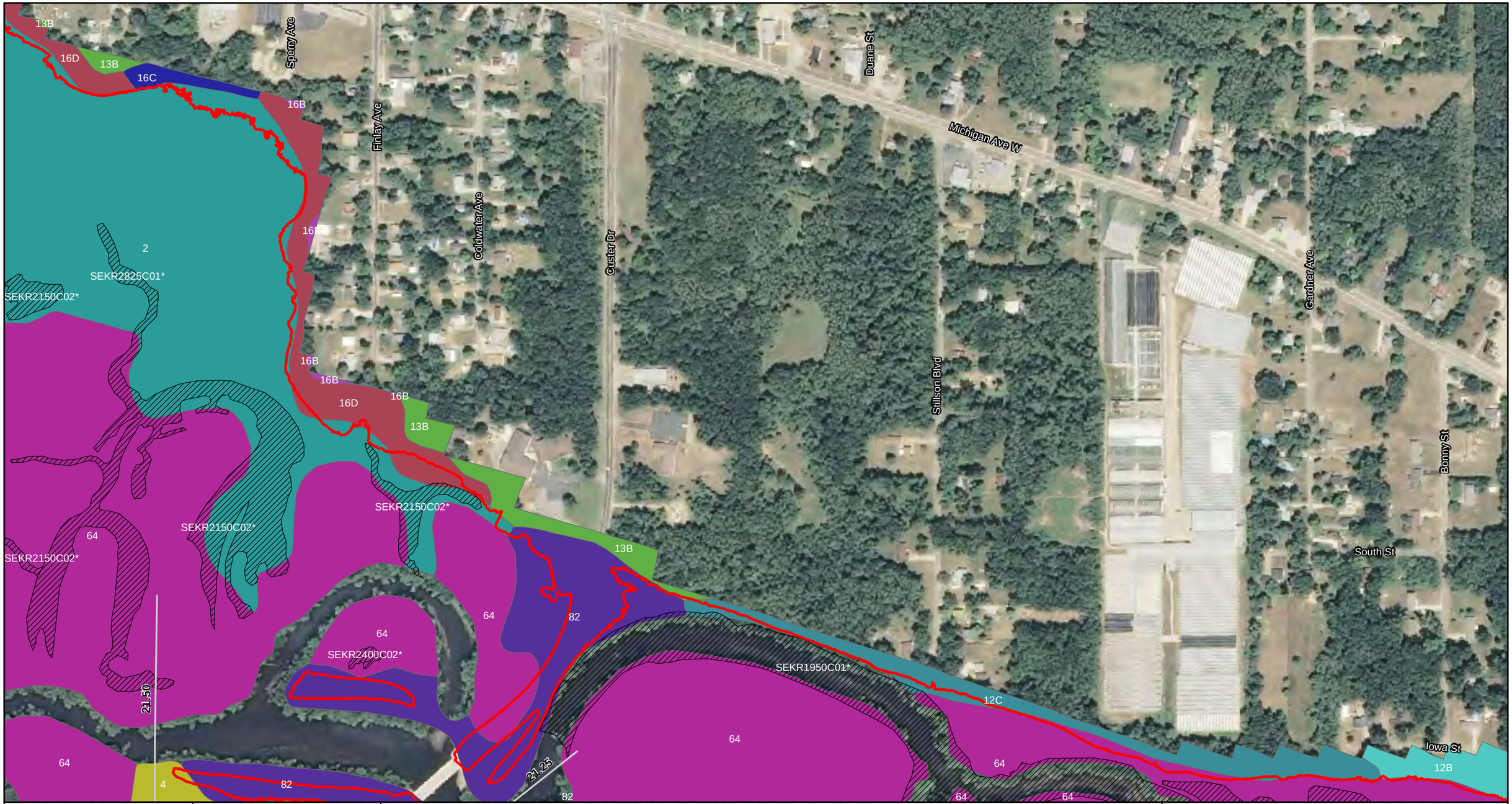
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

SSURGO = Soil Survey Geographic Database

The labels on the overbank standing water areas are the cores used for bulk density and texture assignments.

* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

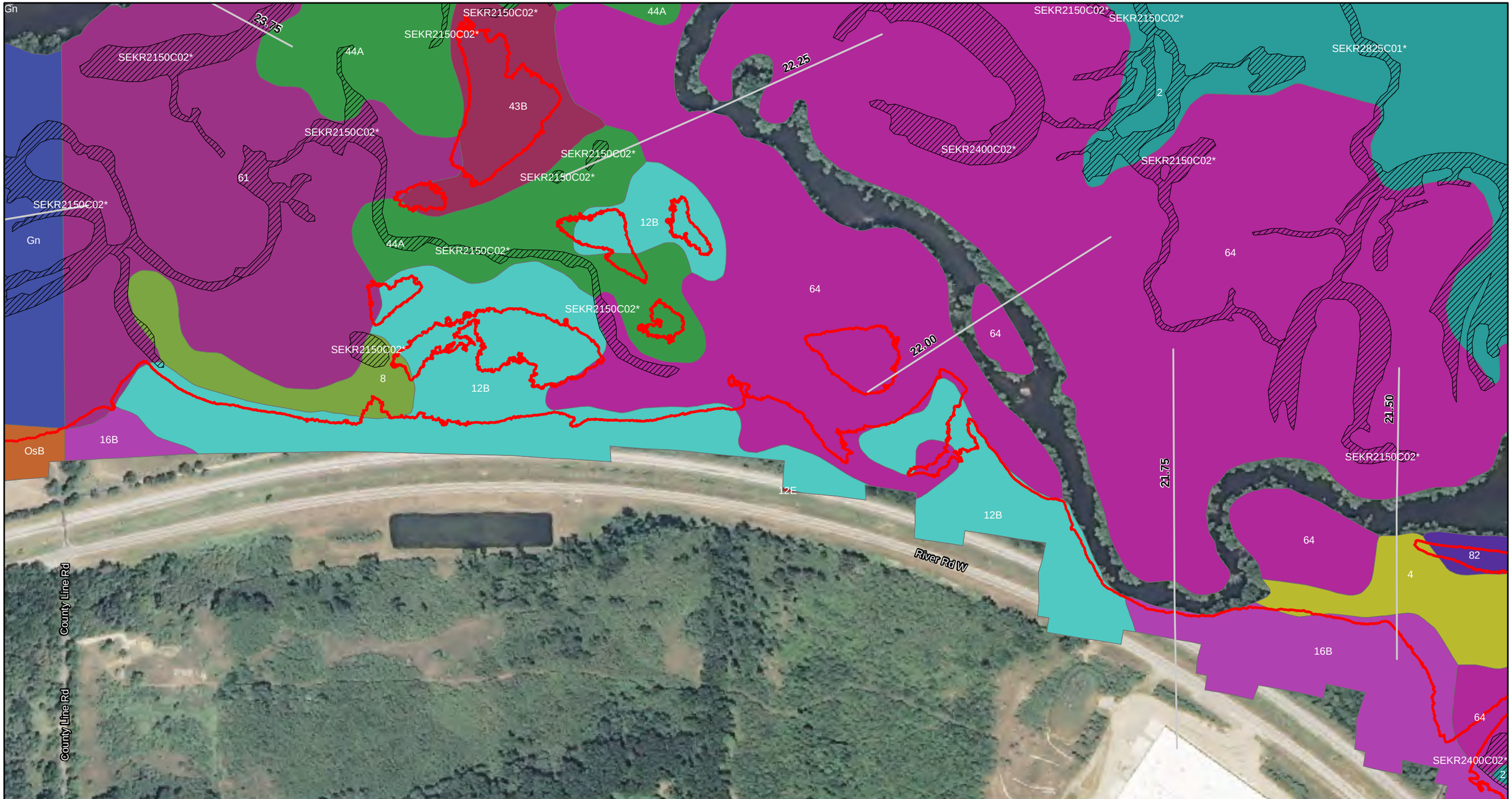
MP 21.36 - MP 21.59

SHEET 22 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Overbank Core Assignment with Map Units.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 21.59 - MP 22.33

SHEET 23 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 22.33 - MP 24.01

SHEET 24 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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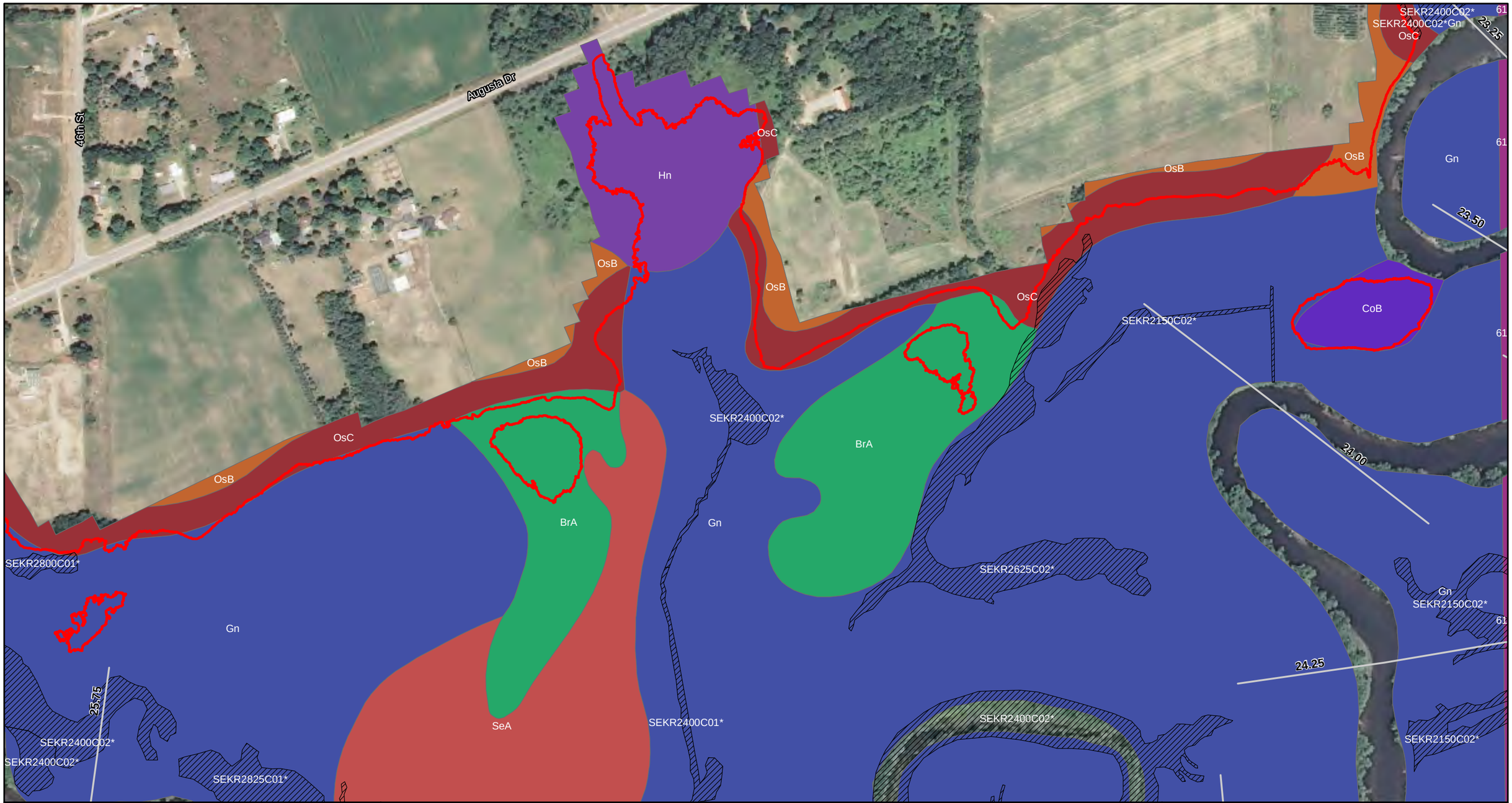
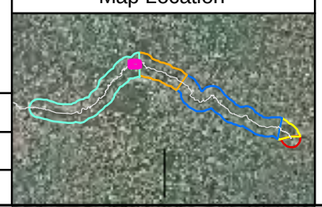
Aerial Photography Date: July & August 2009



Map Location



Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 24.01 - MP 24.33

SHEET 25 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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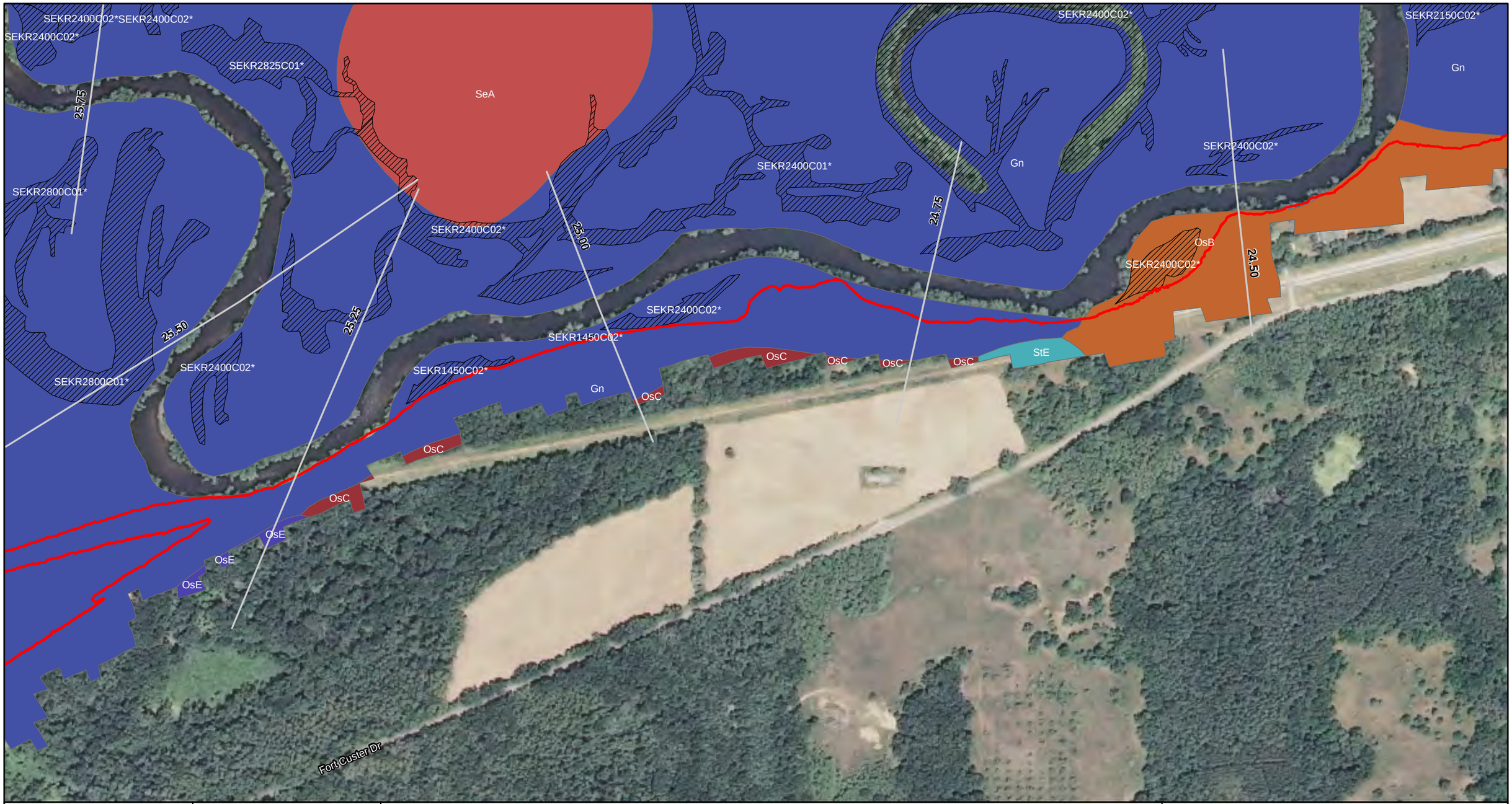
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 24.33 - MP 25.79

SHEET 26 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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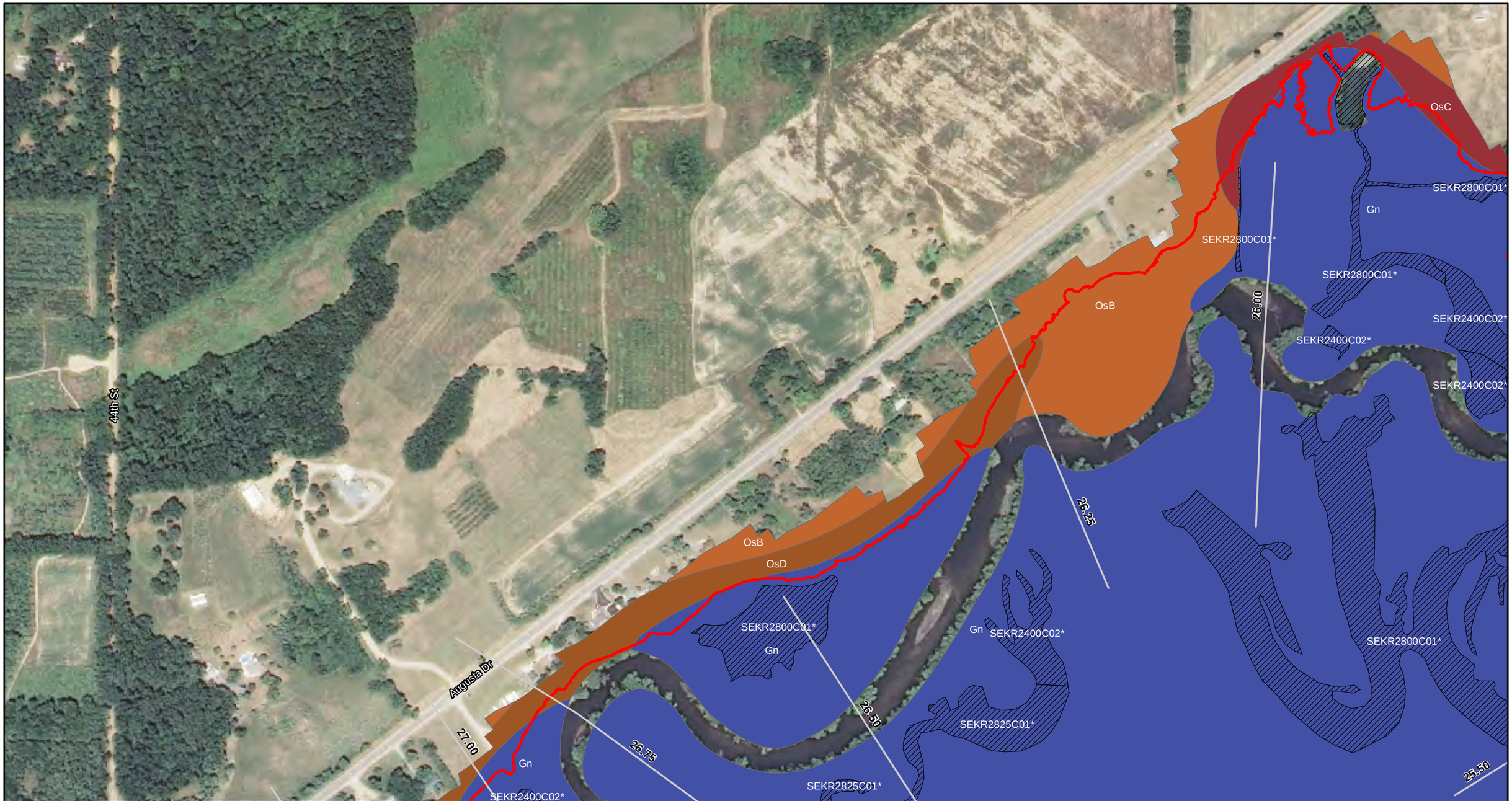
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 25.79 - MP 26.80

SHEET 27 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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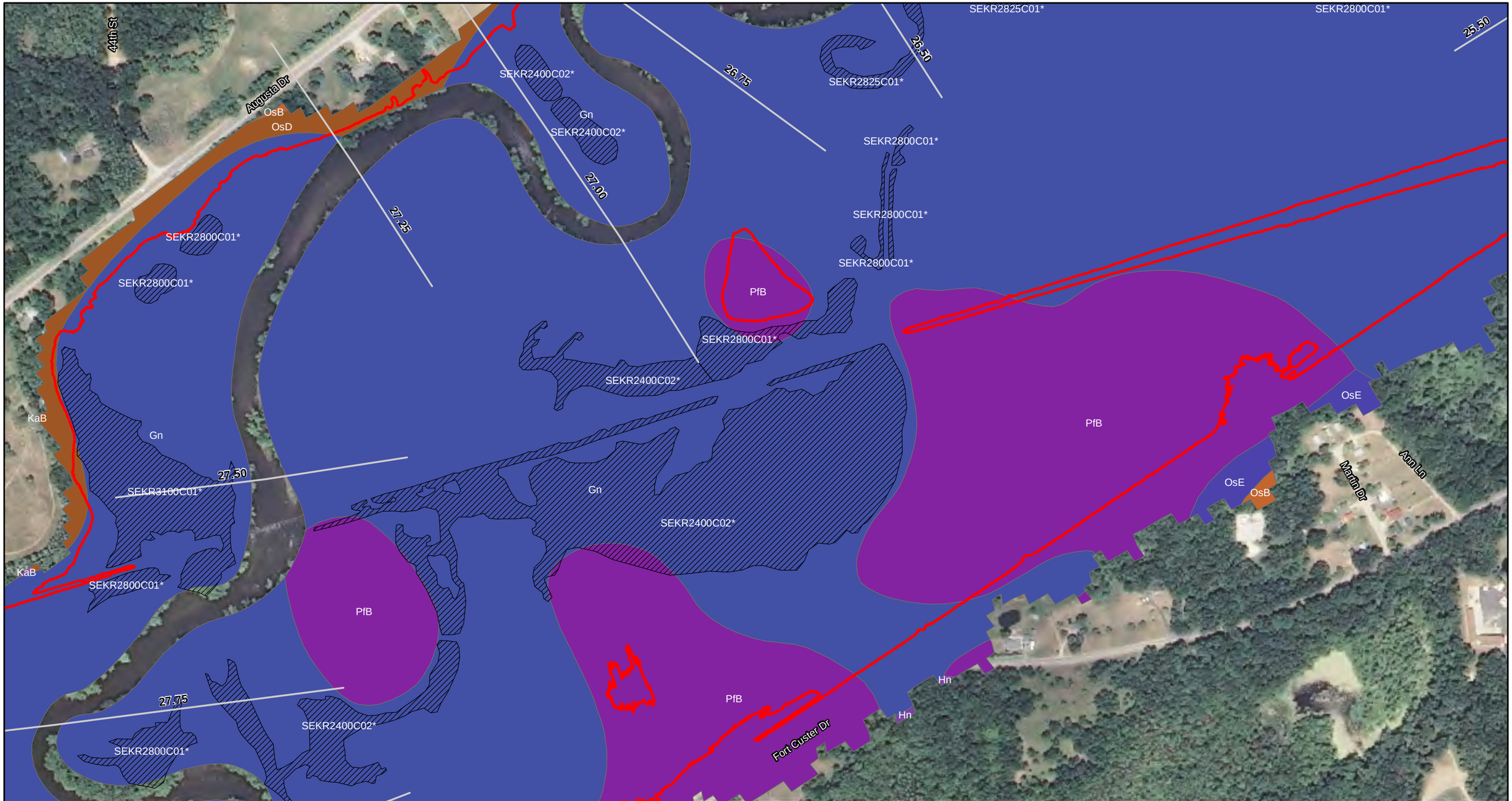
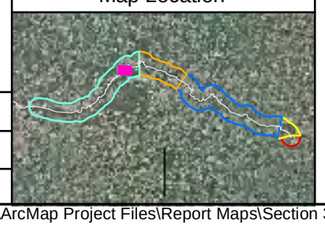
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 26.80 - MP 27.80

SHEET 28 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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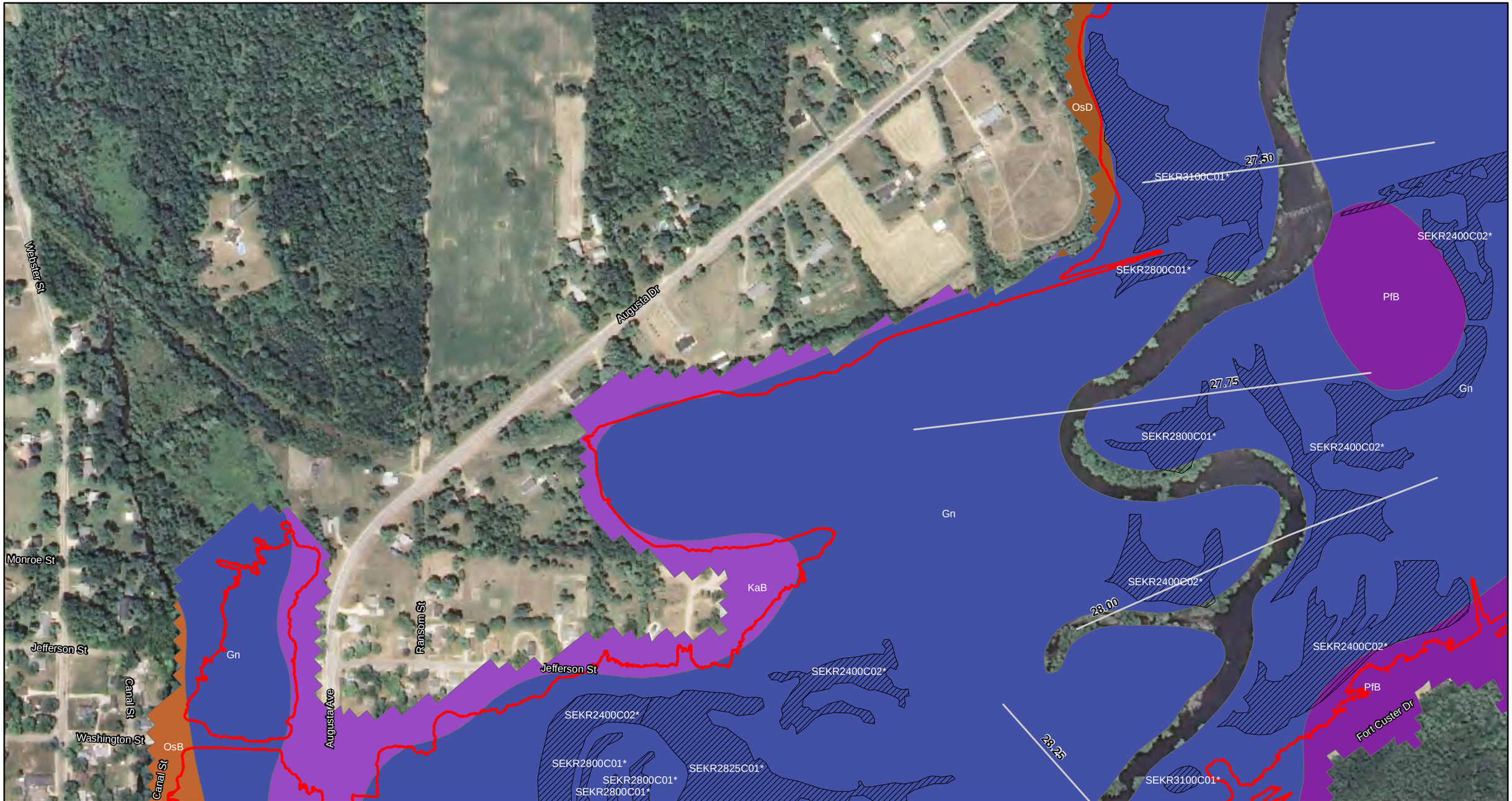
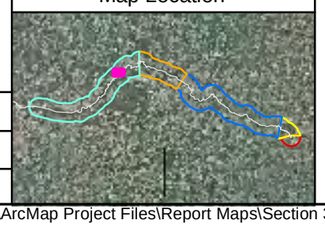
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 27.80NW - MP 28.22NW

SHEET 29 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

SEKR2800C01*
SEKR2400C02*
Gn
SEKR2400C02*
28.00
Gn
SEKR2400C02*
PfB
Fort Custer Dr
SEKR3100C01*
SEKR2400C02*
SEKR2800C01*
SEKR2400C02*
28.25
PfB
Hn
SEKR2400C02*
CoC
Fort Custer Dr
Chippewa Way
Augusta Dr

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 27.80SE - MP 28.22SE

SHEET 30 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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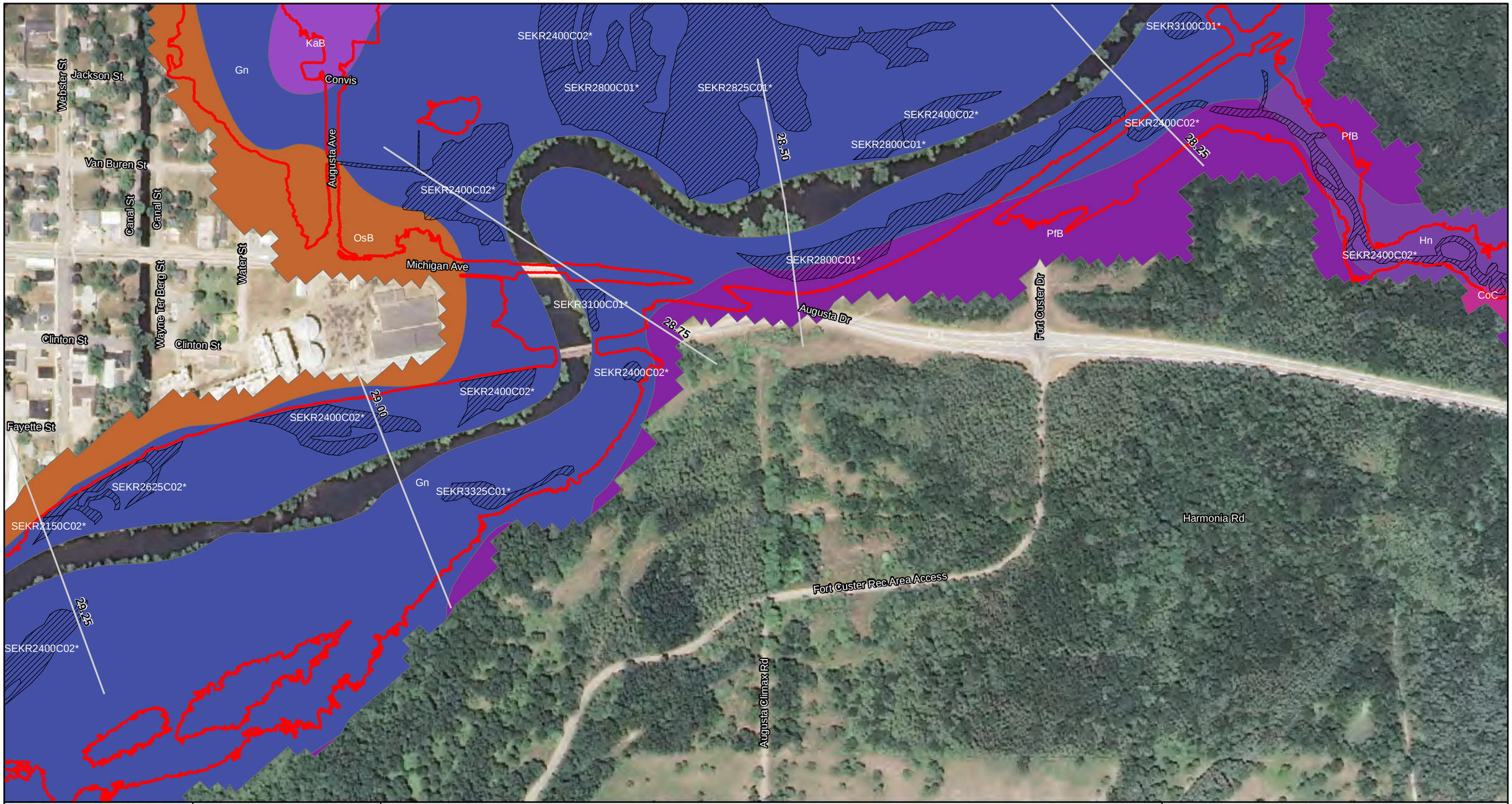
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 28.22 - MP 29.20

SHEET 31 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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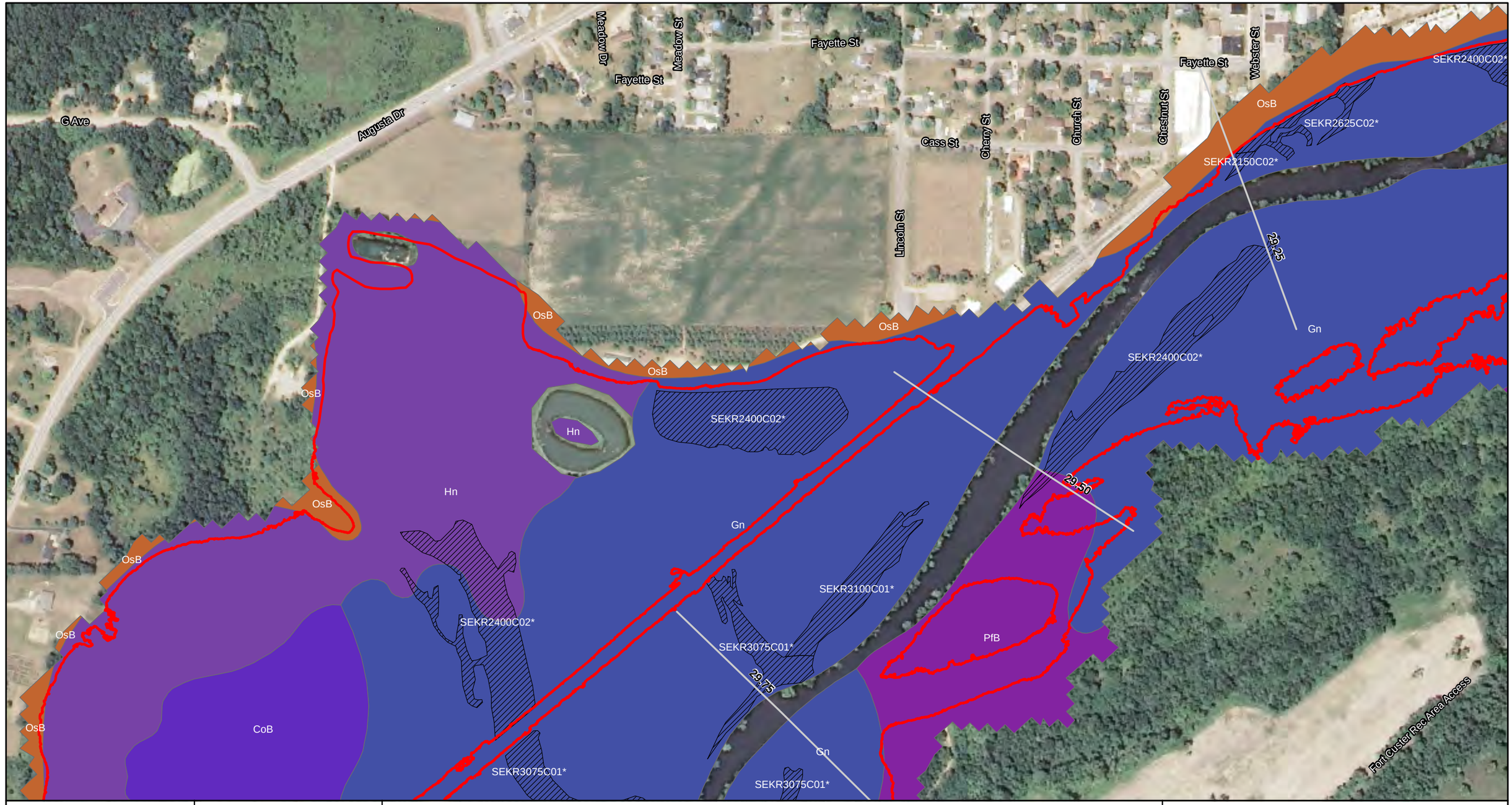
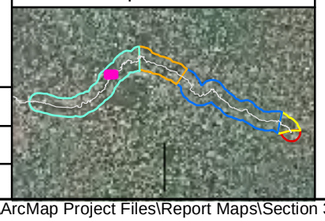
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 29.20 - MP 29.82

SHEET 32 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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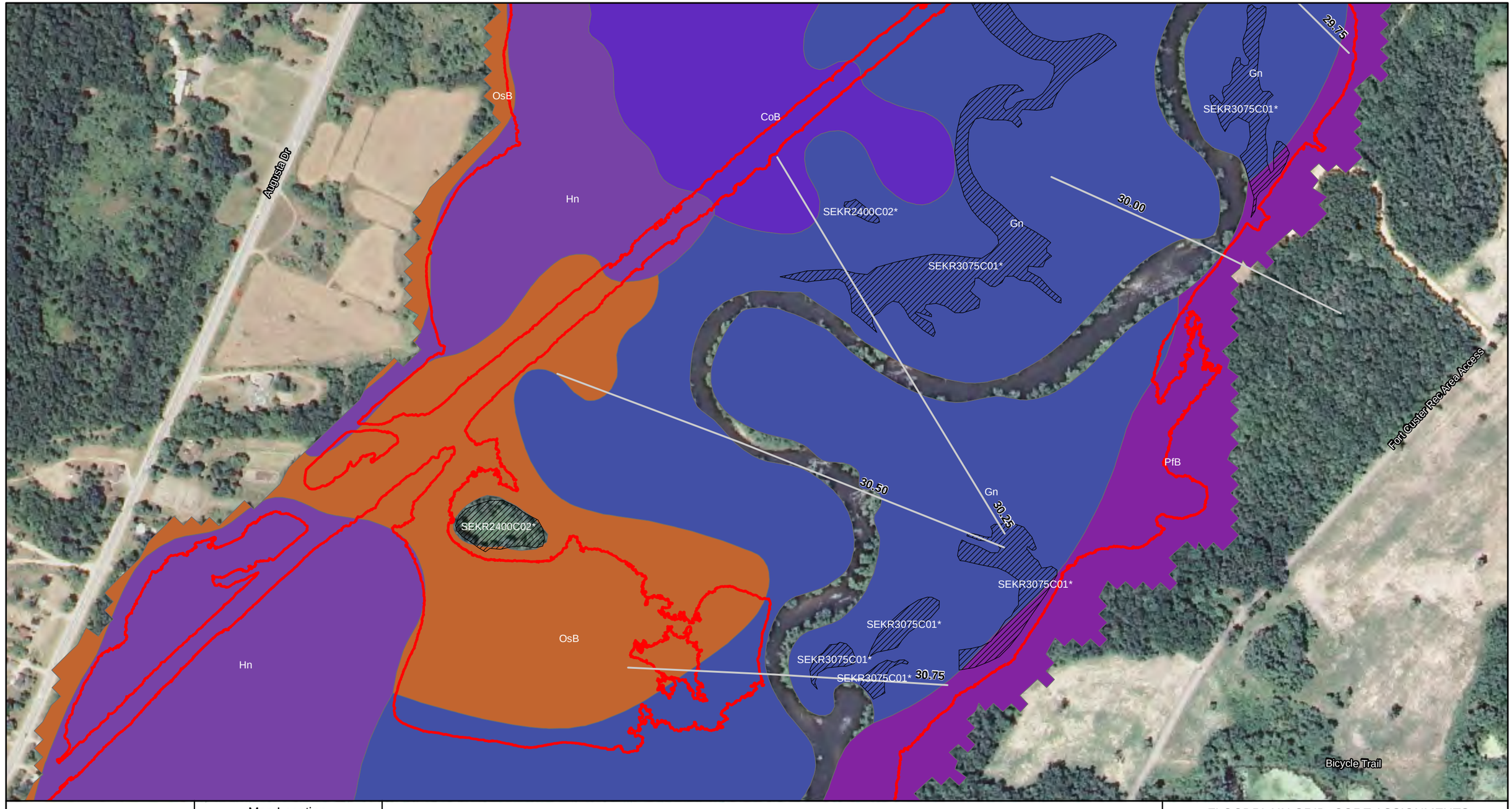
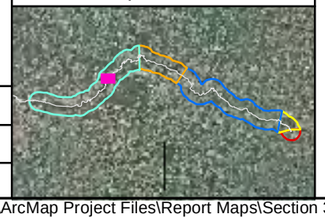
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 29.82 - MP 30.84

SHEET 33 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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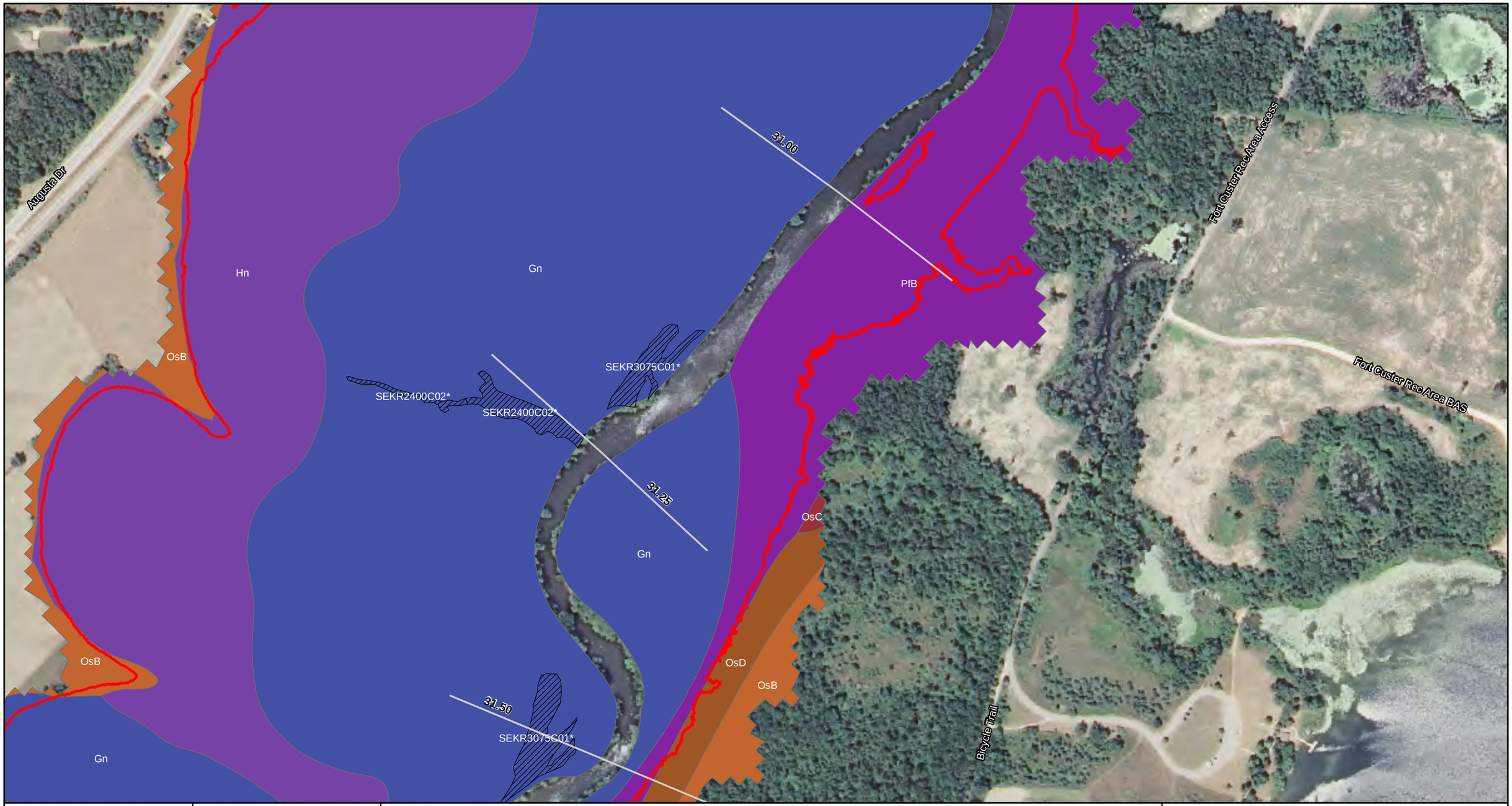
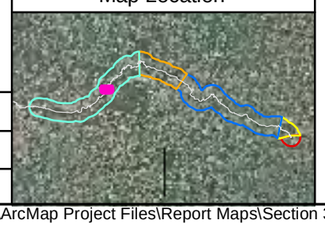
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 30.84 - MP 31.40

SHEET 34 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 31.40 - MP 31.94

SHEET 35 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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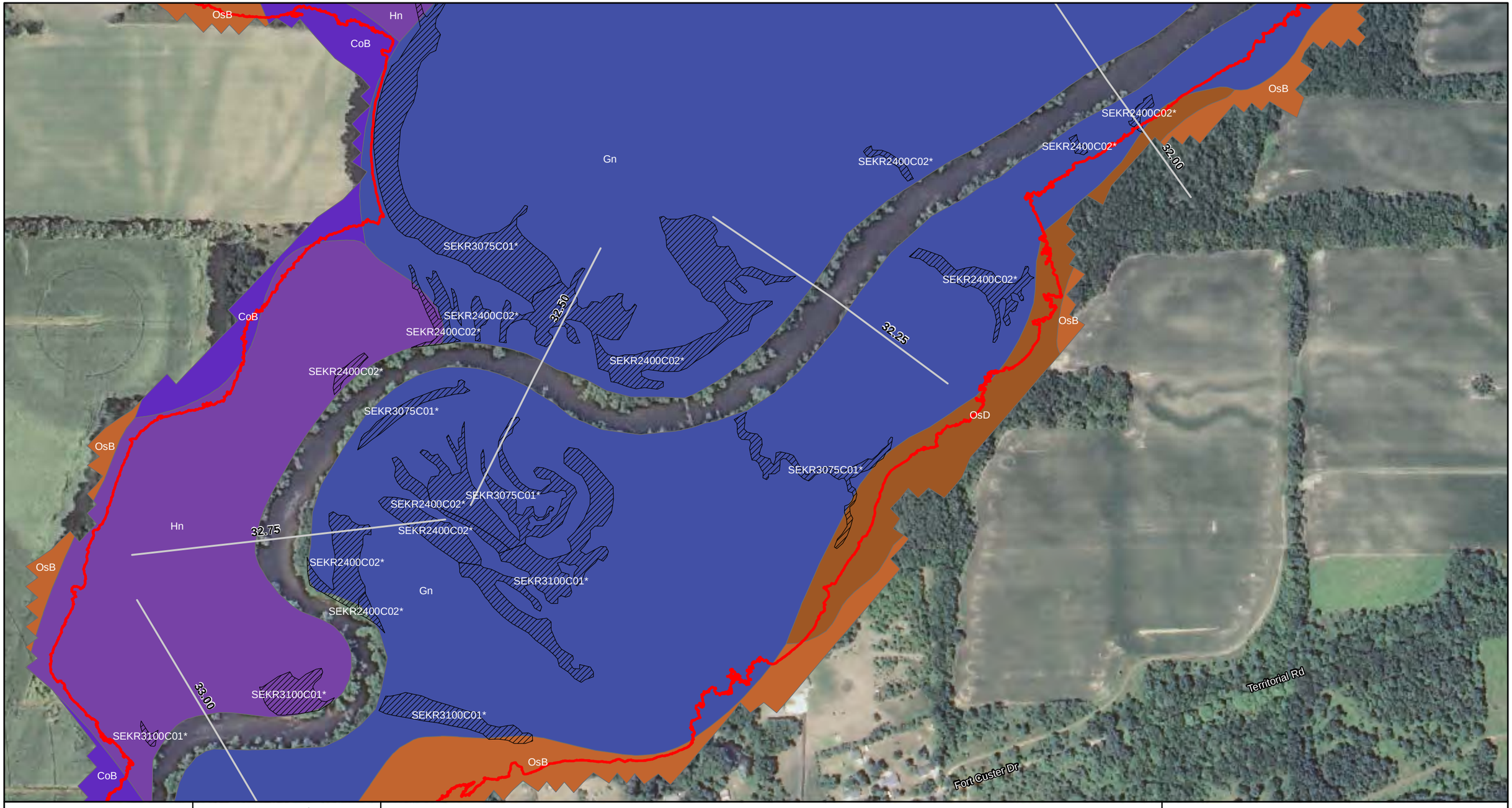
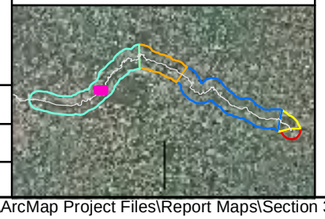


ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



- SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
- Overbank Standing Water Areas
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

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N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 31.94 - MP 33.00

SHEET 36 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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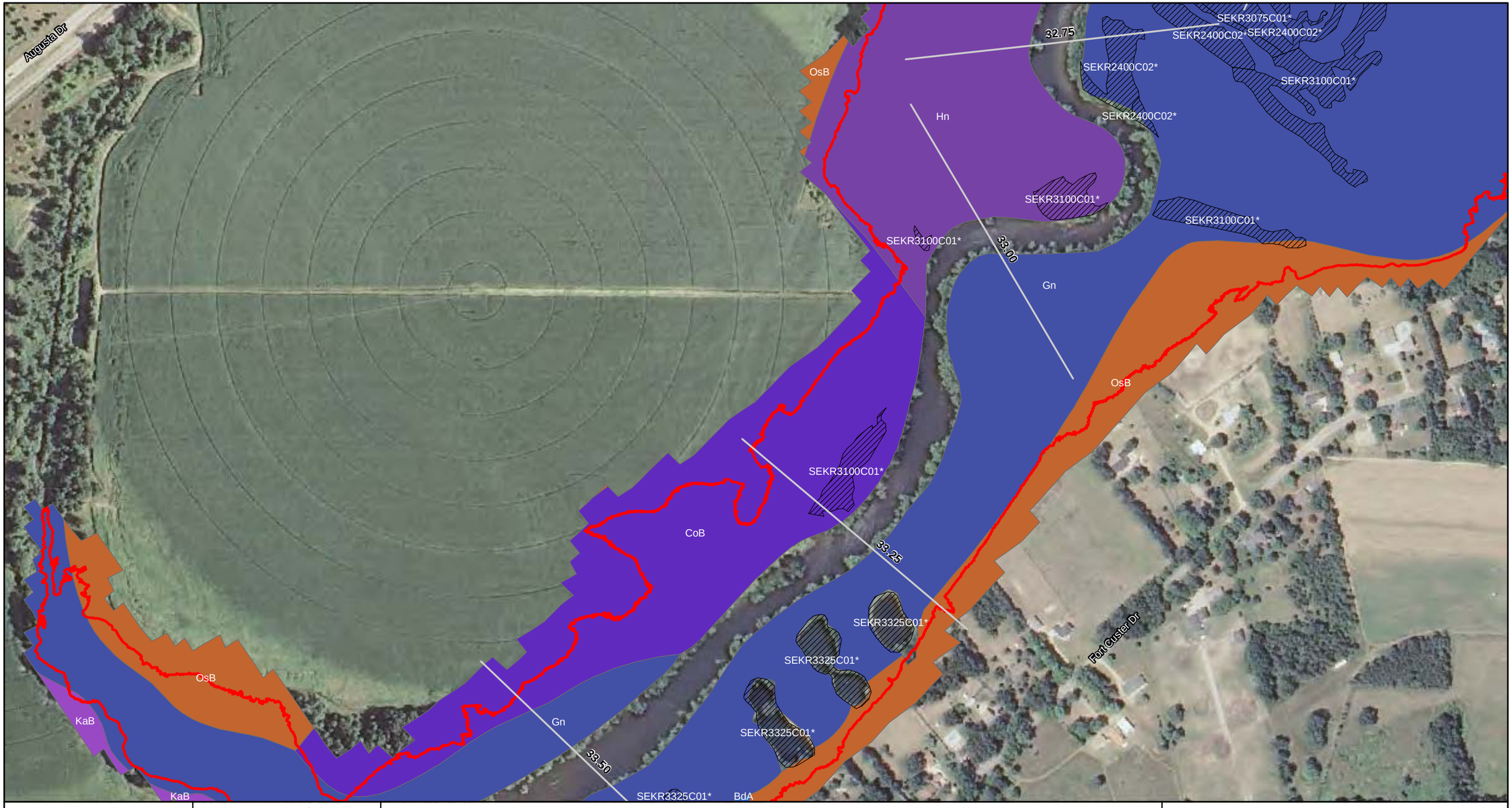
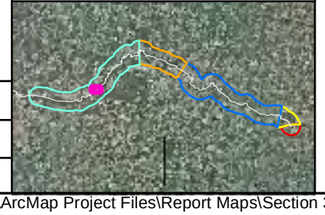
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

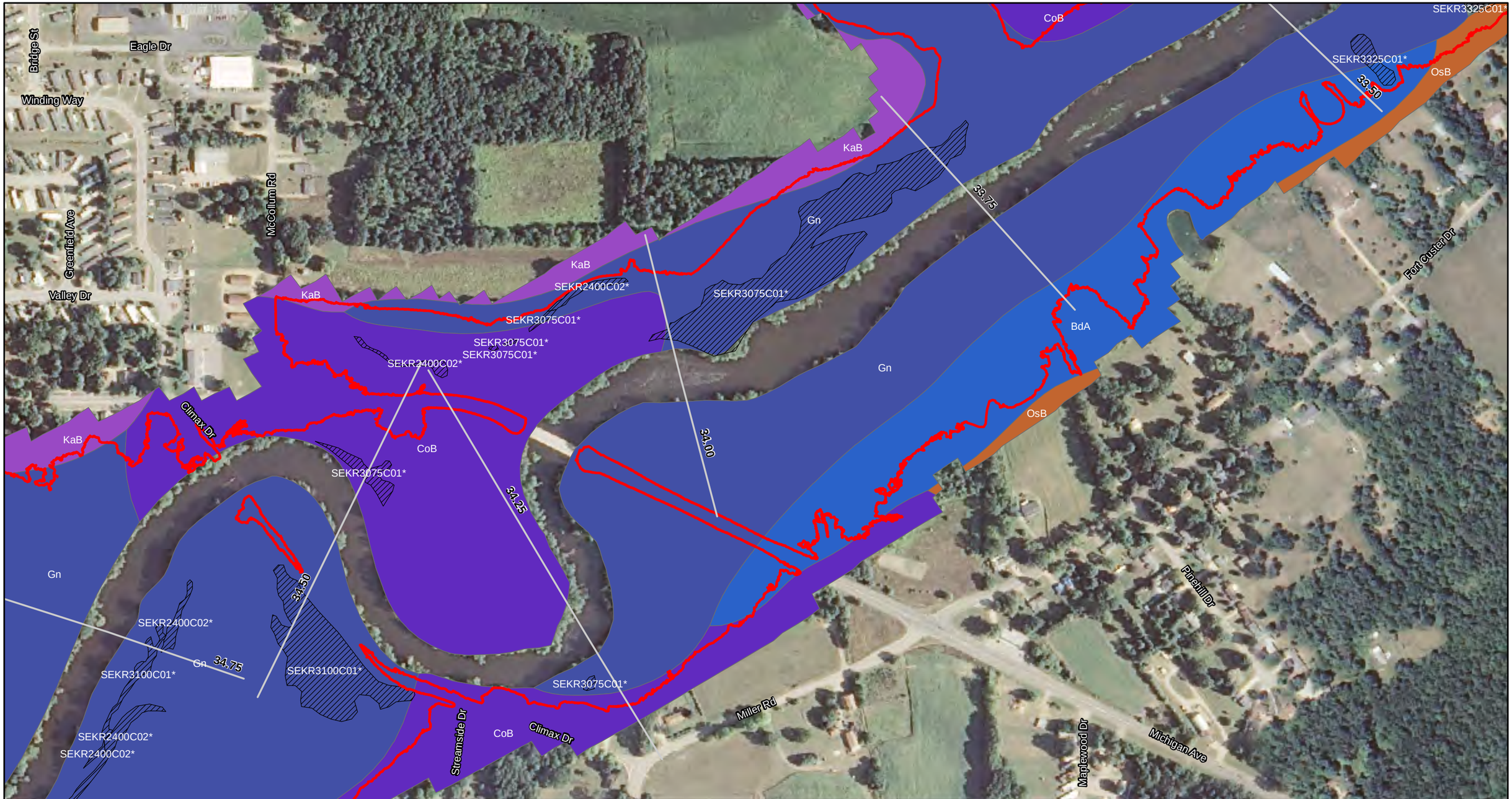
MP 33.00 - MP 33.52

SHEET 37 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

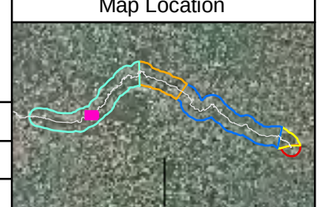
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Overbank Core Assignment with Map Units.mxd

Aerial Photography Date: July & August 2009



Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

SSURGO = Soil Survey Geographic Database

The labels on the overbank standing water areas are the cores used for bulk density and texture assignments.

* = Core assigned manually due to no exact match for fluvial setting and sediment category combination.
** = The assigned core is within the polygon.

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 33.52 - MP 34.70

SHEET 38 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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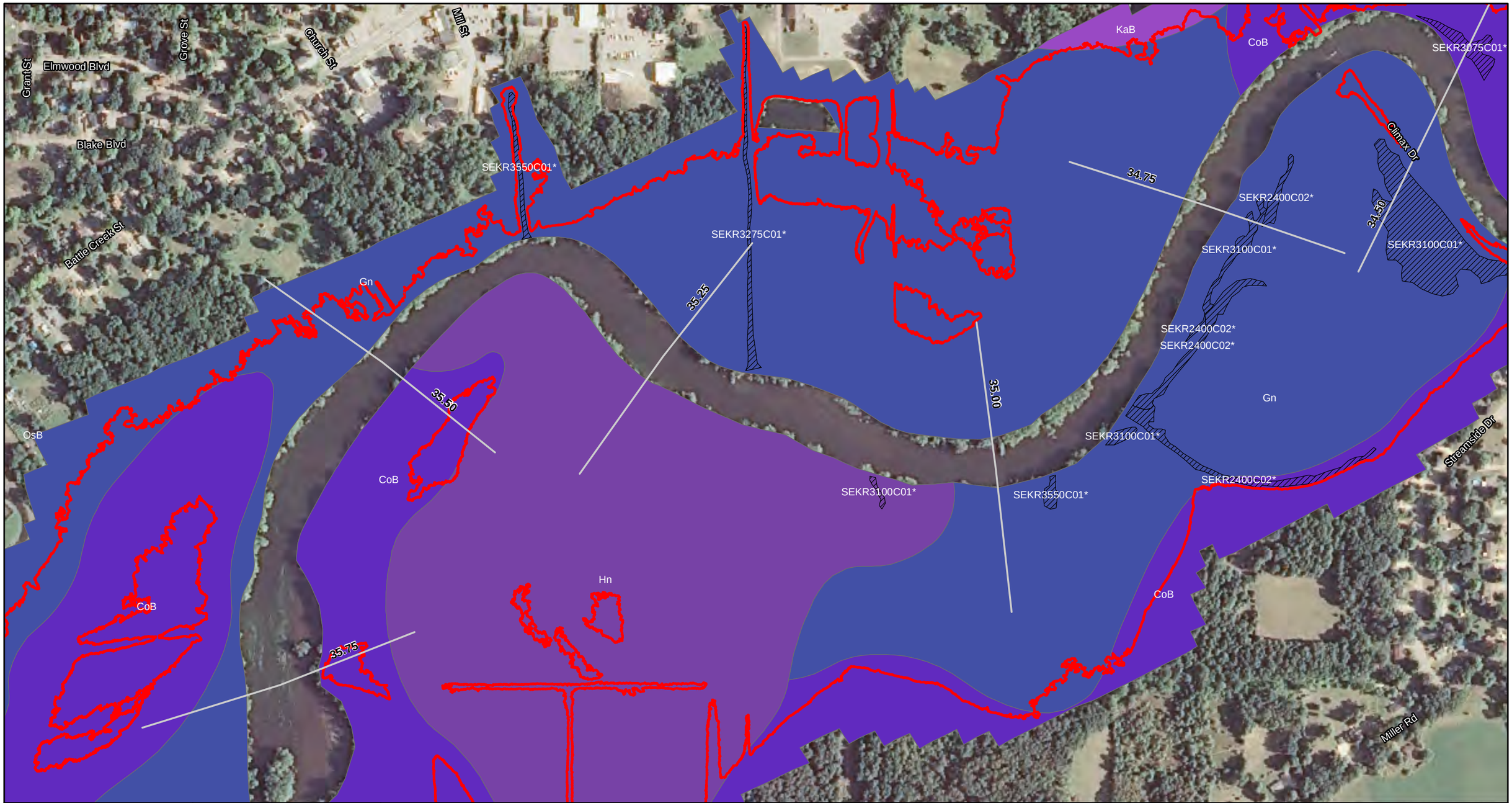
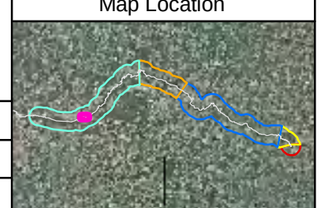
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 34.70 - MP 35.75

SHEET 39 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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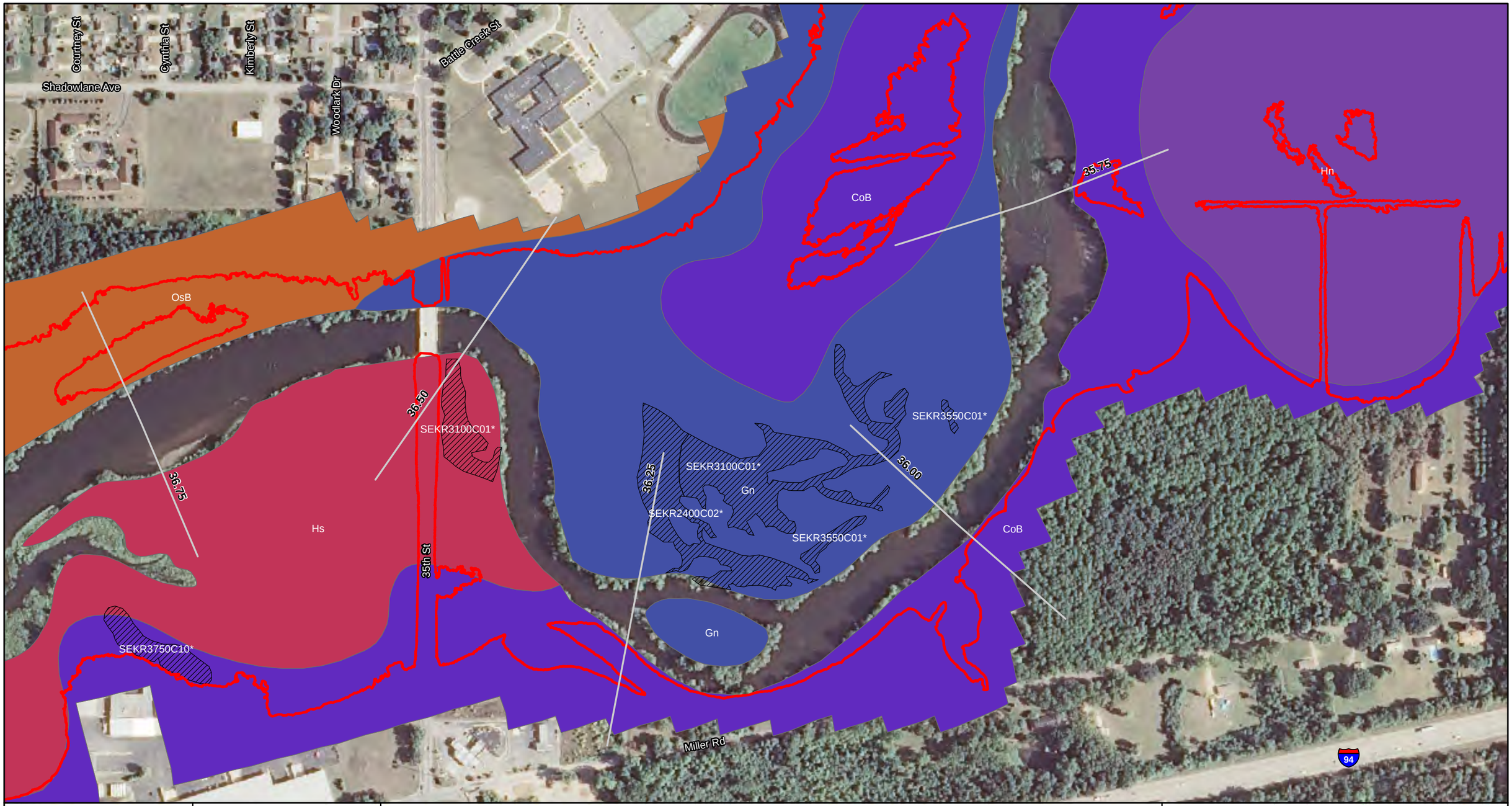
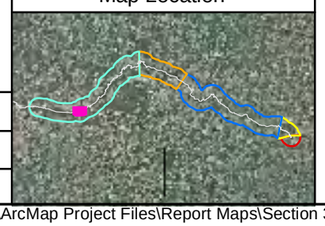
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 35.75 - MP 36.75

SHEET 40 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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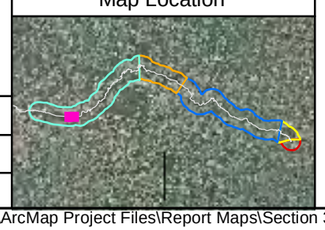
Aerial Photography Date: July & August 2009

OsC
OsB
OsB
BrA
SEKR2400C02*
SEKR3750C06*
SEKR3750C08*
SEKR2400C02*
37.75
37.50
37.25
37.00
36.75
Hs
SEKR3750C10*
RdB
SEKR3775C05*
SEKR3775C01*
SEKR3775C01*
CoB
CoB
Miller Dr
94

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

SSURGO = Soil Survey Geographic Database

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** = The assigned core is within the polygon.

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 36.75 - MP 37.75

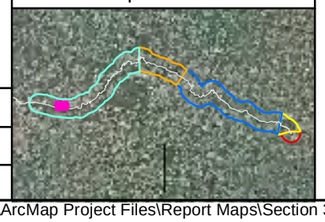
SHEET 41 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Overbank Core Assignment with Map Units.mxd

Aerial Photography Date: July & August 2009

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)

Overbank Standing Water Areas

HEC-RAS 100-Year Floodplain

Quarter Mile Grid Segment

SSURGO = Soil Survey Geographic Database

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N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 37.75N - MP 38.80N

SHEET 42 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

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Aerial Photography Date: July & August 2009

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Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location

SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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** = The assigned core is within the polygon.

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 37.75S - MP 38.80S

SHEET 43 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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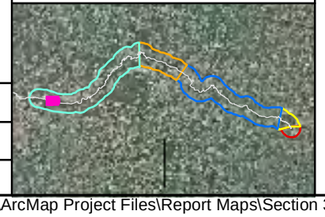
Aerial Photography Date: July & August 2009

Arden Ave
Morrow St
Elliot Rd
Lawndale Ave
Chene Dr
Consumers Power Dr
39.75
39.50
39.25
39.00
Ad
Ad
UkB
SeA
SeA
Gd
Ug
Hs
Hs

ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

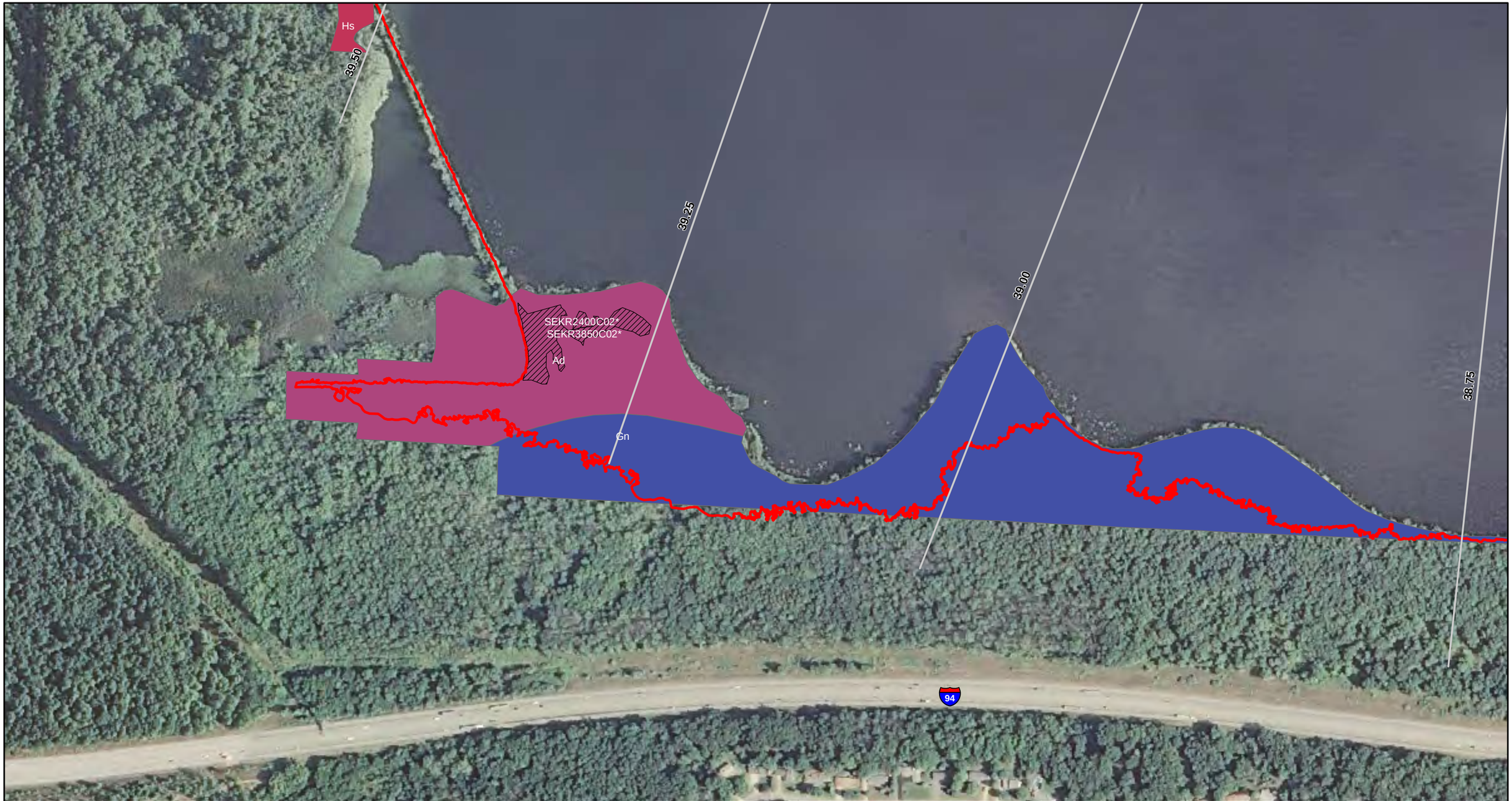
MP 38.80N - MP 39.95N

SHEET 44 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Overbank Core Assignment with Map Units.mxd

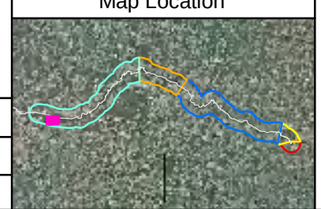
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/20/2012
Approved:	DBR 3/20/2012
Project #:	106-4186

Map Location



SSURGO Map Units (Unique Symbol and Color for Each; See Table 3-2 for Full Name and Description of All 330 Map Units)
Overbank Standing Water Areas
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

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N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: CORE ASSIGNMENTS & SSURGO MAP UNITS

MP 38.80S - MP 39.95S

SHEET 45 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

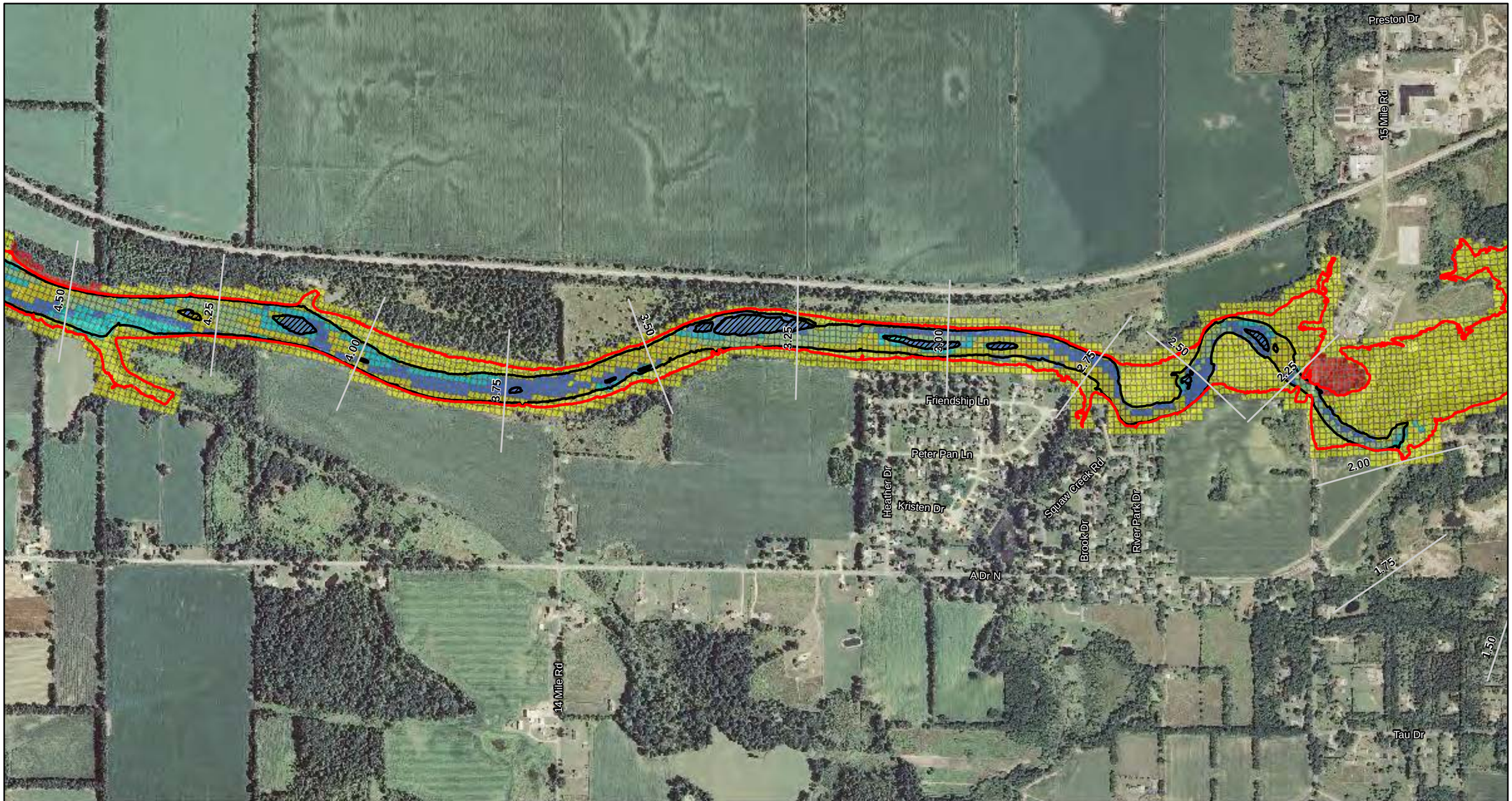
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Overbank Core Assignment with Map Units.mxd

Aerial Photography Date: July & August 2009

Figure 3-20

Floodplain Grid: Percent Sand

Sheets 1 through 16



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

% Sand

- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

% = Percent

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

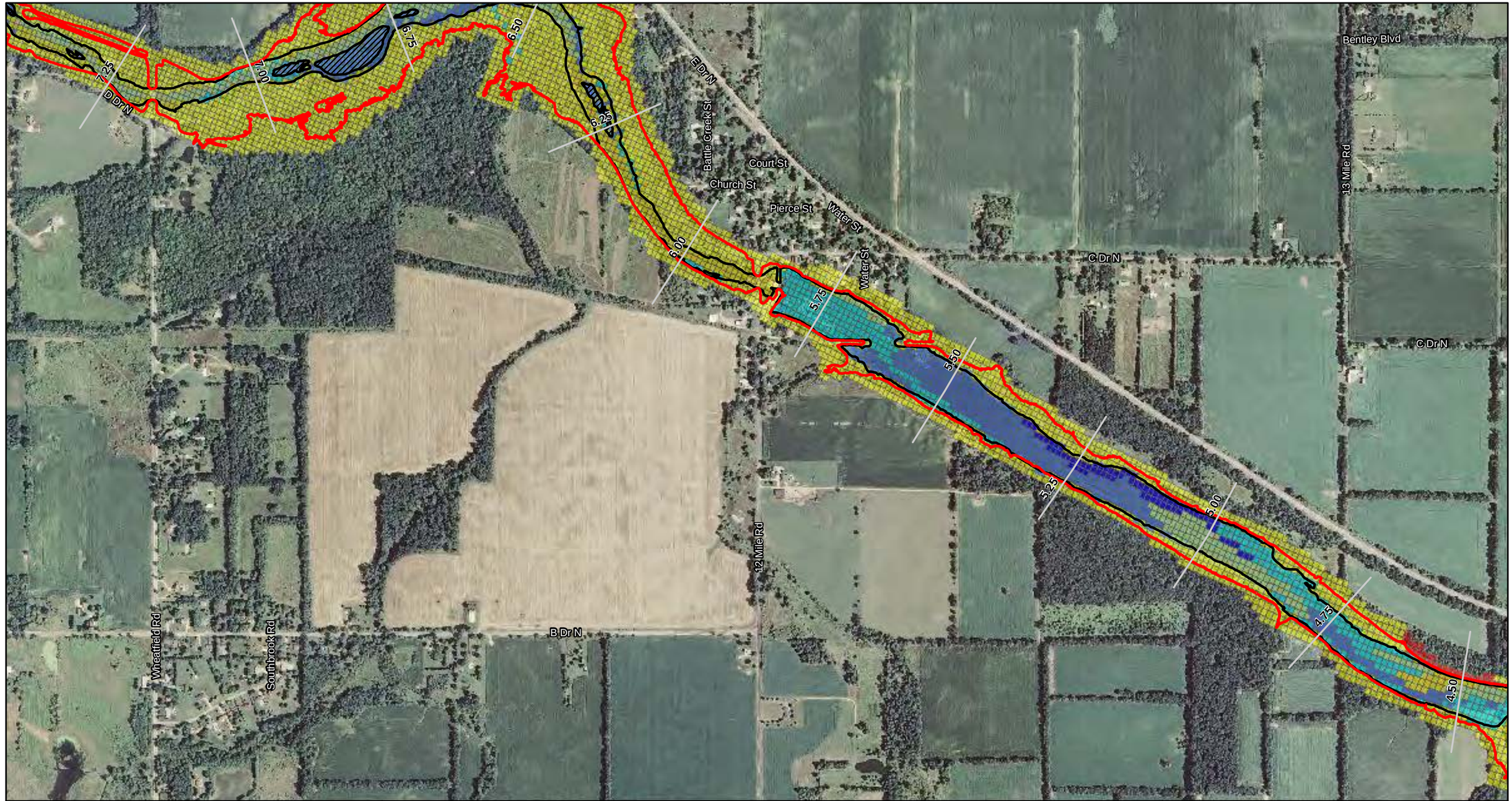
MP 1.50 - MP 4.50

SHEET 1 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

% Sand

- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

MP 4.50 - MP 6.25

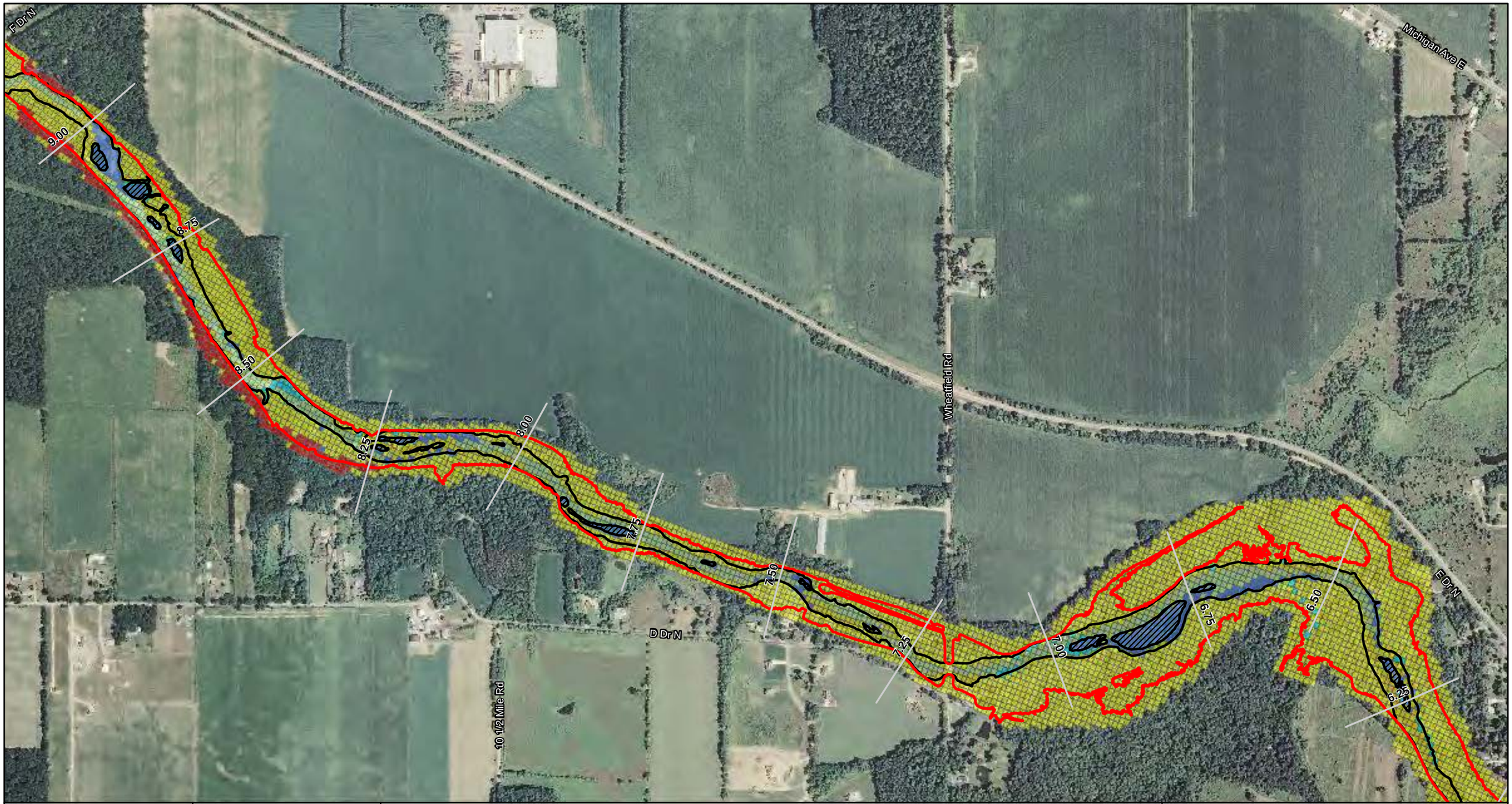
SHEET 2 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

% Sand
- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

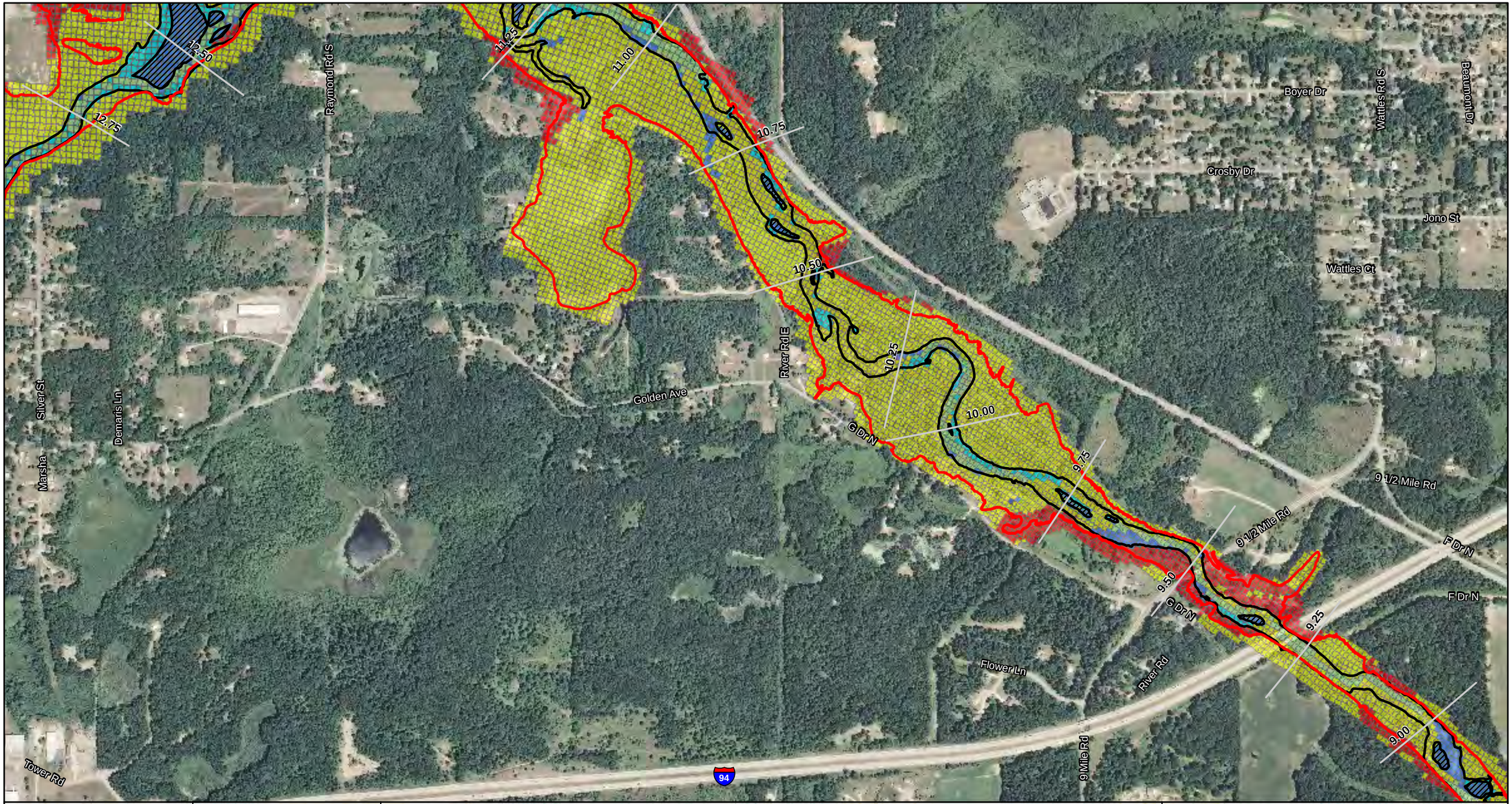
MP 6.25 - MP 9.00

SHEET 3 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

% Sand
- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

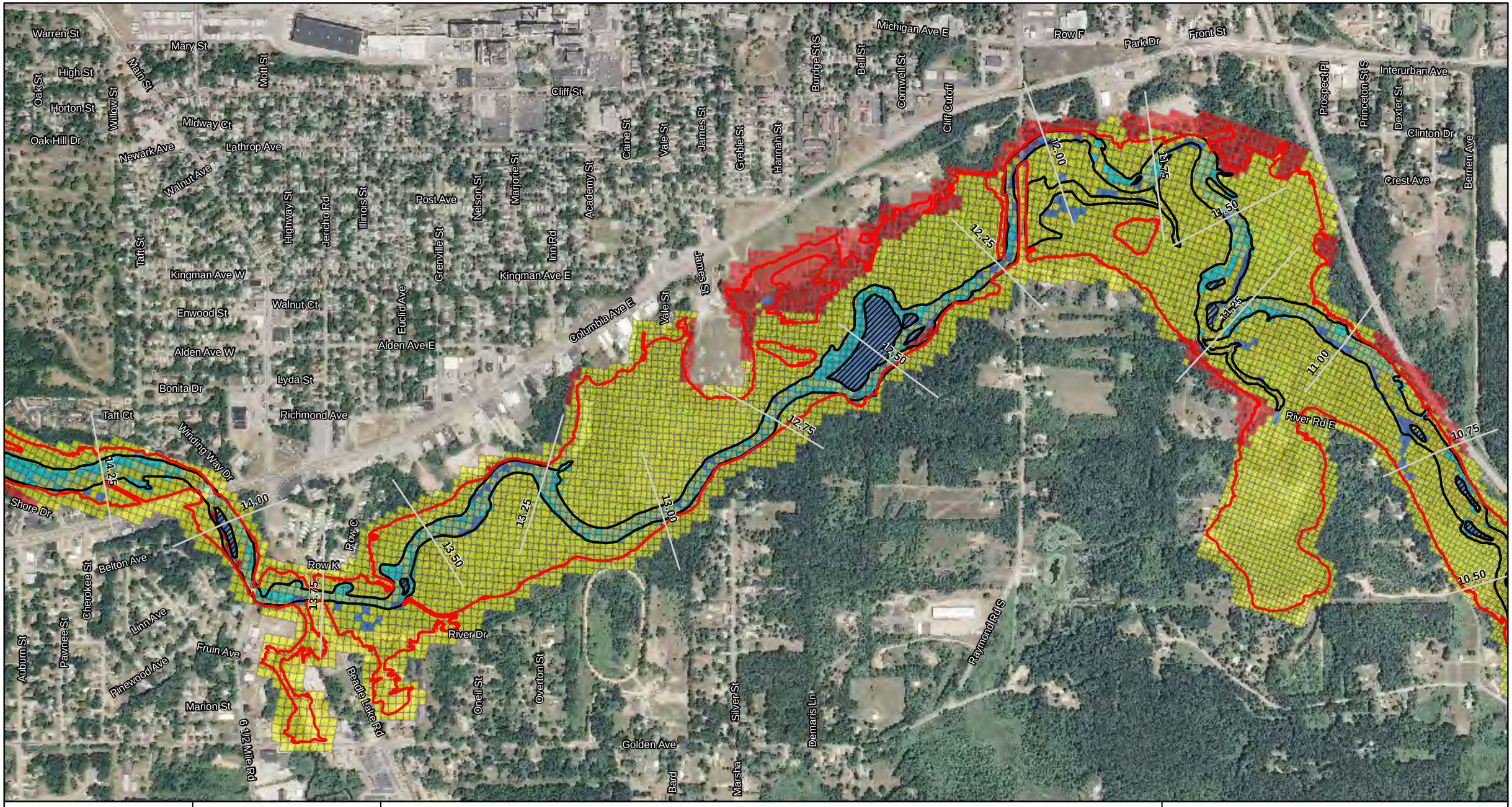
MP 9.00 - MP 10.50

SHEET 4 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

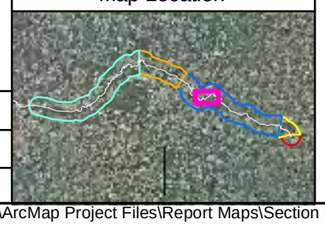
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

% Sand

- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

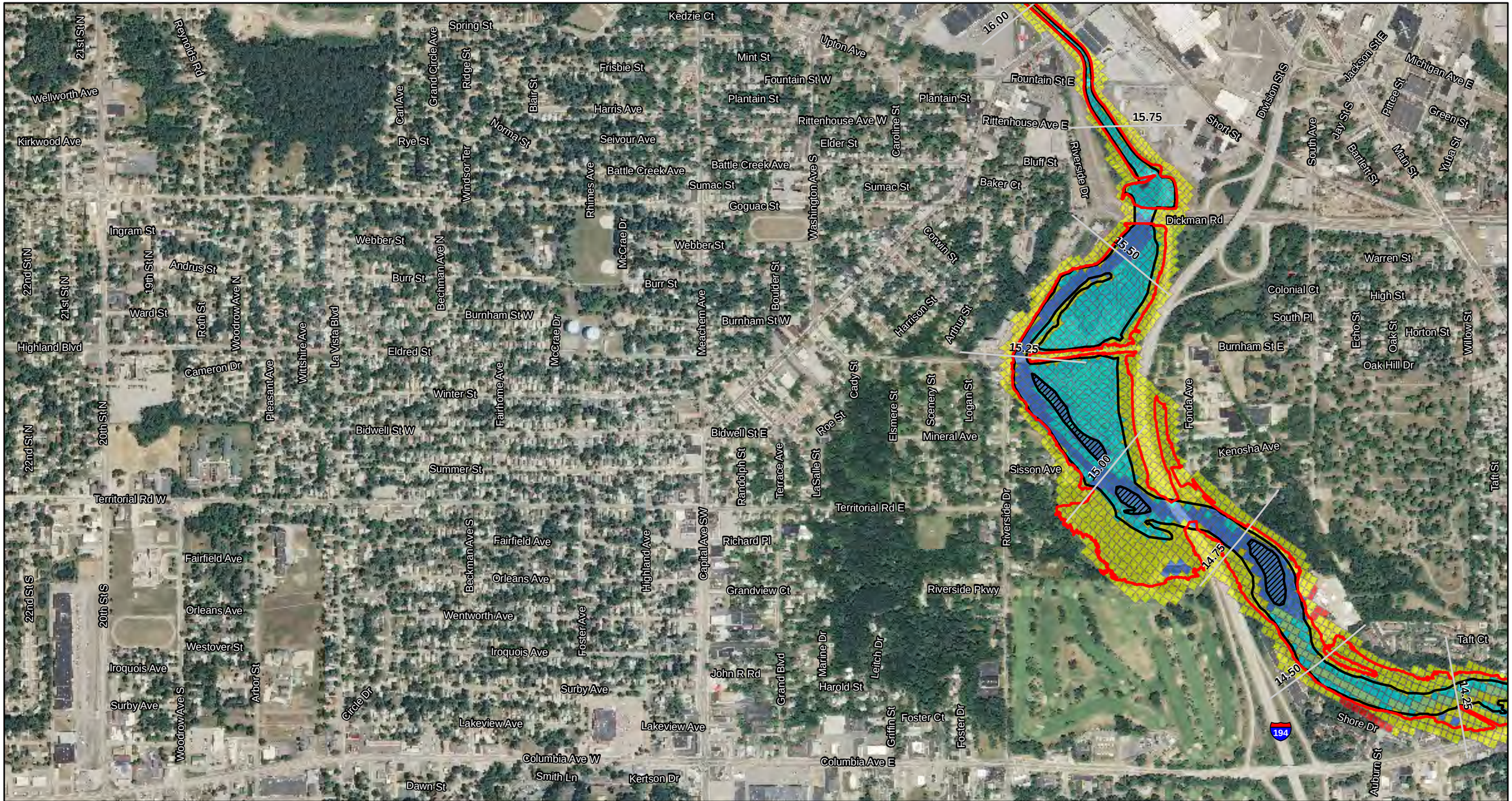
MP 10.50 - MP 14.25

SHEET 5 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

% Sand
- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

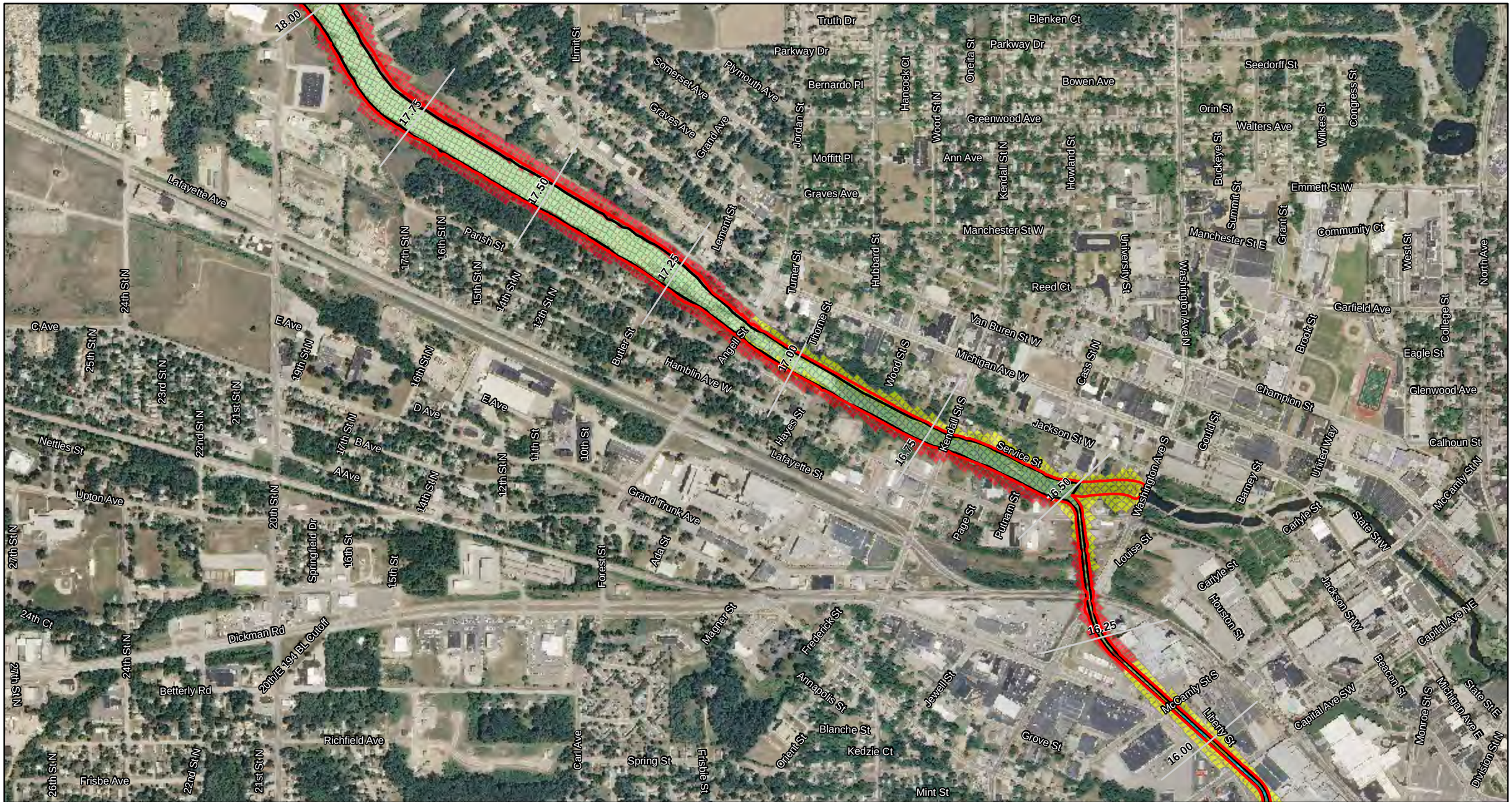
MP 14.25 - MP 16.00

SHEET 6 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

% Sand
- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

FLOODPLAIN GRID: PERCENT SAND

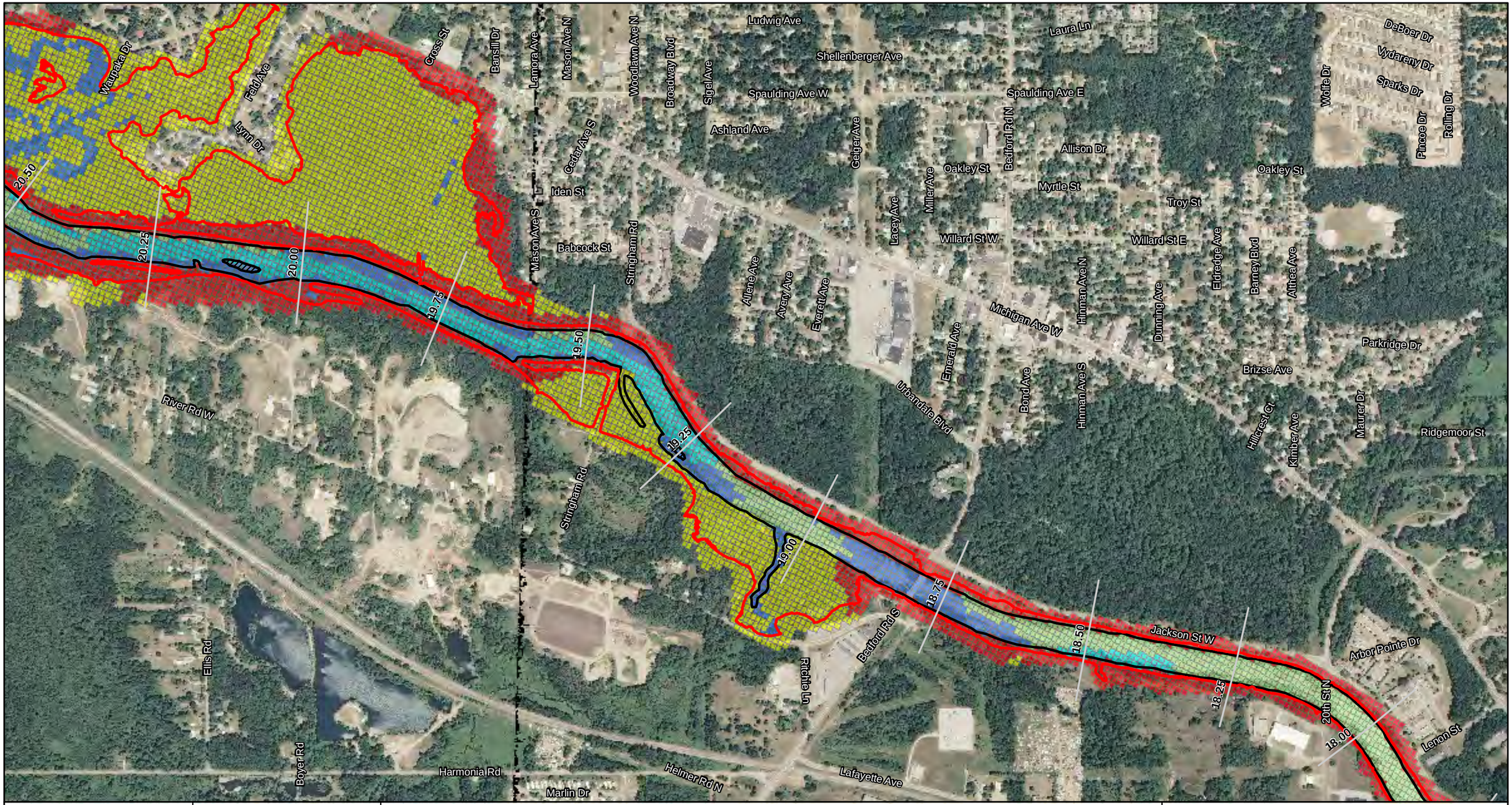
MP 16.00 - MP 18.00

SHEET 7 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

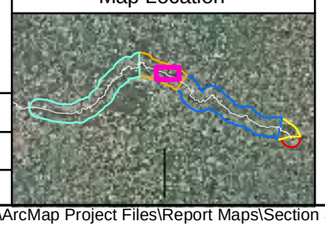
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

% Sand

- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

% = Percent

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

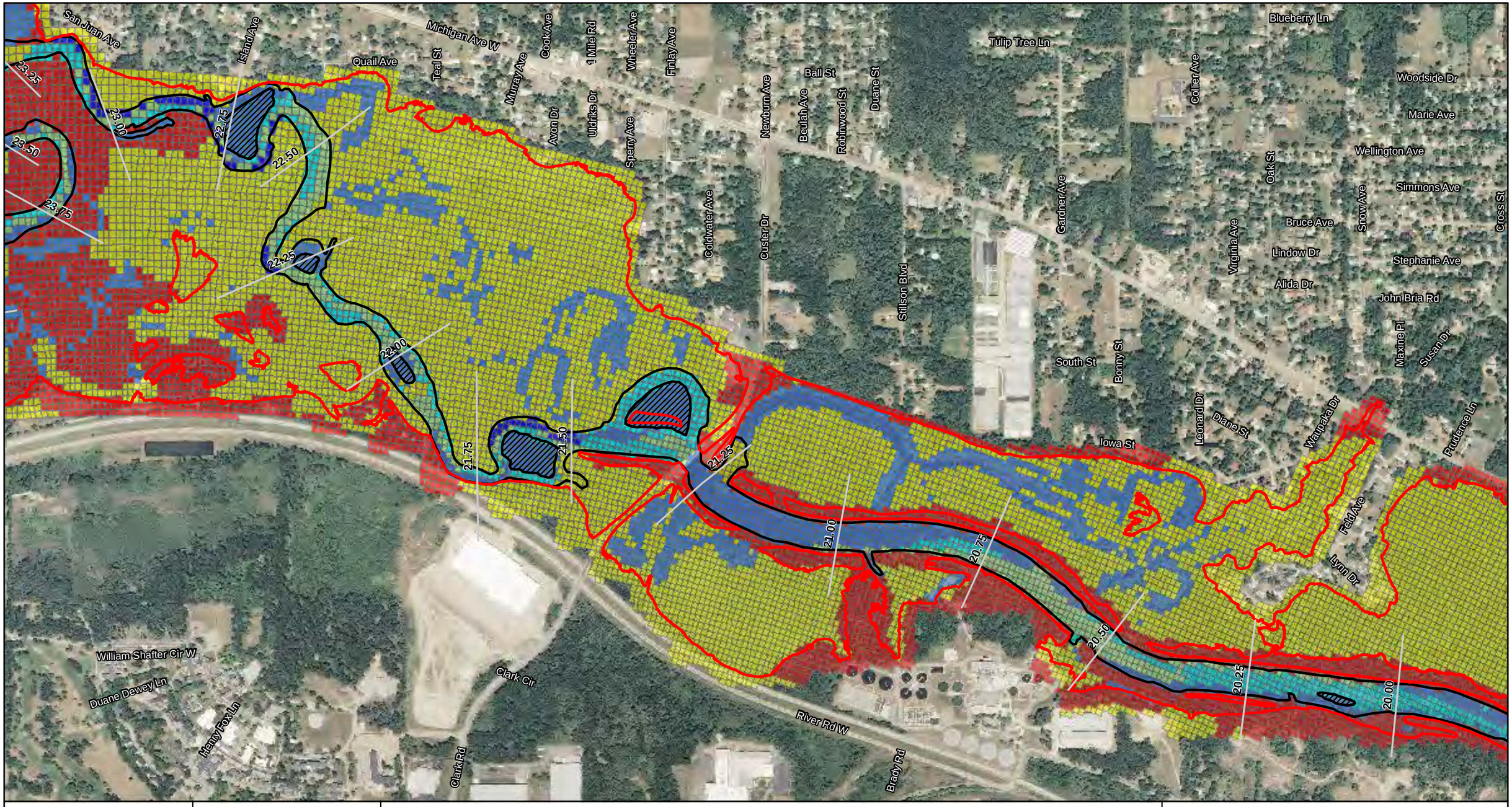
MP 18.00 - MP 20.00

SHEET 8 OF 16

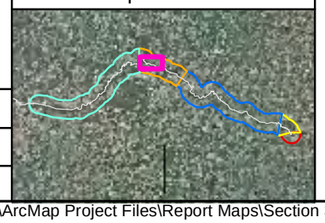
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

% Sand

- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

% = Percent

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

FLOODPLAIN GRID: PERCENT SAND

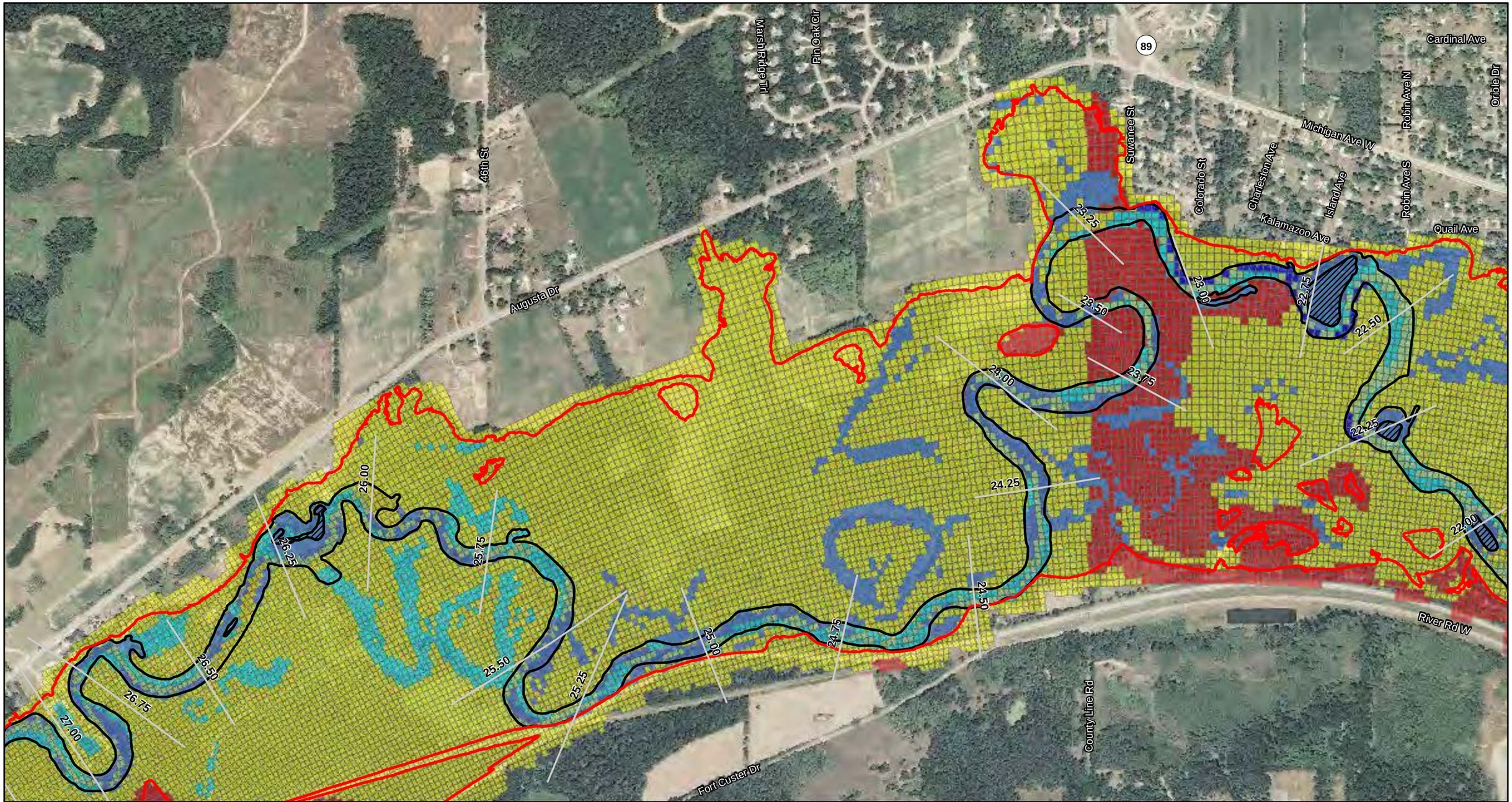
MP 20.00 - MP 22.50

SHEET 9 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

% Sand
- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

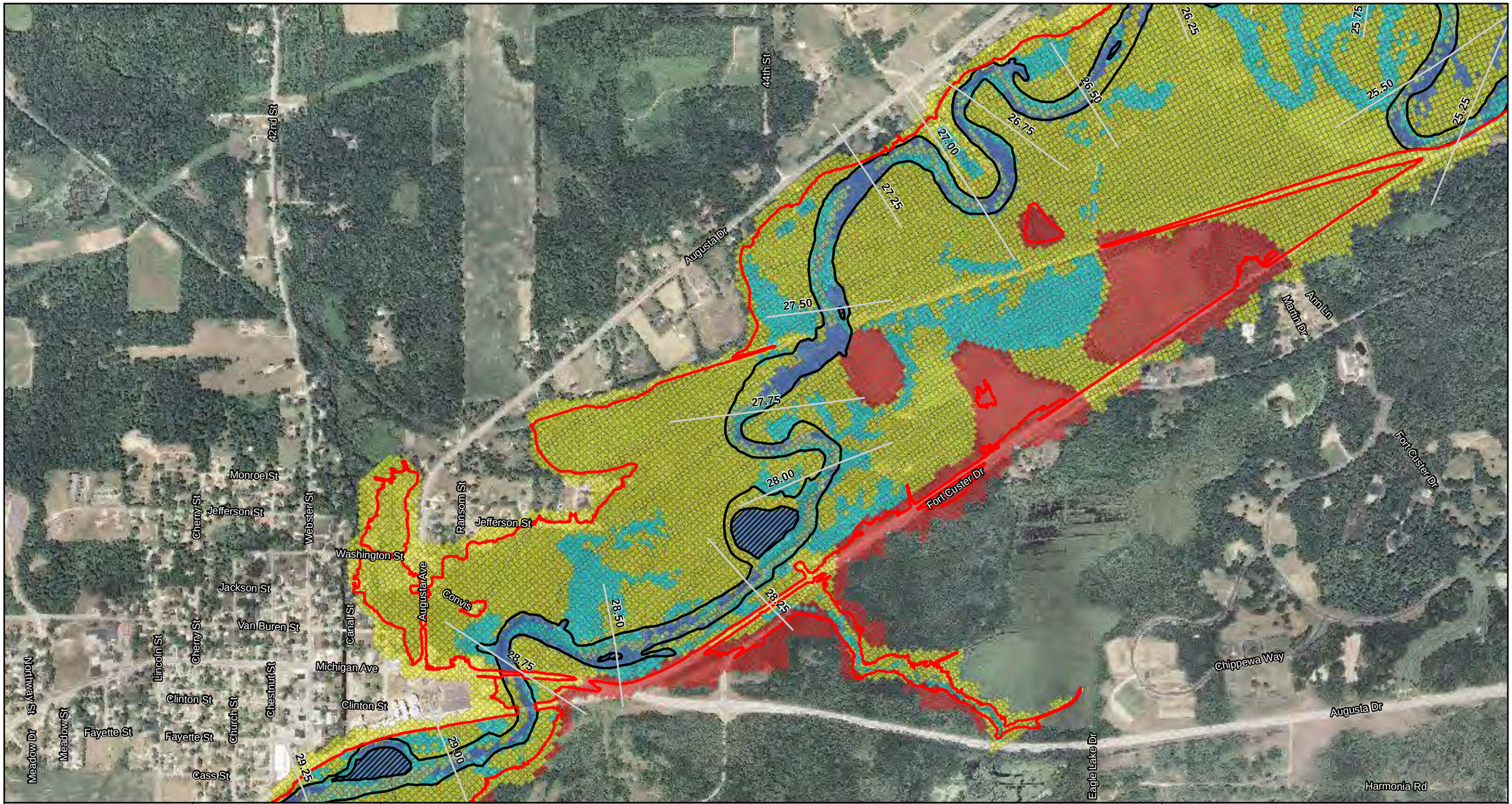
MP 22.50 - MP 27.00

SHEET 10 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

% Sand
- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

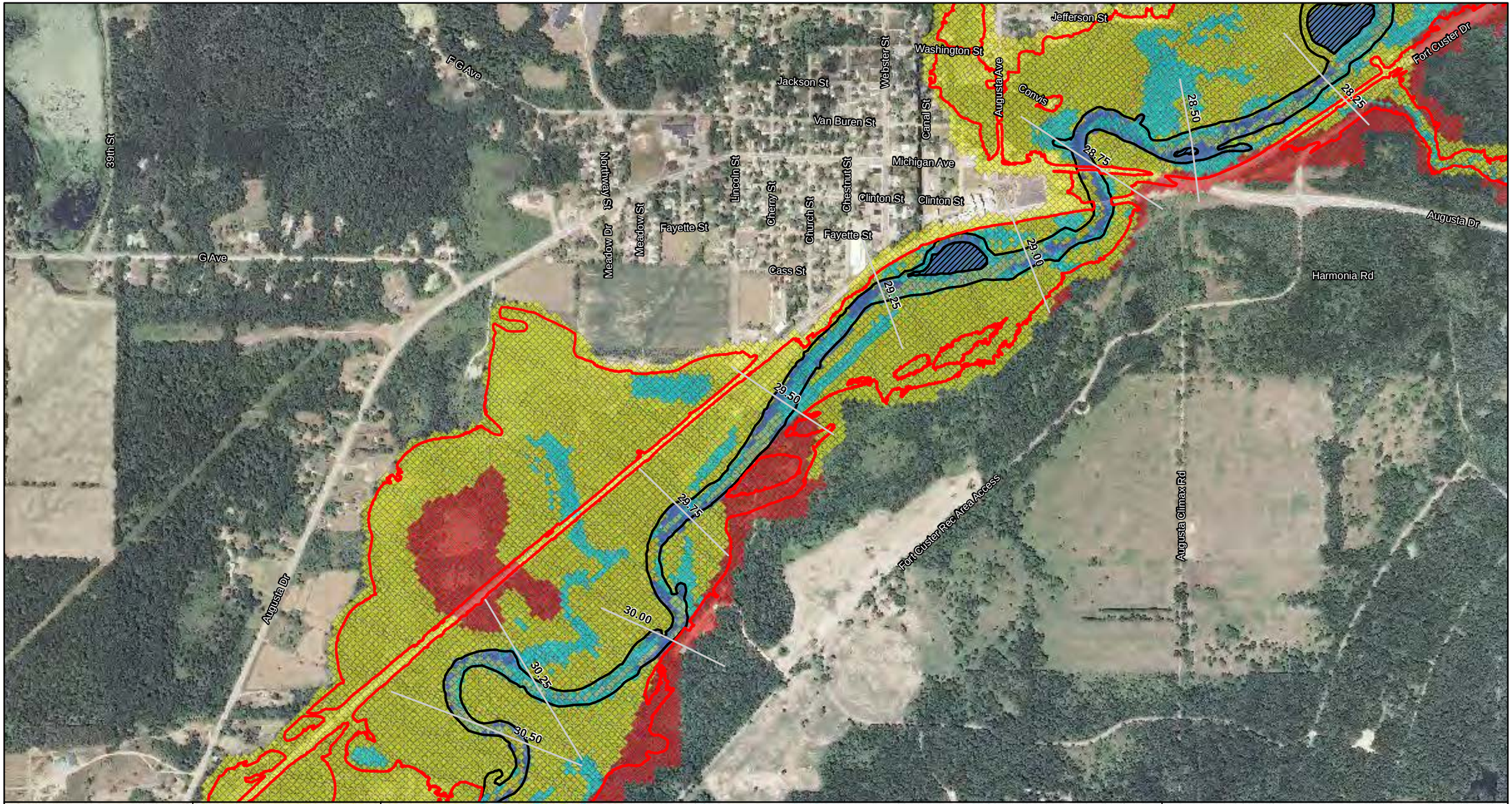
MP 27.00 - MP 28.75

SHEET 11 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

% Sand
- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

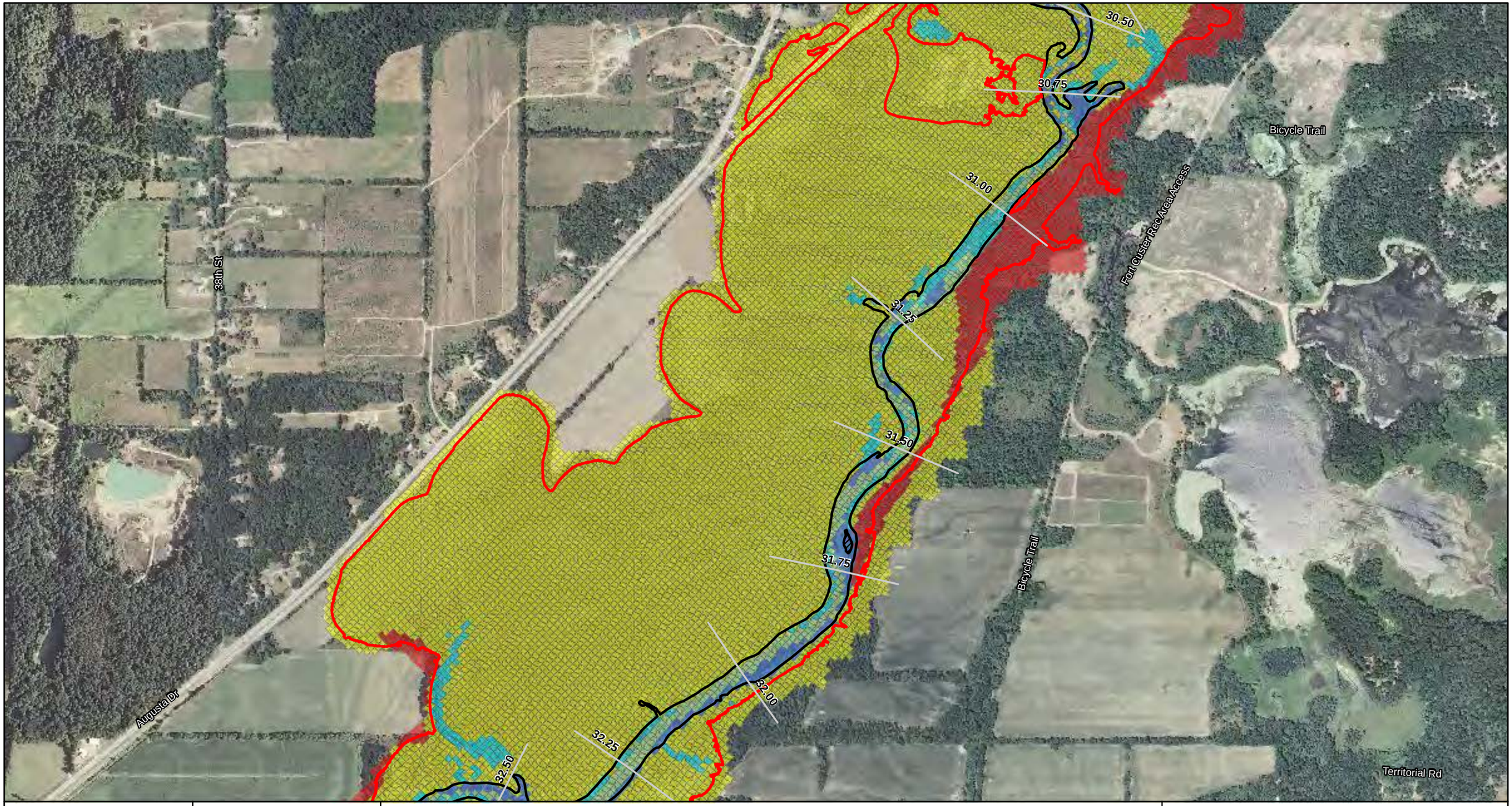
MP 28.75 - MP 30.50

SHEET 12 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

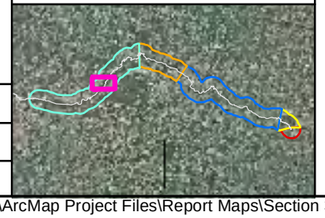
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

% Sand
- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

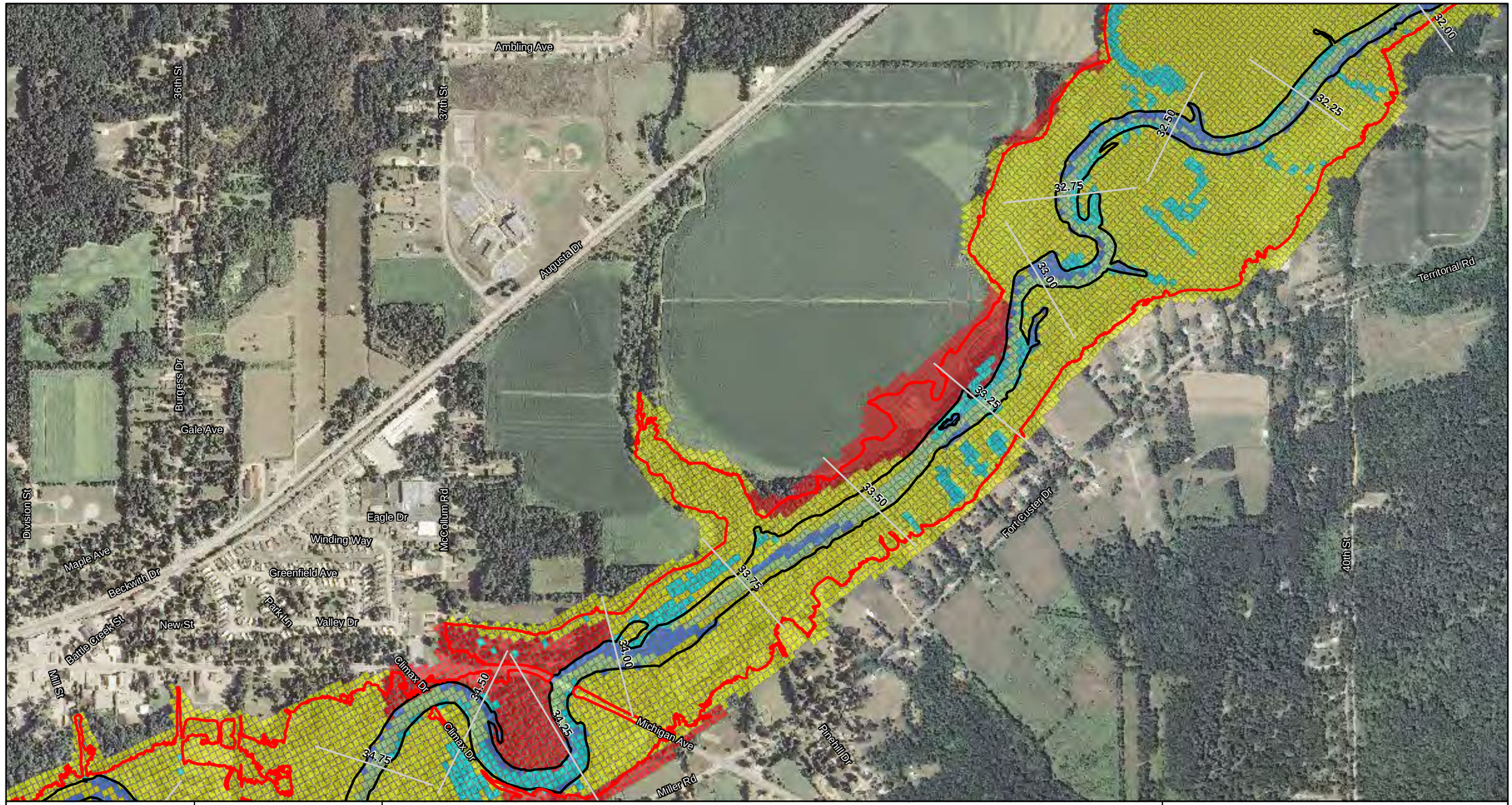
MP 30.50 - MP 32.25

SHEET 13 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

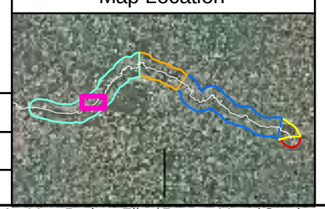
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

% Sand

- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

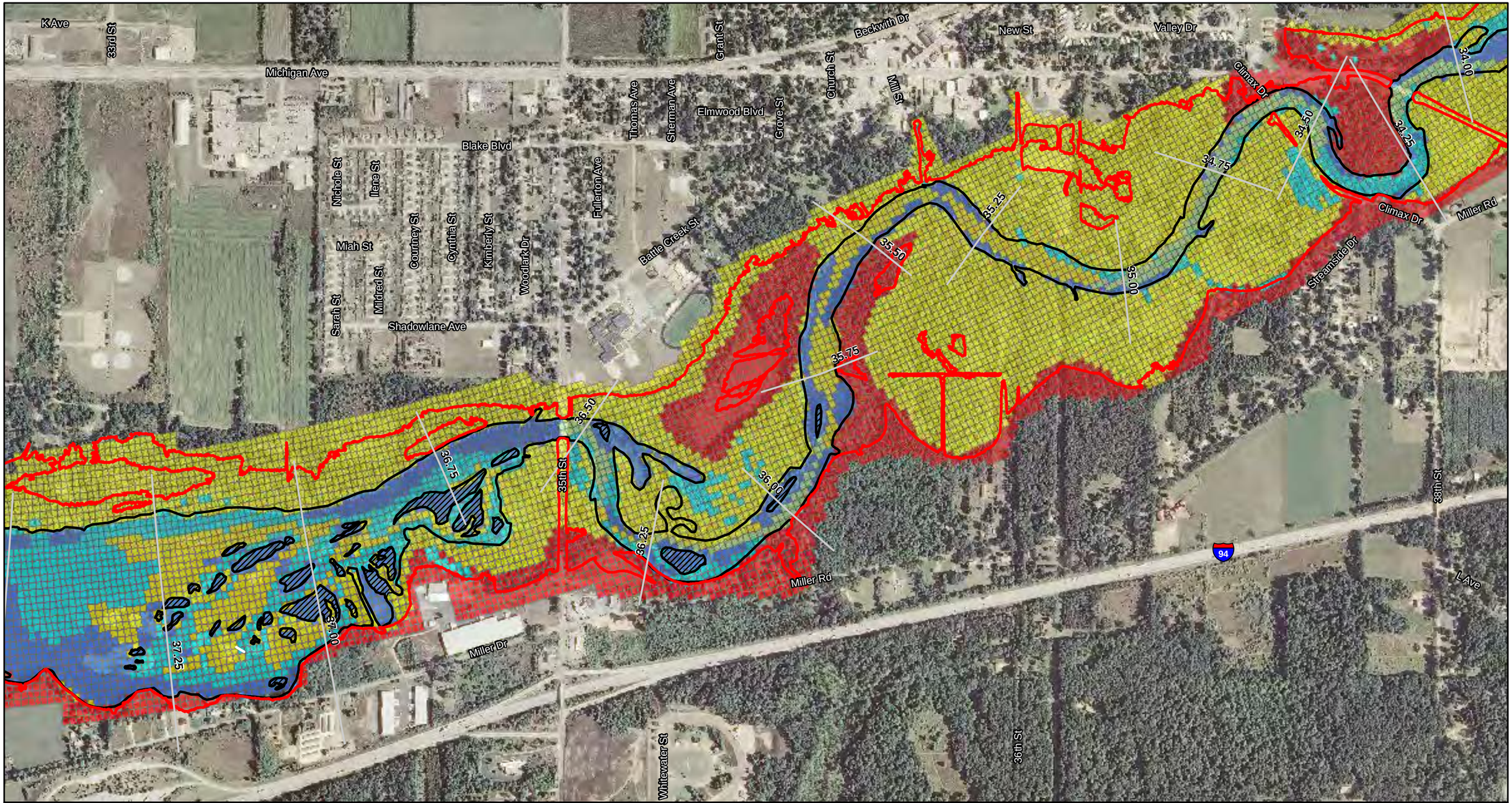
MP 32.25 - MP 34.75

SHEET 14 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

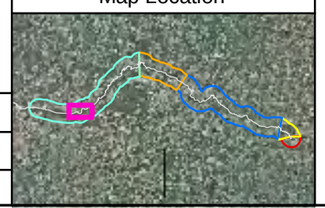
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

% Sand

- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

MP 34.25 - MP 37.50

SHEET 15 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009

Gleason St
Hunt St
Morrow St
Elliot Rd
Lawndale Ave
Rosemont Dr
Van Bruggen St
Sparks St
Krum Ave
Plaza Pl
40.00
39.75
39.50
39.25
39.00
38.75
38.50
38.25
38.00
37.75
37.50
L Ave E
Lyth Rd
Miller Dr
Gleneagle Dr
Cooks Dr
Kilowatt Dr
94

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

% Sand
- < 20 %
- 21 - 30 %
- 31 - 40 %
- 41 - 50 %
- 51 - 60 %
- 61 - 70 %
- 70+ %

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

% = Percent

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: PERCENT SAND

MP 37.50 - MP 40.00

SHEET 16 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

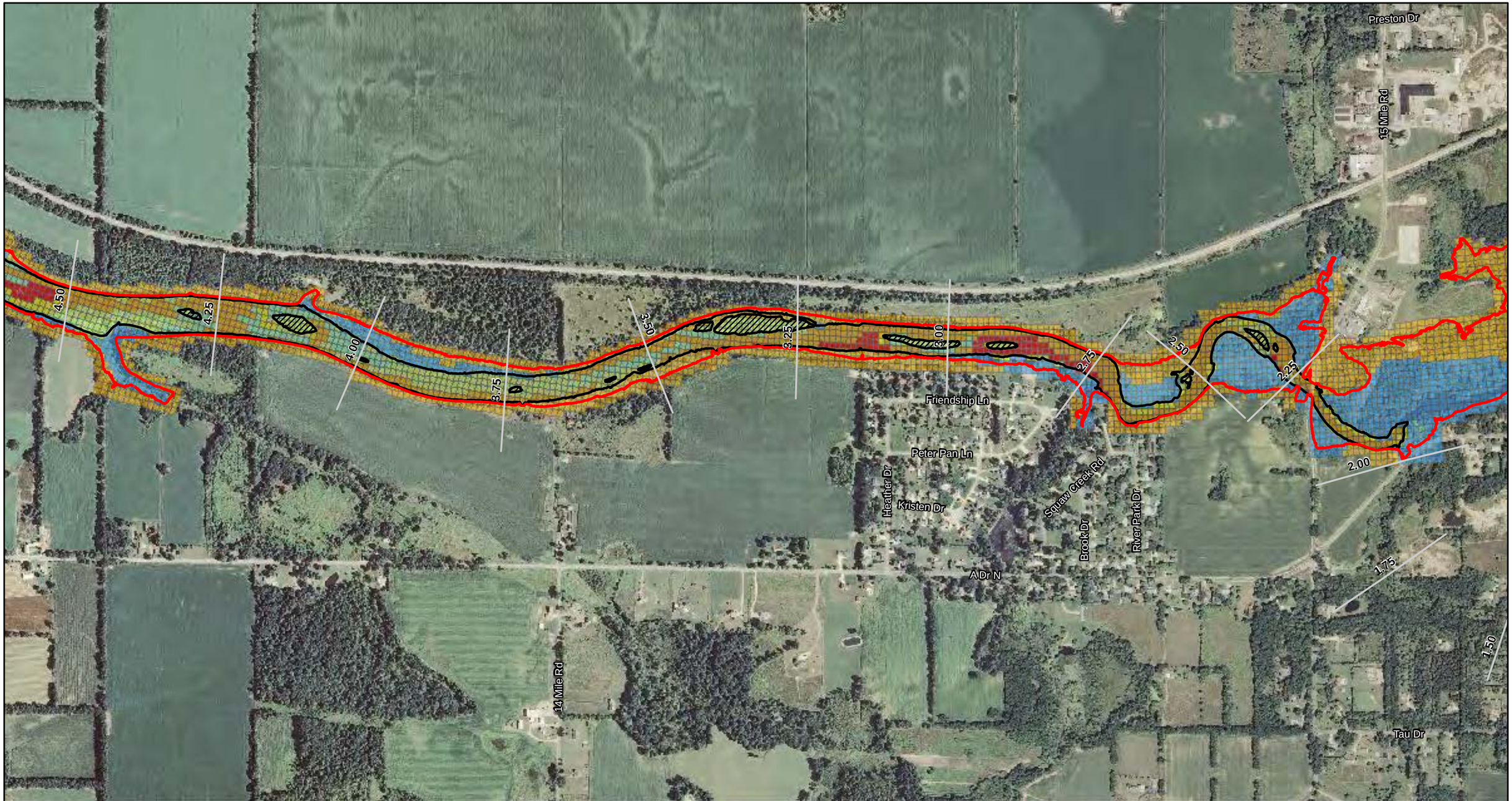
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model Percent Sand Input.mxd

Aerial Photography Date: July & August 2009

Figure 3-21

Floodplain Grid: Wet Bulk Density

Sheets 1 through 16



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

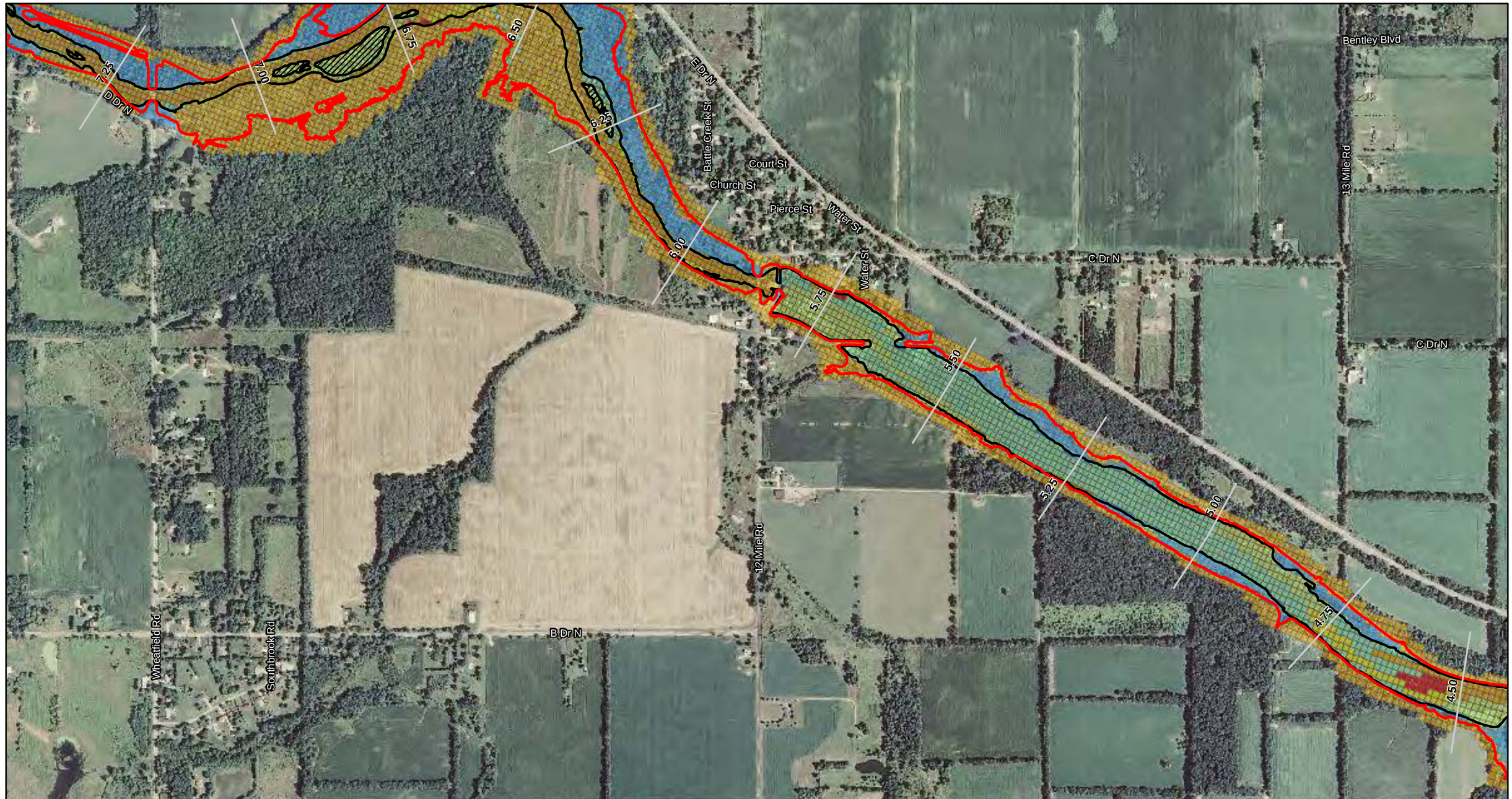
MP 1.50 - MP 4.50

SHEET 1 OF 16

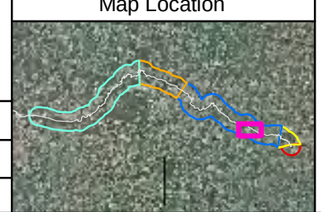
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model WBD Input.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Wet Bulb Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

FLOODPLAIN GRID: WET BULK DENSITY

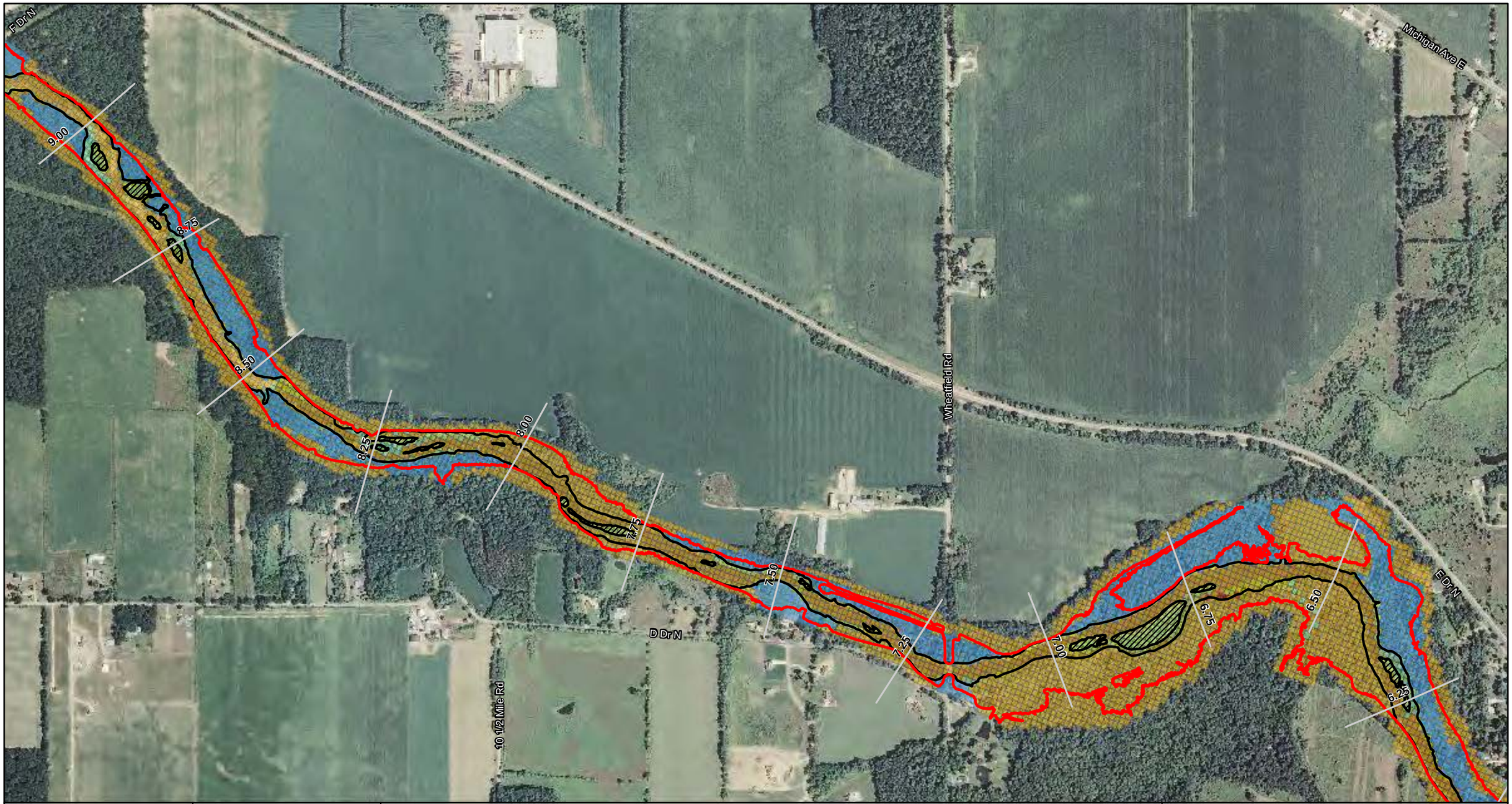
MP 4.50 - MP 6.25

SHEET 2 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model WBD Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

Channel Bankline
Island Bankline
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

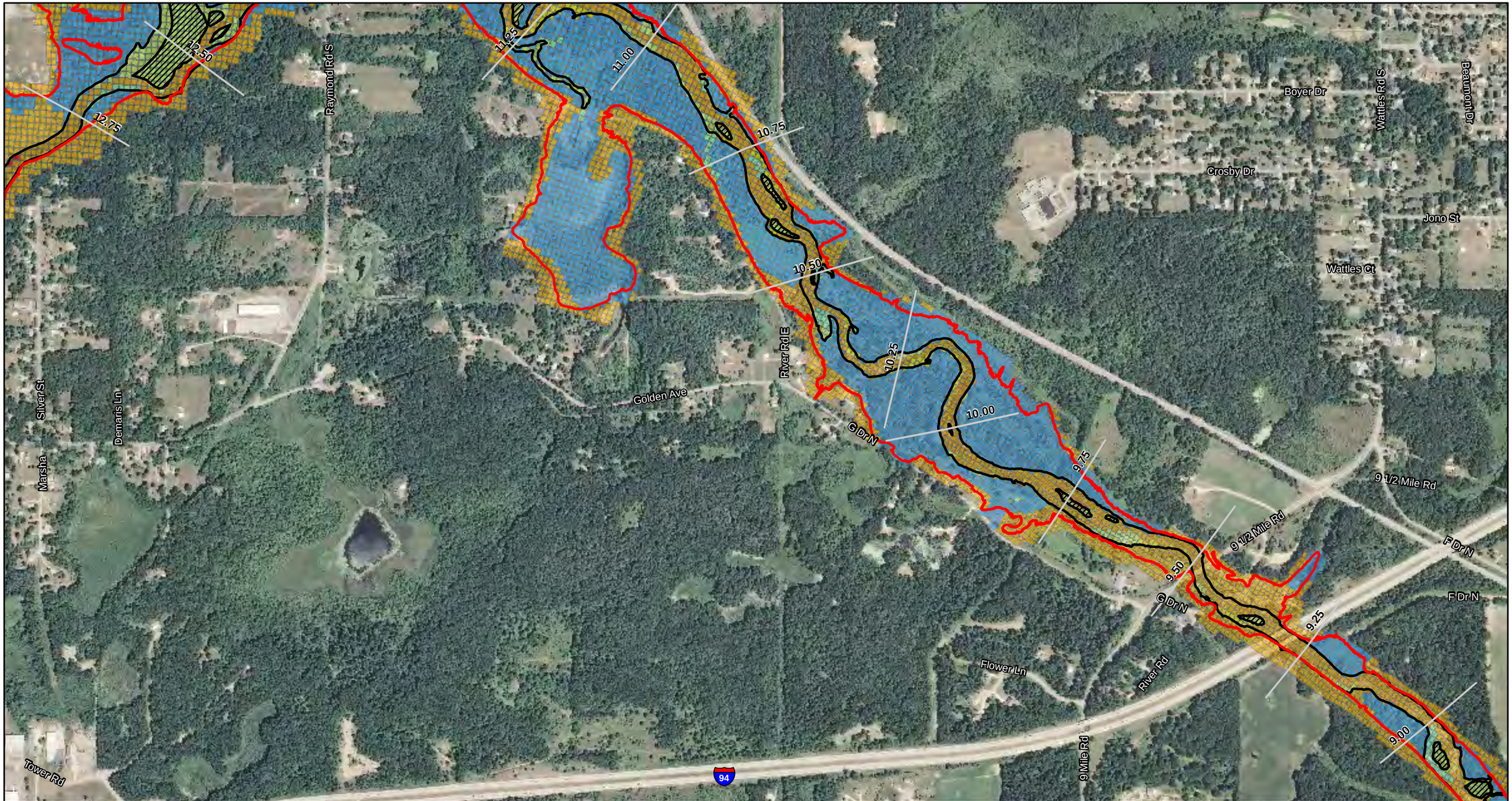
MP 6.25 - MP 9.00

SHEET 3 OF 16

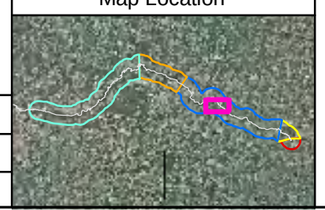
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model WBD Input.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

Channel Bankline
Island Bankline
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600
Scale in Feet

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

FLOODPLAIN GRID: WET BULK DENSITY

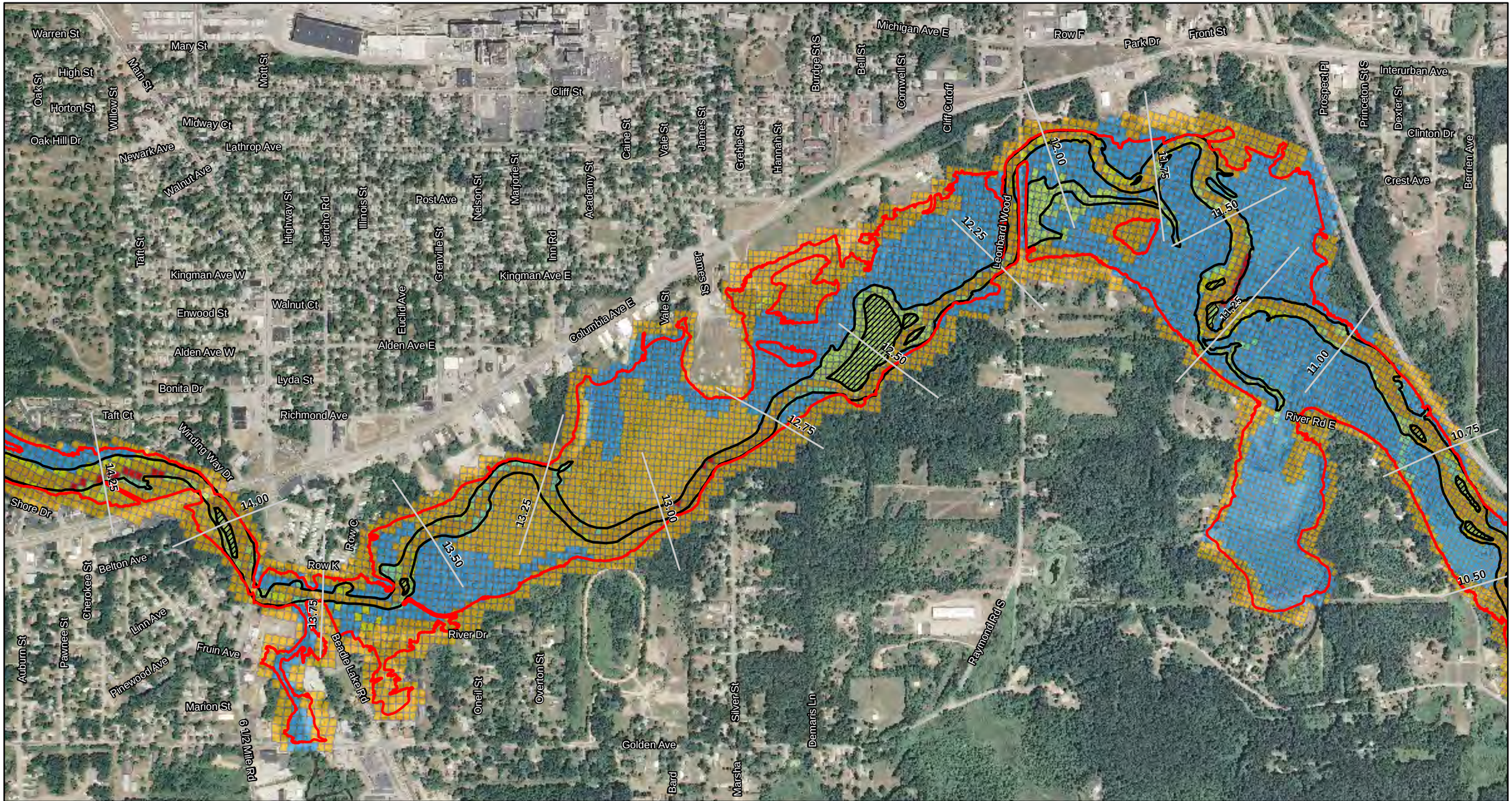
MP 9.00 - MP 10.50

SHEET 4 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model WBD Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

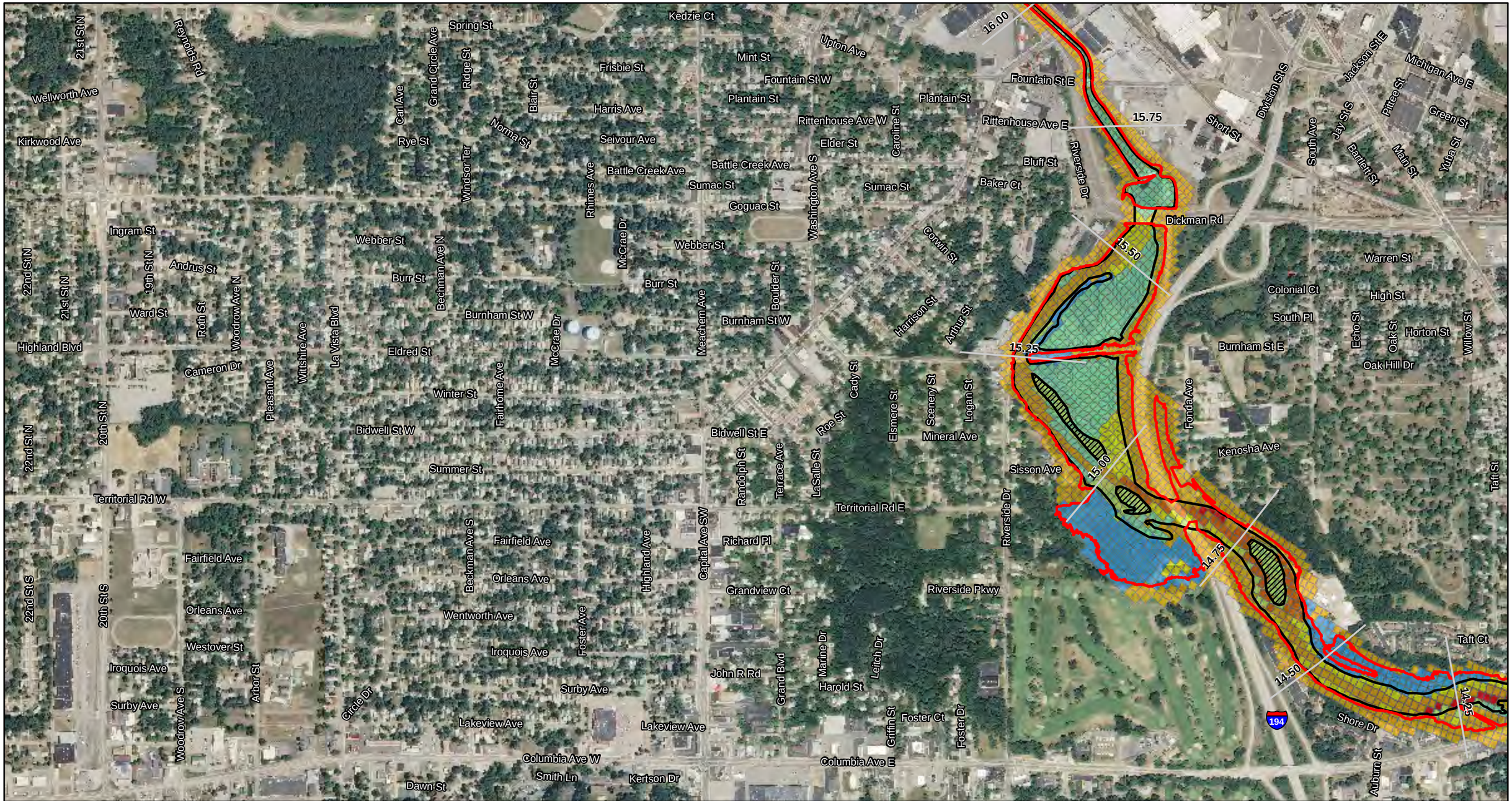
MP 10.50 - MP 14.25

SHEET 5 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model WBD Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

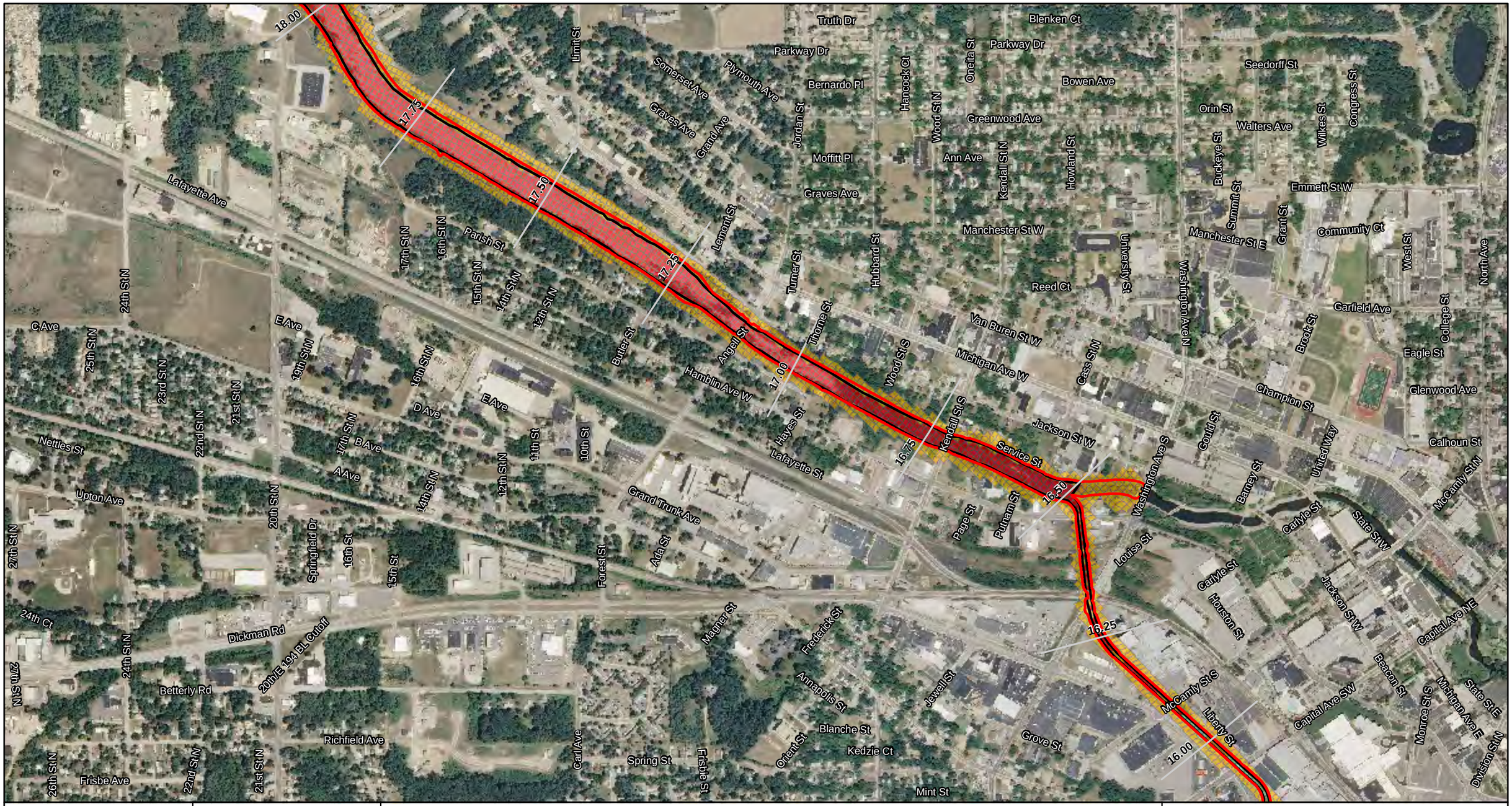
MP 14.25 - MP 16.00

SHEET 6 OF 16

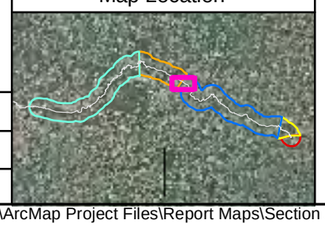
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model WBD Input.mxd

Aerial Photography Date: July & August 2009



Map Location



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

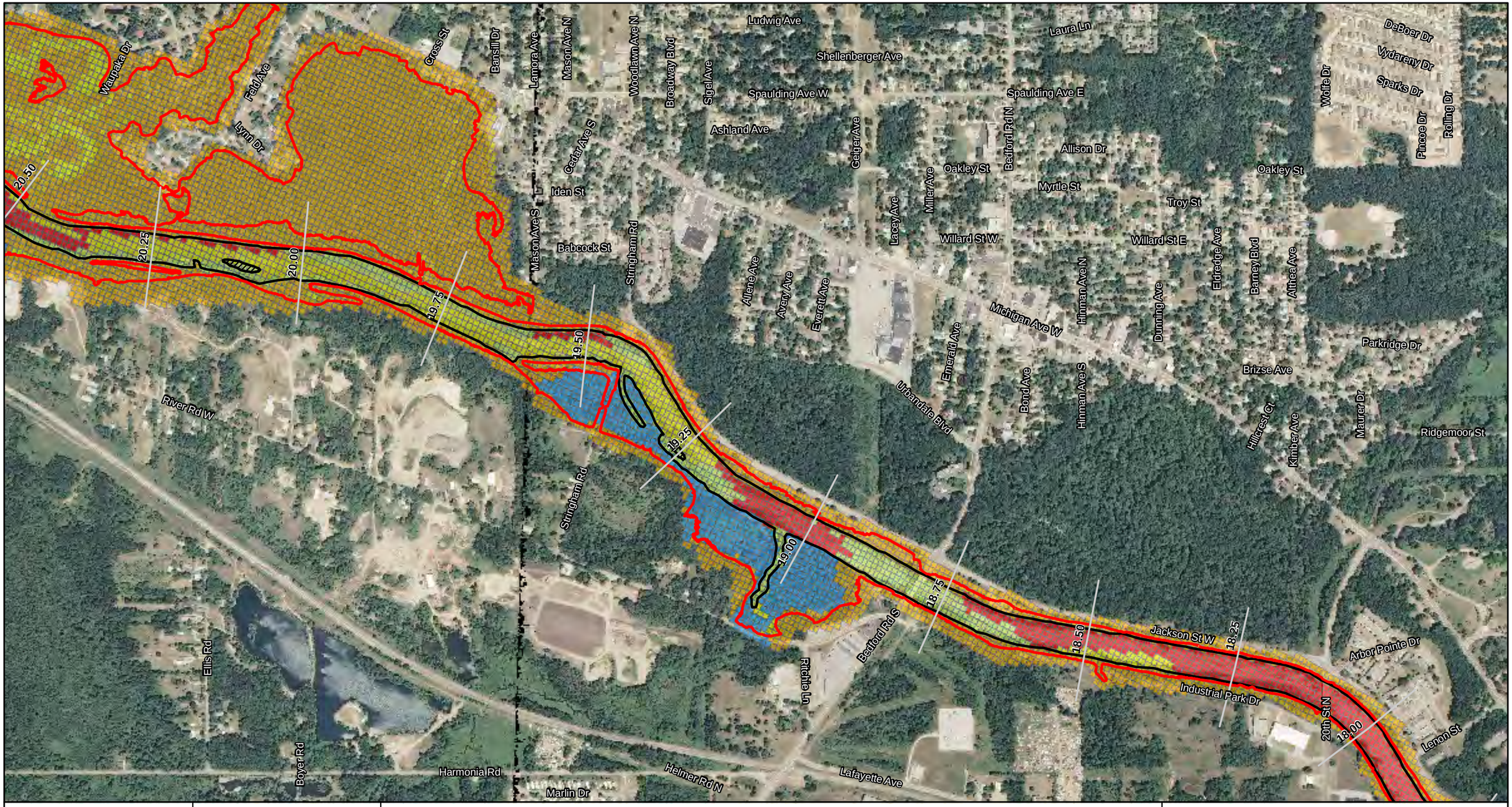
MP 16.00 - MP 18.00

SHEET 7 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model WBD Input.mxd

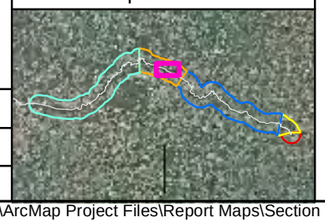
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

MP 18.00 - MP 20.00

SHEET 8 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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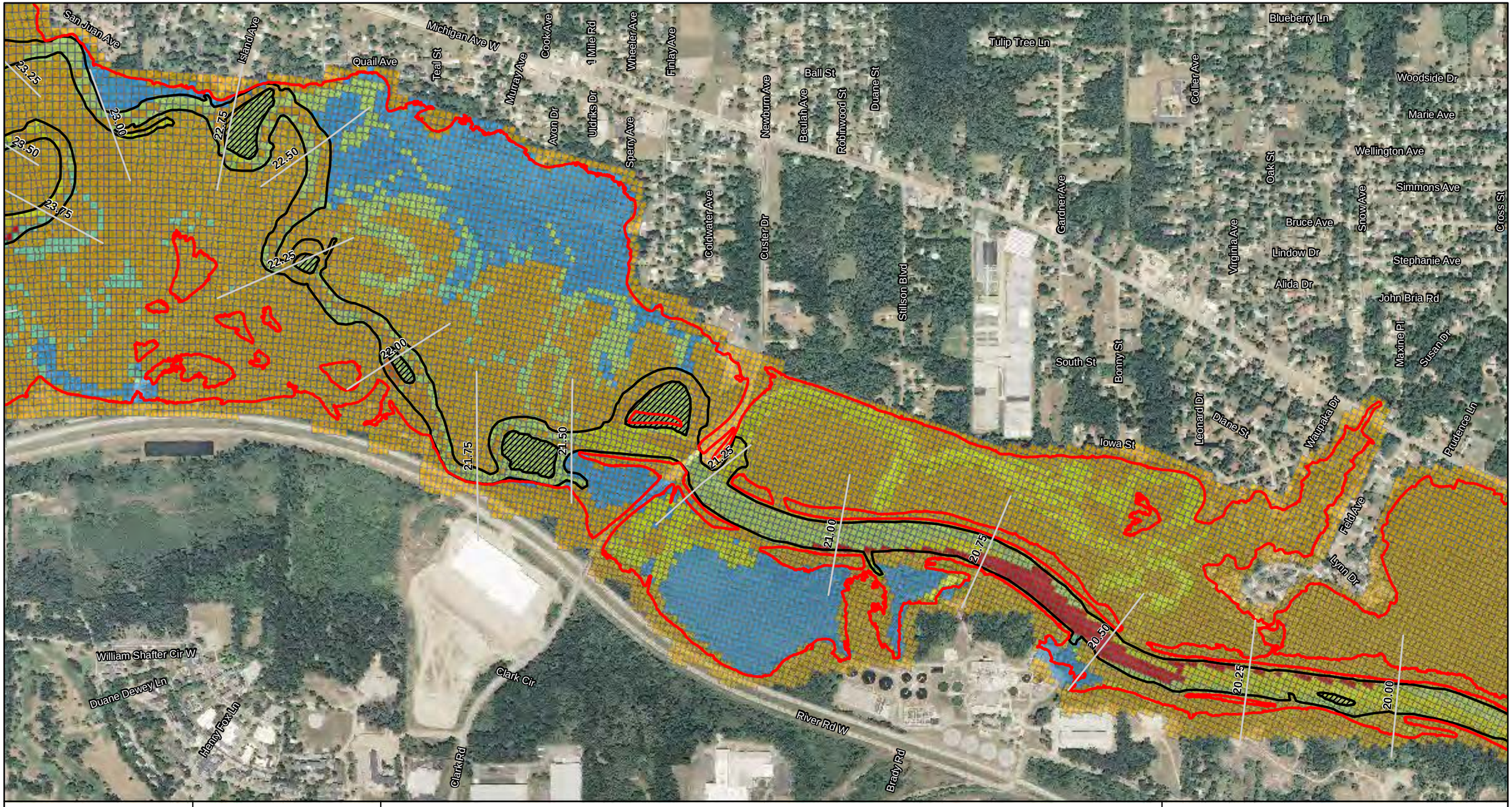
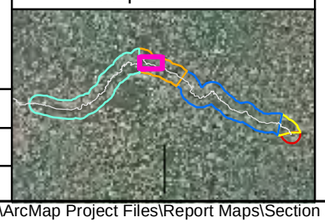
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

MP 20.00 - MP 22.50

SHEET 9 OF 16

ENBRIDGE LINE 6B MP 608
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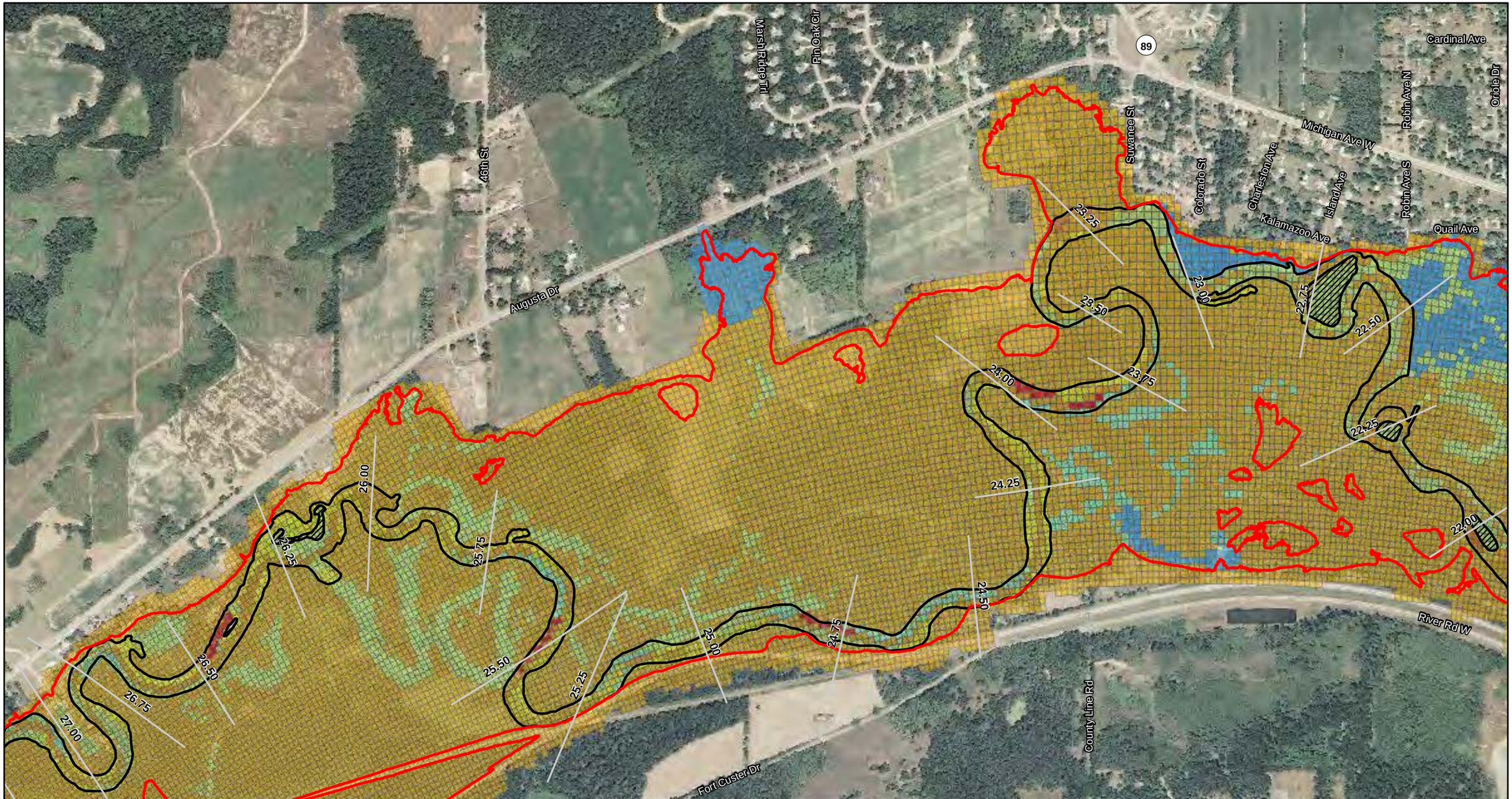
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

MP 22.50 - MP 27.00

SHEET 10 OF 16

ENBRIDGE LINE 6B MP 608
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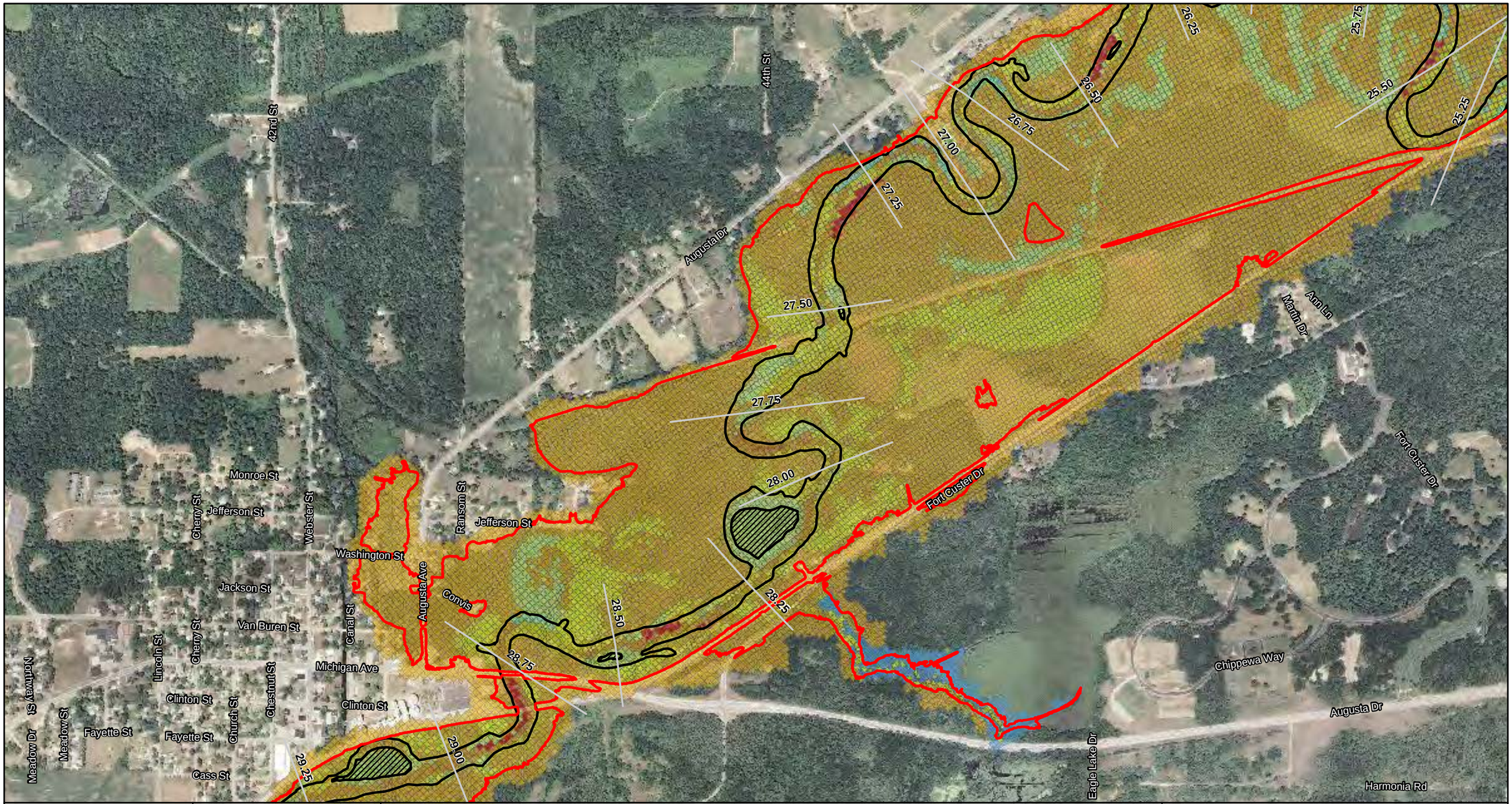
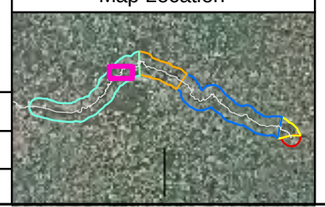
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

MP 27.00 - MP 28.75

SHEET 11 OF 16

ENBRIDGE LINE 6B MP 608
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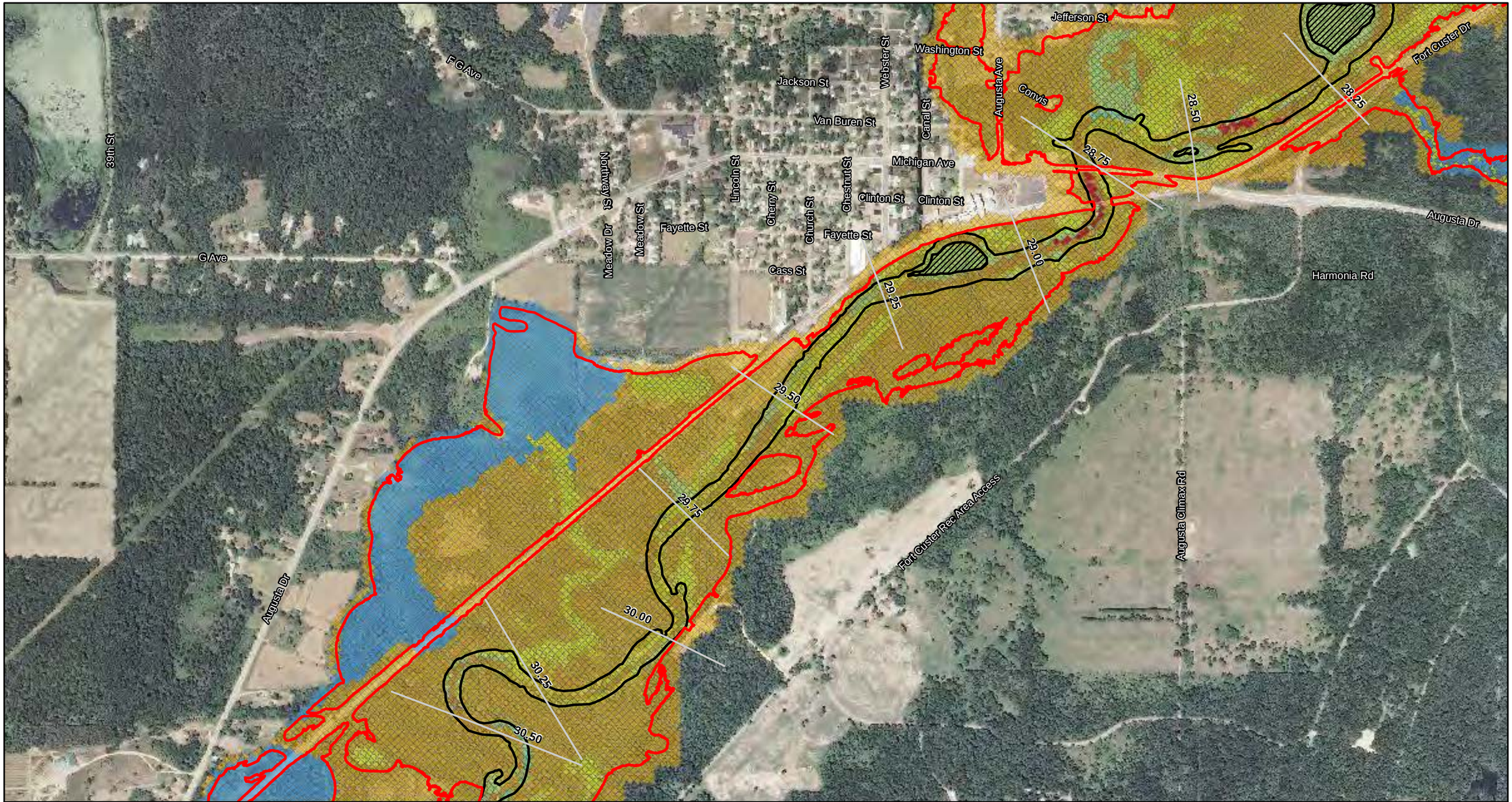
Aerial Photography Date: July & August 2009



Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

Channel Bankline
Island Bankline
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

MP 28.75 - MP 30.50

SHEET 12 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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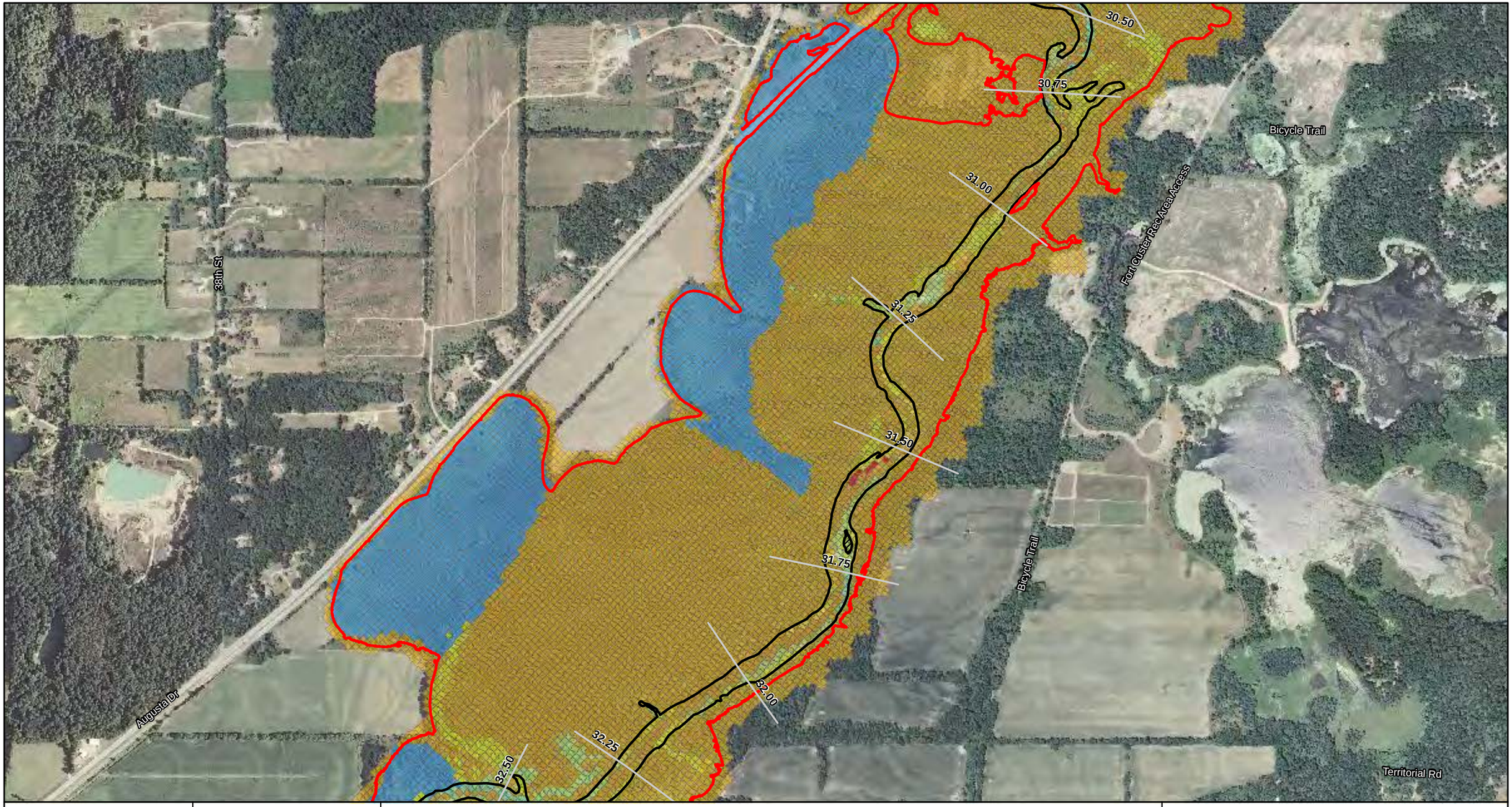
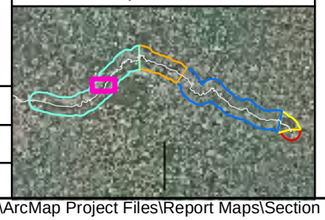
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

Channel Bankline
Island Bankline
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

MP 30.50 - MP 32.25

SHEET 13 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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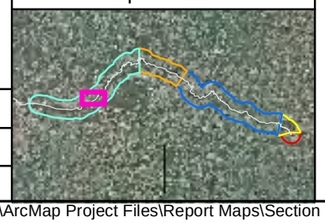
Ambling Ave
36th St
37th St
Augusta Dr
Territorial Rd
Burgess Dr
Gale Ave
Division St
Eagle Dr
McCollum Rd
Winding Way
Maple Ave
Beckwith Dr
Greenfield Ave
Park Ln
Valley Dr
New St
Battle Creek St
Mill St
Climax Dr
Climax Dr
Michigan Ave
Miller Rd
Pinehill Dr
Fort Custer Dr
40th St
32.00
32.25
32.50
32.75
33.00
33.25
33.50
33.75
34.00
34.25
34.50
34.75

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Wet Bulk Density (g/cm3)
- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

Channel Bankline
Island Bankline
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

MP 32.25 - MP 34.75

SHEET 14 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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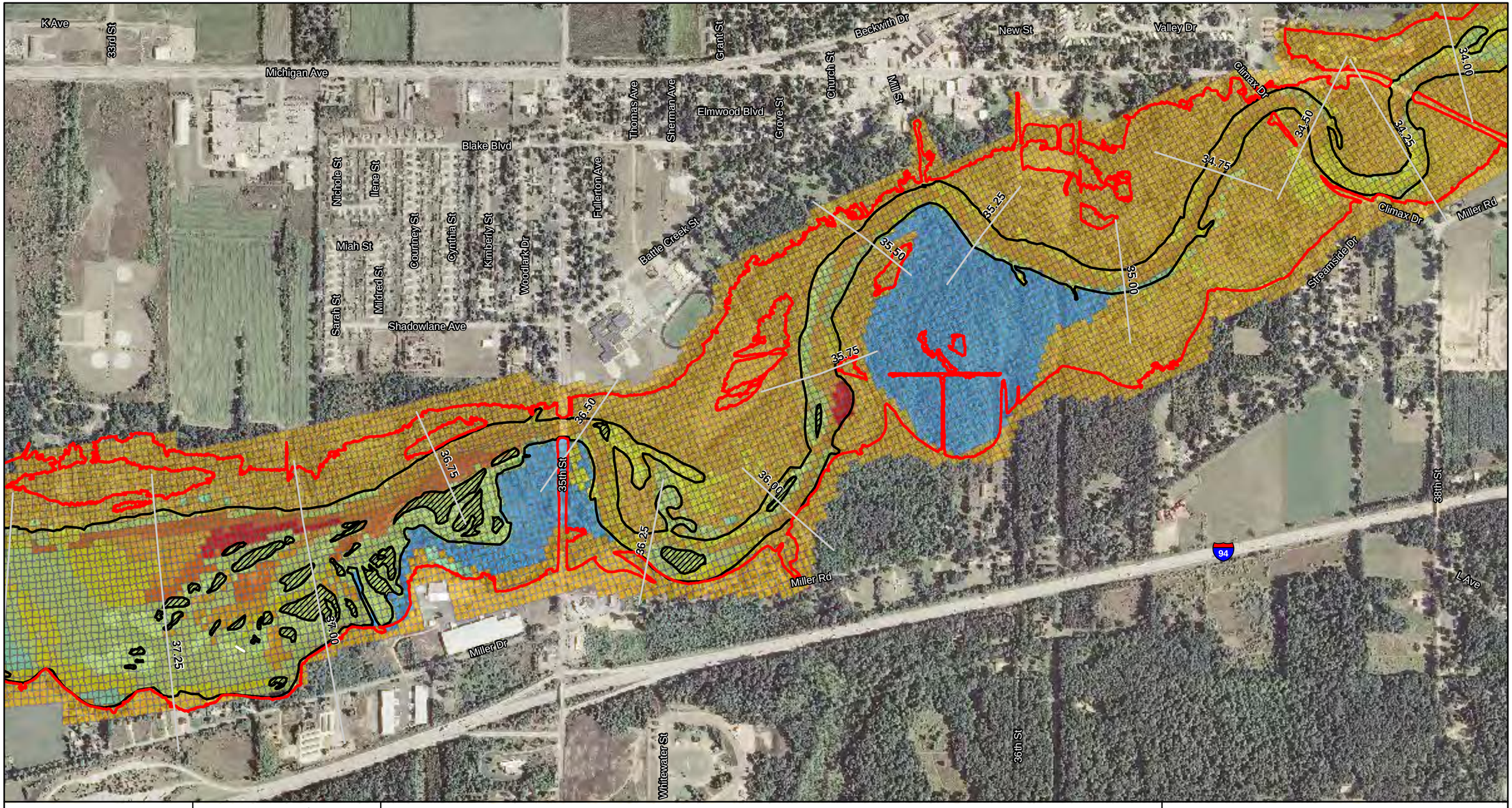
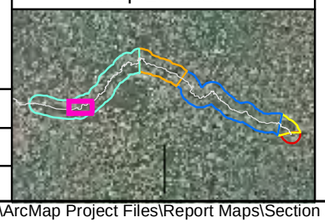
Aerial Photography Date: July & August 2009



Map Location



Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

Channel Bankline
Island Bankline
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/29/2012
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Project #:	106-4186

FLOODPLAIN GRID: WET BULK DENSITY

MP 34.25 - MP 37.50

SHEET 15 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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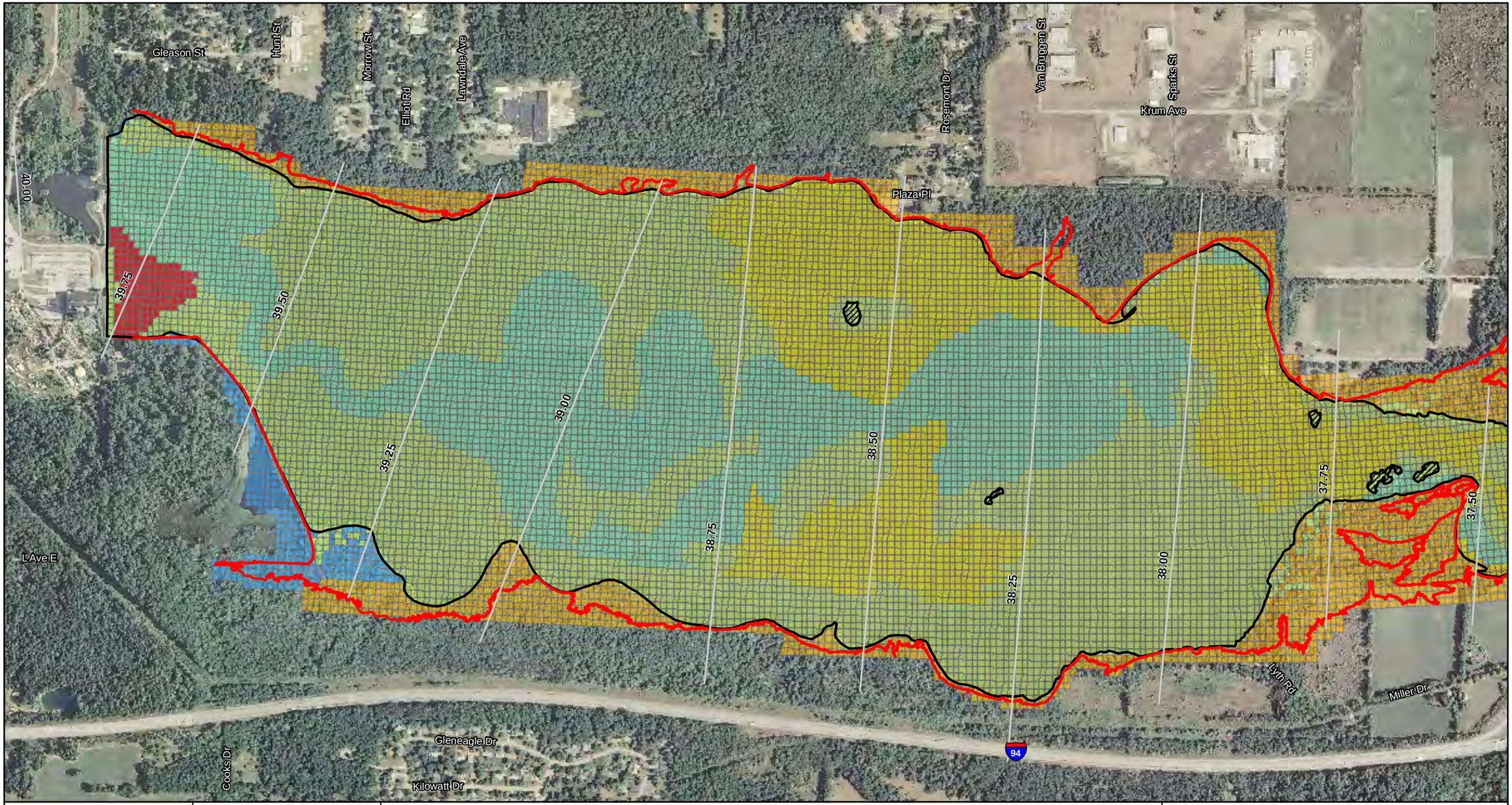
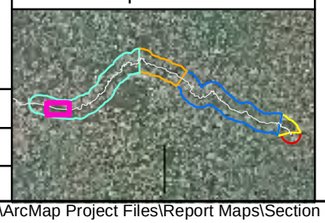
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Wet Bulk Density (g/cm3)

- <0.300001
- 0.300001 - 0.500000
- 0.500001 - 0.700000
- 0.700001 - 0.900000
- 0.900001 - 1.100000
- 1.100001 - 1.300000
- 1.300001 - 1.500000
- 1.500001 - 1.700000
- 1.700001 - 1.900000
- 1.900001 - 1.950000

Channel Bankline
Island Bankline
HEC-RAS 100-Year Floodplain
Quarter Mile Grid Segment

g/cm3 = Grams Per Cubic Centimeter

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: WET BULK DENSITY

MP 37.50 - MP 40.00

SHEET 16 OF 16

ENBRIDGE LINE 6B MP 608
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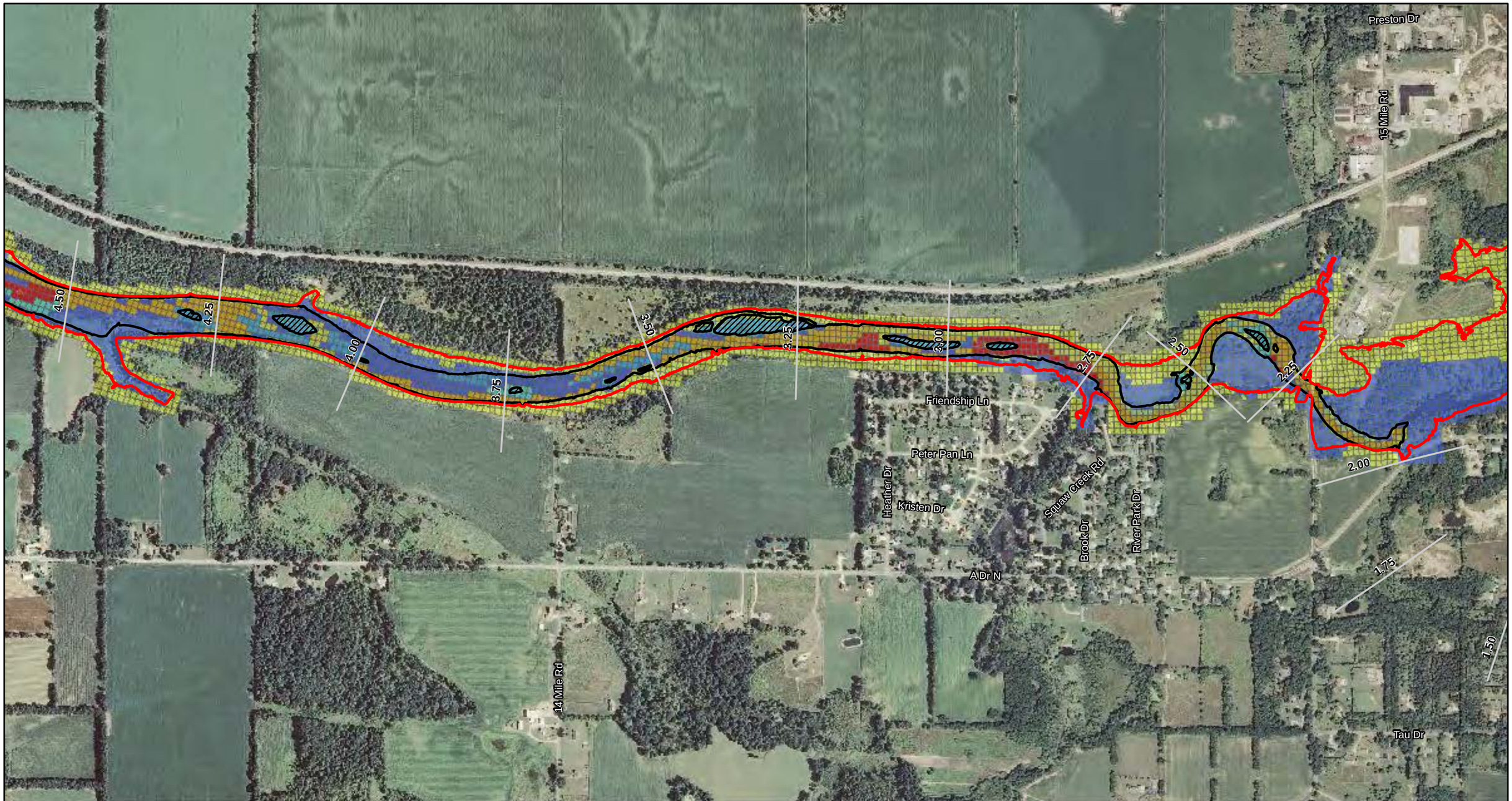
Aerial Photography Date: July & August 2009

Figure 3-22

Floodplain Grid: Dry Bulk Density

Sheets 1 through 16



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

MP 1.50 - MP 4.50

SHEET 1 OF 16

ENBRIDGE LINE 6B MP 608
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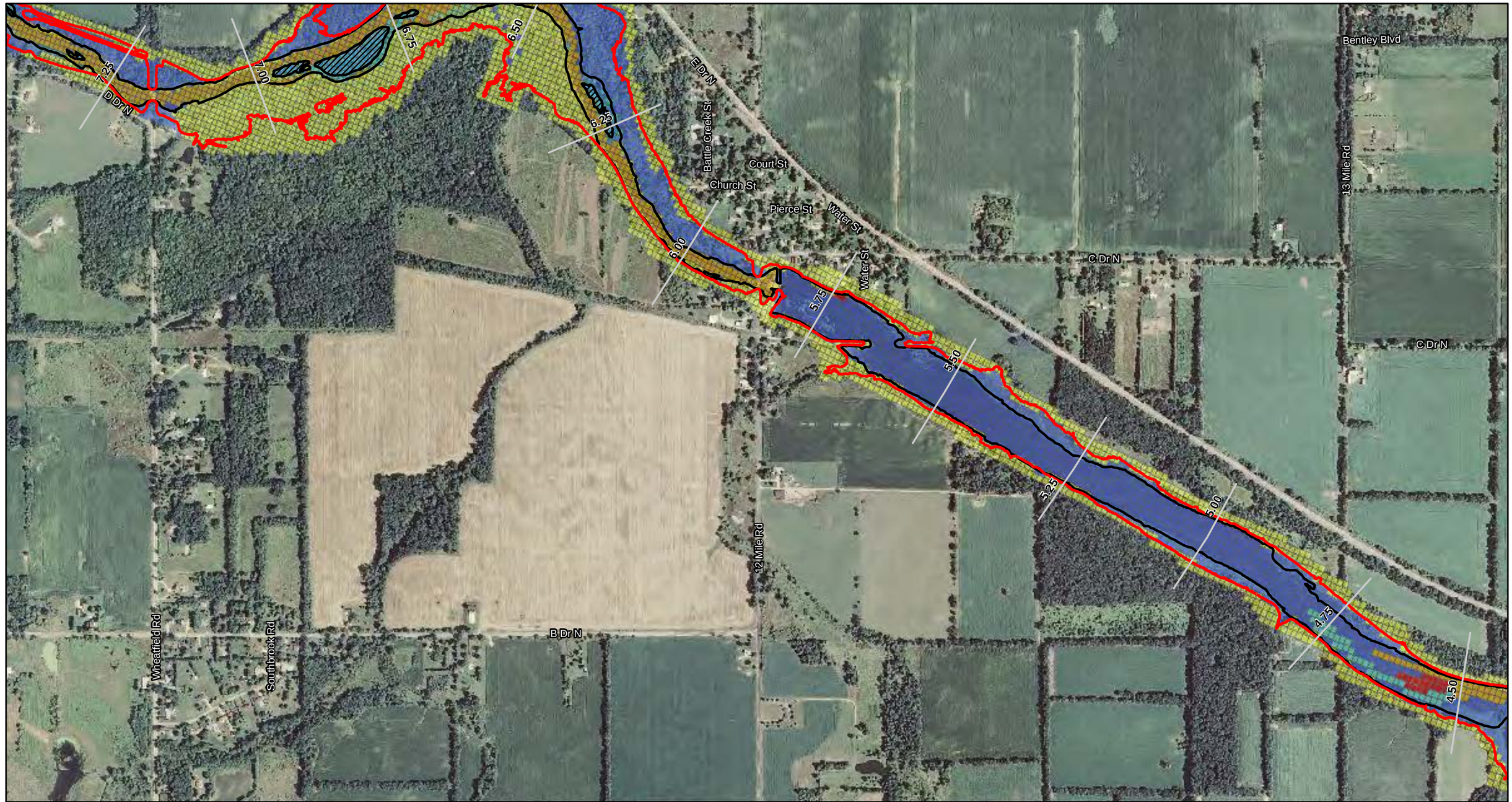
Aerial Photography Date: July & August 2009



Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

MP 4.50 - MP 6.25

SHEET 2 OF 16

ENBRIDGE LINE 6B MP 608
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Approved:	DBR 3/29/2012
Project #:	106-4186

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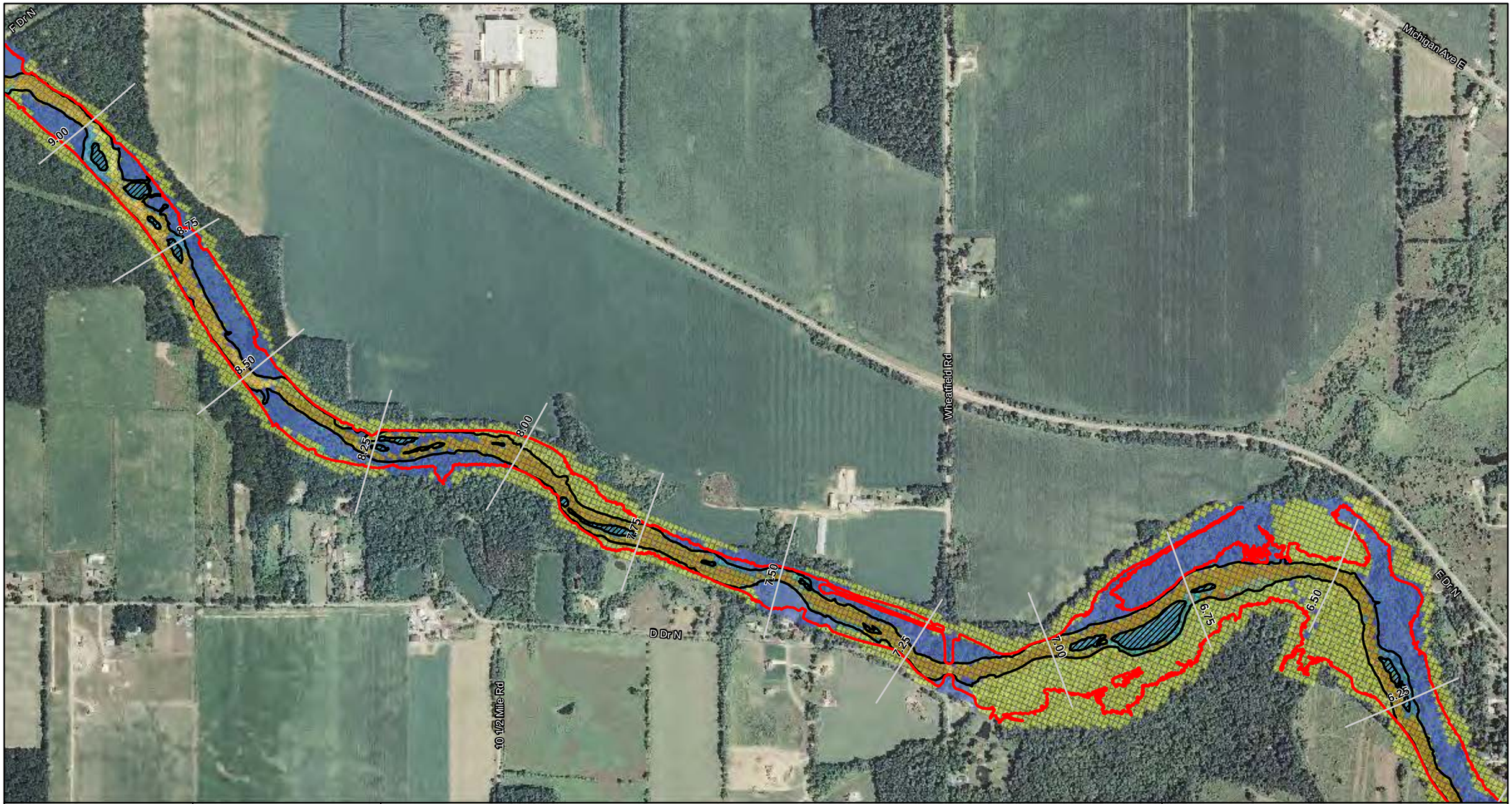
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

MP 6.25 - MP 9.00

SHEET 3 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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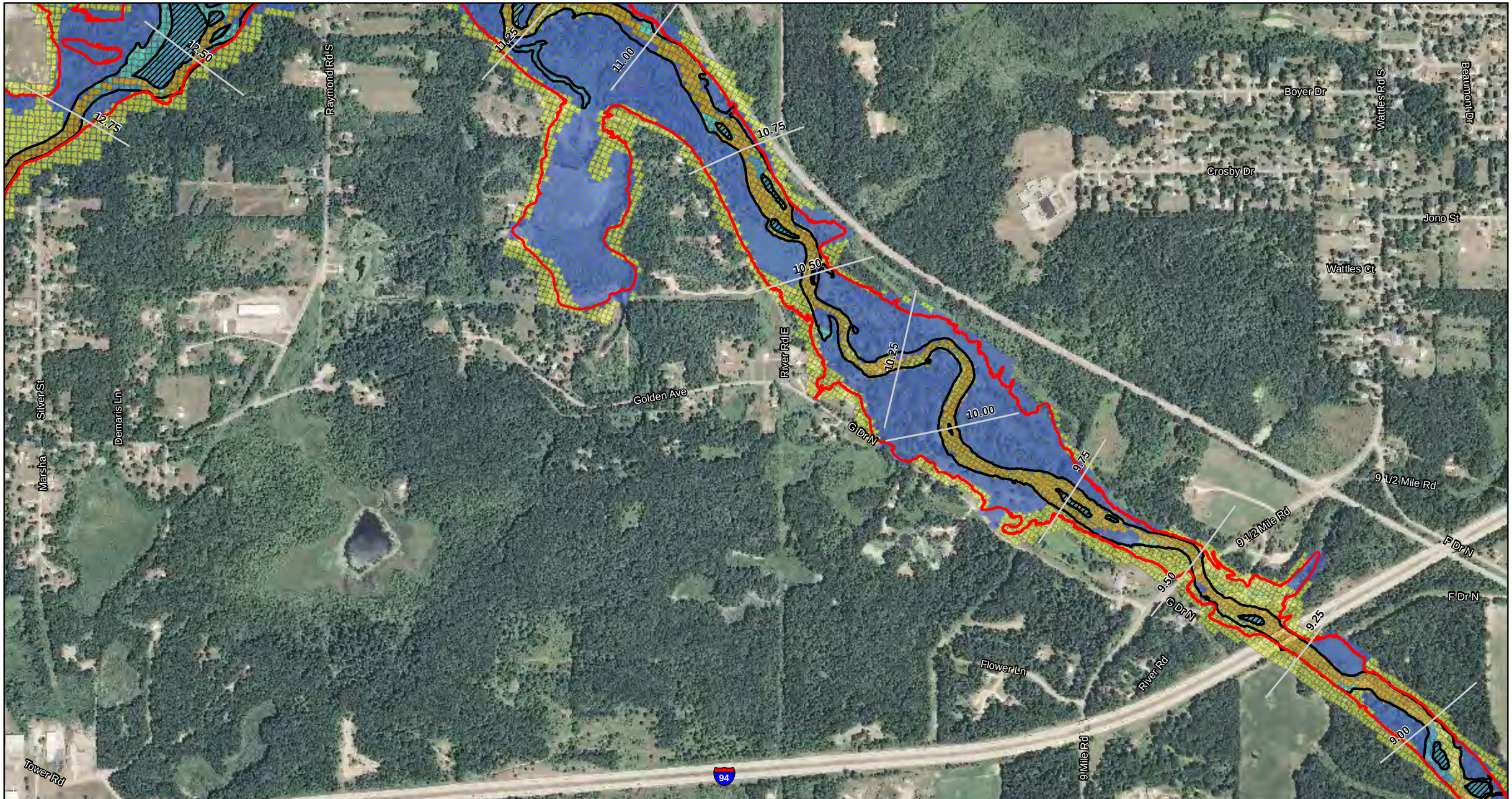
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

MP 9.00 - MP 10.50

SHEET 4 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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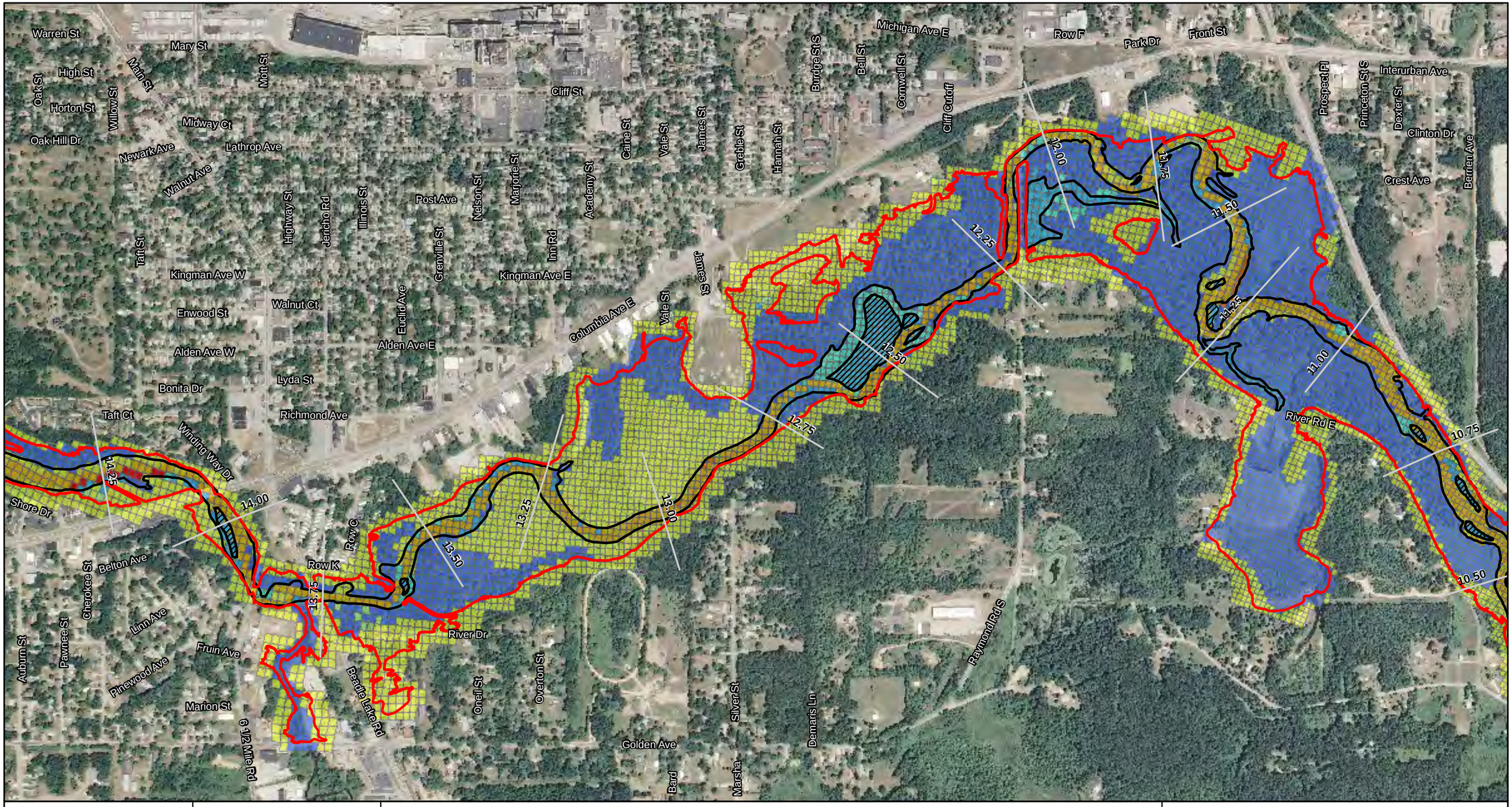
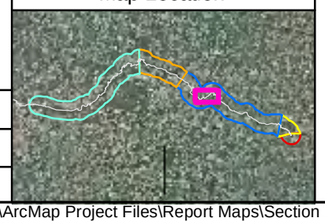
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

MP 10.50 - MP 14.25

SHEET 5 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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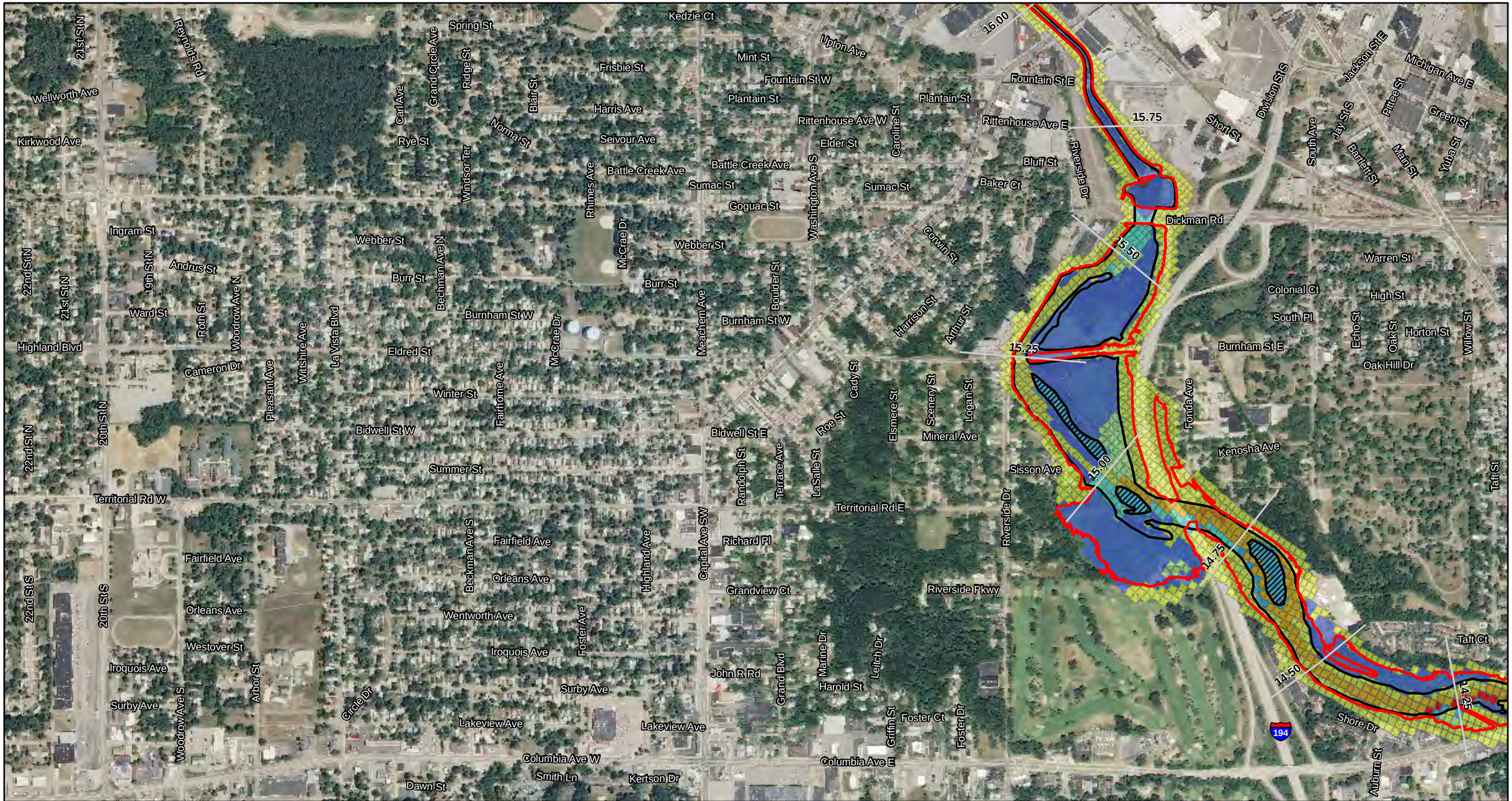
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

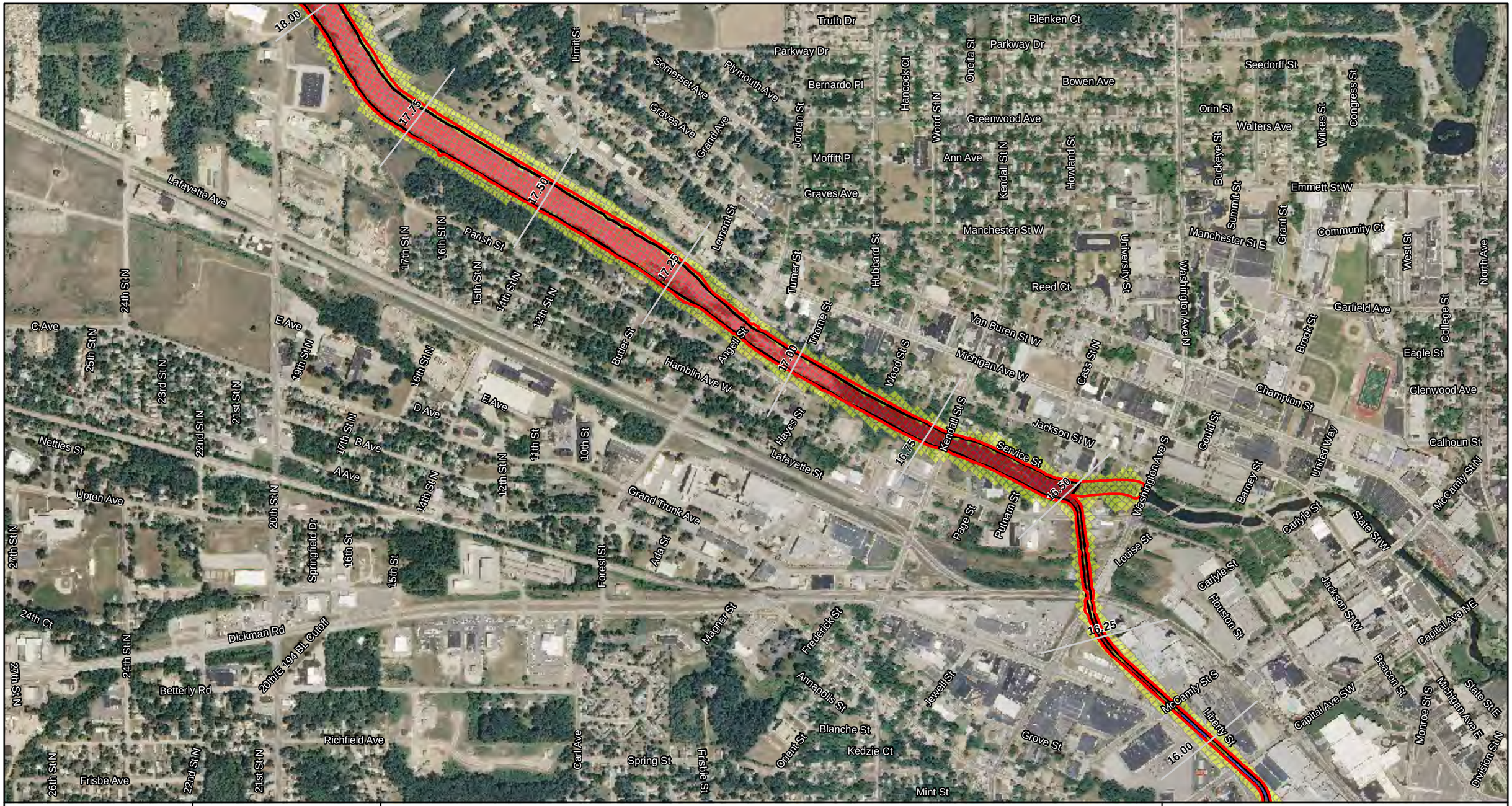
MP 14.25 - MP 16.00

SHEET 6 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model DBD Input.mxd

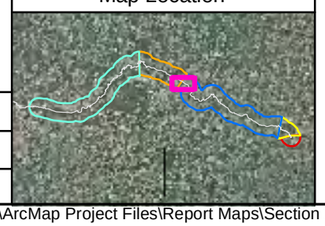
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

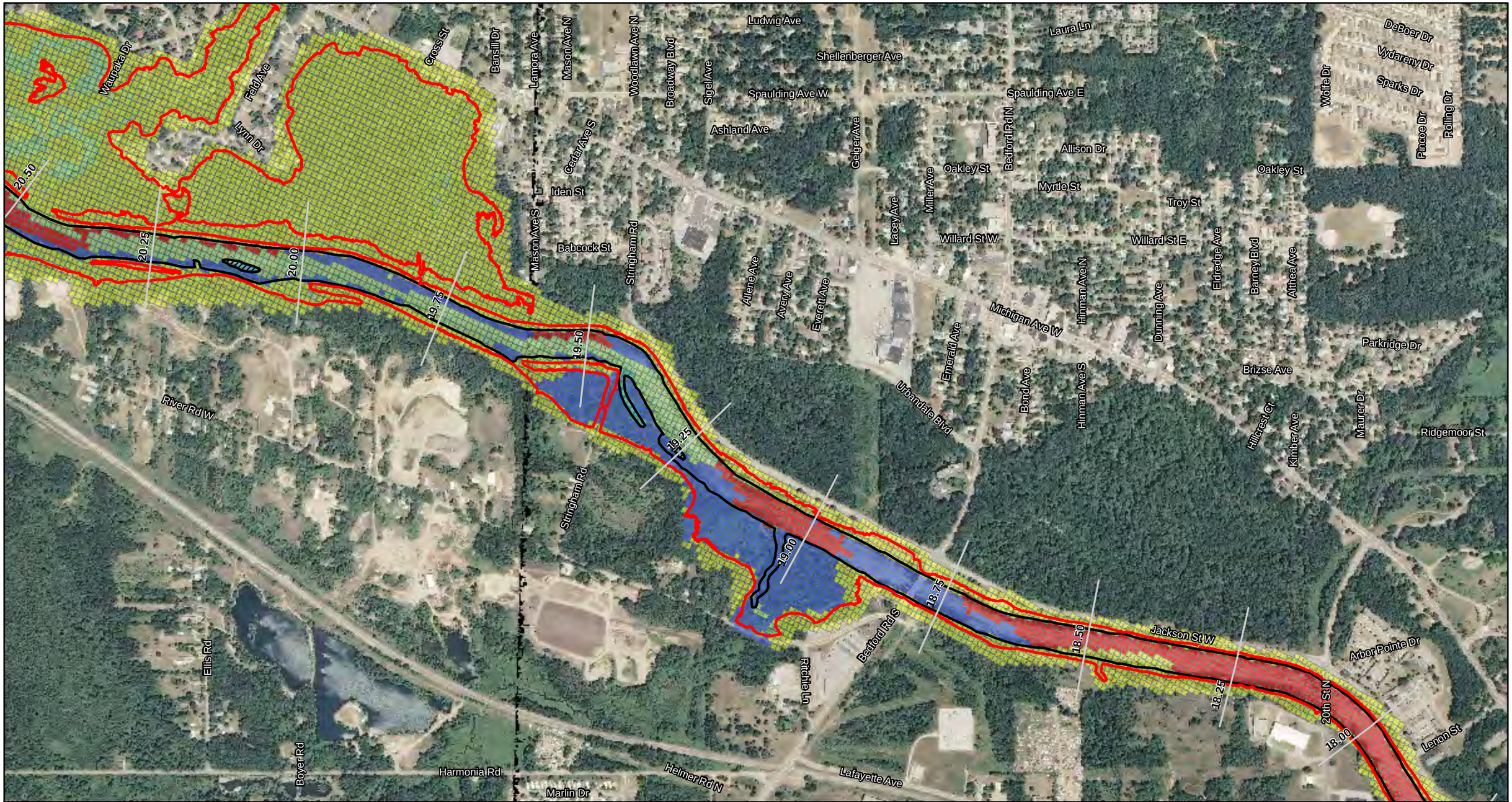
MP 16.00 - MP 18.00

SHEET 7 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model DBD Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

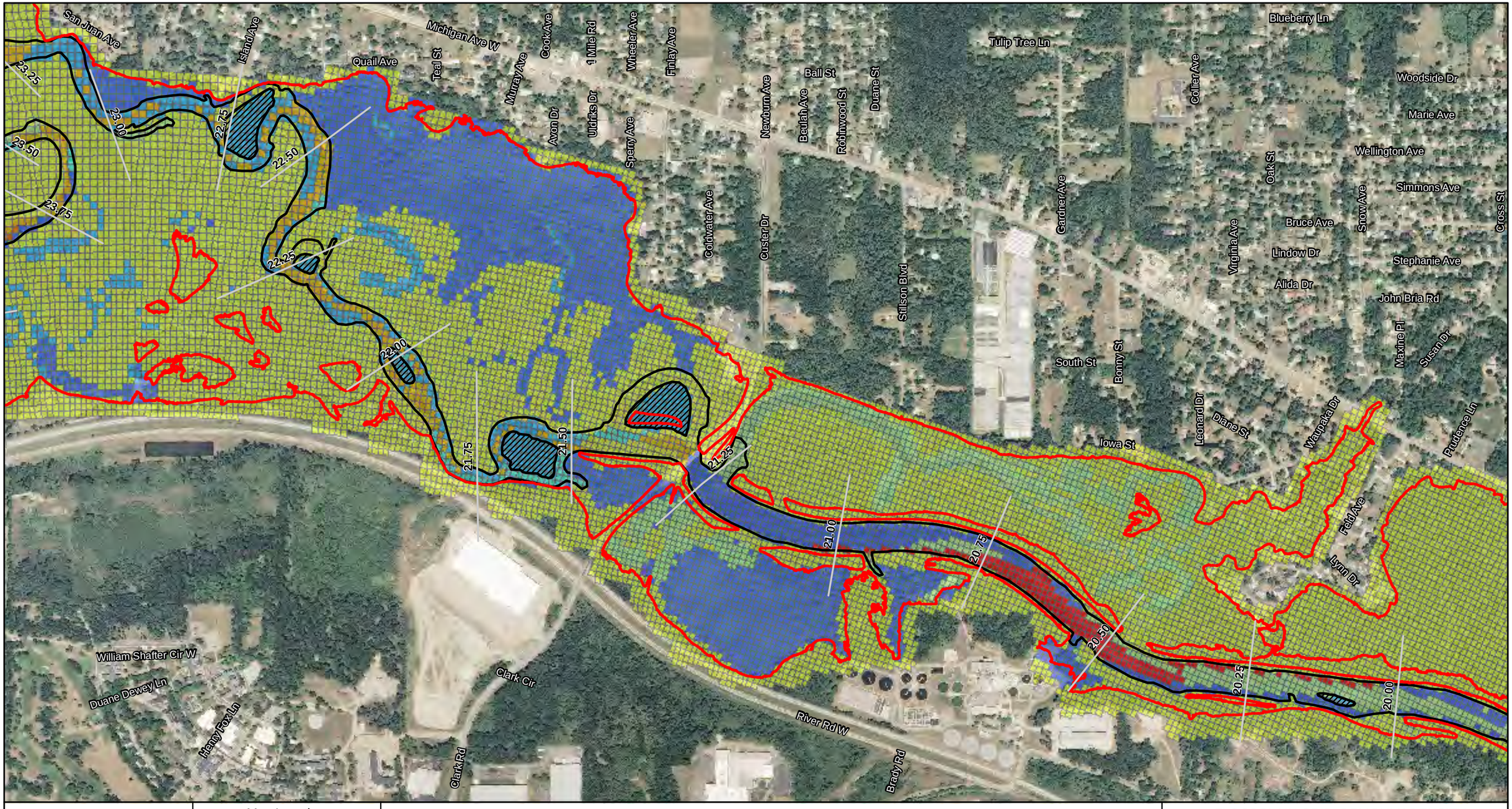
MP 18.00 - MP 20.00

SHEET 8 OF 16

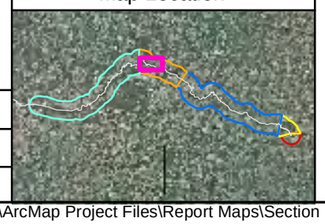
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model DBD Input.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

FLOODPLAIN GRID: DRY BULK DENSITY

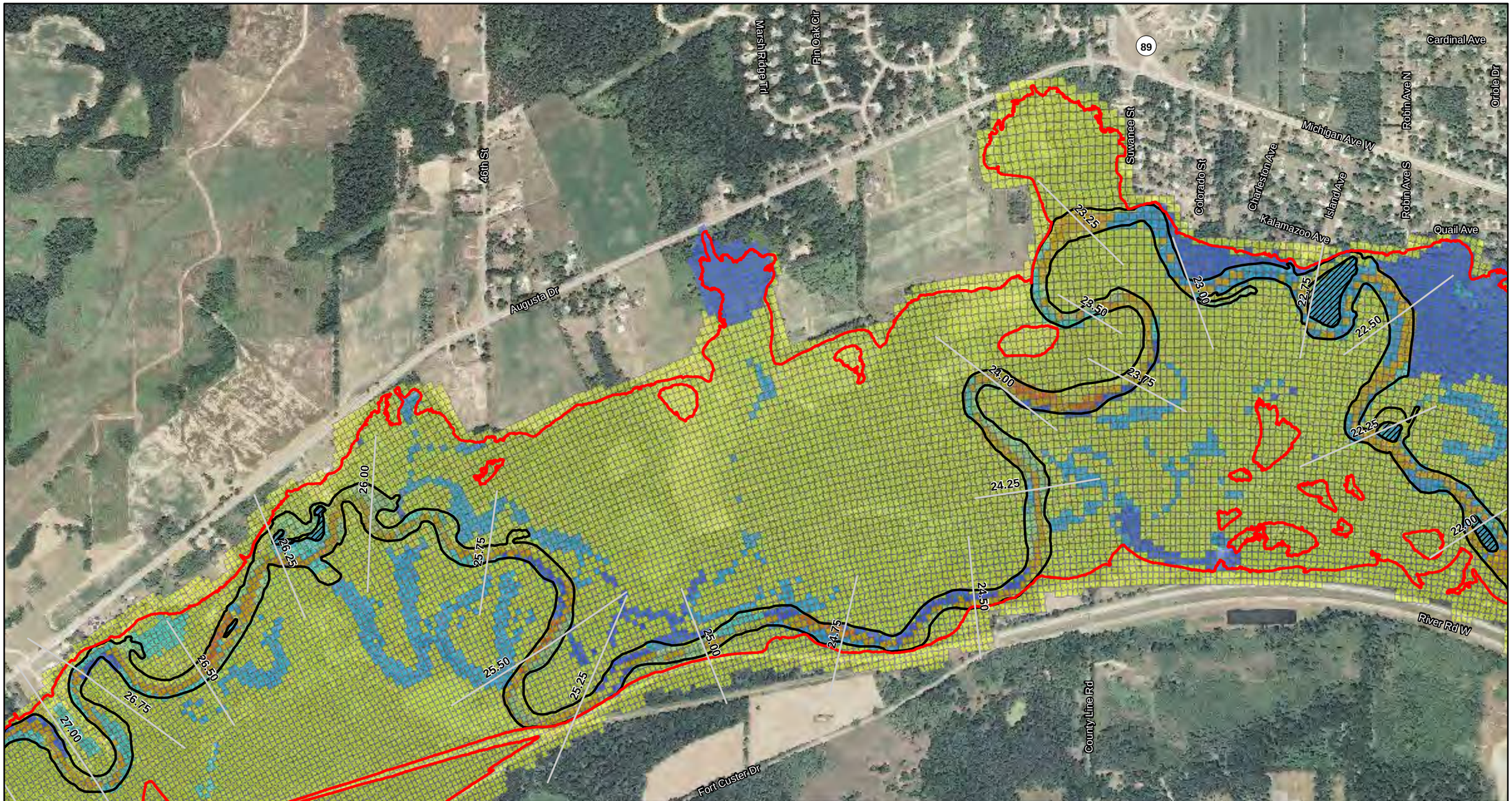
MP 20.00 - MP 22.50

SHEET 9 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model DBD Input.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

MP 22.50 - MP 27.00

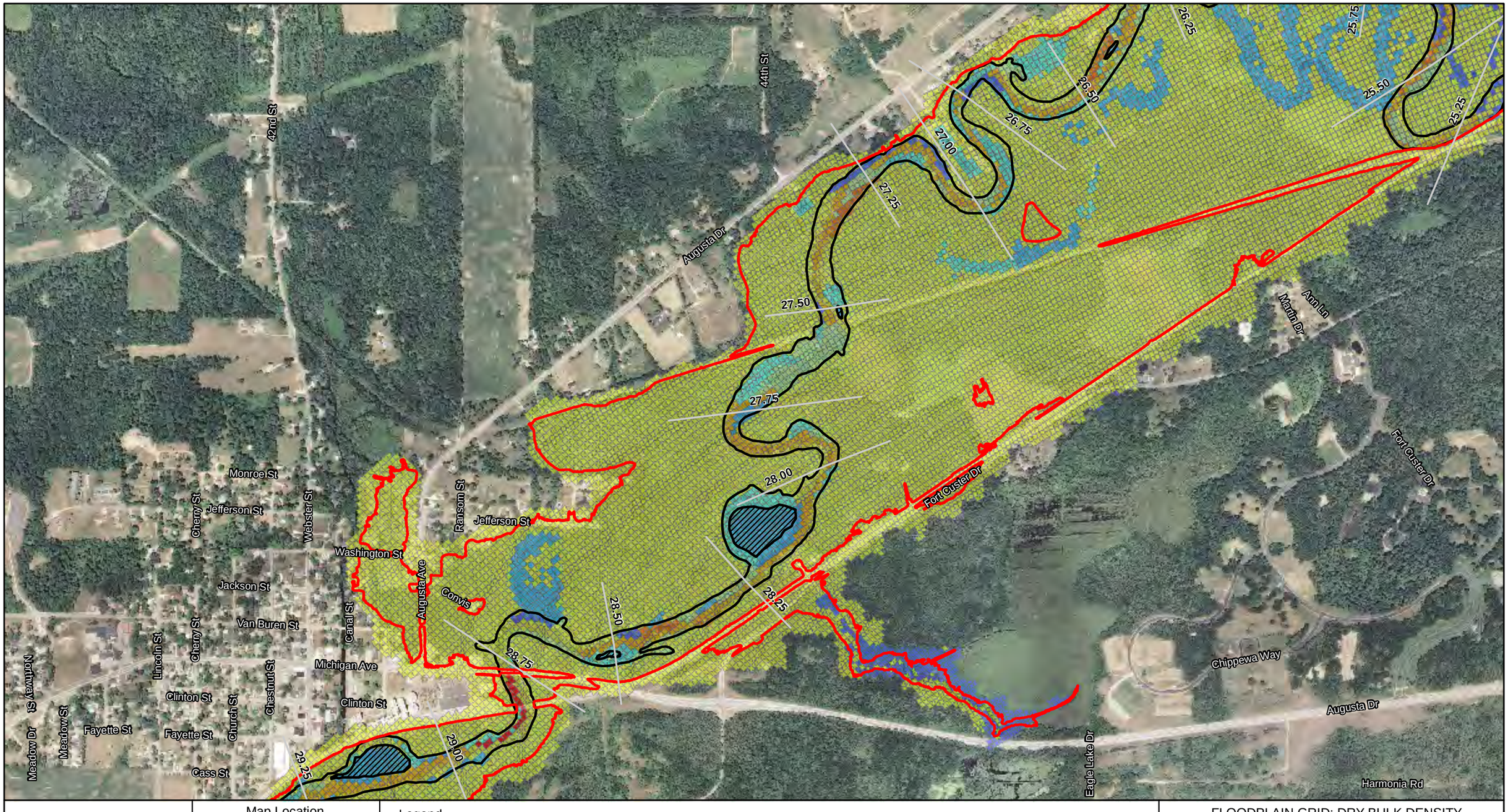
SHEET 10 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model DBD Input.mxd

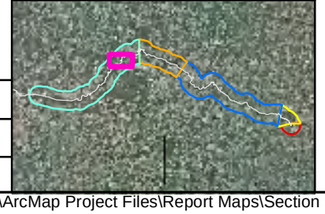
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

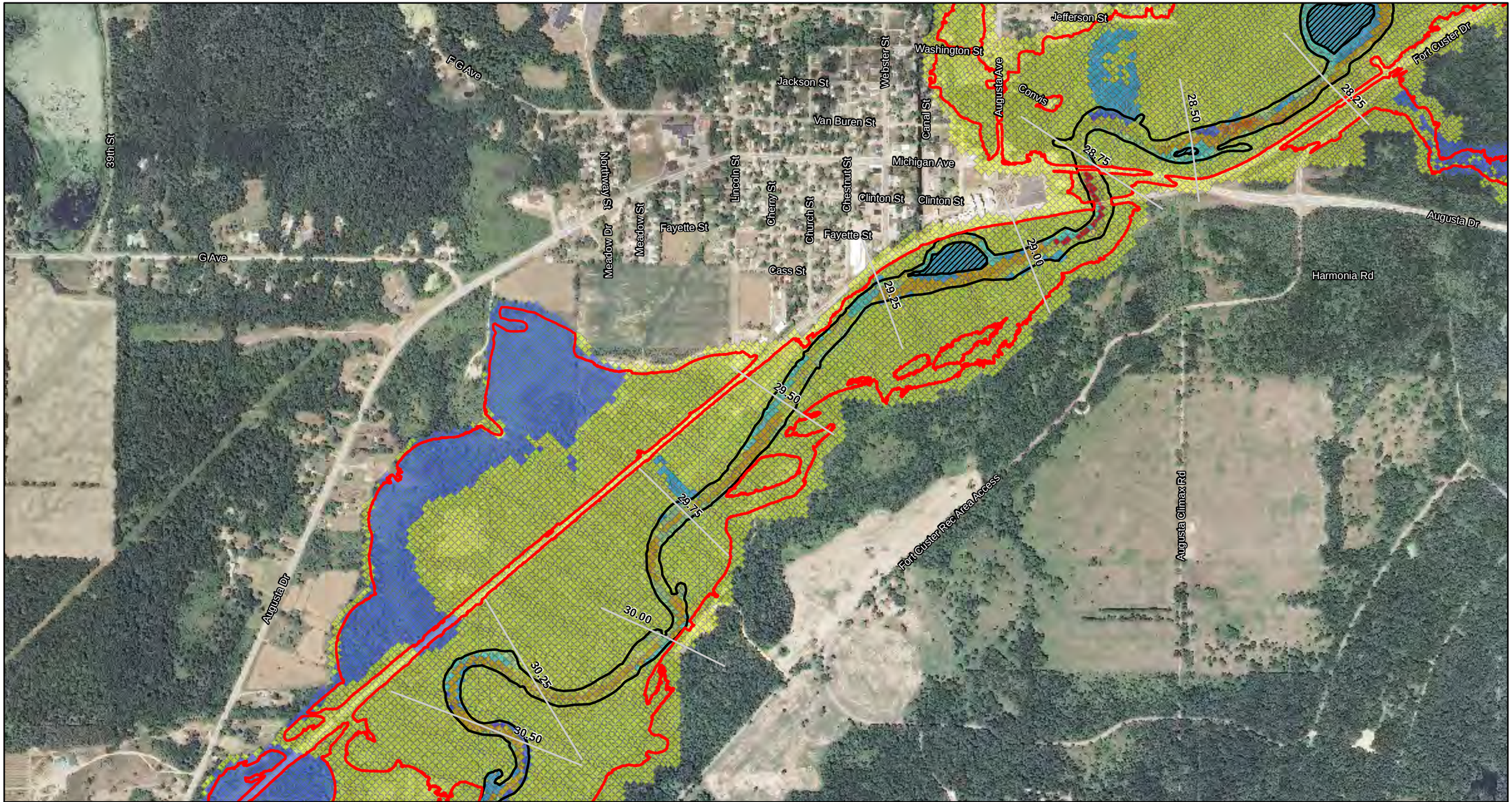
MP 27.00 - MP 28.75

SHEET 11 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model DBD Input.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Map Location

Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

MP 28.75 - MP 30.50

SHEET 12 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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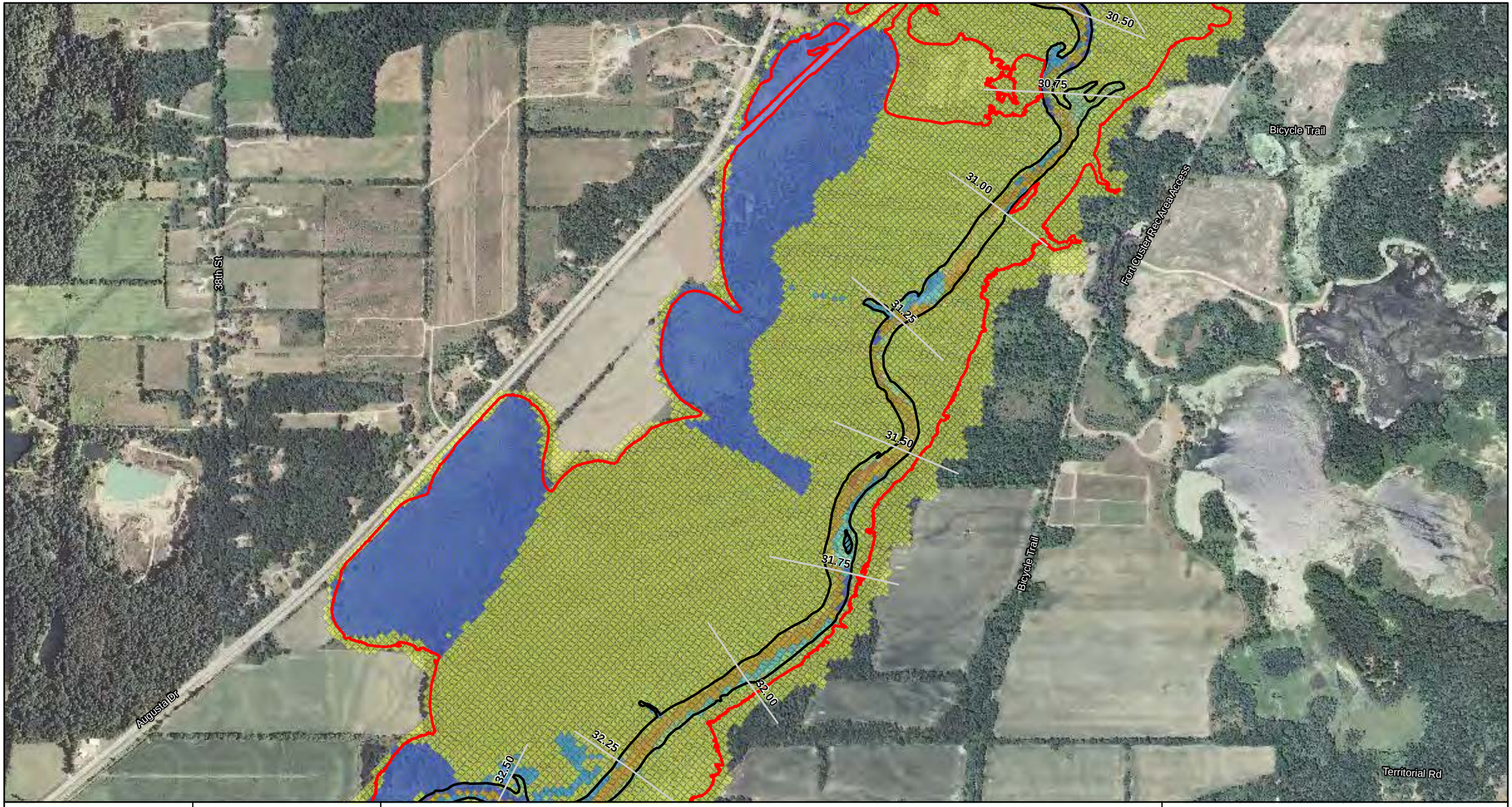
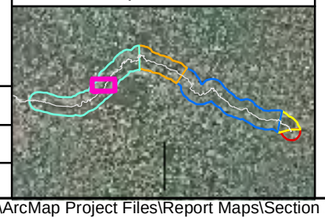
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

MP 30.50 - MP 32.25

SHEET 13 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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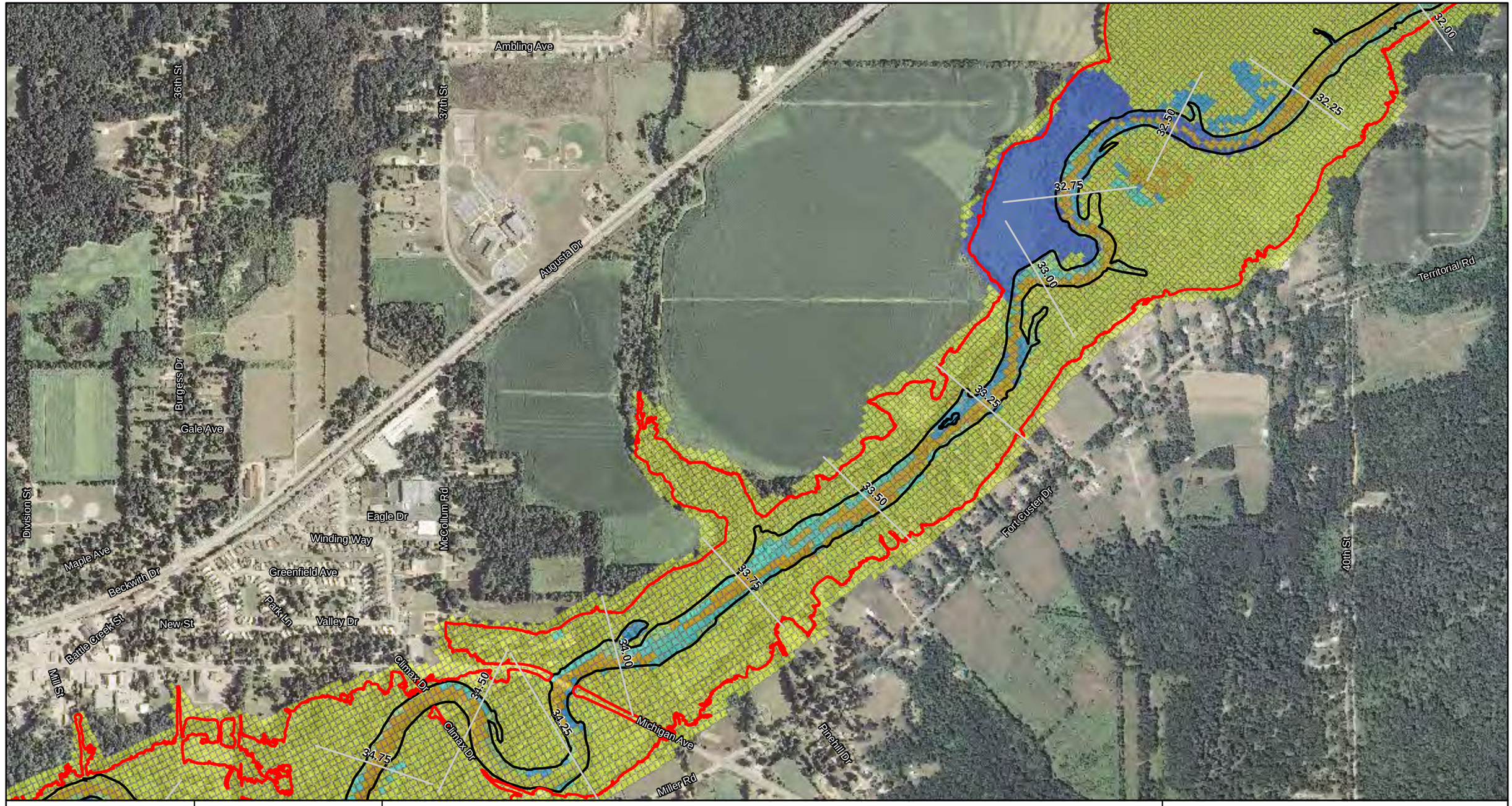
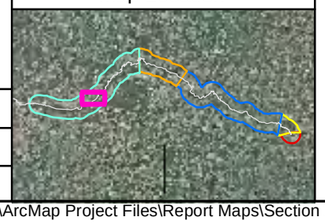
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

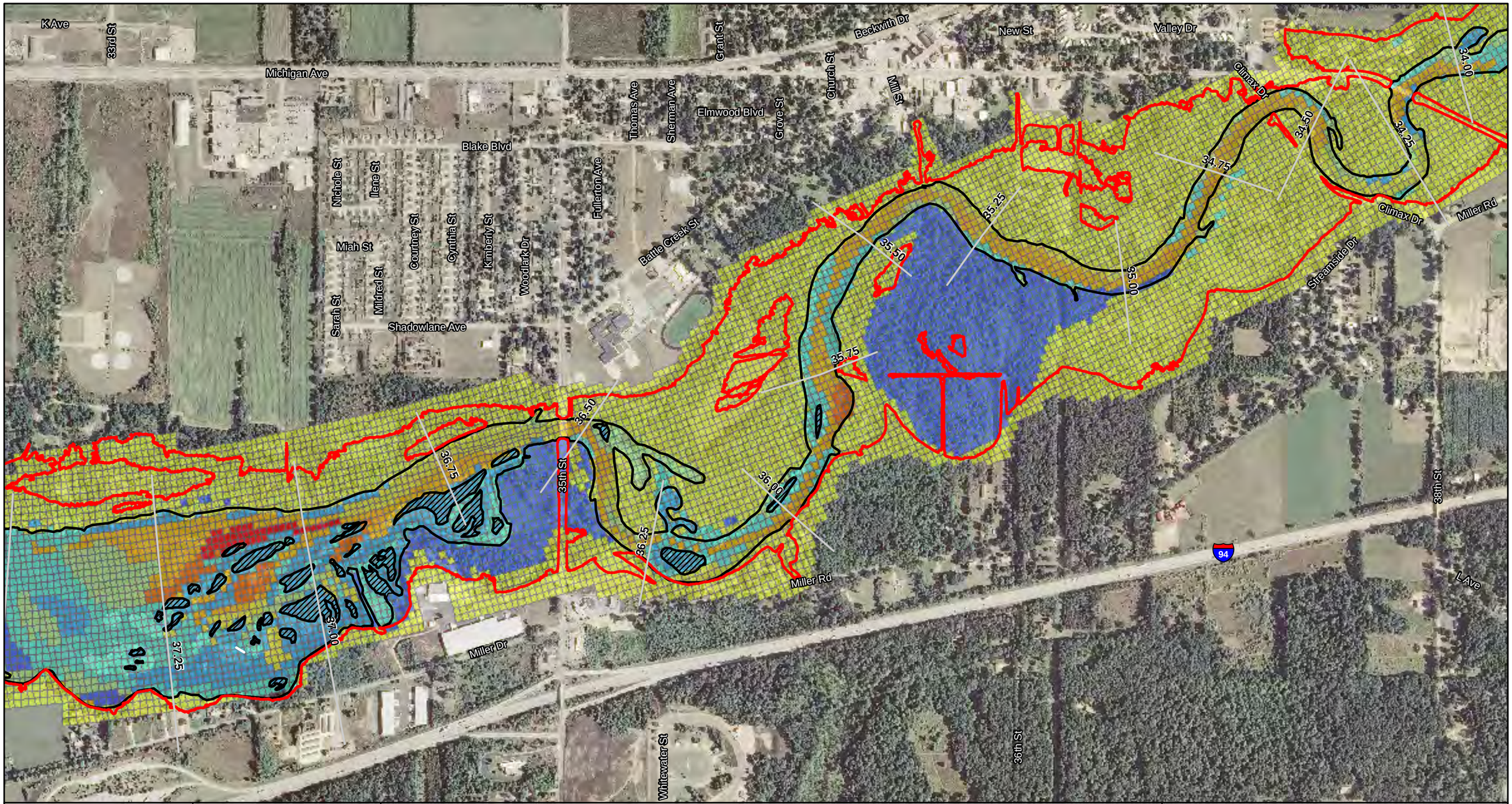
MP 32.25 - MP 34.75

SHEET 14 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\Report Maps\Section 3\Floodplain Model DBD Input.mxd

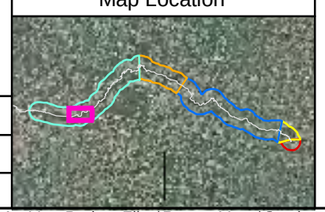
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/29/2012
Approved:	DBR 3/29/2012
Project #:	106-4186

Map Location



Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

MP 34.25 - MP 37.50

SHEET 15 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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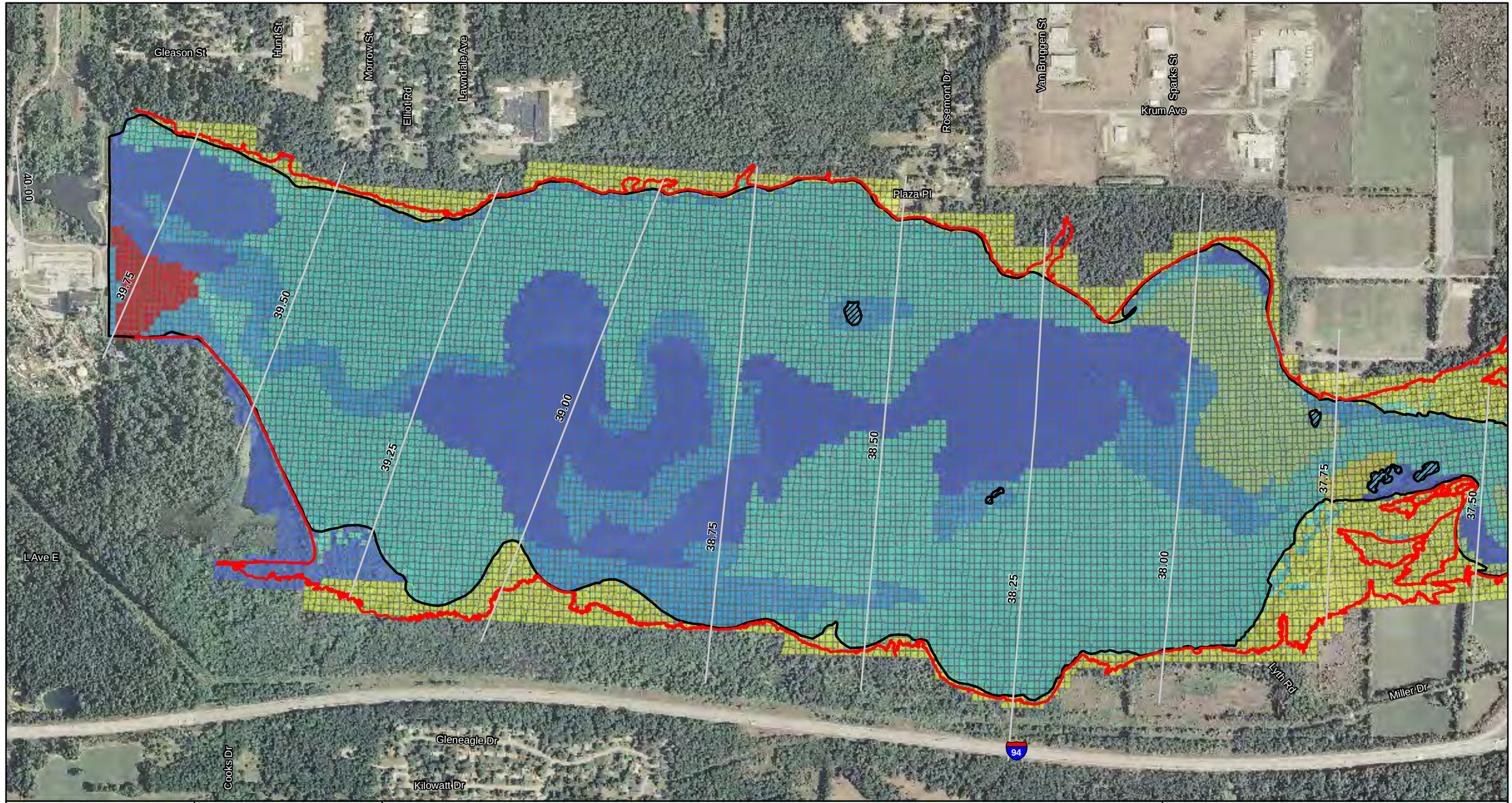
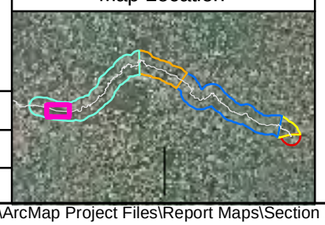
Aerial Photography Date: July & August 2009



Map Location



ENBRIDGE

Drawn:	BRS	3/29/2012
Approved:	DBR	3/29/2012
Project #:	106-4186	

Legend

Dry Bulk Density (g/cm3)

- < 0.200001
- 0.200001 - 0.400000
- 0.400001 - 0.600000
- 0.600001 - 0.800000
- 0.800001 - 1.000000
- 1.000001 - 1.200000
- 1.200001 - 1.400000
- 1.400001 - 1.600000
- 1.600001 - 1.800000

g/cm3 = Grams Per Cubic Centimeter

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 400 800 1,600

Scale in Feet

FLOODPLAIN GRID: DRY BULK DENSITY

MP 37.50 - MP 40.00

SHEET 16 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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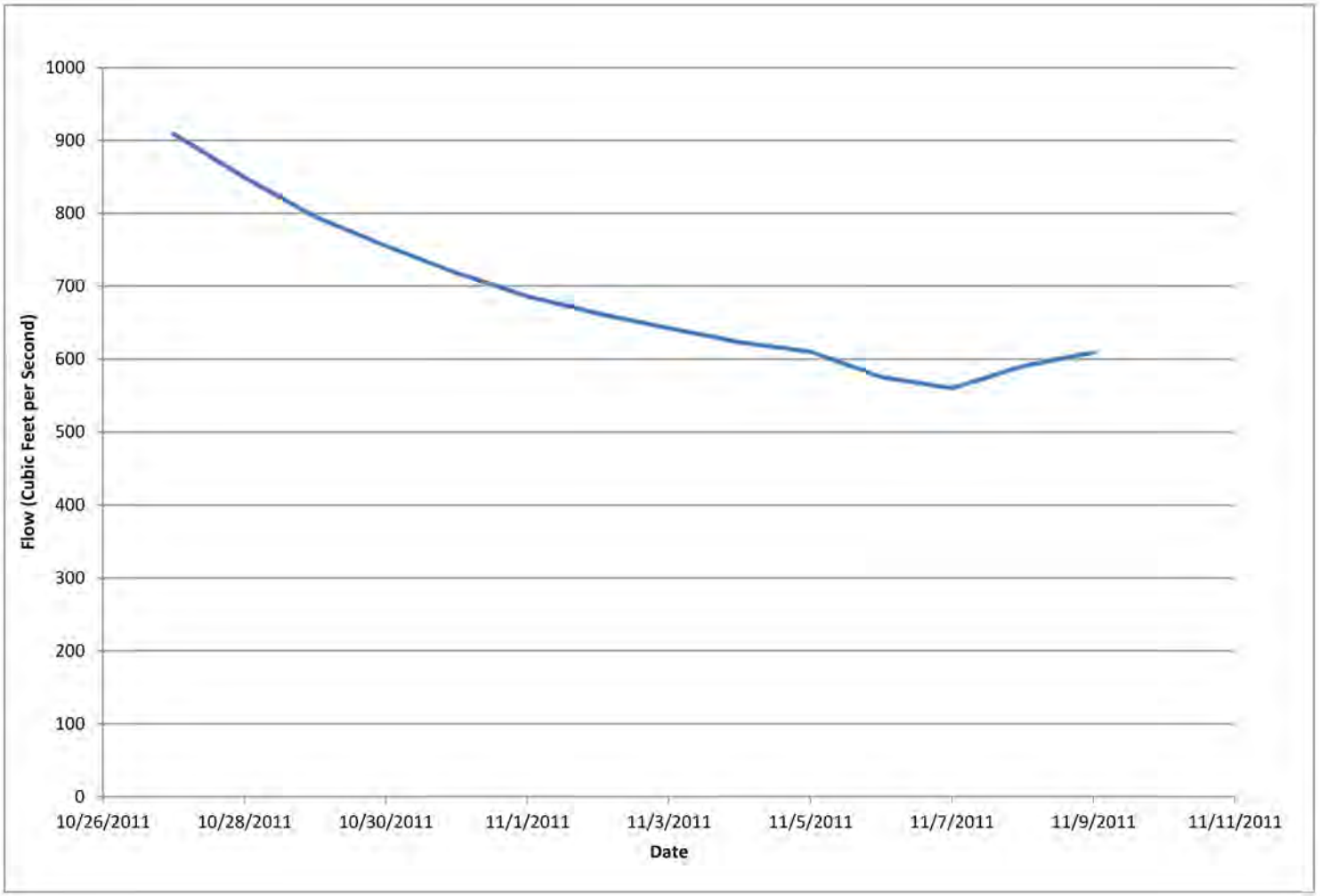
Aerial Photography Date: July & August 2009

Figure 4-1

Flow at Kalamazoo Gage near Battle Creek for October/November Calibration Period



ENBRIDGE

Drawn:	JLH	04/16/2012
Approved:	DBR	04/16/2012
Project #:	106-4186	

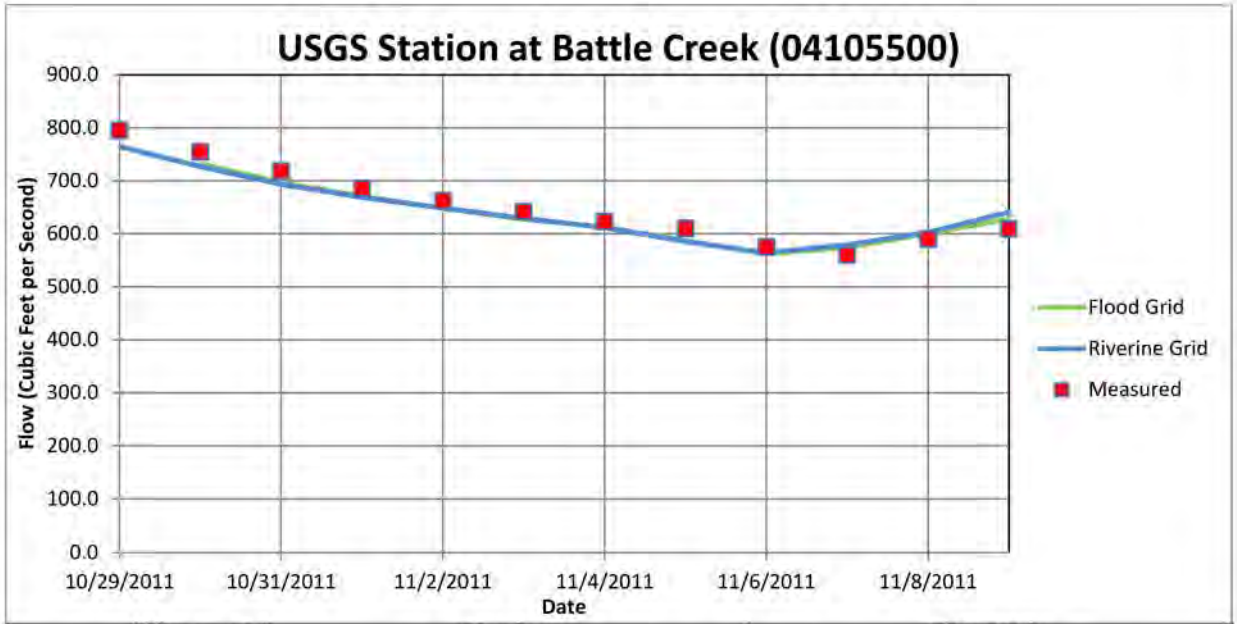
FLOW AT KALAMAZOO RIVER
GAGE NEAR BATTLE CREEK
FOR OCTOBER/NOVEMBER
CALIBRATION PERIOD

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 4-2

Flow Calibration

Sheets 1 through 2



Date	Measured	Riverine			Floodplain		
	Flow (cfs)	Flow (cfs)	Difference (cfs)	Difference (%)	Flow (cfs)	Difference (cfs)	Difference (%)
10/28/2011	849	806.9	-42.1	-5			
10/29/2011	795	764.5	-30.5	-4			
10/30/2011	755	726.7	-28.3	-4	732.3	-22.7	-3
10/31/2011	718	693.6	-24.4	-3	696.7	-21.3	-3
11/1/2011	686	668.5	-17.5	-3	670.7	-15.3	-2
11/2/2011	662	648.7	-13.3	-2	648.3	-13.7	-2
11/3/2011	642	629.2	-12.8	-2	627.4	-14.6	-2
11/4/2011	623	611.7	-11.3	-2	612.4	-10.6	-2
11/5/2011	610	585.4	-24.6	-4	586.7	-23.3	-4
11/6/2011	575	564.3	-10.7	-2	562.1	-12.9	-2
11/7/2011	560	579.3	19.3	3	574.2	14.2	3
11/8/2011	590	602.1	12.1	2	600.4	10.4	2
11/9/2011	609	641.0	32.0	5	628.0	19.0	3

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

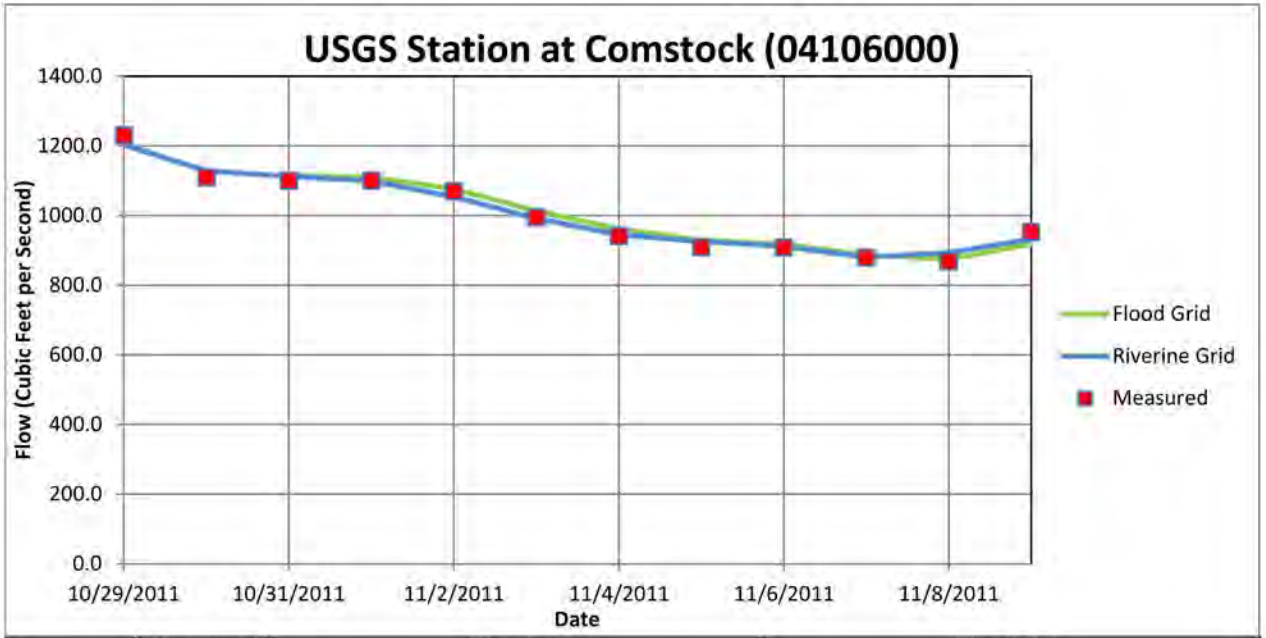
Footnotes:

cfs = Cubic Feet per Second
% = Percent

FLOW CALIBRATION

SHEET 1 OF 2

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



Date	Measured	Riverine			Floodplain		
	Flow (cfs)	Flow (cfs)	Difference (cfs)	Difference (%)	Flow (cfs)	Difference (cfs)	Difference (%)
10/29/2011	1230	1203.1	-26.9	-2			
10/30/2011	1110	1128.0	18.0	2			
10/31/2011	1100	1112.4	12.4	1	1115.9	15.9	1
11/1/2011	1100	1098.8	-1.2	0	1109.2	9.2	1
11/2/2011	1070	1054.3	-15.7	-1	1076.2	6.2	1
11/3/2011	995	991.4	-3.6	0	1013.0	18.0	2
11/4/2011	941	945.0	4.0	0	960.8	19.8	2
11/5/2011	909	925.8	16.8	2	928.8	19.8	2
11/6/2011	908	911.5	3.5	0	918.3	10.3	1
11/7/2011	879	879.3	0.3	0	885.7	6.7	1
11/8/2011	868	893.4	25.4	3	875.1	7.1	1
11/9/2011	953	931.6	-21.4	-2	918.4	-34.6	-4

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

Footnotes:

cfs = Cubic Feet per Second
% = Percent

FLOW CALIBRATION

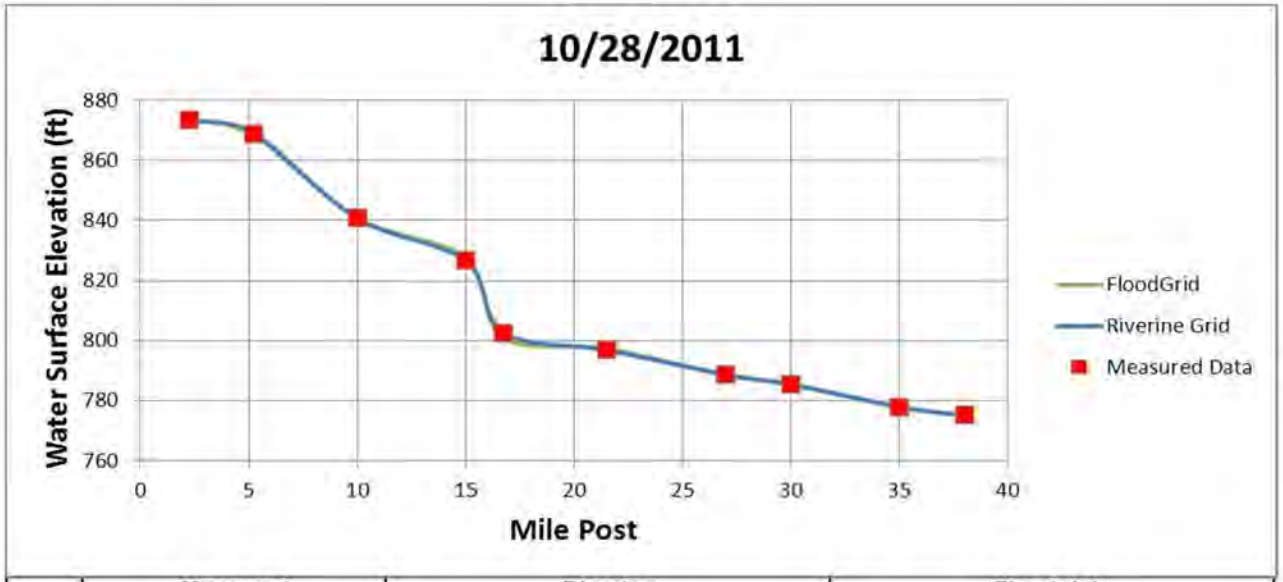
SHEET 2 OF 2

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 4-3

Water Surface Elevation Calibration

Sheets 1 through 10



	Measured		Riverine			Floodplain		
Mile Post	Water Surface Elevation (ft)	Water Depth (ft)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)
2.25	873.57	4.88	873.69	0.12	2	873.86	0.28	6
5.25	868.88	4.89	868.31	-0.57	-12	868.28	-0.60	-12
10.00	840.74	3.42	841.42	0.68	20	840.83	0.09	3
15.00	826.57	3.95	826.49	-0.08	-2	827.58	1.01	25
16.75	802.58	3.68	803.04	0.46	13	800.94	-1.64	-44
21.50	796.81	3.62	796.65	-0.16	-4	797.37	0.56	15
27.00	788.66	5.46	788.71	0.05	1	788.48	-0.18	-3
30.00	785.29	5.76	784.87	-0.42	-7	785.59	0.30	5
35.00	777.88	4.79	778.18	0.30	6	777.82	-0.07	-1
38.00	775.08	6.68	775.29	0.21	3	774.97	-0.12	-2

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

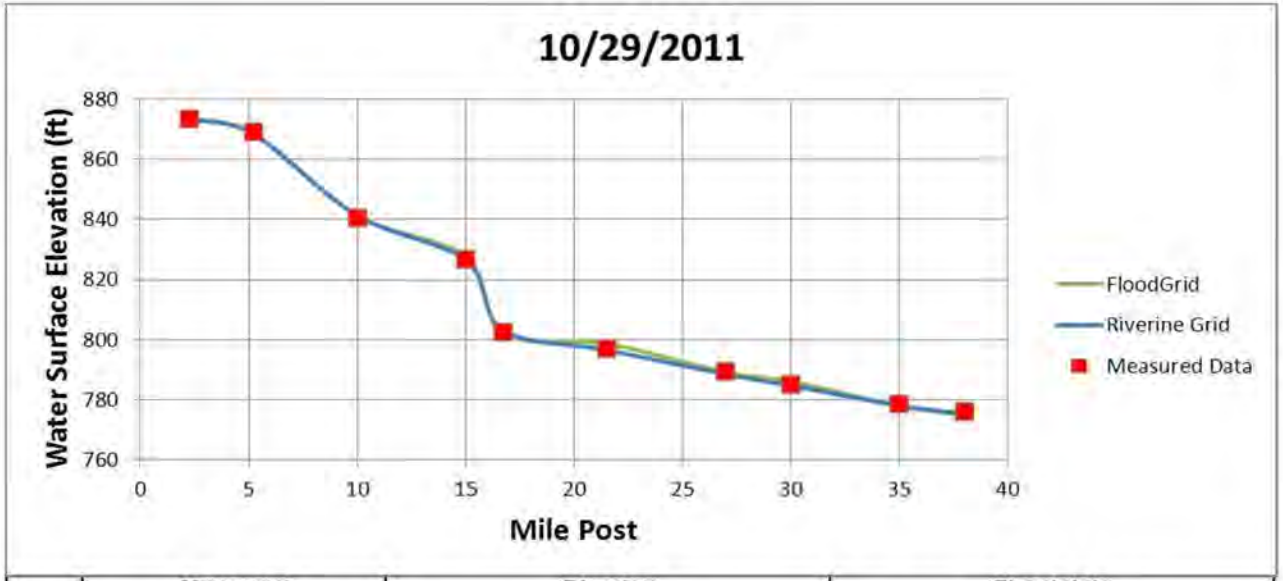
Footnotes:

ft = Feet
% = Percent

WATER SURFACE ELEVATION CALIBRATION

SHEET 1 OF 10

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



	Measured		Riverine			Floodplain		
Mile Post	Water Surface Elevation (ft)	Water Depth (ft)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)
2.25	873.57	4.88	873.63	0.05	1	873.89	0.32	7
5.25	869.08	5.09	868.28	-0.80	-16	868.45	-0.64	-13
10.00	840.54	3.22	841.35	0.81	25	841.35	0.81	25
15.00	826.62	4.00	826.46	-0.16	-4	827.58	0.96	24
16.75	802.51	3.68	803.04	0.53	14	802.06	-0.45	-12
21.50	796.81	3.62	796.52	-0.29	-8	798.58	1.77	49
27.00	789.46	6.26	788.48	-0.98	-16	789.10	-0.36	-6
30.00	785.09	5.56	784.64	-0.45	-8	786.02	0.93	17
35.00	778.63	5.53	778.02	-0.62	-11	777.82	-0.82	-15
38.00	775.98	7.58	775.23	-0.76	-10	775.00	-0.98	-13

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

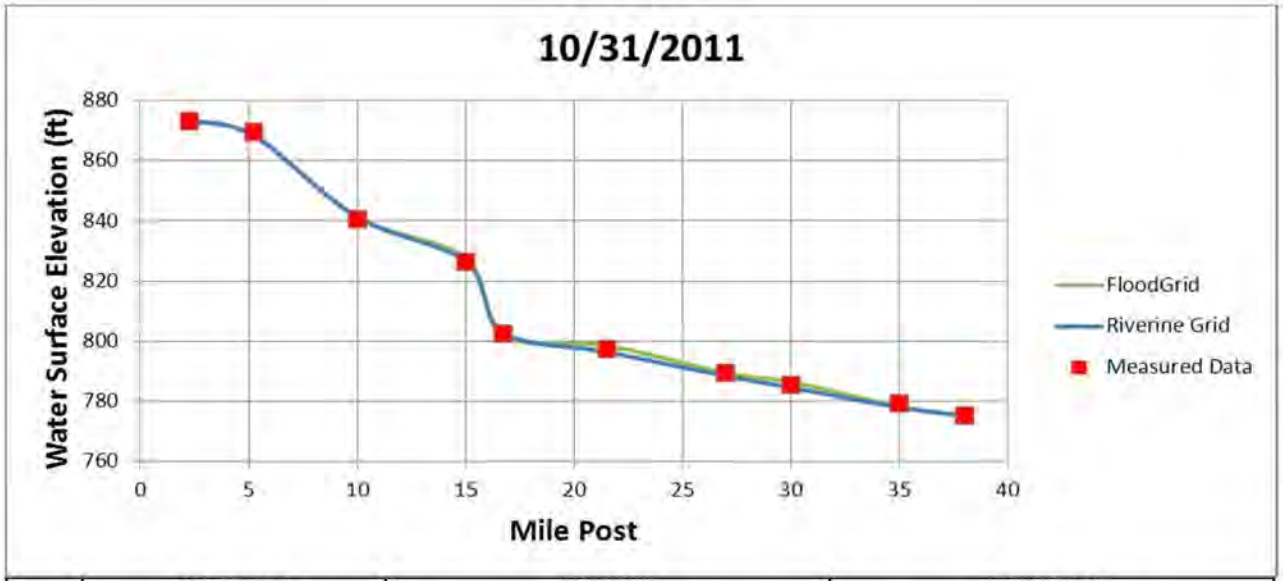
Footnotes:

ft = Feet
% = Percent

WATER SURFACE ELEVATION CALIBRATION

SHEET 2 OF 10

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



	Measured		Riverine			Floodplain		
Mile Post	Water Surface Elevation (ft)	Water Depth (ft)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)
2.25	873.27	4.58	873.56	0.29	6	873.79	0.52	11
5.25	869.48	5.49	868.22	-1.27	-23	868.38	-1.10	-20
10.00	840.49	3.17	841.29	0.80	25	841.32	0.83	26
15.00	826.37	3.75	826.40	0.02	1	827.58	1.21	32
16.75	802.41	3.68	802.88	0.47	13	801.86	-0.55	-15
21.50	797.41	4.22	796.35	-1.06	-25	798.48	1.08	26
27.00	789.31	6.11	788.41	-0.90	-15	789.36	0.06	1
30.00	785.29	5.76	784.54	-0.75	-13	786.41	1.12	19
35.00	779.08	5.98	777.92	-1.17	-19	778.21	-0.87	-15
38.00	775.18	6.78	775.20	0.01	0	775.13	-0.05	-1

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

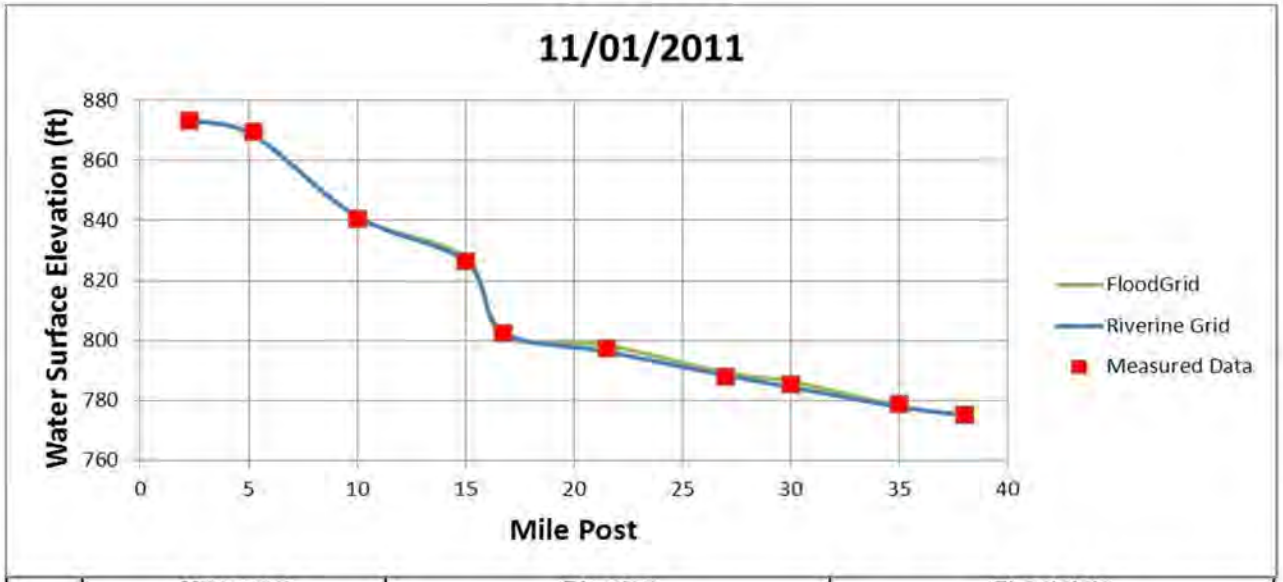
Footnotes:

ft = Feet
% = Percent

WATER SURFACE ELEVATION CALIBRATION

SHEET 3 OF 10

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



	Measured		Riverine			Floodplain		
Mile Post	Water Surface Elevation (ft)	Water Depth (ft)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)
2.25	873.27	4.58	873.53	0.26	6	873.73	0.45	10
5.25	869.48	5.49	868.22	-1.27	-23	868.35	-1.14	-21
10.00	840.69	3.37	841.29	0.60	18	841.29	0.60	18
15.00	826.37	3.75	826.40	0.02	1	827.58	1.21	32
16.75	802.36	3.68	802.81	0.45	12	801.80	-0.57	-15
21.50	797.31	4.12	796.32	-0.99	-24	798.38	1.08	26
27.00	788.01	4.81	788.38	0.37	8	789.30	1.29	27
30.00	785.29	5.76	784.48	-0.81	-14	786.38	1.09	19
35.00	778.98	5.88	777.88	-1.10	-19	778.18	-0.80	-14
38.00	775.18	6.78	775.16	-0.02	0	775.13	-0.05	-1

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

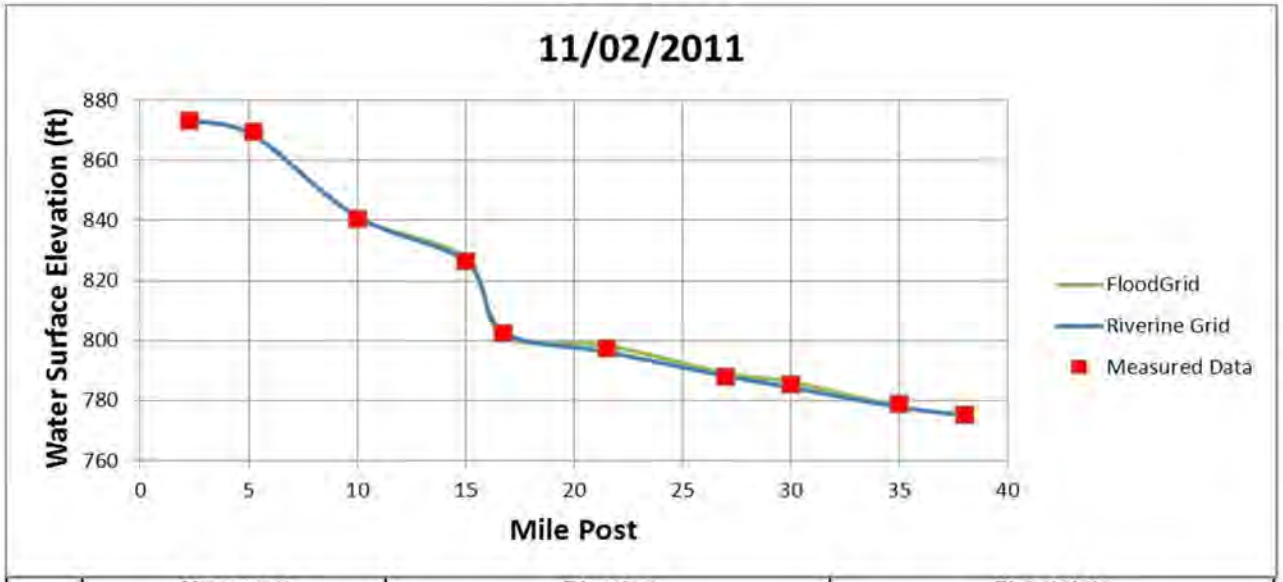
Footnotes:

ft = Feet
% = Percent

WATER SURFACE ELEVATION CALIBRATION

SHEET 4 OF 10

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



	Measured		Riverine			Floodplain		
Mile Post	Water Surface Elevation (ft)	Water Depth (ft)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)
2.25	873.22	4.53	873.50	0.27	6	873.69	0.47	10
5.25	869.38	5.39	868.18	-1.20	-22	868.31	-1.07	-20
10.00	840.59	3.27	841.25	0.66	20	841.25	0.66	20
15.00	826.37	3.75	826.36	-0.01	0	827.58	1.21	32
16.75	802.33	3.68	802.78	0.45	12	801.73	-0.60	-16
21.50	797.21	4.02	796.22	-0.99	-25	798.29	1.08	27
27.00	787.96	4.76	788.22	0.26	5	789.14	1.18	25
30.00	785.24	5.71	784.35	-0.89	-16	786.18	0.94	17
35.00	778.88	5.78	777.79	-1.10	-19	778.08	-0.80	-14
38.00	775.18	6.78	775.13	-0.05	-1	775.13	-0.05	-1

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

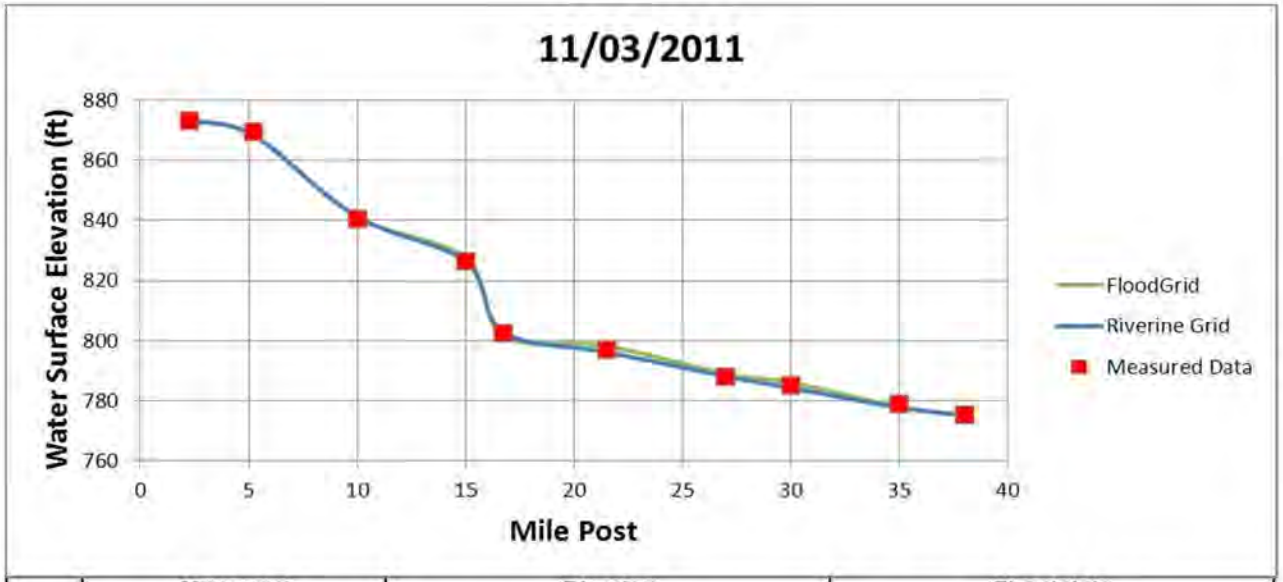
Footnotes:

ft = Feet
% = Percent

WATER SURFACE ELEVATION CALIBRATION

SHEET 5 OF 10

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



	Measured		Riverine			Floodplain		
Mile Post	Water Surface Elevation (ft)	Water Depth (ft)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)
2.25	873.17	4.48	873.46	0.29	6	873.66	0.49	11
5.25	869.38	5.39	868.18	-1.20	-22	868.31	-1.07	-20
10.00	840.49	3.17	841.25	0.76	24	841.22	0.73	23
15.00	826.37	3.75	826.36	-0.01	0	827.58	1.21	32
16.75	802.29	3.68	802.75	0.46	12	801.66	-0.62	-17
21.50	797.01	3.82	796.15	-0.85	-22	798.16	1.15	30
27.00	787.96	4.76	788.12	0.16	3	788.91	0.95	20
30.00	785.09	5.56	784.22	-0.88	-16	785.99	0.90	16
35.00	778.78	5.68	777.69	-1.10	-19	777.95	-0.83	-15
38.00	775.13	6.73	775.10	-0.04	-1	775.06	-0.07	-1

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

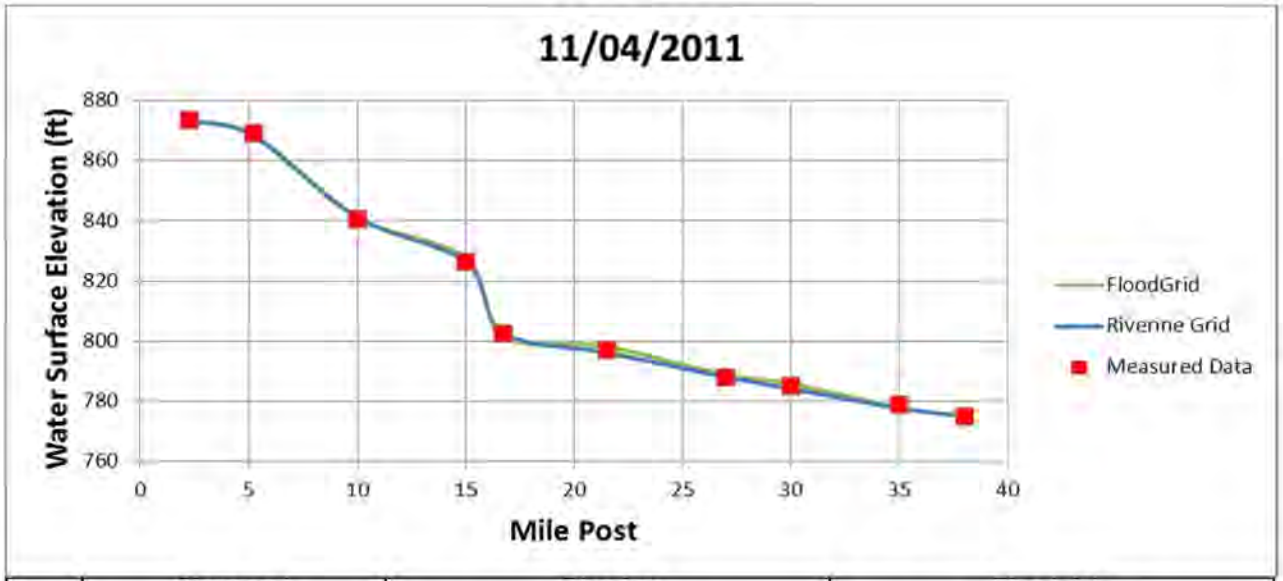
Footnotes:

ft = Feet
% = Percent

WATER SURFACE ELEVATION CALIBRATION

SHEET 6 OF 10

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



	Measured		Riverine			Floodplain		
Mile Post	Water Surface Elevation (ft)	Water Depth (ft)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)
2.25	873.57	4.88	873.46	-0.11	-2	873.66	0.09	2
5.25	869.33	5.34	868.15	-1.18	-22	868.28	-1.05	-20
10.00	840.49	3.17	841.22	0.73	23	841.19	0.70	22
15.00	826.32	3.70	826.33	0.01	0	827.58	1.26	34
16.75	802.26	3.68	802.71	0.45	12	801.63	-0.63	-17
21.50	796.91	3.72	796.12	-0.79	-21	798.09	1.18	32
27.00	787.86	4.66	788.05	0.19	4	788.74	0.88	19
30.00	784.99	5.46	784.15	-0.84	-15	785.82	0.83	15
35.00	778.68	5.58	777.62	-1.06	-19	777.85	-0.83	-15
38.00	774.98	6.58	775.06	0.08	1	775.03	0.05	1

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

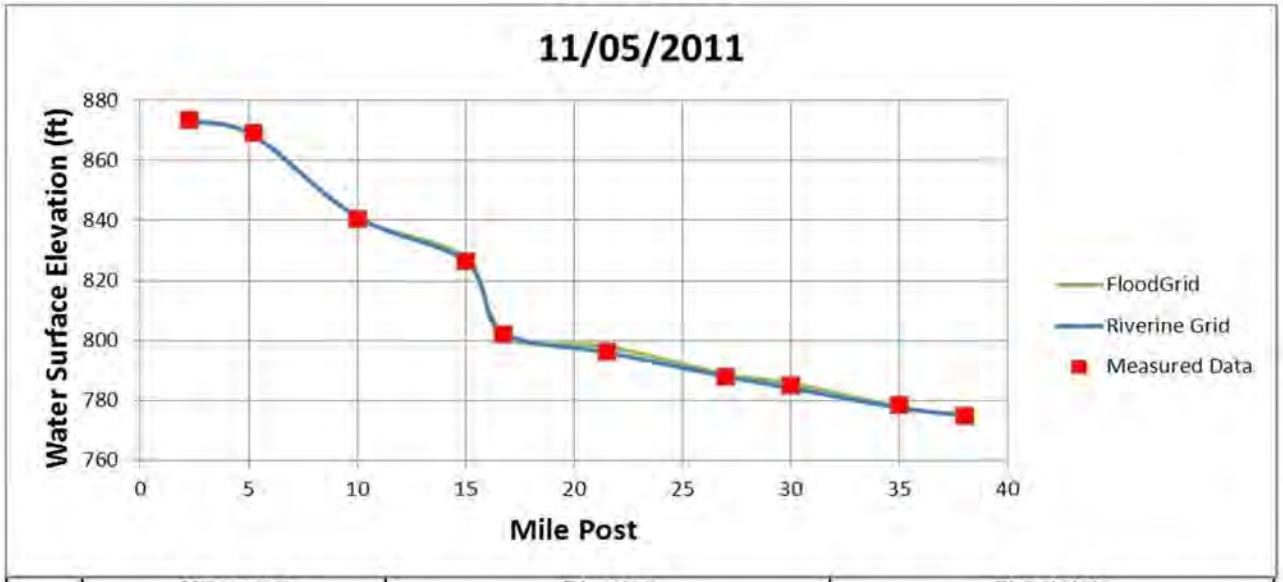
Footnotes:

ft = Feet
% = Percent

WATER SURFACE ELEVATION CALIBRATION

SHEET 7 OF 10

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



	Measured		Riverine			Floodplain		
Mile Post	Water Surface Elevation (ft)	Water Depth (ft)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)
2.25	873.57	4.88	873.43	-0.14	-3	873.66	0.09	2
5.25	869.18	5.19	868.15	-1.03	-20	868.25	-0.93	-18
10.00	840.39	3.07	841.19	0.80	26	841.16	0.77	25
15.00	826.27	3.65	826.33	0.06	2	827.58	1.31	36
16.75	802.24	3.68	802.68	0.44	12	801.53	-0.71	-19
21.50	796.31	3.12	796.06	-0.25	-8	798.02	1.72	55
27.00	787.81	4.61	788.05	0.24	5	788.74	0.93	20
30.00	784.94	5.41	784.15	-0.79	-15	785.79	0.85	16
35.00	778.63	5.53	777.59	-1.05	-19	777.82	-0.82	-15
38.00	774.98	6.58	775.06	0.08	1	775.03	0.05	1

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

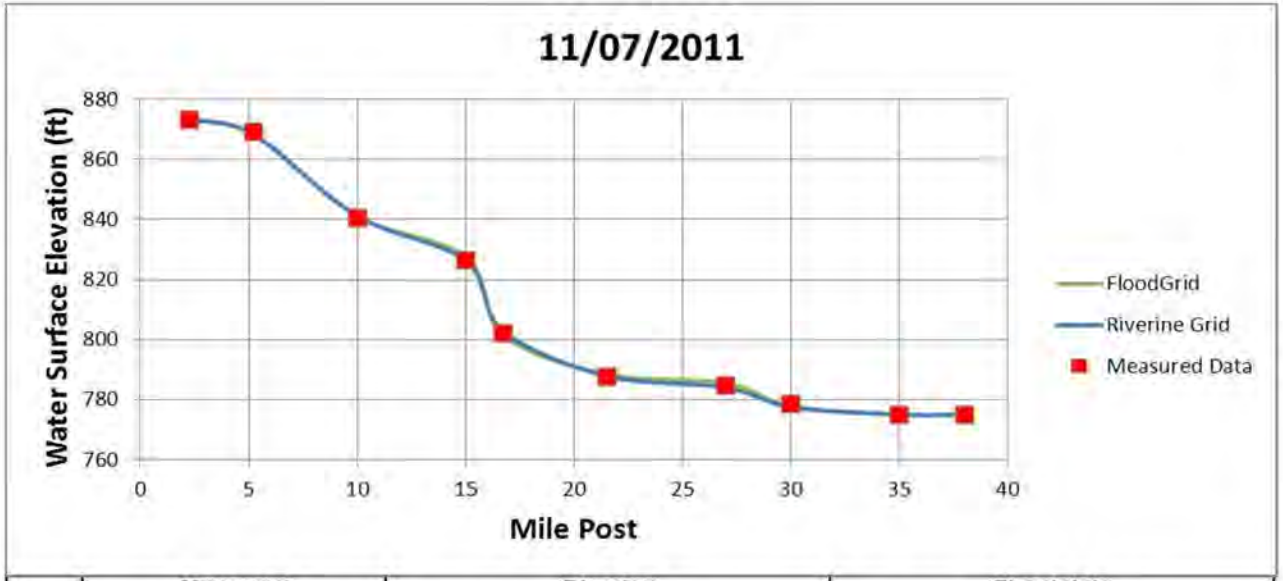
Footnotes:

ft = Feet
% = Percent

WATER SURFACE ELEVATION CALIBRATION

SHEET 8 OF 10

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



	Measured		Riverine			Floodplain		
Mile Post	Water Surface Elevation (ft)	Water Depth (ft)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)
2.25	873.27	4.58	873.46	0.19	4	873.66	0.39	8
5.25	869.08	5.09	868.15	-0.93	-18	868.28	-0.80	-16
10.00	840.39	3.07	841.19	0.80	26	841.19	0.80	26
15.00	826.27	3.65	826.33	0.06	2	827.58	1.31	36
16.75	802.24	3.68	802.71	0.47	13	801.47	-0.77	-21
21.50	787.71	4.51	787.89	0.18	4	788.48	0.77	17
27.00	784.79	5.26	784.02	-0.77	-15	785.53	0.74	14
30.00	778.58	5.48	777.49	-1.09	-20	777.69	-0.90	-16
35.00	774.98	6.58	775.03	0.05	1	775.00	0.01	0
38.00	775.00	6.59	775.03	0.03	0	775.00	0.00	0

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

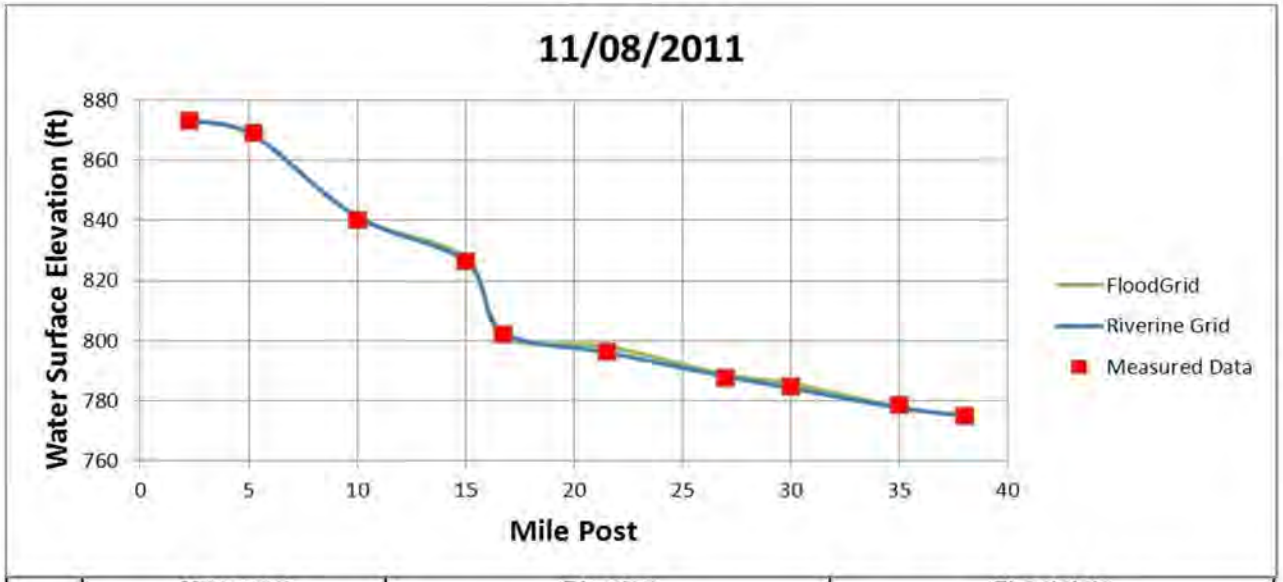
Footnotes:

ft = Feet
% = Percent

WATER SURFACE ELEVATION CALIBRATION

SHEET 9 OF 10

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



	Measured		Riverine			Floodplain		
Mile Post	Water Surface Elevation (ft)	Water Depth (ft)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)	Simulated Water Surface Elevation (ft)	Difference (ft)	Difference Normalized to Depth (%)
2.25	873.27	4.58	873.50	0.22	5	873.69	0.42	9
5.25	869.08	5.09	868.18	-0.90	-18	868.31	-0.77	-15
10.00	840.29	3.07	841.25	0.96	31	841.22	0.93	30
15.00	826.27	3.65	826.36	0.09	3	827.58	1.31	36
16.75	802.24	3.68	802.71	0.47	13	801.57	-0.67	-18
21.50	796.31	3.12	796.09	-0.22	-7	798.02	1.72	55
27.00	787.71	4.51	788.05	0.34	8	788.64	0.93	21
30.00	784.79	5.26	784.15	-0.64	-12	785.72	0.93	18
35.00	778.53	5.48	777.59	-0.95	-17	777.75	-0.78	-14
38.00	774.98	6.58	775.03	0.05	1	774.97	-0.02	0

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

Footnotes:

ft = Feet
% = Percent

WATER SURFACE ELEVATION CALIBRATION

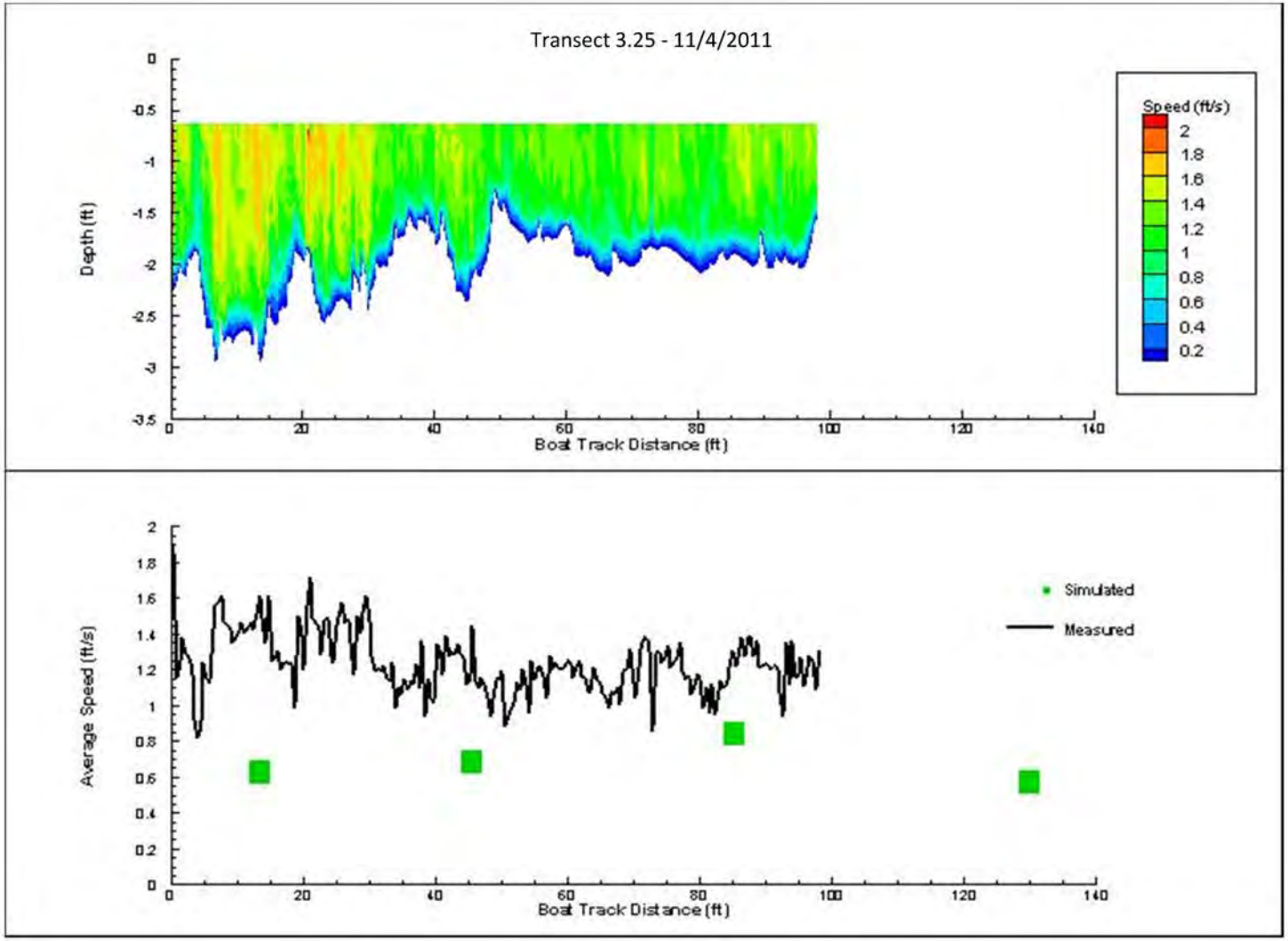
SHEET 10 OF 10

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 4-4

ADCP Transect Data

Sheets 1 through 21



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

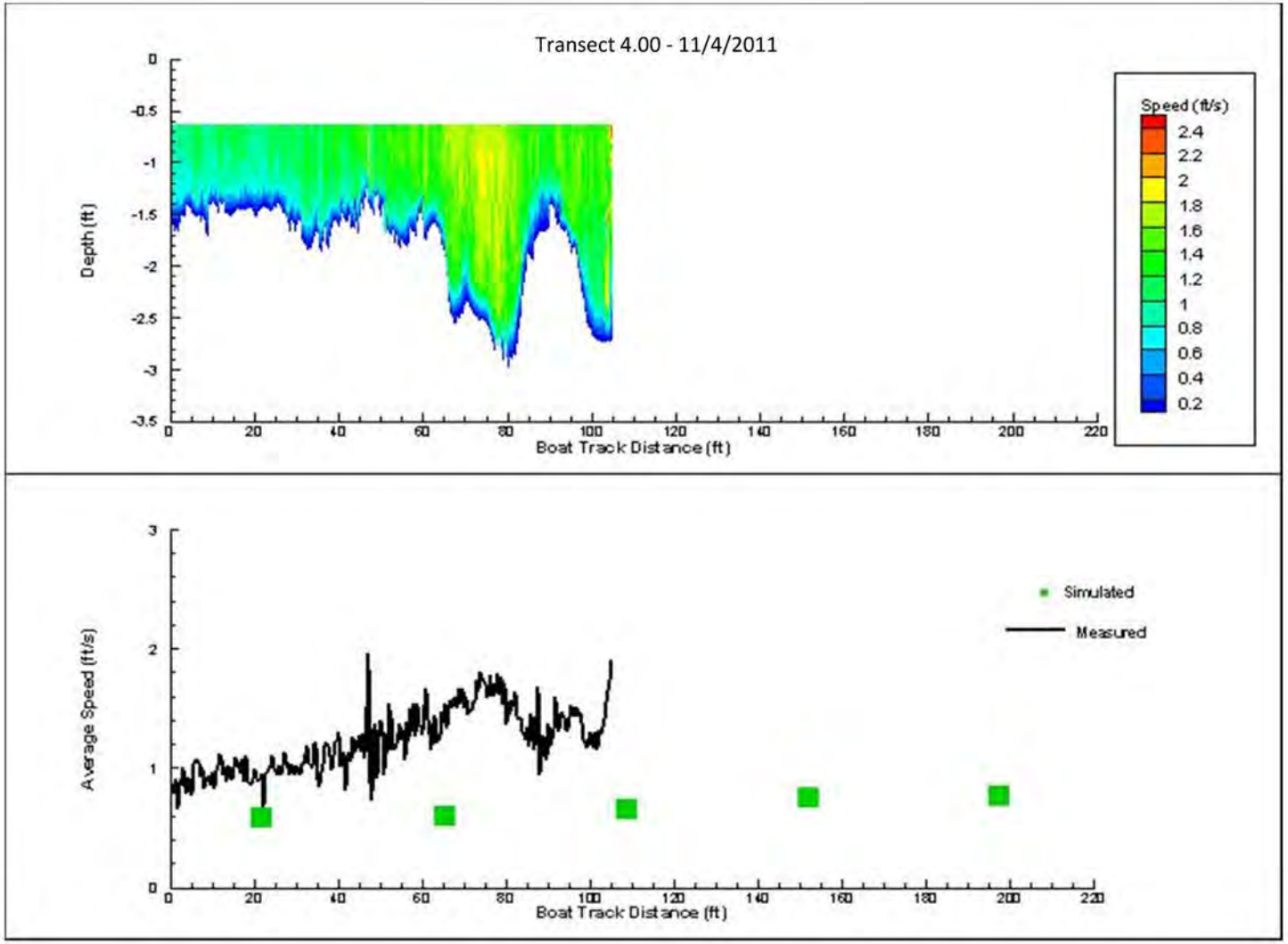
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 3.25 - 11/4/2011

SHEET 1 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

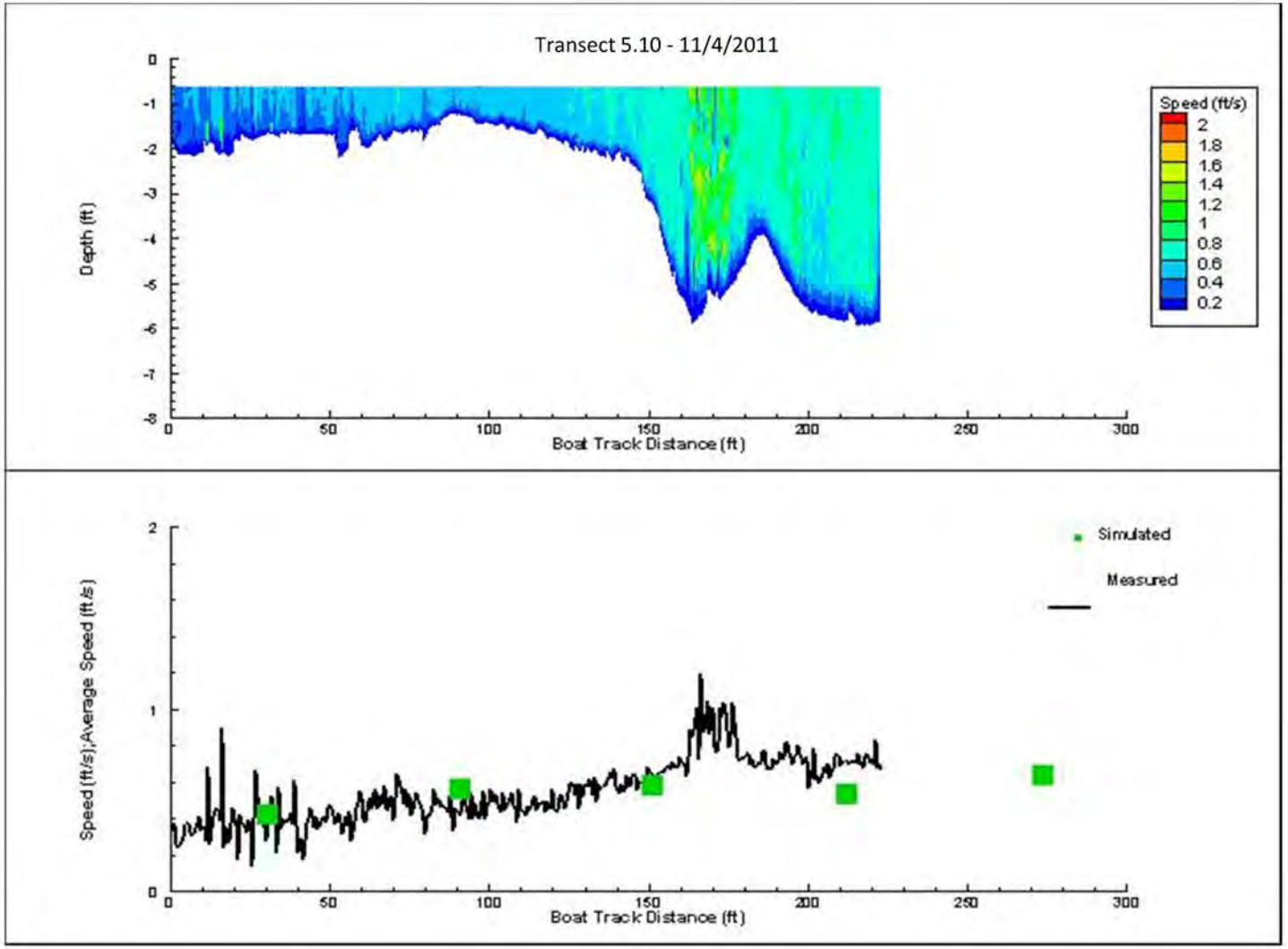
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 4.00 - 11/4/2011

SHEET 2 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

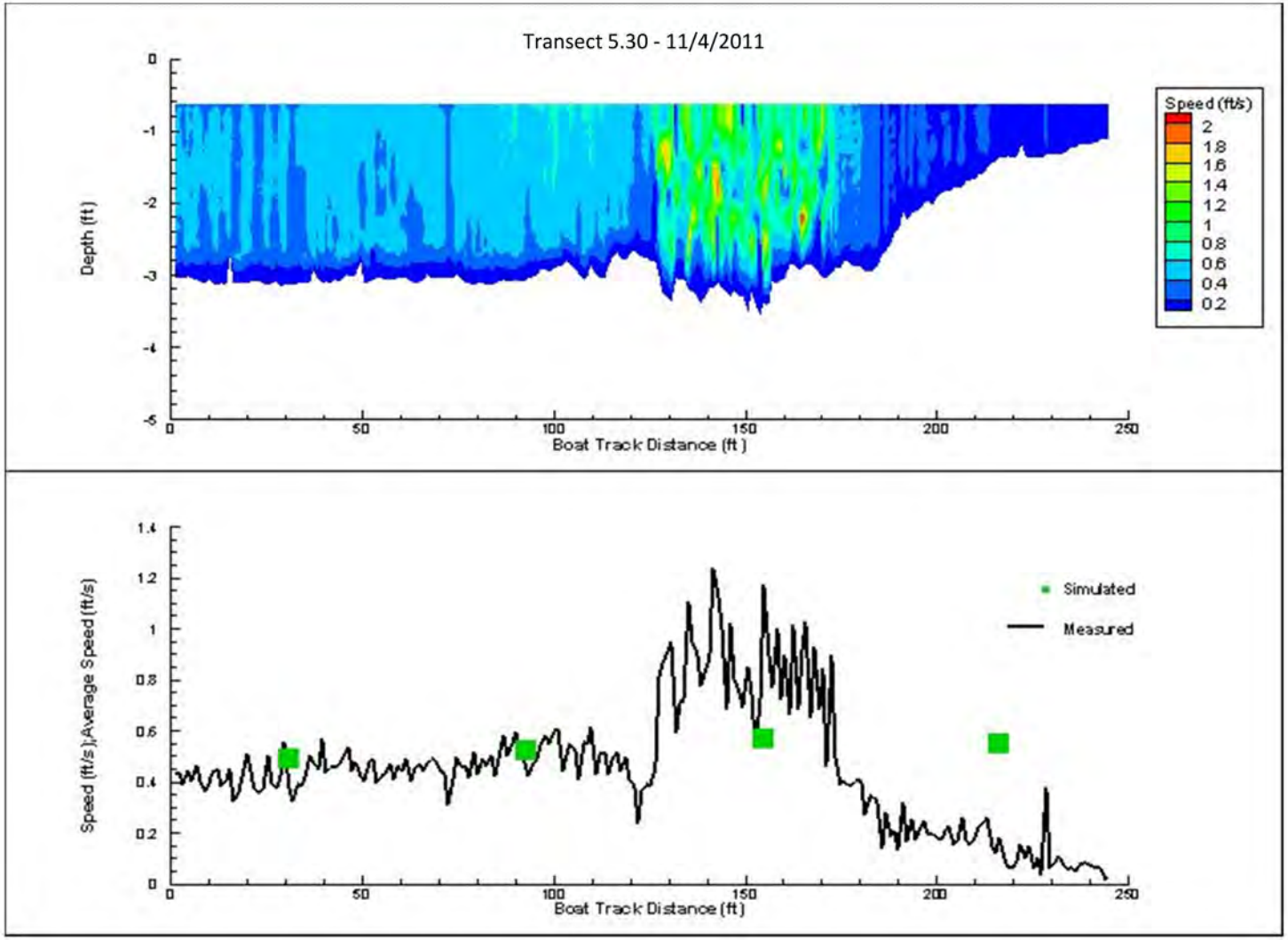
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 5.10 - 11/4/2011

SHEET 3 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



Drawn:	JLH 04/17/2012
Approved:	DBR 04/17/2012
Project #:	106-4186

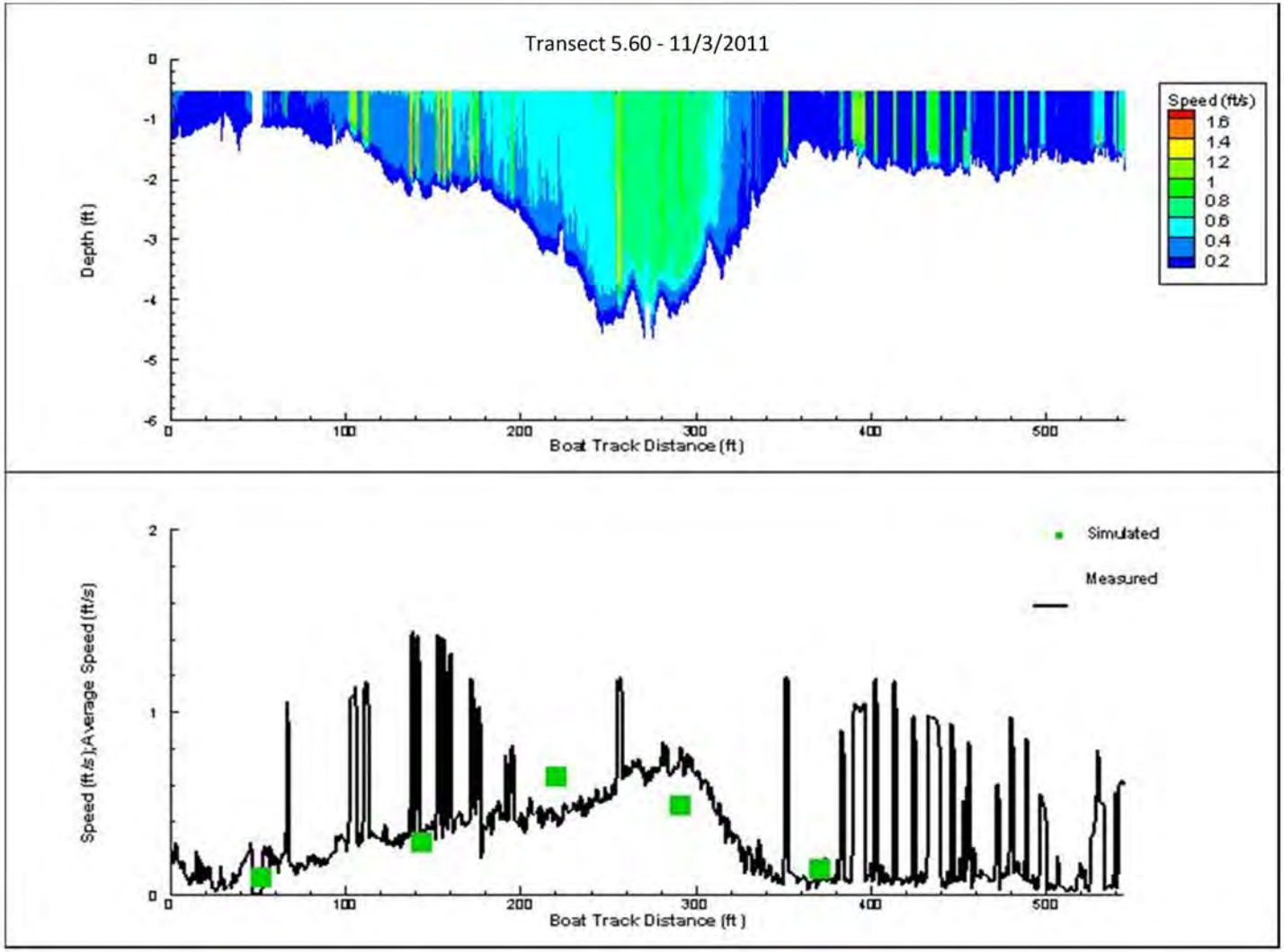
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 5.30 - 11/4/2011

SHEET 4 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

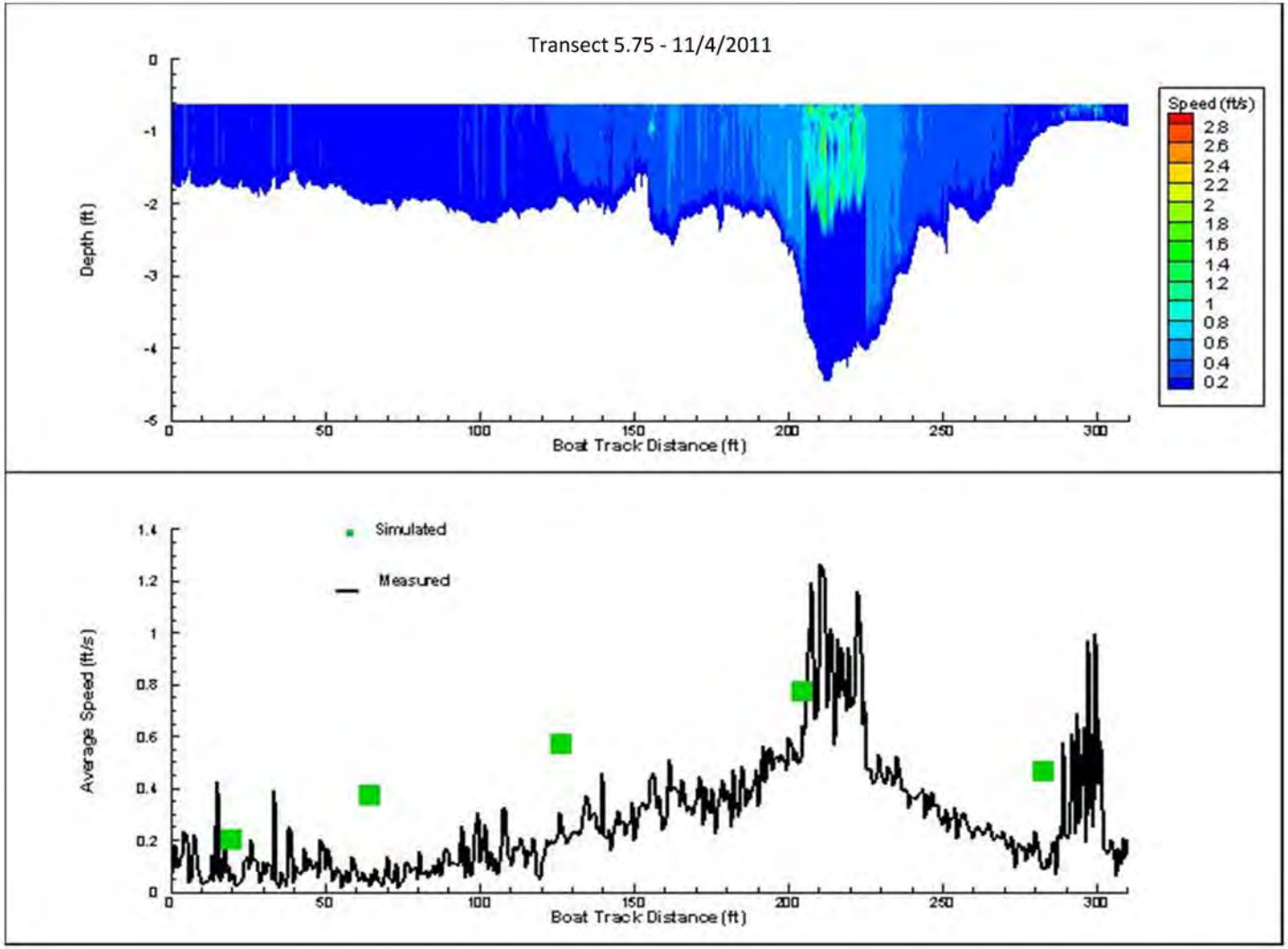
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 5.60 - 11/3/2011

SHEET 5 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

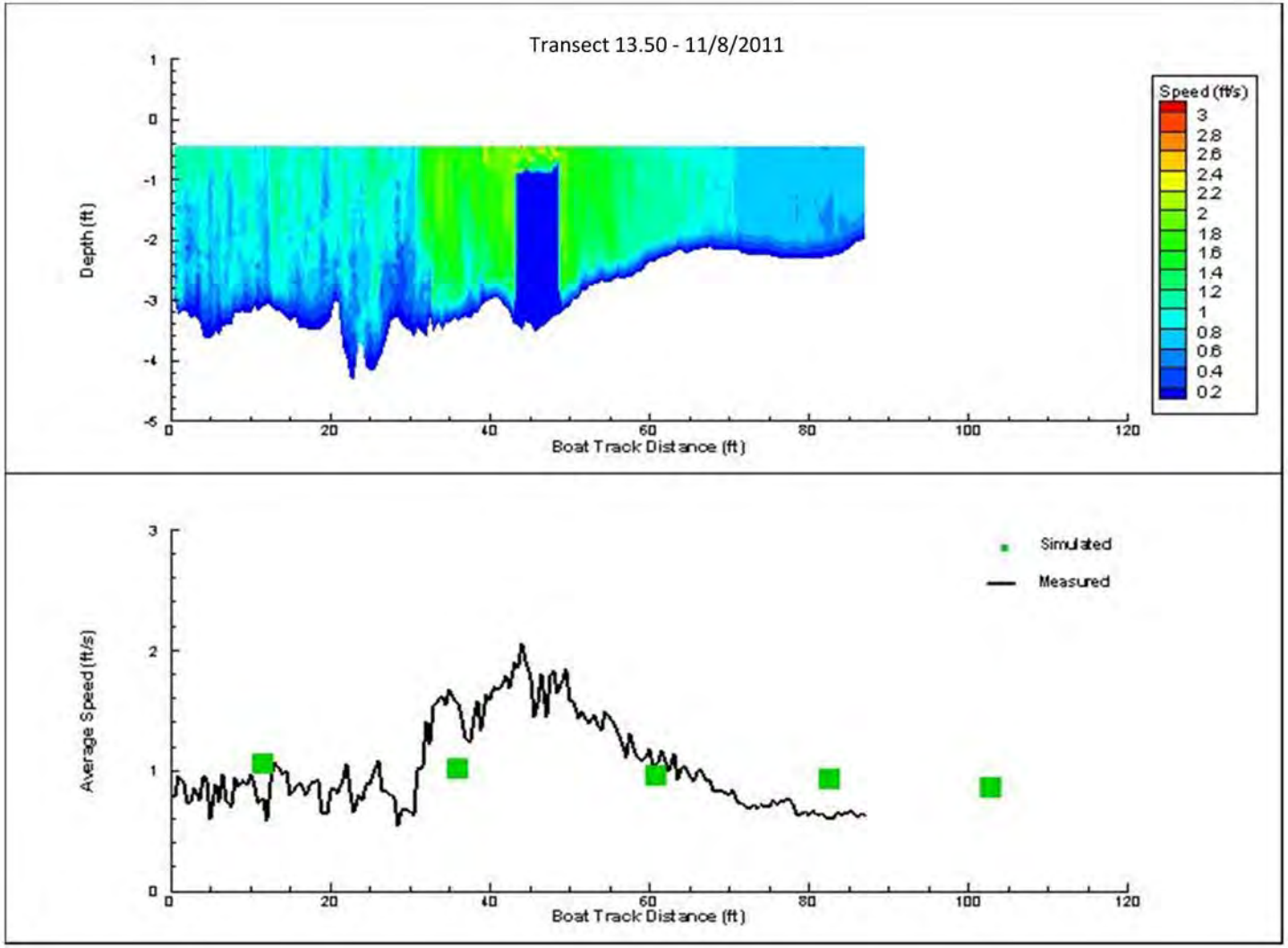
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 5.75 - 11/4/2011

SHEET 6 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

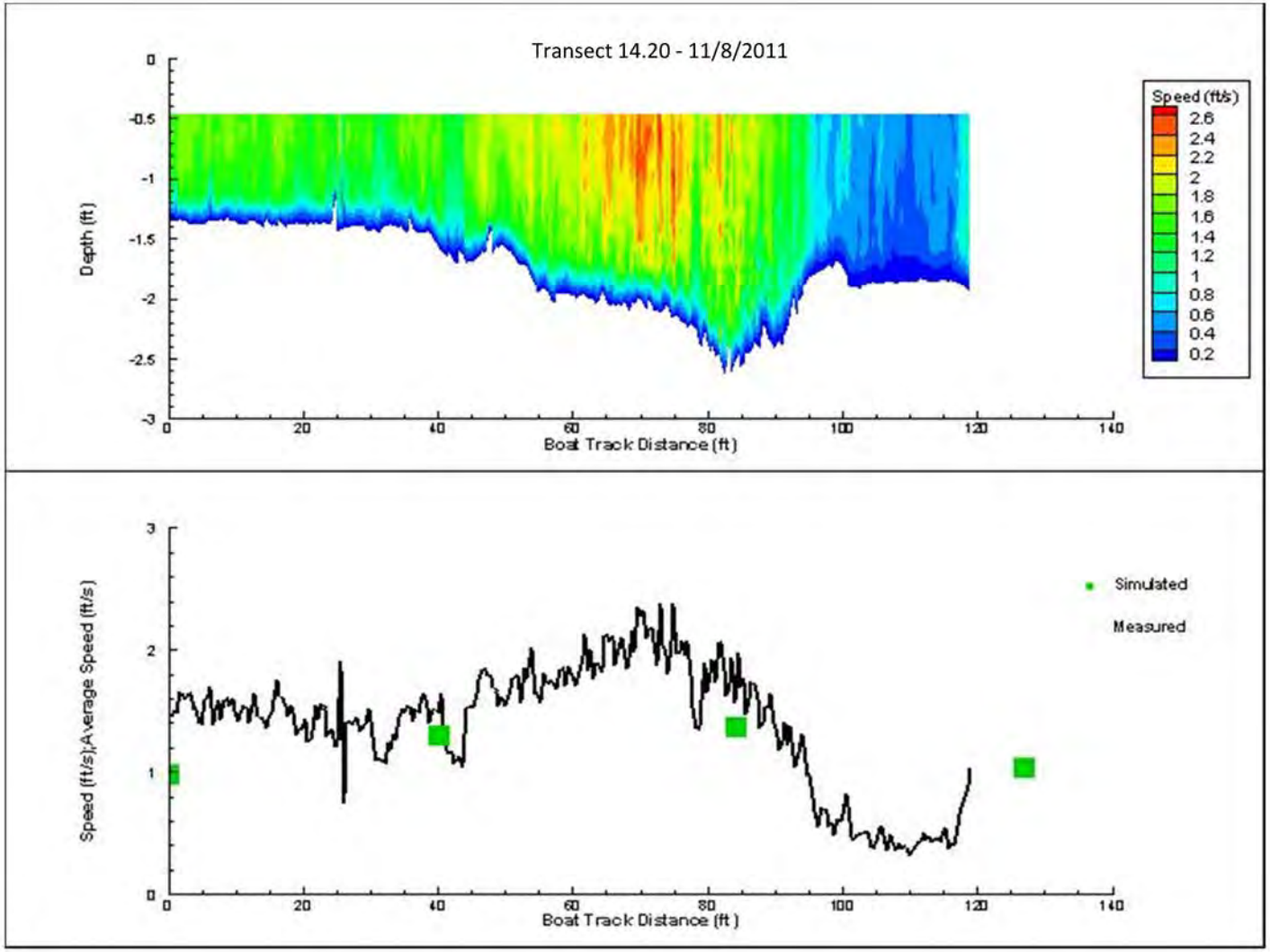
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 13.50 - 11/8/2011

SHEET 7 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

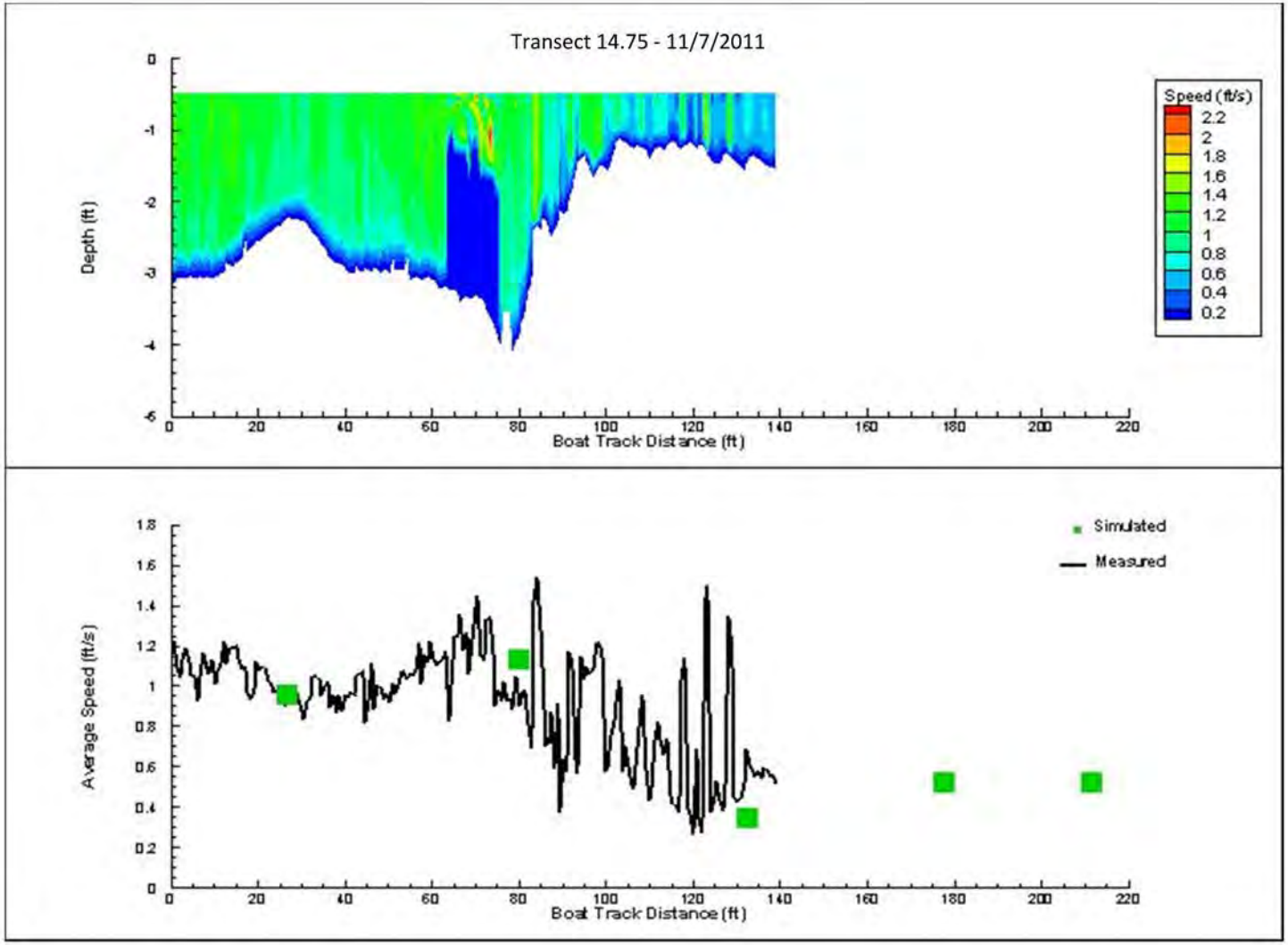
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 14.20 - 11/8/2011

SHEET 8 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



Drawn:	JLH 04/17/2012
Approved:	DBR 04/17/2012
Project #:	106-4186

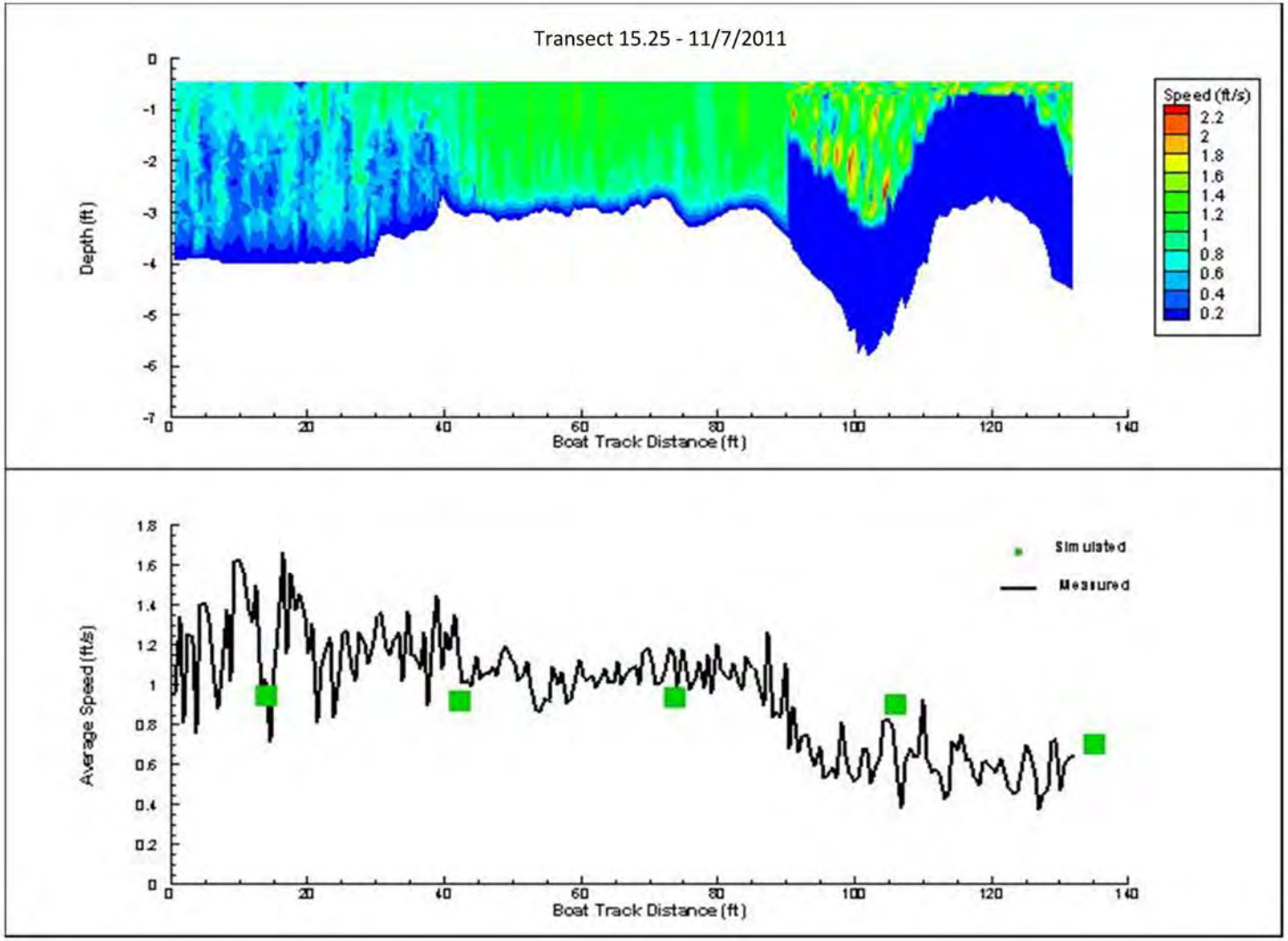
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 14.75 - 11/7/2011

SHEET 9 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



Drawn:	JLH 04/17/2012
Approved:	DBR 04/17/2012
Project #:	106-4186

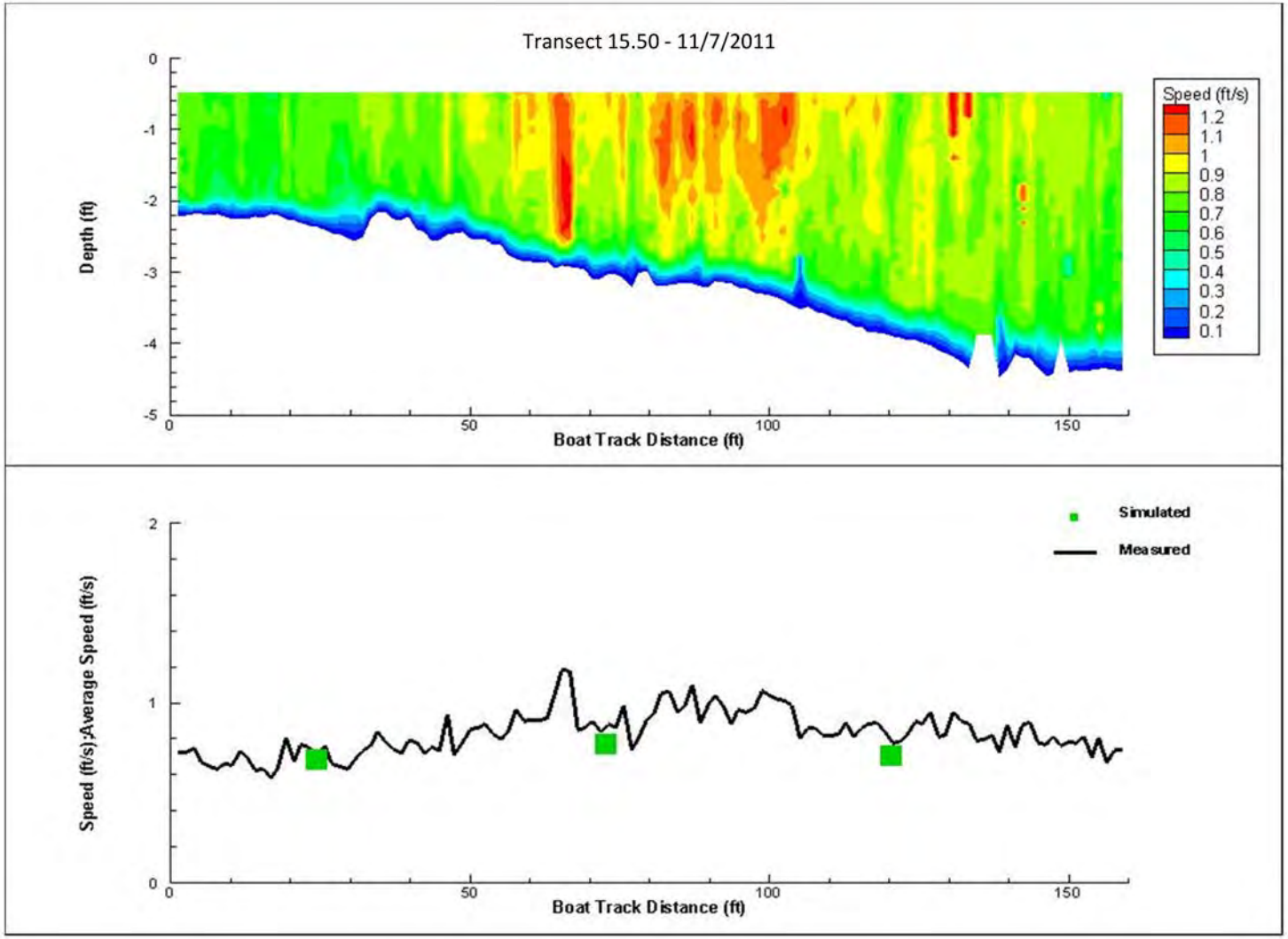
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 15.25 - 11/7/2011

SHEET 10 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

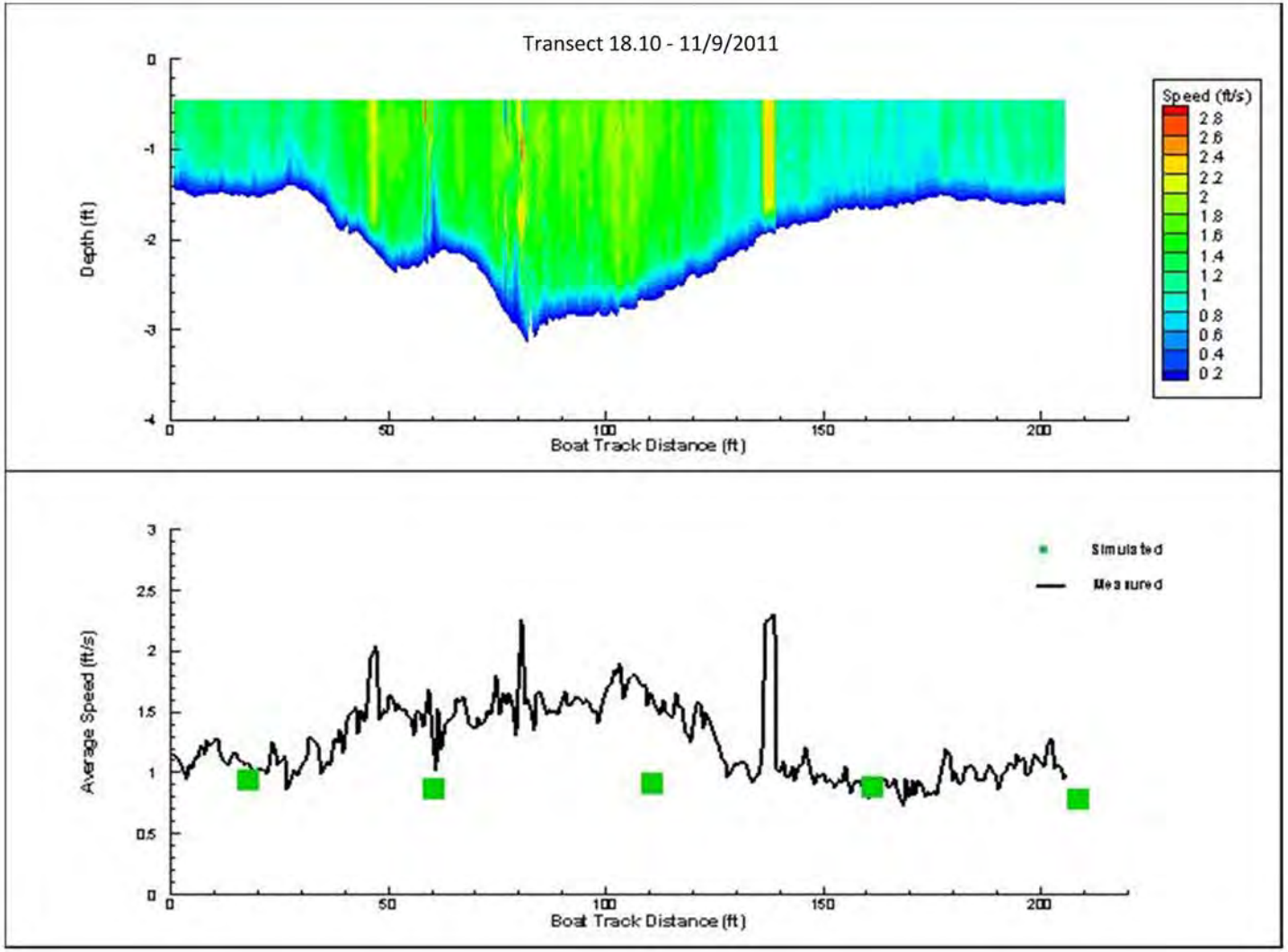
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 15.50 - 11/7/2011

SHEET 11 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

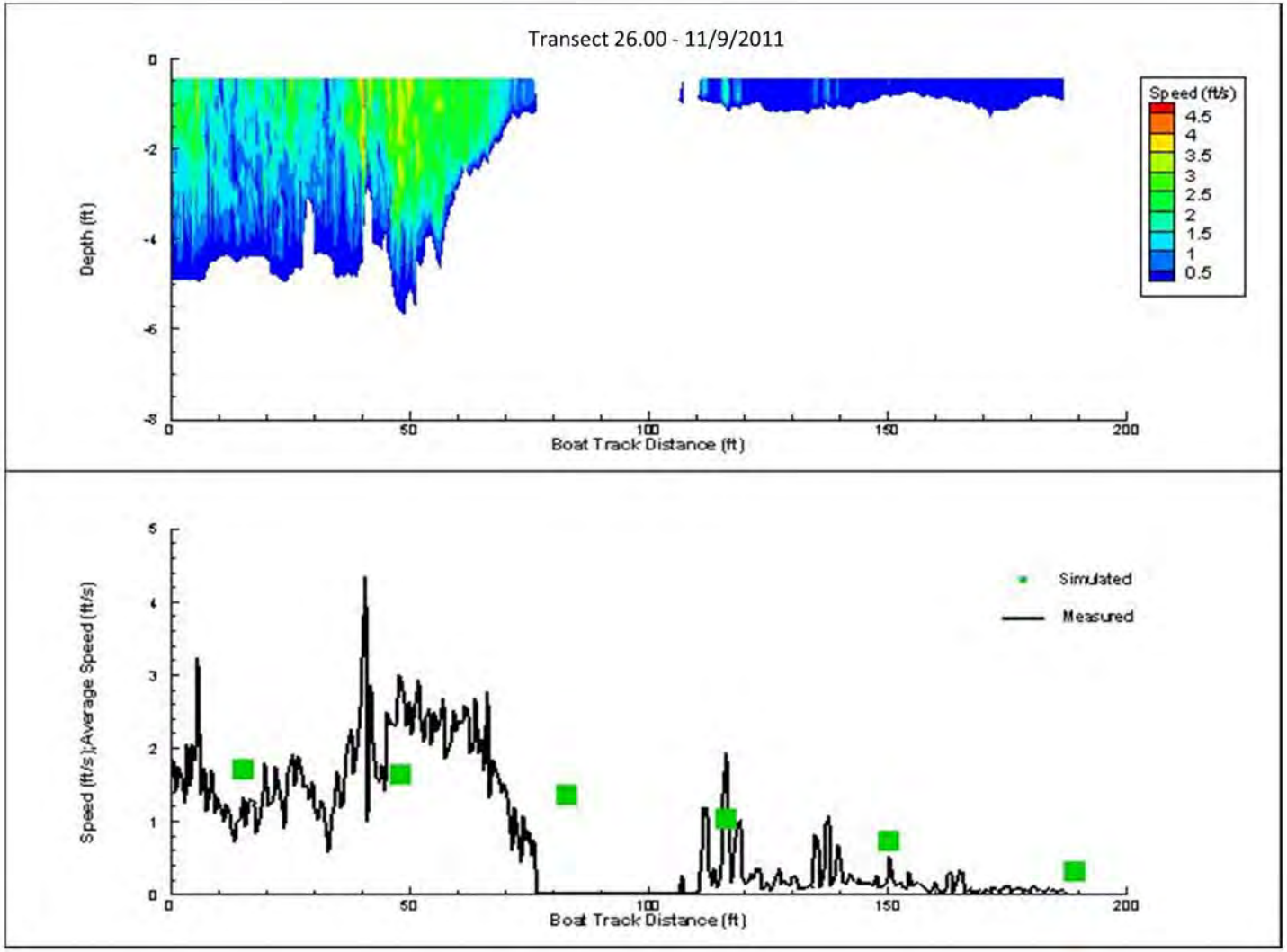
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 18.10 - 11/9/2011

SHEET 12 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

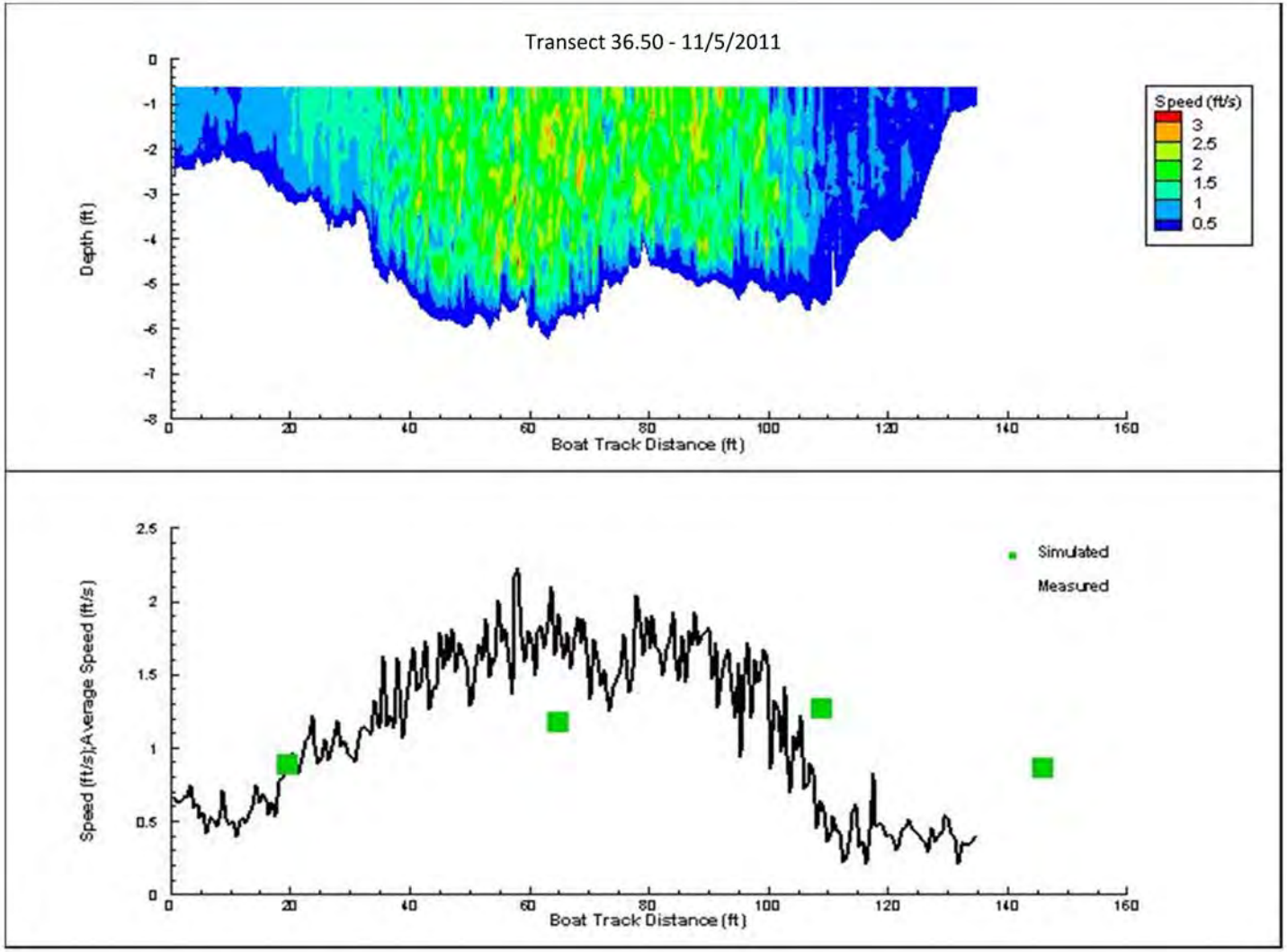
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 26.00 - 11/9/2011

SHEET 13 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

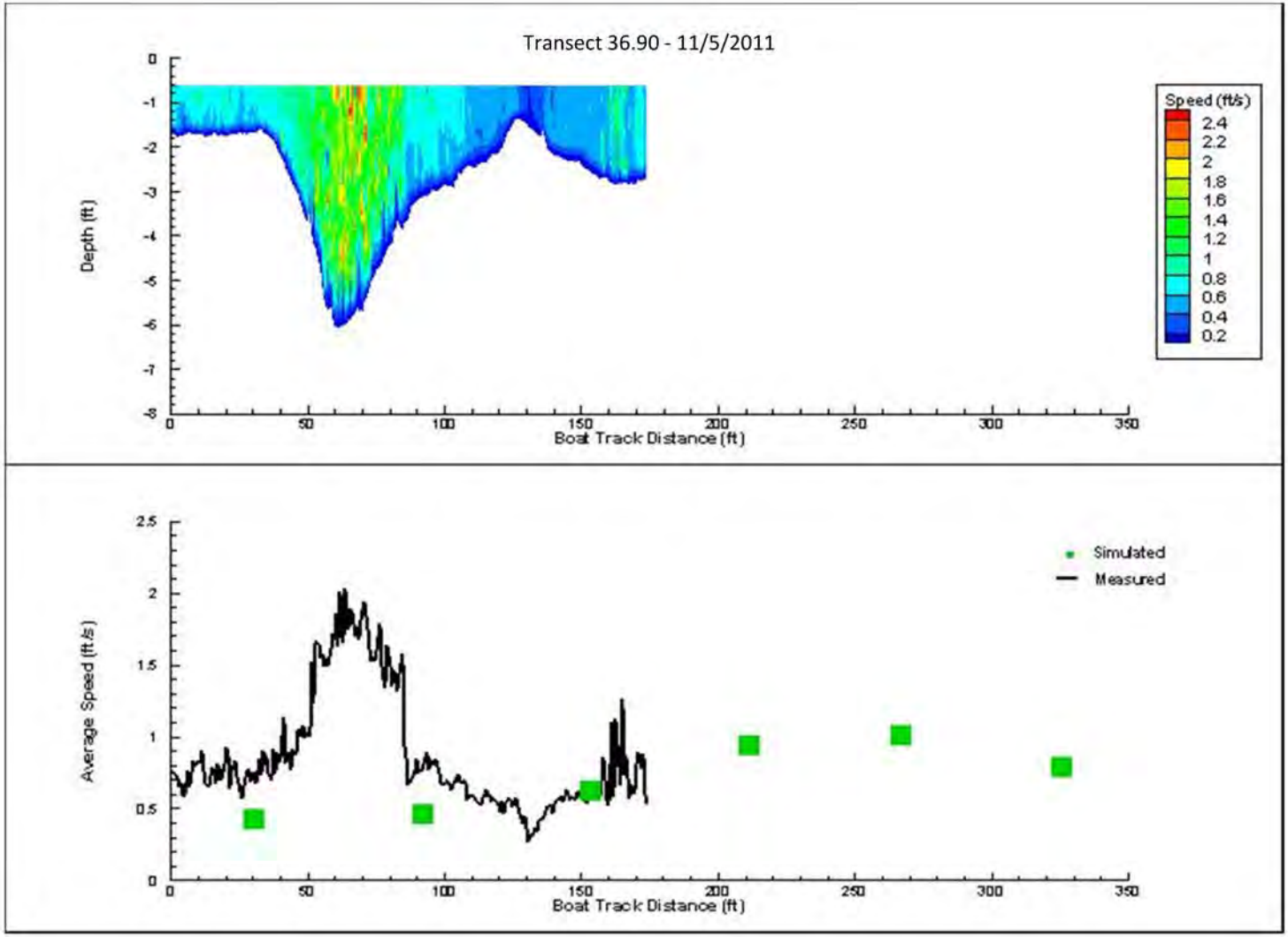
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 36.50 - 11/5/2011

SHEET 14 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

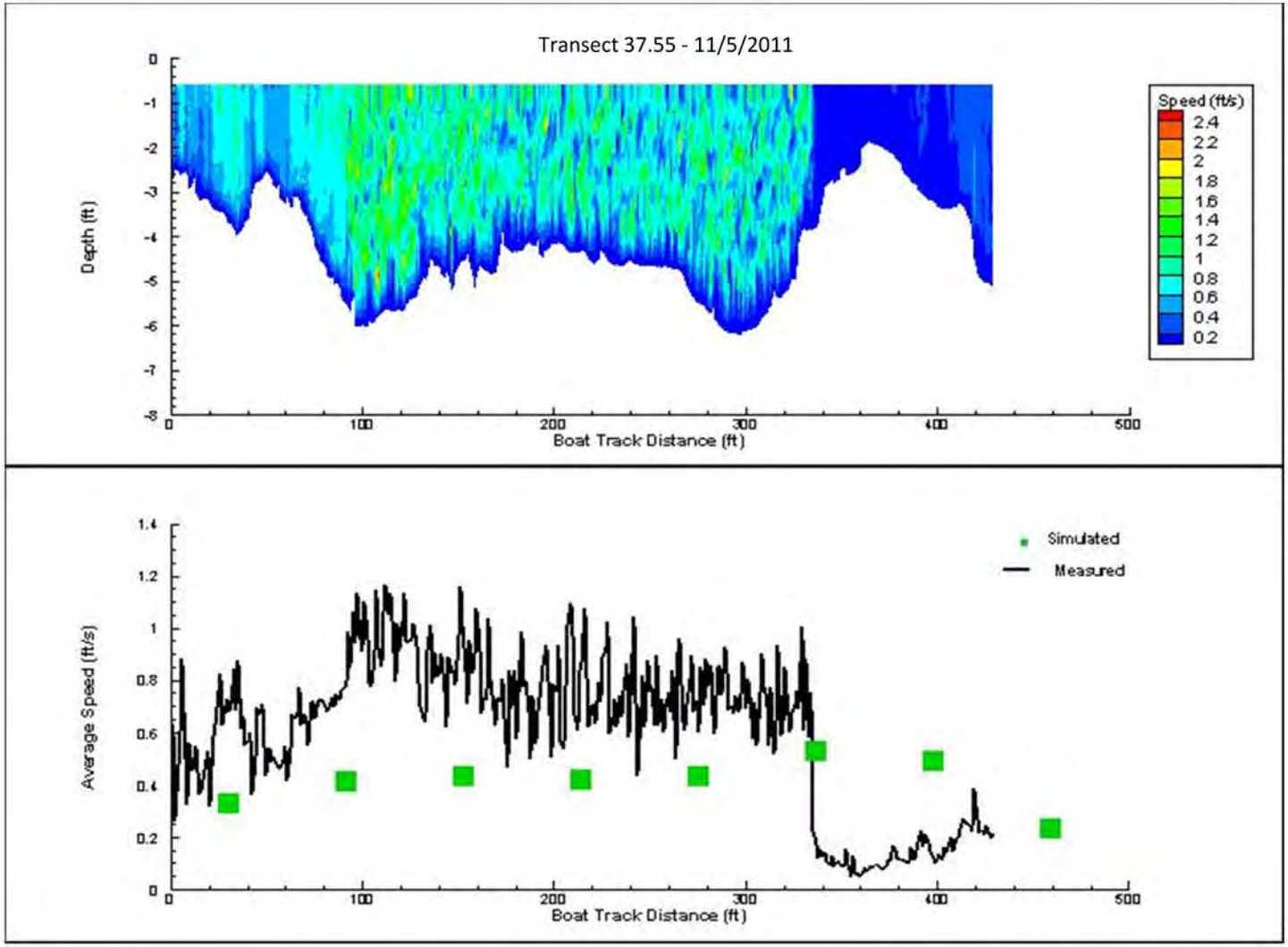
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 36.90 - 11/5/2011

SHEET 15 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

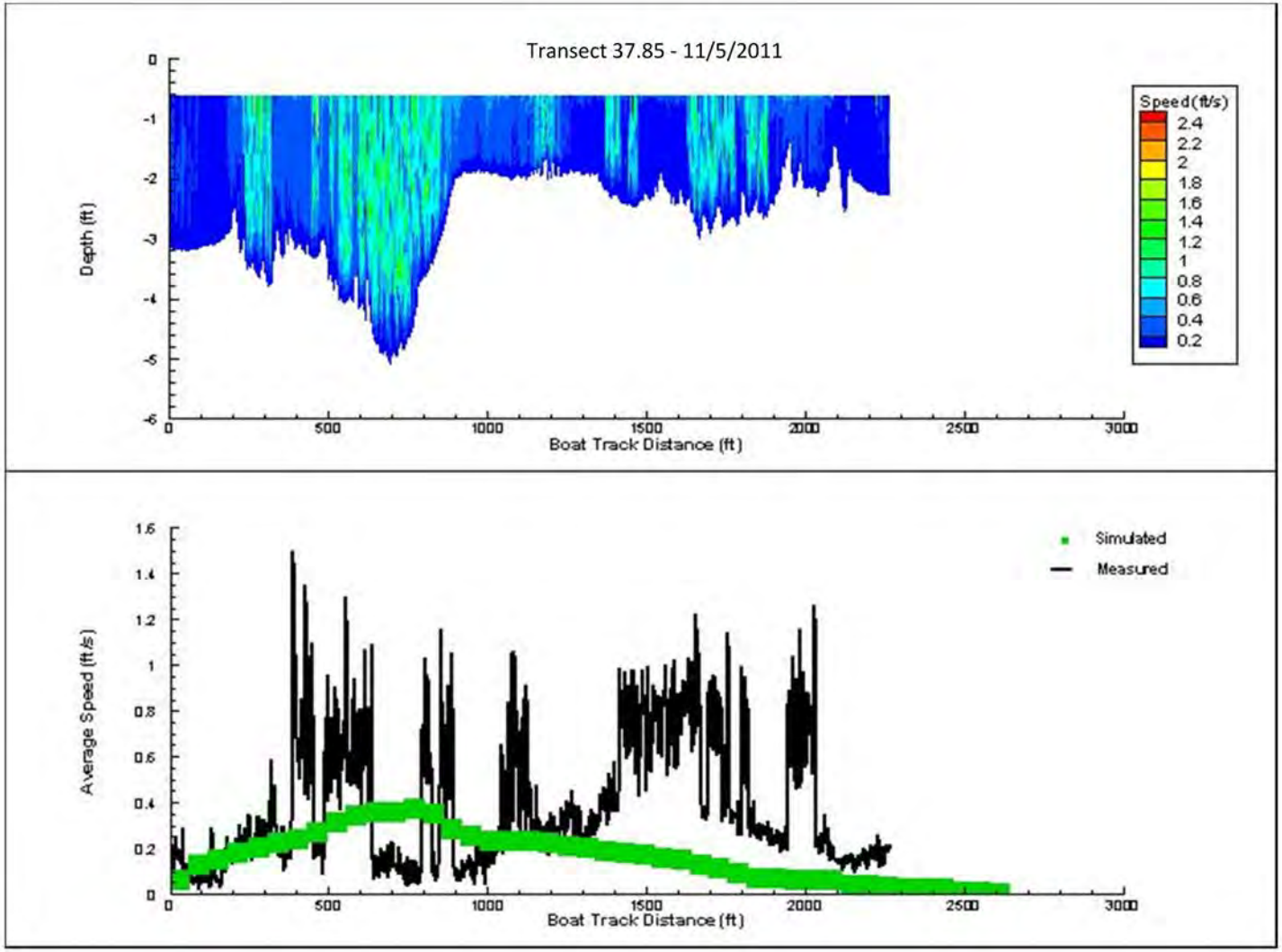
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 37.55 - 11/5/2011

SHEET 16 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

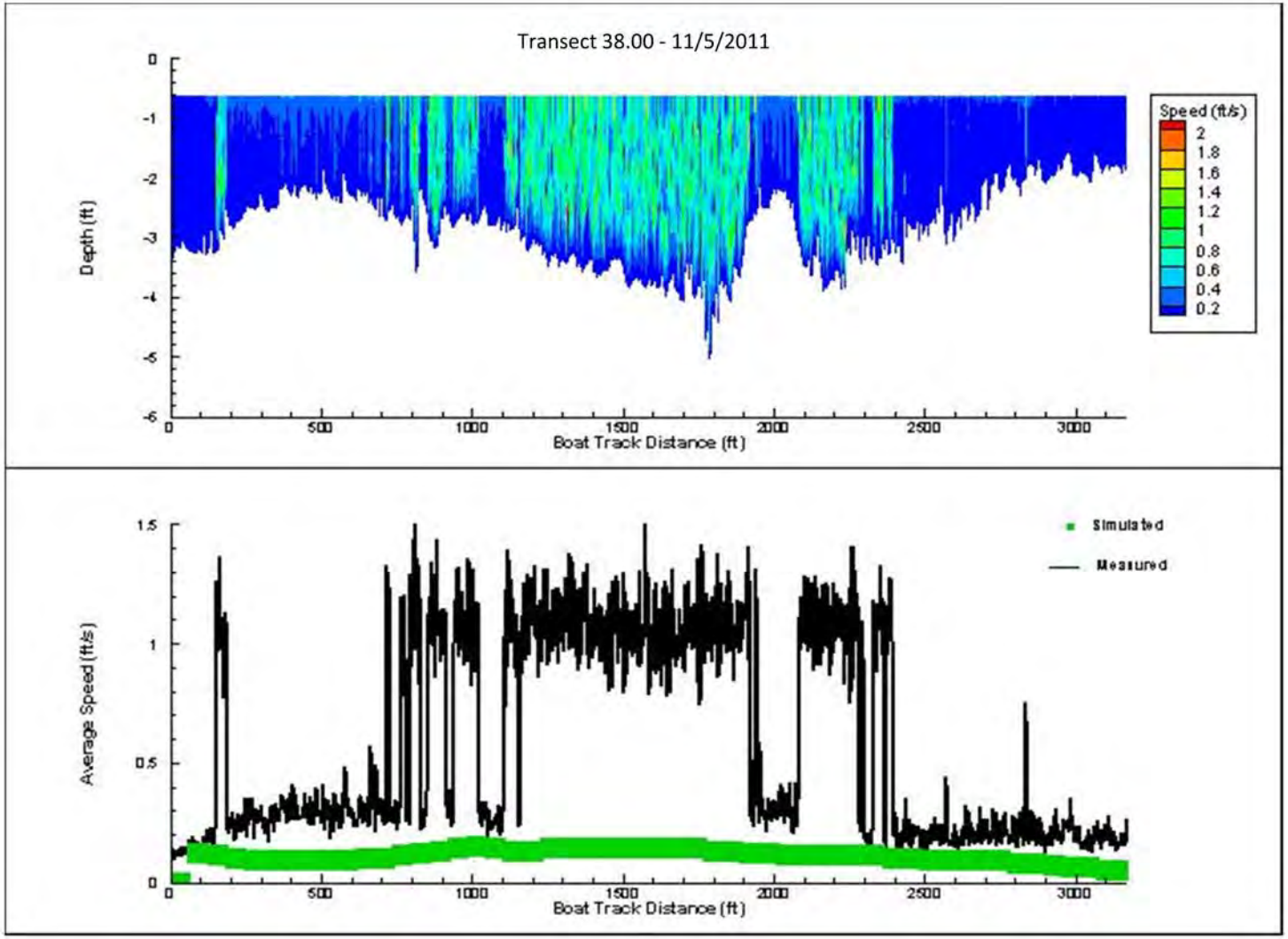
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 37.85 - 11/5/2011

SHEET 17 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

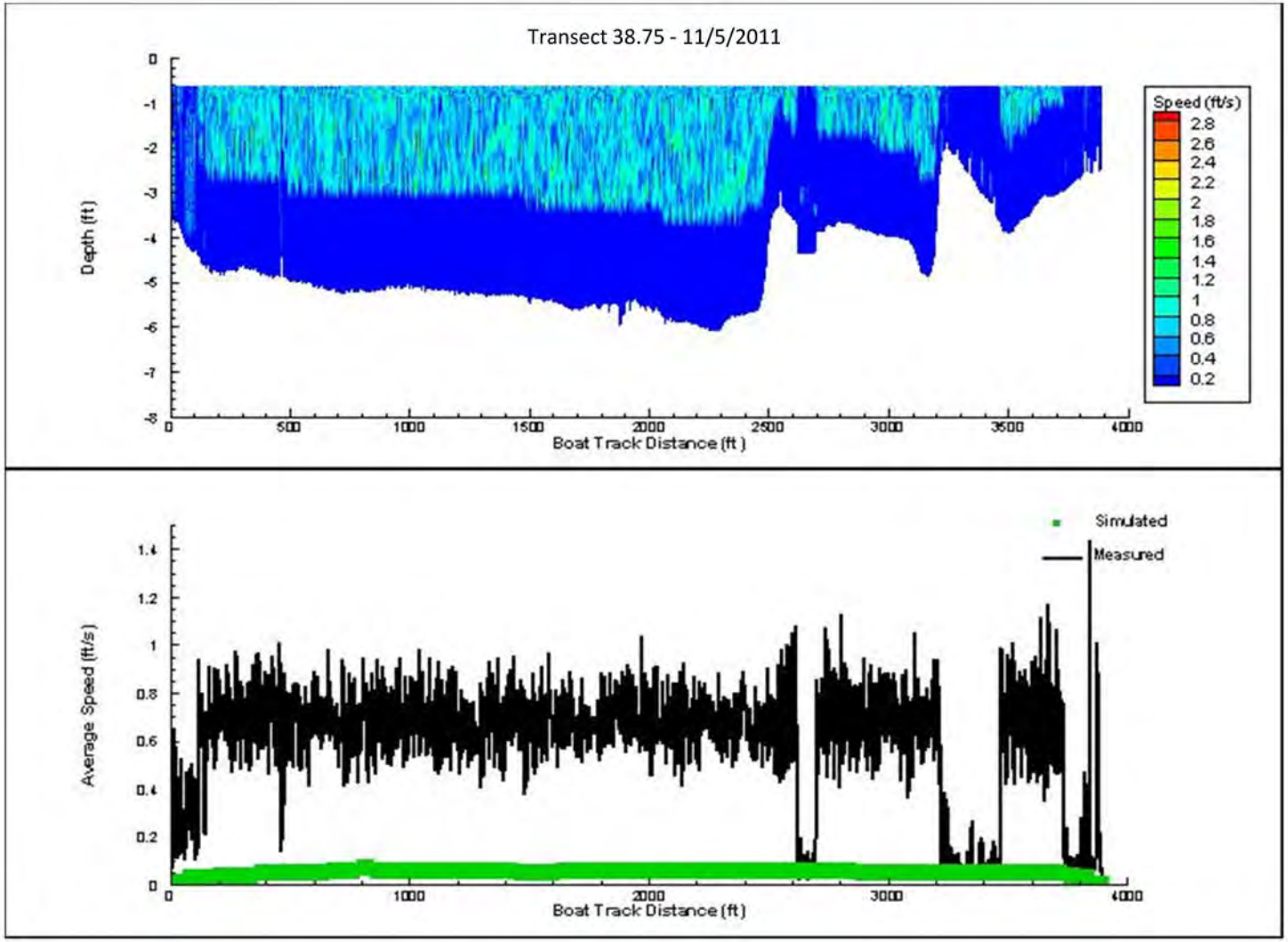
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 38.00 - 11/5/2011

SHEET 18 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

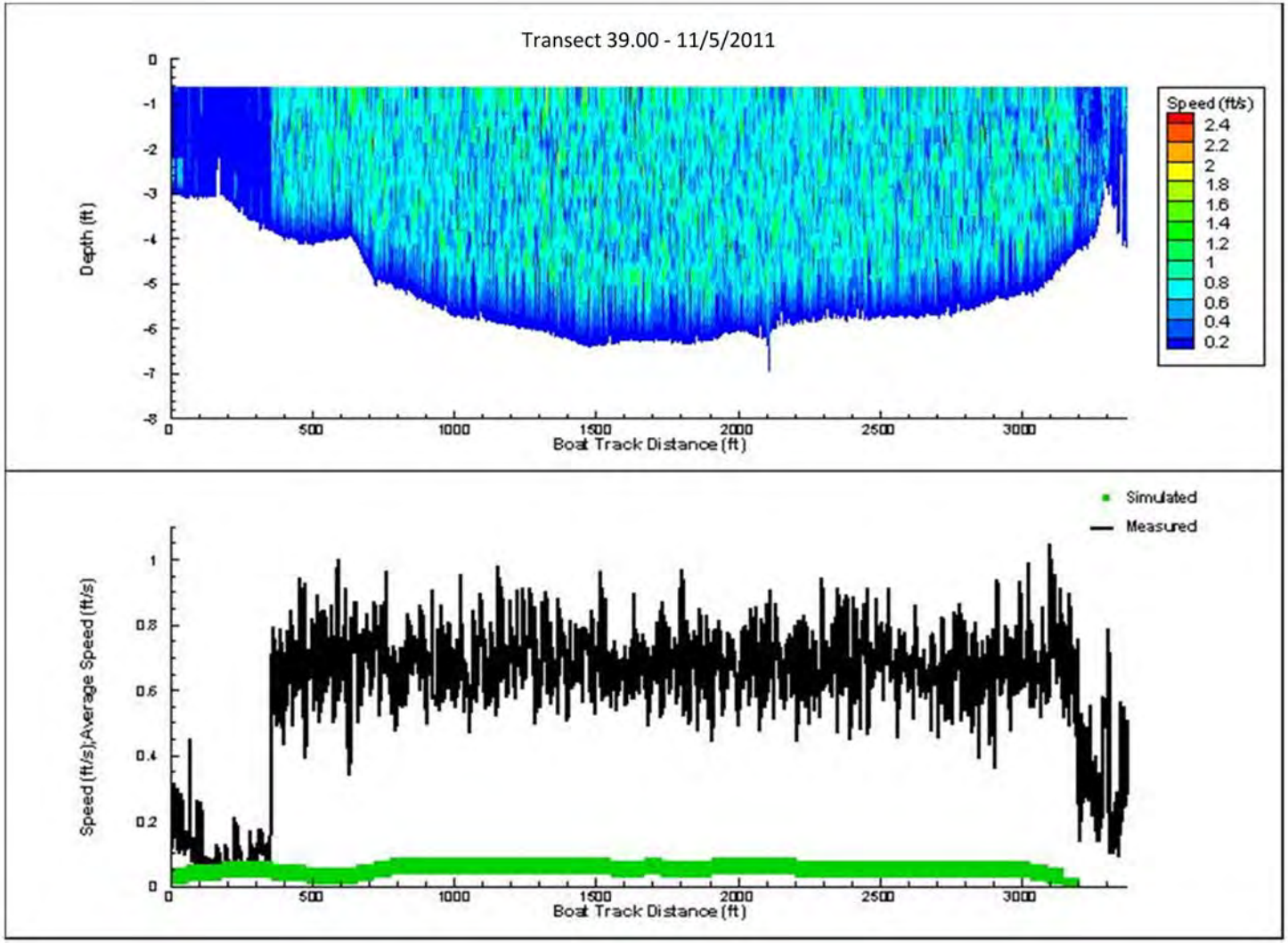
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 38.75 - 11/5/2011

SHEET 19 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

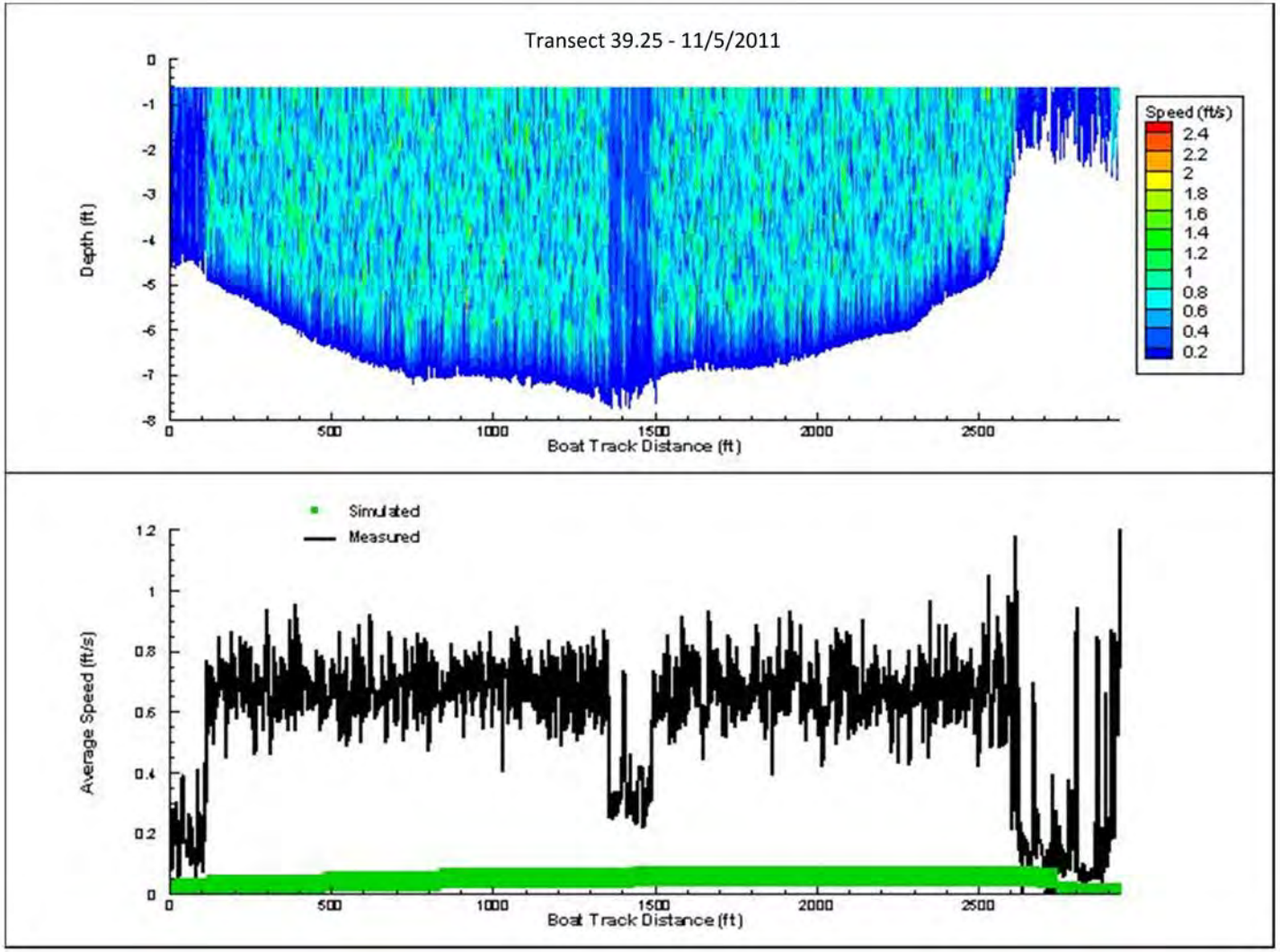
Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 39.00 - 11/5/2011

SHEET 20 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

Footnotes:

ft = Feet
ft/s = Feet per Second

ADCP TRANSECT DATA
TRANSECT 39.25 - 11/5/2011

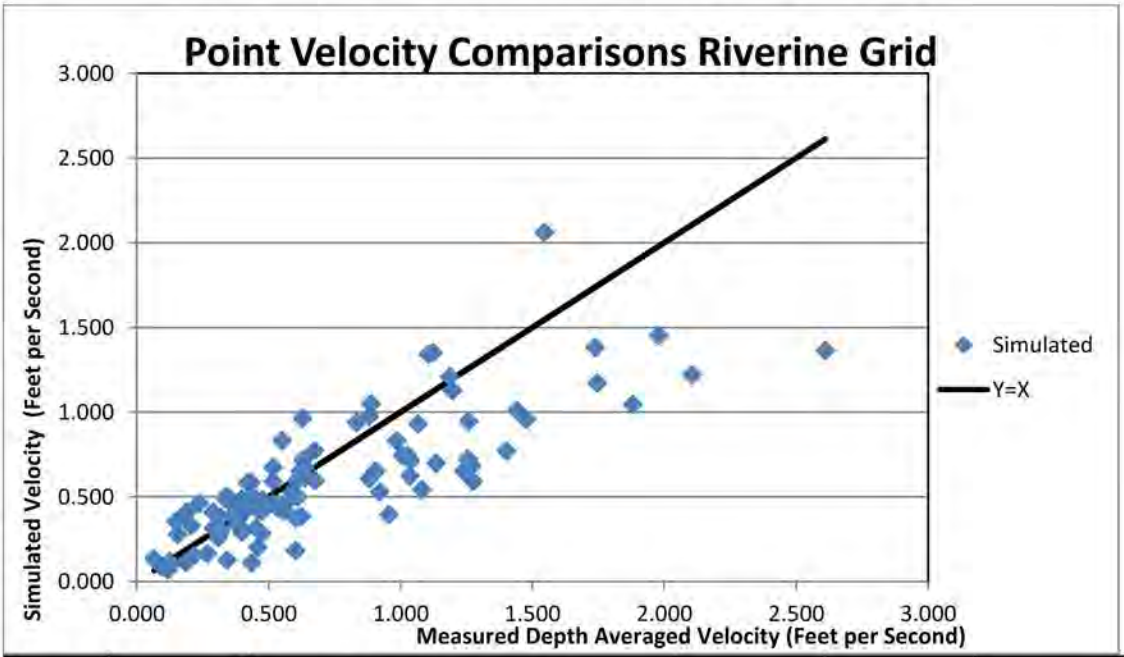
SHEET 21 OF 21

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 4-5

ADP Point Velocity Comparison During Calibration Period-Riverine

Sheets 1 through 4



Station	Date	Measured Velocity (Feet per Second)			Simulated Velocity (Feet per Second)	Difference (Feet per Second)	Difference (Percent)
		Average	Average minus Standard Deviation	Average plus Standard Deviation			
1	11/04/2011	1.771	1.633	1.909	1.429	-0.204	-12
2	11/04/2011	1.136	1.005	1.267	0.844	-0.161	-16
3	11/04/2011	1.271	1.103	1.439	0.683	-0.419	-38
6	11/04/2011	1.402	1.187	1.617	0.772	-0.416	-35
7	11/04/2011	1.240	1.147	1.332	0.652	-0.495	-43
8	11/04/2011	1.275	1.164	1.386	0.590	-0.574	-49
9	11/04/2011	1.036	0.964	1.108	0.623	-0.341	-35
10	11/04/2011	1.038	0.924	1.151	0.713	-0.211	-23
14	11/03/2011	0.629	0.563	0.695	0.718	0.155	28
15	11/03/2011	0.674	0.585	0.763	0.773	0.188	32
16	11/03/2011	0.906	0.866	0.946	0.654	-0.212	-24
17	11/03/2011	0.517	0.496	0.537	0.591	0.095	19
18	11/03/2011	0.461	0.398	0.524	0.422	0.024	6
19	11/03/2011	0.587	0.548	0.625	0.529	-0.018	-3
20	11/02/2011	0.237	0.229	0.244	0.461	0.232	101
22	11/02/2011	0.606	0.559	0.653	0.592	0.032	6
23	11/02/2011	0.439	0.394	0.483	0.504	0.110	28
24	11/03/2011	0.433	0.407	0.459	0.584	0.177	44
25	11/02/2011	0.147	0.126	0.169	0.355	0.229	182

ENBRIDGE

Drawn: JLH 04/17/2012

Approved: DBR 04/17/2012

Project #: 106-4186

ADP POINT VELOCITY COMPARISON DURING CALIBRATION PERIOD-RIVERINE

SHEET 1 OF 4

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Station	Date	Measured Velocity (Feet per Second)			Simulated Velocity (Feet per Second)	Difference (Feet per Second)	Difference (Percent)
		Average	Average minus Standard Deviation	Average plus Standard Deviation			
26	11/02/2011	0.189	0.169	0.209	0.409	0.241	143
27	11/02/2011	0.376	0.342	0.410	0.409	0.068	20
28	11/02/2011	0.619	0.574	0.664	0.652	0.078	14
29	11/02/2011	0.313	0.294	0.333	0.287	-0.007	-2
30	11/03/2011	0.097	0.078	0.116	0.089	0.011	15
31	11/03/2011	0.290	0.258	0.322	0.313	0.055	21
32	11/03/2011	0.517	0.473	0.561	0.674	0.201	43
33	11/03/2011	0.639	0.596	0.681	0.674	0.077	13
34	11/03/2011	0.420	0.380	0.461	0.583	0.203	54
35	11/03/2011	0.317	0.293	0.342	0.380	0.088	30
38	11/08/2011	0.602	0.536	0.668	0.183	-0.352	-66
39	11/08/2011	0.397	0.367	0.428	0.486	0.118	32
40	11/08/2011	1.880	1.615	2.145	1.046	-0.569	-35
41	11/08/2011	1.746	1.509	1.984	1.172	-0.336	-22
42	11/08/2011	1.477	1.281	1.674	0.958	-0.323	-25
43	11/08/2011	0.889	0.848	0.930	1.050	0.202	24
44	11/08/2011	2.612	2.449	2.774	1.363	-1.086	-44
45	11/08/2011	2.106	1.853	2.359	1.220	-0.633	-34
46	11/08/2011	1.186	1.020	1.353	1.210	0.191	19
47	11/08/2011	1.979	1.838	2.119	1.453	-0.385	-21
48	11/08/2011	1.441	1.326	1.557	1.010	-0.315	-24
50	11/07/2011	0.985	0.898	1.072	0.829	-0.068	-8
51	11/07/2011	1.026	0.914	1.138	0.747	-0.167	-18
52	11/07/2011	0.624	0.542	0.706	0.387	-0.156	-29
53	11/07/2011	0.955	0.897	1.013	0.395	-0.502	-56
54	11/07/2011	0.676	0.618	0.735	0.596	-0.022	-4
56	11/07/2011	1.197	1.092	1.303	1.127	0.036	3
58	11/07/2011	1.256	1.146	1.365	0.723	-0.423	-37
60	11/07/2011	1.066	0.966	1.167	0.932	-0.034	-4
62	11/07/2011	1.135	1.082	1.188	0.699	-0.383	-35
97	11/02/2011	1.739	1.448	2.029	1.380	-0.067	-5
98	11/02/2011	0.628	0.584	0.672	0.963	0.379	65
100	10/31/2011	1.258	1.106	1.409	0.946	-0.161	-15
101	11/05/2011	0.881	0.783	0.979	0.975	0.192	24
102	11/05/2011	0.834	0.750	0.918	0.940	0.190	25
104	10/31/2011	1.546	1.398	1.694	2.063	0.665	48
105	10/31/2011	1.081	0.985	1.176	0.543	-0.442	-45

ENBRIDGE

Drawn: JLH 04/17/2012

Approved: DBR 04/17/2012

Project #: 106-4186

ADP POINT VELOCITY COMPARISON DURING CALIBRATION PERIOD-RIVERINE

SHEET 2 OF 4

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Station	Date	Measured Velocity (Feet per Second)			Simulated Velocity (Feet per Second)	Difference (Feet per Second)	Difference (Percent)
		Average	Average minus Standard Deviation	Average plus Standard Deviation			
106	10/31/2011	1.106	1.050	1.162	1.340	0.291	28
107	10/31/2011	0.343	0.312	0.374	0.126	-0.186	-60
108	10/31/2011	1.123	1.041	1.206	1.351	0.310	30
109	10/31/2011	0.518	0.419	0.618	0.462	0.043	10
110	10/31/2011	0.535	0.515	0.556	0.434	-0.081	-16
112	11/01/2011	0.374	0.331	0.417	0.366	0.034	10
113	11/01/2011	0.422	0.388	0.457	0.436	0.048	12
116	11/01/2011	1.007	0.882	1.132	0.745	-0.137	-16
118	11/01/2011	0.603	0.548	0.659	0.374	-0.173	-32
121	11/01/2011	0.309	0.287	0.332	0.261	-0.026	-9
130	11/01/2011	0.563	0.529	0.598	0.461	-0.068	-13
131	11/01/2011	0.459	0.440	0.477	0.204	-0.236	-54
141	11/01/2011	0.551	0.495	0.608	0.832	0.336	68
142	11/01/2011	0.638	0.597	0.678	0.613	0.016	3
143	11/01/2011	0.405	0.390	0.420	0.301	-0.089	-23
144	11/01/2011	0.380	0.344	0.417	0.334	-0.009	-3
145	11/01/2011	0.398	0.365	0.431	0.291	-0.074	-20
146	10/31/2011	0.342	0.320	0.364	0.506	0.185	58
147	10/31/2011	0.476	0.446	0.506	0.481	0.035	8
148	11/01/2011	0.377	0.357	0.397	0.436	0.079	22
149	11/01/2011	0.289	0.271	0.307	0.409	0.138	51
150	11/01/2011	0.388	0.362	0.415	0.376	0.014	4
151	11/01/2011	0.371	0.328	0.415	0.372	0.045	14
152	11/01/2011	0.319	0.290	0.348	0.304	0.014	5
153	11/01/2011	0.156	0.129	0.182	0.279	0.150	116
154	11/01/2011	0.453	0.424	0.483	0.316	-0.108	-26
156	11/05/2011	0.336	0.295	0.377	0.487	0.192	65
157	11/05/2011	0.921	0.883	0.959	0.529	-0.354	-40
158	10/31/2011	0.610	0.559	0.662	0.499	-0.060	-11
159	11/05/2011	0.389	0.355	0.422	0.429	0.074	21
160	11/05/2011	0.206	0.175	0.237	0.331	0.156	89
161	10/31/2011	0.881	0.835	0.927	0.609	-0.227	-27
162	10/31/2011	0.557	0.515	0.600	0.417	-0.098	-19
163	10/31/2011	0.066	0.063	0.068	0.135	0.072	115
164	10/31/2011	0.475	0.450	0.500	0.416	-0.035	-8
165	10/29/2011	0.473	0.407	0.540	0.284	-0.123	-30
166	10/29/2011	0.125	0.076	0.174	0.120	0.043	57

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Drawn: JLH 04/17/2012

Approved: DBR 04/17/2012

Project #: 106-4186

ADP POINT VELOCITY COMPARISON DURING CALIBRATION PERIOD-RIVERINE

SHEET 3 OF 4

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Station	Date	Measured Velocity (Feet per Second)			Simulated Velocity (Feet per Second)	Difference (Feet per Second)	Difference (Percent)
		Average	Average minus Standard Deviation	Average plus Standard Deviation			
168	10/29/2011	0.126	0.112	0.140	0.098	-0.014	-12
169	10/29/2011	0.267	0.237	0.298	0.165	-0.072	-30
170	10/29/2011	0.218	0.190	0.245	0.156	-0.035	-18
171	10/29/2011	0.185	0.119	0.252	0.114	-0.005	-4
173	10/29/2011	0.435	0.397	0.472	0.112	-0.286	-72
174	10/29/2011	0.104	0.098	0.111	0.084	-0.014	-14
175	10/29/2011	0.118	0.105	0.130	0.072	-0.034	-32

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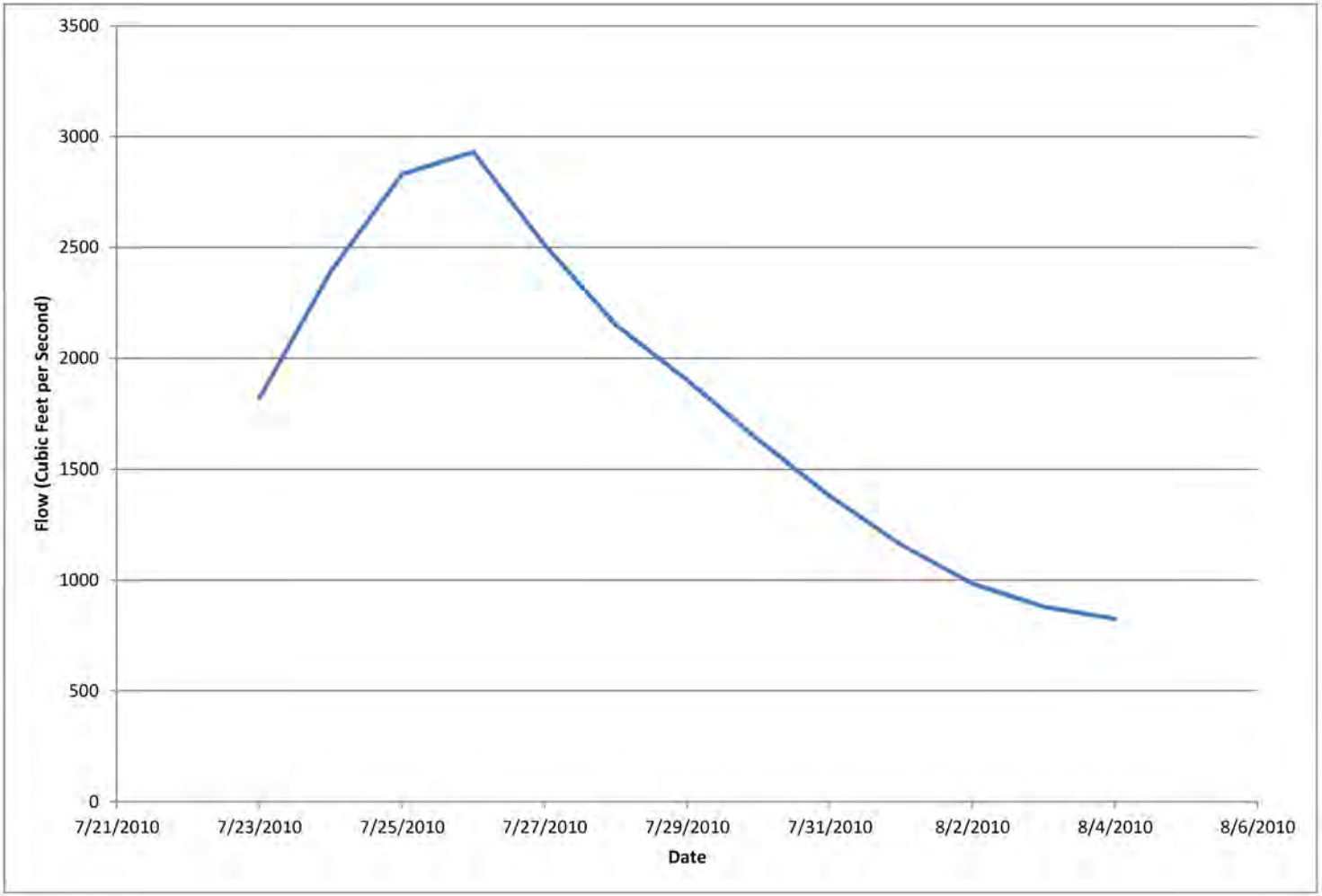
ADP POINT VELOCITY COMPARISON DURING CALIBRATION PERIOD-RIVERINE

SHEET 4 OF 4

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 4-6

Flow at Kalamazoo River Gage Near Battle Creek for July 2010 Calibration Period



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Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

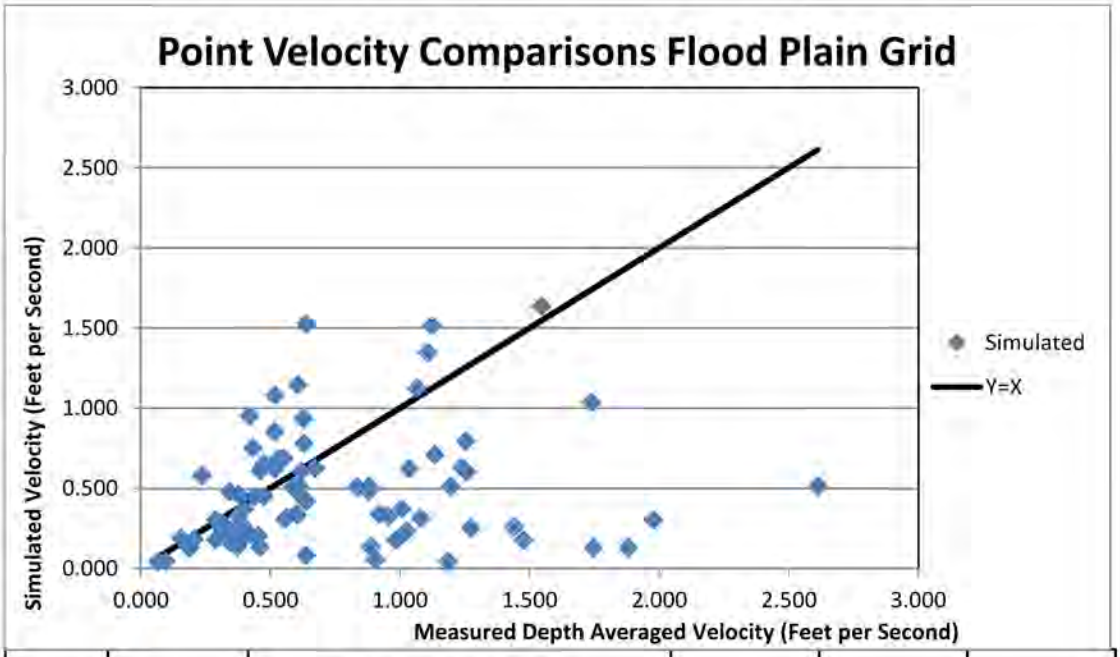
FLOW AT KALAMAZOO RIVER GAGE NEAR BATTLE CREEK FOR JULY 2010 CALIBRATION PERIOD

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 4-7

ADP Point Velocity Comparison During Calibration Period-Floodplain

Sheets 1 through 3



Station	Date	Measured Velocity (Feet per Second)			Simulated Velocity (Feet per Second)	Difference (Feet per Second)	Difference (Percent)
		Average	Average minus Standard Deviation	Average plus Standard Deviation			
1	11/04/2011	1.771	1.633	1.909	1.070	-0.701	-40
2	11/04/2011	1.136	1.005	1.267	0.527	-0.609	-54
3	11/04/2011	1.271	1.103	1.439	0.452	-0.819	-64
6	11/04/2011	1.402	1.187	1.617	0.556	-0.846	-60
7	11/04/2011	1.240	1.147	1.332	0.630	-0.609	-49
8	11/04/2011	1.275	1.164	1.386	0.253	-1.022	-80
9	11/04/2011	1.036	0.964	1.108	0.623	-0.413	-40
14	11/03/2011	0.629	0.563	0.695	0.779	0.150	24
15	11/03/2011	0.674	0.585	0.763	0.626	-0.048	-7
16	11/03/2011	0.906	0.866	0.946	0.055	-0.851	-94
17	11/03/2011	0.517	0.496	0.537	0.621	0.105	20
18	11/03/2011	0.461	0.398	0.524	0.610	0.149	32
19	11/03/2011	0.587	0.548	0.625	0.508	-0.079	-13
20	11/02/2011	0.237	0.229	0.244	0.580	0.343	145
22	11/02/2011	0.606	0.559	0.653	1.145	0.539	89
23	11/02/2011	0.439	0.394	0.483	0.449	0.011	2
24	11/03/2011	0.433	0.407	0.459	0.751	0.318	73
26	11/02/2011	0.189	0.169	0.209	0.129	-0.060	-32
27	11/02/2011	0.376	0.342	0.410	0.463	0.087	23
28	11/02/2011	0.619	0.574	0.664	0.605	-0.014	-2
29	11/02/2011	0.313	0.294	0.333	0.231	-0.082	-26
30	11/03/2011	0.097	0.078	0.116	0.046	-0.051	-53
31	11/03/2011	0.290	0.258	0.322	0.180	-0.110	-38

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ADP POINT VELOCITY COMPARISON DURING CALIBRATION PERIOD-FLOODPLAIN
SHEET 1 OF 3
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Station	Date	Measured Velocity (Feet per Second)			Simulated Velocity (Feet per Second)	Difference (Feet per Second)	Difference (Percent)
		Average	Average minus Standard Deviation	Average plus Standard Deviation			
32	11/03/2011	0.517	0.473	0.561	0.852	0.335	65
33	11/03/2011	0.639	0.596	0.681	1.527	0.888	139
34	11/03/2011	0.420	0.380	0.461	0.952	0.532	127
35	11/03/2011	0.317	0.293	0.342	0.280	-0.037	-12
38	11/08/2011	0.602	0.536	0.668	0.340	-0.262	-44
39	11/08/2011	0.397	0.367	0.428	0.372	-0.025	-6
40	11/08/2011	1.880	1.615	2.145	0.132	-1.748	-93
41	11/08/2011	1.746	1.509	1.984	0.128	-1.618	-93
42	11/08/2011	1.477	1.281	1.674	0.176	-1.302	-88
43	11/08/2011	0.889	0.848	0.930	0.133	-0.756	-85
44	11/08/2011	2.612	2.449	2.774	0.514	-2.098	-80
46	11/08/2011	1.186	1.020	1.353	0.042	-1.144	-96
47	11/08/2011	1.979	1.838	2.119	0.303	-1.676	-85
48	11/08/2011	1.441	1.326	1.557	0.258	-1.183	-82
50	11/07/2011	0.985	0.898	1.072	0.177	-0.808	-82
51	11/07/2011	1.026	0.914	1.138	0.233	-0.793	-77
52	11/07/2011	0.624	0.542	0.706	0.443	-0.182	-29
53	11/07/2011	0.955	0.897	1.013	0.324	-0.631	-66
56	11/07/2011	1.197	1.092	1.303	0.513	-0.684	-57
58	11/07/2011	1.256	1.146	1.365	0.793	-0.462	-37
60	11/07/2011	1.066	0.966	1.167	1.124	0.058	5
62	11/07/2011	1.135	1.082	1.188	0.710	-0.425	-37
97	11/02/2011	1.739	1.448	2.029	1.036	-0.702	-40
98	11/02/2011	0.628	0.584	0.672	0.935	0.307	49
100	10/31/2011	1.258	1.106	1.409	0.602	-0.656	-52
101	11/05/2011	0.881	0.783	0.979	0.486	-0.394	-45
102	11/05/2011	0.834	0.750	0.918	0.509	-0.324	-39
104	10/31/2011	1.546	1.398	1.694	1.636	0.090	6
105	10/31/2011	1.081	0.985	1.176	0.313	-0.767	-71
106	10/31/2011	1.106	1.050	1.162	1.346	0.240	22
107	10/31/2011	0.343	0.312	0.374	0.167	-0.177	-52
108	10/31/2011	1.123	1.041	1.206	1.515	0.392	35
109	10/31/2011	0.518	0.419	0.618	1.081	0.563	109
110	10/31/2011	0.535	0.515	0.556	0.685	0.150	28
111	10/31/2011	0.637	0.574	0.701	0.081	-0.556	-87
112	11/01/2011	0.374	0.331	0.417	0.134	-0.241	-64
113	11/01/2011	0.422	0.388	0.457	0.214	-0.208	-49
116	11/01/2011	1.007	0.882	1.132	0.372	-0.635	-63
118	11/01/2011	0.603	0.548	0.659	0.333	-0.271	-45
121	11/01/2011	0.309	0.287	0.332	0.265	-0.044	-14
130	11/01/2011	0.563	0.529	0.598	0.318	-0.246	-44
131	11/01/2011	0.459	0.440	0.477	0.133	-0.325	-71
141	11/01/2011	0.551	0.495	0.608	0.687	0.136	25
142	11/01/2011	0.638	0.597	0.678	0.419	-0.218	-34

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Drawn: JLH 04/17/2012

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Project #: 106-4186

ADP POINT VELOCITY COMPARISON DURING CALIBRATION PERIOD-FLOODPLAIN
SHEET 2 OF 3
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Station	Date	Measured Velocity (Feet per Second)			Simulated Velocity (Feet per Second)	Difference (Feet per Second)	Difference (Percent)
		Average	Average minus Standard Deviation	Average plus Standard Deviation			
143	11/01/2011	0.405	0.390	0.420	0.235	-0.170	-42
144	11/01/2011	0.380	0.344	0.417	0.266	-0.114	-30
145	11/01/2011	0.398	0.365	0.431	0.192	-0.206	-52
146	10/31/2011	0.342	0.320	0.364	0.478	0.136	40
147	10/31/2011	0.476	0.446	0.506	0.451	-0.025	-5
148	11/01/2011	0.377	0.357	0.397	0.325	-0.052	-14
149	11/01/2011	0.289	0.271	0.307	0.304	0.015	5
150	11/01/2011	0.388	0.362	0.415	0.277	-0.111	-29
151	11/01/2011	0.371	0.328	0.415	0.222	-0.149	-40
152	11/01/2011	0.319	0.290	0.348	0.209	-0.110	-35
153	11/01/2011	0.156	0.129	0.182	0.188	0.033	21
154	11/01/2011	0.453	0.424	0.483	0.202	-0.252	-56
156	11/05/2011	0.336	0.295	0.377	0.247	-0.089	-27
157	11/05/2011	0.921	0.883	0.959	0.338	-0.583	-63
158	10/31/2011	0.610	0.559	0.662	0.515	-0.095	-16
159	11/05/2011	0.389	0.355	0.422	0.265	-0.124	-32
160	11/05/2011	0.206	0.175	0.237	0.180	-0.026	-12
161	10/31/2011	0.881	0.835	0.927	0.513	-0.369	-42
162	10/31/2011	0.557	0.515	0.600	0.308	-0.249	-45
163	10/31/2011	0.066	0.063	0.068	0.042	-0.024	-36
164	10/31/2011	0.475	0.450	0.500	0.654	0.178	38

ENBRIDGE

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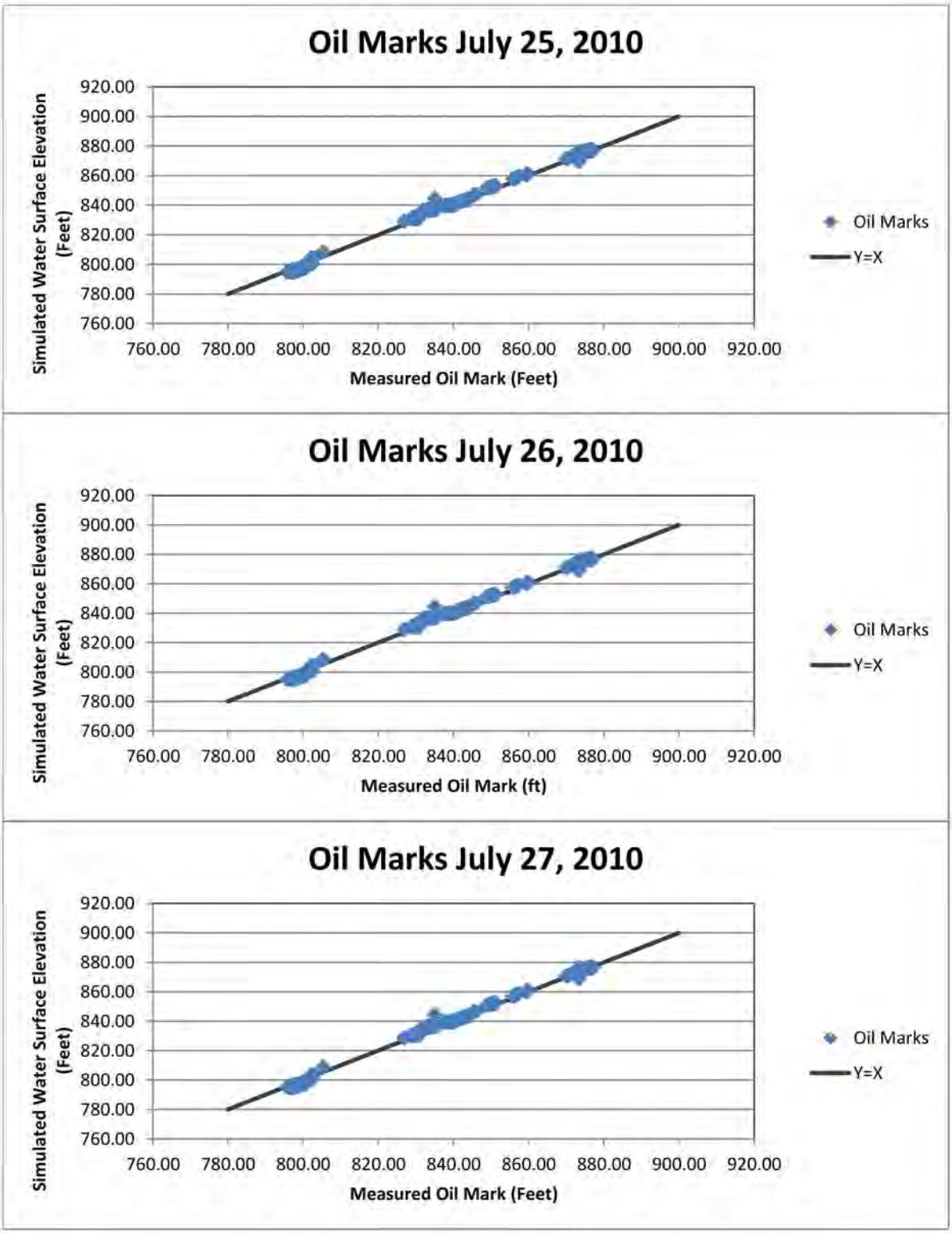
ADP POINT VELOCITY COMPARISON DURING CALIBRATION PERIOD-FLOODPLAIN
SHEET 3 OF 3
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

Figure 4-8

Oil Mark Surveys vs. Simulated Water Surface Elevation July 2010 Run

Sheets 1 through 9



ENBRIDGE		OIL MARK SURVEYS VS. SIMULATED WATER SURFACE ELEVATION JULY 2010 RUN SHEET 1 OF 9 ENBRIDGE LINE 6B MP 608 MARSHALL, MI PIPELINE RELEASE ENBRIDGE ENERGY, LIMITED PARTNERSHIP
Drawn: JLH 04/17/2012		
Approved: DBR 04/17/2012		
Project #: 106-4186		

Location	Measured Oil Mark Elevation (Feet)	July 25		July 26		July 27	
		Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)
TR1	875.81	877.73	1.92	877.40	1.59	877.07	1.26
TR3	877.21	877.66	0.45	877.33	0.12	877.01	-0.21
TR4	876.26	877.63	1.37	877.30	1.05	876.97	0.72
TR5	876.66	877.63	0.97	877.30	0.64	876.97	0.31
TR6	876.31	877.63	1.32	877.30	0.99	876.97	0.66
TR7	877.00	877.63	0.63	877.30	0.30	876.97	-0.03
TR8	876.74	877.60	0.86	877.27	0.53	876.94	0.20
TR9	875.92	877.53	1.61	877.24	1.31	876.91	0.98
TR10	875.96	877.04	1.08	876.74	0.79	876.48	0.52
TR11	875.61	876.97	1.36	876.71	1.10	876.42	0.80
TR12	876.71	876.91	0.20	876.65	-0.07	876.35	-0.36
TR13	877.09	876.91	-0.18	876.61	-0.48	876.32	-0.77
TR15	876.00	876.88	0.87	876.58	0.58	876.28	0.28
TR16	875.47	876.78	1.30	876.48	1.01	876.19	0.71
TR17	875.76	876.74	0.98	876.45	0.69	876.12	0.36
TR18	875.37	876.74	1.38	876.45	1.08	876.12	0.75
TR20	875.72	876.97	1.25	876.68	0.95	876.38	0.66
TR22	875.92	876.94	1.02	876.68	0.76	876.38	0.47
TR23	876.76	876.97	0.21	876.68	-0.08	876.38	-0.38
TR24	875.70	876.97	1.27	876.68	0.97	876.42	0.71
TR25	876.89	877.01	0.12	876.71	-0.17	876.42	-0.47
TR28	876.65	876.65	0.00	876.38	-0.26	876.06	-0.59
TR29	875.48	876.58	1.10	876.28	0.81	875.96	0.48
TR32	874.38	876.55	2.16	876.25	1.87	875.96	1.57
TR33	874.66	876.35	1.69	876.02	1.36	875.73	1.07
TR34	874.90	876.28	1.39	875.99	1.09	875.66	0.76
TR35	874.69	876.35	1.66	876.06	1.37	875.76	1.07
TR36	874.86	876.48	1.62	876.19	1.32	875.86	0.99
TR40	875.85	876.48	0.63	876.48	0.63	876.48	0.63
TR42	873.46	875.89	2.43	875.60	2.14	875.24	1.77
TR43	874.49	875.79	1.31	875.50	1.01	875.17	0.68
TR44	873.22	875.56	2.35	875.27	2.05	874.94	1.72
TR45	873.30	875.37	2.07	875.04	1.74	874.71	1.41
TR48	873.44	875.20	1.76	874.87	1.43	874.51	1.07
TR49	873.57	875.10	1.54	874.81	1.24	874.45	0.88
TR51	873.83	875.07	1.24	874.74	0.91	874.38	0.55
TR53	874.85	874.94	0.09	874.61	-0.24	874.25	-0.60
TR54	873.41	876.45	3.03	876.45	3.03	876.45	3.03
TR55	873.89	874.61	0.72	874.32	0.43	873.96	0.07

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OIL MARK SURVEYS VS. SIMULATED WATER SURFACE ELEVATION JULY 2010 RUN

SHEET 2 OF 9

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Location	Measured Oil Mark Elevation (Feet)	July 25		July 26		July 27	
		Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)
TR57	873.38	874.58	1.20	874.25	0.87	873.92	0.54
TR58	874.17	874.58	0.41	874.25	0.08	873.92	-0.25
TR59	873.31	874.58	1.27	874.25	0.94	873.92	0.62
TR60	873.15	874.55	1.40	874.22	1.07	873.89	0.74
TR62	872.49	873.66	1.17	873.37	0.88	872.97	0.49
TR63	873.06	873.66	0.60	873.33	0.27	872.97	-0.09
TR64	871.88	873.63	1.74	873.30	1.42	872.94	1.06
TR65	872.13	873.63	1.50	873.30	1.17	872.94	0.81
TR66	871.87	873.63	1.75	873.30	1.43	872.94	1.07
TR67	872.68	873.46	0.78	873.17	0.49	872.81	0.13
TR71	870.74	872.12	1.38	871.86	1.12	871.53	0.79
TR77	869.93	871.27	1.33	871.00	1.07	870.74	0.81
TR86	873.37	869.36	-4.00	869.13	-4.23	868.87	-4.50
TR96	859.78	861.36	1.58	861.13	1.35	860.87	1.09
TR97	859.41	861.20	1.78	861.00	1.59	860.74	1.33
TR98	859.68	861.16	1.48	860.93	1.25	860.67	0.99
TR99	859.72	861.00	1.28	860.80	1.08	860.54	0.82
TR100	859.74	861.07	1.32	860.87	1.12	860.61	0.86
TR103	859.40	860.54	1.14	860.31	0.92	860.05	0.65
TR104	859.42	860.48	1.06	860.25	0.83	859.98	0.56
TR114	859.87	861.26	1.39	861.03	1.16	860.77	0.90
TR116	859.74	861.16	1.42	860.97	1.22	860.70	0.96
TR124	857.30	859.39	2.09	859.16	1.86	858.90	1.60
TR131	856.51	858.67	2.16	858.41	1.90	858.15	1.63
TR132	856.79	858.64	1.85	858.38	1.58	858.08	1.29
TR133	856.60	858.51	1.91	858.24	1.64	857.95	1.35
TR134	855.84	857.62	1.78	857.33	1.49	856.97	1.13
TR135	855.94	857.62	1.69	857.33	1.39	856.97	1.03
TR162	851.07	853.13	2.06	852.83	1.76	852.44	1.37
TR163	851.21	853.13	1.92	852.83	1.62	852.44	1.23
TR167	850.69	853.00	2.31	852.70	2.01	852.31	1.62
TR171	850.22	852.80	2.58	852.54	2.32	852.14	1.93
TR175	850.41	852.64	2.22	852.37	1.96	851.98	1.57
TR178	850.48	852.50	2.03	852.24	1.76	851.85	1.37
TR190	850.57	852.37	1.80	852.08	1.51	851.68	1.12
TR192	849.75	852.21	2.46	851.91	2.17	851.55	1.81
TR194	850.11	852.18	2.07	851.88	1.77	851.52	1.41
TR196	850.11	852.11	2.00	851.85	1.74	851.49	1.38
TR197	849.63	852.08	2.45	851.82	2.19	851.42	1.79

ENBRIDGE

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OIL MARK SURVEYS VS. SIMULATED WATER SURFACE ELEVATION JULY 2010 RUN

SHEET 3 OF 9

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Location	Measured Oil Mark Elevation (Feet)	July 25		July 26		July 27	
		Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)
TR198	849.92	852.08	2.16	851.82	1.90	851.42	1.51
TR200	849.27	851.75	2.48	851.49	2.22	851.13	1.86
TR203	848.94	851.62	2.68	851.32	2.39	850.96	2.03
TR240	845.43	847.16	1.73	846.96	1.53	846.63	1.20
TR242	845.97	847.22	1.26	846.99	1.03	846.70	0.73
TR278	843.93	843.52	-0.41	843.35	-0.57	843.09	-0.84
TR280	843.74	843.48	-0.26	843.29	-0.46	843.03	-0.72
TR284	843.04	843.35	0.32	843.19	0.15	842.89	-0.14
TR285	842.70	843.29	0.58	843.12	0.42	842.83	0.12
TR286	842.91	843.32	0.41	843.16	0.25	842.86	-0.05
TR288	842.84	843.32	0.48	843.12	0.29	842.86	0.02
TR293	843.72	844.14	0.42	844.01	0.29	843.78	0.06
TR294	843.53	844.11	0.58	843.94	0.42	843.75	0.22
TR298	843.95	843.94	0.00	843.81	-0.13	843.58	-0.36
TR299	843.54	843.91	0.37	843.75	0.20	843.52	-0.03
TR301	843.82	843.75	-0.07	843.58	-0.24	843.35	-0.47
TR303	843.79	843.58	-0.20	843.42	-0.37	843.16	-0.63
TR305	843.58	843.68	0.10	843.48	-0.09	843.22	-0.35
TR308	843.06	843.35	0.29	843.16	0.09	842.89	-0.17
TR310	842.46	843.26	0.80	843.06	0.60	842.80	0.34
TR311	842.84	843.26	0.42	843.06	0.22	842.80	-0.04
TR317	842.24	842.99	0.75	842.80	0.56	842.53	0.30
TR319	842.16	842.83	0.67	842.66	0.51	842.40	0.25
TR321	842.71	843.22	0.51	843.06	0.35	842.76	0.06
TR323	842.29	843.12	0.83	842.93	0.64	842.66	0.37
TR327	842.59	843.06	0.47	842.86	0.27	842.60	0.01
TR330	842.16	842.73	0.57	842.57	0.41	842.30	0.15
TR331	842.08	842.60	0.51	842.44	0.35	842.17	0.09
TR333	841.48	842.37	0.89	842.21	0.72	841.91	0.43
TR335	841.42	842.14	0.71	841.94	0.52	841.65	0.22
TR340	841.18	842.04	0.86	841.88	0.70	841.58	0.40
TR344	841.24	841.98	0.73	841.78	0.53	841.48	0.24
TR347	841.37	841.91	0.54	841.71	0.35	841.45	0.09
TR351	841.21	841.75	0.54	841.58	0.37	841.29	0.08
TR353	841.16	841.71	0.55	841.55	0.39	841.29	0.12
TR354	841.36	841.65	0.29	841.48	0.13	841.22	-0.13
TR359	840.55	841.02	0.47	840.86	0.31	840.63	0.08
TR360	840.61	840.80	0.19	840.63	0.02	840.37	-0.24
TR362	840.64	840.66	0.02	840.50	-0.14	840.24	-0.40

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OIL MARK SURVEYS VS. SIMULATED WATER SURFACE ELEVATION JULY 2010 RUN

SHEET 4 OF 9

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Location	Measured Oil Mark Elevation (Feet)	July 25		July 26		July 27	
		Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)
TR363	840.31	840.47	0.15	840.30	-0.01	840.04	-0.27
TR364	840.78	840.40	-0.37	840.24	-0.54	839.98	-0.80
TR365	839.97	840.40	0.43	840.27	0.30	839.98	0.00
TR366	840.73	840.53	-0.20	840.37	-0.36	840.11	-0.63
TR368	840.36	840.60	0.24	840.43	0.08	840.17	-0.18
TR388	839.42	840.11	0.68	839.94	0.52	839.68	0.26
TR389	839.63	840.07	0.44	839.91	0.28	839.61	-0.02
TR390	839.79	840.07	0.29	839.94	0.15	839.65	-0.14
TR392	839.45	840.07	0.62	839.91	0.46	839.61	0.16
TR395	839.23	840.11	0.88	839.94	0.71	839.68	0.45
TR399	838.85	840.07	1.23	839.91	1.06	839.61	0.77
TR400	838.50	840.04	1.54	839.91	1.41	839.61	1.12
TR406	838.81	840.04	1.23	839.91	1.10	839.61	0.81
TR408	838.29	840.04	1.75	839.88	1.59	839.58	1.30
TR410	839.73	840.27	0.54	840.11	0.38	839.81	0.08
TR412	840.13	840.17	0.04	840.01	-0.12	839.71	-0.42
TR414	840.07	840.14	0.07	840.01	-0.07	839.71	-0.36
TR418	838.57	840.04	1.47	839.88	1.31	839.58	1.01
TR420	839.13	840.01	0.88	839.88	0.75	839.58	0.46
TR421	838.25	840.01	1.76	839.84	1.59	839.58	1.33
TR424	838.71	840.01	1.30	839.84	1.13	839.58	0.87
TR425	838.68	840.01	1.33	839.84	1.16	839.58	0.90
TR427	838.41	839.98	1.56	839.81	1.40	839.55	1.14
TR432	837.70	839.91	2.21	839.75	2.04	839.48	1.78
TR433	837.70	839.91	2.21	839.75	2.05	839.48	1.79
TR434	837.75	839.88	2.12	839.71	1.96	839.45	1.70
TR436	838.24	840.01	1.76	839.84	1.60	839.55	1.31
TR438	838.40	839.98	1.58	839.81	1.41	839.52	1.12
TR440	837.74	839.94	2.20	839.78	2.04	839.52	1.78
TR441	837.82	839.94	2.12	839.81	1.99	839.52	1.69
TR446	838.21	839.91	1.70	839.75	1.54	839.48	1.28
TR447	838.52	839.88	1.35	839.71	1.19	839.45	0.93
TR449	837.93	839.88	1.95	839.71	1.78	839.45	1.52
TR458	834.79	837.09	2.30	836.89	2.10	836.40	1.61
TR459	835.21	837.02	1.81	836.86	1.65	836.37	1.16
TR460	834.95	837.02	2.08	836.86	1.91	836.33	1.39
TR461	834.87	837.02	2.15	836.83	1.96	836.33	1.47
TR463	834.84	836.99	2.15	836.83	1.99	836.30	1.47
TR464	834.52	836.99	2.47	836.83	2.30	836.30	1.78

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Project #: 106-4186

OIL MARK SURVEYS VS. SIMULATED WATER SURFACE ELEVATION JULY 2010 RUN

SHEET 5 OF 9

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Location	Measured Oil Mark Elevation (Feet)	July 25		July 26		July 27	
		Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)
TR465	834.42	836.99	2.57	836.79	2.37	836.30	1.88
TR467	834.36	838.93	4.57	838.93	4.57	838.93	4.57
TR469	835.06	844.57	9.51	844.57	9.51	844.57	9.51
TR470	834.82	837.09	2.27	836.89	2.07	836.40	1.58
TR473	835.39	837.19	1.80	837.02	1.63	836.53	1.14
TR500	834.98	837.12	2.14	836.96	1.98	836.47	1.49
TR501	835.00	837.12	2.12	836.96	1.96	836.47	1.47
TR502	834.92	837.12	2.20	836.96	2.03	836.47	1.54
TR503	835.07	837.12	2.05	836.96	1.89	836.47	1.40
TR504	834.64	837.12	2.48	836.92	2.29	836.43	1.79
TR505	835.17	837.12	1.95	836.96	1.79	836.47	1.30
TR506	834.99	837.12	2.13	836.96	1.97	836.47	1.48
TR510	834.75	837.06	2.30	836.89	2.14	836.40	1.65
TR512	834.33	836.89	2.56	836.73	2.39	836.20	1.87
TR514	834.22	836.86	2.64	836.70	2.48	836.17	1.95
TR515	833.56	836.83	3.27	836.66	3.11	836.14	2.58
TR518	833.92	836.83	2.91	836.66	2.75	836.14	2.22
TR522	833.83	836.83	3.00	836.66	2.84	836.14	2.31
TR523	834.00	836.83	2.83	836.66	2.66	836.14	2.14
TR524	833.48	836.83	3.35	836.66	3.18	836.14	2.66
TR525	833.87	836.83	2.95	836.66	2.79	836.14	2.26
TR526	833.80	836.83	3.03	836.66	2.86	836.14	2.34
TR527	833.36	836.83	3.46	836.66	3.30	836.14	2.77
TR529	832.71	836.83	4.12	836.66	3.96	836.14	3.43
TR530	832.97	836.83	3.85	836.66	3.69	836.14	3.17
TR531	833.09	836.83	3.74	836.66	3.57	836.14	3.05
TR532	833.19	836.83	3.63	836.66	3.47	836.14	2.95
TR534	833.26	836.83	3.56	836.66	3.40	836.14	2.87
TR535	833.38	836.83	3.45	836.66	3.28	836.14	2.76
TR536	833.28	836.83	3.55	836.66	3.38	836.14	2.86
TR537	833.16	836.83	3.66	836.66	3.50	836.14	2.97
TR538	833.86	836.83	2.96	836.66	2.80	836.14	2.27
TR539	833.04	836.83	3.78	836.66	3.62	836.14	3.09
TR540	833.05	836.83	3.77	836.66	3.61	836.14	3.08
TR541	833.51	836.83	3.32	836.66	3.15	836.14	2.63
TR542	833.39	836.83	3.44	836.66	3.28	836.14	2.75
TR543	833.73	836.83	3.10	836.66	2.93	836.14	2.41
TR544	833.42	836.83	3.41	836.66	3.25	836.14	2.72
TR545	833.17	836.83	3.66	836.66	3.50	836.14	2.97

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OIL MARK SURVEYS VS. SIMULATED WATER SURFACE ELEVATION JULY 2010 RUN

SHEET 6 OF 9

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Location	Measured Oil Mark Elevation (Feet)	July 25		July 26		July 27	
		Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)
TR546	833.68	836.83	3.14	836.66	2.98	836.14	2.45
TR548	833.88	836.83	2.95	836.66	2.78	836.14	2.26
TR553	833.86	836.89	3.03	836.73	2.87	836.20	2.35
TR554	833.92	836.92	3.01	836.73	2.81	836.20	2.29
TR555	834.16	836.89	2.73	836.73	2.57	836.20	2.04
TR556	834.10	836.92	2.83	836.76	2.66	836.24	2.14
TR560	834.92	836.96	2.04	836.79	1.87	836.27	1.35
TR562	834.38	836.96	2.58	836.79	2.42	836.27	1.89
TR565	834.06	836.83	2.77	836.63	2.57	836.14	2.08
TR569	833.44	836.83	3.38	836.63	3.19	836.10	2.66
TR570	832.84	836.79	3.95	836.63	3.79	836.10	3.26
TR572	833.87	836.79	2.92	836.63	2.76	836.10	2.23
TR576	832.84	836.79	3.95	836.63	3.79	836.10	3.26
TR578	833.28	836.73	3.44	836.56	3.28	836.04	2.76
TR582	833.17	836.76	3.59	836.60	3.43	836.07	2.91
TR583	832.85	836.63	3.78	836.47	3.61	835.94	3.09
TR585	831.80	836.63	4.83	836.47	4.67	835.94	4.14
TR602	832.84	836.76	3.92	836.60	3.75	836.07	3.23
TR603	832.72	836.76	4.04	836.60	3.87	836.07	3.35
TR604	833.75	836.76	3.01	836.60	2.84	836.07	2.32
TR605	833.55	836.76	3.21	836.60	3.05	836.07	2.53
TR608	833.37	836.79	3.42	836.63	3.26	836.10	2.73
TR609	833.10	836.79	3.70	836.63	3.53	836.10	3.01
TR611	833.51	836.79	3.28	836.63	3.12	836.10	2.59
TR612	834.14	836.83	2.69	836.63	2.49	836.10	1.96
TR615	833.58	836.83	3.24	836.66	3.08	836.14	2.56
TR616	833.26	836.83	3.56	836.66	3.40	836.14	2.87
TR617	832.97	836.83	3.85	836.66	3.69	836.14	3.17
TR618	834.10	836.83	2.73	836.66	2.56	836.14	2.04
TR619	833.97	836.83	2.85	836.66	2.69	836.14	2.16
TR622	833.17	836.83	3.66	836.63	3.46	836.10	2.94
TR624	833.84	836.83	2.99	836.63	2.79	836.14	2.30
TR625	833.43	836.83	3.39	836.63	3.20	836.10	2.67
TR626	833.48	836.83	3.35	836.63	3.15	836.10	2.62
TR628	833.75	836.83	3.07	836.63	2.88	836.10	2.35
TR629	834.16	836.79	2.63	836.63	2.47	836.10	1.95
TR630	833.88	836.83	2.94	836.63	2.75	836.10	2.22
TR653	830.26	832.46	2.20	832.23	1.97	831.74	1.48
TR654	830.63	832.46	1.83	832.23	1.60	831.74	1.11

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OIL MARK SURVEYS VS. SIMULATED WATER SURFACE ELEVATION JULY 2010 RUN

SHEET 7 OF 9

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Location	Measured Oil Mark Elevation (Feet)	July 25		July 26		July 27	
		Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)
TR657	830.16	832.37	2.21	832.17	2.01	831.64	1.49
TR664	829.19	831.71	2.52	831.51	2.33	831.05	1.87
TR667	829.82	831.12	1.30	830.96	1.14	830.46	0.65
TR669	830.16	831.12	0.96	830.96	0.79	830.46	0.30
TR671	830.38	831.02	0.64	830.89	0.51	830.40	0.01
TR675	826.87	829.25	2.37	829.02	2.15	828.63	1.75
TR677	830.18	830.89	0.71	830.76	0.58	830.27	0.09
TR679	830.70	830.89	0.19	830.79	0.10	830.30	-0.40
TR680	829.25	830.96	1.70	830.82	1.57	830.33	1.08
TR684	828.75	830.92	2.17	830.79	2.04	830.30	1.55
TR685	829.65	831.02	1.37	830.89	1.24	830.40	0.75
TR688	829.76	831.48	1.72	831.32	1.55	830.82	1.06
TR690	829.89	831.58	1.69	831.41	1.52	830.92	1.03
TR693	830.18	831.64	1.46	831.48	1.30	831.02	0.84
TR694	829.74	831.74	2.00	831.58	1.84	831.09	1.35
TR765	805.38	808.68	3.30	808.72	3.33	808.72	3.33
TR800	802.80	804.42	1.62	804.35	1.55	803.76	0.96
TR801	802.31	804.62	2.30	804.39	2.07	803.53	1.22
TR802	802.86	804.03	1.17	804.35	1.50	803.70	0.84
TR811	801.73	802.94	1.22	803.17	1.45	802.45	0.72
TR840	802.26	800.42	-1.84	800.48	-1.77	800.39	-1.87
TR848	802.41	800.48	-1.93	800.55	-1.86	800.45	-1.96
TR857	799.71	798.55	-1.16	798.65	-1.06	798.55	-1.16
TR858	799.50	797.14	-2.36	797.37	-2.13	797.34	-2.16
TR859	799.15	797.14	-2.01	797.37	-1.78	797.34	-1.81
TR860	800.51	797.14	-3.37	797.37	-3.14	797.34	-3.18
TR861	799.76	797.14	-2.62	797.37	-2.39	797.34	-2.43
TR862	798.29	797.14	-1.15	797.37	-0.92	797.34	-0.95
TR865	797.03	795.76	-1.27	795.99	-1.04	795.96	-1.08
TR867	798.26	795.73	-2.53	795.99	-2.27	795.92	-2.33
TR868	798.73	795.73	-3.00	795.99	-2.74	795.92	-2.81
TR873	798.14	796.71	-1.42	796.94	-1.19	796.91	-1.23
TR875	797.17	796.74	-0.42	796.97	-0.19	796.94	-0.23
TR884	795.76	794.97	-0.78	795.27	-0.49	795.24	-0.52
TR887	796.91	795.10	-1.80	795.40	-1.51	795.37	-1.54
TR888	797.28	795.20	-2.07	795.47	-1.81	795.43	-1.84
TR889	798.14	795.20	-2.93	795.50	-2.64	795.43	-2.70
TR890	796.78	795.24	-1.54	795.50	-1.28	795.47	-1.31
TR892	797.43	795.24	-2.20	795.50	-1.94	795.47	-1.97

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OIL MARK SURVEYS VS. SIMULATED WATER SURFACE ELEVATION JULY 2010 RUN

SHEET 8 OF 9

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Location	Measured Oil Mark Elevation (Feet)	July 25		July 26		July 27	
		Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)	Water Surface Elevation (Feet)	Difference (Feet)
TR893	797.39	795.24	-2.16	795.53	-1.86	795.47	-1.93
TR894	796.42	795.27	-1.15	795.56	-0.85	795.50	-0.92
TR896	797.10	794.97	-2.13	795.27	-1.83	795.24	-1.86
TR898	796.88	794.97	-1.91	795.30	-1.58	795.24	-1.65
TR899	796.20	795.01	-1.19	795.30	-0.90	795.27	-0.93
TR901	796.09	795.04	-1.05	795.33	-0.75	795.30	-0.79
TR902	796.47	795.04	-1.43	795.37	-1.11	795.30	-1.17
TR903	797.25	795.04	-2.21	795.33	-1.91	795.30	-1.95
TR904	797.55	794.97	-2.58	795.27	-2.29	795.20	-2.35
TR906	797.30	794.42	-2.89	794.68	-2.62	794.65	-2.66

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OIL MARK SURVEYS VS. SIMULATED WATER SURFACE ELEVATION JULY 2010 RUN

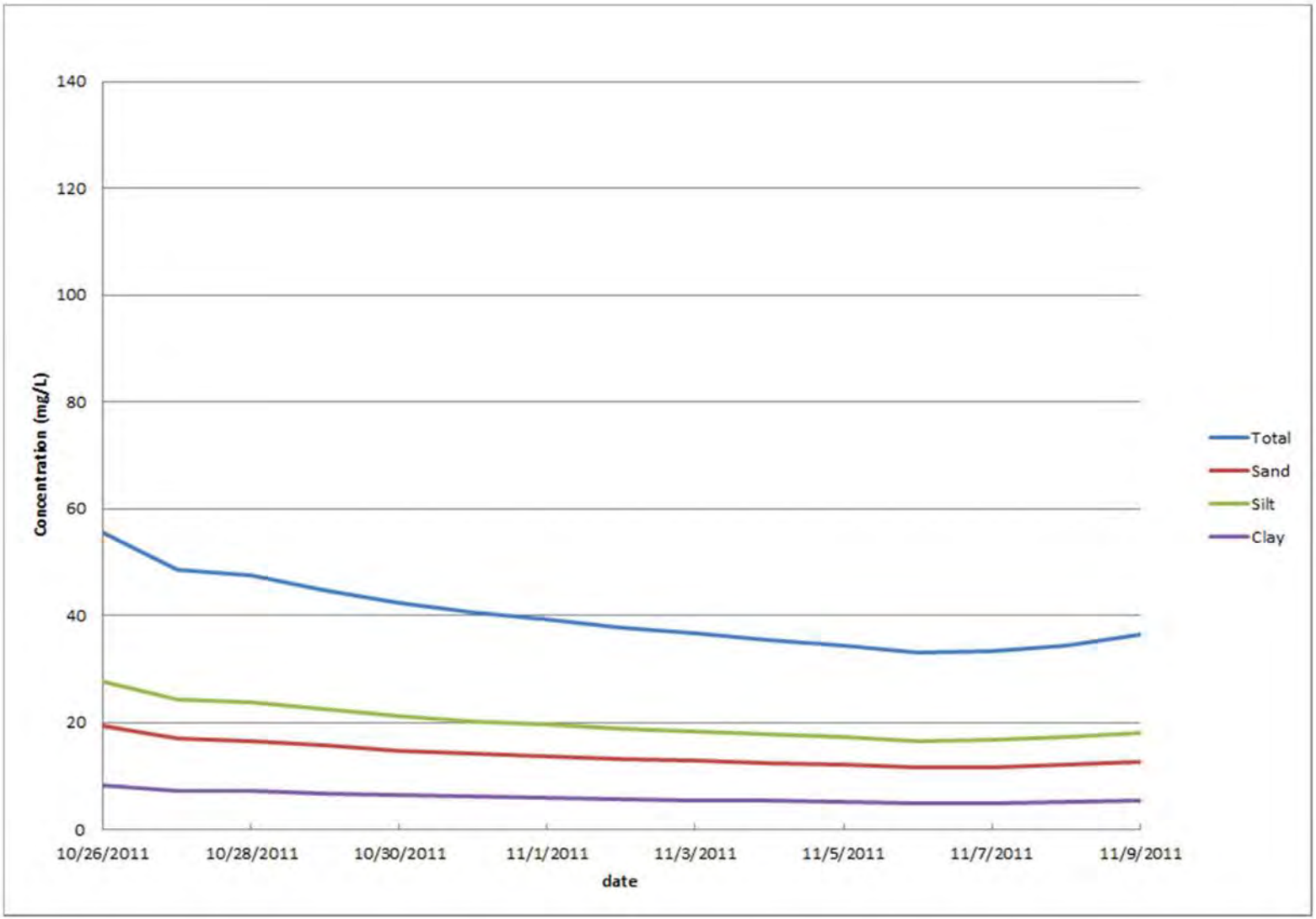
SHEET 9 OF 9

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 4-9

Riverine Model Boundary Suspended Sediment Concentration

October/November 2011

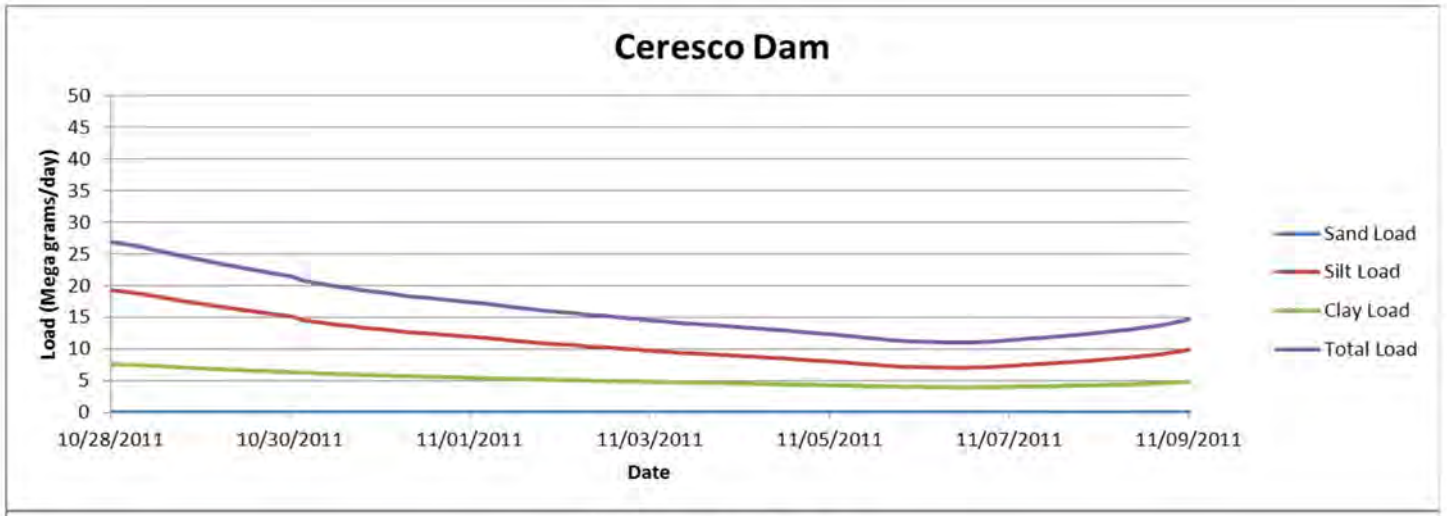


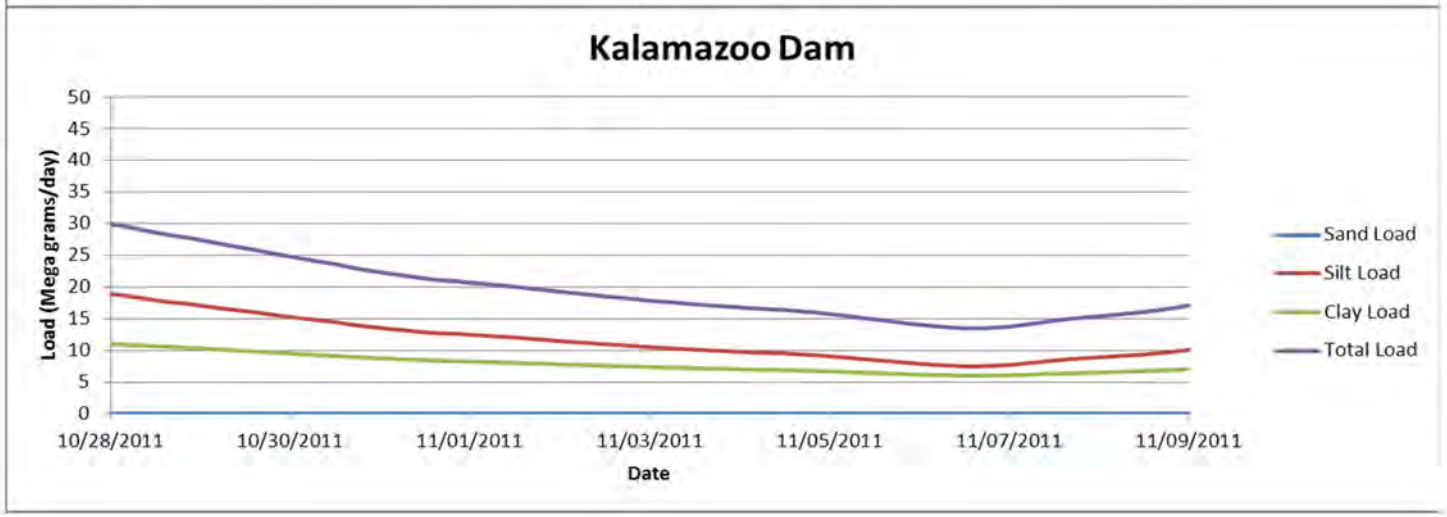
ENBRIDGE	Footnotes: mg/L=Milligrams per Liter	RIVERINE MODEL BOUNDARY SUSPENDED SEDIMENT CONCENTRATION OCTOBER/NOVEMBER 2011 ENBRIDGE LINE 6B MP 608 MARSHALL, MI PIPELINE RELEASE ENBRIDGE ENERGY, LIMITED PARTNERSHIP
Drawn: JLH 04/17/2012		
Approved: DBR 04/17/2012		
Project #: 106-4186		

Figure 4-10

Riverine Simulated Sediment Mass Flux (Megagrams per Day) in Kalamazoo River Calibration

Sheets 1 through 6





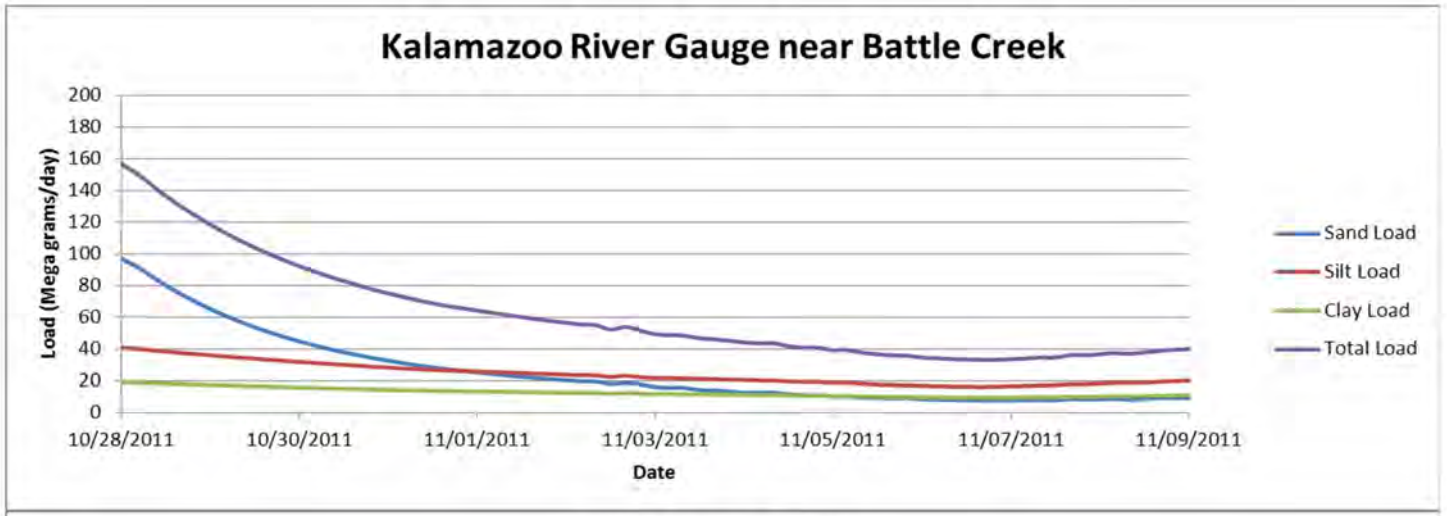
ENBRIDGE

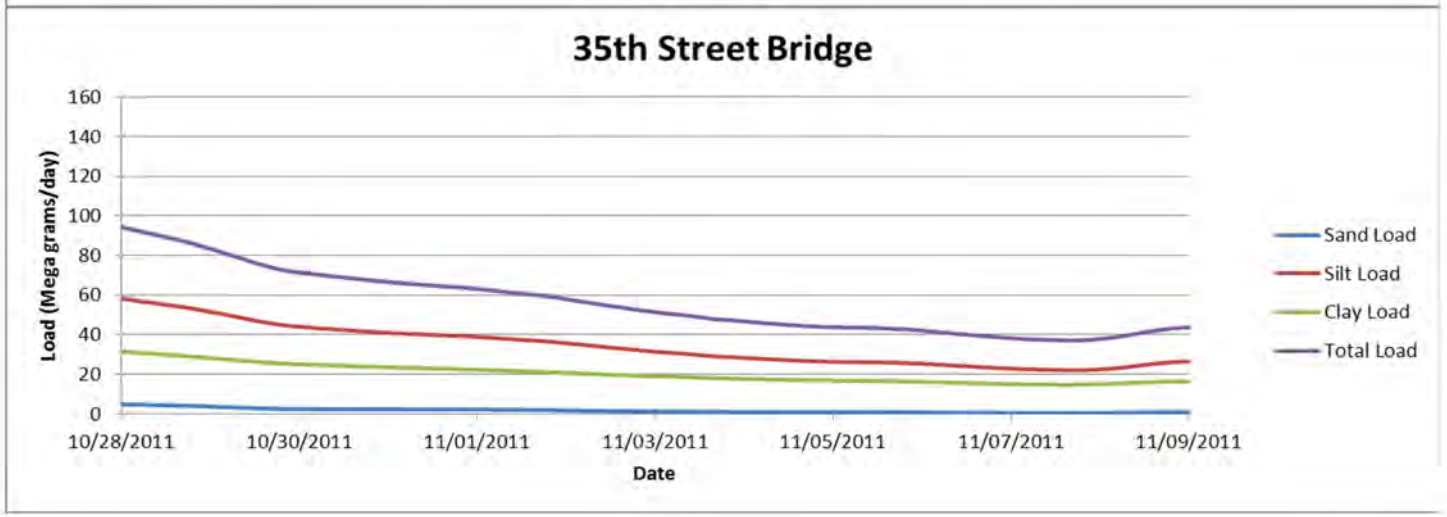
Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

RIVERINE SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 1 OF 6

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP





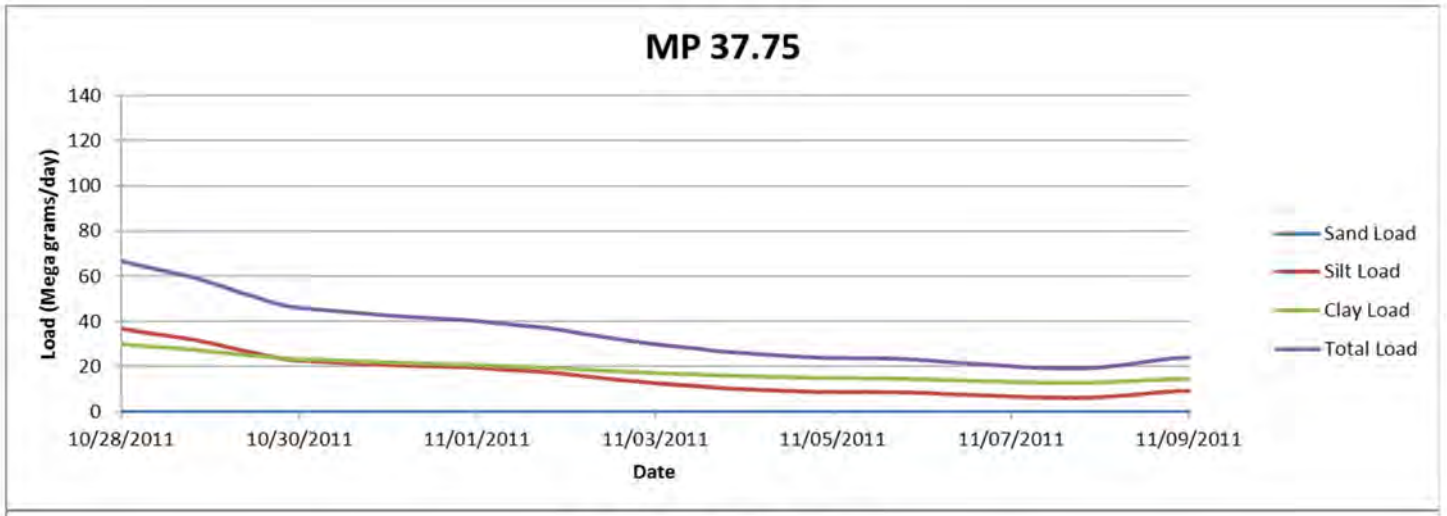
ENBRIDGE

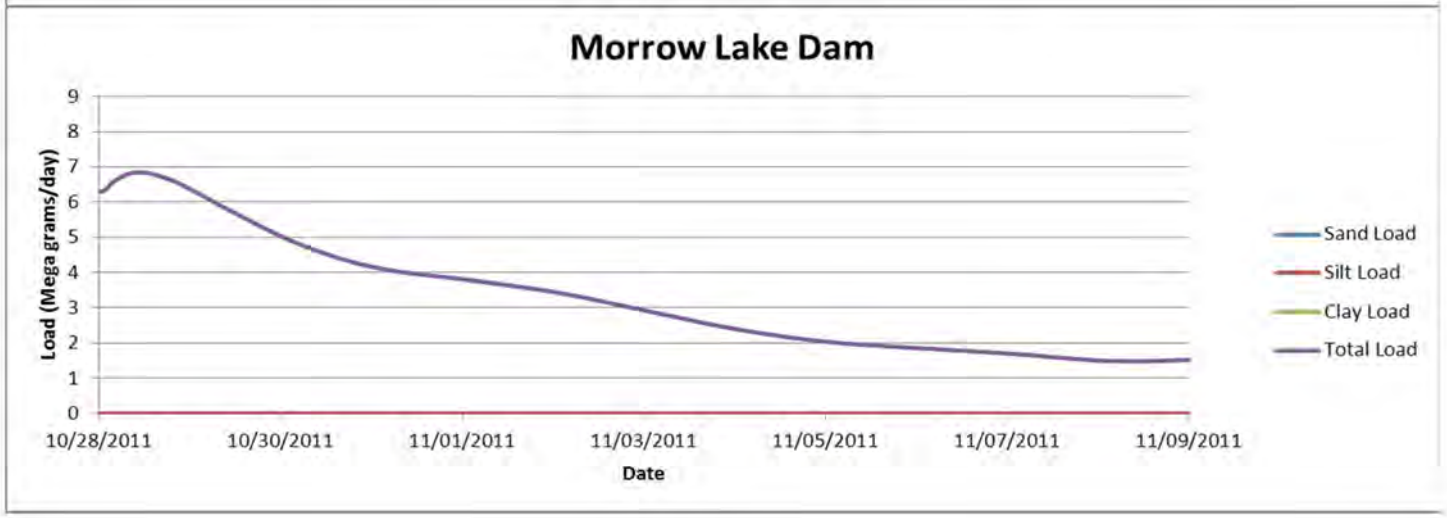
Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

RIVERINE SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 2 OF 6

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP





ENBRIDGE

Drawn:	JLH 04/17/2012
Approved:	DBR 04/17/2012
Project #:	106-4186

RIVERINE SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 3 OF 6

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Date	Time	Ceresco Dam			Kalamazoo Dam			Kalamazoo River Gauge Near Battle Creek			35th Street Bridge			Delta Neck			Morrow Dam		
		Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)
10/28/2011	12:00 AM	0.0	19.3	7.6	0.0	18.9	11.0	97.1	40.8	19.0	4.8	58.2	31.3	0.0	36.9	30.0	0.0	0.0	6.3
10/28/2011	4:00 AM	0.0	19.0	7.5	0.0	18.7	10.9	92.2	40.1	18.8	4.6	57.1	30.8	0.0	35.7	29.4	0.0	0.0	6.6
10/28/2011	7:59 AM	0.0	18.7	7.4	0.0	18.3	10.8	86.0	39.2	18.5	4.4	56.1	30.3	0.0	34.7	28.9	0.0	0.0	6.8
10/28/2011	12:00 PM	0.0	18.3	7.3	0.0	17.9	10.7	80.0	38.3	18.1	4.2	55.1	29.8	0.0	33.8	28.5	0.0	0.0	6.8
10/28/2011	4:00 PM	0.0	17.9	7.2	0.0	17.6	10.6	74.6	37.5	17.9	4.1	54.1	29.3	0.0	32.8	28.0	0.0	0.0	6.7
10/28/2011	7:59 PM	0.0	17.5	7.1	0.0	17.4	10.4	69.7	36.8	17.6	3.8	52.9	28.8	0.0	31.8	27.4	0.0	0.0	6.6
10/29/2011	12:00 AM	0.0	17.2	6.9	0.0	17.1	10.3	65.1	36.0	17.3	3.6	51.5	28.1	0.0	30.5	26.8	0.0	0.0	6.4
10/29/2011	4:00 AM	0.0	16.8	6.8	0.0	16.8	10.2	61.0	35.3	17.0	3.3	50.1	27.5	0.0	28.9	26.1	0.0	0.0	6.1
10/29/2011	7:59 AM	0.0	16.4	6.7	0.0	16.5	10.0	57.1	34.5	16.8	3.0	48.6	26.9	0.0	27.4	25.5	0.0	0.0	5.9
10/29/2011	12:00 PM	0.0	16.1	6.6	0.0	16.2	9.9	53.6	33.8	16.5	2.8	47.1	26.3	0.0	26.0	24.9	0.0	0.0	5.7
10/29/2011	4:00 PM	0.0	15.8	6.5	0.0	15.9	9.8	50.4	33.2	16.2	2.5	45.8	25.7	0.0	24.6	24.2	0.0	0.0	5.5
10/29/2011	7:59 PM	0.0	15.5	6.4	0.0	15.6	9.6	47.5	32.5	15.9	2.4	44.7	25.3	0.0	23.3	23.7	0.0	0.0	5.2
10/30/2011	12:00 AM	0.0	15.2	6.3	0.0	15.3	9.5	44.8	31.8	15.7	2.3	44.0	25.0	0.0	22.7	23.4	0.0	0.0	5.0
10/30/2011	4:00 AM	0.0	14.5	6.2	0.0	15.0	9.4	42.3	31.2	15.4	2.3	43.3	24.8	0.0	22.3	23.1	0.0	0.0	4.8
10/30/2011	7:59 AM	0.0	14.2	6.1	0.0	14.7	9.2	39.9	30.6	15.2	2.2	42.8	24.5	0.0	22.0	22.9	0.0	0.0	4.7
10/30/2011	12:00 PM	0.0	13.9	6.0	0.0	14.5	9.1	37.9	30.0	15.0	2.2	42.3	24.2	0.0	21.7	22.7	0.0	0.0	4.5
10/30/2011	4:00 PM	0.0	13.6	6.0	0.0	14.1	9.0	36.0	29.4	14.7	2.2	41.8	23.9	0.0	21.4	22.4	0.0	0.0	4.4
10/30/2011	7:59 PM	0.0	13.3	5.9	0.0	13.8	8.9	34.2	28.7	14.5	2.2	41.3	23.7	0.0	21.0	22.1	0.0	0.0	4.3
10/31/2011	12:00 AM	0.0	13.1	5.8	0.0	13.6	8.8	32.5	28.2	14.3	2.2	40.9	23.5	0.0	20.8	21.9	0.0	0.0	4.2
10/31/2011	4:00 AM	0.0	12.9	5.8	0.0	13.3	8.6	31.0	27.7	14.1	2.1	40.5	23.2	0.0	20.5	21.7	0.0	0.0	4.1
10/31/2011	7:59 AM	0.0	12.6	5.7	0.0	13.1	8.6	29.6	27.2	13.9	2.1	40.2	23.0	0.0	20.3	21.5	0.0	0.0	4.0
10/31/2011	12:00 PM	0.0	12.5	5.6	0.0	12.9	8.5	28.3	26.7	13.7	2.1	39.9	22.8	0.0	20.2	21.3	0.0	0.0	4.0
10/31/2011	4:00 PM	0.0	12.3	5.6	0.0	12.7	8.4	27.1	26.4	13.6	2.1	39.5	22.6	0.0	20.0	21.1	0.0	0.0	3.9
10/31/2011	7:59 PM	0.0	12.1	5.5	0.0	12.7	8.3	26.1	26.2	13.4	2.1	39.3	22.4	0.0	19.8	20.9	0.0	0.0	3.9
11/1/2011	12:00 AM	0.0	11.9	5.5	0.0	12.5	8.2	25.1	25.8	13.3	2.1	38.8	22.2	0.0	19.5	20.7	0.0	0.0	3.8
11/1/2011	4:00 AM	0.0	11.8	5.4	0.0	12.3	8.2	24.2	25.5	13.1	2.0	38.3	21.9	0.0	19.1	20.4	0.0	0.0	3.8
11/1/2011	7:59 AM	0.0	11.5	5.3	0.0	12.2	8.1	23.3	25.1	13.0	2.0	37.8	21.7	0.0	18.7	20.2	0.0	0.0	3.7
11/1/2011	12:00 PM	0.0	11.3	5.3	0.0	12.0	8.0	22.5	24.8	12.9	1.9	37.3	21.5	0.0	18.3	20.0	0.0	0.0	3.6
11/1/2011	4:00 PM	0.0	11.1	5.2	0.0	11.8	7.9	21.7	24.4	12.7	1.8	36.9	21.2	0.0	17.9	19.7	0.0	0.0	3.6
11/1/2011	7:59 PM	0.0	10.9	5.2	0.0	11.7	7.9	20.9	24.1	12.6	1.8	36.4	21.0	0.0	17.4	19.5	0.0	0.0	3.5
11/2/2011	12:00 AM	0.0	10.7	5.1	0.0	11.5	7.8	20.3	23.7	12.5	1.6	35.6	20.7	0.0	16.7	19.1	0.0	0.0	3.5

ENBRIDGE

Drawn: JLH 04/17/2012

Approved: DBR 04/17/2012

Project #: 106-4186

Footnotes:

Mg=Megagram

RIVERINE SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 4 OF 6

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Date	Time	Ceresco Dam			Kalamazoo Dam			Kalamazoo River Gauge Near Battle Creek			35th Street Bridge			Delta Neck			Morrow Dam		
		Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)
11/2/2011	4:00 AM	0.0	10.6	5.1	0.0	11.3	7.7	19.7	23.4	12.4	1.5	34.9	20.3	0.0	16.0	18.8	0.0	0.0	3.4
11/2/2011	7:59 AM	0.0	10.3	5.0	0.0	11.2	7.7	19.5	23.3	12.3	1.4	34.2	20.0	0.0	15.3	18.4	0.0	0.0	3.3
11/2/2011	12:00 PM	0.0	10.3	4.9	0.0	11.0	7.6	17.9	22.3	11.9	1.3	33.4	19.7	0.0	14.5	18.1	0.0	0.0	3.2
11/2/2011	4:00 PM	0.0	10.1	4.9	0.0	10.9	7.5	18.6	23.1	12.3	1.3	32.7	19.4	0.0	13.9	17.8	0.0	0.0	3.1
11/2/2011	7:59 PM	0.0	9.9	4.9	0.0	10.7	7.4	17.6	22.2	11.8	1.2	31.9	19.1	0.0	13.3	17.5	0.0	0.0	3.0
11/3/2011	12:00 AM	0.0	9.7	4.8	0.0	10.5	7.4	16.0	21.7	11.6	1.1	31.4	18.9	0.0	12.7	17.2	0.0	0.0	2.9
11/3/2011	4:00 AM	0.0	9.6	4.8	0.0	10.4	7.3	15.5	21.7	11.6	1.1	30.8	18.7	0.0	12.2	17.0	0.0	0.0	2.8
11/3/2011	7:59 AM	0.0	9.4	4.7	0.0	10.2	7.2	15.4	21.4	11.5	1.0	30.3	18.5	0.0	11.8	16.8	0.0	0.0	2.7
11/3/2011	12:00 PM	0.0	9.3	4.7	0.0	10.1	7.2	14.1	21.1	11.5	1.0	29.6	18.2	0.0	11.4	16.5	0.0	0.0	2.7
11/3/2011	4:00 PM	0.0	9.2	4.6	0.0	10.0	7.1	13.9	20.9	11.3	0.9	29.0	17.9	0.0	10.8	16.2	0.0	0.0	2.6
11/3/2011	7:59 PM	0.0	9.0	4.6	0.0	9.9	7.1	13.3	20.6	11.2	0.9	28.7	17.8	0.0	10.4	16.0	0.0	0.0	2.5
11/4/2011	12:00 AM	0.0	8.9	4.5	0.0	9.8	7.0	12.5	20.5	11.1	0.8	28.2	17.6	0.0	10.2	15.9	0.0	0.0	2.4
11/4/2011	4:00 AM	0.0	8.8	4.5	0.0	9.7	7.0	12.4	20.1	11.0	0.8	27.8	17.4	0.0	9.8	15.7	0.0	0.0	2.3
11/4/2011	7:59 AM	0.0	8.6	4.5	0.0	9.6	6.9	12.5	20.1	11.0	0.8	27.4	17.3	0.0	9.6	15.5	0.0	0.0	2.3
11/4/2011	12:00 PM	0.0	8.5	4.4	0.0	9.5	6.9	11.4	19.5	10.7	0.8	27.1	17.1	0.0	9.4	15.4	0.0	0.0	2.2
11/4/2011	4:00 PM	0.0	8.3	4.4	0.0	9.4	6.8	10.9	19.3	10.6	0.7	26.7	17.0	0.0	9.1	15.2	0.0	0.0	2.1
11/4/2011	7:59 PM	0.0	8.2	4.3	0.0	9.3	6.8	10.9	19.2	10.6	0.7	26.4	16.8	0.0	9.0	15.1	0.0	0.0	2.1
11/5/2011	12:00 AM	0.0	8.0	4.3	0.0	9.1	6.7	10.2	18.6	10.4	0.7	26.2	16.8	0.0	8.9	15.0	0.0	0.0	2.0
11/5/2011	4:00 AM	0.0	7.9	4.2	0.0	8.9	6.6	10.1	18.7	10.4	0.7	26.1	16.7	0.0	8.9	14.9	0.0	0.0	2.0
11/5/2011	7:59 AM	0.0	7.7	4.2	0.0	8.7	6.5	9.4	18.1	10.1	0.7	26.1	16.7	0.0	8.9	14.9	0.0	0.0	2.0
11/5/2011	12:00 PM	0.0	7.5	4.1	0.0	8.5	6.4	9.0	17.6	10.0	0.7	26.0	16.6	0.0	8.9	14.8	0.0	0.0	1.9
11/5/2011	4:00 PM	0.0	7.3	4.1	0.0	8.3	6.3	8.8	17.3	9.8	0.7	25.8	16.4	0.0	8.8	14.7	0.0	0.0	1.9
11/5/2011	7:59 PM	0.0	7.2	4.1	0.0	8.1	6.2	9.0	17.0	9.7	0.7	25.6	16.3	0.0	8.7	14.6	0.0	0.0	1.9
11/6/2011	12:00 AM	0.0	7.1	4.0	0.0	7.9	6.2	8.3	16.7	9.6	0.7	25.3	16.1	0.0	8.5	14.4	0.0	0.0	1.9
11/6/2011	4:00 AM	0.0	7.1	4.0	0.0	7.7	6.1	8.1	16.5	9.5	0.5	24.9	15.9	0.0	8.3	14.2	0.0	0.0	1.8
11/6/2011	7:59 AM	0.0	7.0	4.0	0.0	7.6	6.1	7.9	16.3	9.5	0.5	24.4	15.7	0.0	7.9	14.0	0.0	0.0	1.8
11/6/2011	12:00 PM	0.0	7.0	4.0	0.0	7.5	6.0	7.8	16.1	9.4	0.5	24.0	15.5	0.0	7.7	13.8	0.0	0.0	1.8
11/6/2011	4:00 PM	0.0	7.1	4.0	0.0	7.5	6.0	7.6	16.1	9.4	0.5	23.5	15.3	0.0	7.5	13.6	0.0	0.0	1.8
11/6/2011	7:59 PM	0.0	7.2	4.0	0.0	7.6	6.0	7.6	16.2	9.4	0.5	23.2	15.1	0.0	7.2	13.4	0.0	0.0	1.7
11/7/2011	12:00 AM	0.0	7.3	4.0	0.0	7.7	6.0	7.7	16.5	9.4	0.4	22.8	15.0	0.0	7.0	13.3	0.0	0.0	1.7
11/7/2011	4:00 AM	0.0	7.5	4.1	0.0	7.9	6.1	7.7	16.6	9.5	0.4	22.4	14.8	0.0	6.7	13.1	0.0	0.0	1.7

ENBRIDGE

Drawn: JLH 04/17/2012

Approved: DBR 04/17/2012

Project #: 106-4186

Footnotes:

Mg=Megagram

RIVERINE SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 5 OF 6

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Date	Time	Ceresco Dam			Kalamazoo Dam			Kalamazoo River Gauge Near Battle Creek			35th Street Bridge			Delta Neck			Morrow Dam		
		Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)
11/7/2011	7:59 AM	0.0	7.6	4.1	0.0	8.2	6.2	8.0	16.9	9.6	0.4	22.3	14.7	0.0	6.5	12.9	0.0	0.0	1.6
11/7/2011	12:00 PM	0.0	7.8	4.2	0.0	8.4	6.3	7.6	17.2	9.7	0.4	22.1	14.7	0.0	6.4	12.9	0.0	0.0	1.6
11/7/2011	4:00 PM	0.0	7.9	4.2	0.0	8.6	6.4	8.4	17.8	9.9	0.4	22.0	14.7	0.0	6.3	12.8	0.0	0.0	1.6
11/7/2011	7:59 PM	0.0	8.1	4.3	0.0	8.8	6.4	8.2	17.9	9.9	0.4	22.0	14.7	0.0	6.4	12.9	0.0	0.0	1.5
11/8/2011	12:00 AM	0.0	8.3	4.3	0.0	8.9	6.5	8.3	18.2	10.1	0.4	22.4	15.0	0.0	6.6	13.1	0.0	0.0	1.5
11/8/2011	4:00 AM	0.0	8.5	4.4	0.0	9.1	6.6	8.6	18.5	10.3	0.5	22.9	15.2	0.0	7.1	13.3	0.0	0.0	1.5
11/8/2011	7:59 AM	0.0	8.6	4.4	0.0	9.2	6.6	8.0	18.7	10.3	0.5	23.7	15.5	0.0	7.5	13.6	0.0	0.0	1.5
11/8/2011	12:00 PM	0.0	8.9	4.5	0.0	9.4	6.7	8.6	18.8	10.4	0.7	24.7	15.8	0.0	8.2	13.9	0.0	0.0	1.5
11/8/2011	4:00 PM	0.0	9.1	4.6	0.0	9.6	6.8	9.0	19.3	10.5	0.8	25.5	16.1	0.0	8.7	14.2	0.0	0.0	1.5
11/8/2011	7:59 PM	0.0	9.5	4.7	0.0	9.8	6.9	9.1	19.7	10.7	0.8	26.1	16.3	0.0	9.2	14.5	0.0	0.0	1.5
11/9/2011	12:00 AM	0.0	9.9	4.8	0.0	10.1	7.0	9.3	20.0	10.8	0.8	26.4	16.4	0.0	9.4	14.6	0.0	0.0	1.5
11/9/2011	4:00 AM	0.0	10.5	4.9	0.0	10.4	7.2	10.6	20.9	11.2	0.8	26.6	16.4	0.0	9.4	14.6	0.0	0.0	1.5
11/9/2011	7:59 AM	0.0	11.0	5.1	0.0	10.9	7.4	9.9	21.6	11.5	0.8	26.7	16.5	0.0	9.4	14.7	0.0	0.0	1.6
11/9/2011	12:00 PM	0.0	11.6	5.2	0.0	11.4	7.6	11.5	22.2	11.7	0.8	26.8	16.6	0.0	9.4	14.7	0.0	0.0	1.6
11/9/2011	4:00 PM	0.0	12.1	5.4	0.0	12.1	7.9	12.7	23.7	12.3	0.8	27.0	16.8	0.0	9.4	14.9	0.0	0.0	1.6
11/9/2011	7:59 PM	0.0	12.6	5.5	0.0	12.7	8.1	13.1	24.3	12.5	0.8	27.5	17.0	0.0	9.6	15.1	0.0	0.0	1.7
11/10/2011	12:00 AM	0.0	13.0	5.7	0.0	13.2	8.3	13.6	25.2	12.8	0.8	28.2	17.4	0.0	10.0	15.4	0.0	0.0	1.7

ENBRIDGE

Drawn: JLH 04/17/2012

Approved: DBR 04/17/2012

Project #: 106-4186

Footnotes:

Mg=Megagram

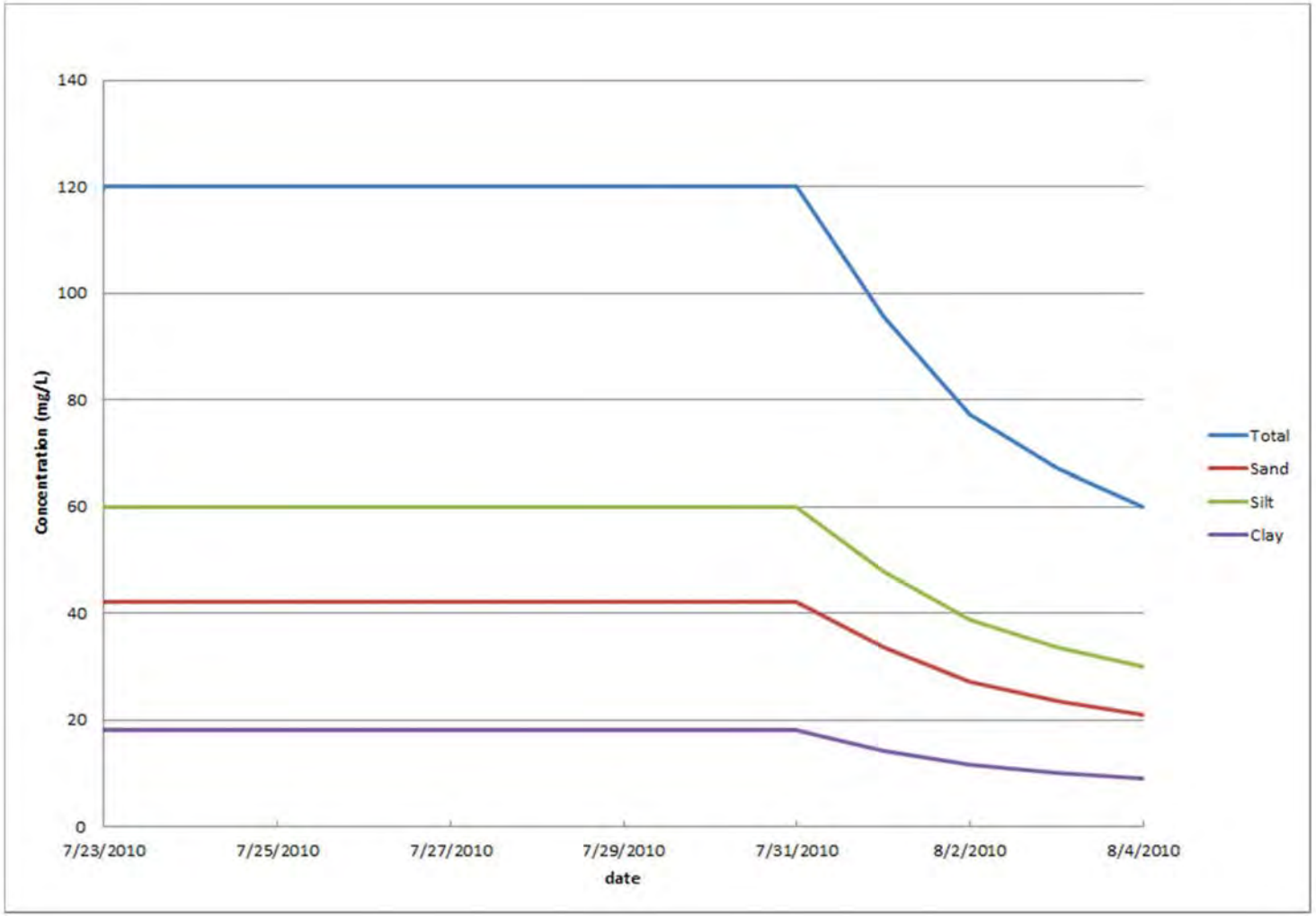
RIVERINE SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 6 OF 6

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 4-11

Floodplain Model Boundary Suspended Sediment Concentration for July 2010



ENBRIDGE

Drawn:	JLH	04/17/2012
Approved:	DBR	04/17/2012
Project #:	106-4186	

Footnotes:

mg/L=Milligrams per Liter

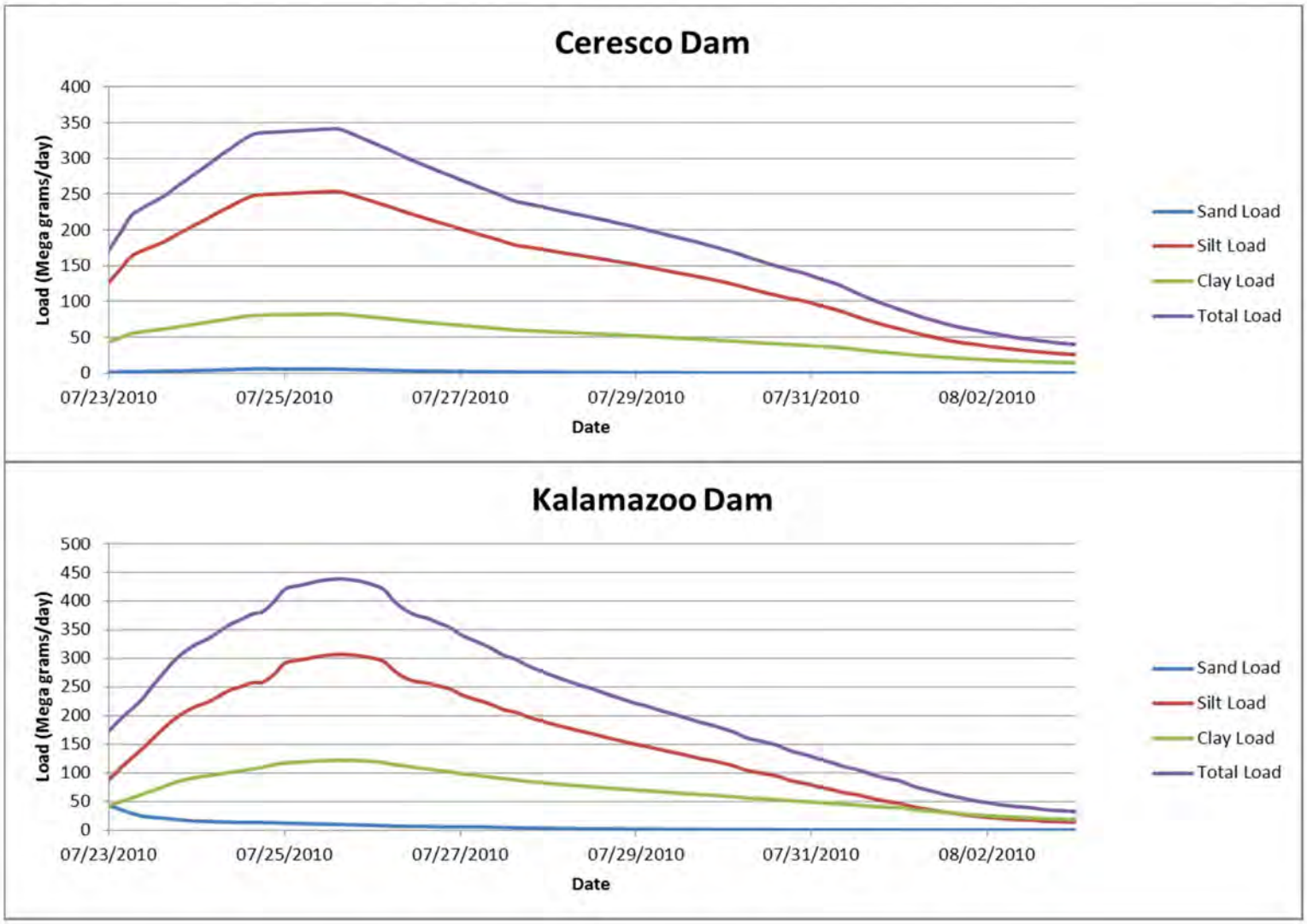
FLOODPLAIN MODEL BOUNDARY
SUSPENDED SEDIMENT
CONCENTRATION FOR JULY 2010

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 4-12

Floodplain Simulated Sediment Mass Flux (Megagrams per Day) in Kalamazoo River Calibration

Sheets 1 through 7



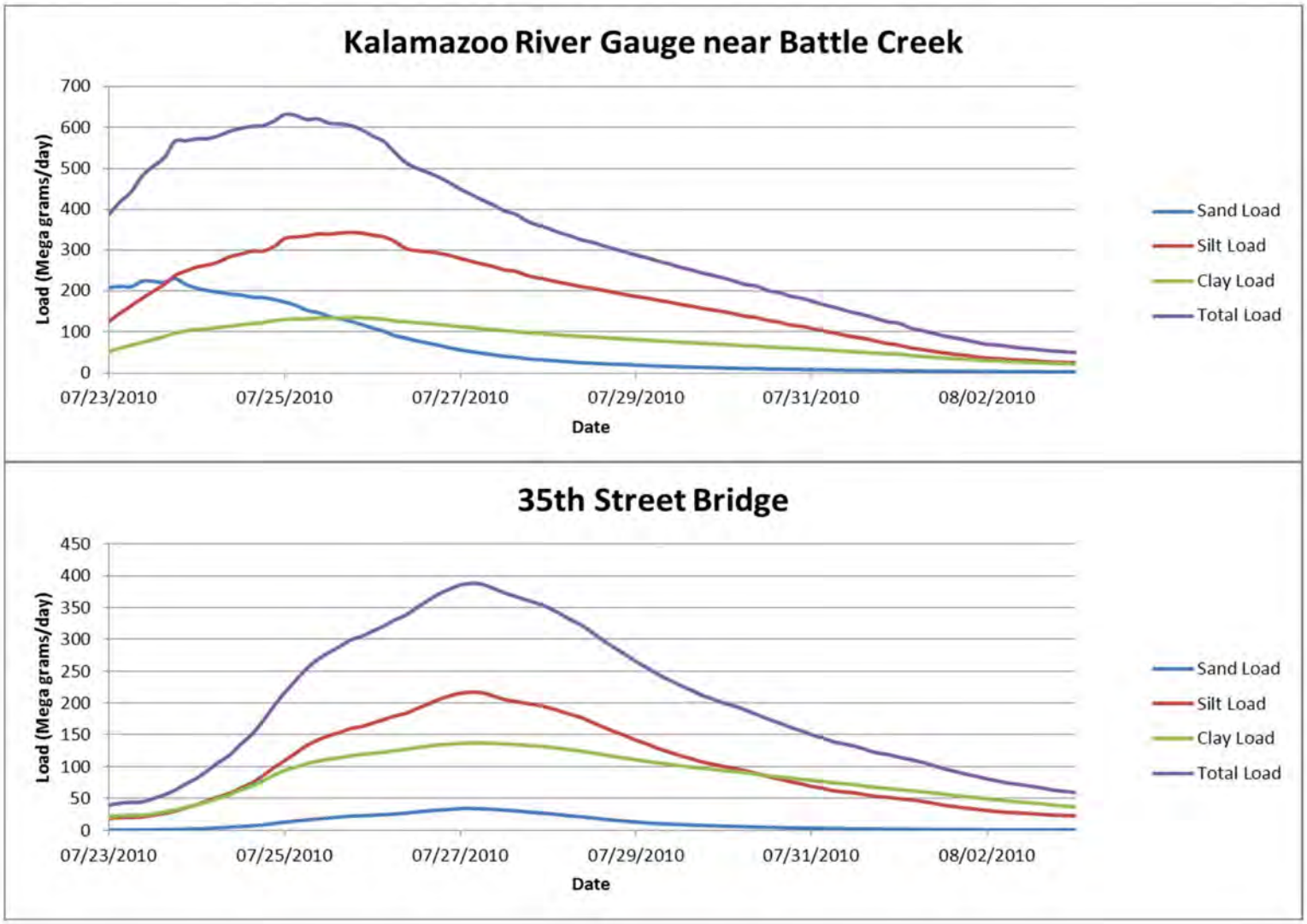
ENBRIDGE

Drawn:	JLH	04/18/2012
Approved:	DBR	04/18/2012
Project #:	106-4186	

FLOODPLAIN SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 1 OF 7

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP



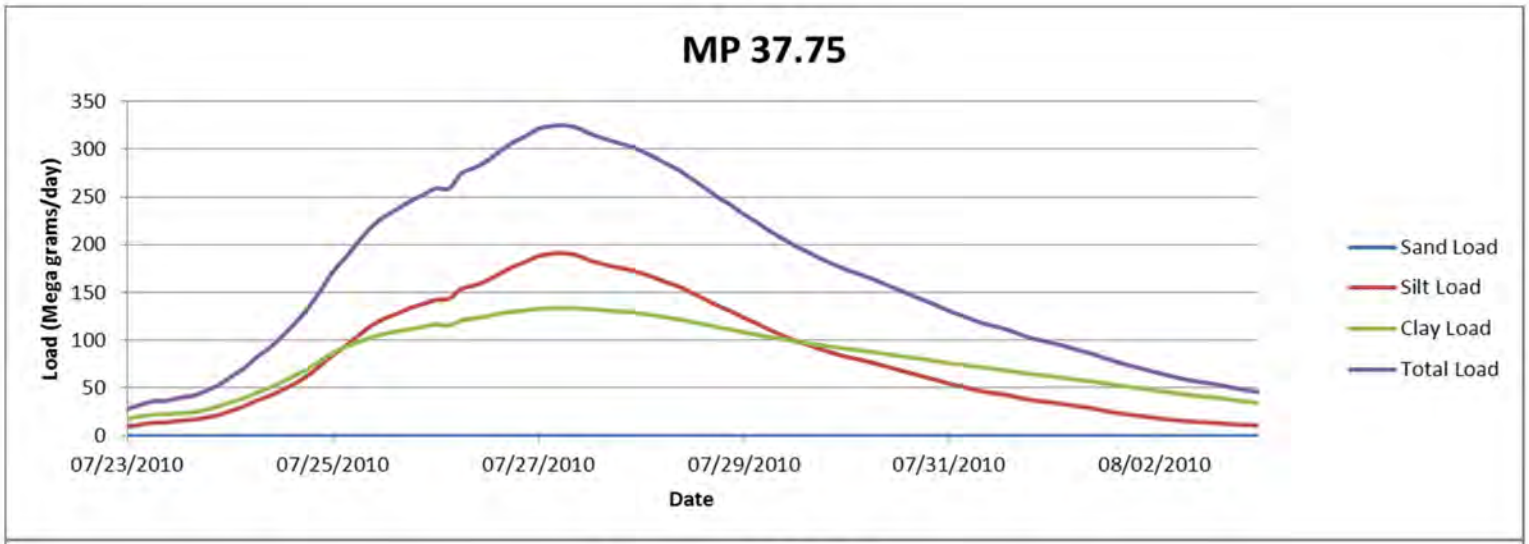
ENBRIDGE

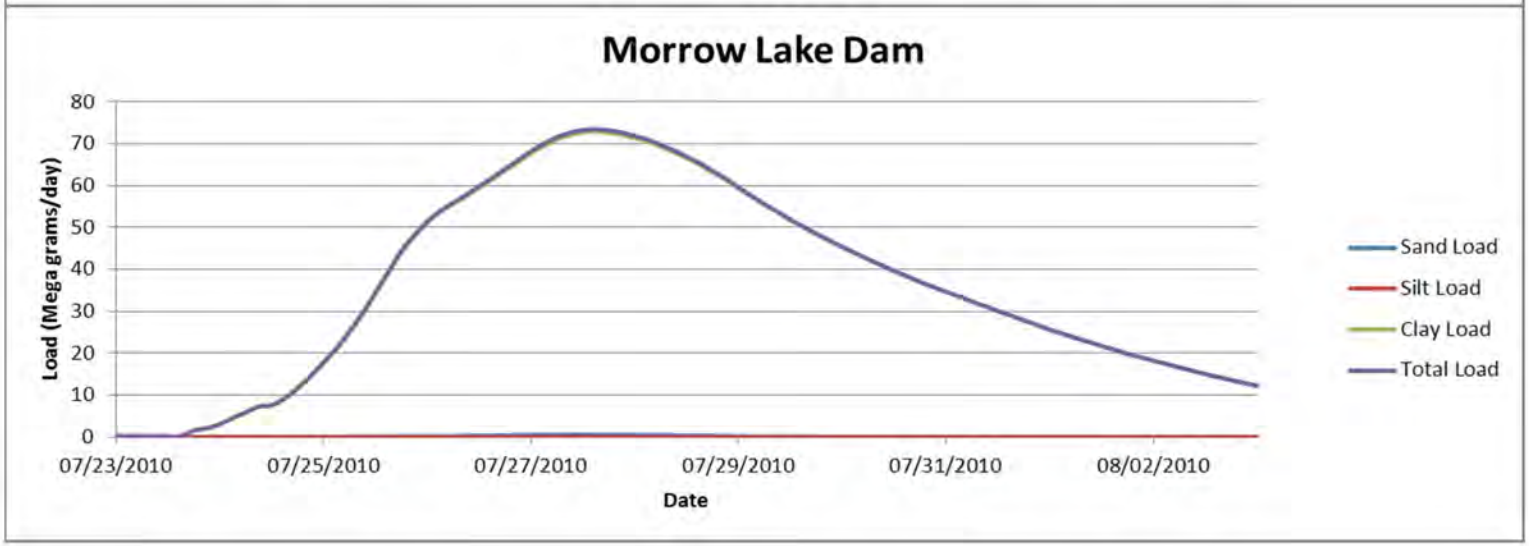
Drawn:	JLH	04/18/2012
Approved:	DBR	04/18/2012
Project #:	106-4186	

FLOODPLAIN SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 2 OF 7

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP





ENBRIDGE

Drawn:	JLH	04/18/2012
Approved:	DBR	04/18/2012
Project #:	106-4186	

FLOODPLAIN SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 3 OF 7

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Date	Time	Ceresco Dam			Kalamazoo Dam			Kalamazoo River Gauge Near Battle Creek			35th Street Bridge			MP 37.75			Morrow Dam		
		Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)
7/20/2010	3:07 AM	0.0	0.0	0.0	0.0	0.0	0.0	99.5	9.8	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/20/2010	6:00 AM	0.0	0.0	0.0	0.0	0.0	0.0	60.4	10.2	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/20/2010	9:07 AM	0.0	0.7	1.0	0.0	0.0	0.0	40.4	10.6	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/20/2010	12:00 PM	0.0	7.2	6.9	0.0	0.0	0.0	29.0	11.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/20/2010	3:07 PM	0.0	7.4	7.3	0.0	0.0	0.0	21.8	11.7	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/20/2010	6:00 PM	0.0	7.6	7.3	0.0	0.0	0.0	17.0	11.8	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/20/2010	9:07 PM	0.0	8.0	7.4	0.0	0.0	0.0	13.7	12.1	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/21/2010	12:00 AM	0.0	8.4	7.5	0.0	0.0	0.8	11.3	12.7	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/21/2010	3:07 AM	0.0	8.9	7.6	0.4	0.0	6.0	184.8	12.3	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/21/2010	6:00 AM	0.0	9.3	7.7	2.7	5.5	8.8	131.9	15.8	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/21/2010	9:07 AM	0.0	9.7	7.8	3.6	5.2	9.9	113.7	17.9	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/21/2010	12:00 PM	0.0	10.1	8.0	4.0	5.4	10.6	105.3	18.7	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/21/2010	3:07 PM	0.0	10.9	8.3	4.8	5.8	10.9	102.4	19.5	15.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/21/2010	6:00 PM	0.0	14.4	9.3	6.7	7.5	12.3	103.8	20.9	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/21/2010	9:07 PM	0.0	20.1	10.7	9.9	6.5	11.4	111.4	22.5	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
7/22/2010	12:00 AM	0.1	24.9	11.9	12.9	8.8	12.1	115.3	24.8	17.3	0.0	0.4	1.4	0.0	0.0	0.0	0.0	0.0	0.2
7/22/2010	3:07 AM	0.1	32.2	13.8	18.7	11.7	13.4	128.2	31.1	19.6	0.0	0.3	11.8	0.0	0.1	0.3	0.0	0.0	0.2
7/22/2010	6:00 AM	0.2	37.0	15.1	24.2	15.5	14.9	129.7	37.0	21.7	0.0	5.6	13.7	0.0	0.3	11.2	0.0	0.0	0.2
7/22/2010	9:07 AM	0.3	46.2	18.3	42.1	23.1	18.8	157.4	47.2	26.4	0.0	5.0	10.8	0.0	2.1	13.0	0.0	0.0	0.2
7/22/2010	12:00 PM	0.4	60.3	23.1	45.5	31.3	21.9	159.2	58.4	30.4	0.0	6.0	13.2	0.0	2.7	11.0	0.0	0.0	0.2
7/22/2010	3:07 PM	0.6	77.1	28.4	53.5	44.0	26.6	176.0	73.8	36.0	0.0	10.8	16.6	0.0	3.7	13.1	0.0	0.0	0.2
7/22/2010	6:00 PM	0.9	94.1	33.5	53.0	58.1	31.1	190.2	90.9	41.6	0.0	11.9	16.7	0.0	6.4	15.5	0.0	0.0	0.2
7/22/2010	9:07 PM	1.2	110.5	38.6	51.7	72.6	36.2	204.8	108.9	47.7	0.0	14.5	18.4	0.0	7.6	15.8	0.0	0.0	0.2
7/23/2010	12:00 AM	1.4	127.2	43.8	43.0	88.9	41.9	208.6	126.5	53.6	0.0	17.8	21.3	0.0	9.9	18.4	0.0	0.0	0.2
7/23/2010	3:07 AM	1.6	145.2	49.4	36.2	108.7	49.6	211.7	146.8	61.5	0.0	19.6	22.9	0.0	12.2	20.8	0.0	0.0	0.2
7/23/2010	6:00 AM	1.9	162.7	54.9	29.6	125.3	56.1	210.3	164.3	68.3	0.1	20.2	23.4	0.0	13.9	22.5	0.0	0.0	0.2
7/23/2010	9:07 AM	2.1	170.9	57.5	24.4	142.7	62.4	224.6	183.0	75.4	0.3	20.9	23.4	0.0	14.3	22.7	0.0	0.0	0.2
7/23/2010	12:00 PM	2.4	176.8	59.4	22.5	160.8	69.4	223.9	199.3	81.8	0.5	23.6	25.6	0.0	16.2	23.8	0.0	0.0	0.2
7/23/2010	3:07 PM	2.6	183.4	61.4	20.7	179.0	76.6	221.5	216.9	88.8	0.8	26.5	28.5	0.0	17.2	24.6	0.0	0.0	0.2
7/23/2010	6:00 PM	2.9	191.9	63.7	18.9	194.9	83.4	230.8	238.2	97.5	1.0	30.1	31.8	0.0	19.1	27.3	0.0	0.0	1.6
7/23/2010	9:07 PM	3.2	200.4	66.1	16.9	208.1	88.8	215.6	249.7	102.6	1.6	35.4	36.3	0.0	21.9	30.8	0.0	0.0	2.1

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

Footnotes:

Mg=Megagrams
MP=Mile Post

FLOODPLAIN SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Date	Time	Ceresco Dam			Kalamazoo Dam			Kalamazoo River Gauge Near Battle Creek			35th Street Bridge			MP 37.75			Morrow Dam		
		Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)
7/24/2010	12:00 AM	3.6	208.3	68.5	15.8	217.1	92.5	207.1	259.2	106.5	2.0	40.2	39.8	0.0	26.2	35.2	0.0	0.0	3.0
7/24/2010	3:07 AM	4.0	216.4	70.8	15.1	224.1	95.2	200.9	264.1	108.3	3.0	47.0	44.7	0.0	31.0	39.5	0.0	0.0	4.6
7/24/2010	6:00 AM	4.4	224.8	73.3	14.5	234.2	98.0	197.5	271.8	111.1	3.9	52.5	50.6	0.0	37.0	44.8	0.0	0.0	5.9
7/24/2010	9:07 AM	4.8	232.8	75.8	13.9	244.7	101.1	192.5	284.7	114.4	4.7	58.5	55.8	0.0	41.9	50.1	0.0	0.0	7.3
7/24/2010	12:00 PM	5.3	240.4	78.1	13.5	250.4	103.8	190.5	290.3	117.4	5.8	66.4	63.3	0.0	47.8	56.0	0.0	0.0	7.6
7/24/2010	3:07 PM	5.7	247.2	80.2	13.4	257.4	106.7	185.1	297.9	120.2	6.9	74.4	70.0	0.0	54.7	63.2	0.0	0.0	9.2
7/24/2010	6:00 PM	5.7	249.3	80.8	13.2	258.5	110.1	184.3	297.7	122.9	8.4	85.7	77.5	0.0	62.8	69.9	0.0	0.0	11.7
7/24/2010	9:07 PM	5.6	249.9	81.1	12.8	272.3	114.5	179.4	309.2	127.7	10.5	98.7	86.9	0.0	73.7	78.6	0.0	0.0	14.6
7/25/2010	12:00 AM	5.6	250.6	81.3	12.1	291.4	117.3	173.1	328.6	130.7	12.5	109.5	94.2	0.0	84.8	87.0	0.1	0.0	17.7
7/25/2010	3:07 AM	5.5	251.3	81.5	11.5	296.2	118.7	165.0	332.8	131.8	14.5	121.8	99.4	0.0	94.5	93.2	0.1	0.0	21.2
7/25/2010	6:00 AM	5.5	252.0	81.7	11.1	299.2	119.8	153.1	334.7	132.1	16.0	133.1	104.6	0.0	105.4	98.4	0.1	0.0	25.0
7/25/2010	9:07 AM	5.5	252.7	81.9	10.6	303.4	120.9	147.6	339.9	133.9	17.7	142.1	108.7	0.0	115.7	103.4	0.1	0.0	29.5
7/25/2010	12:00 PM	5.4	253.4	82.1	10.2	305.7	121.7	138.2	339.2	133.6	19.0	148.5	111.5	0.0	122.8	106.6	0.1	0.0	34.3
7/25/2010	3:07 PM	5.3	253.3	82.0	9.9	307.1	122.2	132.3	342.2	134.7	20.8	154.0	114.0	0.0	128.0	109.5	0.2	0.0	39.3
7/25/2010	6:00 PM	5.0	249.3	80.8	9.4	306.0	122.0	126.5	343.5	135.3	22.0	160.0	117.0	0.0	133.7	111.8	0.2	0.0	44.1
7/25/2010	9:07 PM	4.6	244.3	79.3	8.9	304.1	121.4	118.0	341.9	134.9	22.6	163.2	119.0	0.0	138.2	114.1	0.2	0.0	48.0
7/26/2010	12:00 AM	4.3	239.9	77.9	8.3	300.3	120.1	109.4	337.0	133.0	23.4	168.4	121.0	0.0	142.2	116.7	0.2	0.0	51.2
7/26/2010	3:07 AM	3.9	234.9	76.4	7.7	294.5	118.1	101.8	332.8	131.5	24.4	174.0	122.4	0.0	143.5	115.4	0.2	0.0	53.8
7/26/2010	6:00 AM	3.6	230.0	74.9	7.0	277.9	114.5	91.0	321.9	127.1	25.4	179.7	125.2	0.0	153.8	120.9	0.2	0.0	55.6
7/26/2010	9:07 AM	3.3	224.6	73.2	6.7	265.3	112.1	85.4	303.9	125.0	26.9	183.8	127.3	0.0	157.5	123.0	0.3	0.0	57.5
7/26/2010	12:00 PM	3.0	220.0	71.8	6.5	259.1	109.3	79.1	299.1	122.9	28.6	190.9	129.9	0.0	162.6	125.1	0.3	0.0	59.5
7/26/2010	3:07 PM	2.8	215.2	70.4	6.3	256.9	106.9	73.3	296.3	120.7	30.2	198.3	132.2	0.1	170.0	128.1	0.4	0.0	61.5
7/26/2010	6:00 PM	2.6	210.6	69.0	5.9	251.5	104.4	68.1	292.9	118.5	31.7	205.3	134.1	0.1	176.8	129.9	0.4	0.0	63.5
7/26/2010	9:07 PM	2.4	206.1	67.7	5.7	246.9	101.9	61.9	287.3	115.8	32.5	211.1	135.3	0.2	182.4	131.3	0.5	0.0	65.6
7/27/2010	12:00 AM	2.2	201.4	66.4	5.7	237.3	98.8	56.5	280.0	112.8	34.0	215.1	136.5	0.2	188.2	133.1	0.5	0.0	67.7
7/27/2010	3:07 AM	2.1	196.8	65.1	5.7	230.3	96.7	52.6	272.8	110.7	34.0	216.8	137.1	0.2	190.6	133.4	0.5	0.0	69.5
7/27/2010	6:00 AM	1.9	192.4	63.8	5.5	225.2	94.6	48.4	266.4	108.0	33.6	215.9	137.1	0.2	191.1	133.6	0.5	0.0	71.0
7/27/2010	9:07 AM	1.8	188.0	62.5	5.0	218.1	92.2	44.8	260.1	105.7	32.7	210.8	136.5	0.2	188.9	133.3	0.6	0.0	72.1
7/27/2010	12:00 PM	1.6	183.3	61.2	4.6	210.3	89.9	40.9	252.1	103.4	31.6	205.8	135.8	0.2	183.5	132.6	0.6	0.0	72.7
7/27/2010	3:07 PM	1.5	178.4	59.9	4.2	206.3	88.0	38.9	248.5	101.1	30.4	202.5	134.7	0.2	179.6	131.7	0.5	0.0	72.9
7/27/2010	6:00 PM	1.4	176.3	59.1	3.8	199.1	85.6	35.2	238.8	98.5	28.9	199.6	133.6	0.2	176.6	130.5	0.5	0.0	72.6

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

Footnotes:

Mg=Megagrams
MP=Mile Post

FLOODPLAIN SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 5 OF 7

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Date	Time	Ceresco Dam			Kalamazoo Dam			Kalamazoo River Gauge Near Battle Creek			35th Street Bridge			MP 37.75			Morrow Dam		
		Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)
7/27/2010	9:07 PM	1.3	173.9	58.4	3.5	193.0	83.6	32.8	232.5	96.4	27.5	196.8	132.3	0.1	174.0	129.4	0.5	0.0	72.1
7/28/2010	12:00 AM	1.2	171.2	57.7	3.2	187.6	81.8	31.2	227.6	94.8	26.1	193.0	131.0	0.1	170.1	127.8	0.5	0.0	71.3
7/28/2010	3:07 AM	1.2	168.6	56.9	3.0	182.3	80.1	29.2	221.1	92.8	24.3	187.7	128.7	0.1	165.5	125.9	0.5	0.0	70.4
7/28/2010	6:00 AM	1.1	166.1	56.2	2.8	177.7	78.6	27.3	216.8	91.1	22.5	182.4	126.5	0.0	160.5	123.8	0.5	0.0	69.3
7/28/2010	9:07 AM	1.1	163.8	55.6	2.6	172.7	77.2	25.3	210.8	89.2	21.0	177.1	124.4	0.0	155.7	121.6	0.4	0.0	67.9
7/28/2010	12:00 PM	1.0	161.4	54.8	2.4	168.7	75.8	24.3	207.3	88.1	19.3	169.9	121.8	0.0	149.4	119.0	0.3	0.0	66.5
7/28/2010	3:07 PM	0.9	158.9	54.1	2.2	163.3	74.3	22.9	201.8	86.5	17.3	162.2	118.6	0.0	142.6	116.4	0.3	0.0	65.0
7/28/2010	6:00 PM	0.9	156.5	53.4	2.1	159.0	72.8	21.7	196.9	84.8	15.6	155.4	115.9	0.0	136.1	113.3	0.3	0.0	63.2
7/28/2010	9:07 PM	0.8	153.8	52.6	1.9	154.1	71.5	20.9	191.5	83.3	14.2	148.8	113.4	0.0	130.2	111.1	0.3	0.0	61.3
7/29/2010	12:00 AM	0.7	151.3	51.9	1.8	149.8	70.0	19.4	186.9	81.7	12.8	141.5	110.6	0.0	123.5	108.3	0.2	0.0	59.3
7/29/2010	3:07 AM	0.7	148.0	51.1	1.6	146.3	68.8	18.3	182.8	80.4	11.2	135.7	108.2	0.0	117.5	105.9	0.2	0.0	57.3
7/29/2010	6:00 AM	0.6	145.2	50.3	1.5	141.7	67.4	17.2	177.7	78.7	10.4	128.7	105.8	0.0	111.0	103.4	0.1	0.0	55.4
7/29/2010	9:07 AM	0.6	142.0	49.5	1.4	137.5	66.0	16.2	173.2	77.3	9.6	122.8	103.8	0.0	105.0	101.4	0.1	0.0	53.6
7/29/2010	12:00 PM	0.5	139.3	48.8	1.3	133.6	64.7	15.3	167.8	75.5	8.8	117.5	101.5	0.0	99.5	99.1	0.1	0.0	51.7
7/29/2010	3:07 PM	0.5	136.3	48.0	1.2	128.9	63.5	14.6	163.3	74.2	8.1	112.6	99.3	0.0	95.2	96.9	0.1	0.0	50.0
7/29/2010	6:00 PM	0.4	133.5	47.2	1.1	124.6	62.2	13.8	158.1	72.7	7.5	107.5	97.3	0.0	90.6	94.8	0.1	0.0	48.3
7/29/2010	9:07 PM	0.2	130.2	46.3	1.0	121.2	61.0	13.2	153.7	71.6	6.9	103.7	95.6	0.0	86.2	92.9	0.1	0.0	46.8
7/30/2010	12:00 AM	0.2	127.0	45.4	0.9	116.8	59.4	12.4	149.8	69.7	6.3	100.2	93.7	0.0	82.7	91.1	0.1	0.0	45.2
7/30/2010	3:07 AM	0.1	123.2	44.5	0.9	111.7	58.3	11.8	144.0	68.4	5.8	97.2	92.1	0.0	79.6	89.3	0.1	0.0	43.7
7/30/2010	6:00 AM	0.1	119.2	43.6	0.7	104.9	56.2	11.0	138.3	66.5	5.3	93.4	90.2	0.0	76.6	87.8	0.1	0.0	42.3
7/30/2010	9:07 AM	0.1	115.0	42.6	0.7	101.1	55.4	11.3	135.2	66.0	4.8	89.2	87.9	0.0	72.8	85.7	0.1	0.0	40.9
7/30/2010	12:00 PM	0.1	111.2	41.7	0.7	97.7	54.4	9.9	128.0	63.6	4.5	84.7	85.9	0.0	69.2	83.7	0.1	0.0	39.5
7/30/2010	3:07 PM	0.1	107.6	40.8	0.6	93.9	53.0	9.7	124.5	62.6	4.2	80.7	84.1	0.0	65.4	81.9	0.1	0.0	38.2
7/30/2010	6:00 PM	0.1	104.1	39.9	0.6	87.0	51.5	9.3	117.5	61.3	3.7	76.6	82.2	0.0	62.0	80.1	0.1	0.0	37.0
7/30/2010	9:07 PM	0.1	101.5	39.1	0.5	83.0	50.4	8.9	114.1	60.0	3.4	72.9	80.2	0.0	58.2	78.1	0.0	0.0	35.8
7/31/2010	12:00 AM	0.1	97.5	38.1	0.5	79.2	49.1	8.4	109.2	58.5	3.1	68.9	78.3	0.0	54.6	76.1	0.0	0.0	34.7
7/31/2010	3:07 AM	0.1	93.0	37.1	0.4	74.0	47.7	8.0	102.4	56.8	2.9	65.6	76.5	0.0	51.4	74.3	0.0	0.0	33.5
7/31/2010	6:00 AM	0.1	89.4	36.2	0.4	70.3	46.5	7.7	98.1	55.3	2.6	62.1	74.5	0.0	48.2	72.5	0.0	0.0	32.3
7/31/2010	9:07 AM	0.1	84.5	34.9	0.4	65.1	45.2	7.2	92.3	53.5	2.4	60.2	73.0	0.0	45.4	70.8	0.0	0.0	31.2
7/31/2010	12:00 PM	0.1	79.2	33.2	0.3	62.4	43.9	6.9	87.5	52.1	2.2	58.4	71.3	0.0	43.8	69.4	0.0	0.0	30.1
7/31/2010	3:07 PM	0.0	74.0	31.5	0.3	57.8	42.4	6.5	83.6	50.3	2.0	55.4	69.0	0.0	41.4	67.2	0.0	0.0	29.0

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

Footnotes:

Mg=Megagrams
MP=Mile Post

FLOODPLAIN SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Date	Time	Ceresco Dam			Kalamazoo Dam			Kalamazoo River Gauge Near Battle Creek			35th Street Bridge			MP 37.75			Morrow Dam		
		Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)	Sand (Mg)	Silt (Mg)	Clay (Mg)
7/31/2010	6:00 PM	0.0	69.7	29.9	0.3	53.5	41.1	6.2	77.3	48.6	1.8	52.7	67.1	0.0	38.6	65.3	0.0	0.0	27.8
7/31/2010	9:07 PM	0.0	65.3	28.5	0.2	49.6	39.6	5.9	71.8	46.7	1.6	51.6	65.6	0.0	36.5	63.6	0.0	0.0	26.7
8/1/2010	12:00 AM	0.0	61.5	27.2	0.2	46.9	39.5	6.2	68.4	46.7	1.5	49.5	63.9	0.0	35.1	62.1	0.0	0.0	25.7
8/1/2010	3:07 AM	0.0	57.5	25.8	0.2	41.8	36.5	5.2	61.4	42.9	1.3	47.6	62.2	0.0	33.2	60.4	0.0	0.0	24.6
8/1/2010	6:00 AM	0.0	53.7	24.5	0.2	38.0	34.7	5.0	57.8	41.1	1.1	45.6	60.5	0.0	31.2	58.6	0.0	0.0	23.6
8/1/2010	9:07 AM	0.0	50.3	23.2	0.2	35.1	32.9	4.8	53.6	39.0	1.0	42.5	58.7	0.0	29.4	56.9	0.0	0.0	22.7
8/1/2010	12:00 PM	0.0	47.2	22.2	0.1	31.8	31.2	4.5	49.7	37.0	0.9	39.4	56.8	0.0	26.7	55.1	0.0	0.0	21.8
8/1/2010	3:07 PM	0.0	44.1	21.2	0.1	29.1	29.5	4.3	46.2	35.2	0.8	37.1	54.7	0.0	24.2	53.1	0.0	0.0	20.8
8/1/2010	6:00 PM	0.0	41.9	20.3	0.1	26.6	28.1	4.2	43.7	33.7	0.7	34.9	52.8	0.0	22.5	51.3	0.0	0.0	19.9
8/1/2010	9:07 PM	0.0	39.9	19.5	0.1	24.1	26.6	3.9	39.8	31.8	0.6	32.9	51.1	0.0	20.8	49.4	0.0	0.0	19.0
8/2/2010	12:00 AM	0.0	37.7	18.6	0.1	22.6	25.4	3.7	36.5	30.2	0.5	30.8	49.3	0.0	19.1	47.6	0.0	0.0	18.2
8/2/2010	3:07 AM	0.0	35.9	17.9	0.1	20.5	24.1	3.7	35.4	29.2	0.5	29.2	47.5	0.0	17.4	45.8	0.0	0.0	17.4
8/2/2010	6:00 AM	0.0	34.0	17.2	0.1	19.2	23.3	3.6	33.4	28.1	0.4	27.9	45.5	0.0	16.1	44.0	0.0	0.0	16.6
8/2/2010	9:07 AM	0.0	32.1	16.5	0.1	18.1	22.3	3.3	31.5	26.5	0.4	27.1	44.3	0.0	15.1	42.4	0.0	0.0	15.8
8/2/2010	12:00 PM	0.0	30.8	16.0	0.1	17.8	21.4	3.2	30.7	25.7	0.3	26.0	42.9	0.0	14.3	41.1	0.0	0.0	15.0
8/2/2010	3:07 PM	0.0	29.3	15.5	0.1	15.7	20.5	3.1	28.4	24.8	0.3	24.8	41.3	0.0	13.4	39.8	0.0	0.0	14.3
8/2/2010	6:00 PM	0.0	27.9	15.1	0.1	15.1	19.5	3.1	27.1	23.8	0.2	23.6	39.4	0.0	12.5	38.0	0.0	0.0	13.6
8/2/2010	9:07 PM	0.0	26.7	14.7	0.1	14.5	19.1	3.0	26.3	23.0	0.2	23.1	37.9	0.0	11.7	36.3	0.0	0.0	12.9
8/3/2010	12:00 AM	0.0	25.9	14.3	0.1	13.9	18.4	2.9	25.5	22.2	0.2	22.5	36.7	0.0	11.2	34.8	0.0	0.0	12.2
8/3/2010	3:07 AM	0.0	24.9	13.9	0.1	13.0	17.6	2.8	24.5	21.4	0.1	21.3	35.4	0.0	10.6	33.6	0.0	0.0	11.6
8/3/2010	6:00 AM	0.0	23.9	13.5	0.0	12.4	17.1	2.7	23.4	20.8	0.1	20.7	34.0	0.0	9.8	32.3	0.0	0.0	10.9
8/3/2010	9:07 AM	0.0	23.0	13.1	0.0	11.9	16.7	2.7	22.8	20.2	0.1	20.3	32.9	0.0	9.3	31.0	0.0	0.0	10.4
8/3/2010	12:00 PM	0.0	22.1	12.9	0.0	11.5	16.3	2.6	22.1	19.8	0.1	19.8	31.9	0.0	8.9	29.9	0.0	0.0	9.8
8/3/2010	3:07 PM	0.0	21.3	12.6	0.0	11.1	15.9	2.5	21.4	19.3	0.1	19.5	30.8	0.0	8.5	28.9	0.0	0.0	9.3
8/3/2010	6:00 PM	0.0	20.5	12.3	0.0	10.8	15.5	2.5	20.8	18.8	0.0	19.1	29.8	0.0	8.1	27.9	0.0	0.0	8.8
8/3/2010	9:07 PM	0.0	19.8	12.1	0.0	10.3	15.1	2.4	20.3	18.4	0.0	18.7	28.9	0.0	7.8	26.9	0.0	0.0	8.3
8/4/2010	12:00 AM	0.0	19.2	11.8	0.0	9.8	14.6	2.3	19.4	17.9	0.0	18.1	28.2	0.0	7.5	26.1	0.0	0.0	7.9

ENBRIDGE

Drawn: JLH 04/16/2012

Approved: DBR 04/16/2012

Project #: 106-4186

Footnotes:

Mg=Megagrams
MP=Mile Post

FLOODPLAIN SIMULATED SEDIMENT MASS FLUX (MEGAGRAMS PER DAY) IN KALAMAZOO RIVER CALIBRATION

SHEET 7 OF 7

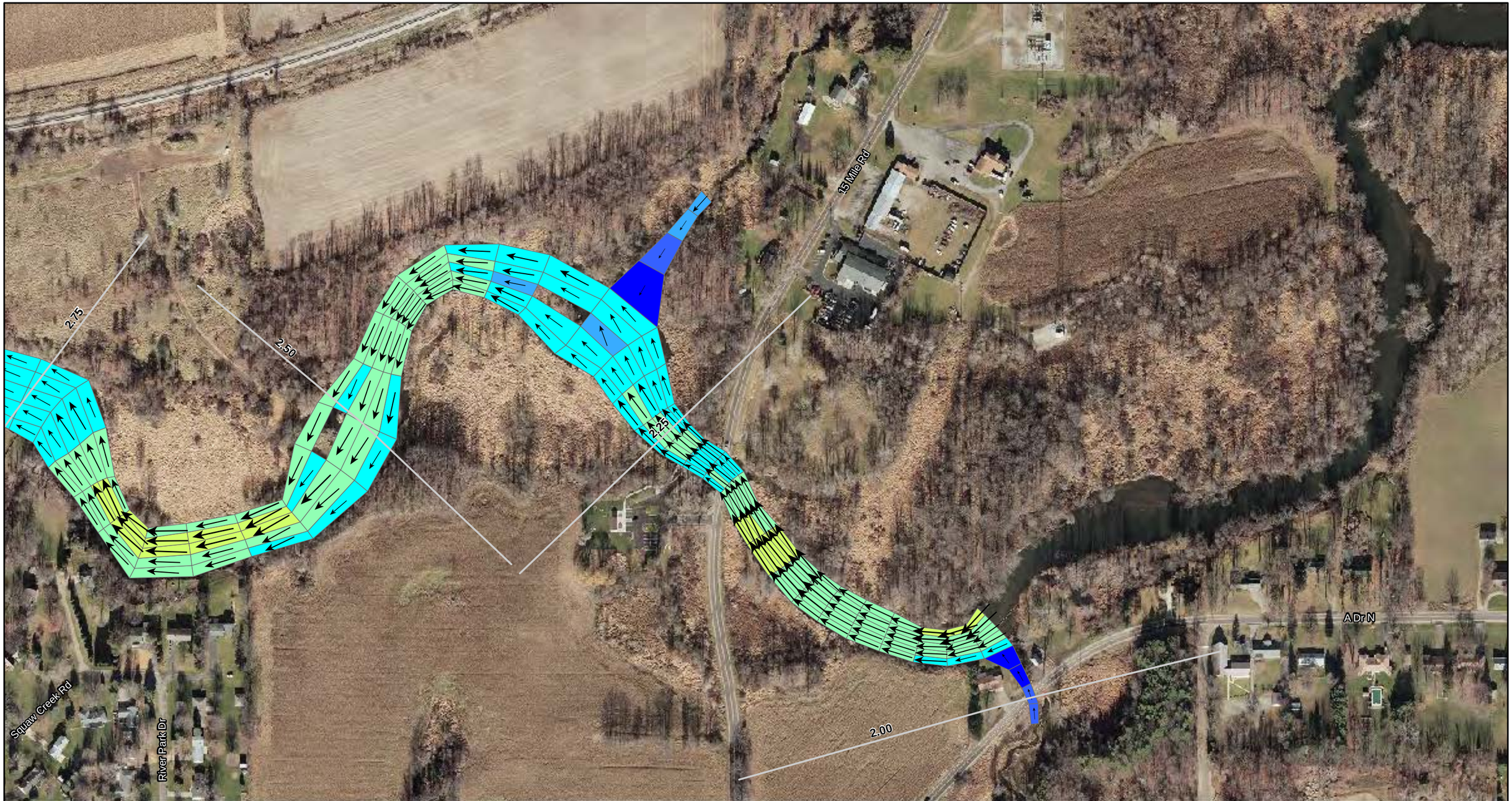
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY,
LIMITED PARTNERSHIP

Figure 4-13

Riverine Grid: Velocity

October 31, 2011

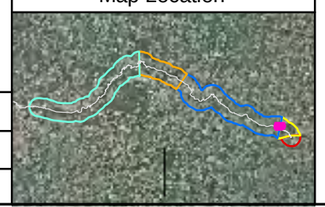
Sheets 1 through 56



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

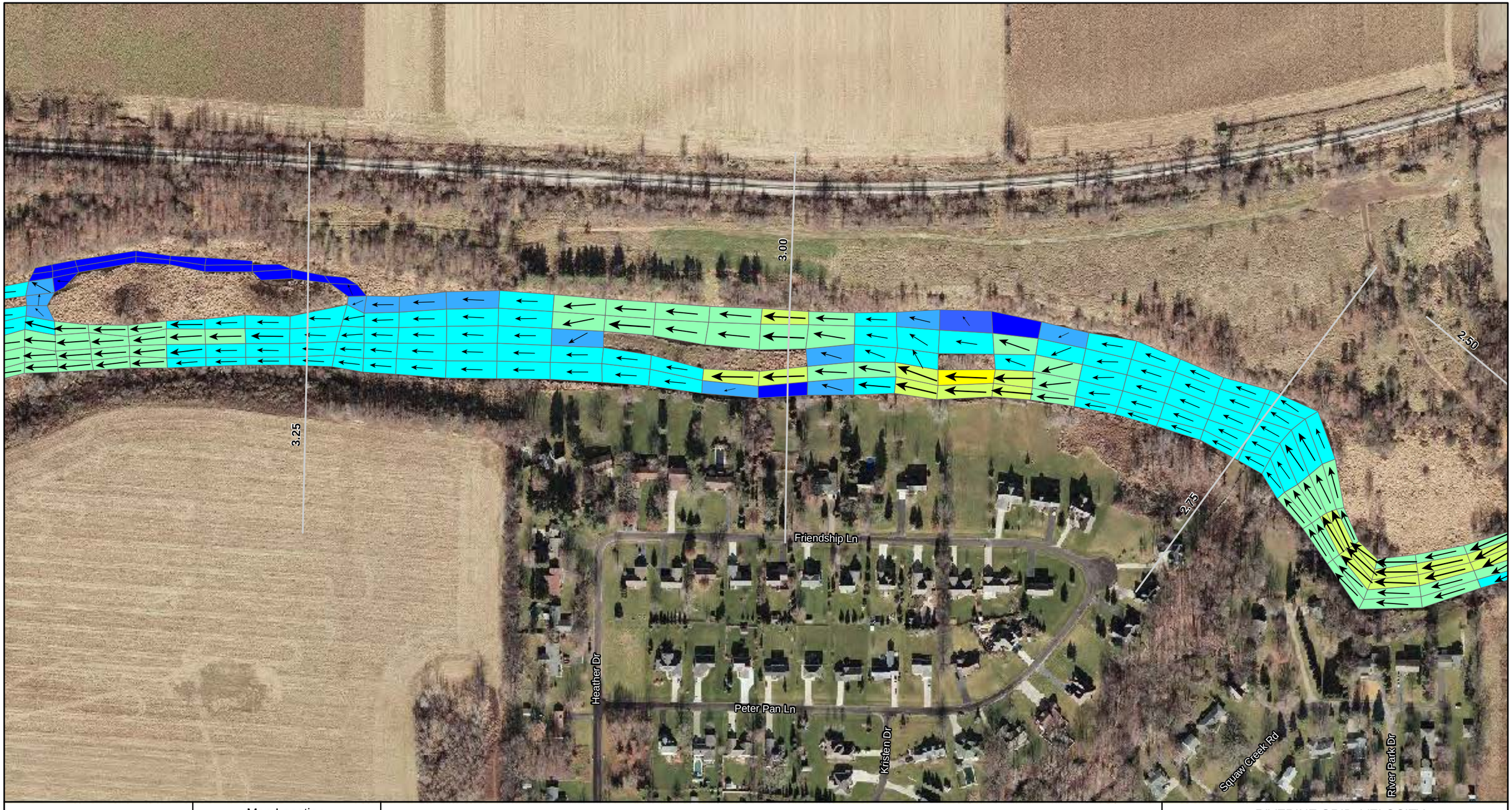
MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

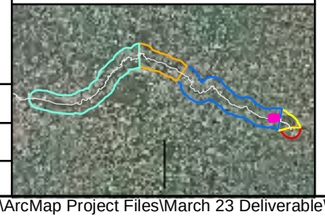
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

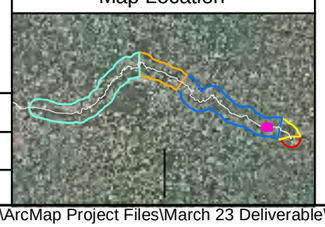
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

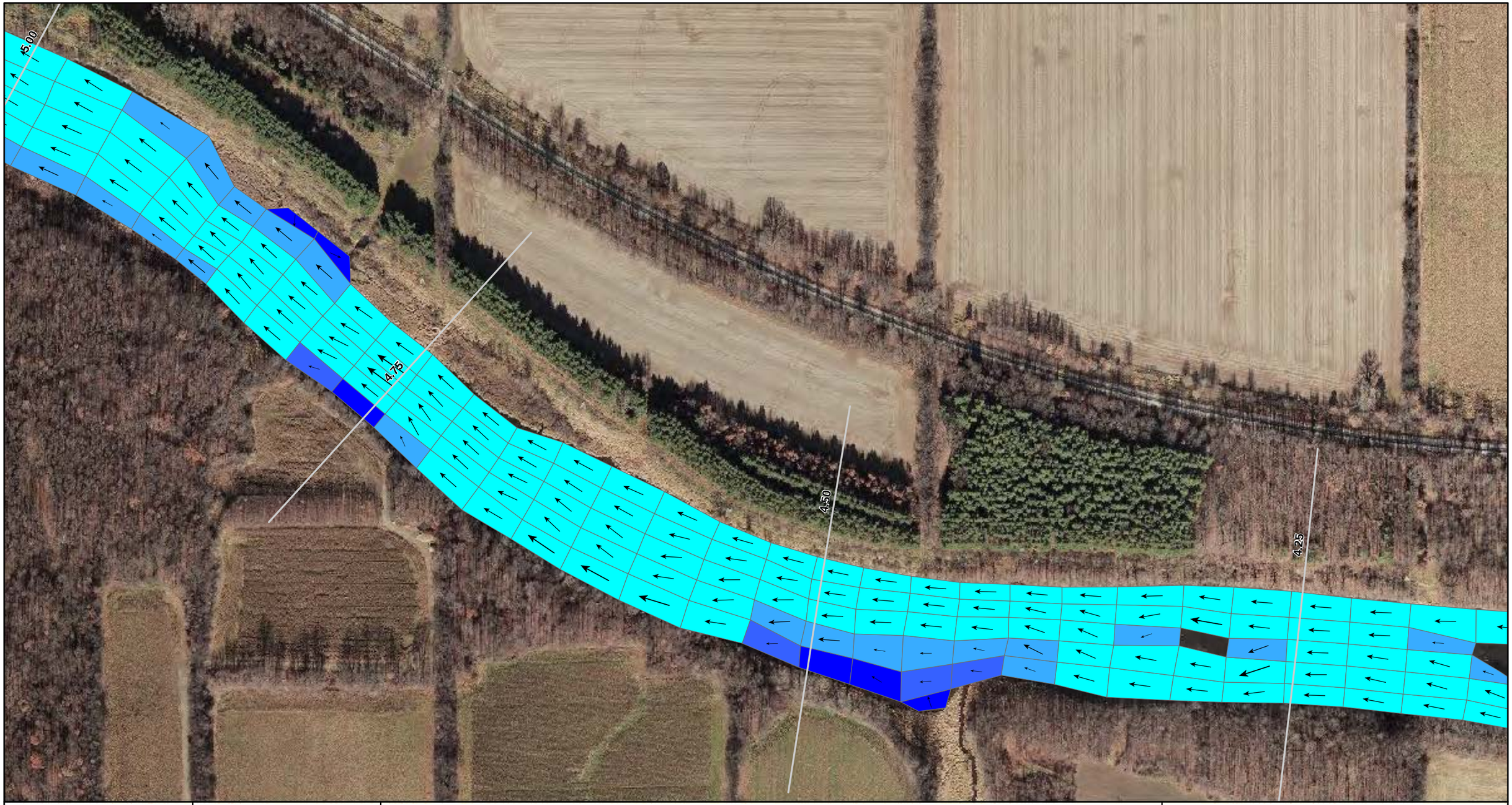
MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

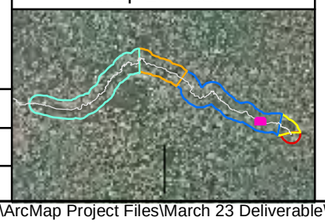
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

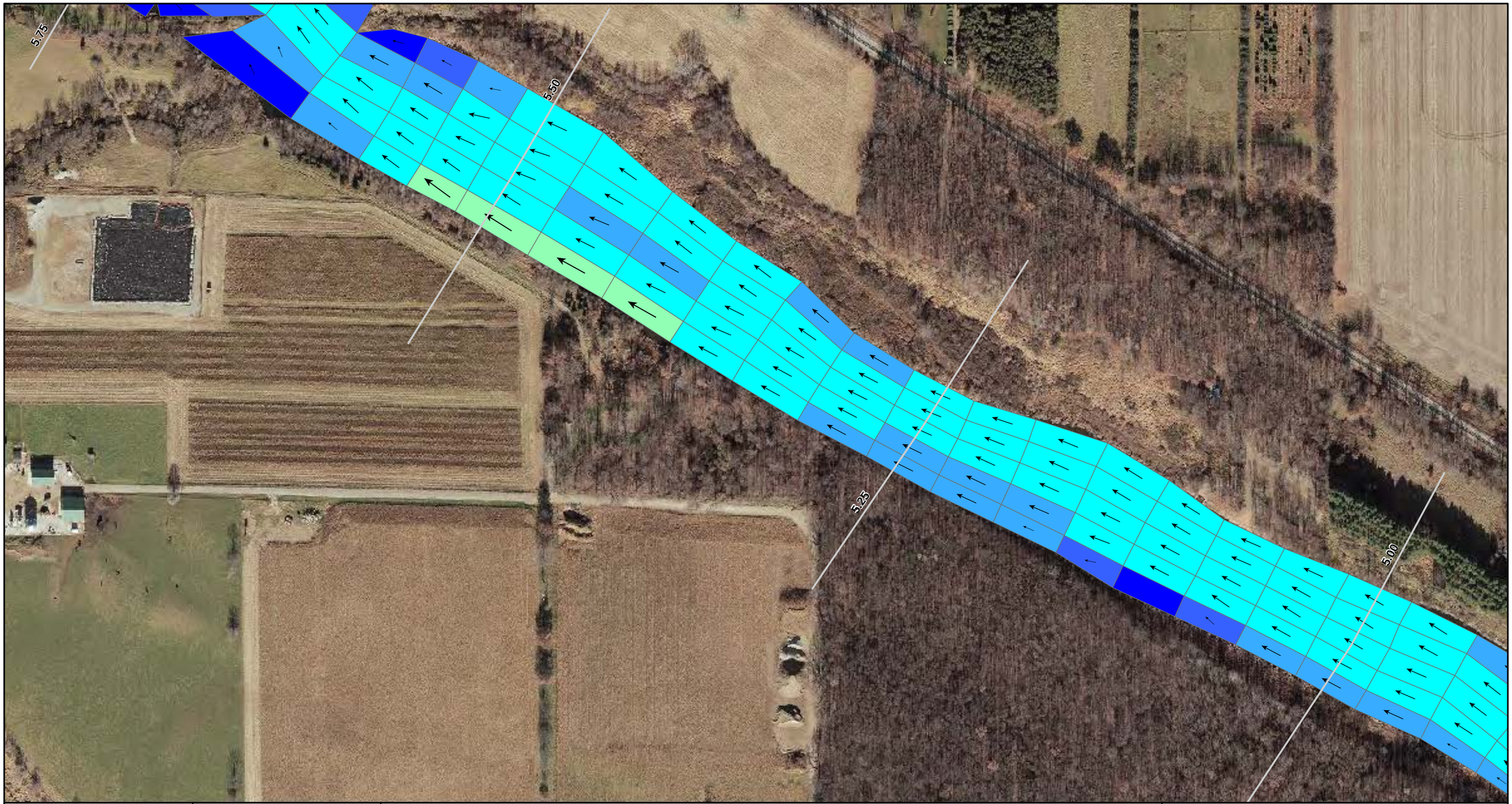
MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

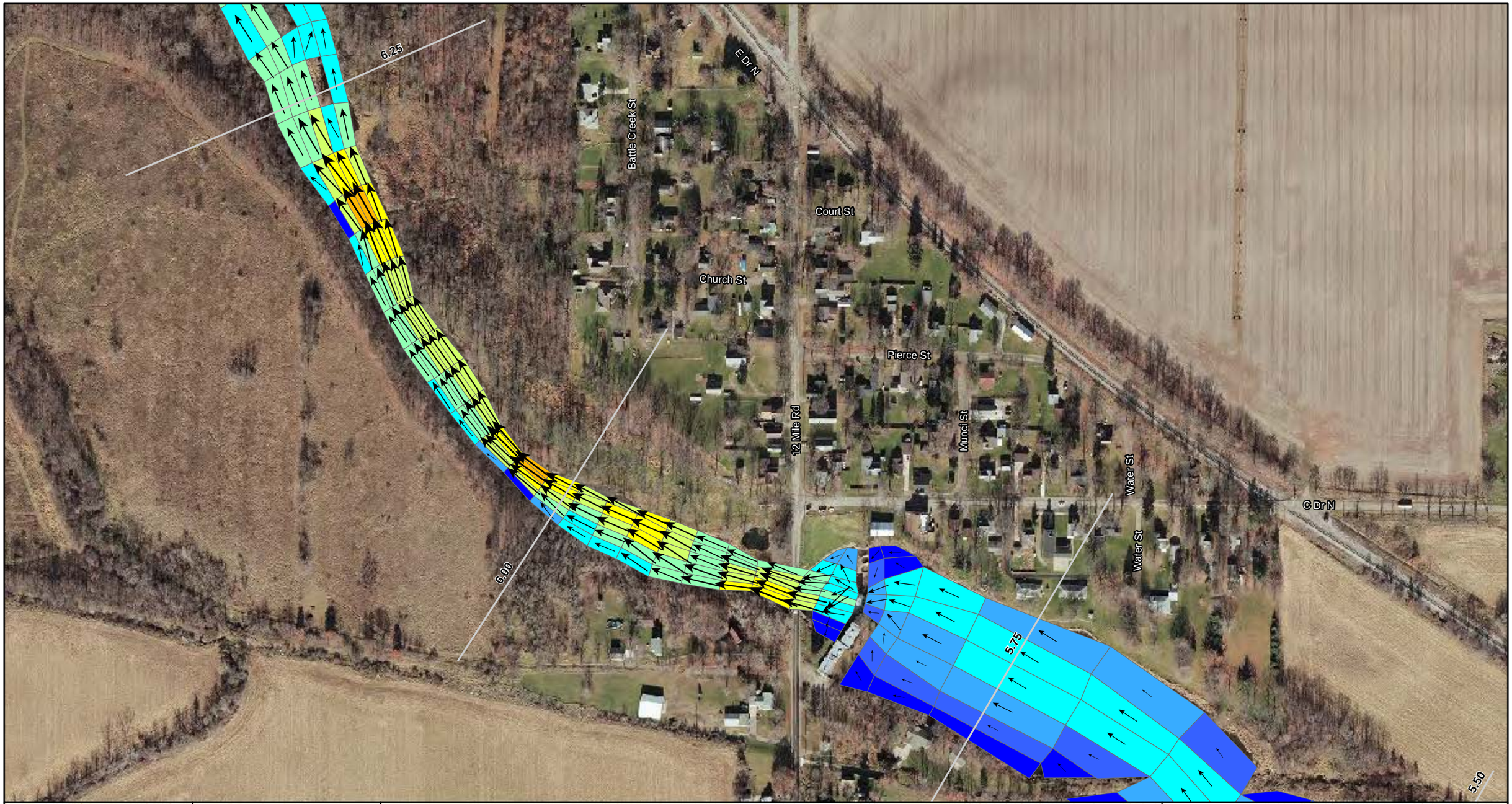
MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

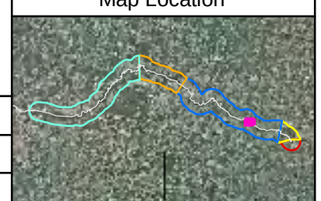
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

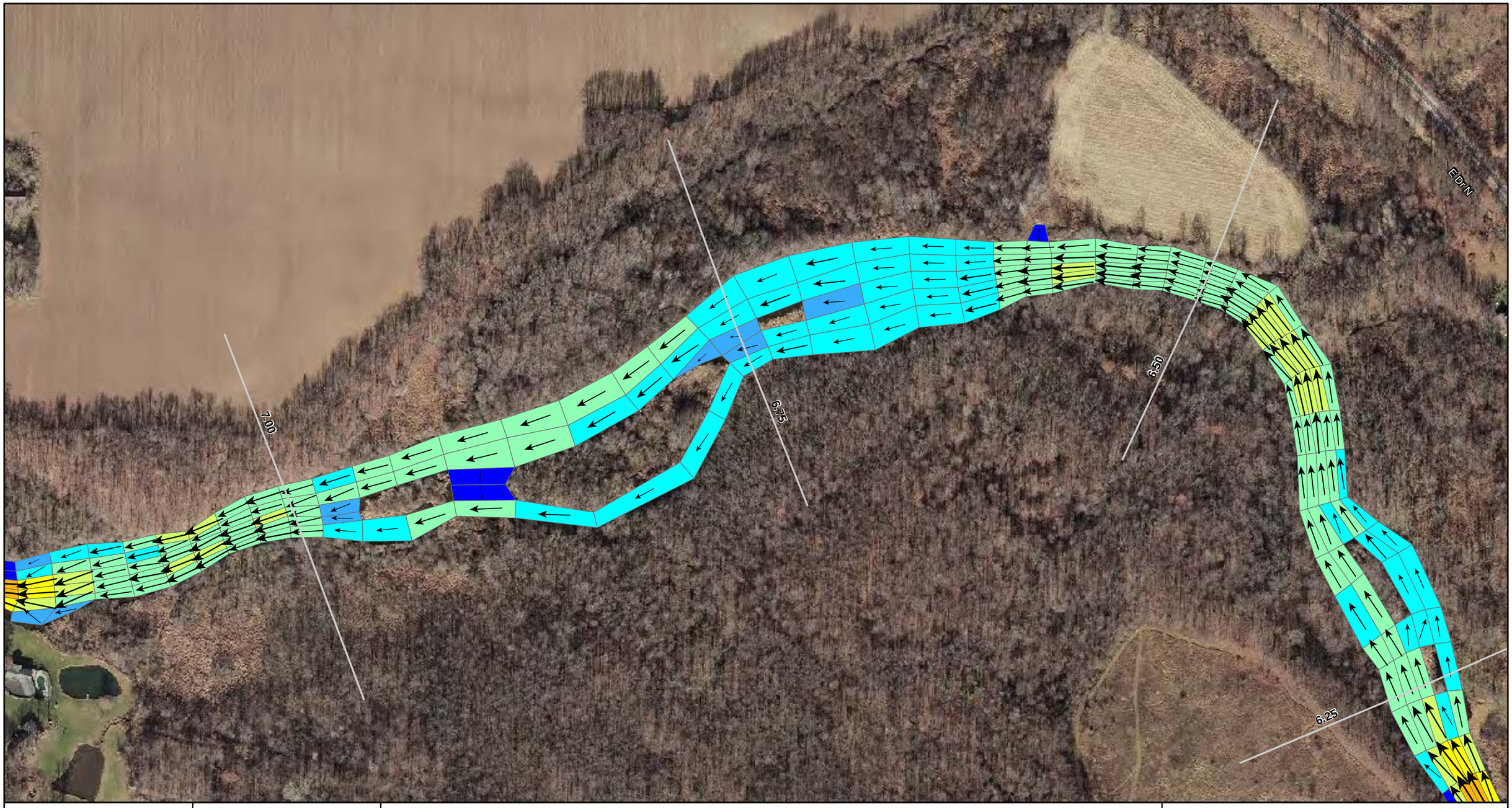
MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

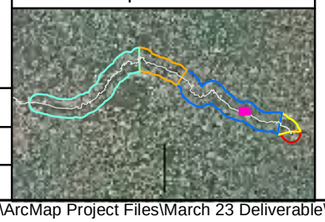
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

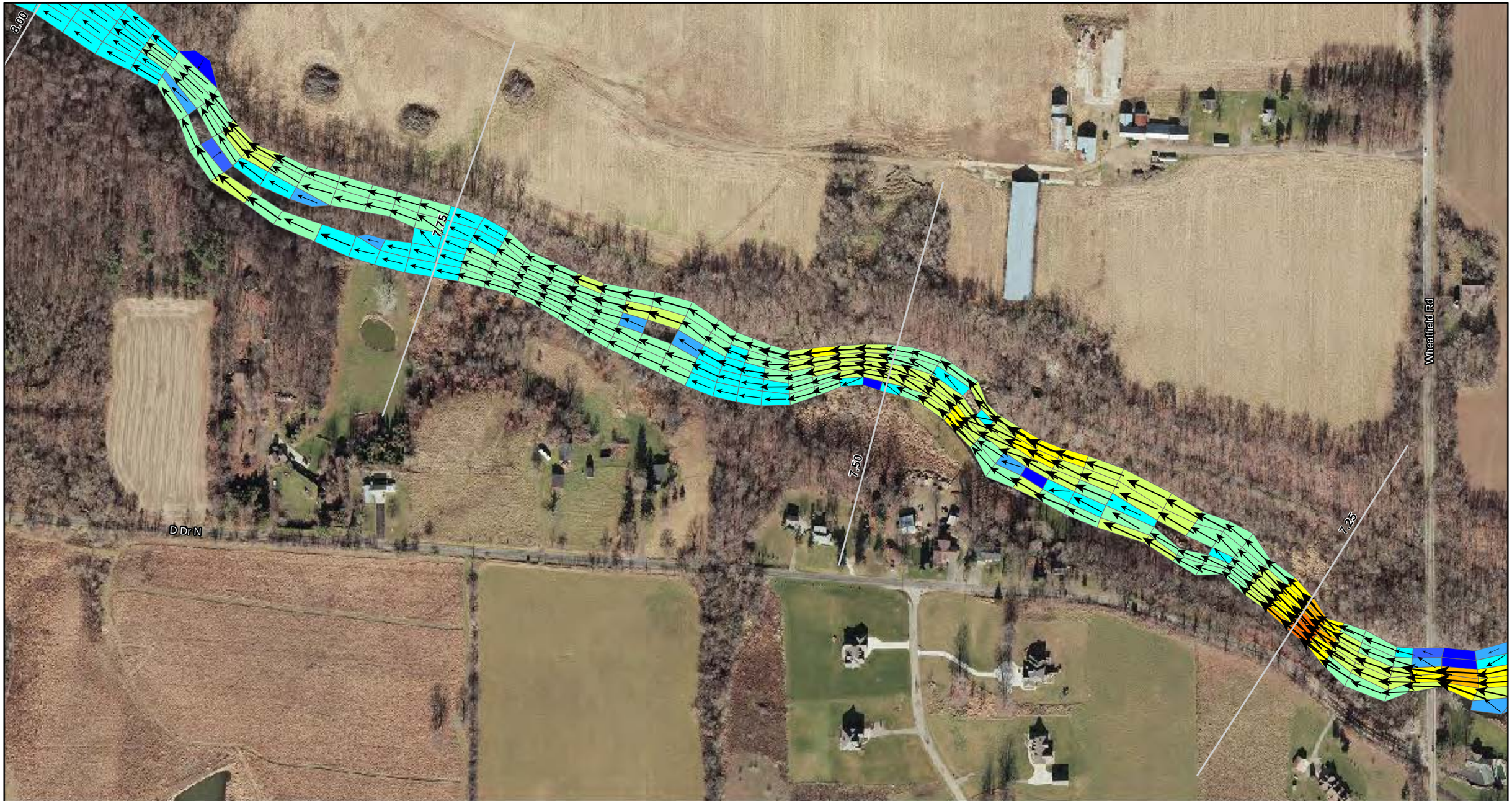
MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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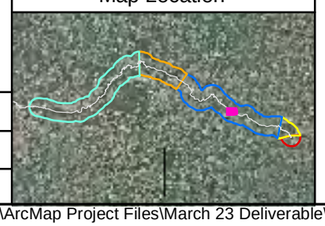
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

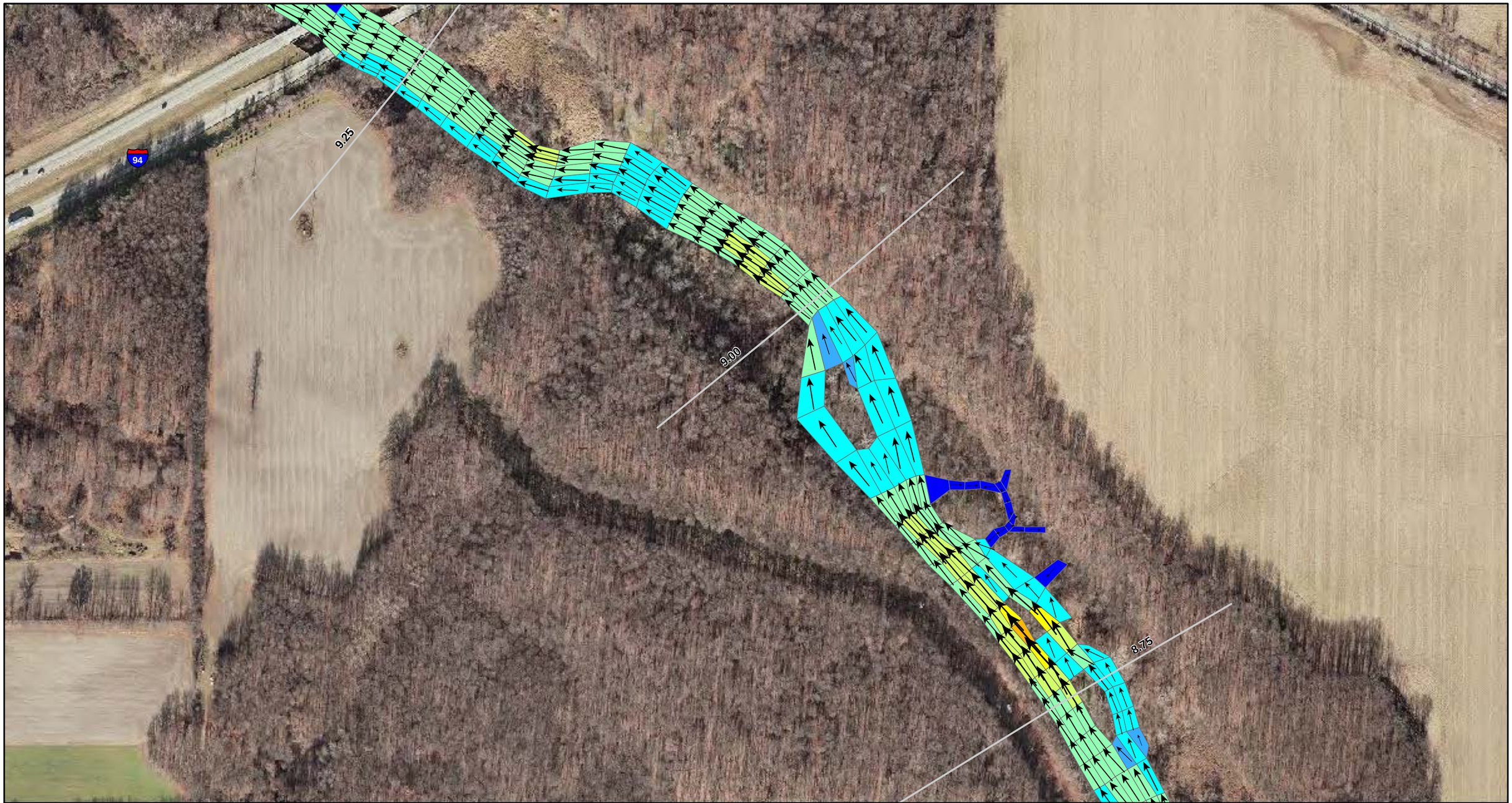
MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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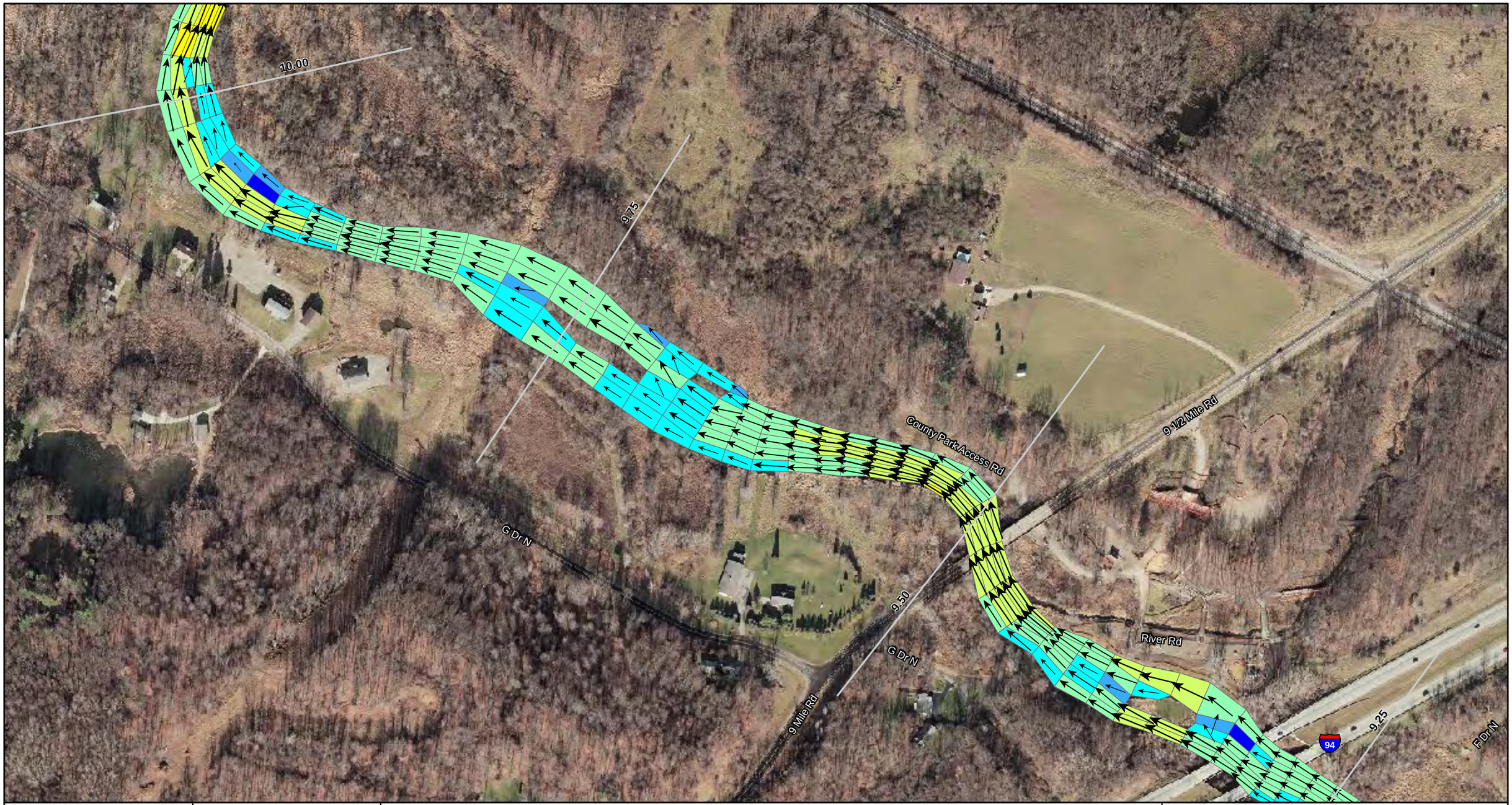
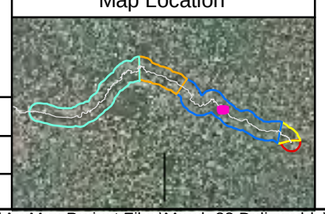
Aerial Photography Date: November 2011



Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

10.50

10.25

10.00

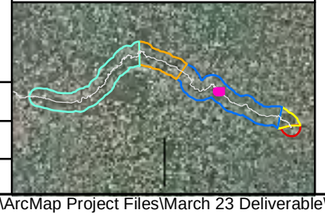
River Rd E

Golden Ave

G Dr N

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

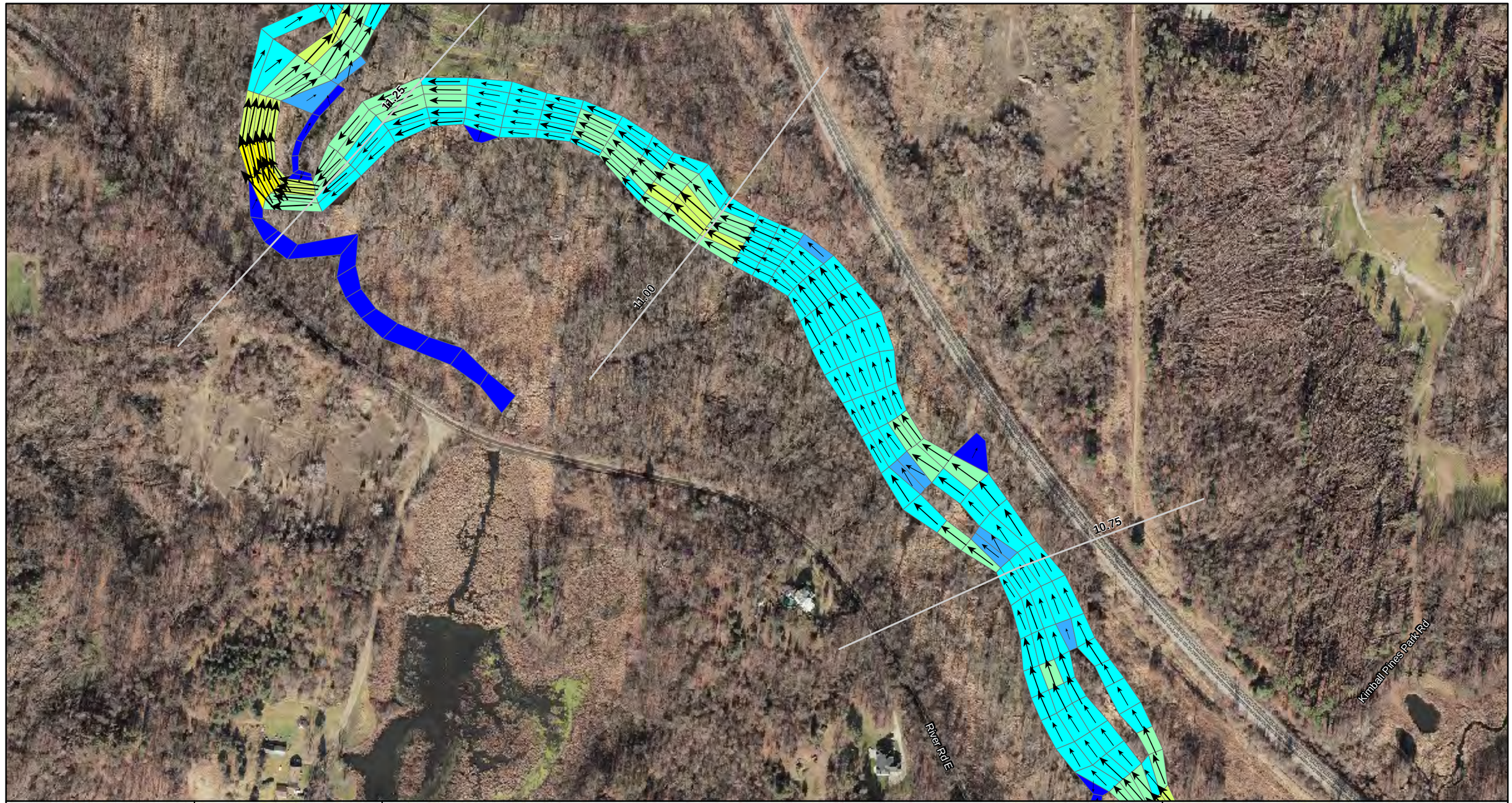
MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

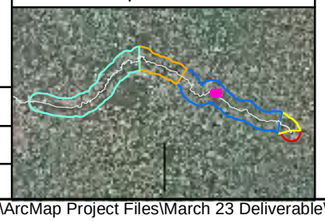
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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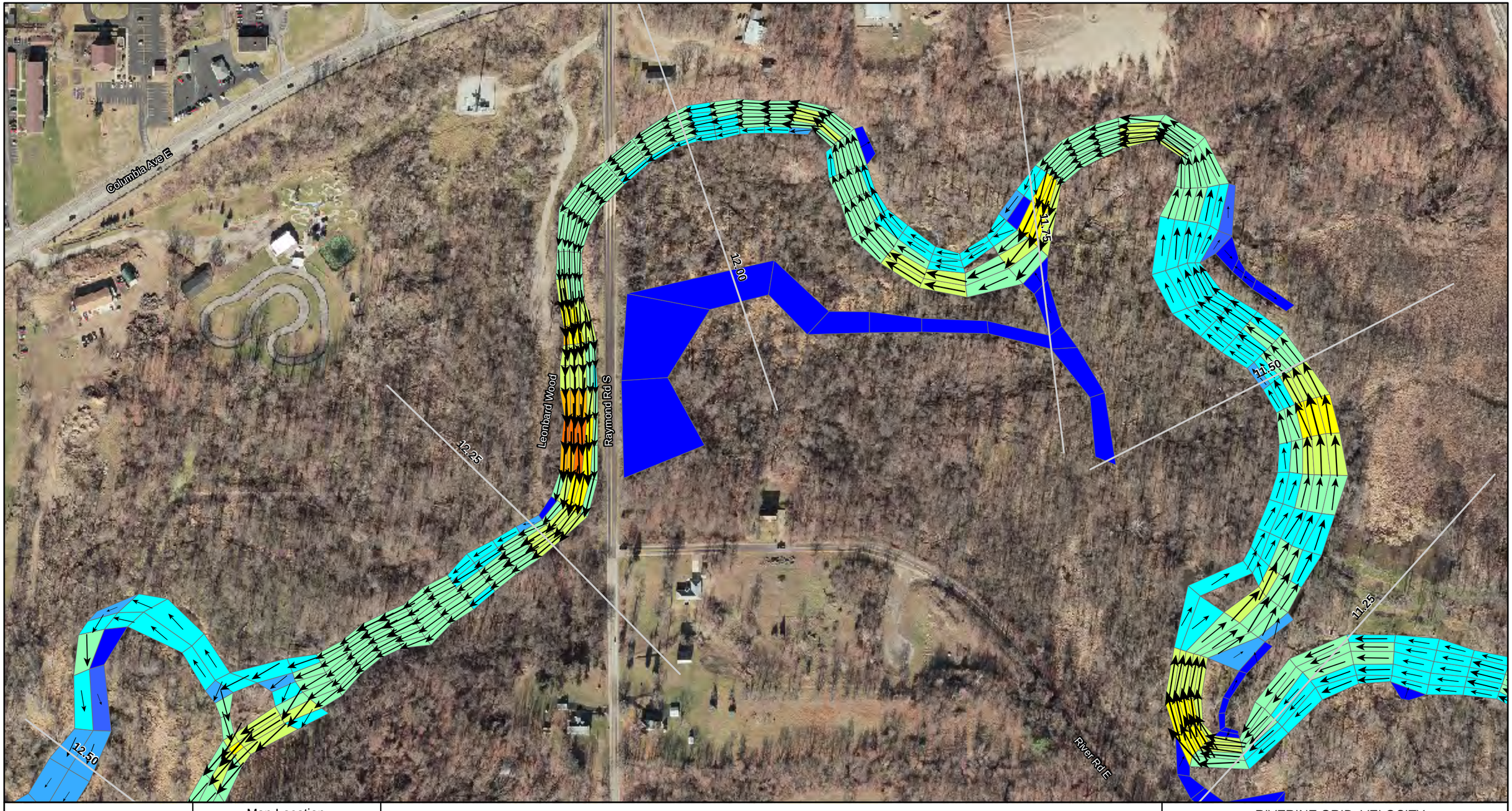
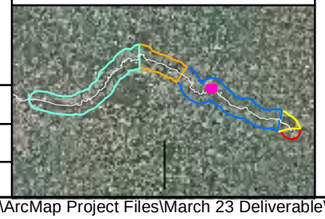
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

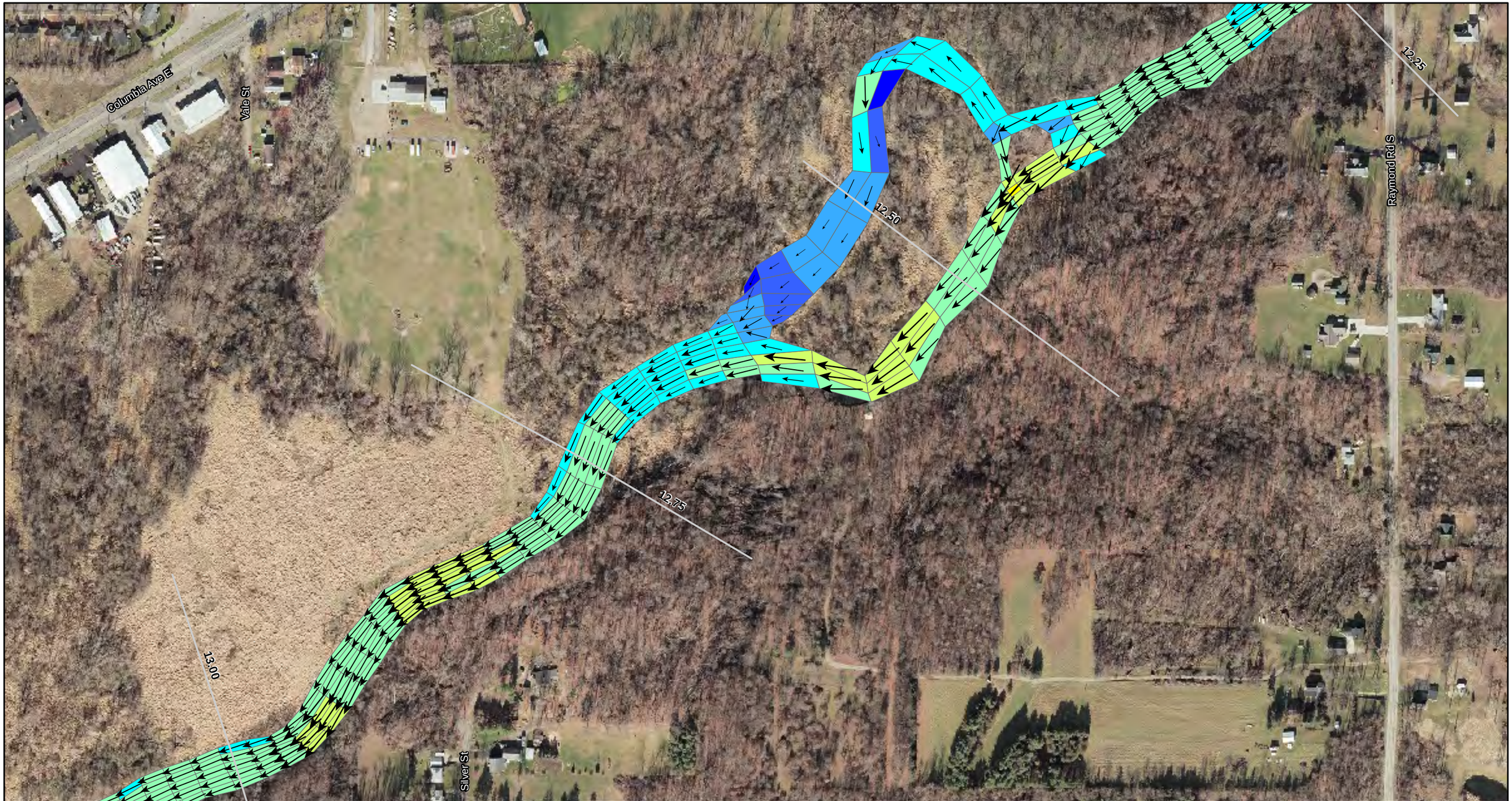
MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

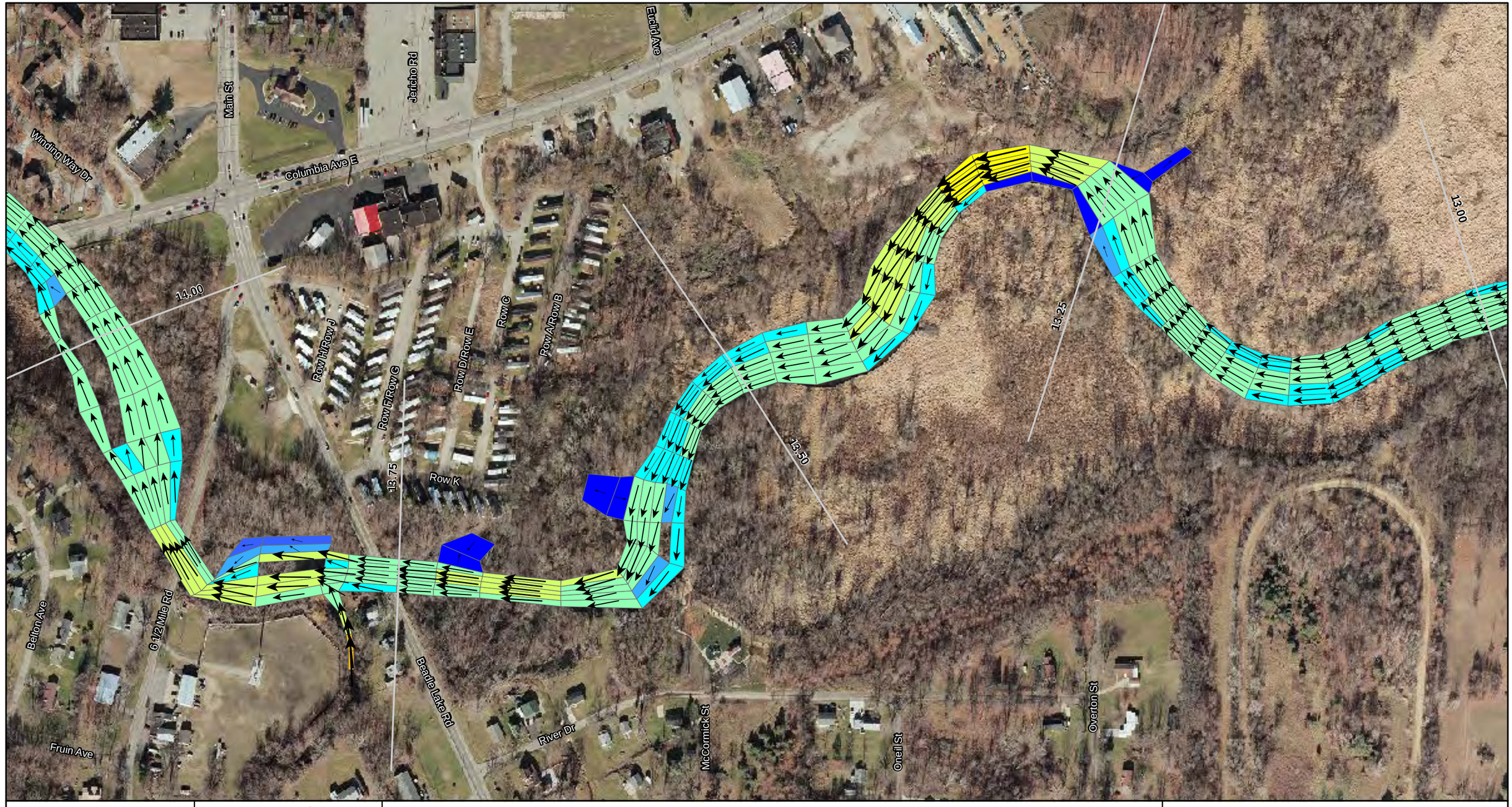
MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

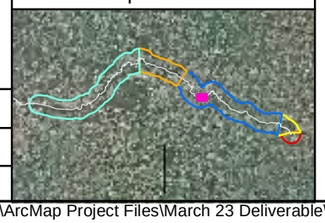
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

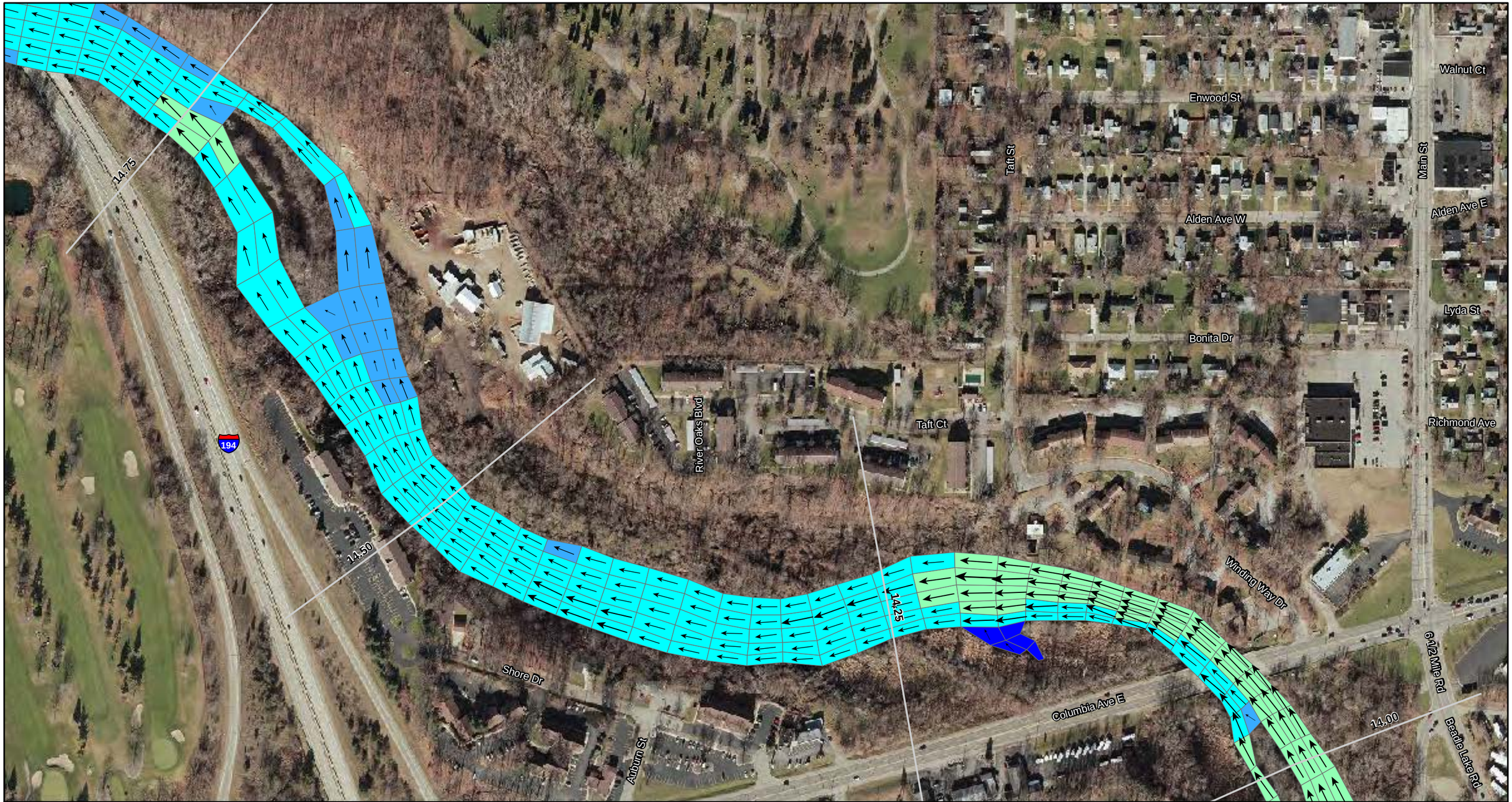
MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

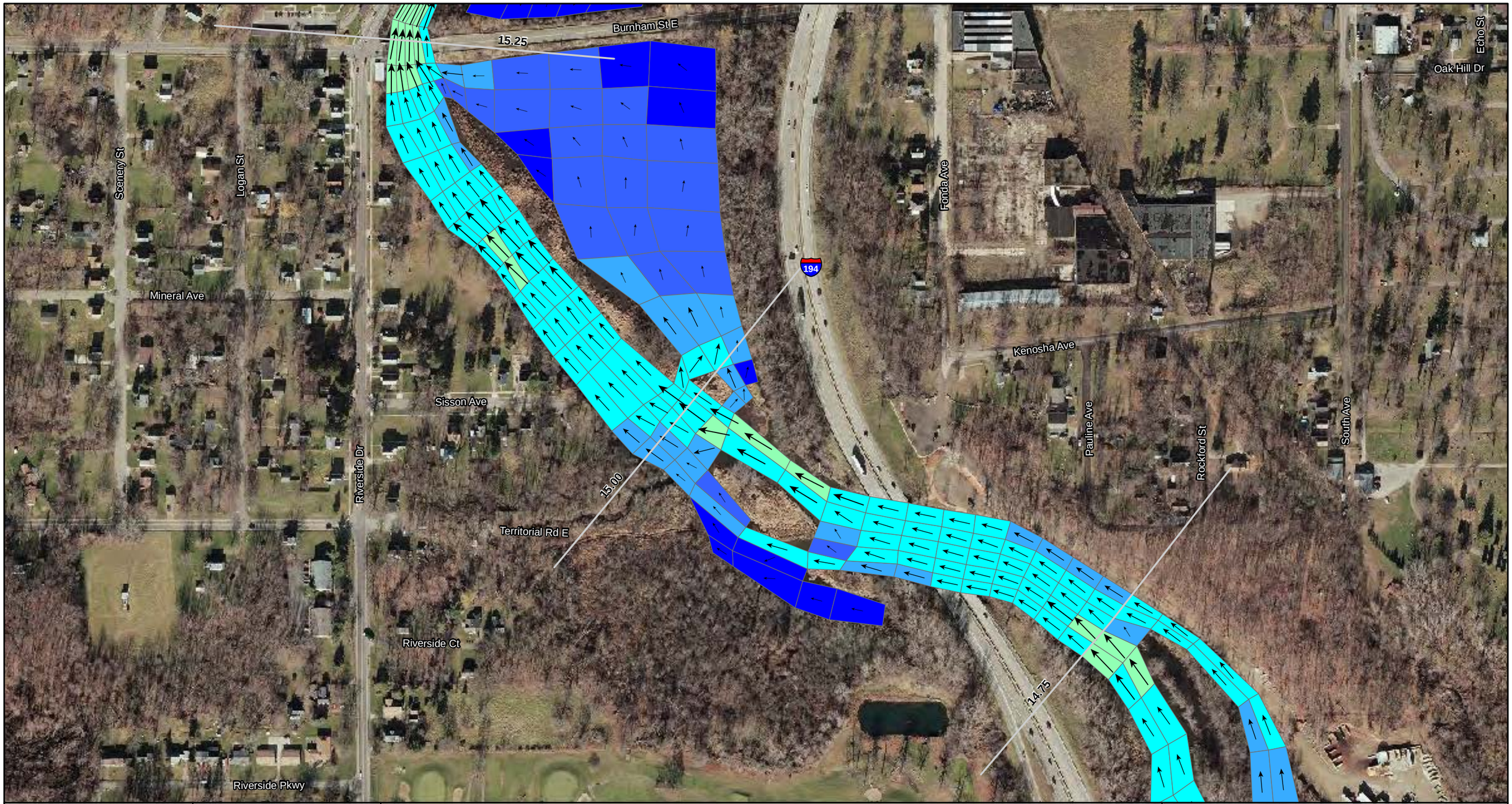
MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

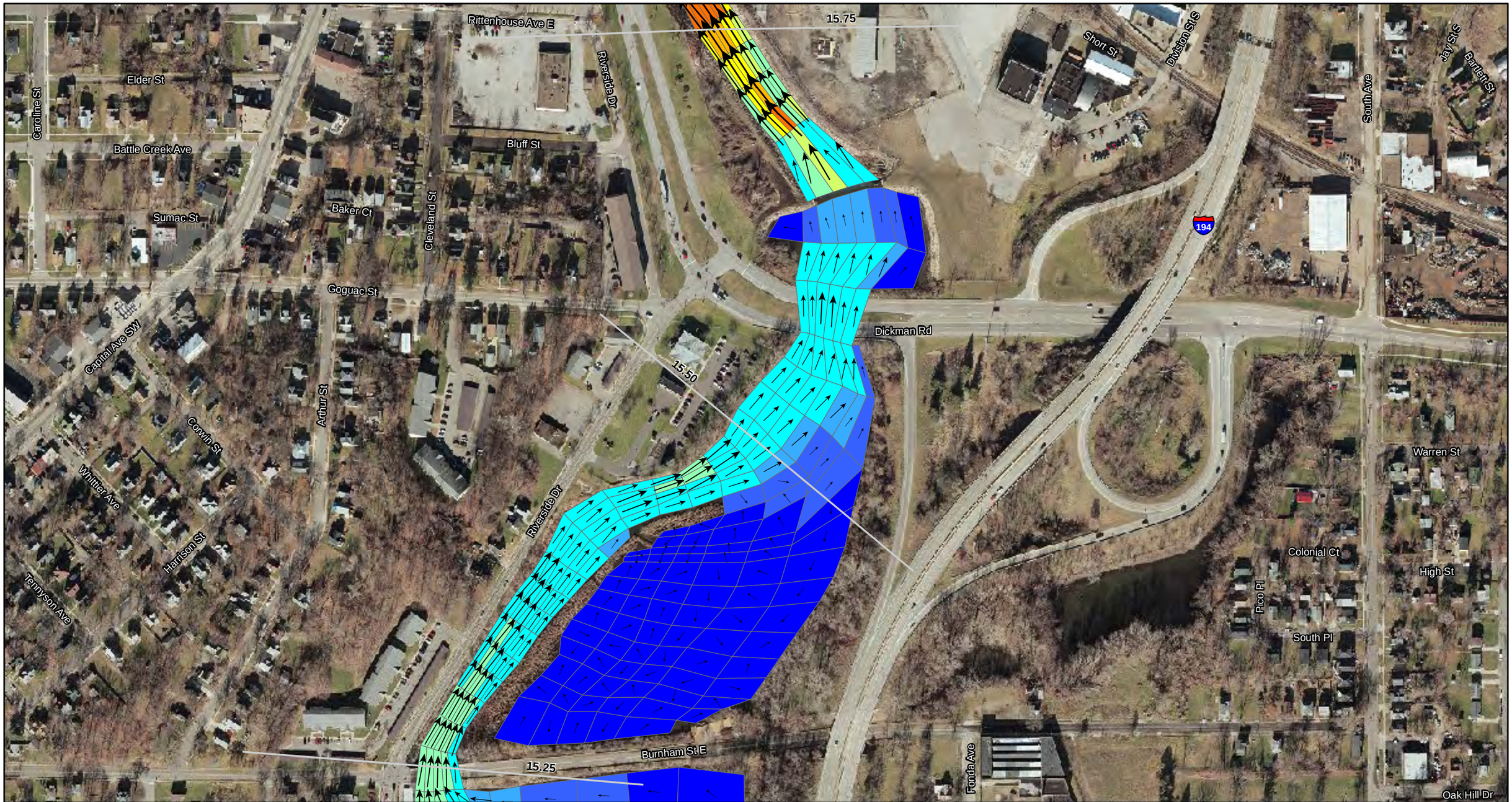
MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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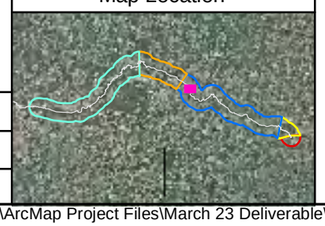
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

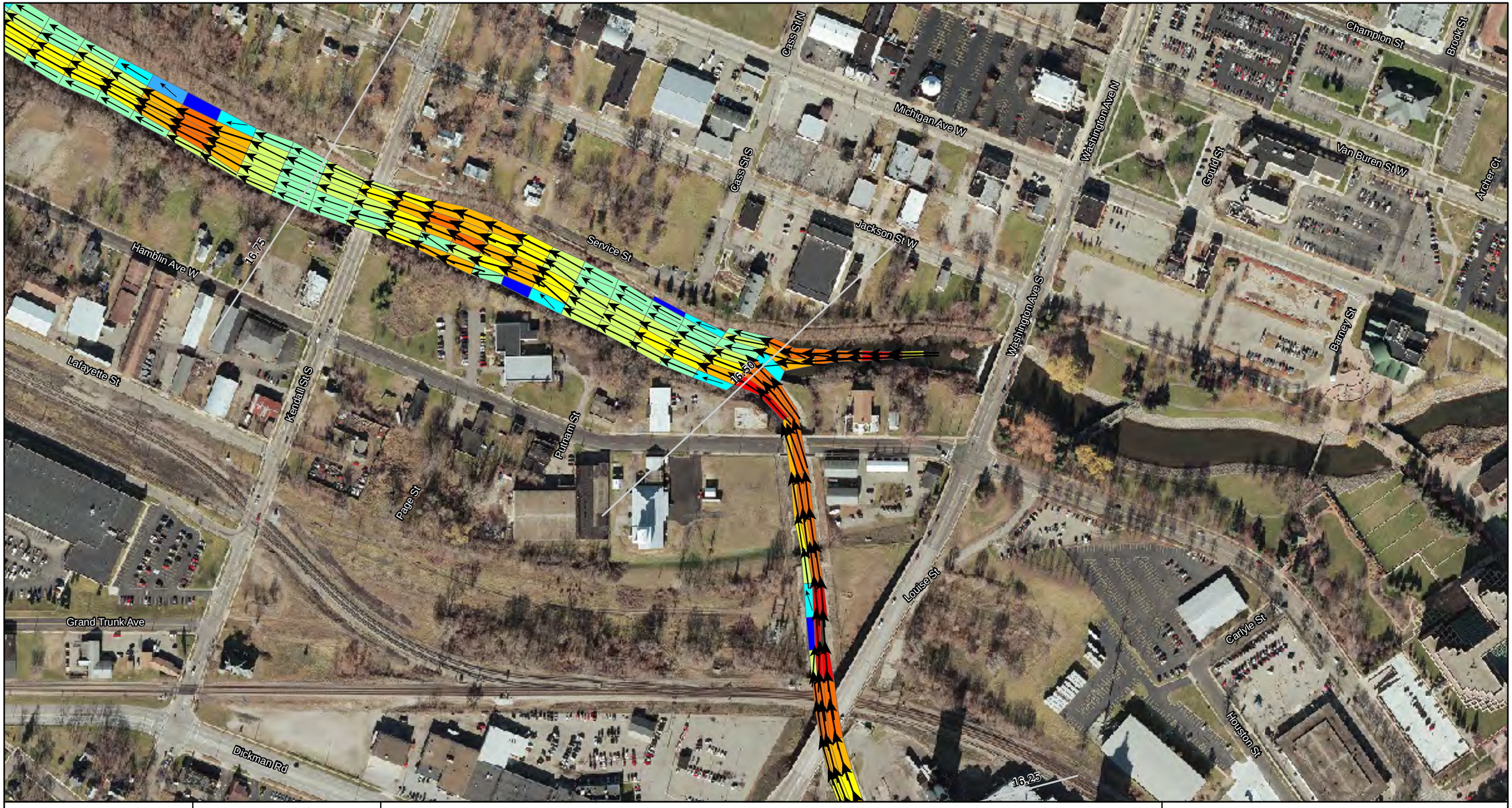
MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

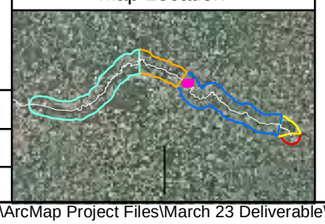
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

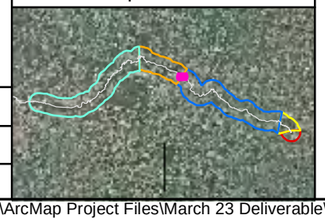
Aerial Photography Date: November 2011

Jackson St W
Grand Ave
Van Buren St W
Graves Ave
Graves Ave
Hubbard St
Manchester St W
Lemont St
17.30
17.25
15th St N
14th St N
12th St N
Jordan St
Turner St
Michigan Ave W
Thorne St
17.00
Wood St S
Lafayette Ave
14th St N
Butler St
Hamblin Ave W
Angell St
Parish St
Lafayette St
E Ave

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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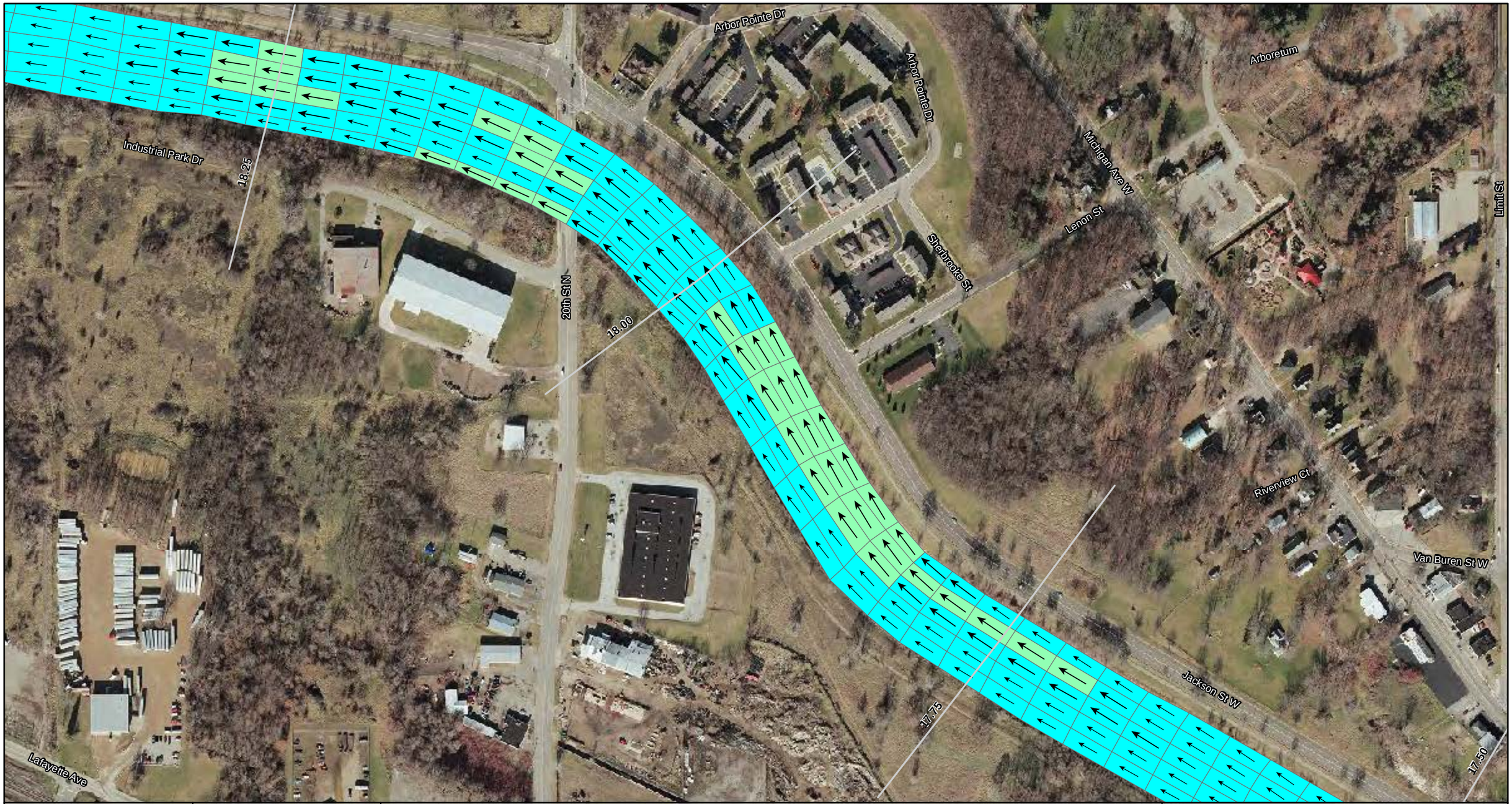
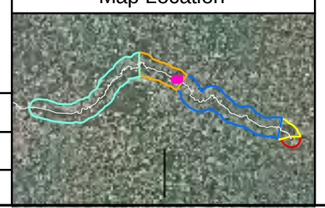
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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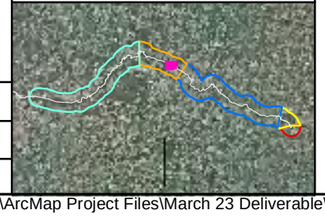
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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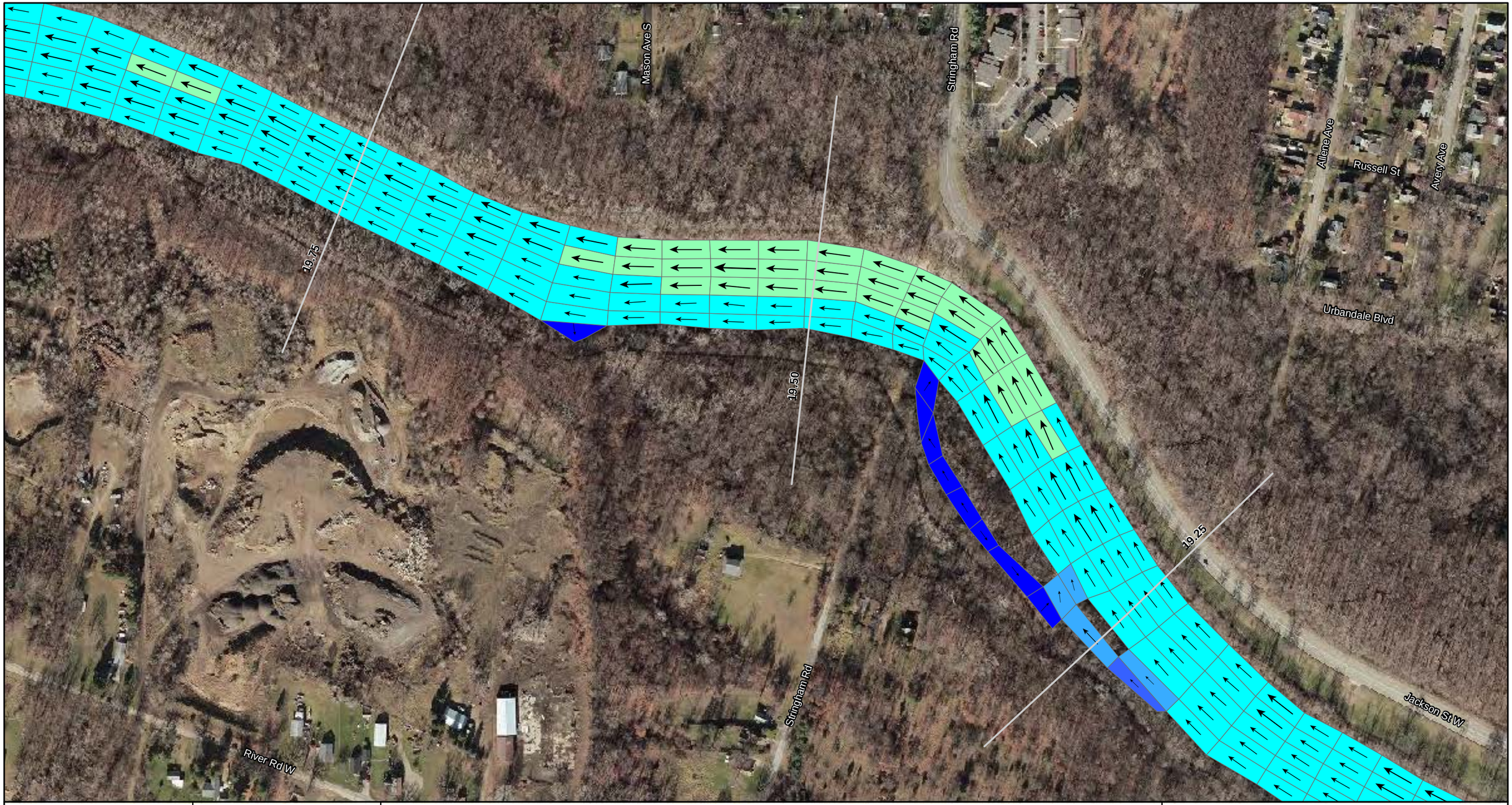
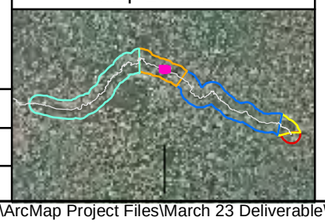
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

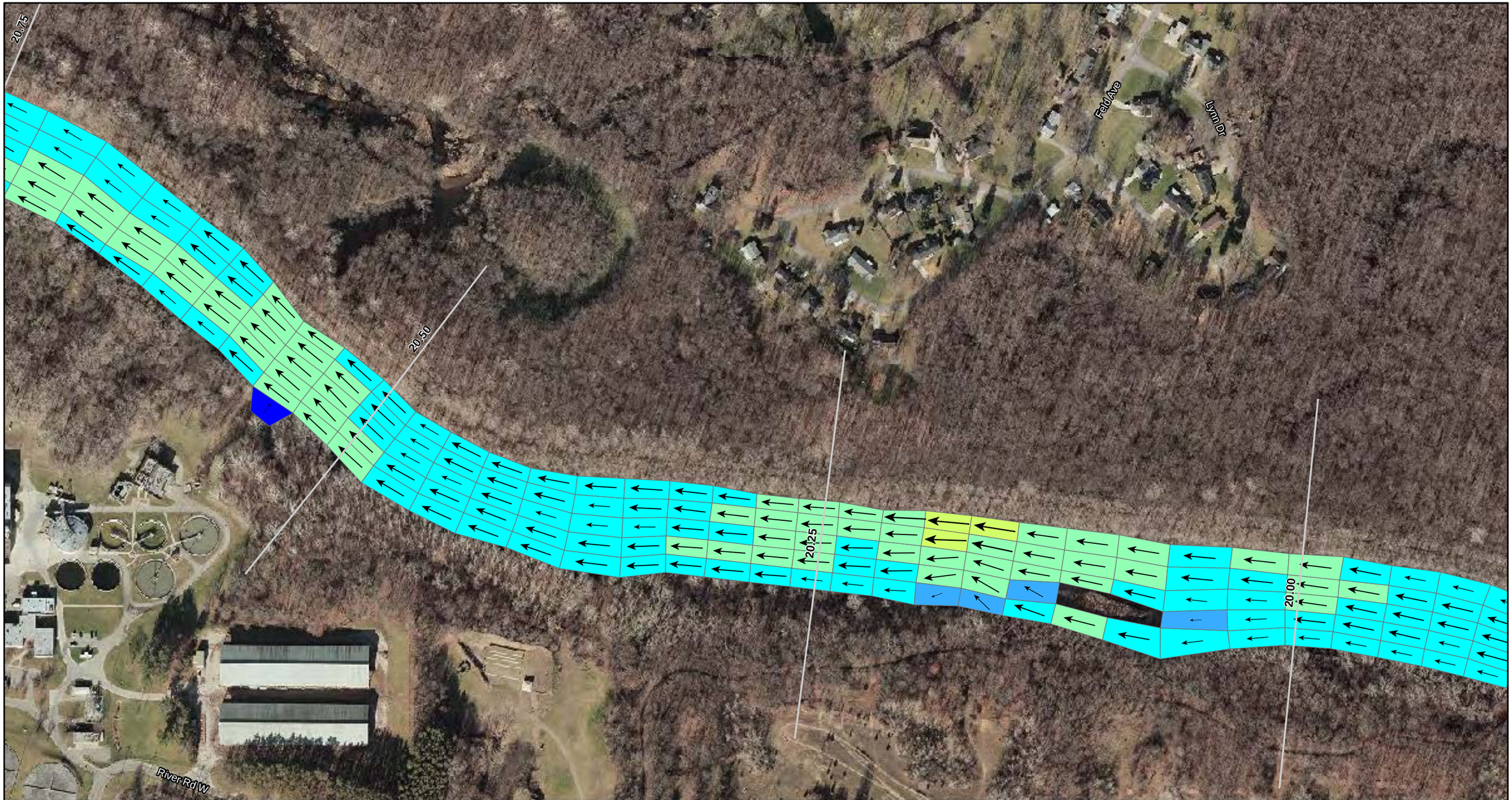
MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

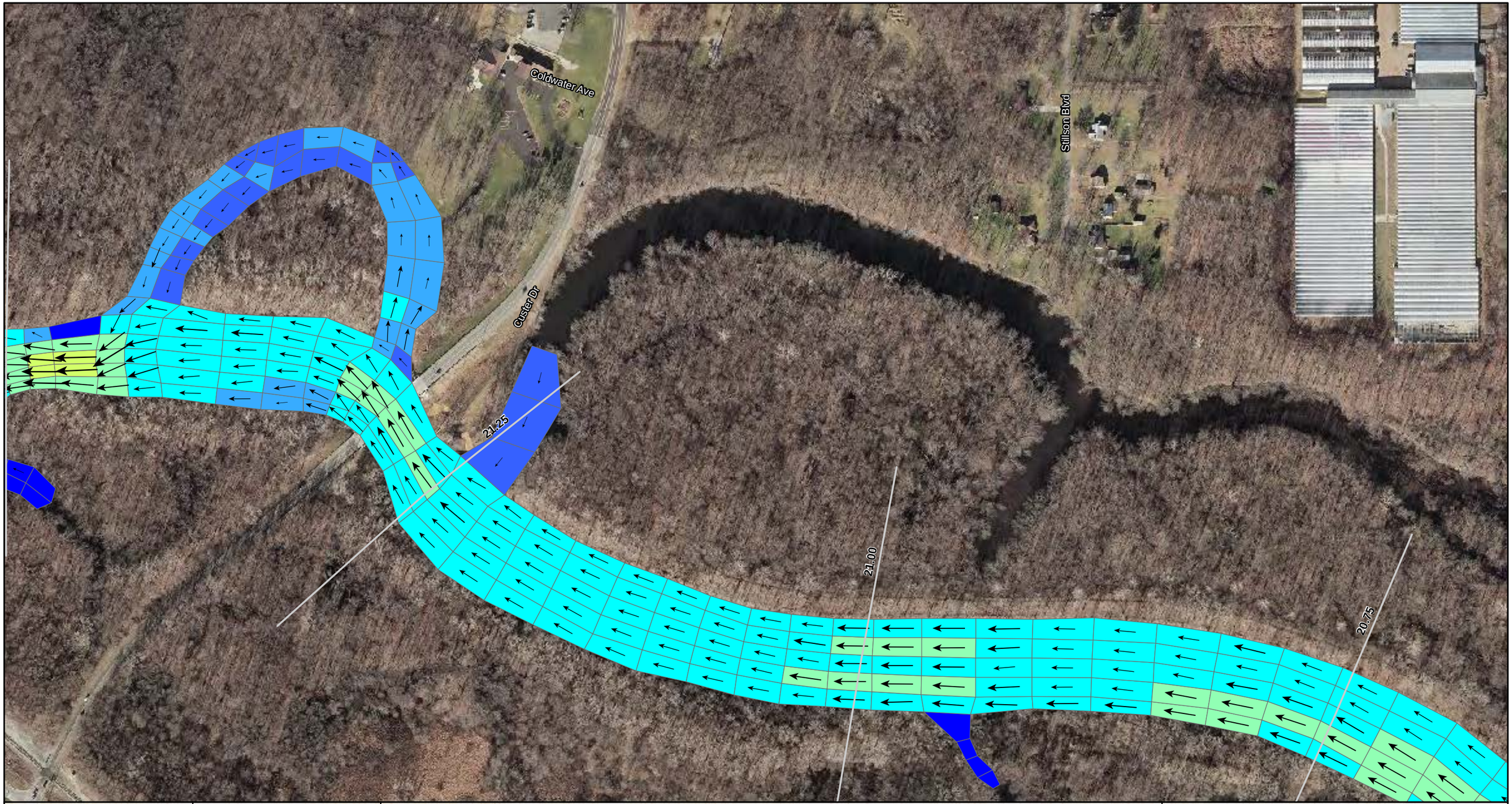
MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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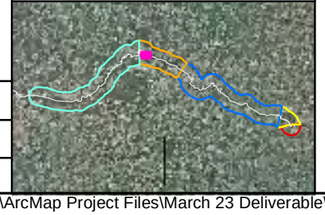
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

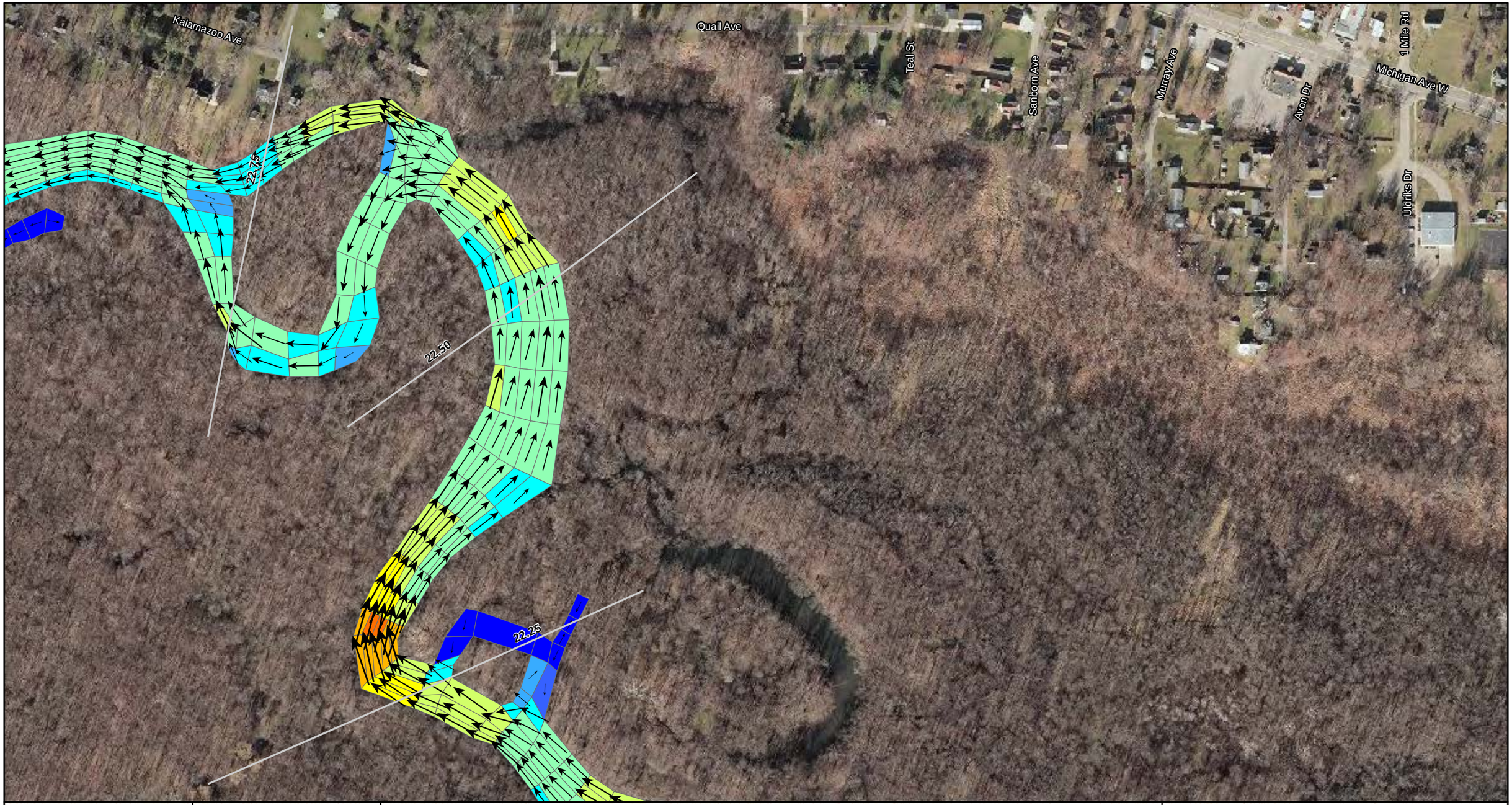
MP 21.35 - MP 22.15

SHEET 28 OF 56

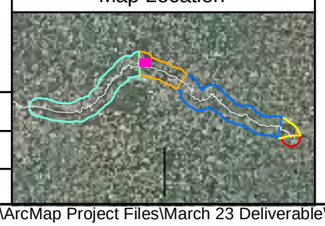
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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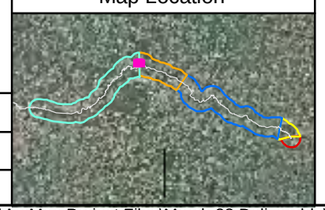
Aerial Photography Date: November 2011

San Juan Ave
Colorado St
Charleston Ave
Kalamazoo Ave
23.25
23.50
23.00
23.75
24.00

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

24.00
24.25
24.50
24.75
River Rd W
Fort Custer Dr
County Line Rd

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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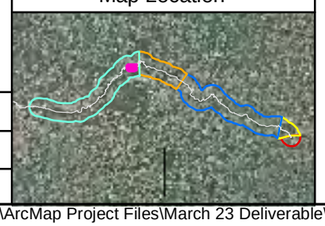
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011

Augusta Dr

26.00

26.25

26.50

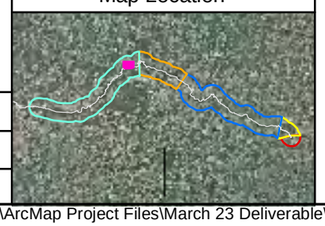
25.75

25.50

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

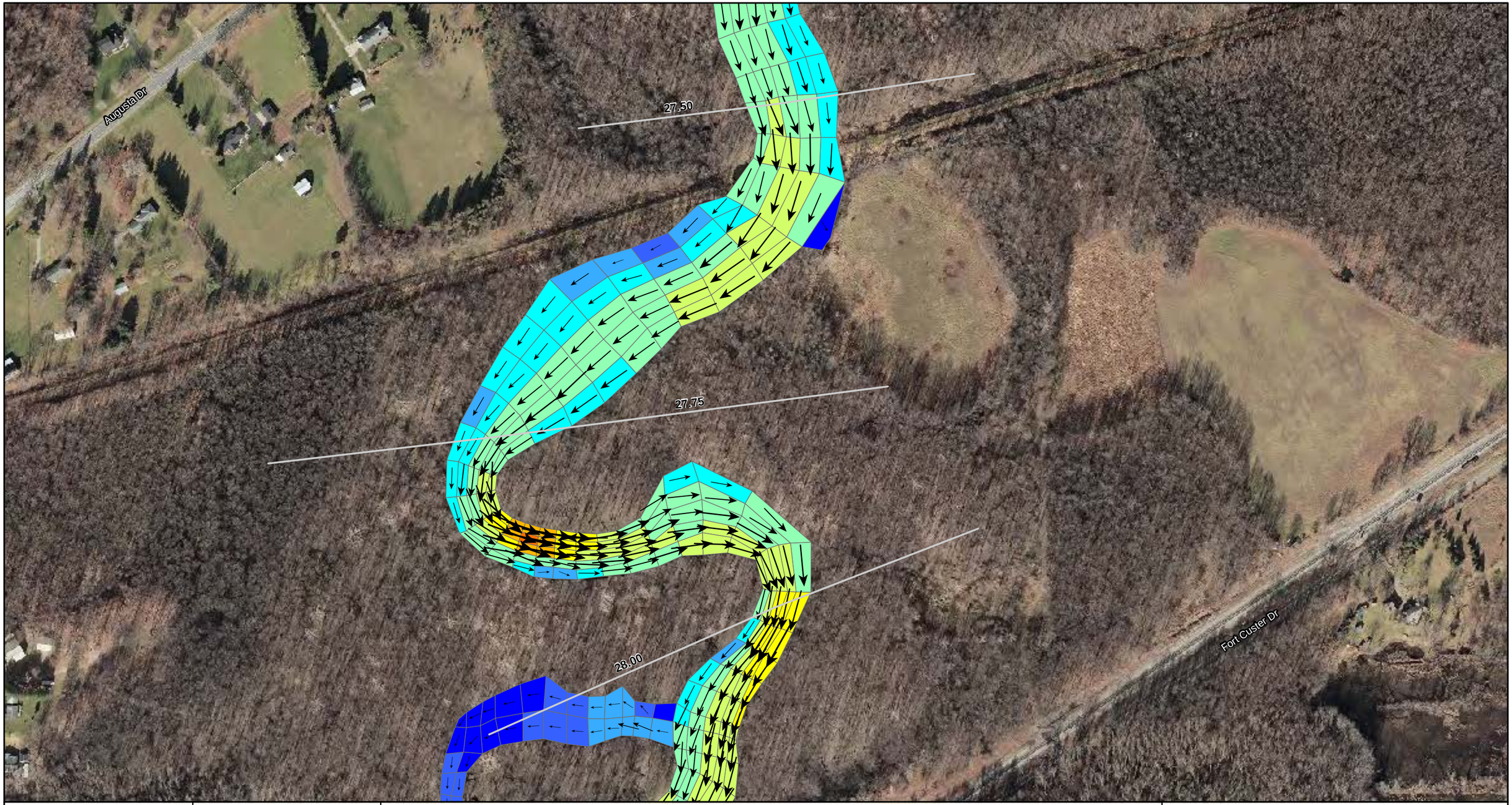
MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

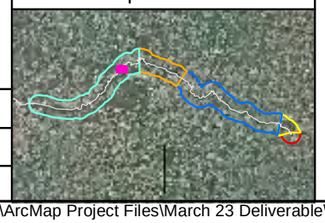
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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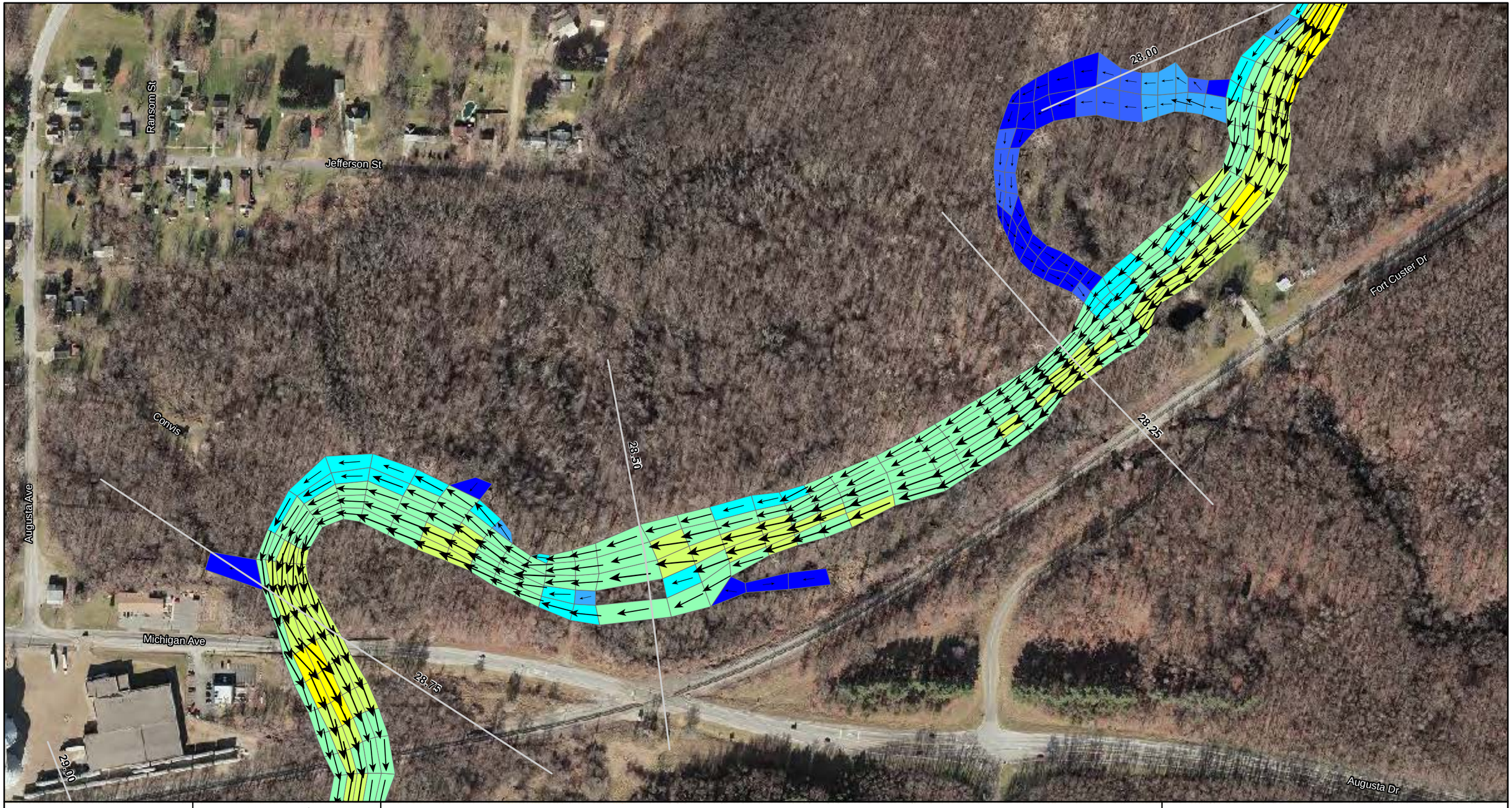
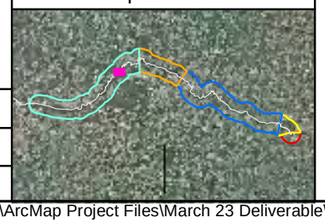
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Clinton St
Clinton St
Chestnut St
Webster St
Church St
Fayette St
Cass St
Cherry St
Lincoln St
28.75
29.00
29.25
29.50
Augusta Climax Rd
Fort Custer Rec Area Access

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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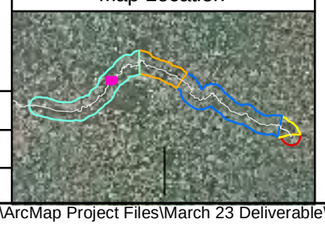
Aerial Photography Date: November 2011

29.50
29.75
30.00
30.25
Fort Custer Rec Area Service
Fort Custer Rec Area Access

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

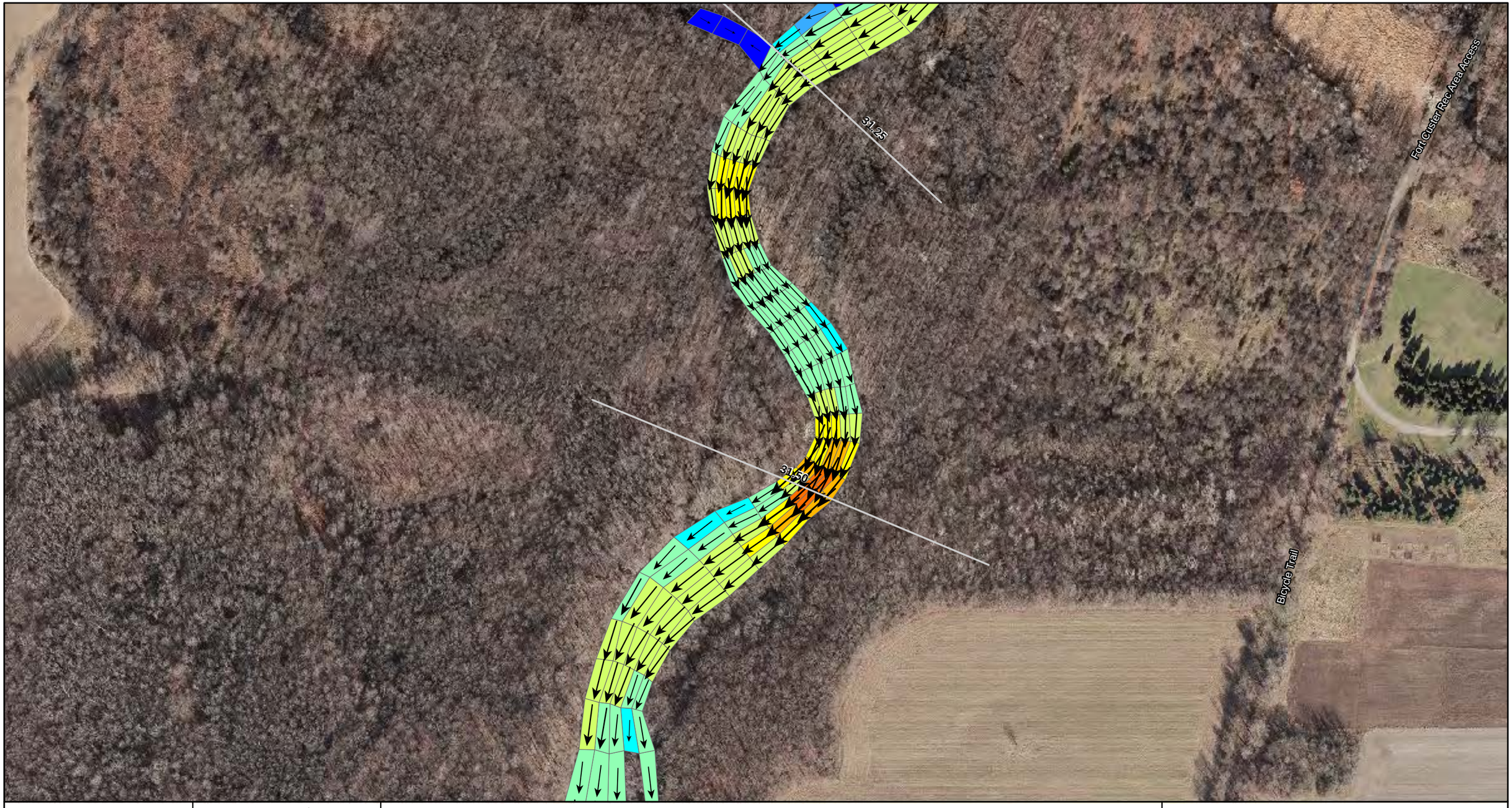
MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

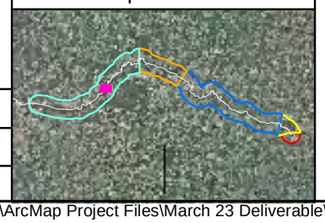
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

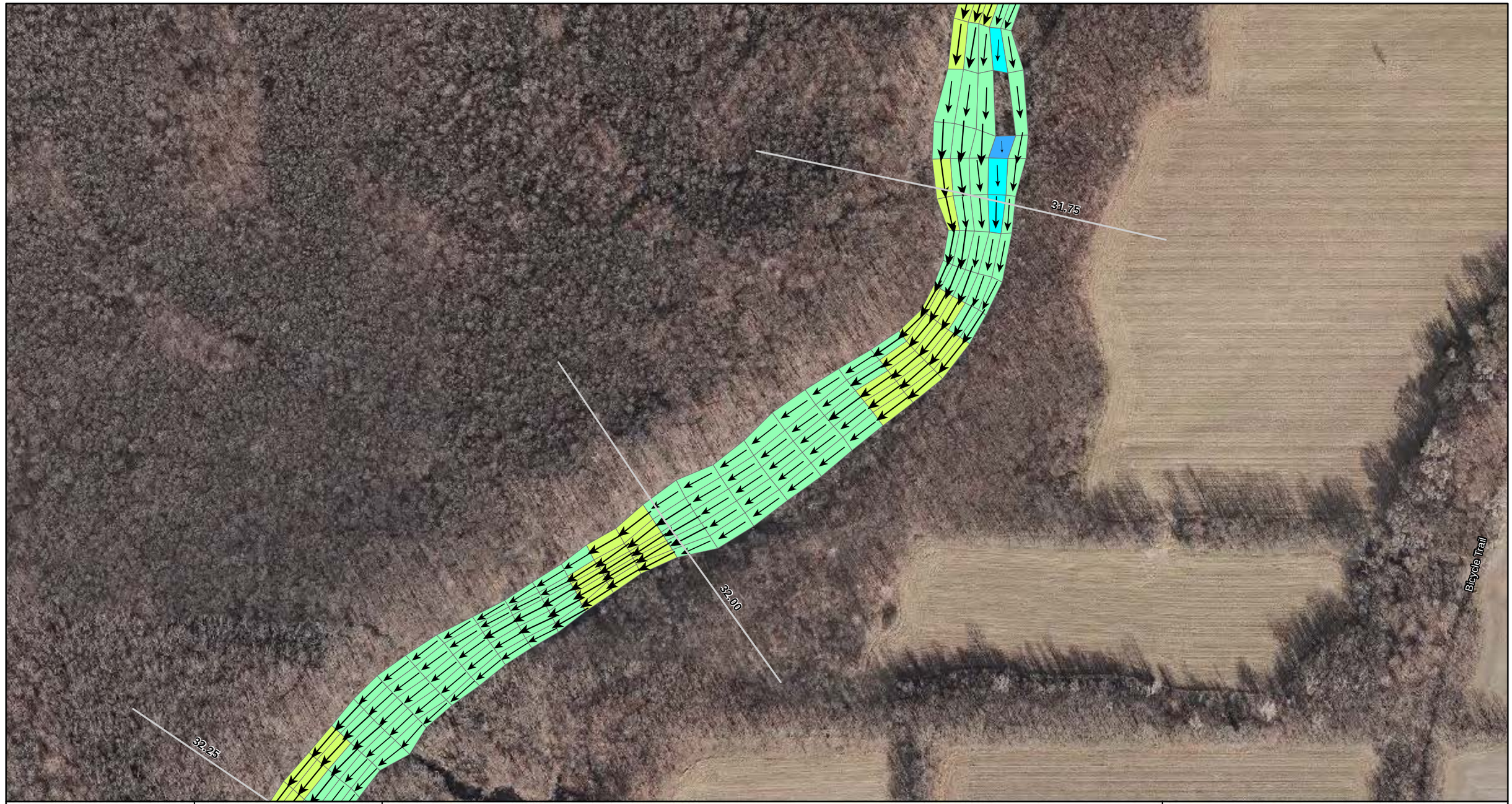
MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

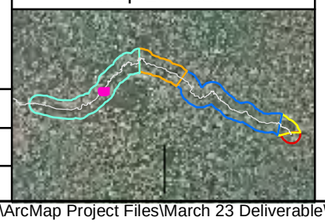
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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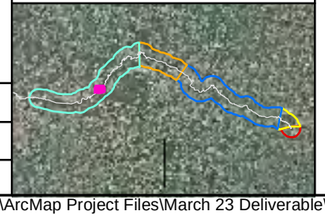
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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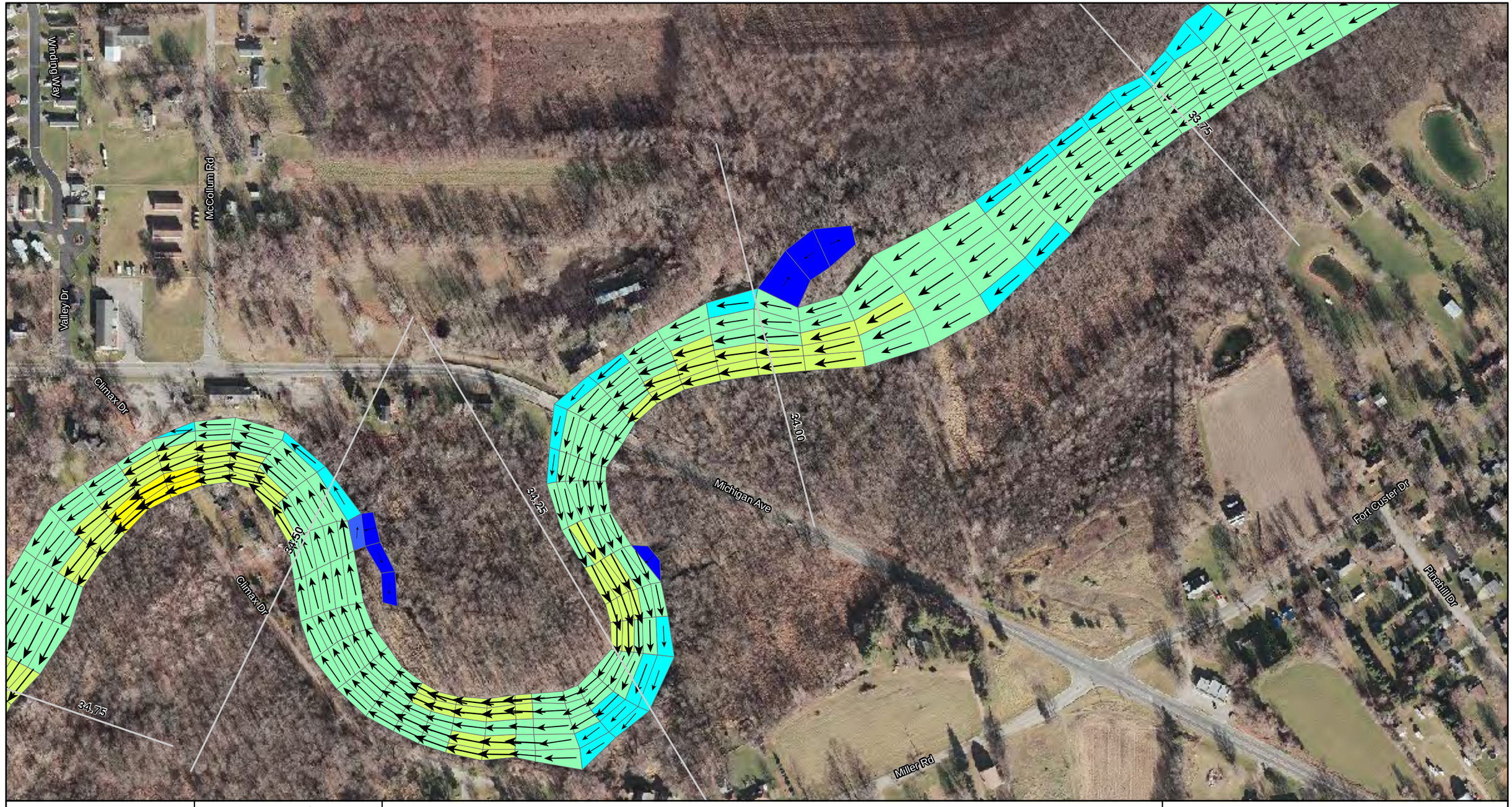
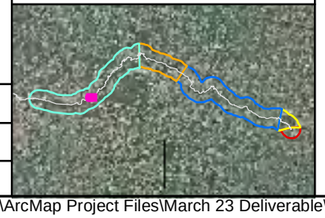
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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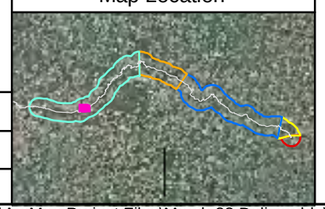
Aerial Photography Date: November 2011

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

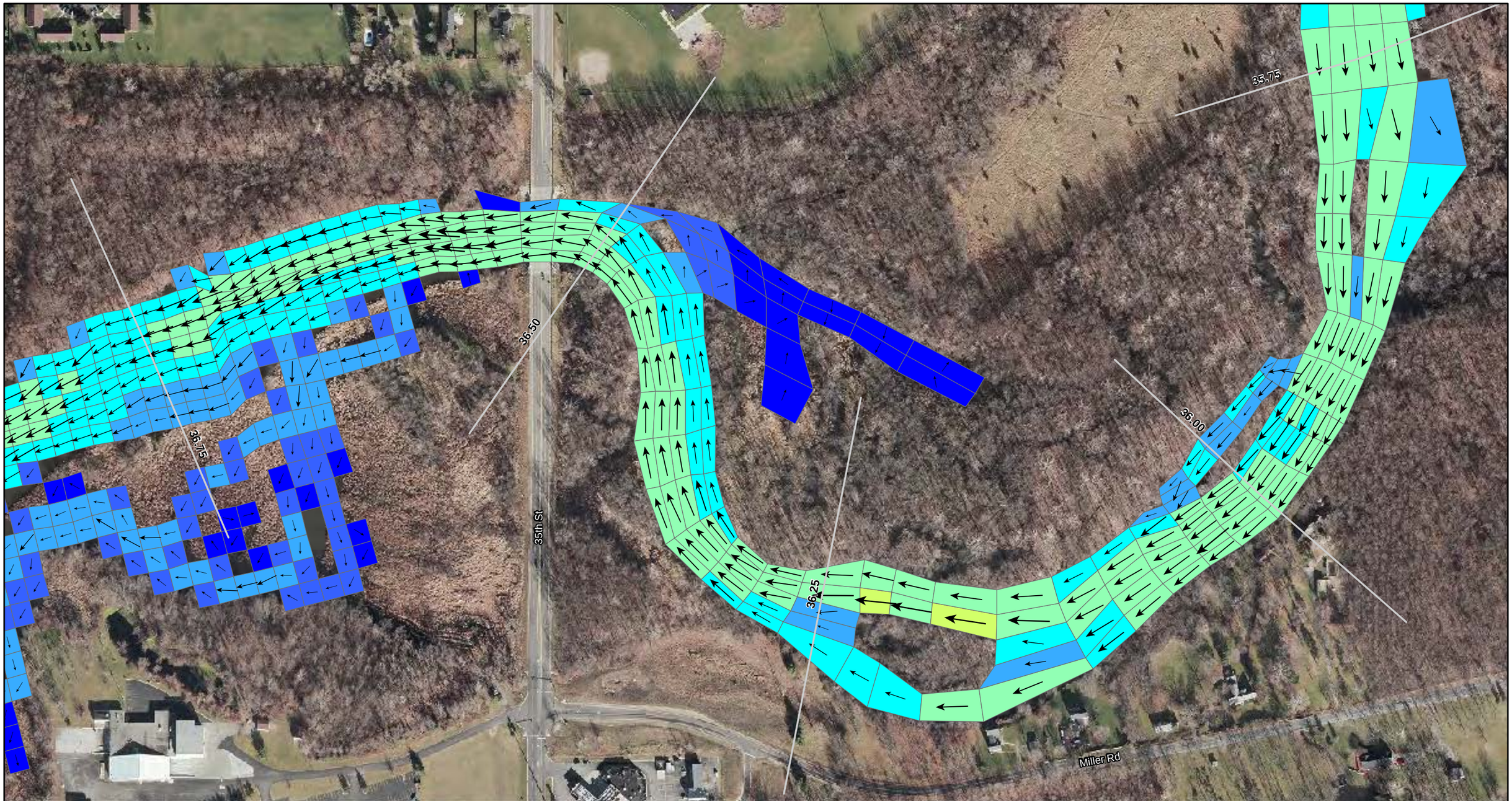
MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

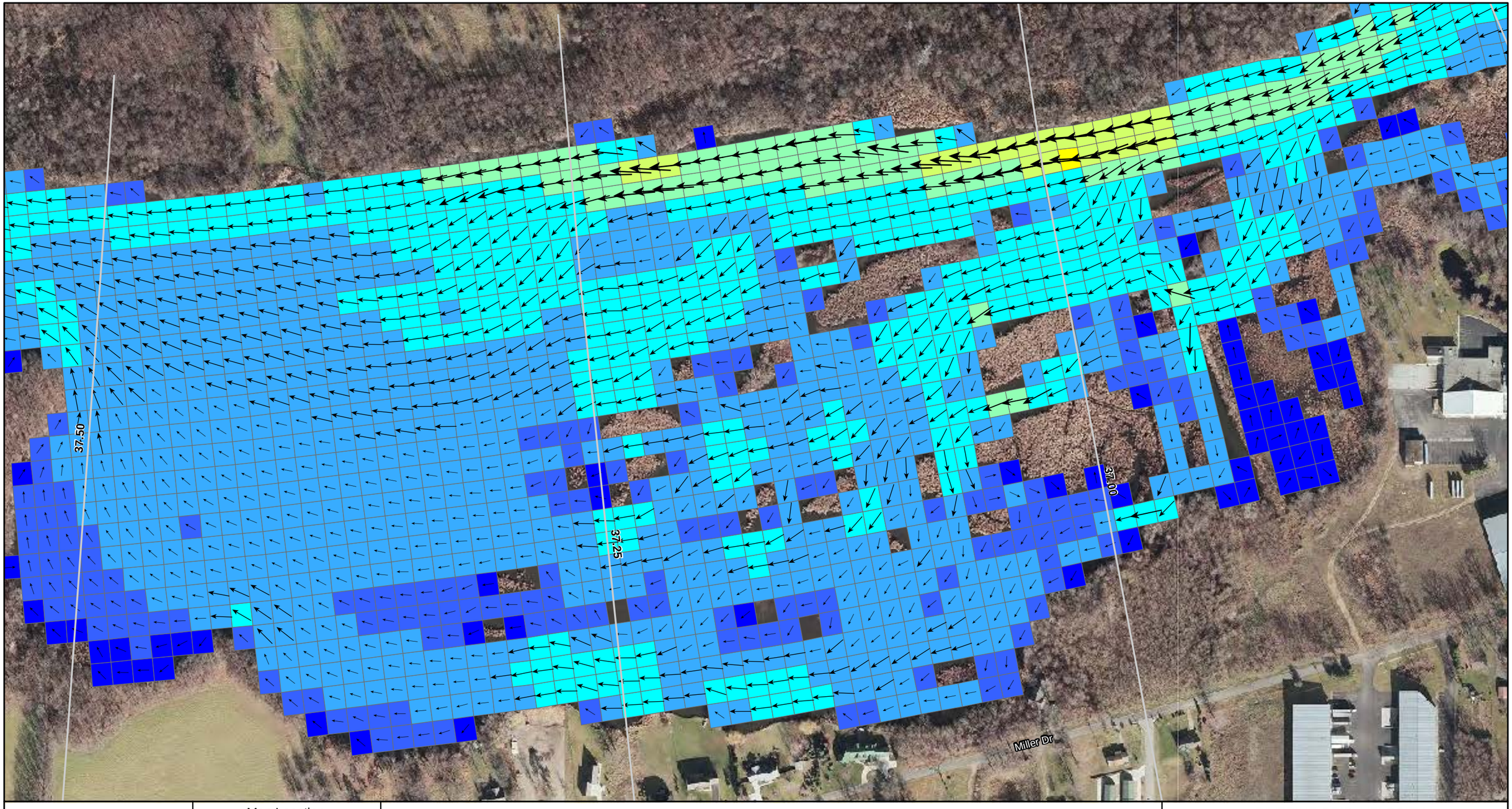
MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

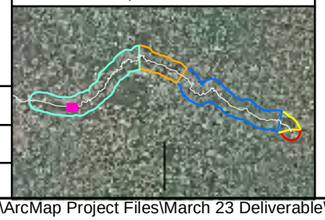
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

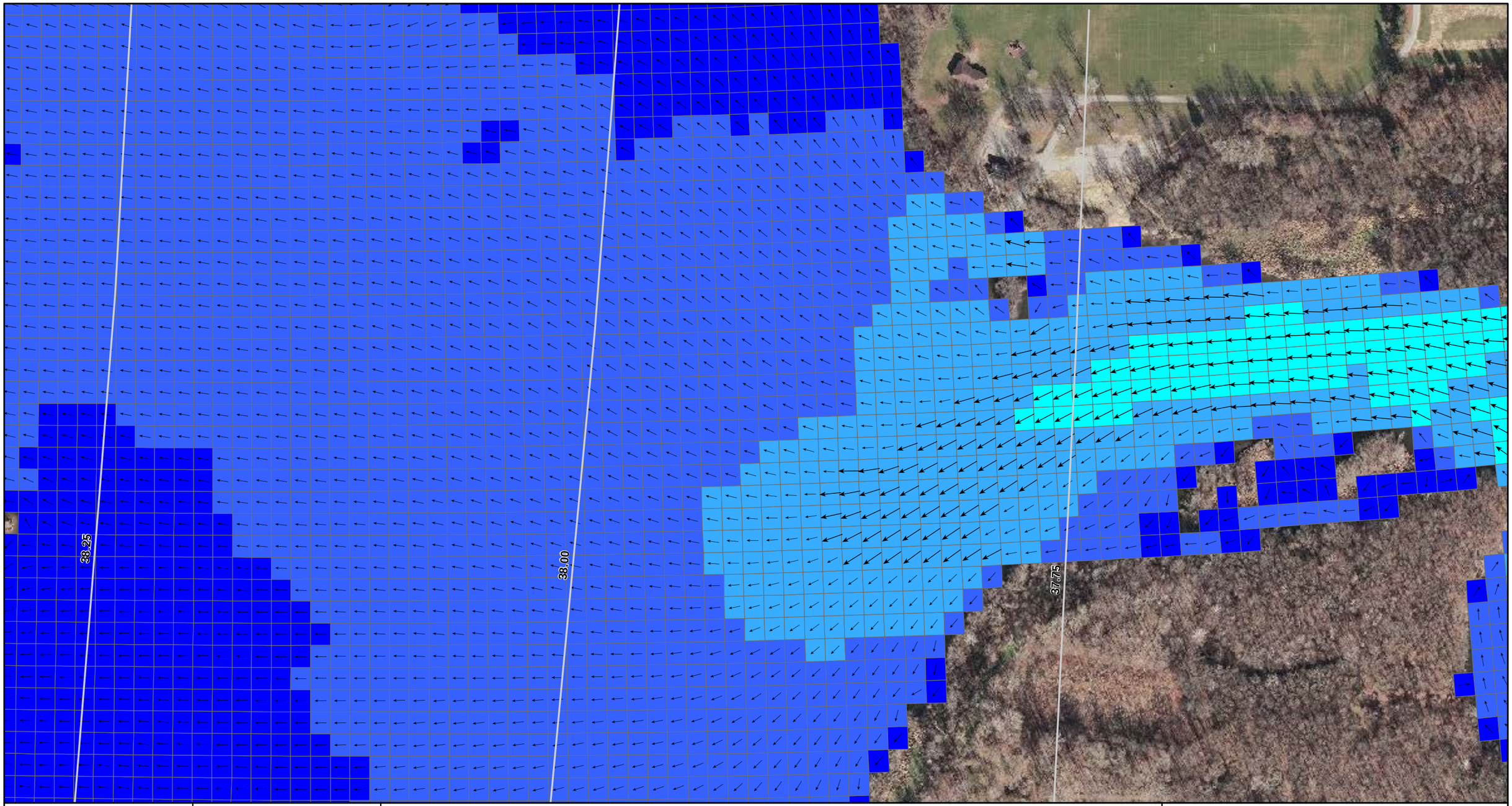
MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

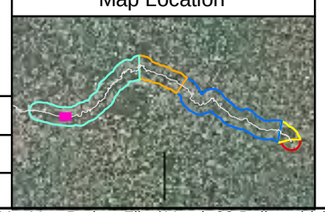
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

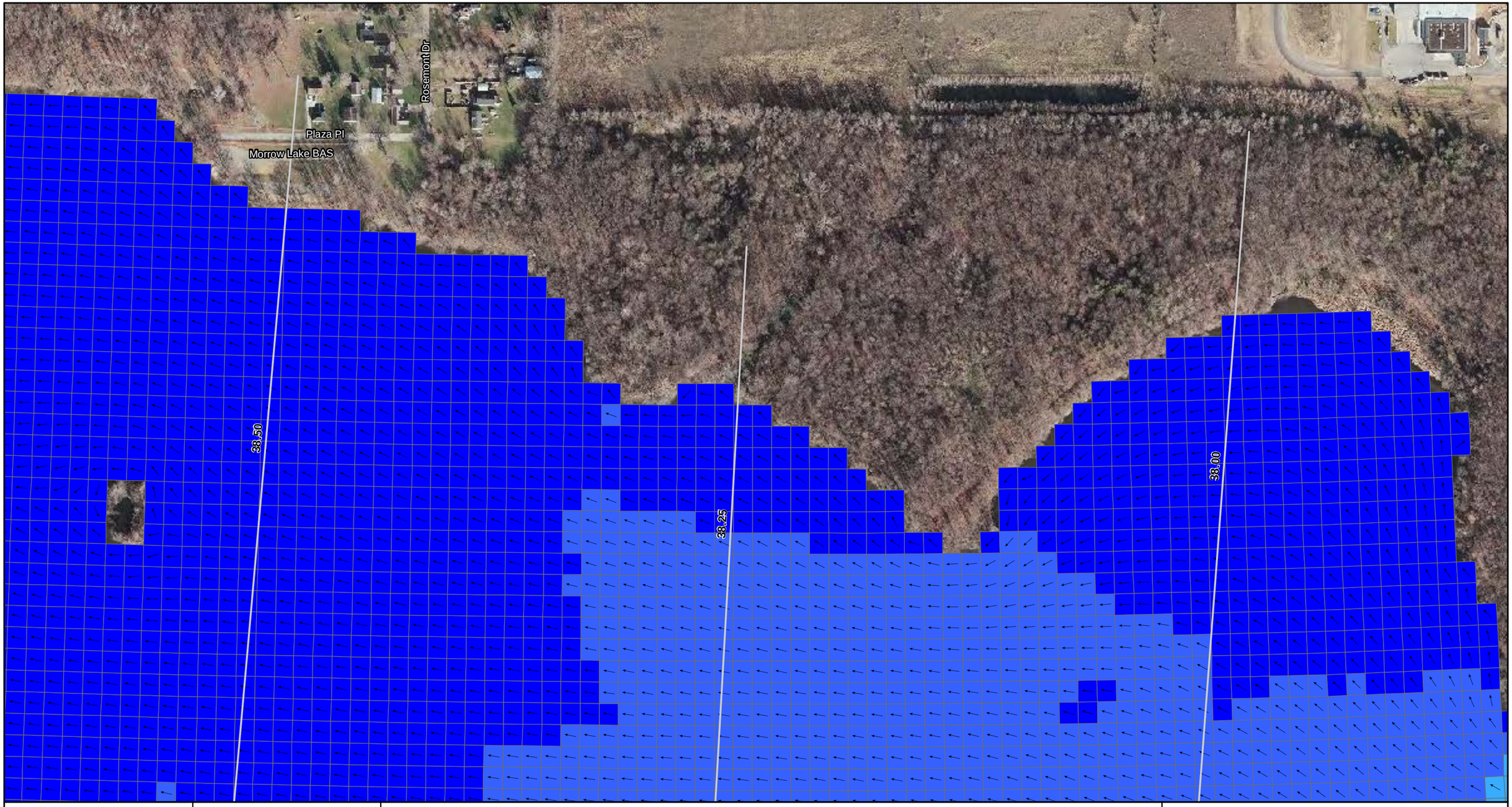
MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

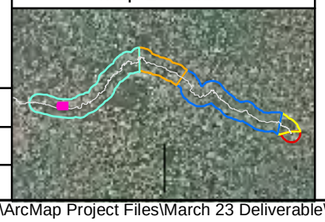
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

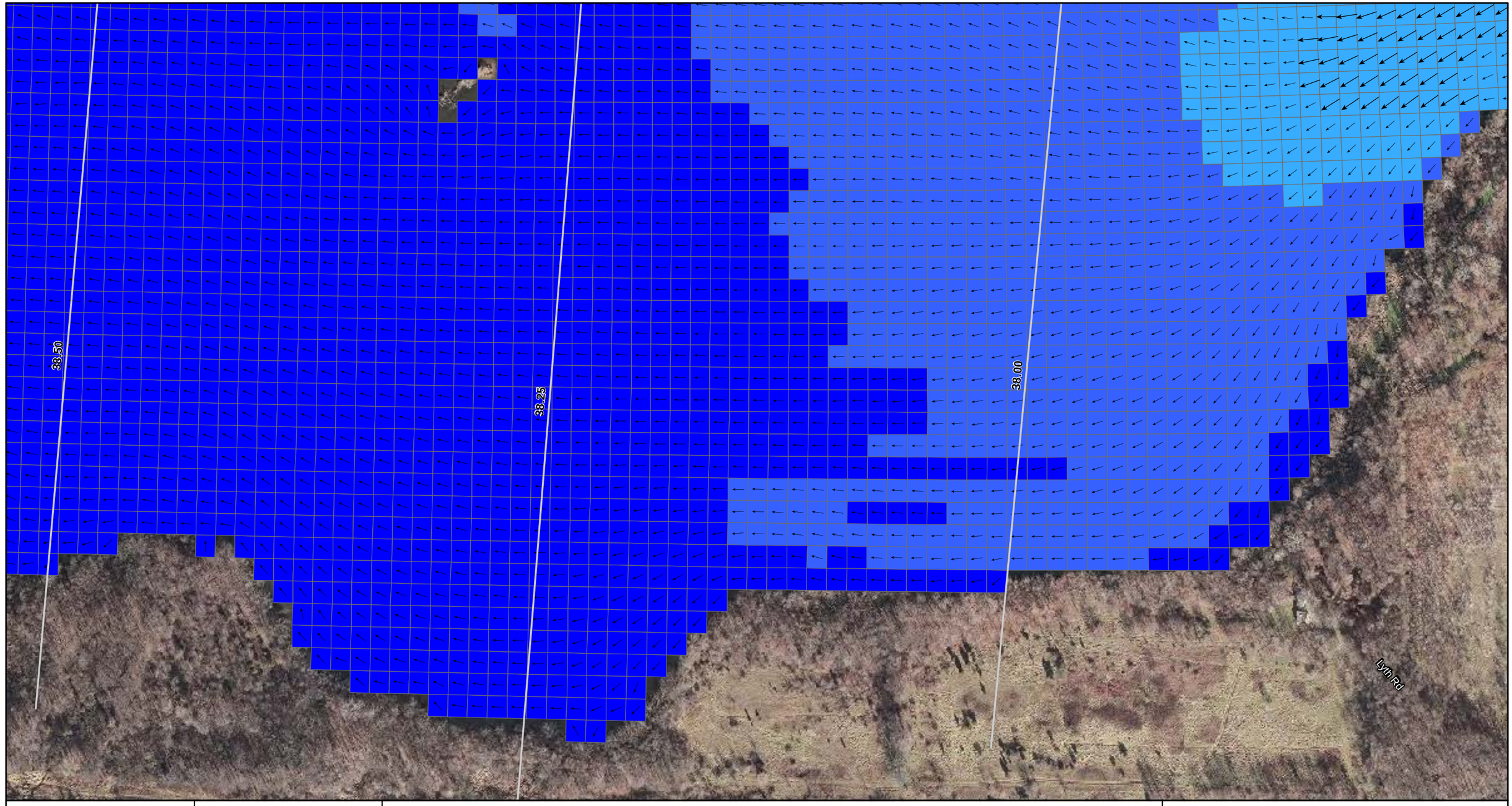
MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

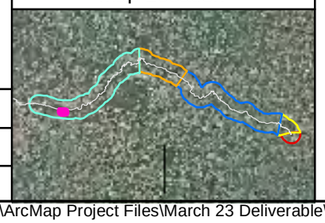
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

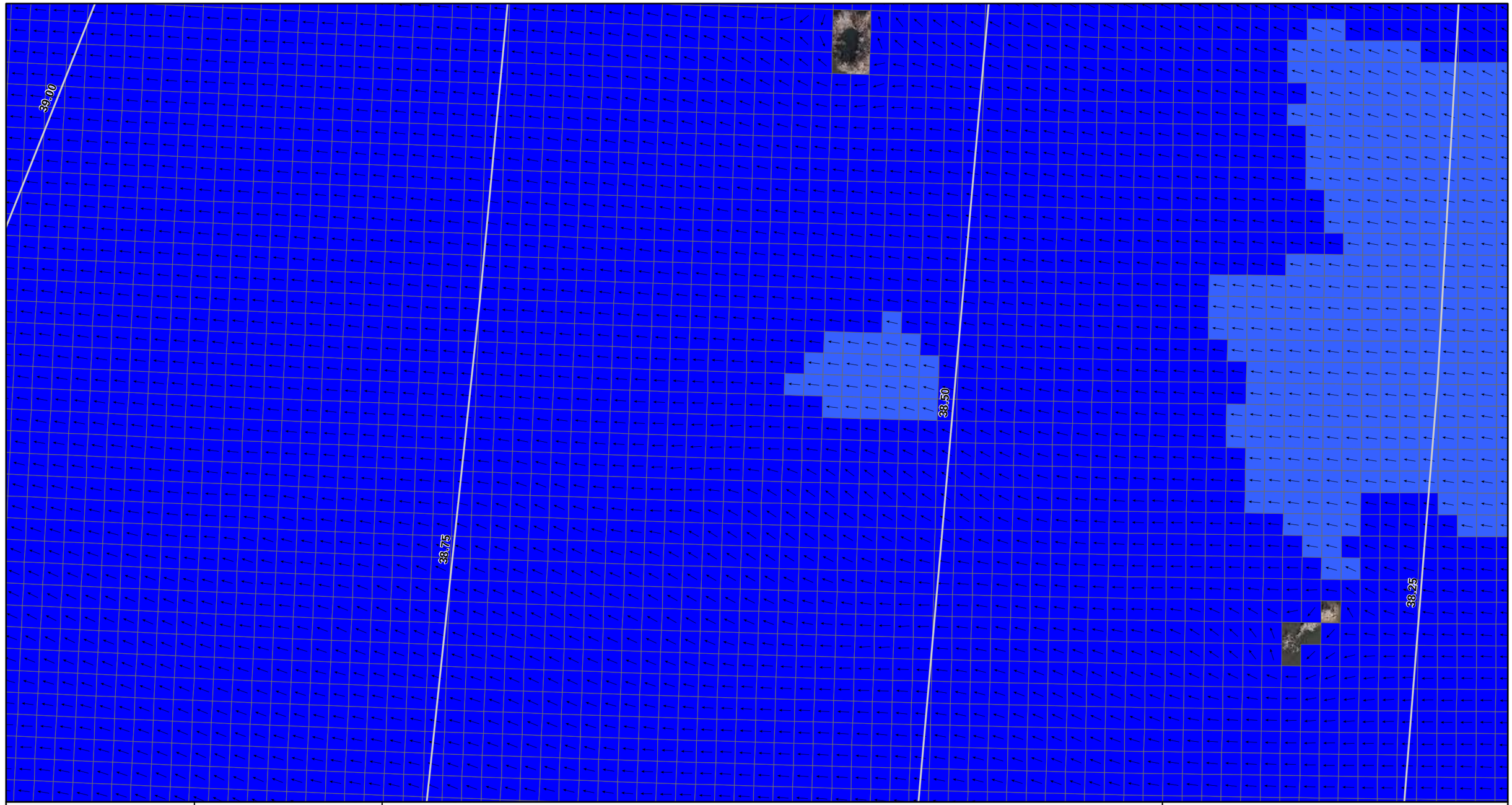
MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

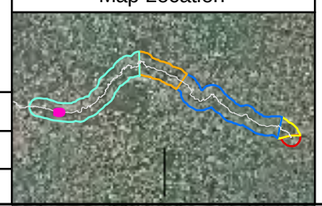
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

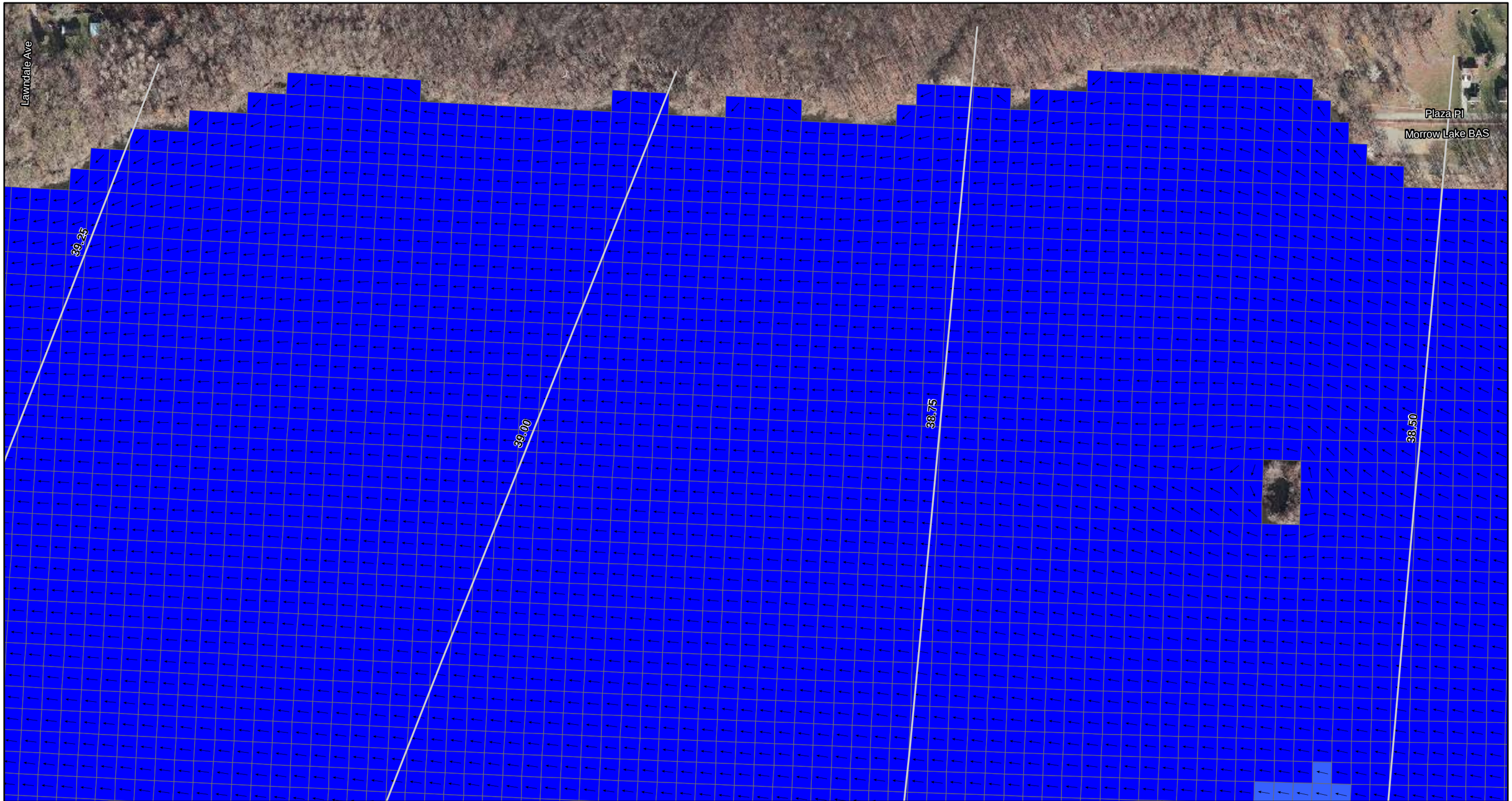
MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

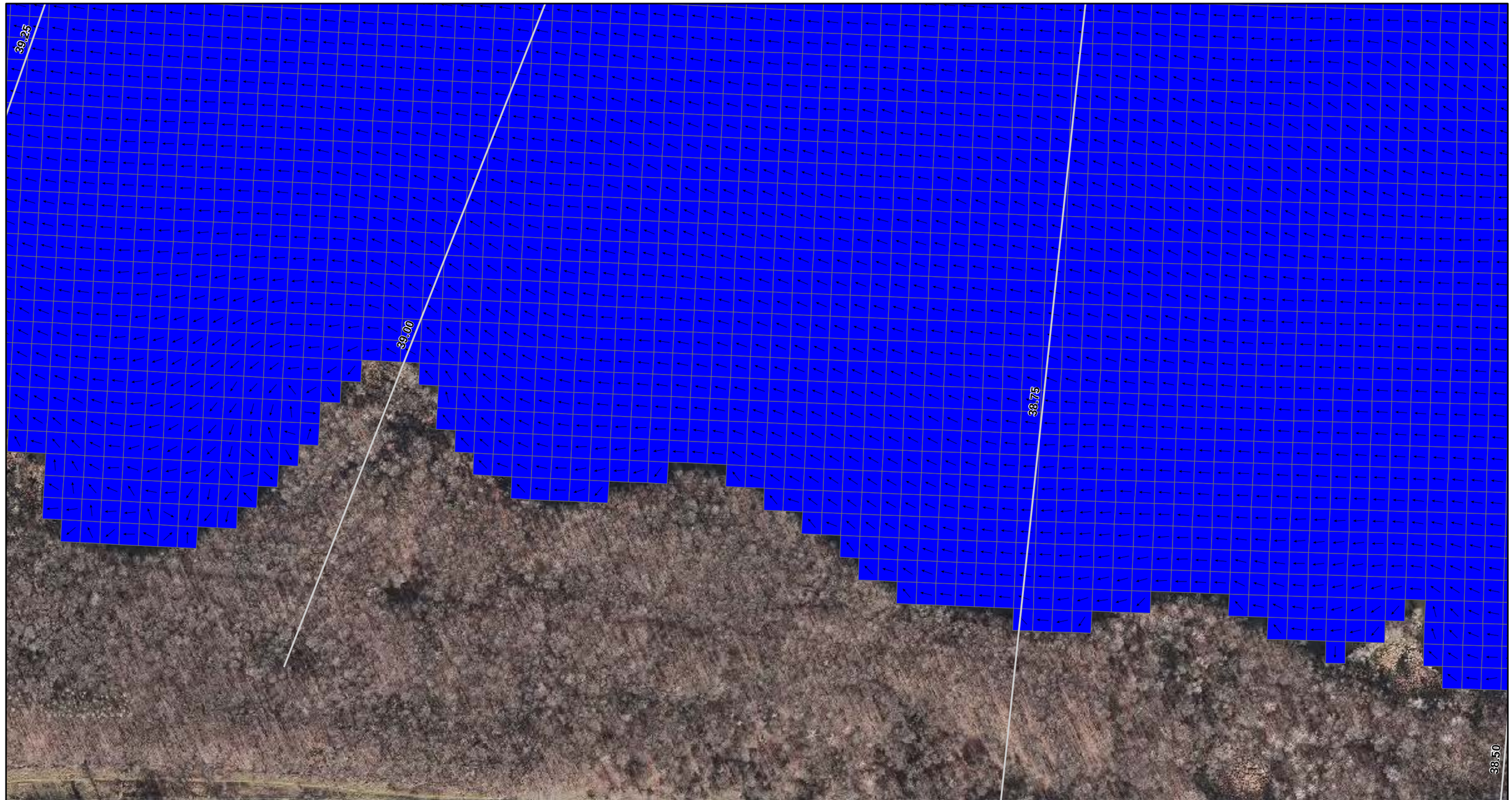
MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

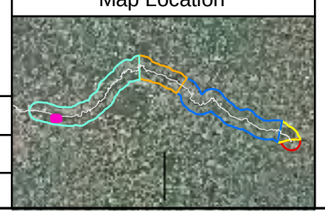
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

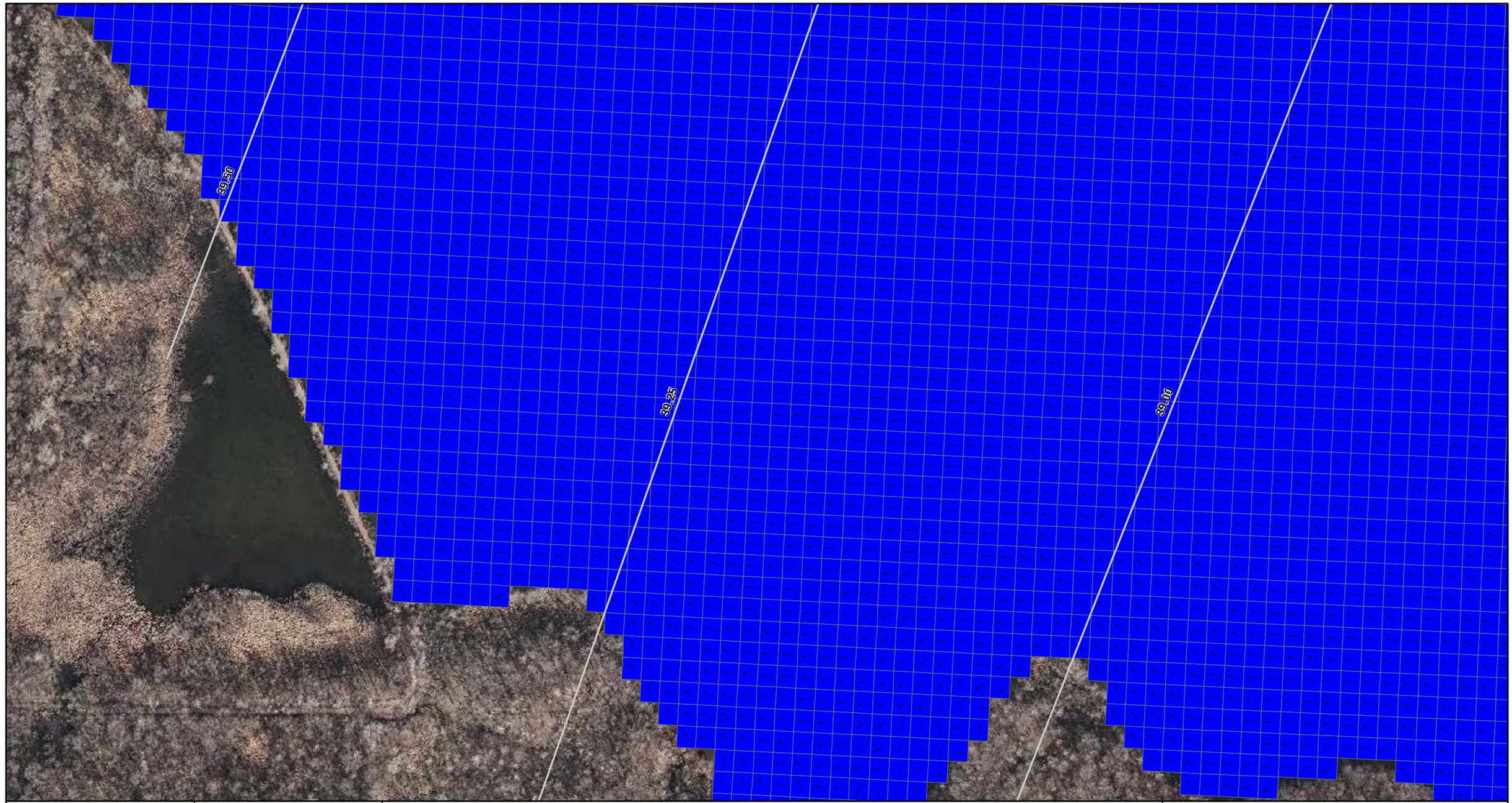
MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

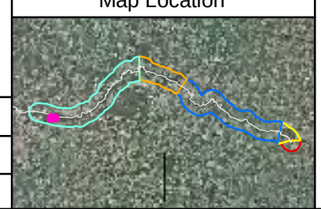
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

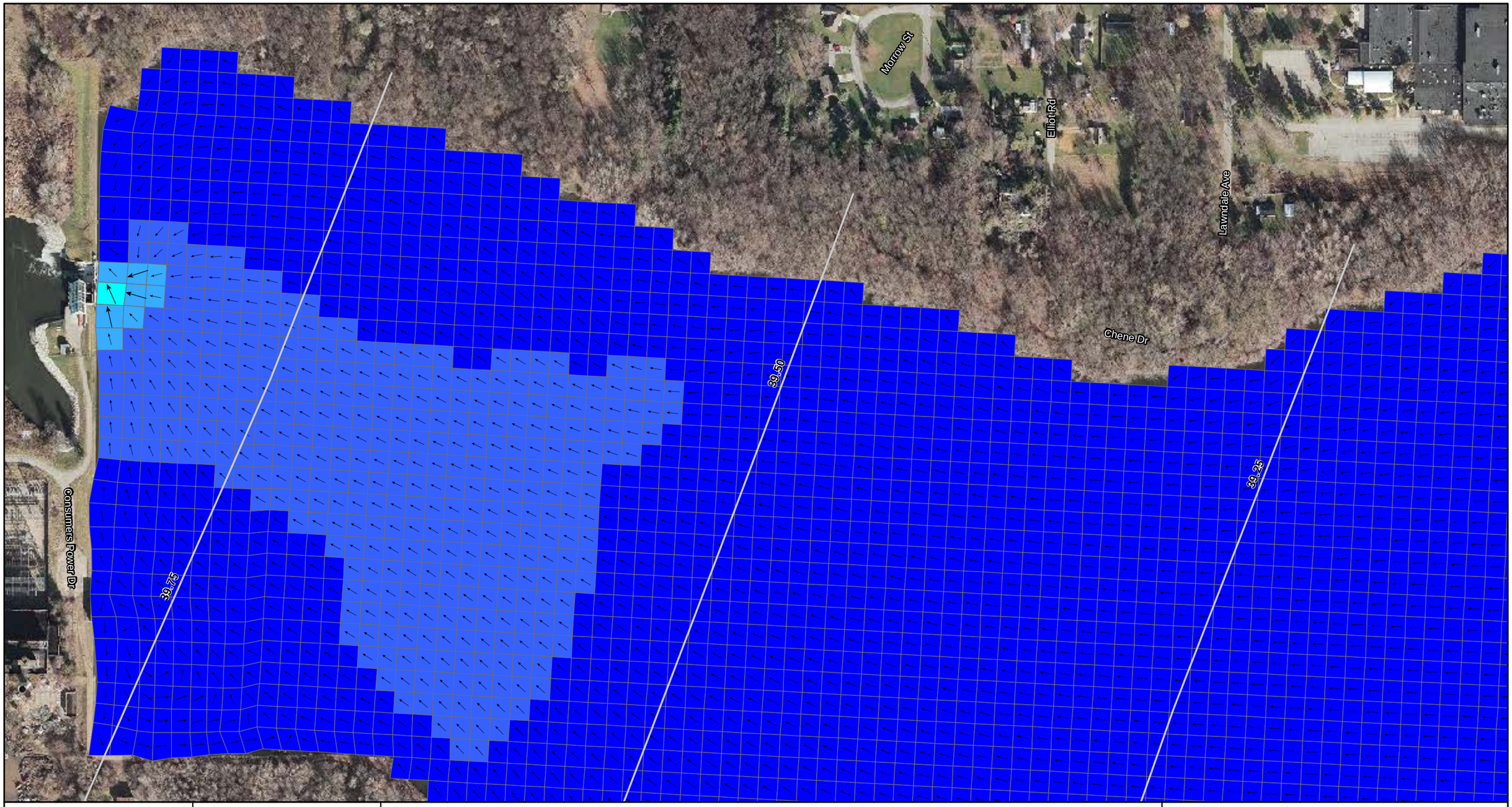
MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

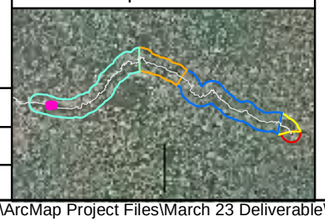
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - October 31, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
OCTOBER 31, 2011

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Oct31_2011.mxd

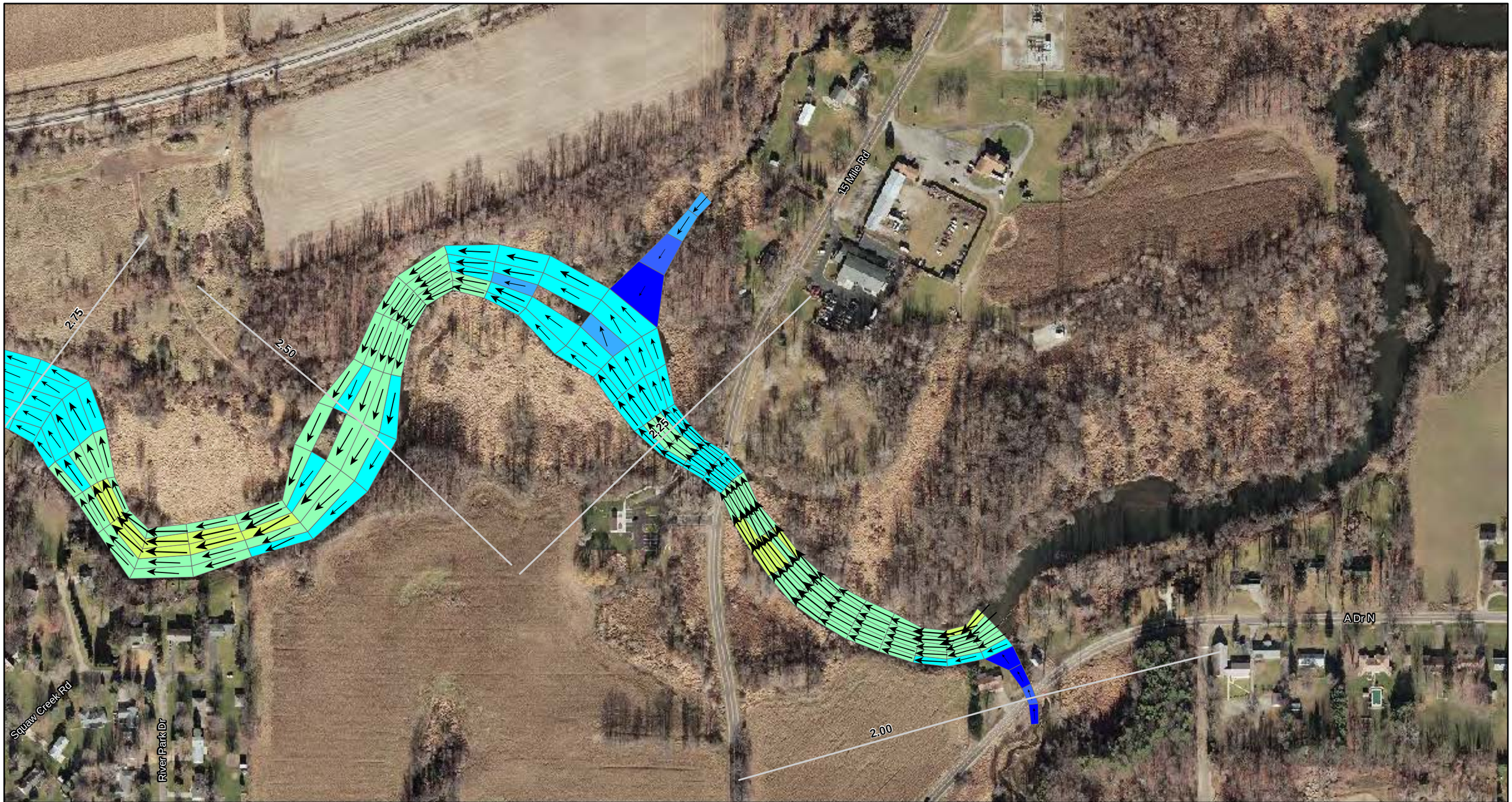
Aerial Photography Date: November 2011

Figure 4-14

Riverine Grid: Velocity

November 3, 2011

Sheets 1 through 56



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011

3.25

3.00

2.50

2.75

Friendship Ln

Heather Dr

Peter Pan Ln

Kristen Dr

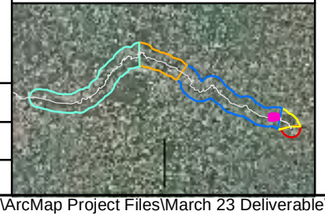
Squaw Creek Rd

River Park Dr

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

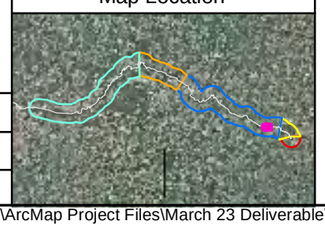
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

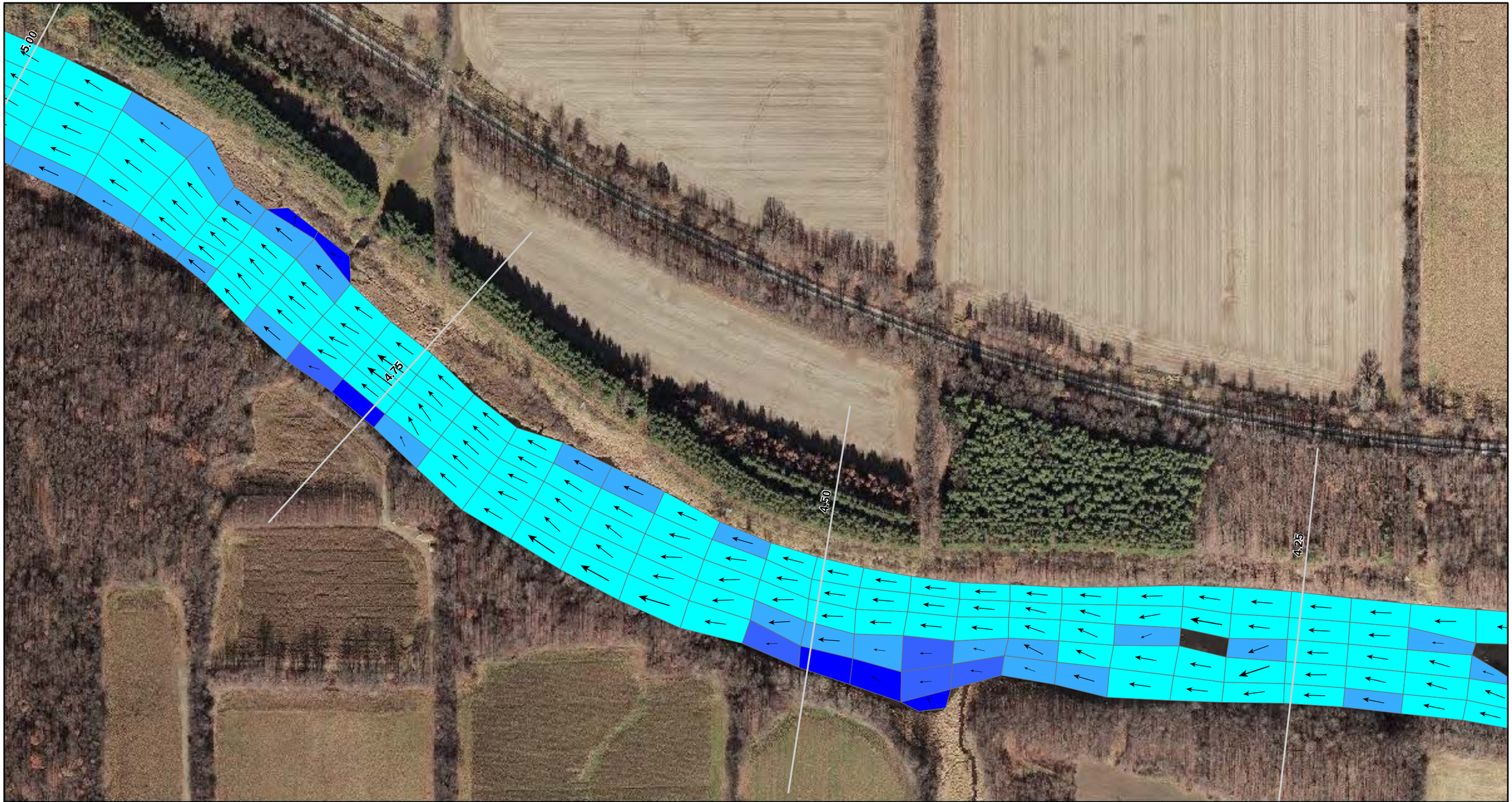
MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

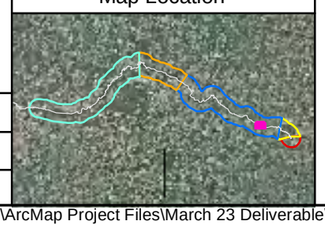
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011

5.75

5.50

5.25

5.00

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

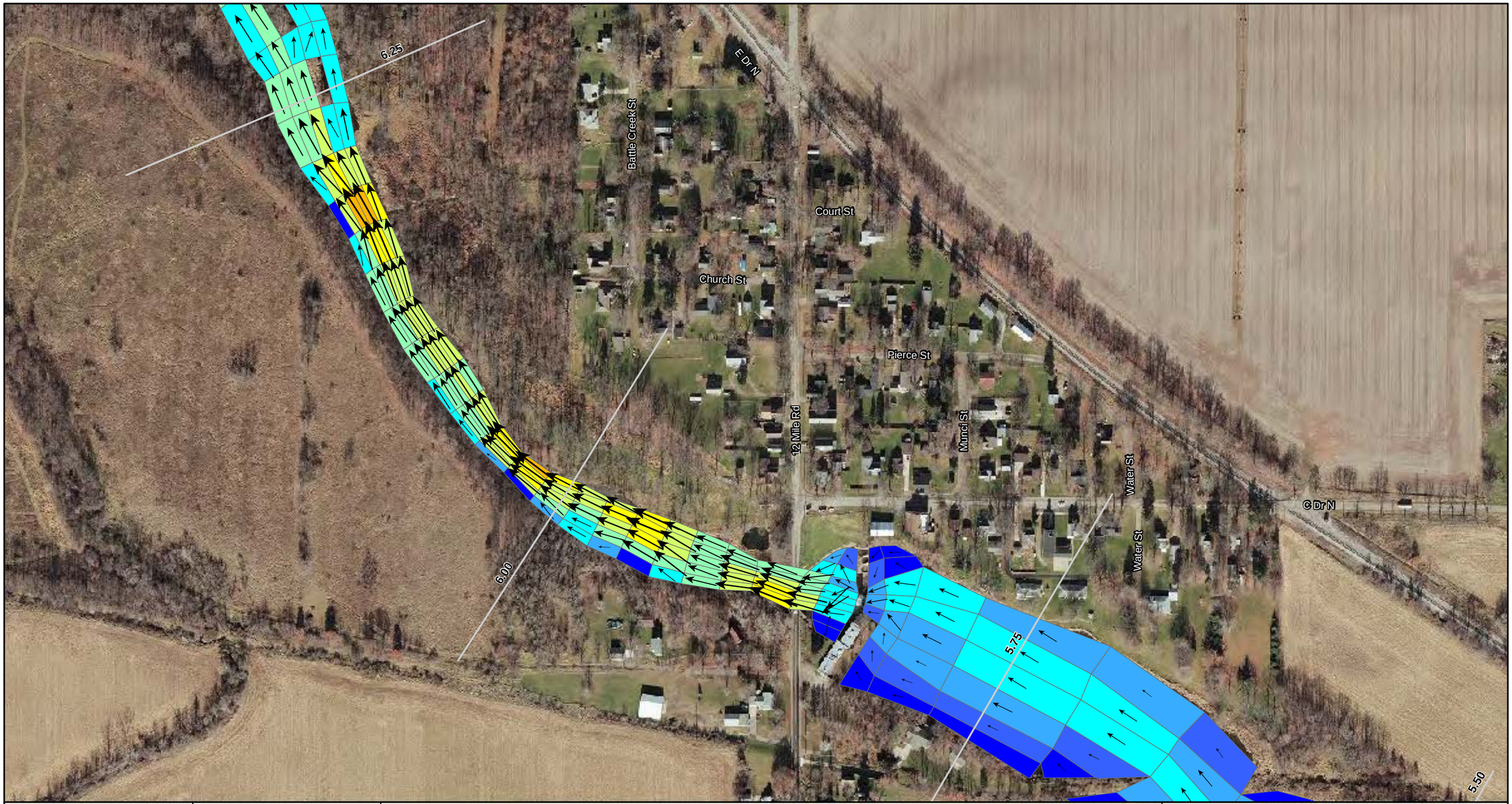
MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

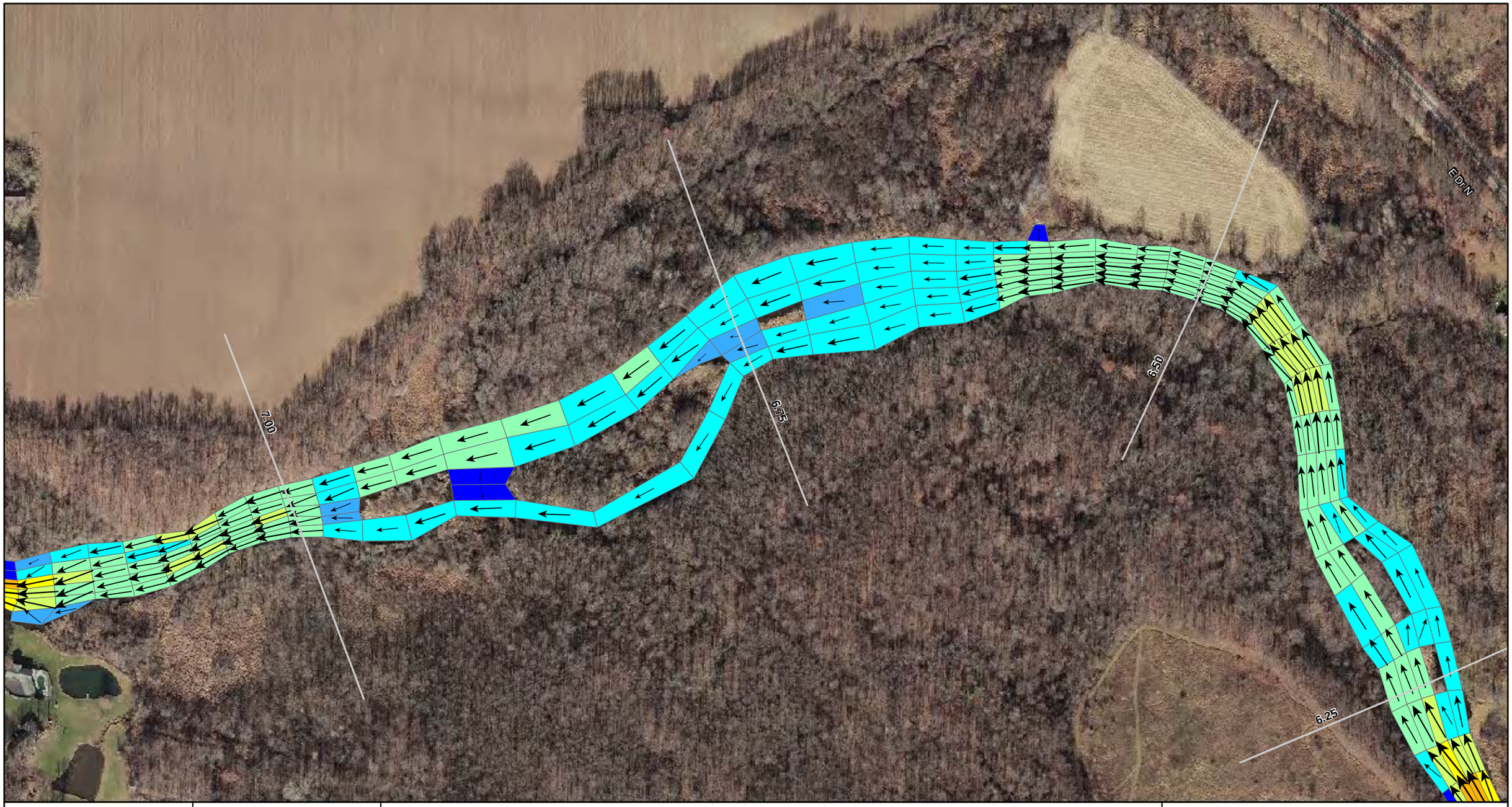
MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

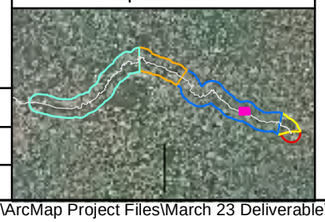
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

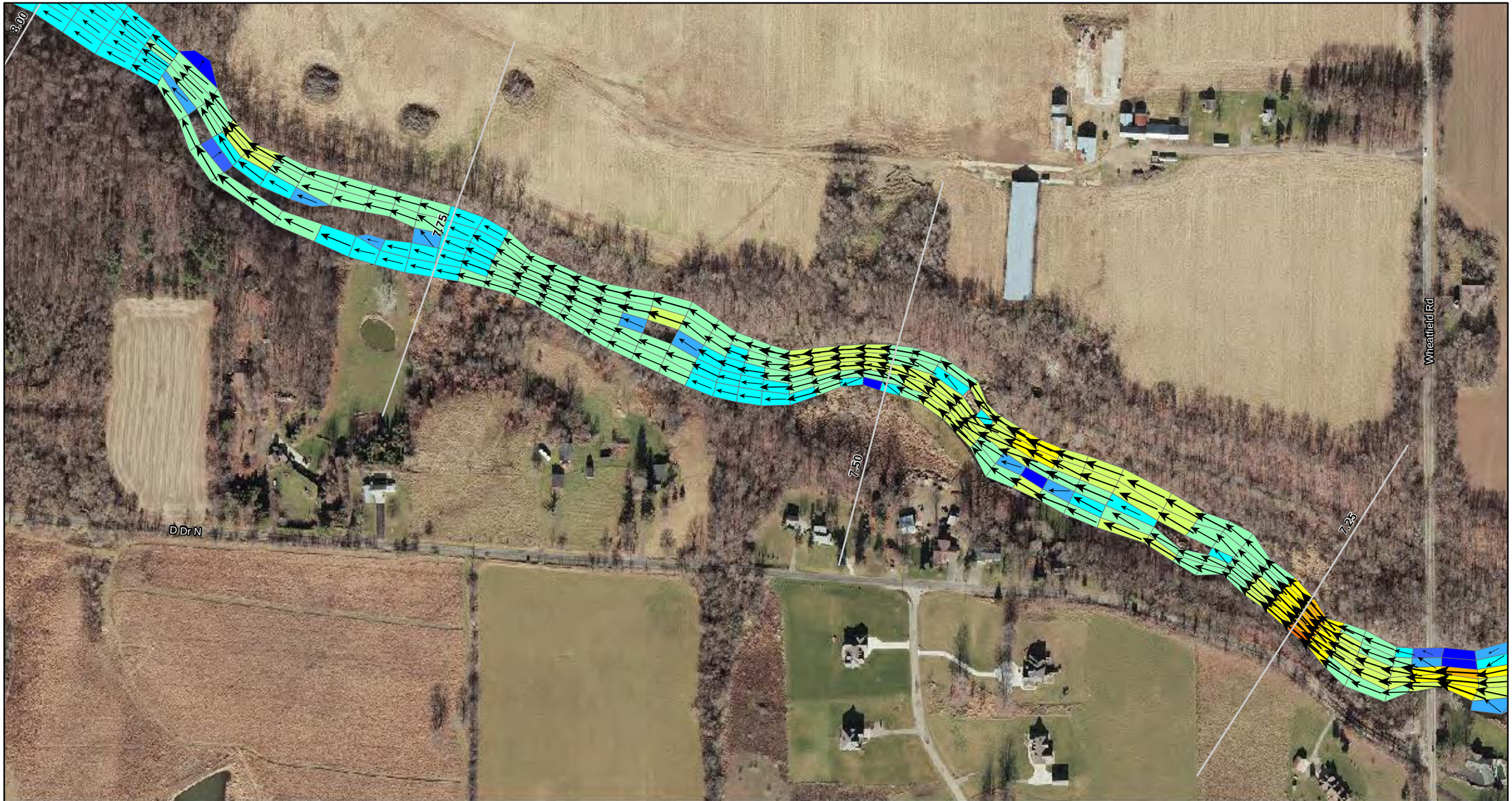
MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 07.15 - MP 07.95

SHEET 8 OF 56

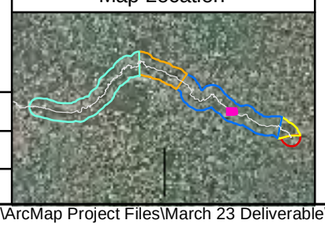
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

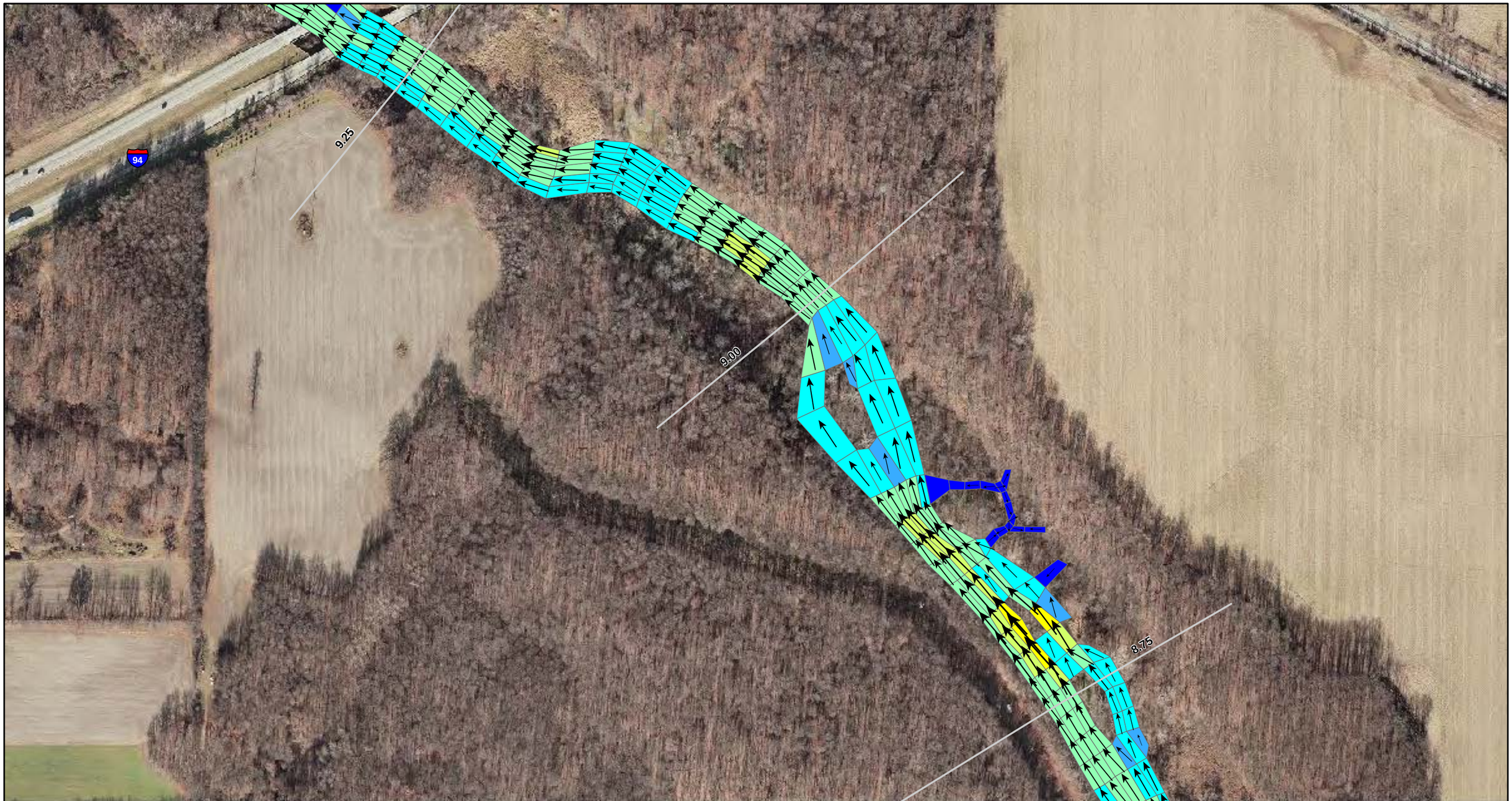
MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

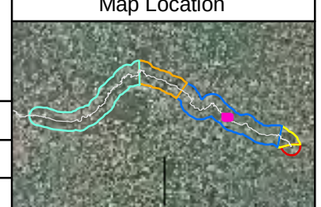
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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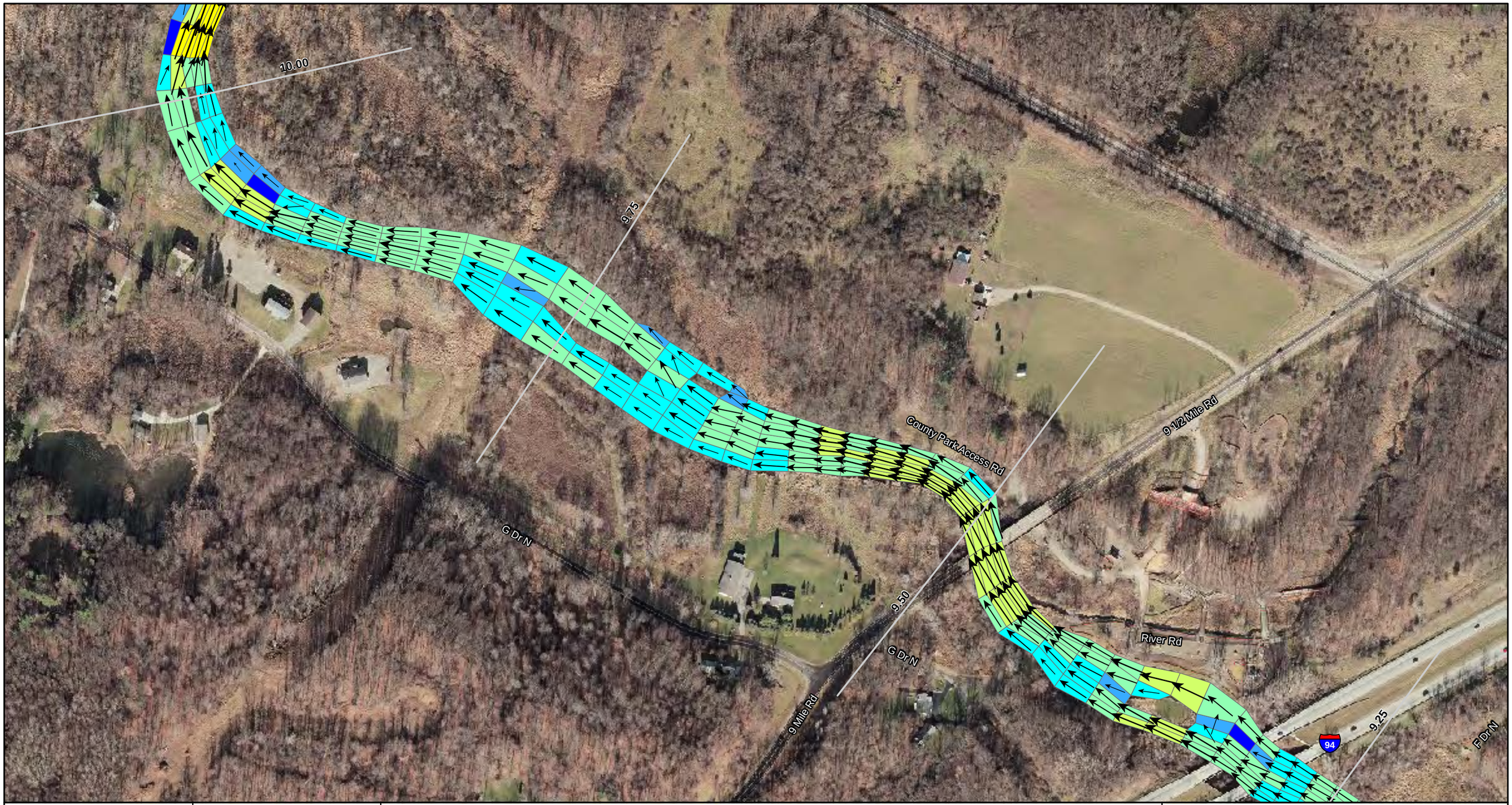
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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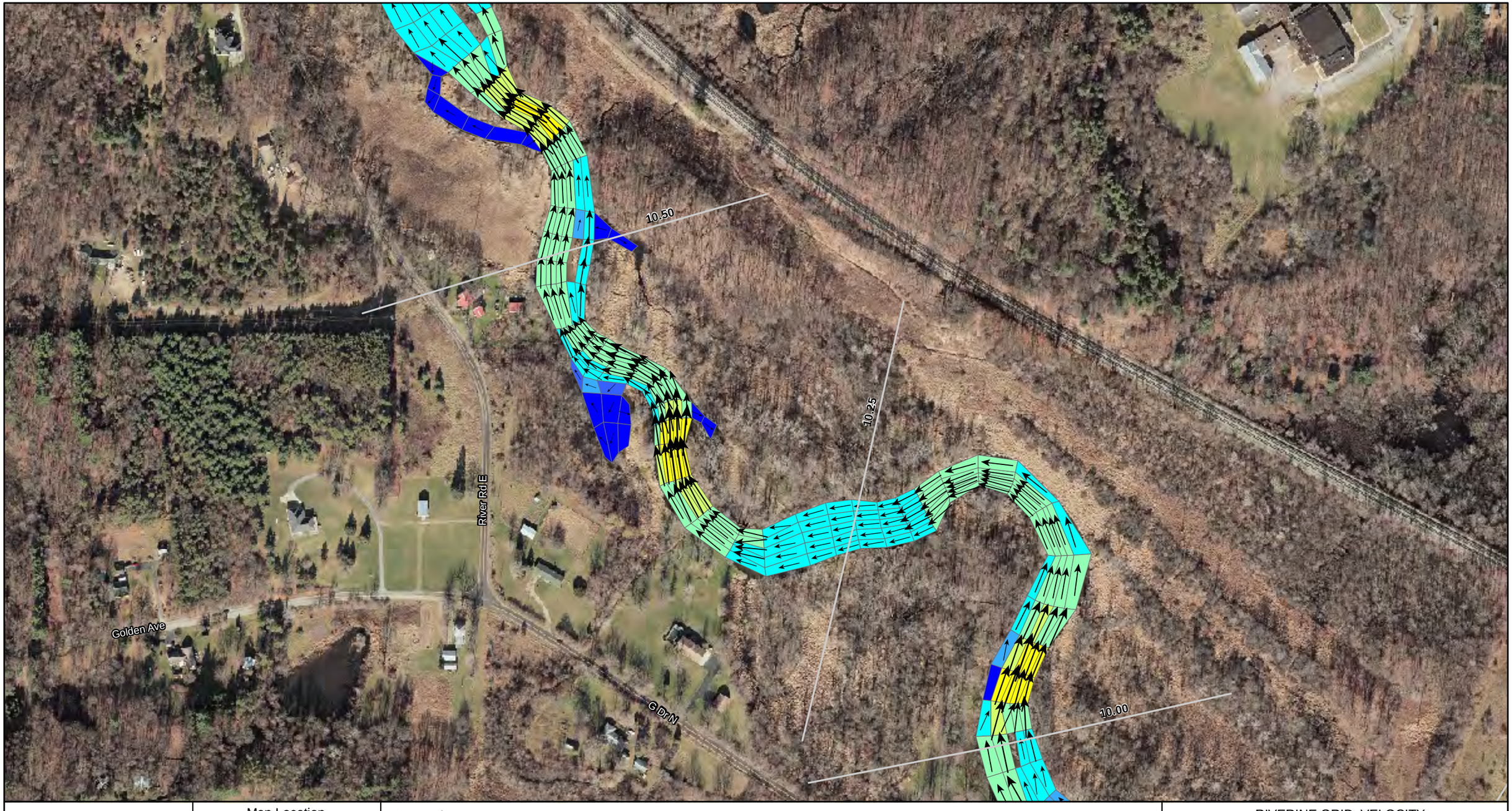
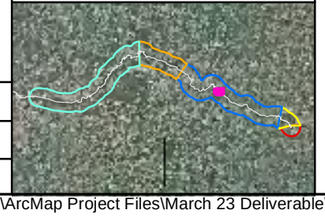
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

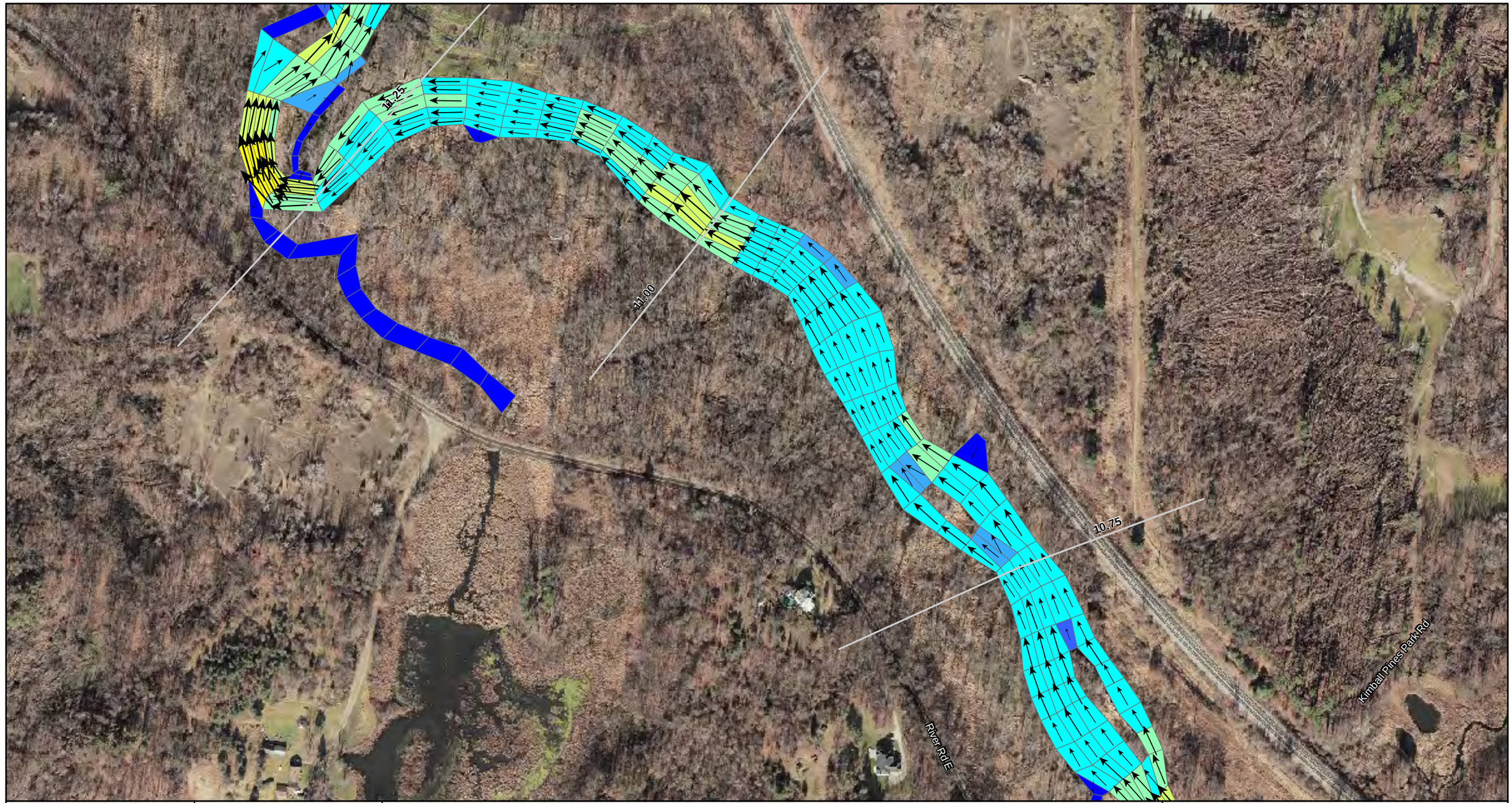
MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

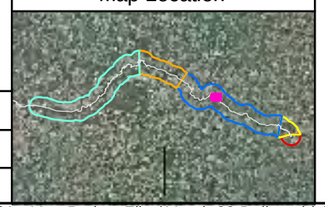
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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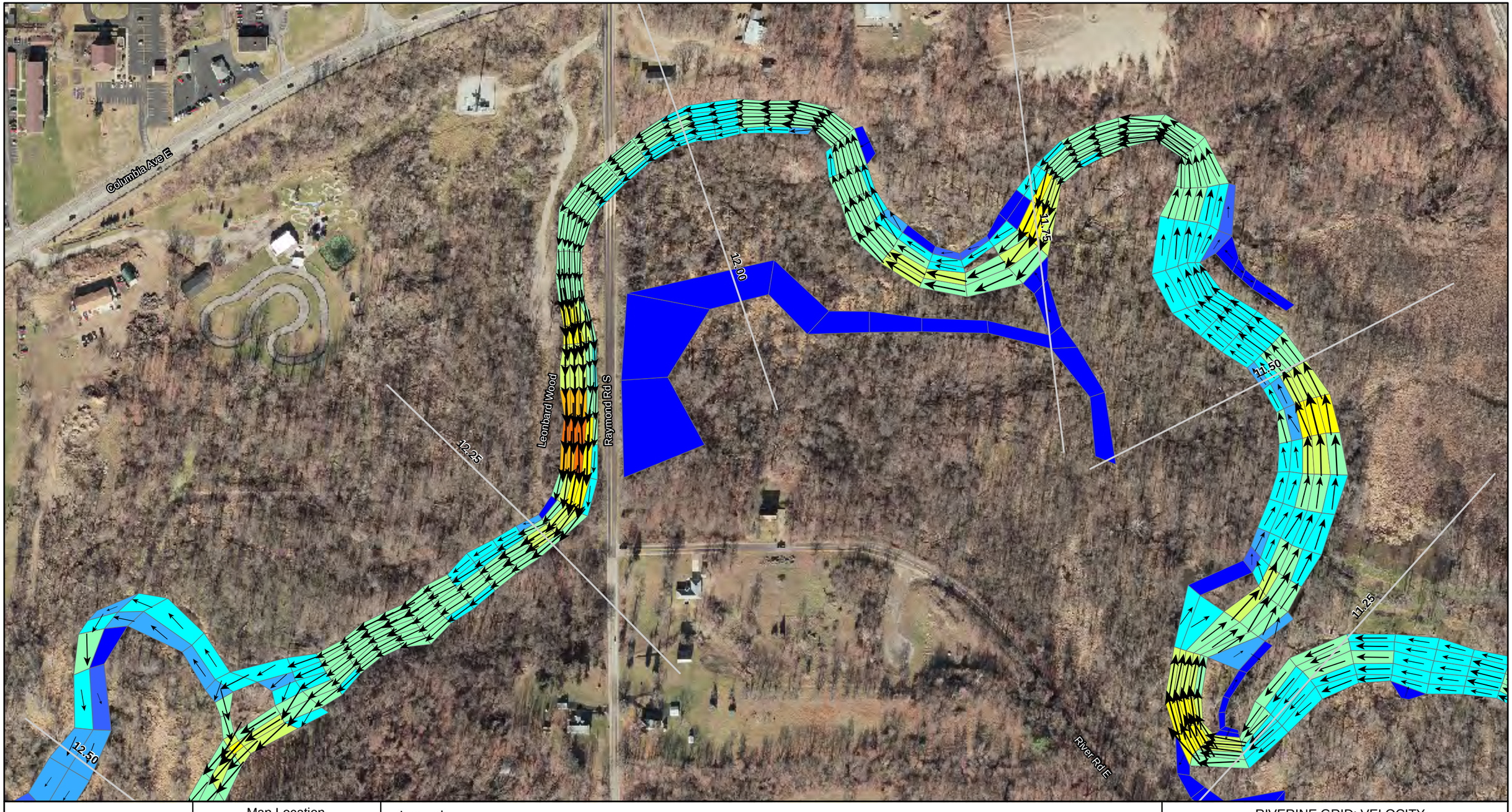
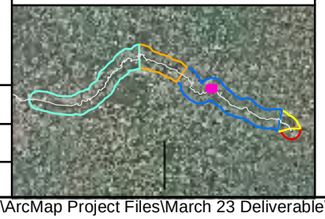
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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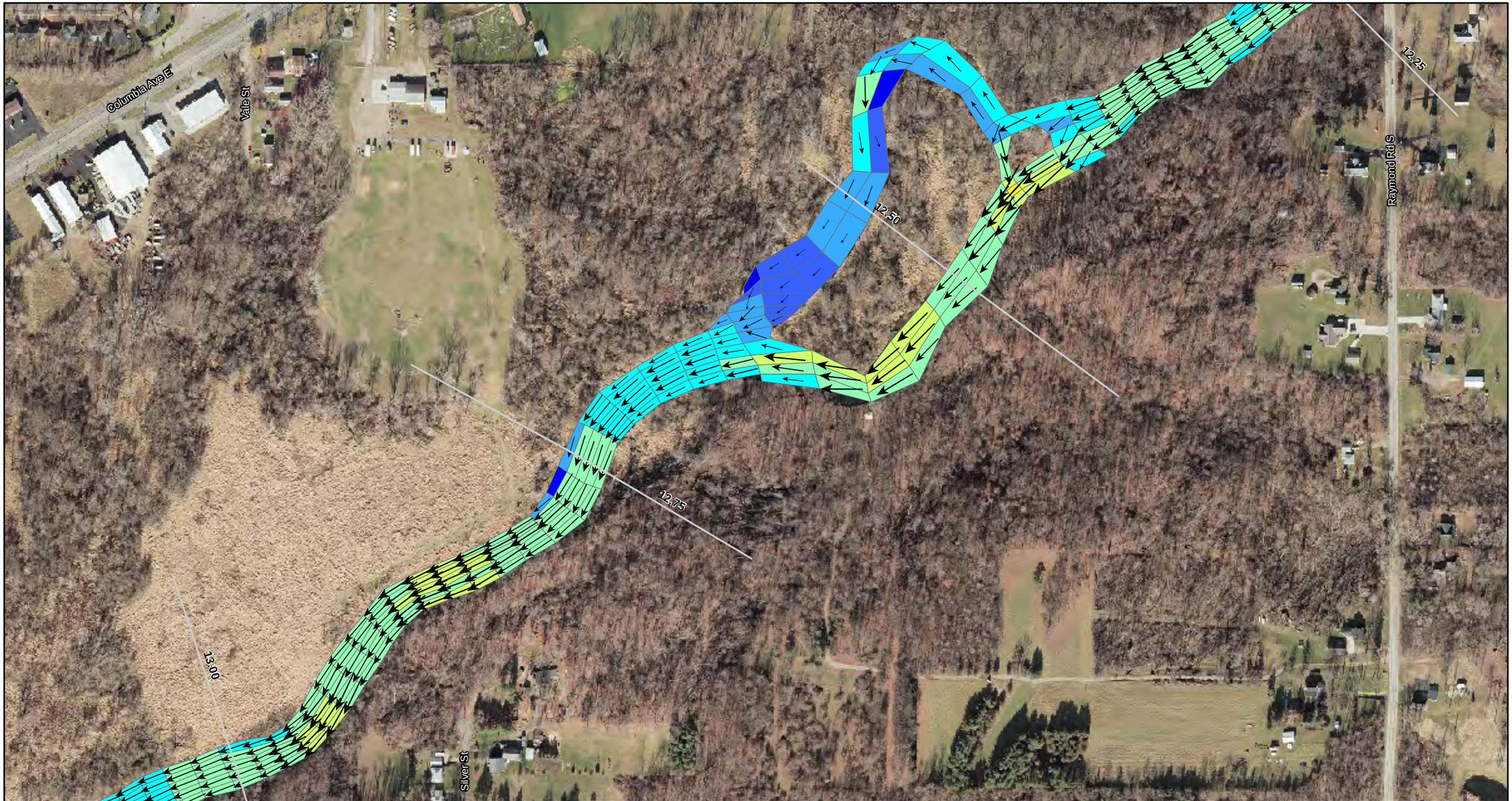
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

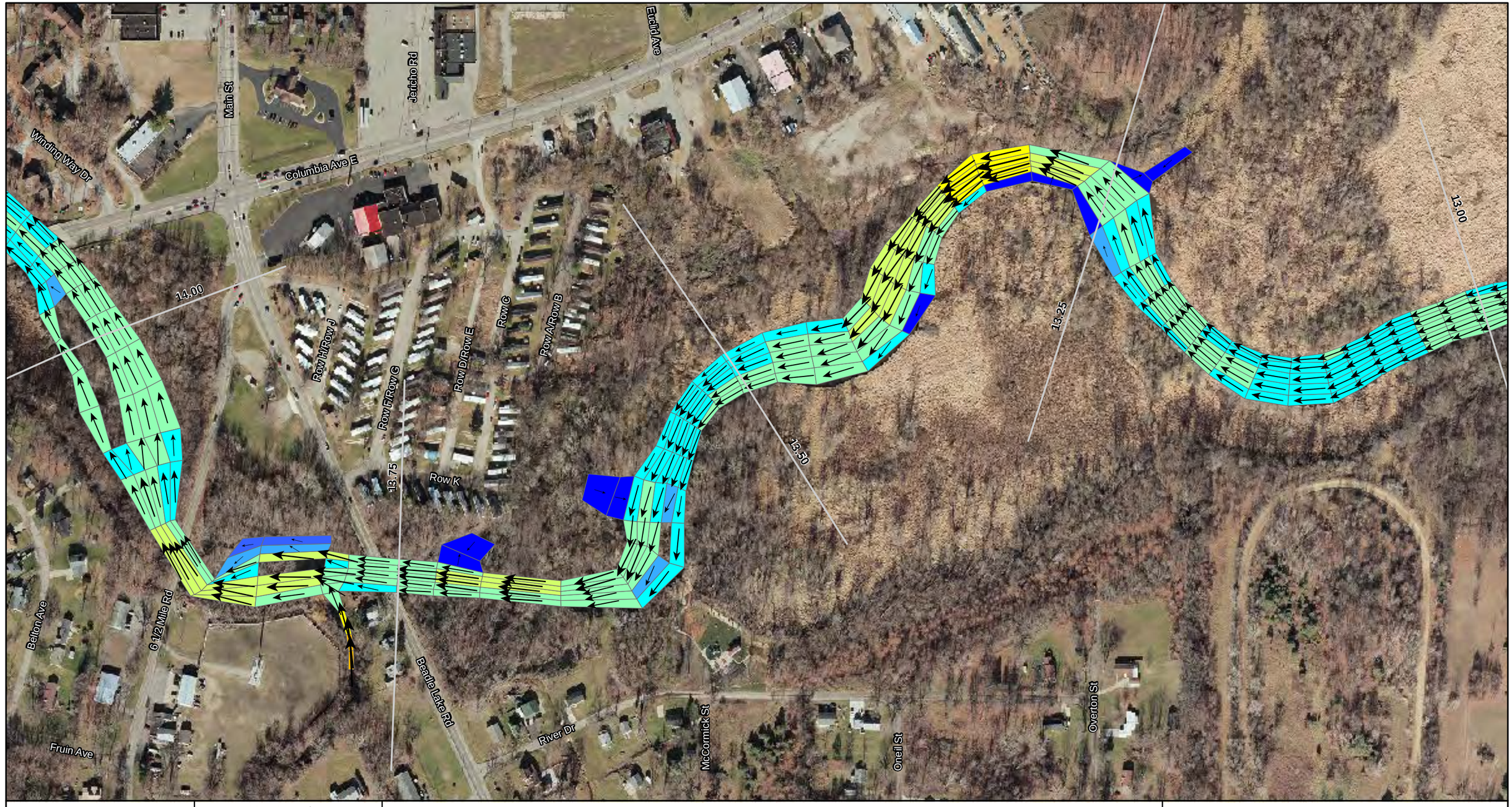
MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

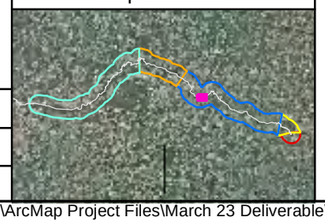
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

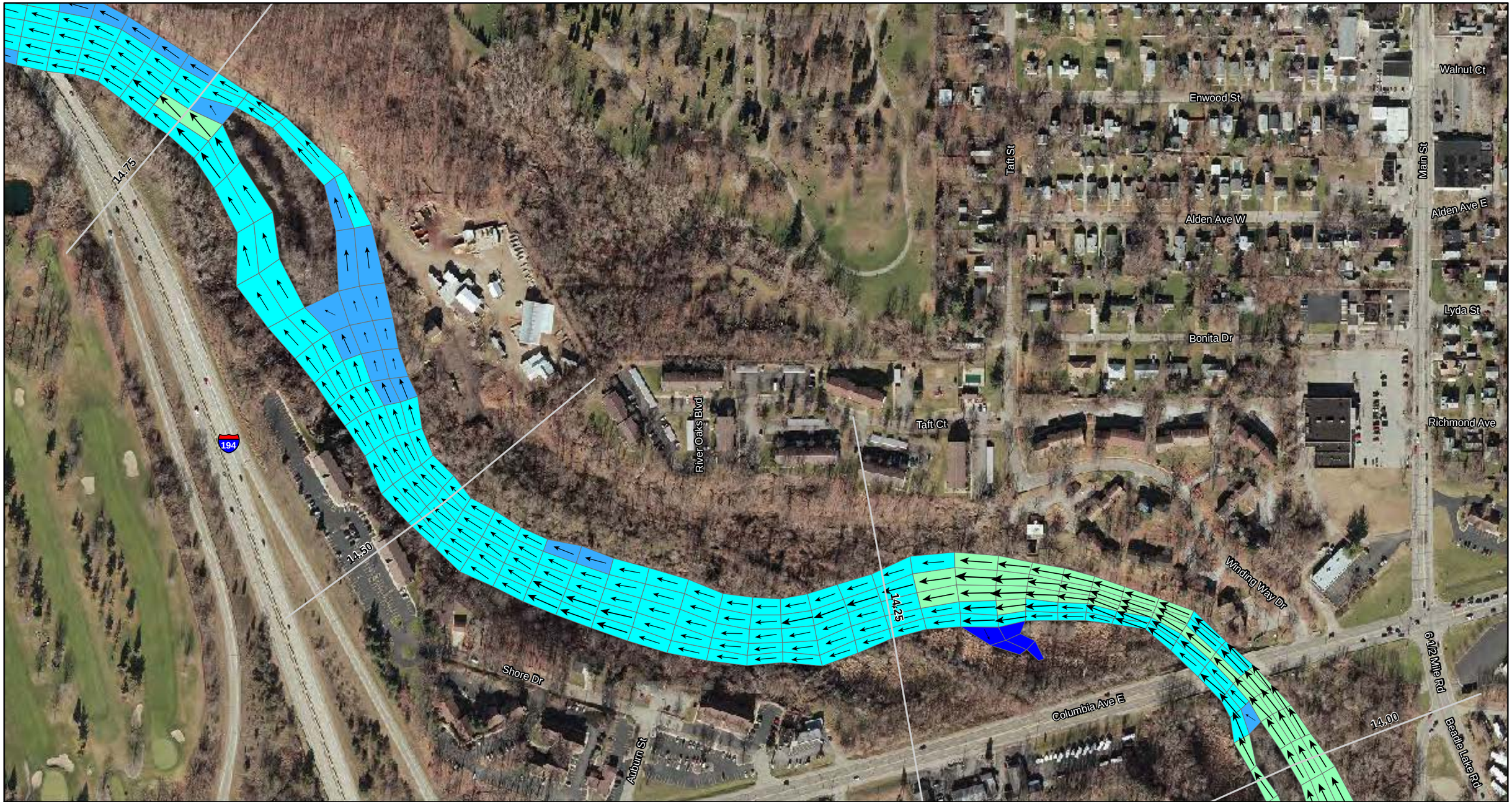
MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

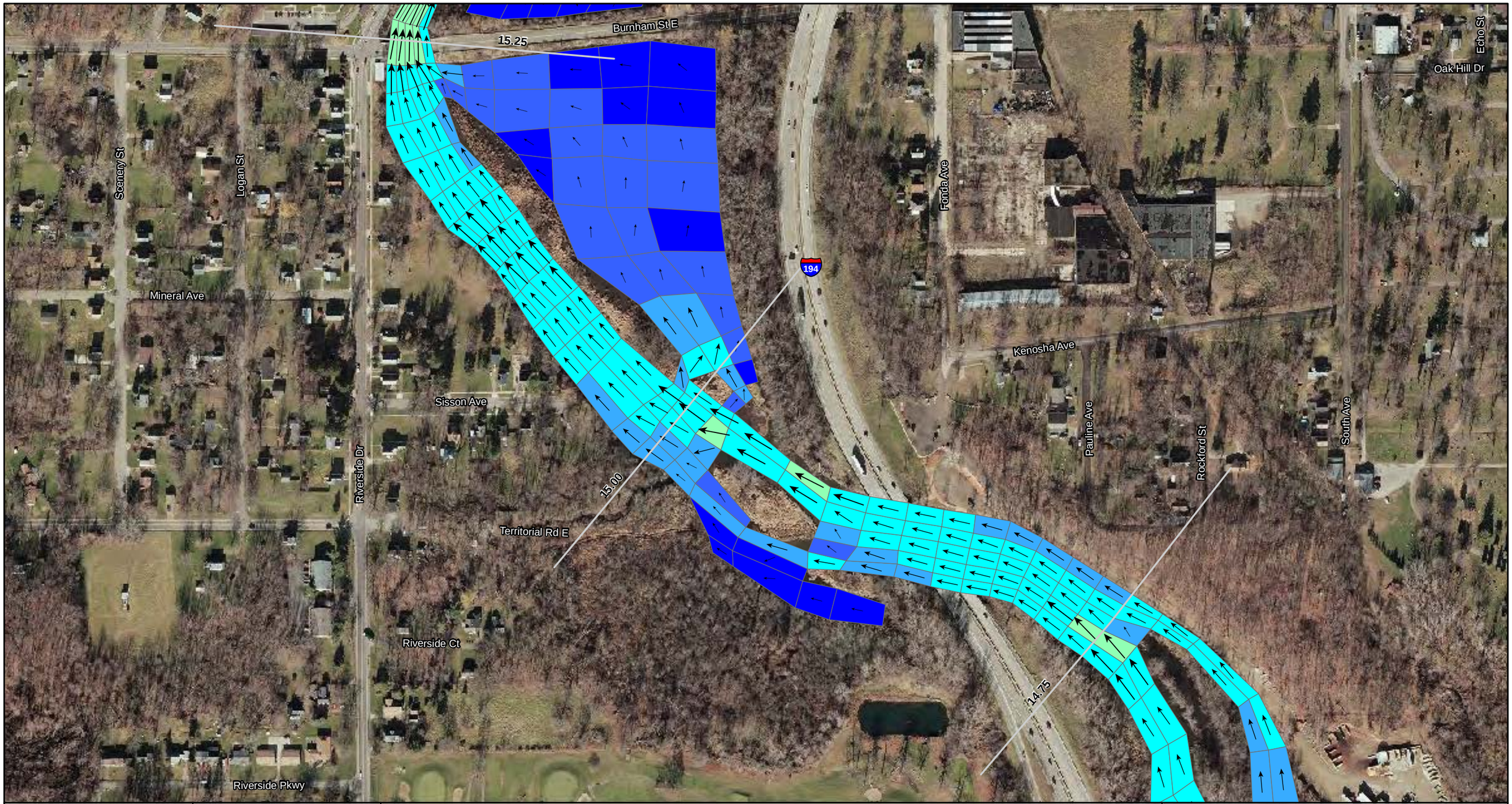
MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011



Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

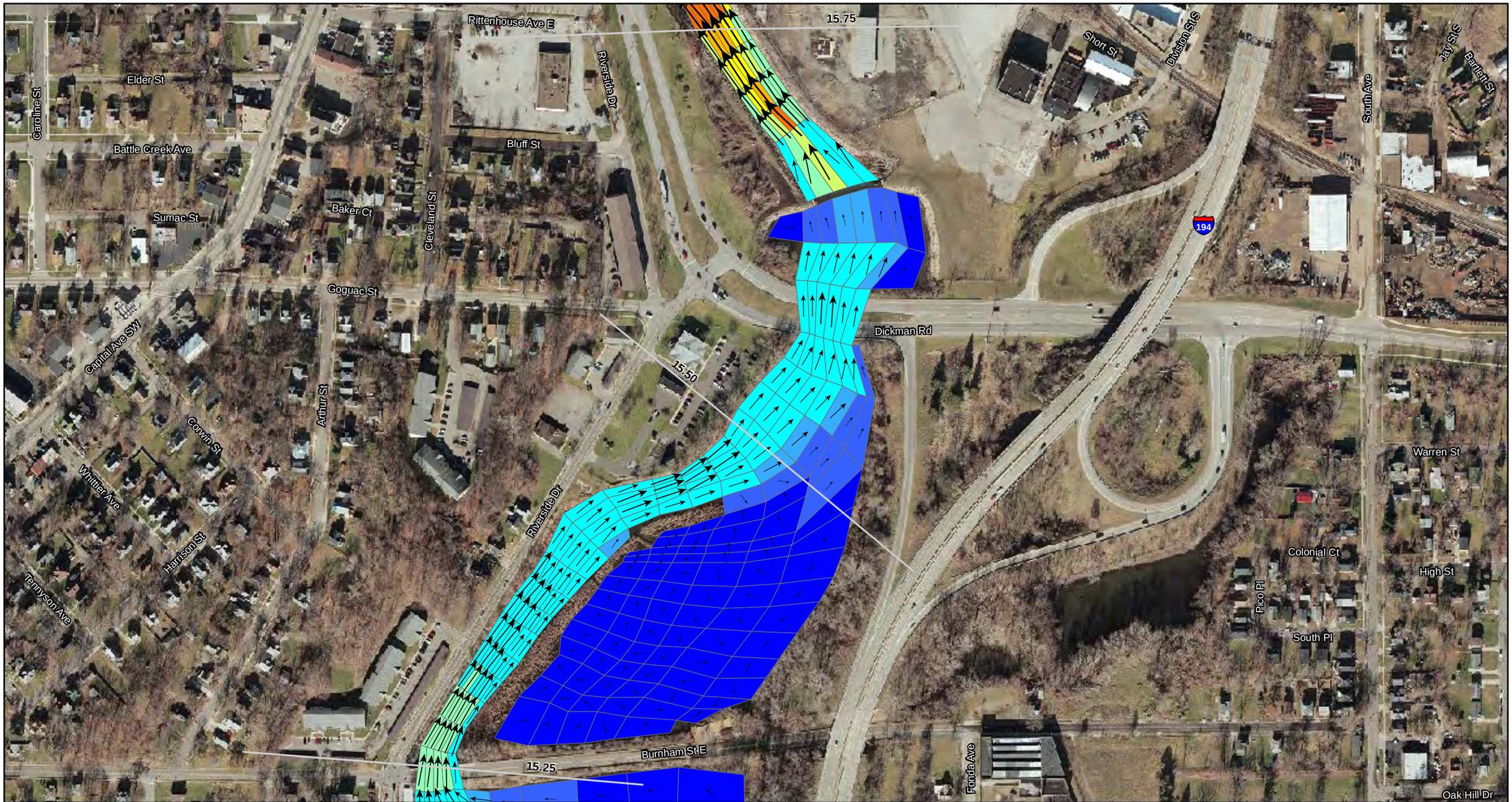
MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

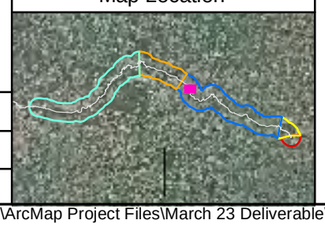
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

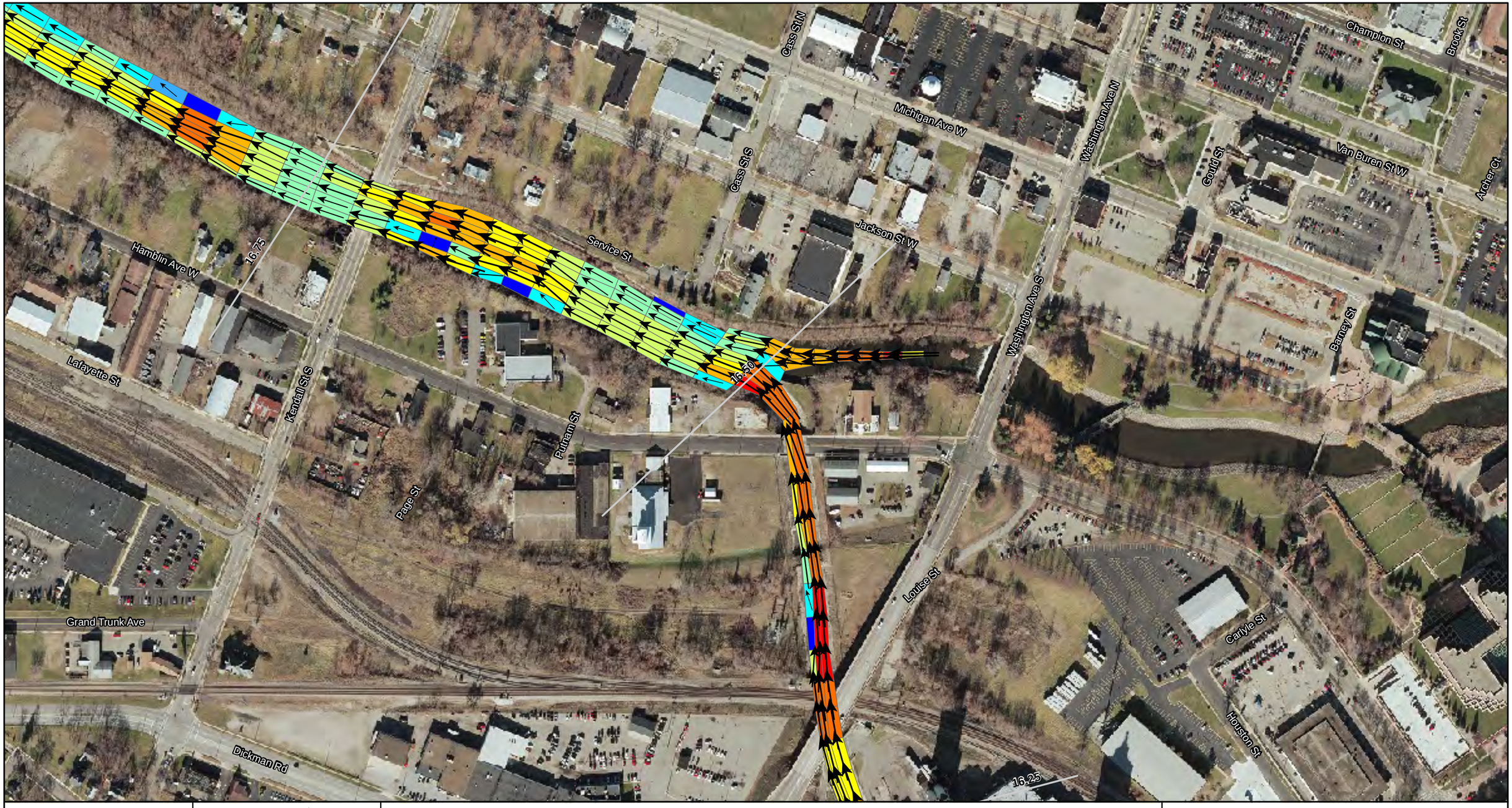
MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

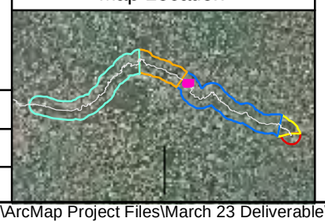
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

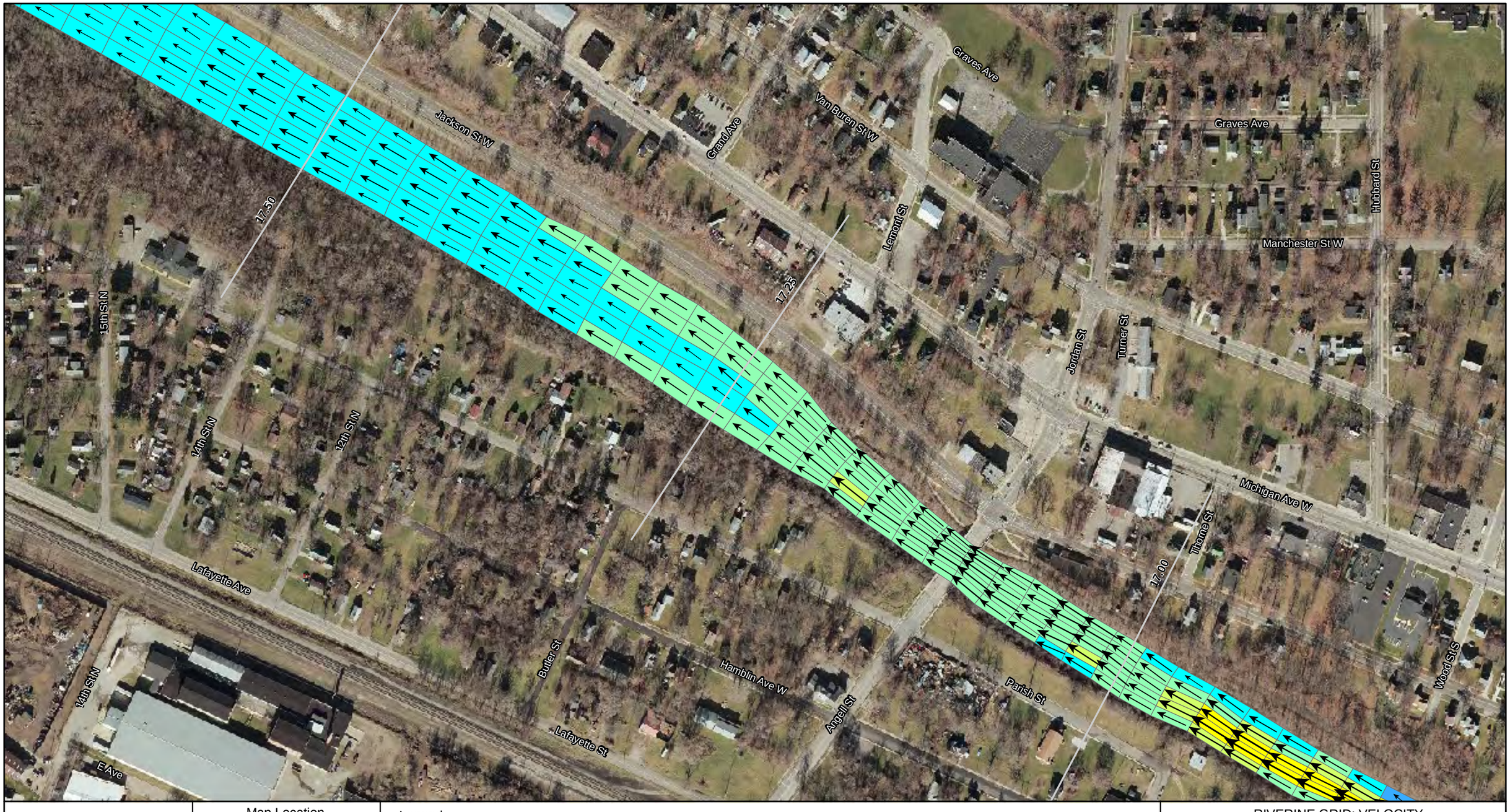
MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

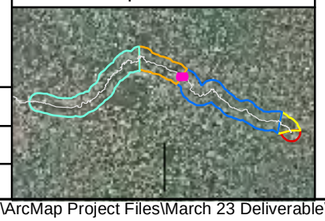
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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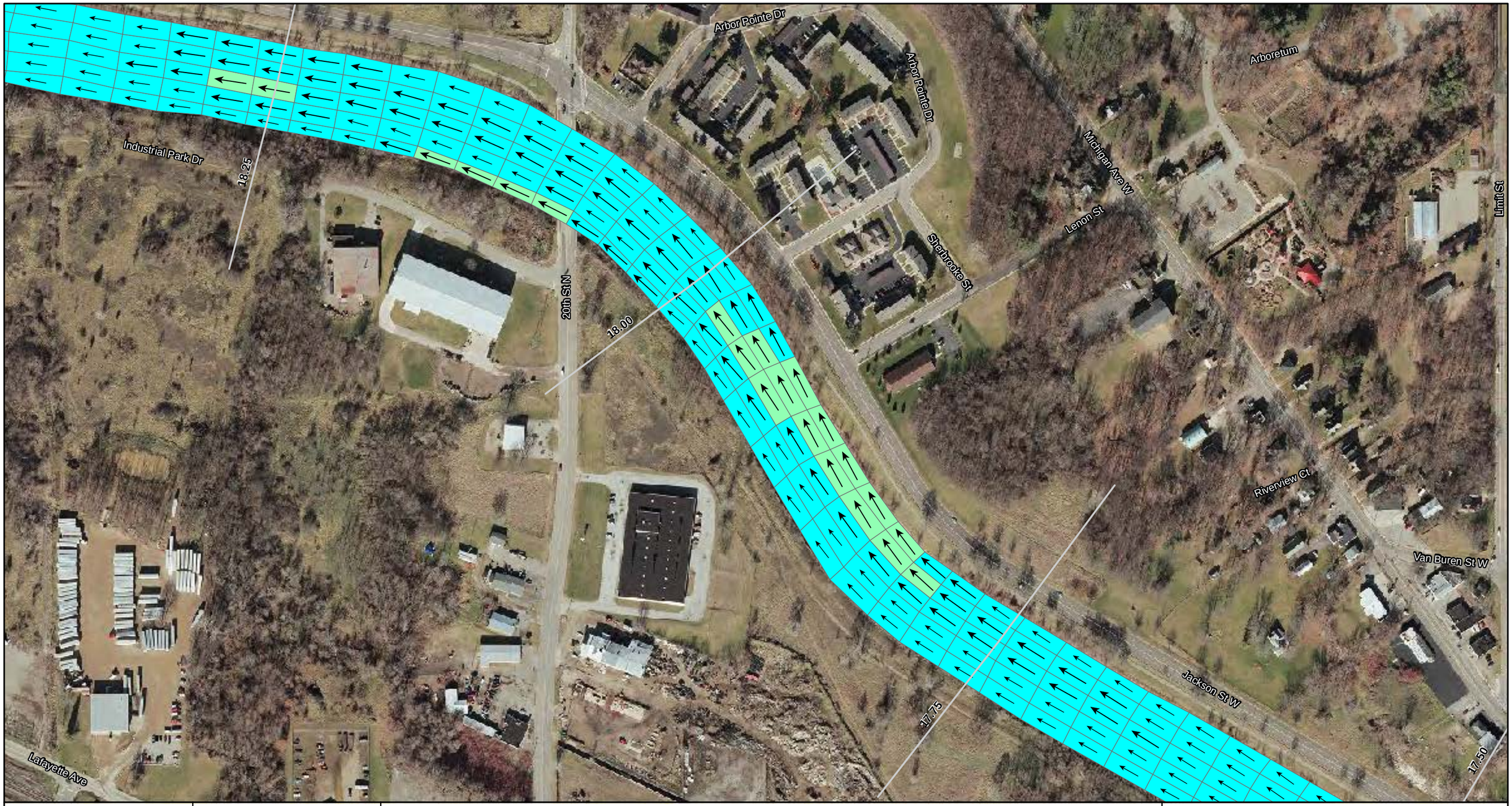
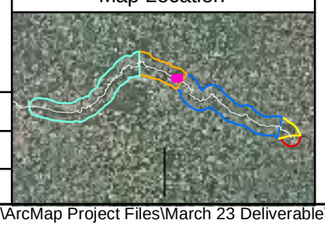
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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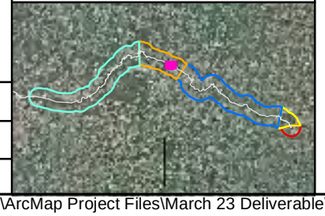
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

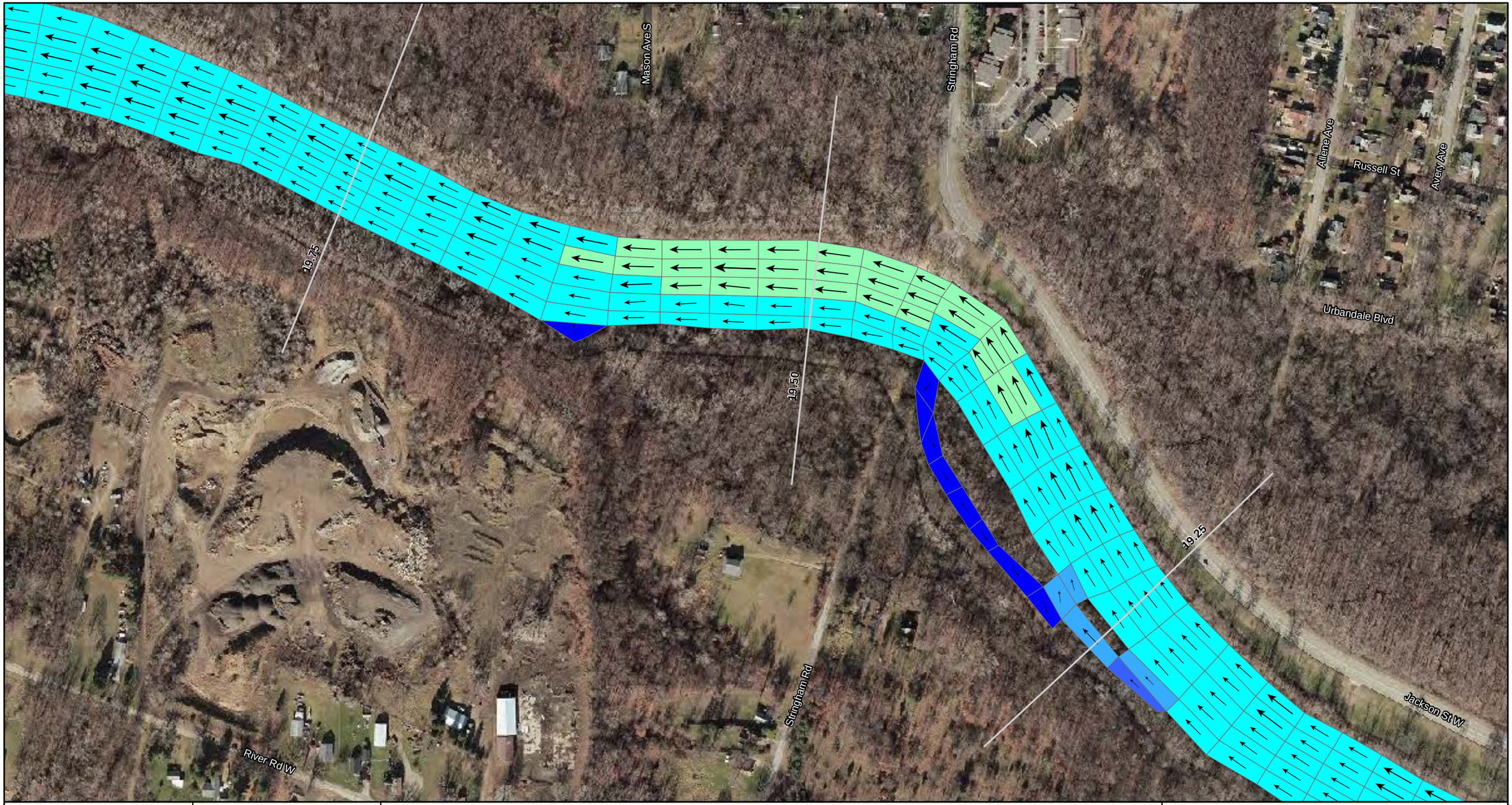
MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

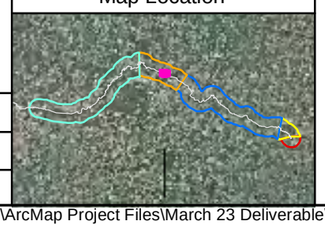
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

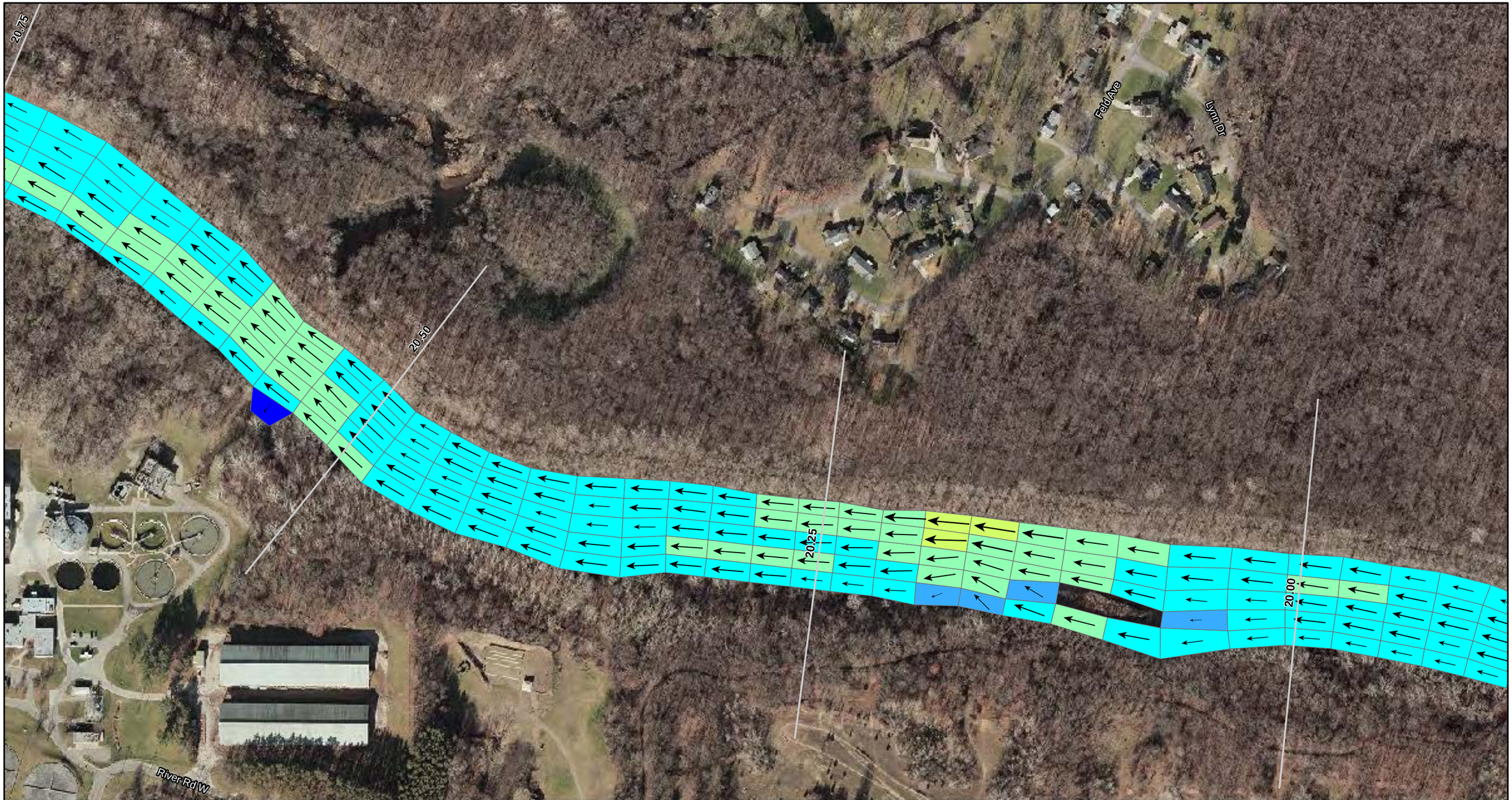
MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

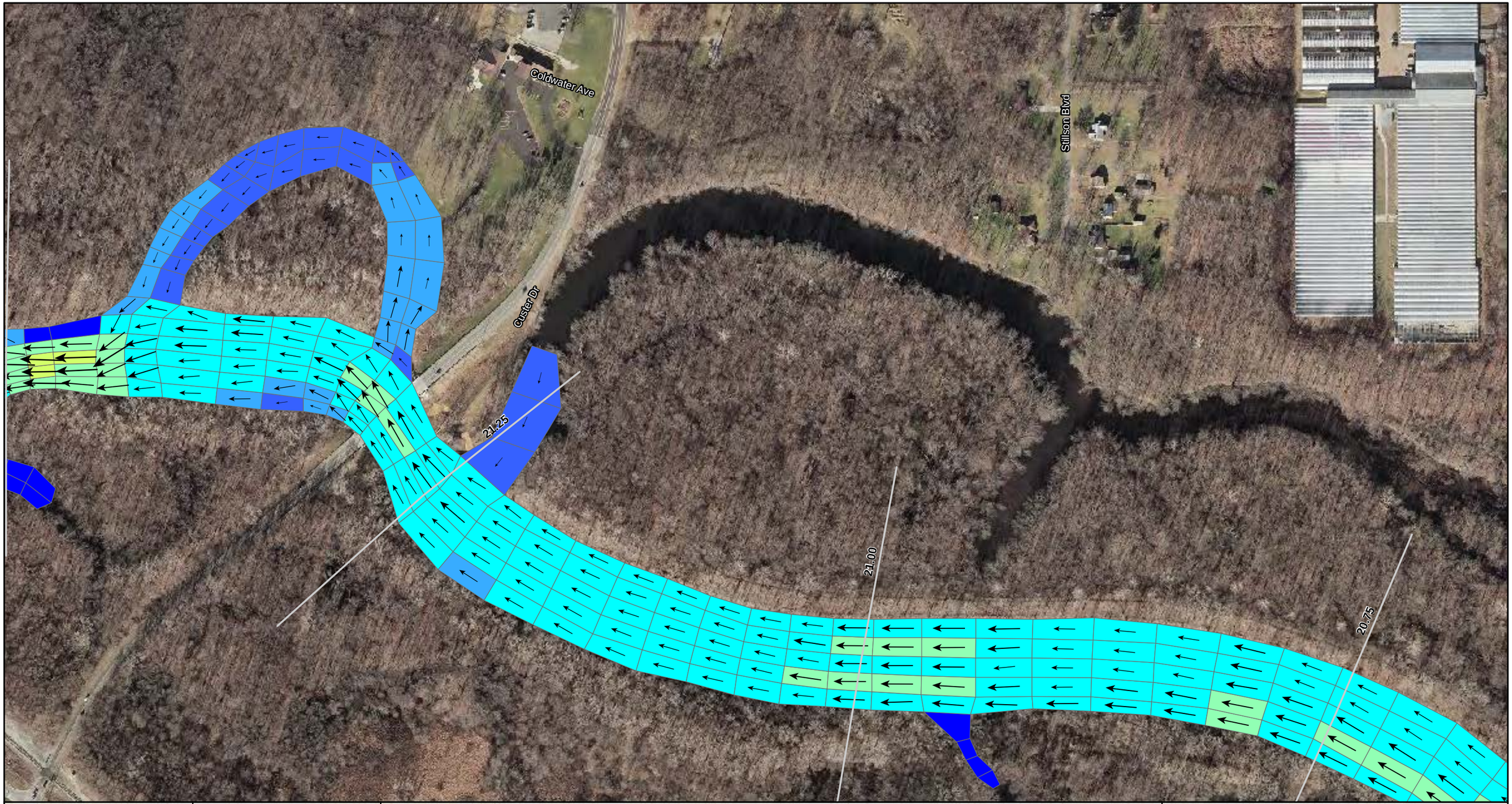
MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

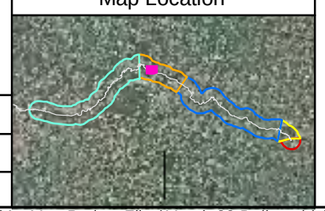
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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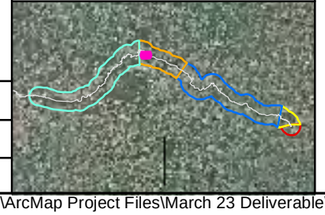
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

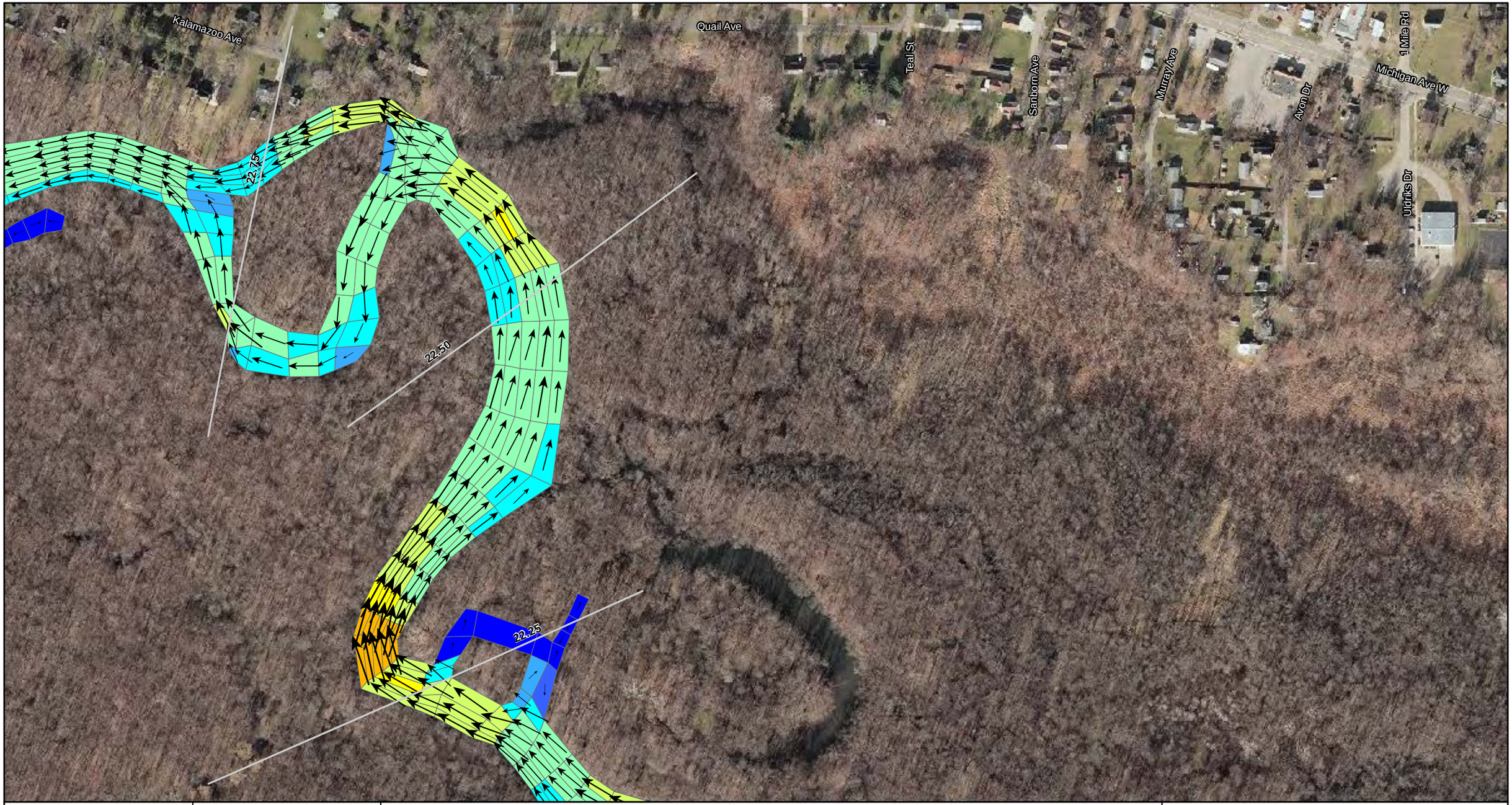
MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

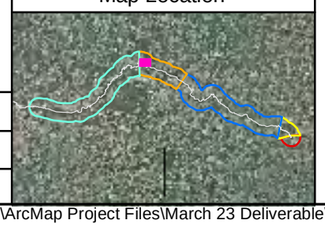
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

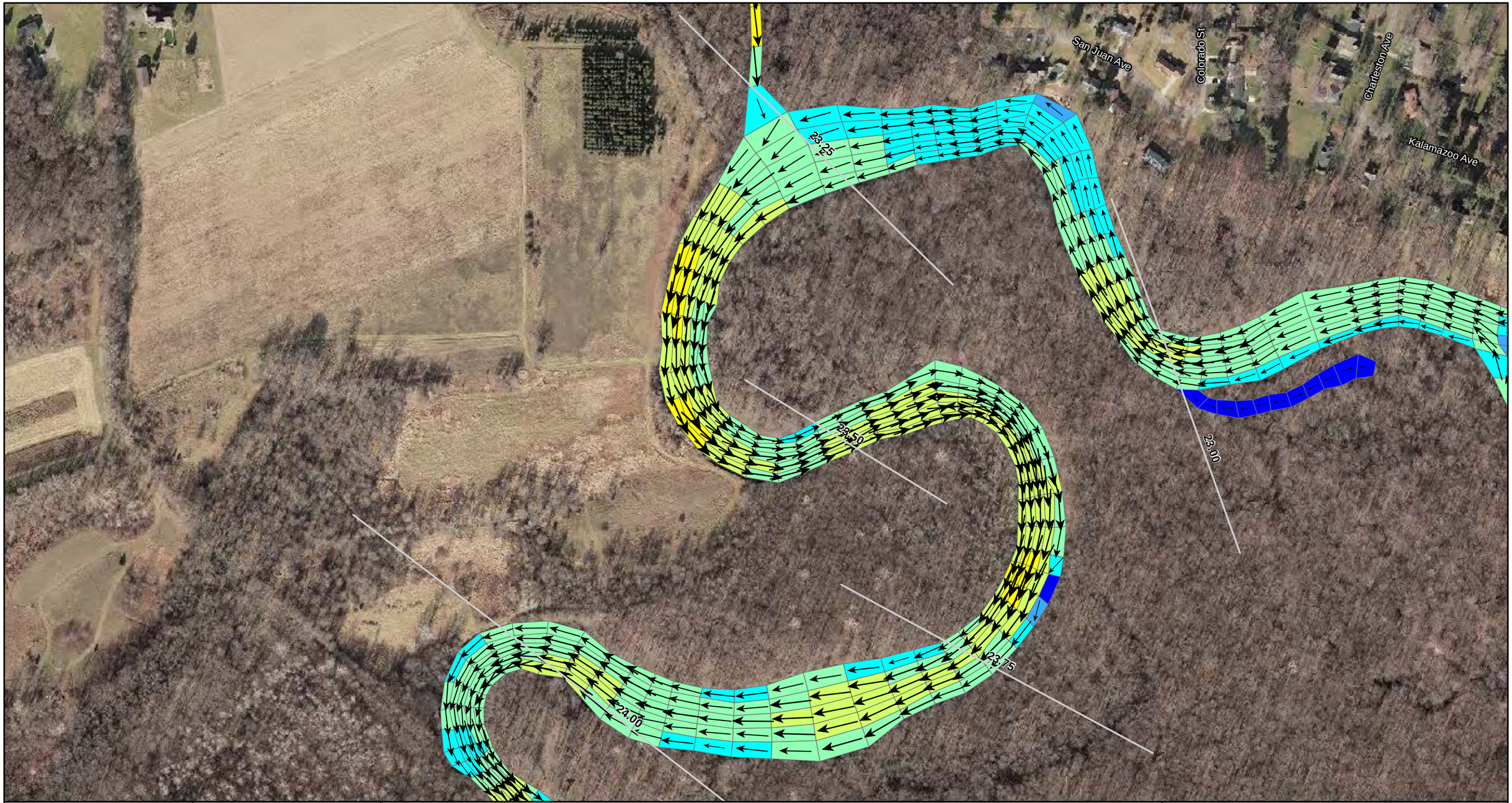
MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

24.00
24.25
24.50
24.75
River Rd W
Fort Custer Dr
County Line Rd

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

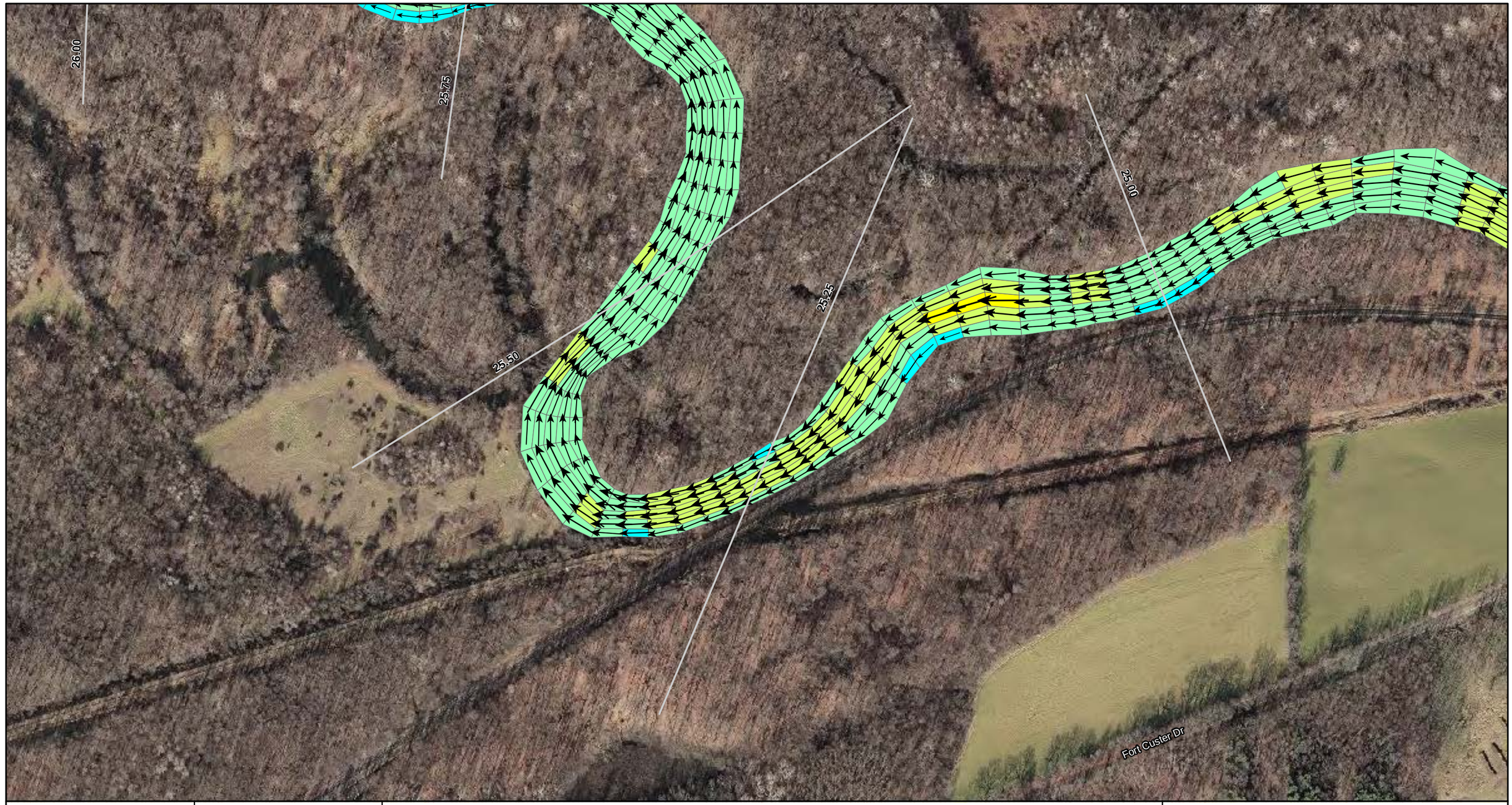
MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

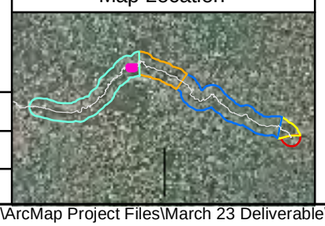
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

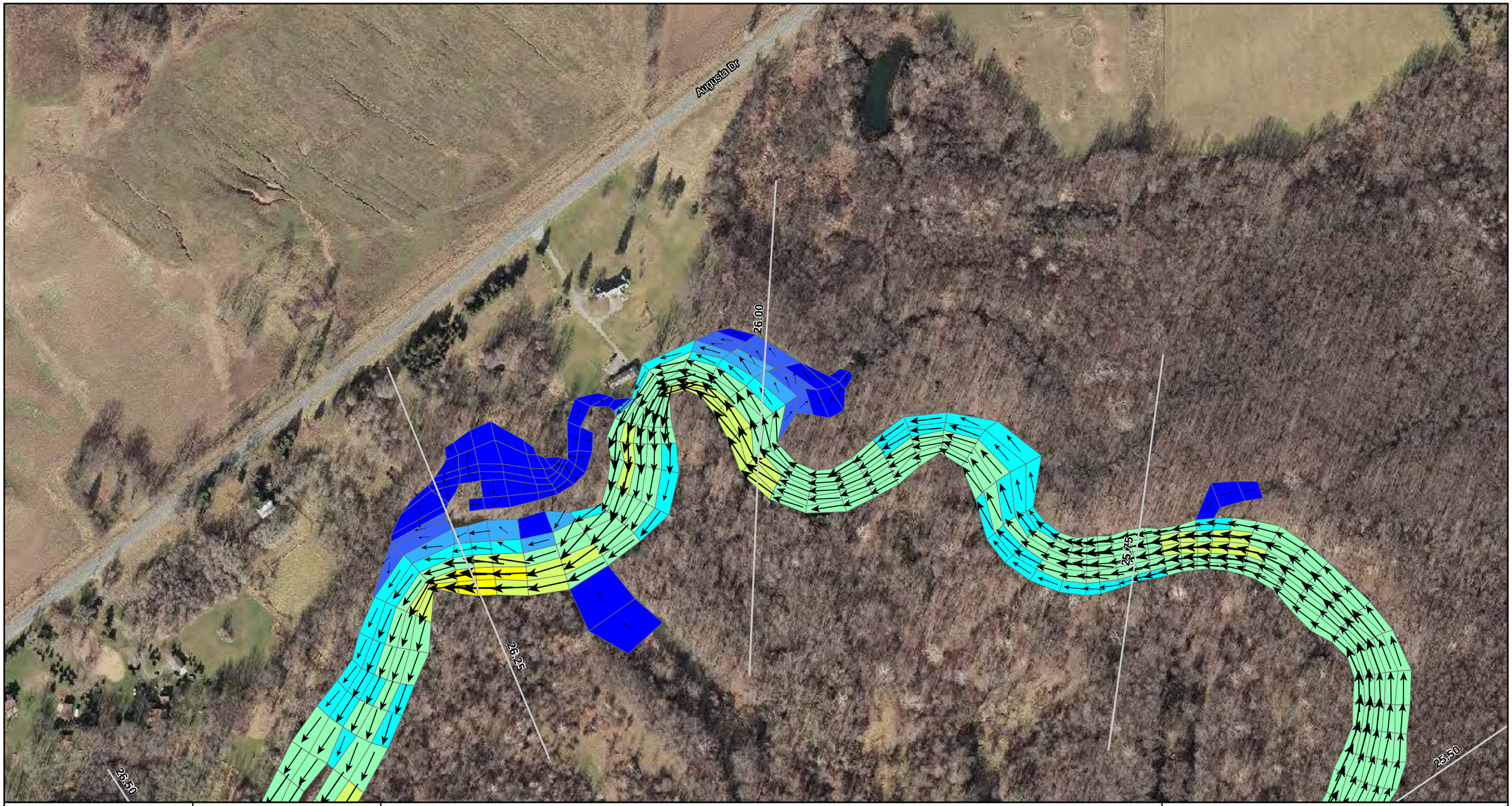
MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

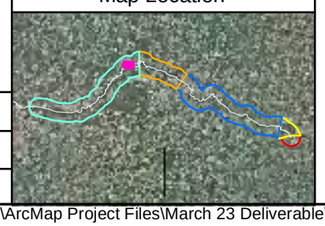
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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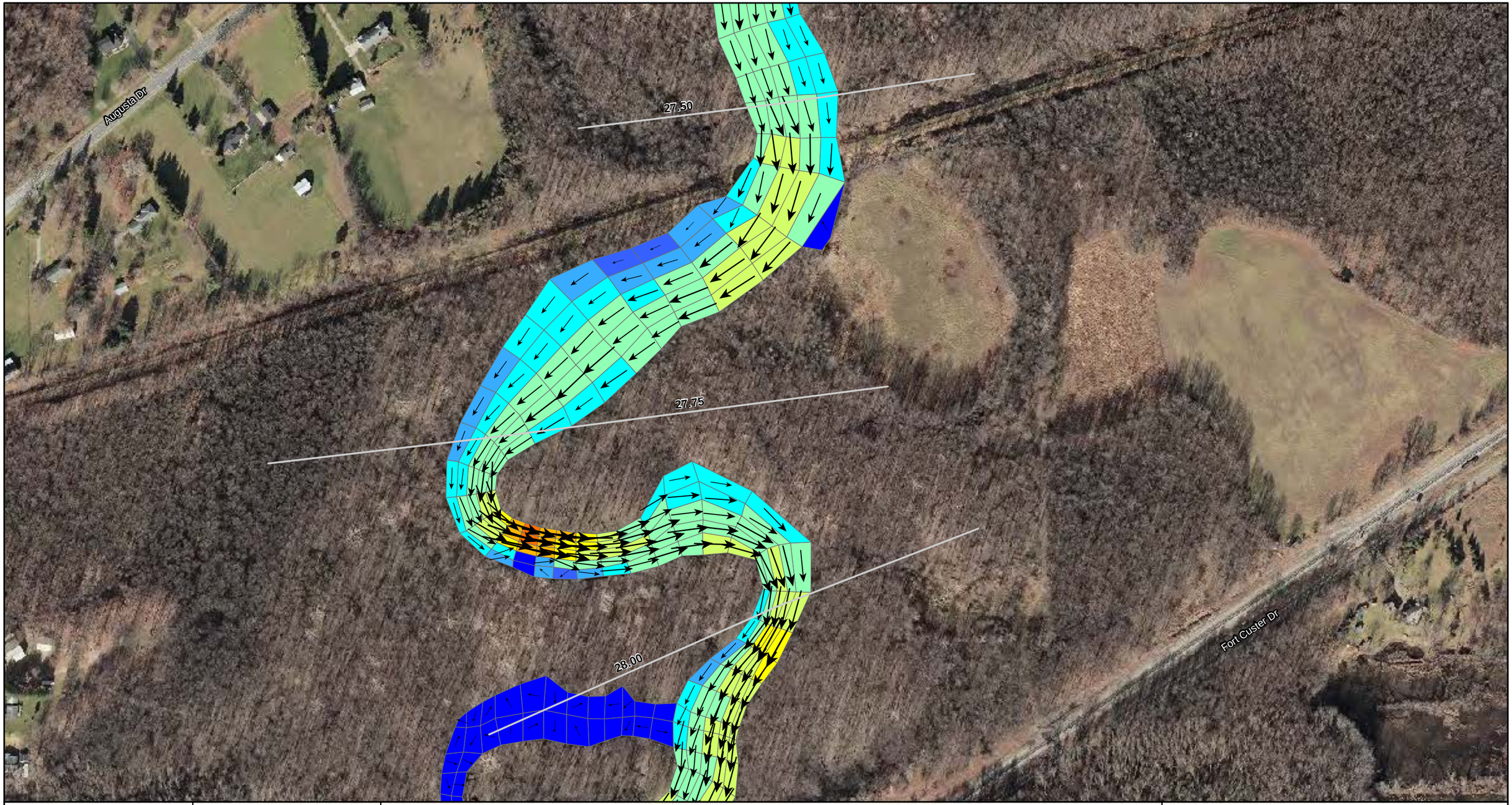
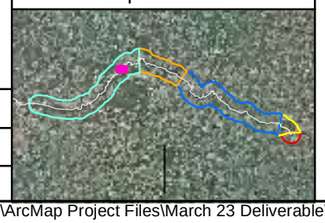
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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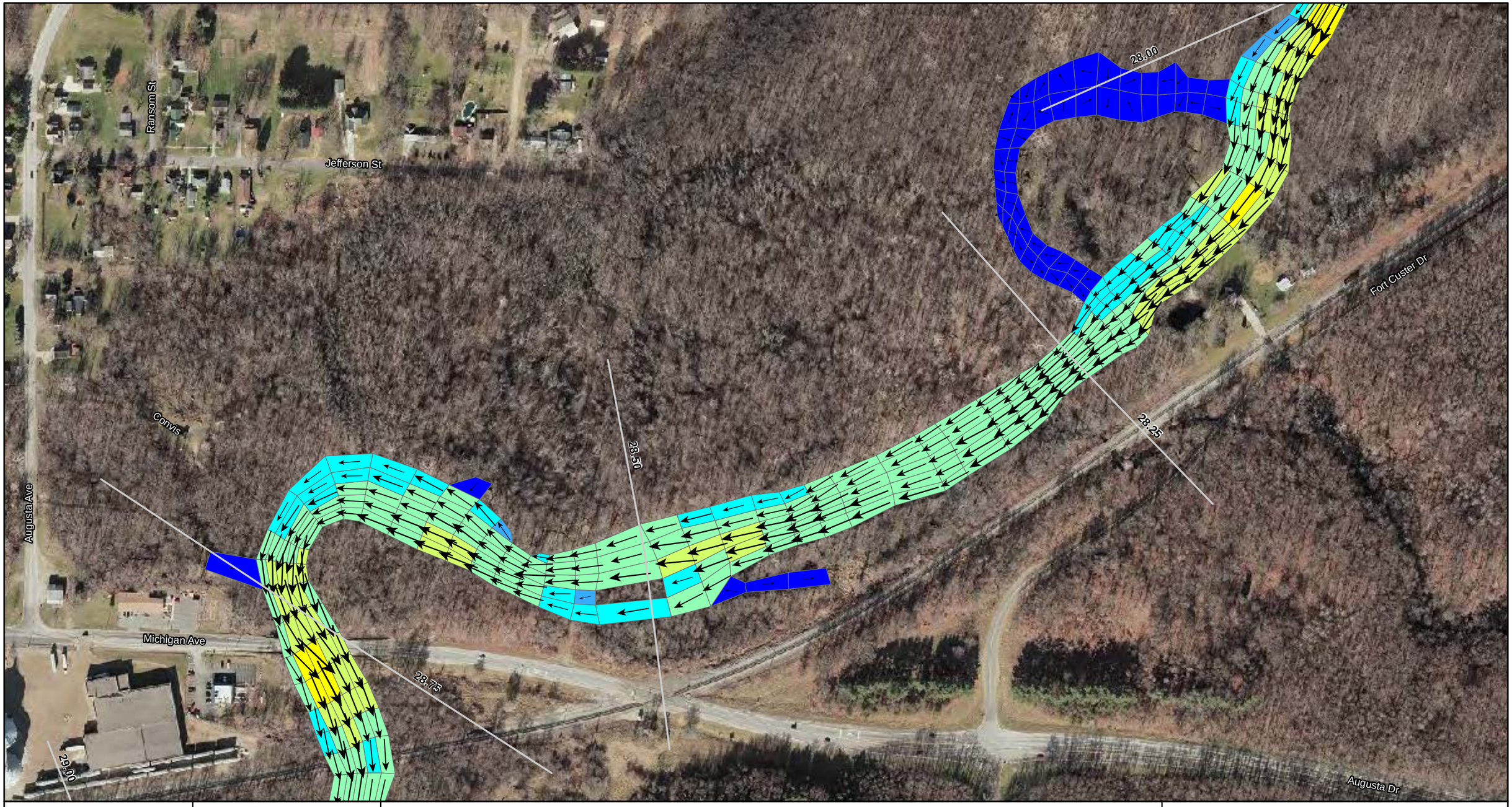
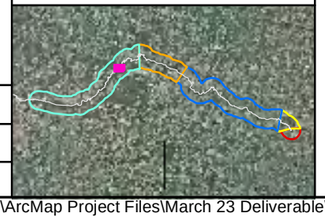
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Clinton St
Clinton St
Chestnut St
Webster St
Church St
Fayette St
Cass St
Cherry St
Lincoln St
28.75
29.00
29.25
29.50
Augusta Climax Rd
Fort Custer Rec Area Access

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

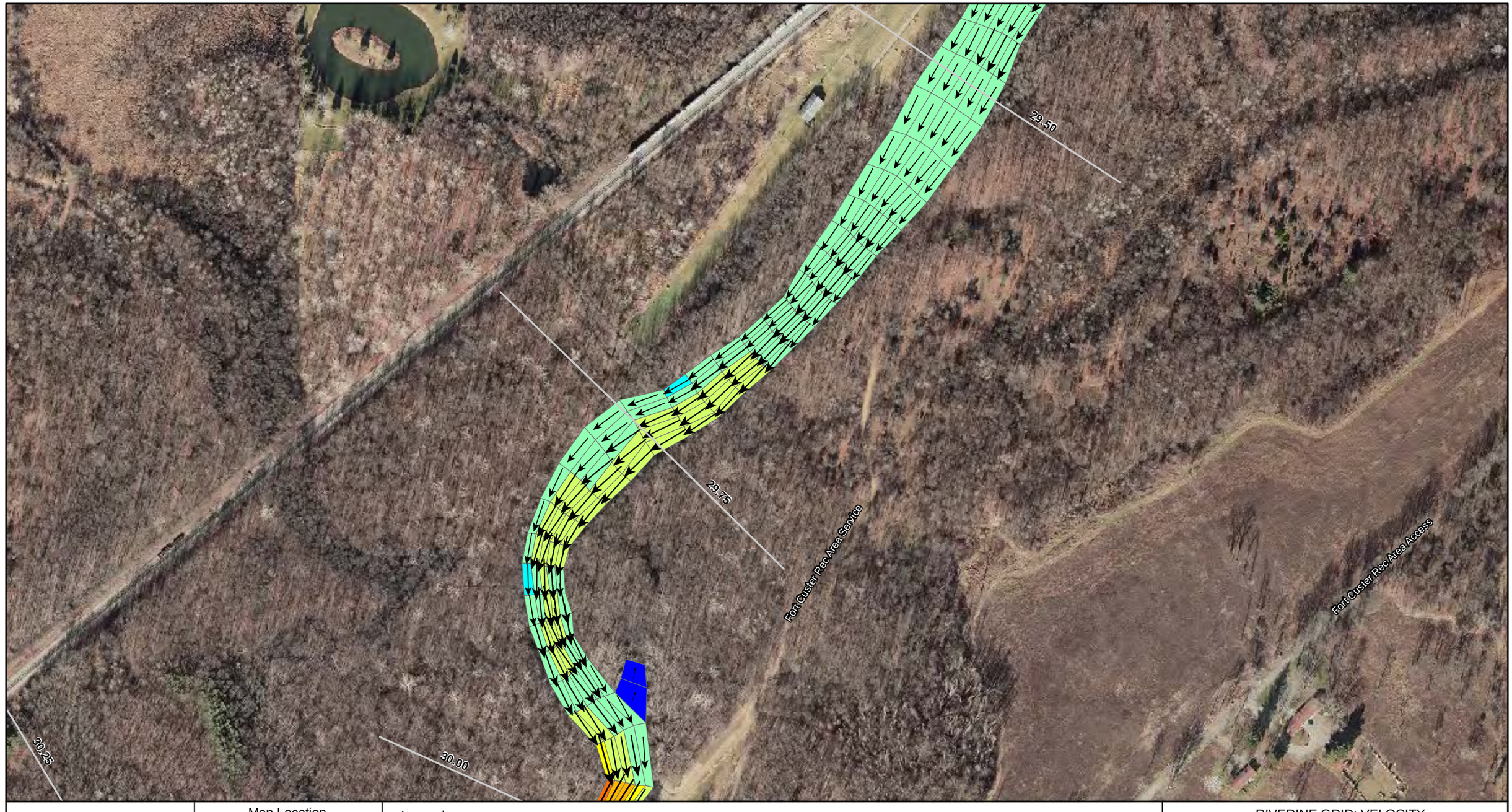
MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

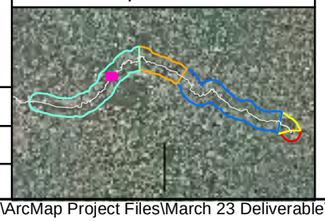
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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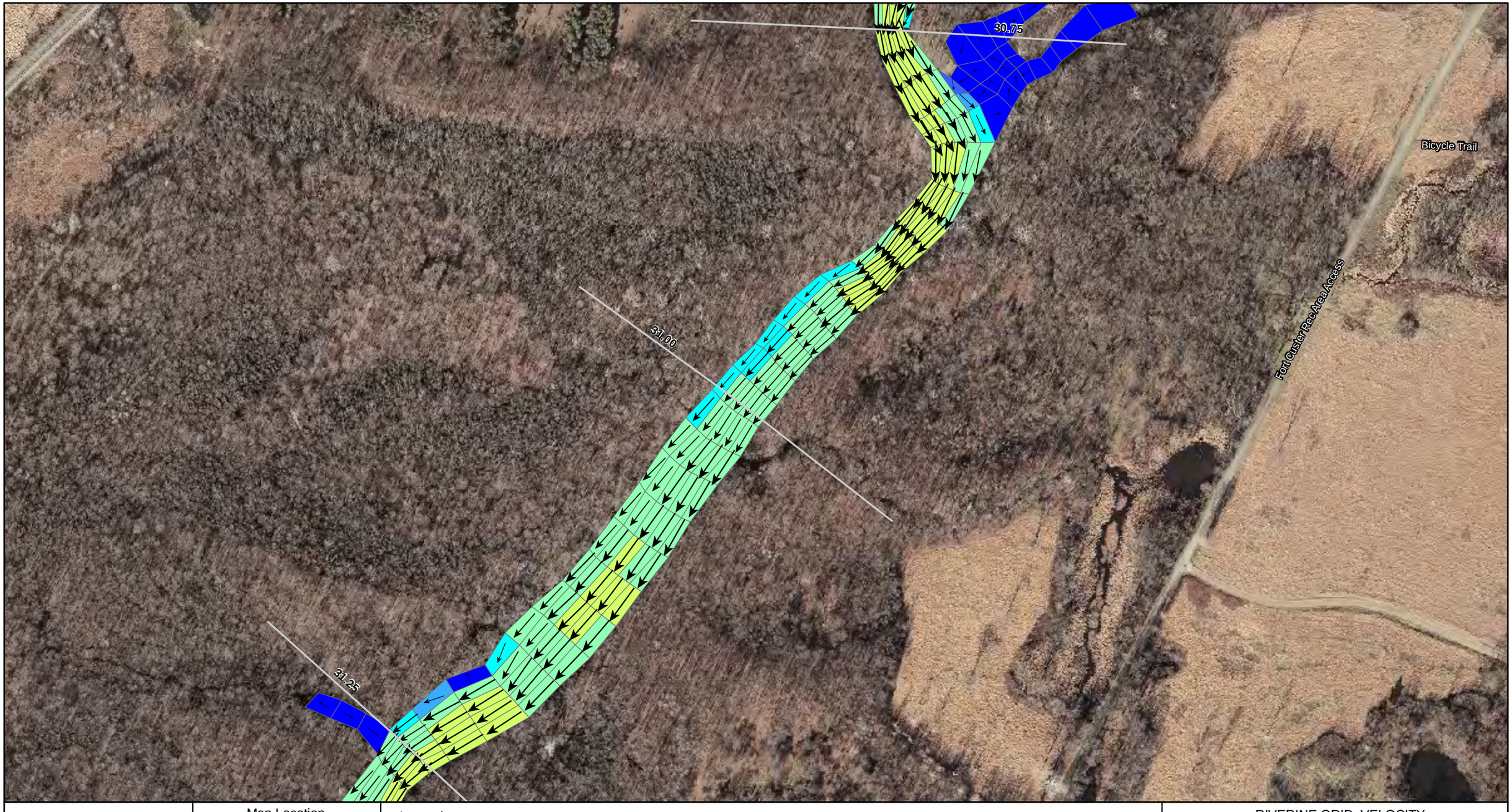
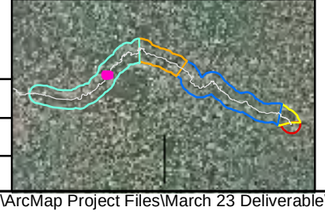
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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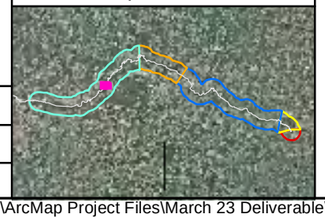
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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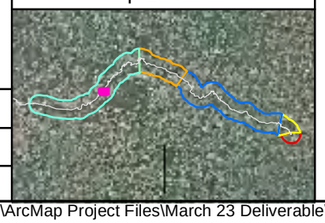
Aerial Photography Date: November 2011

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

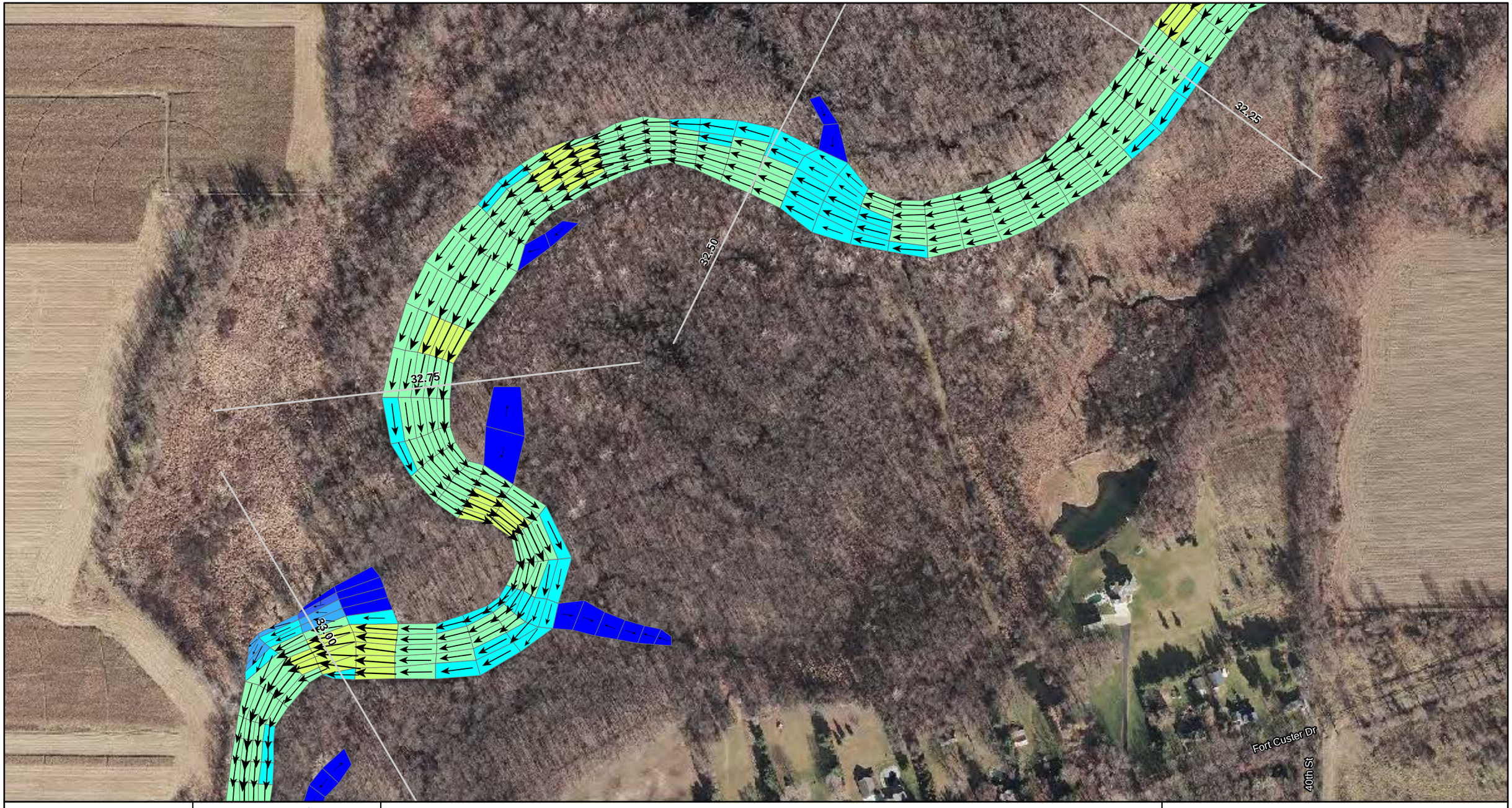
MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

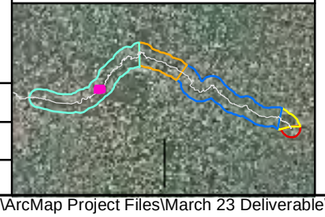
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

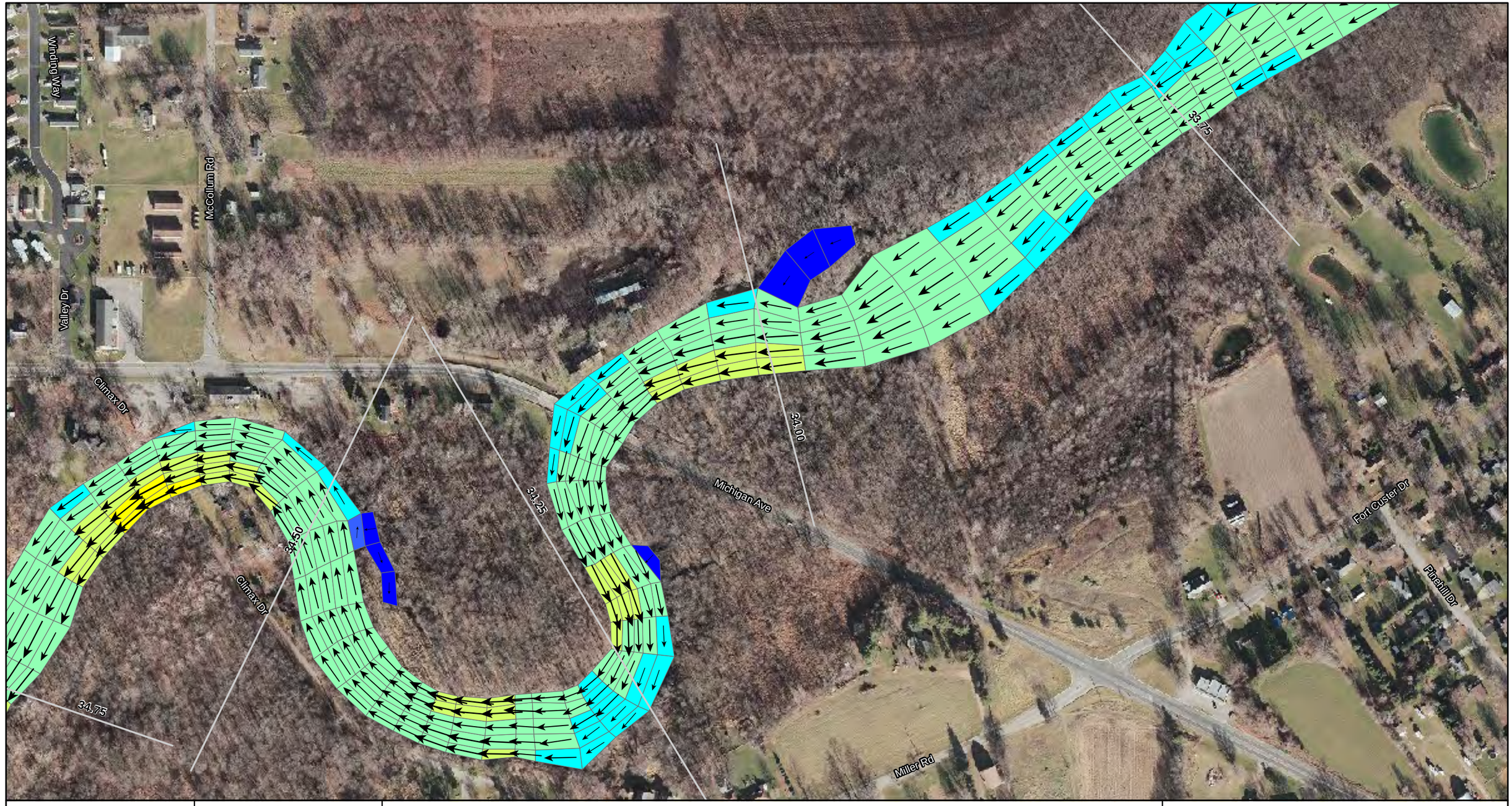
MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

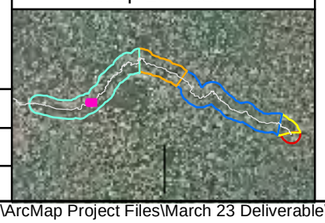
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 33.70 - MP 34.70

SHEET 45 OF 56

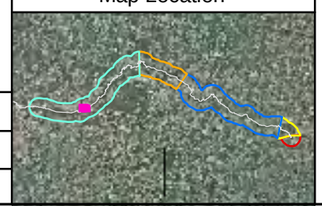
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

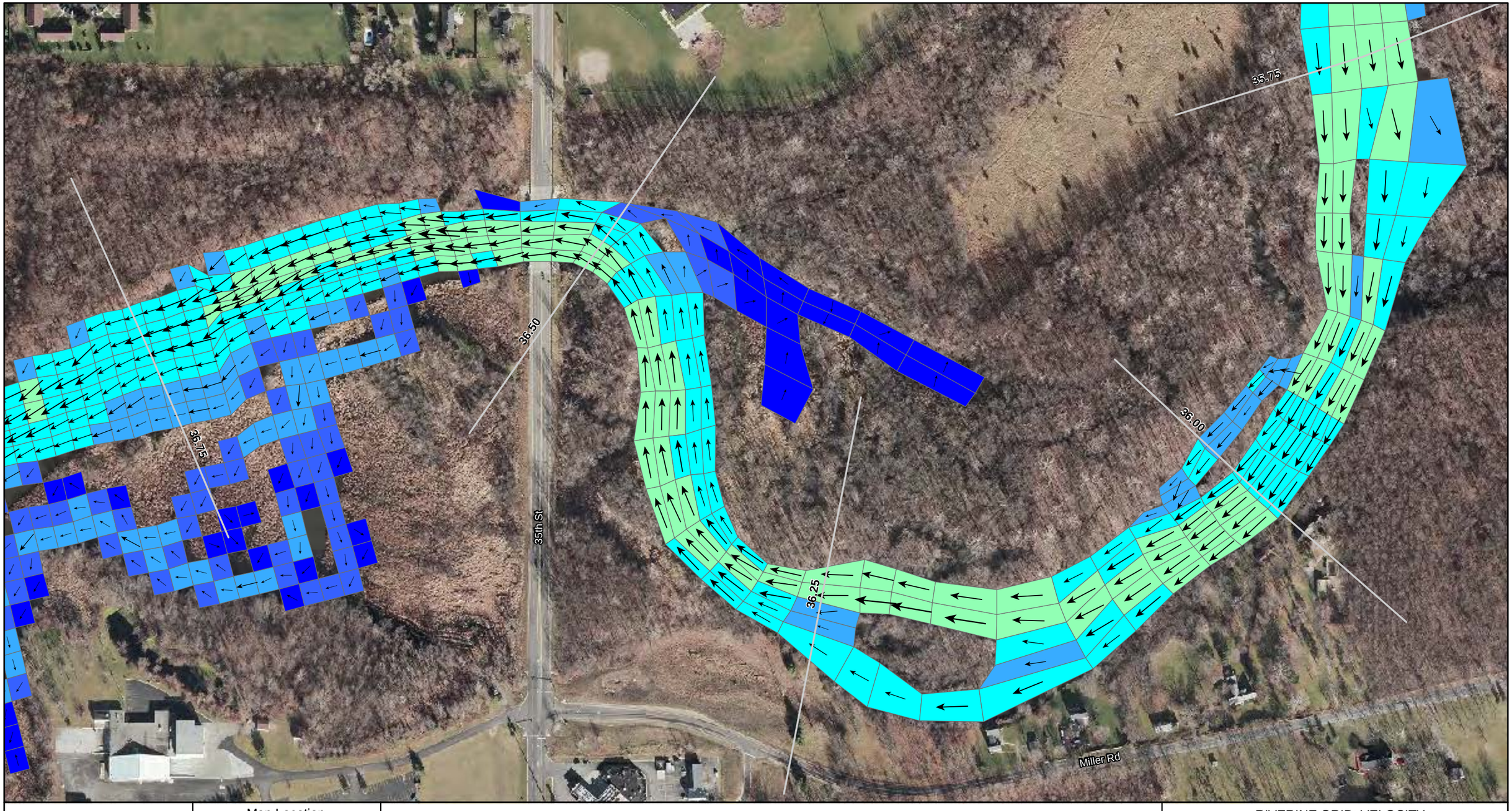
MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

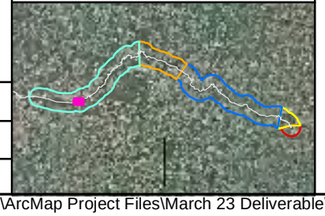
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

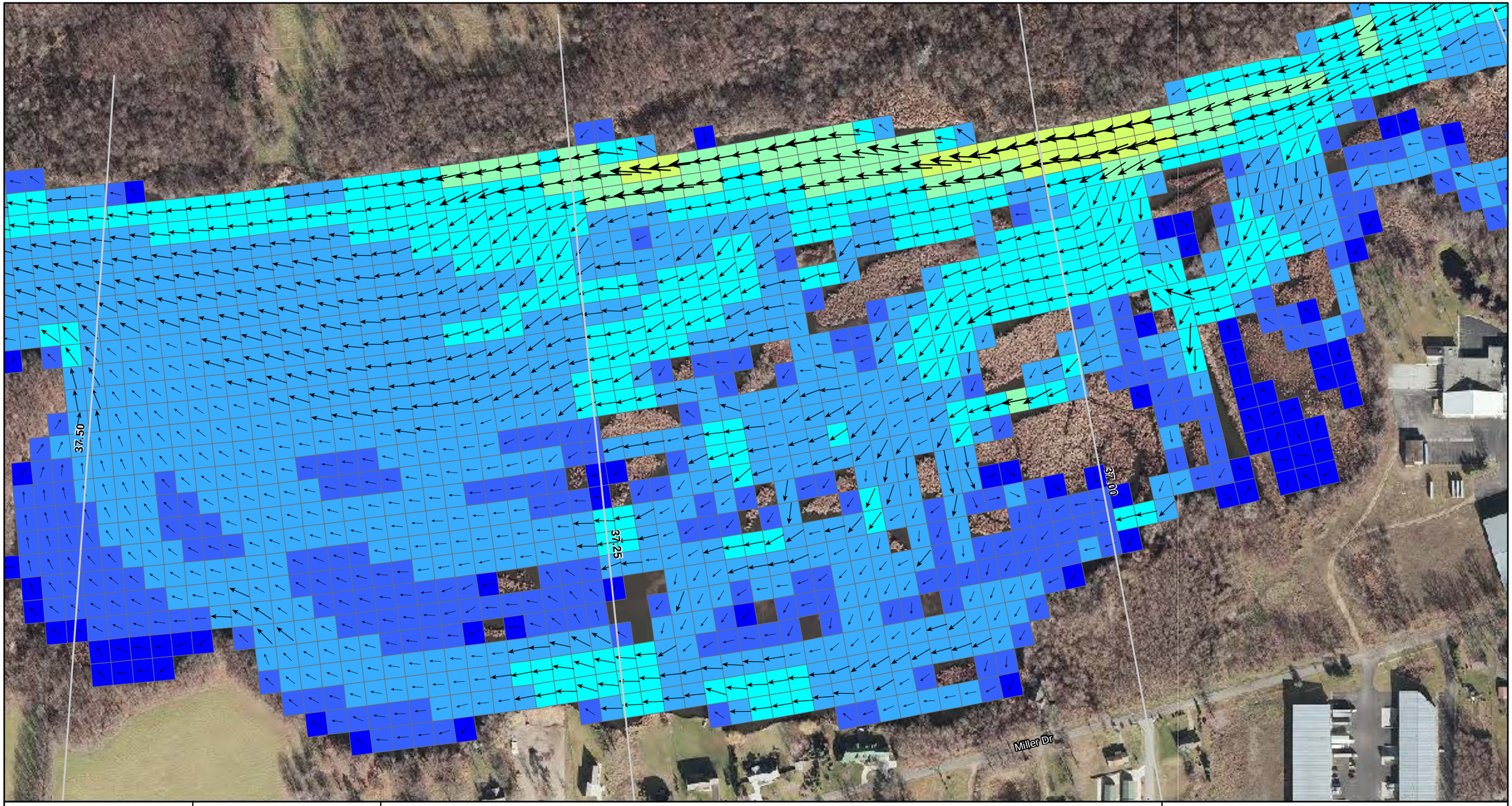
MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

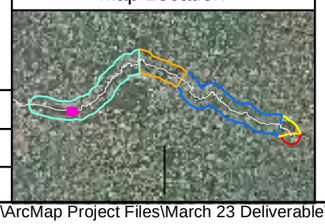
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

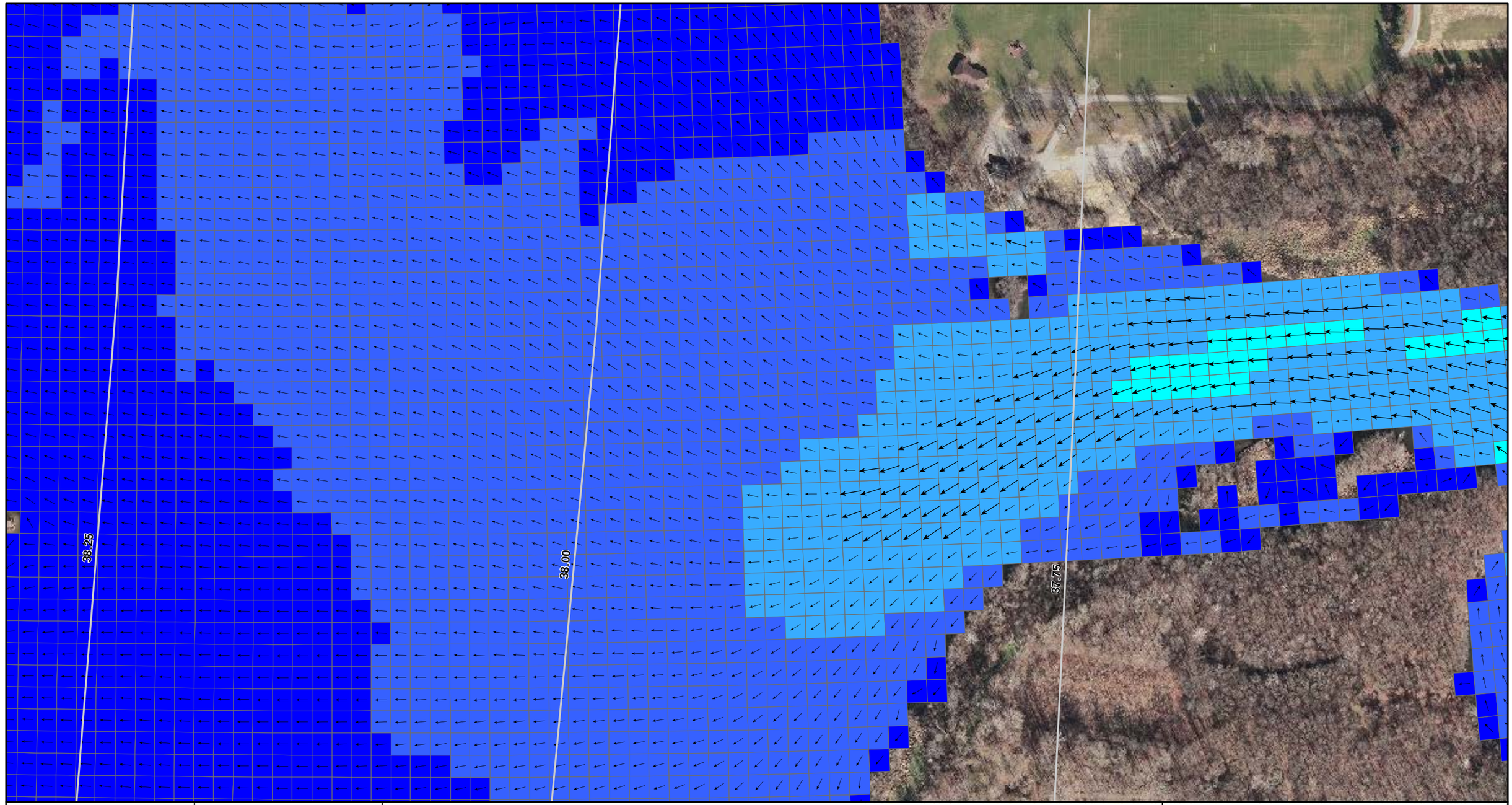
MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

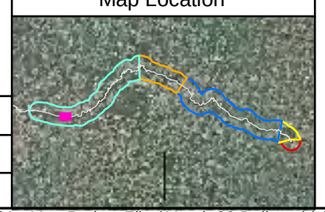
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

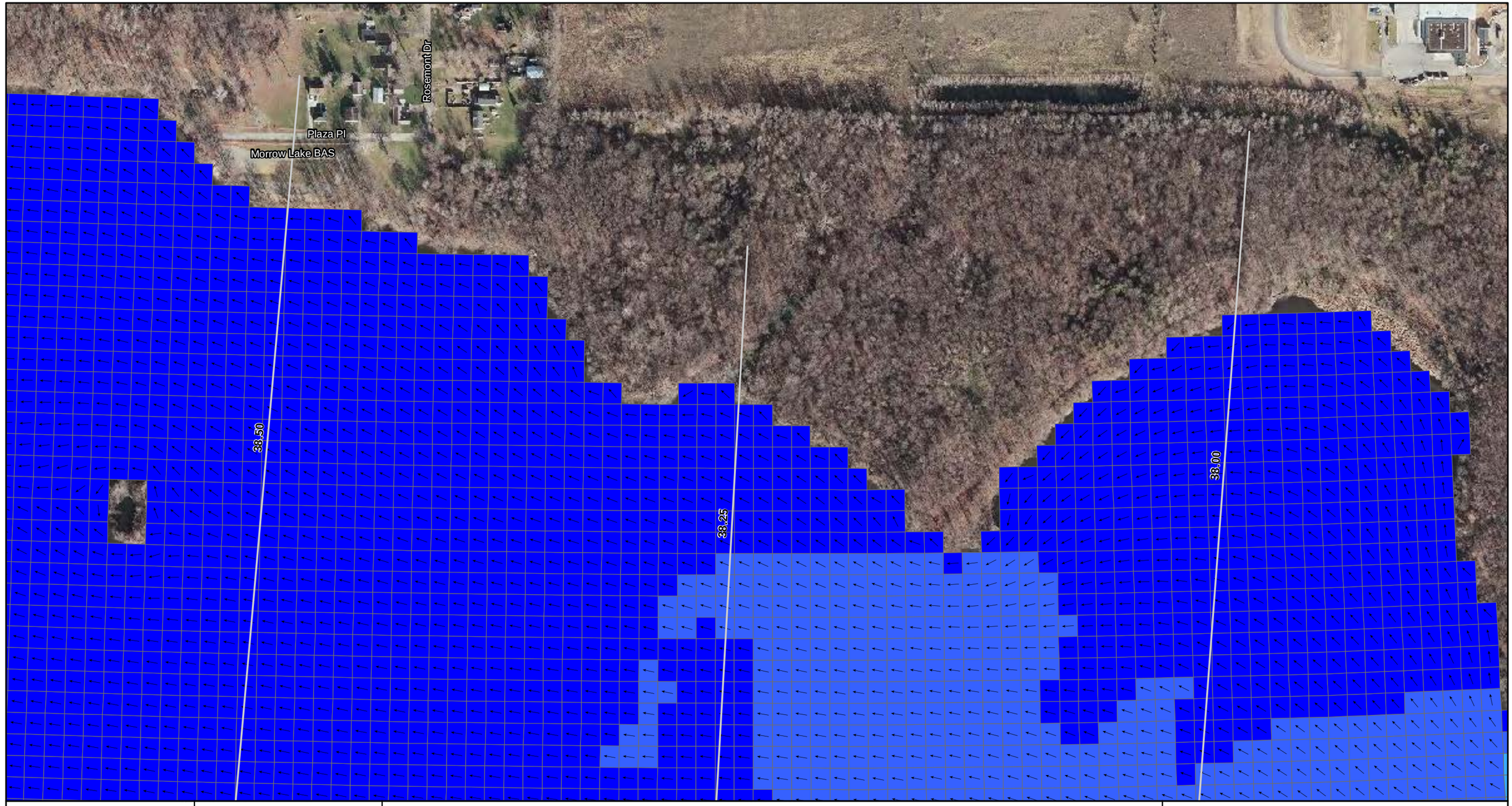
MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

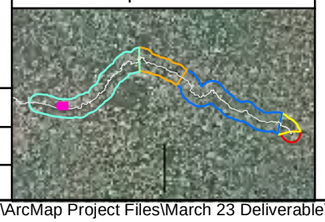
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011

38.50

38.25

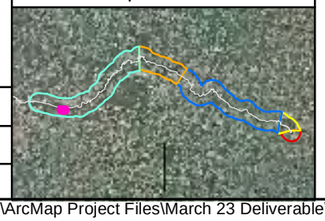
38.00

Lyth Rd

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

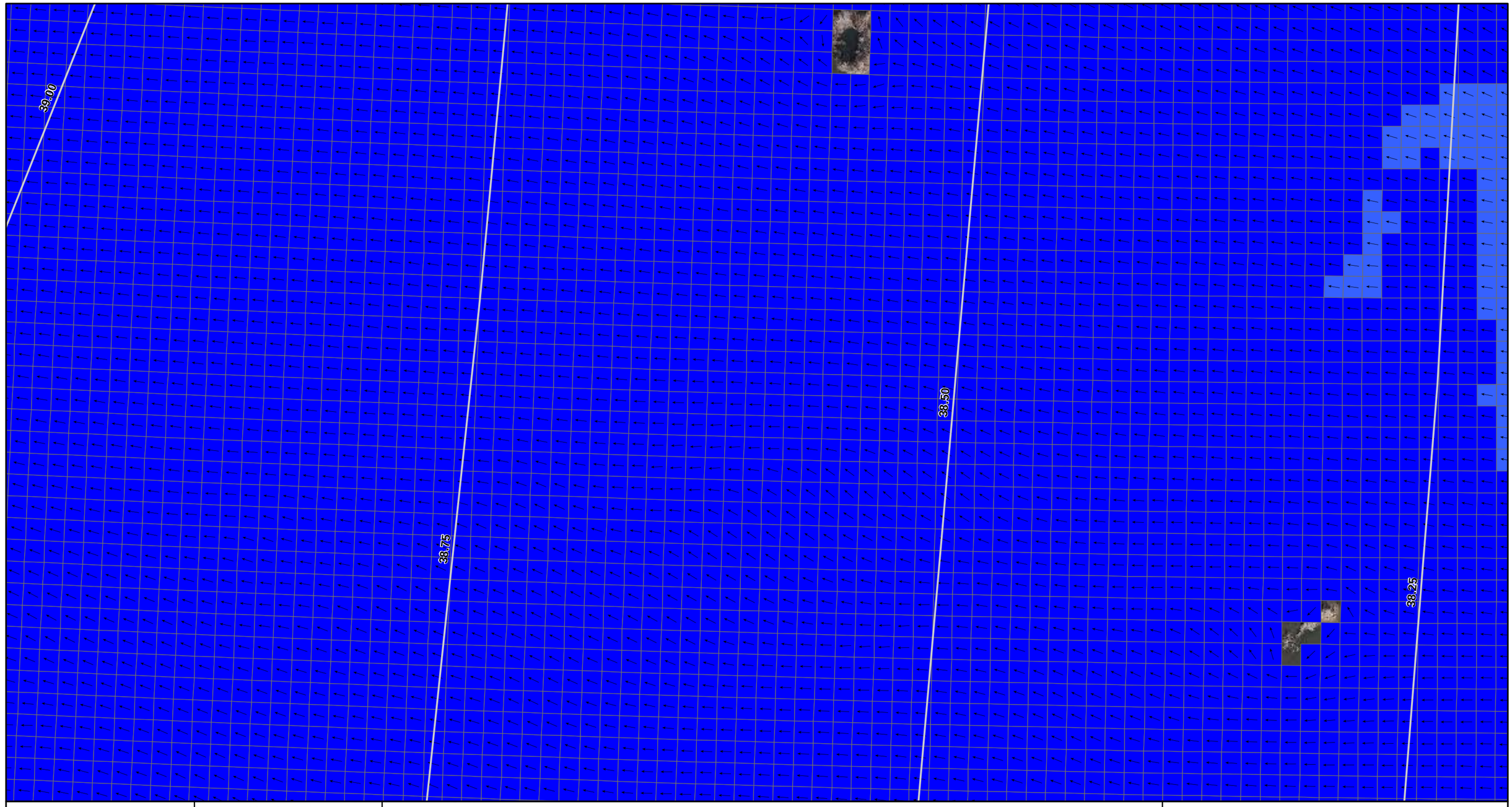
MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

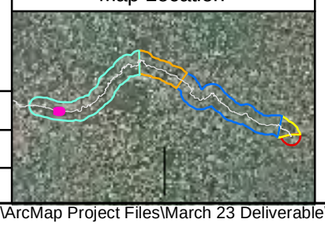
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

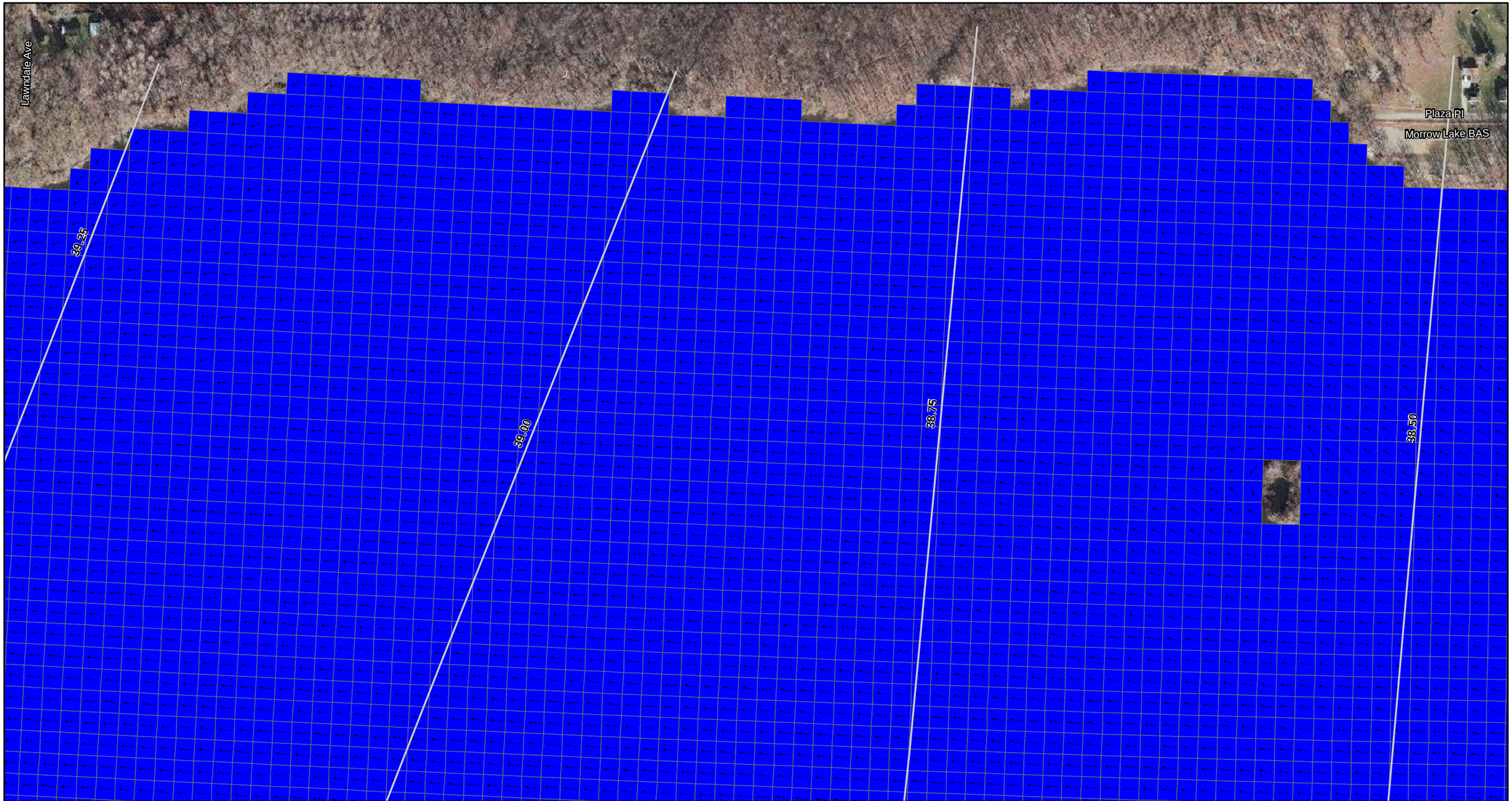
MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011

39.25

39.00

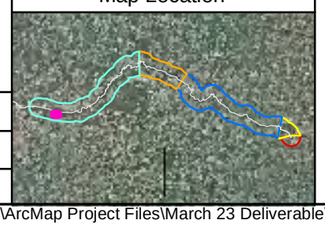
38.75

38.50

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

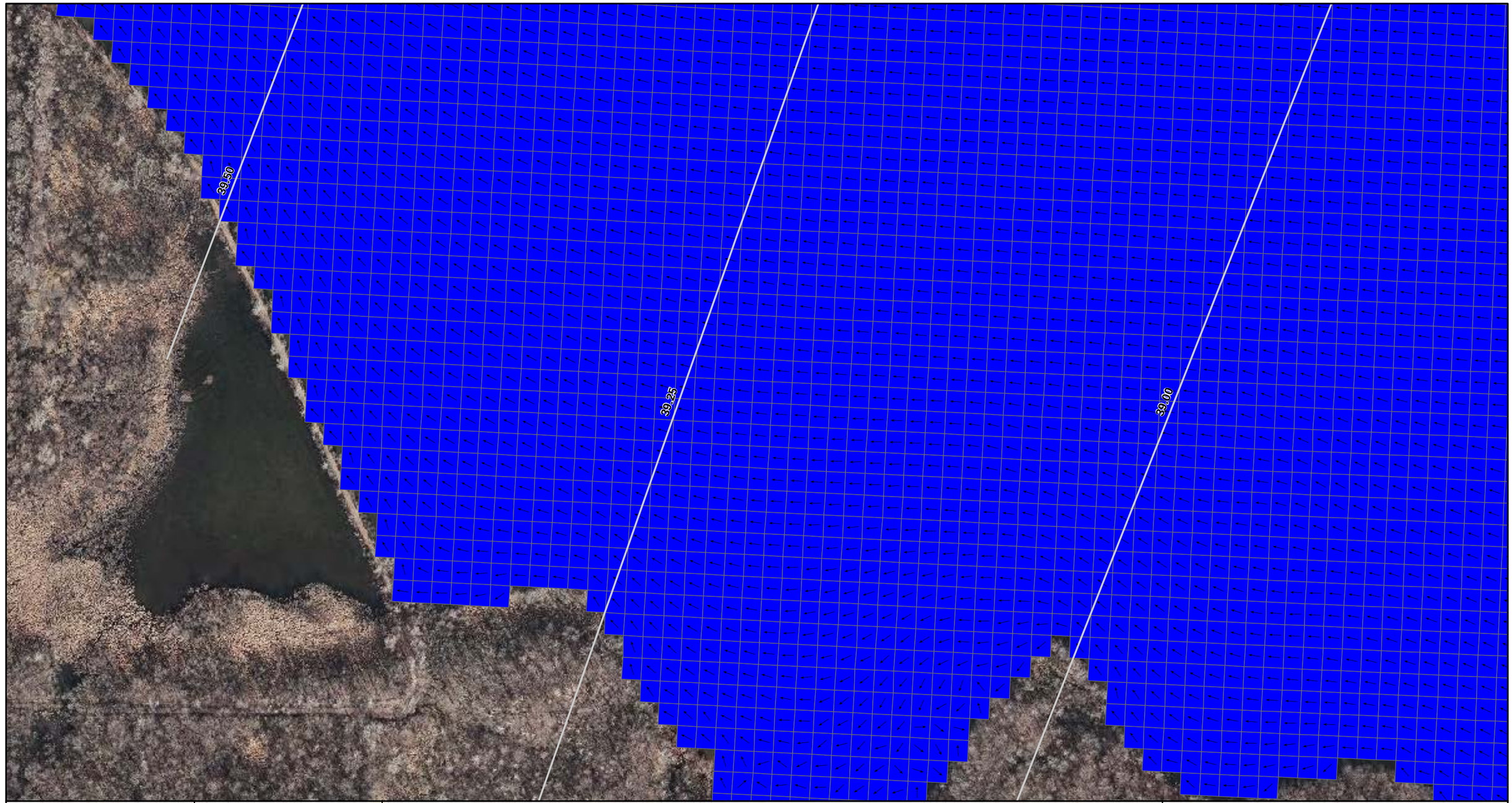
MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

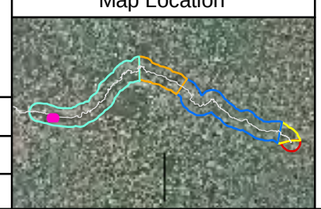
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

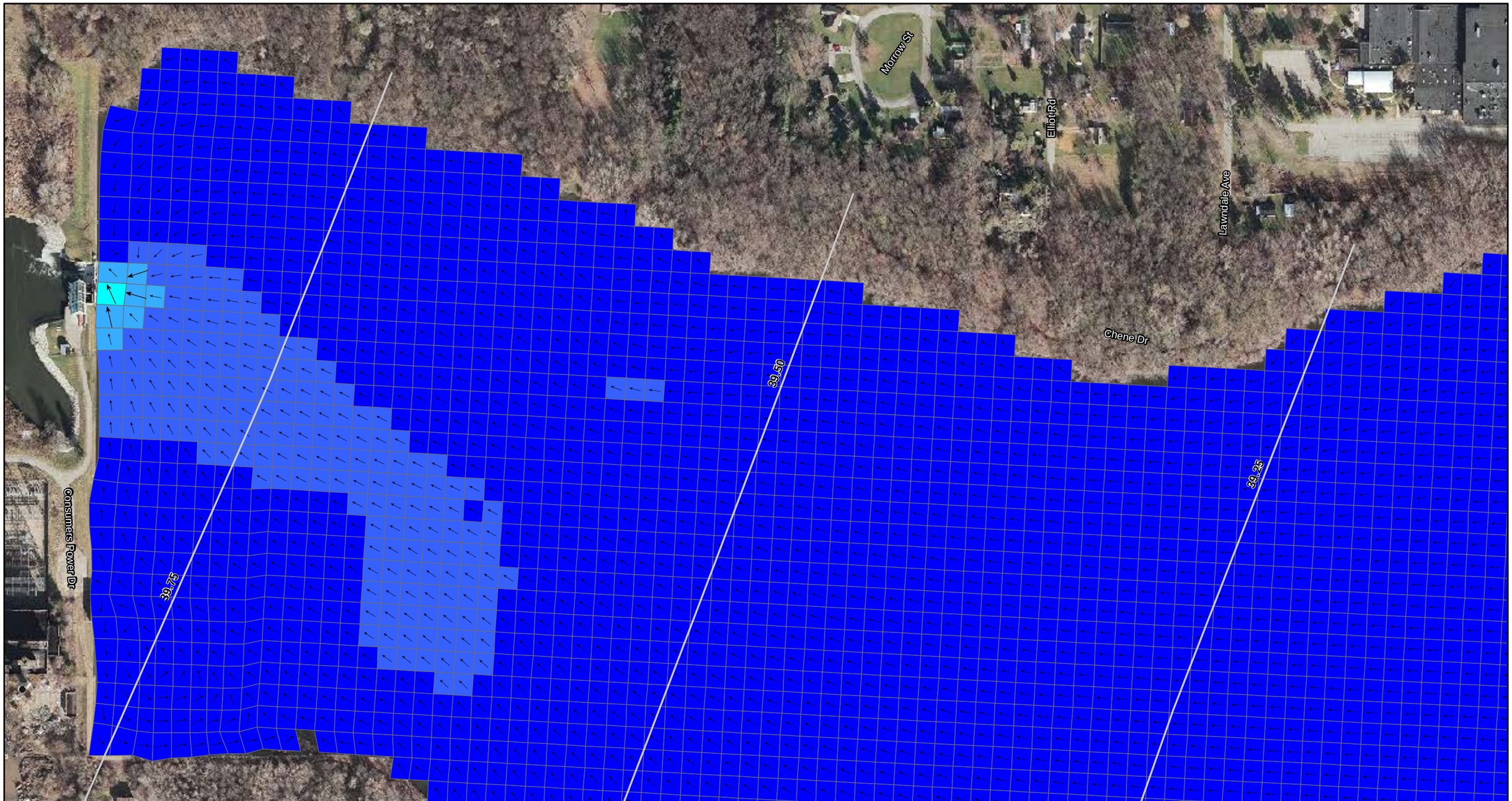
MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE	
Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec) - November 3, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 3, 2011

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov3_2011.mxd

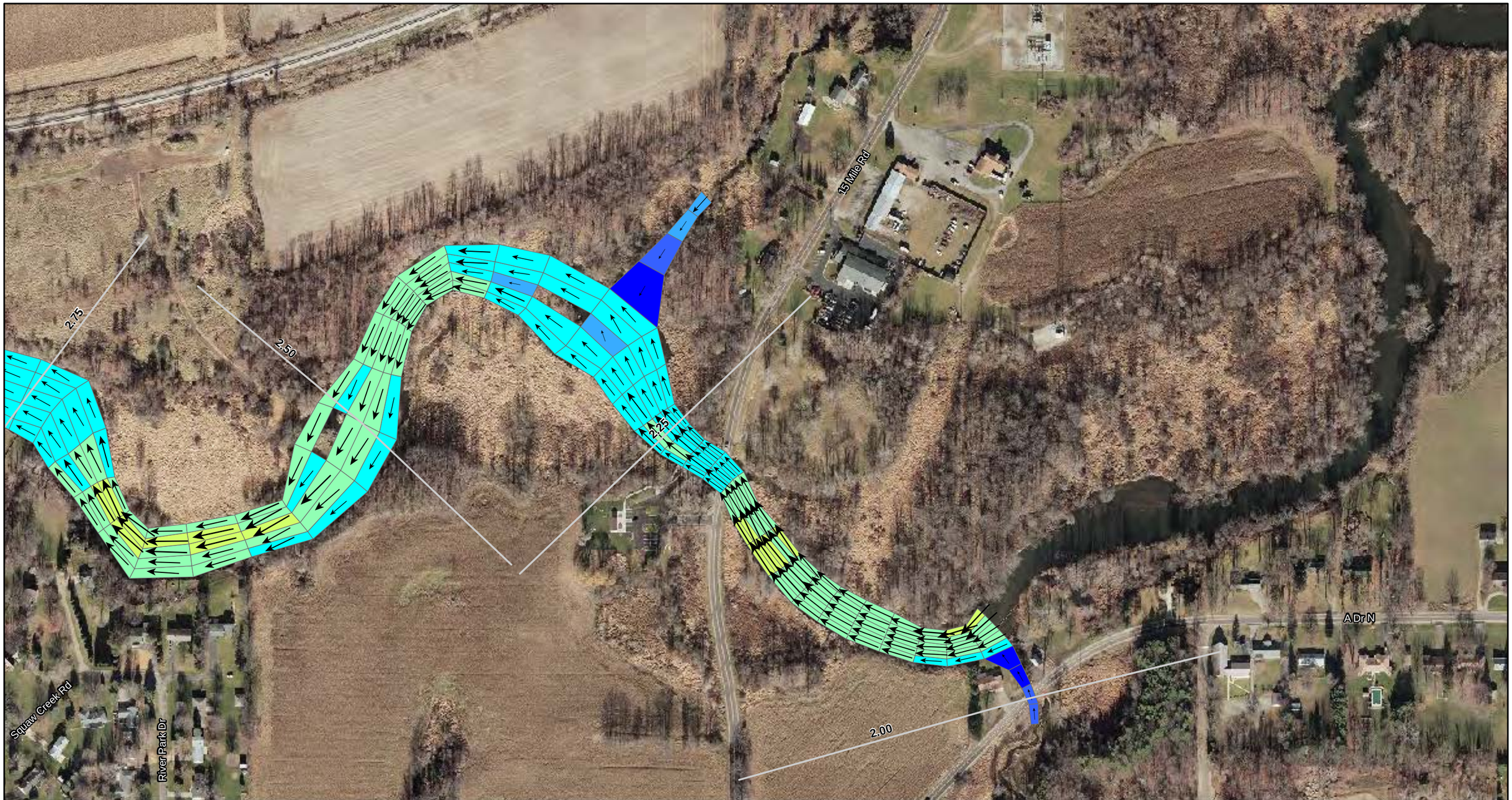
Aerial Photography Date: November 2011

Figure 4-15

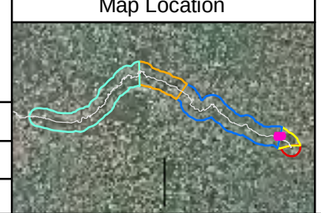
Riverine Grid: Velocity

November 7, 2011

Sheets 1 through 56



Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

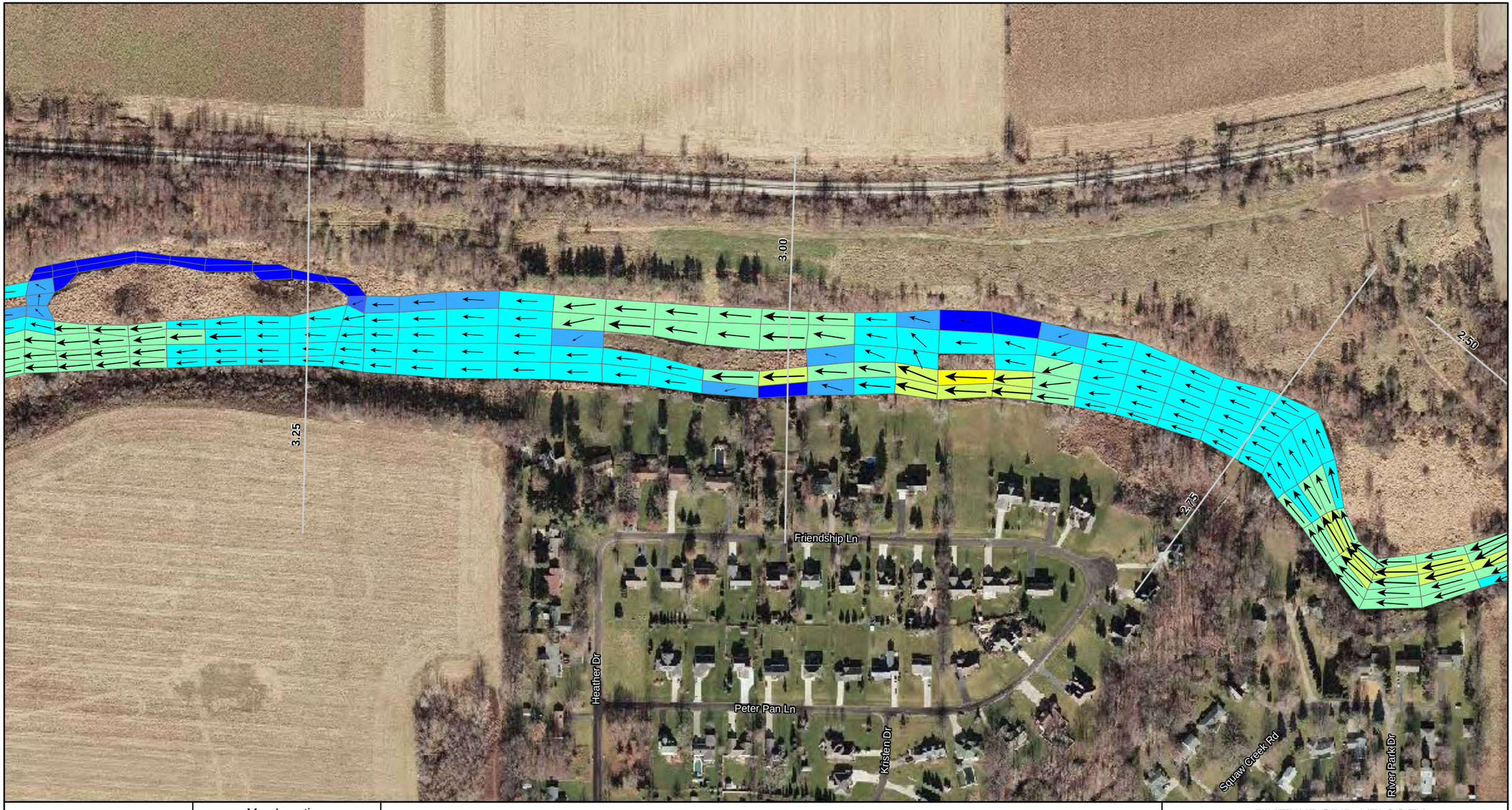
MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

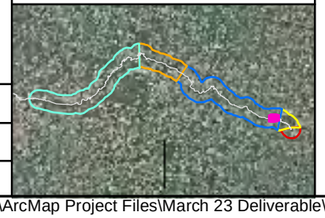
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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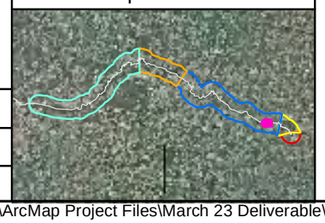
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

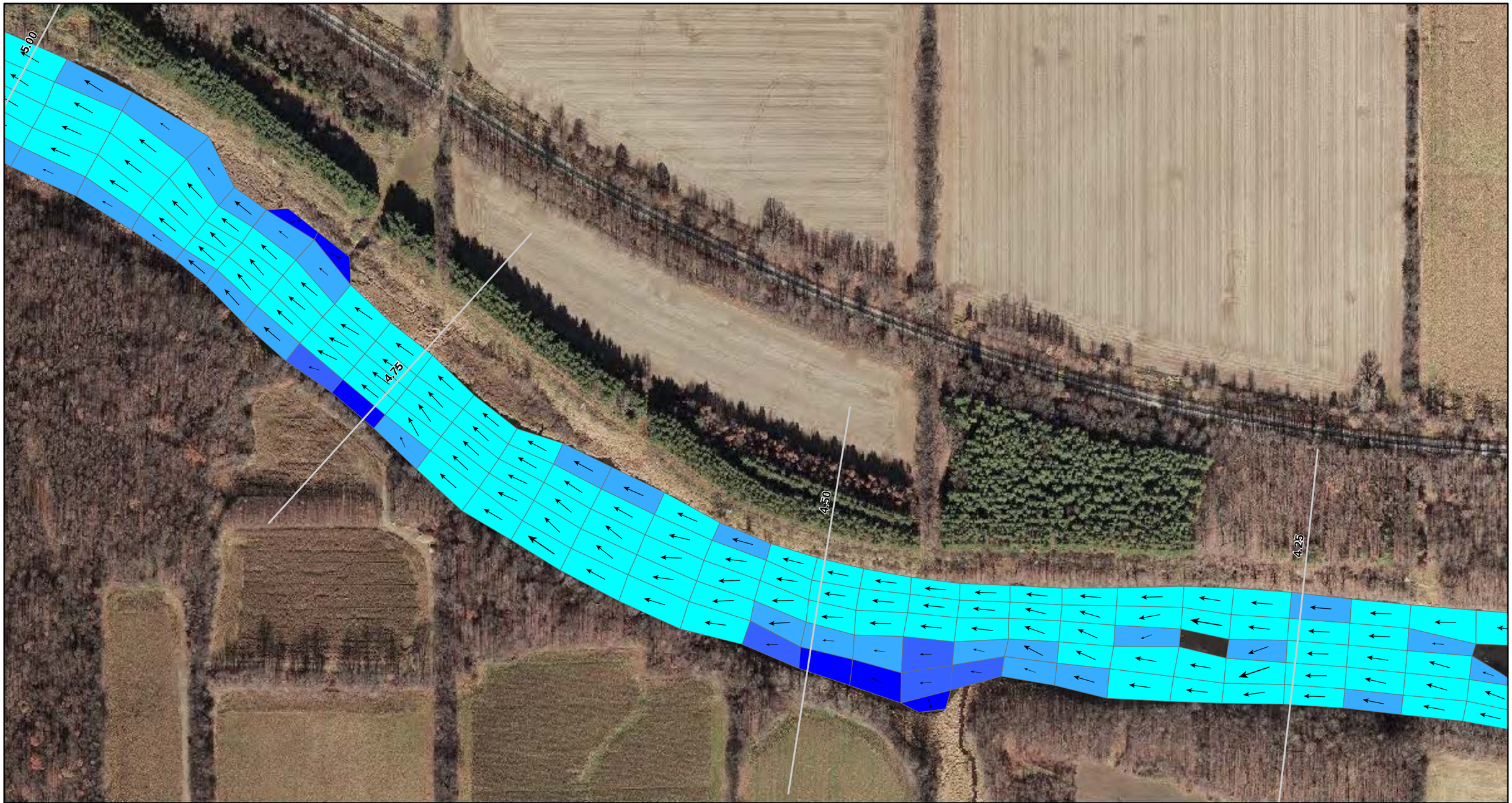
MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

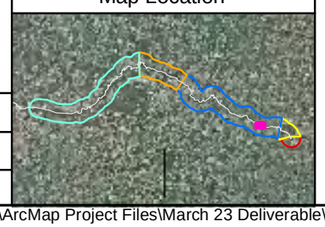
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

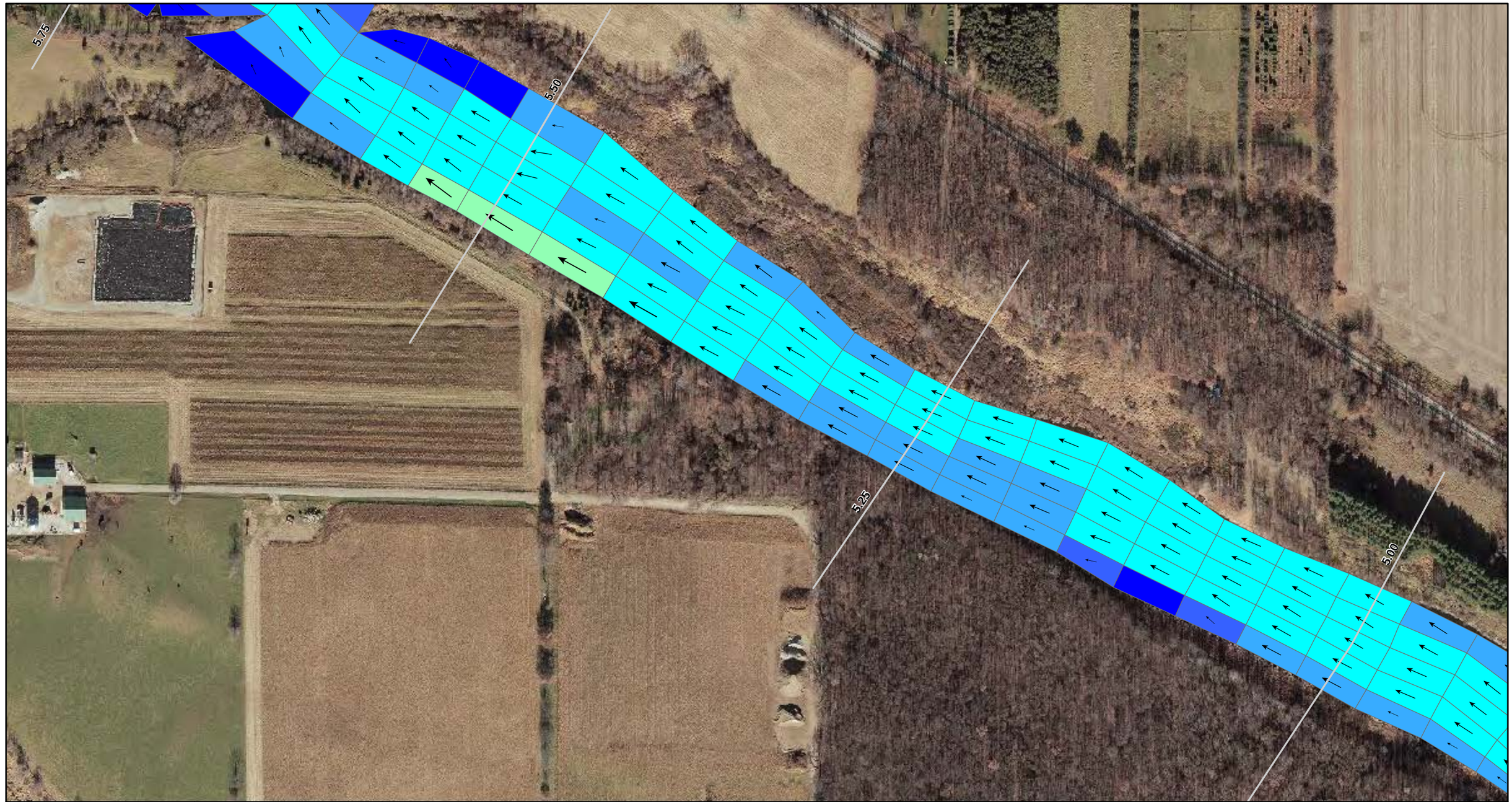
MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

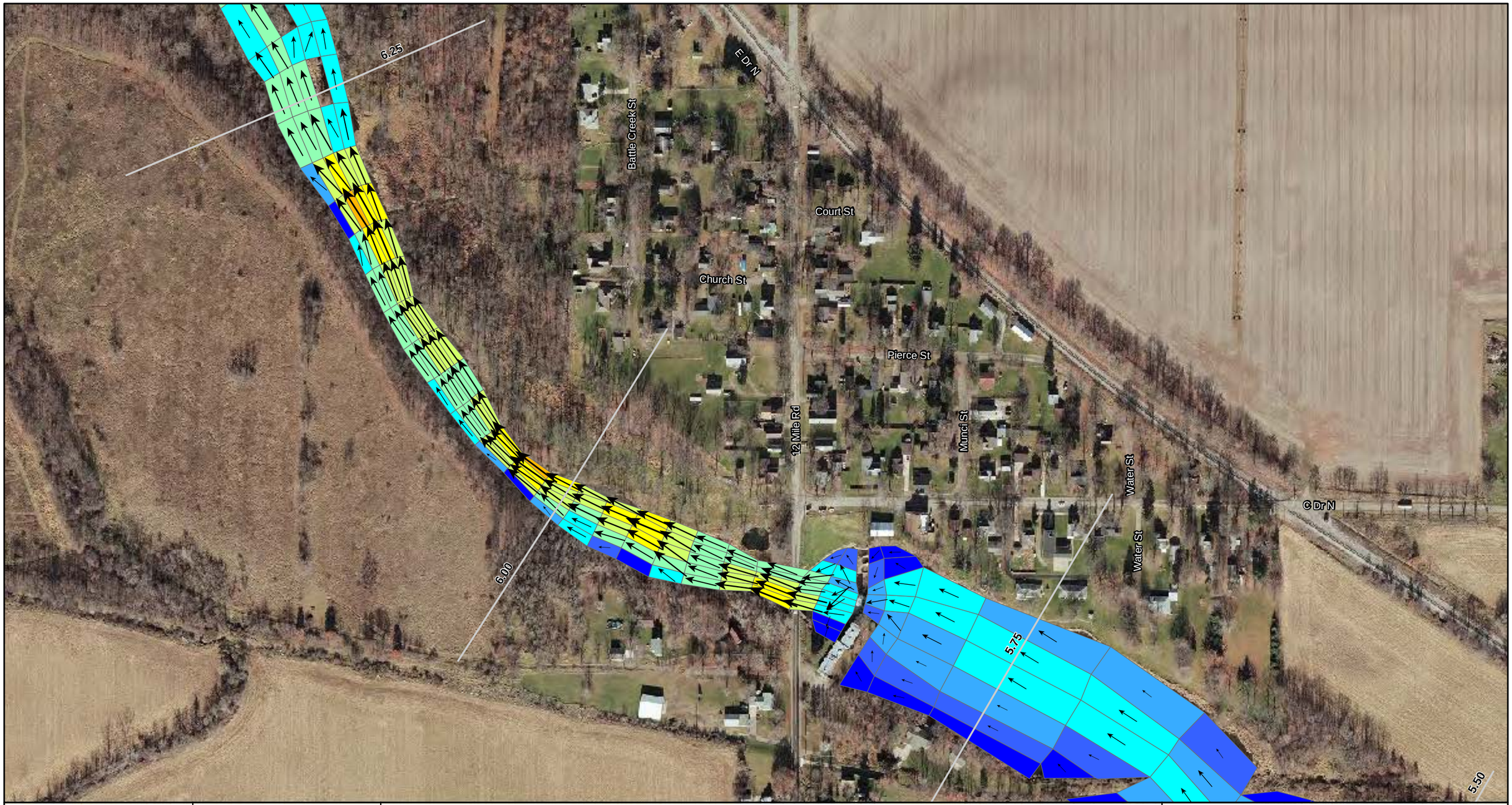
MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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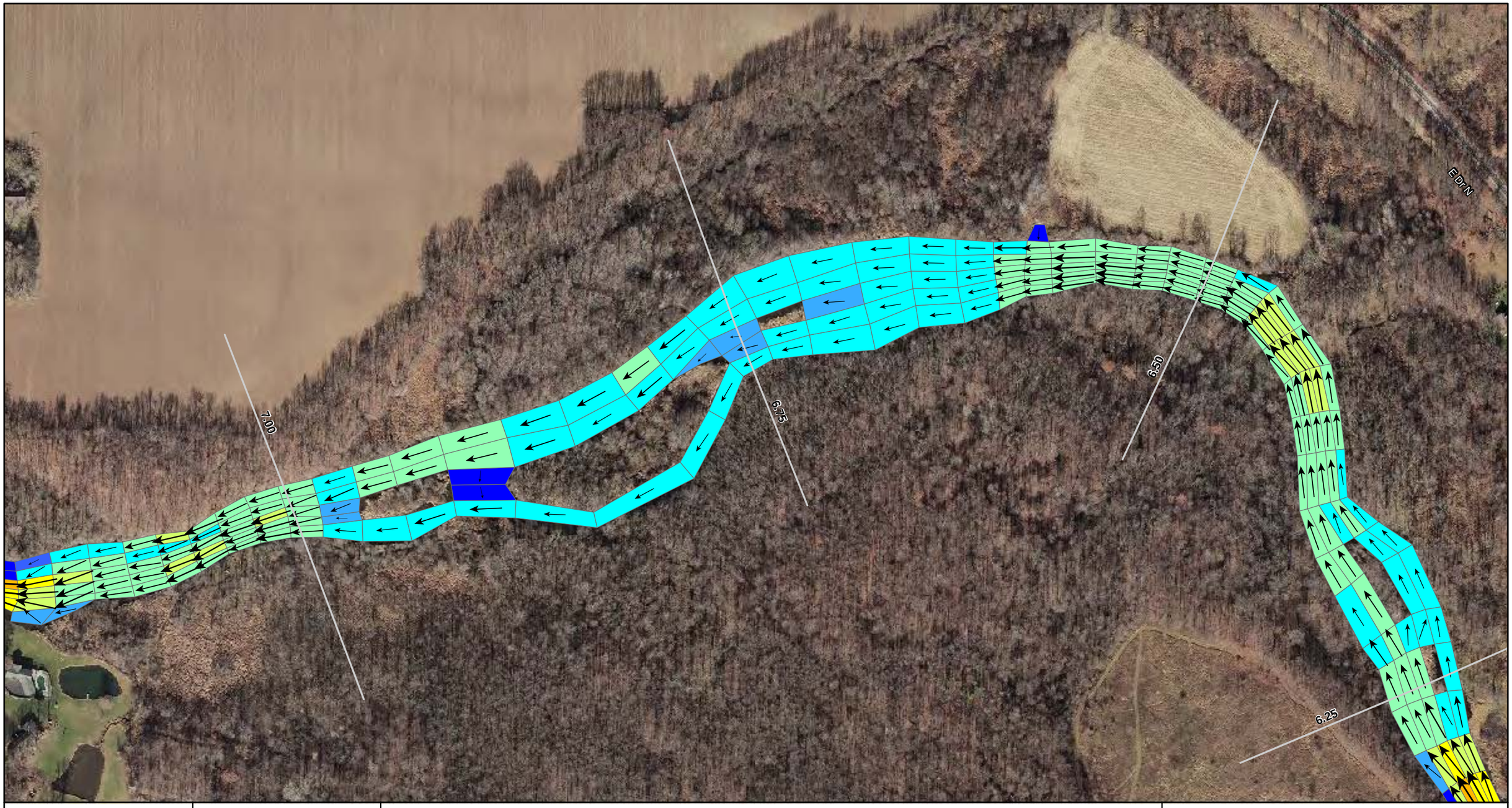
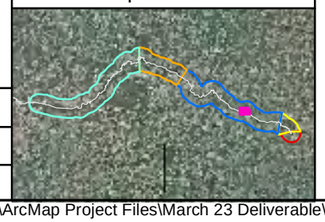
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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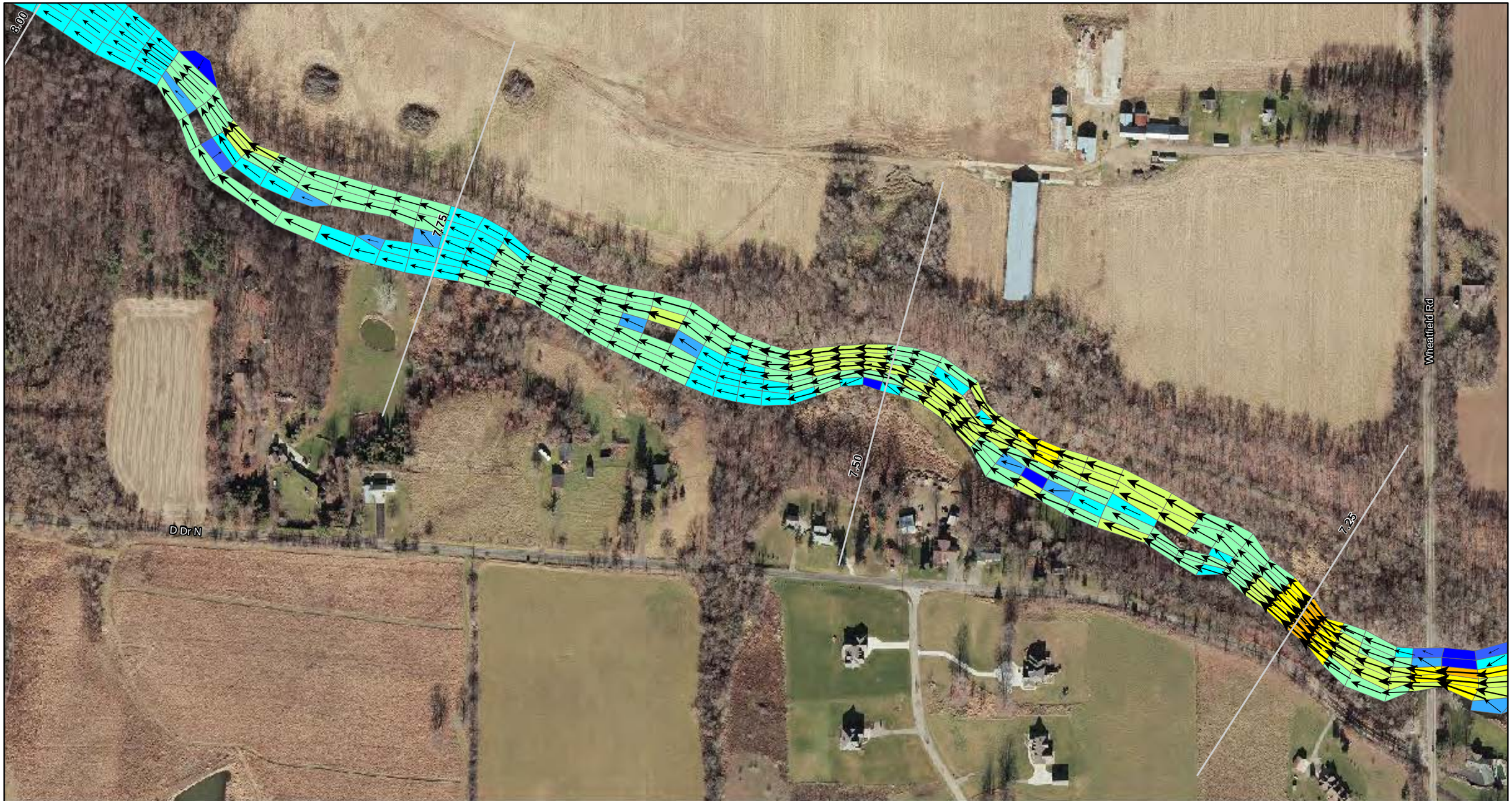
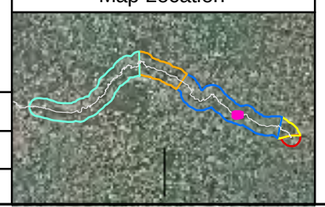
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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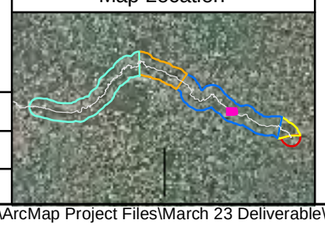
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

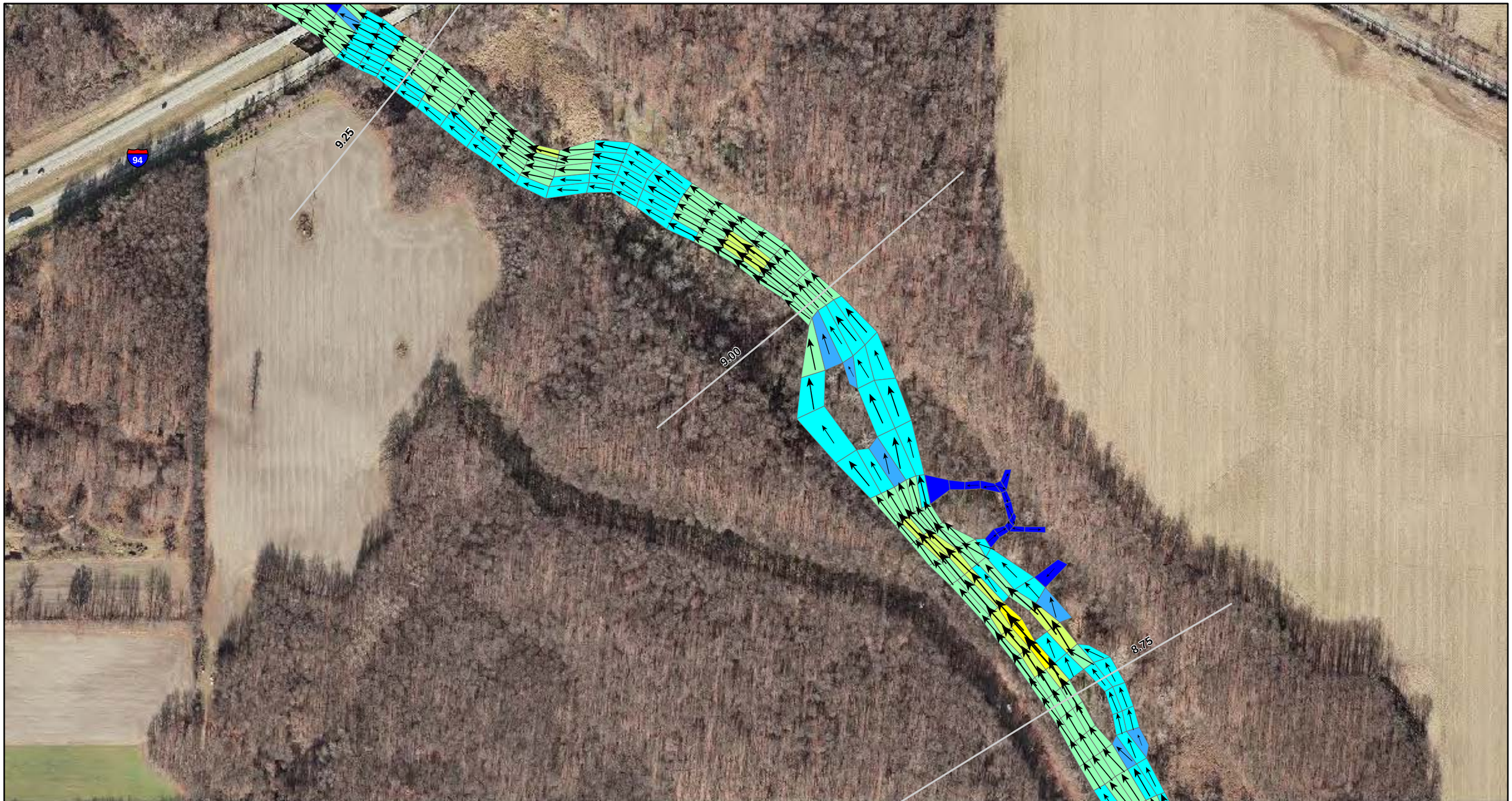
MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

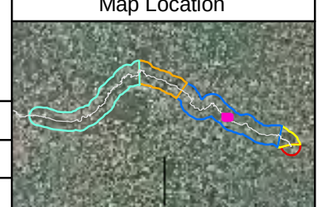
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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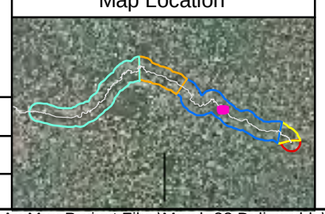
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

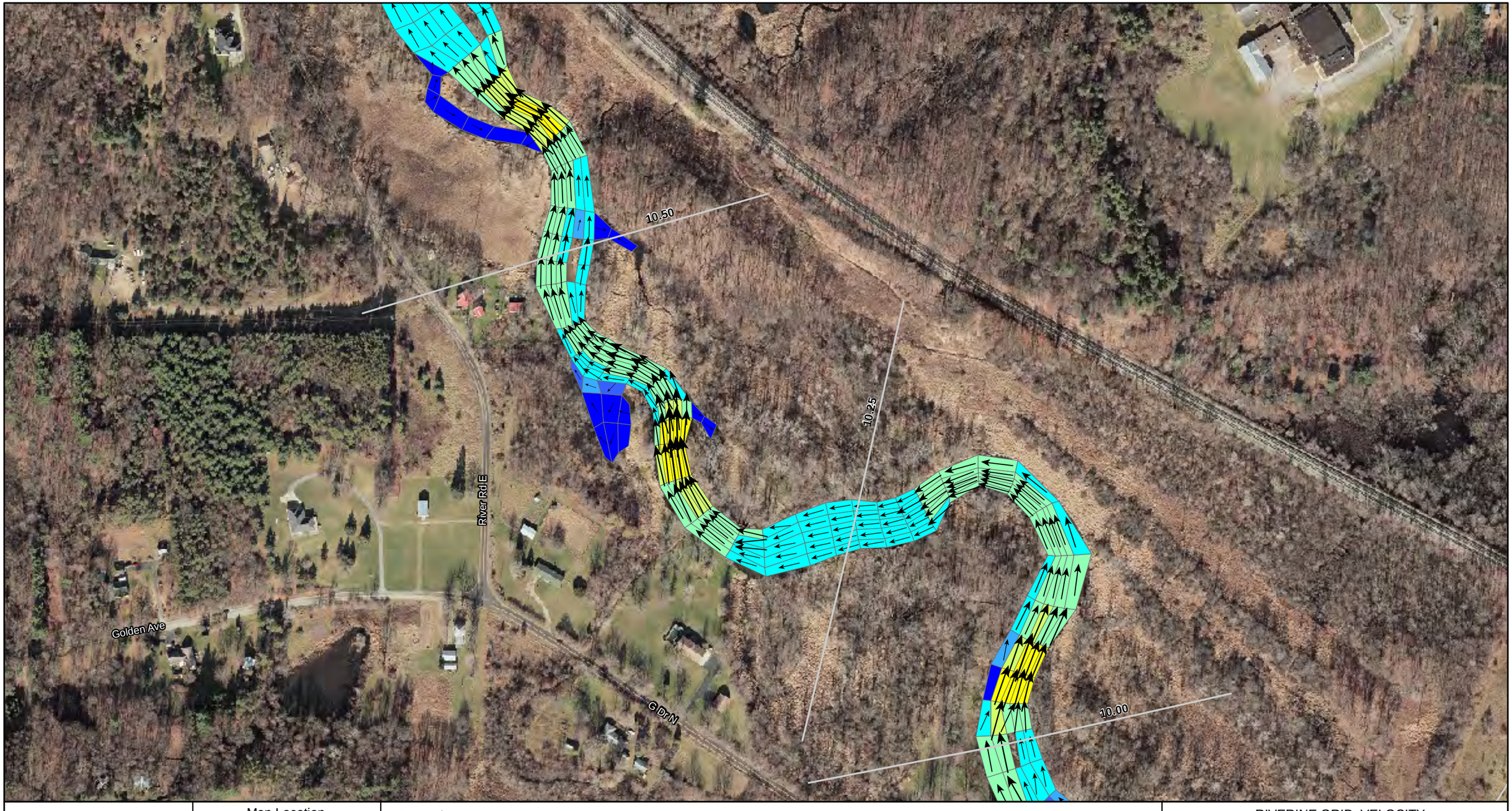
MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

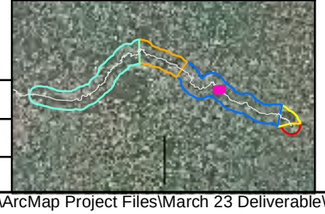
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 10.00 - MP 10.65

SHEET 12 OF 56

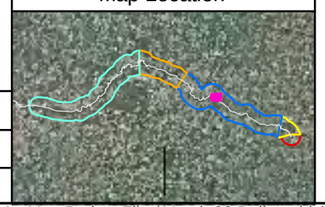
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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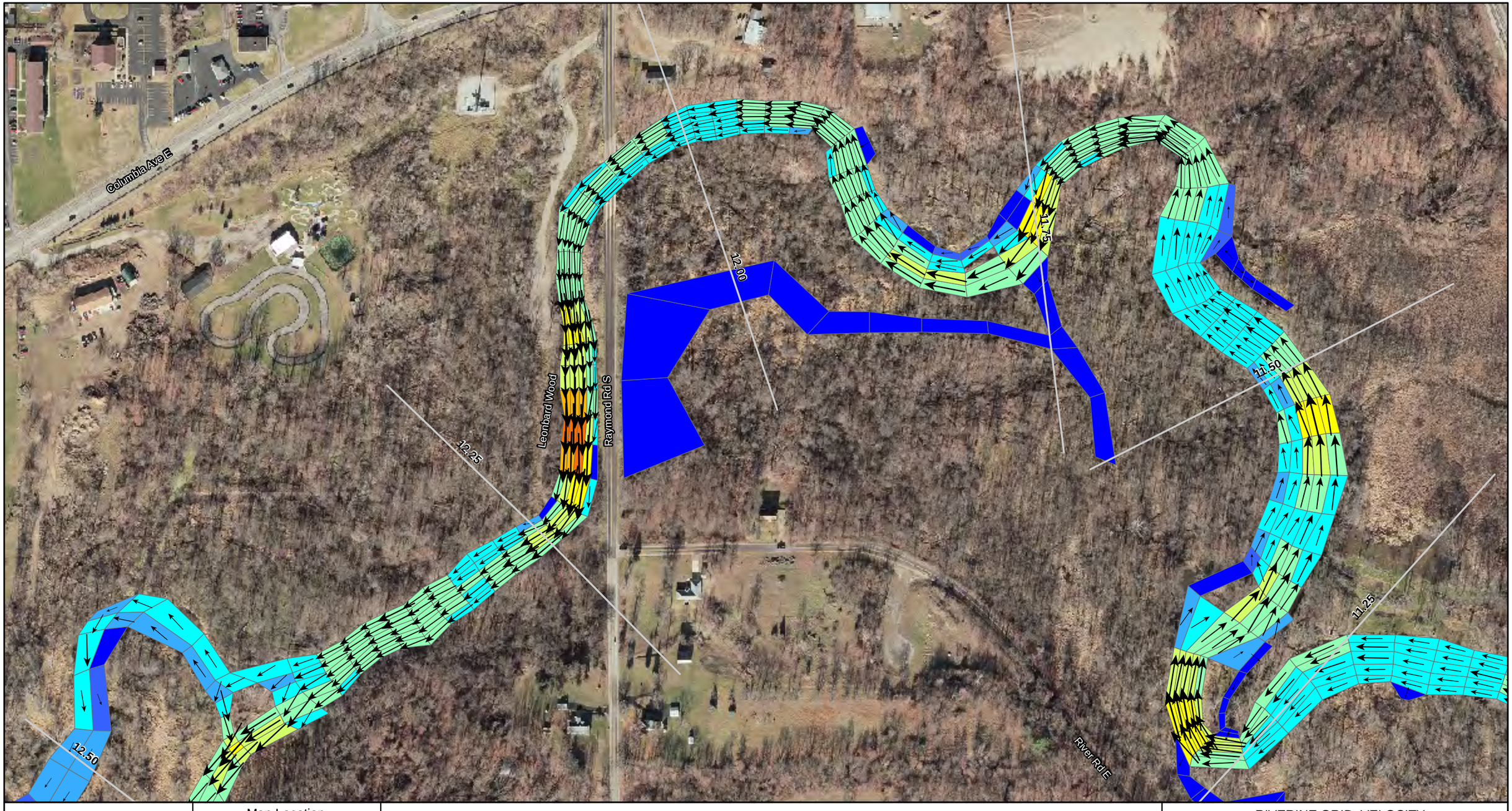
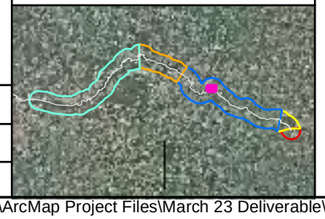
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

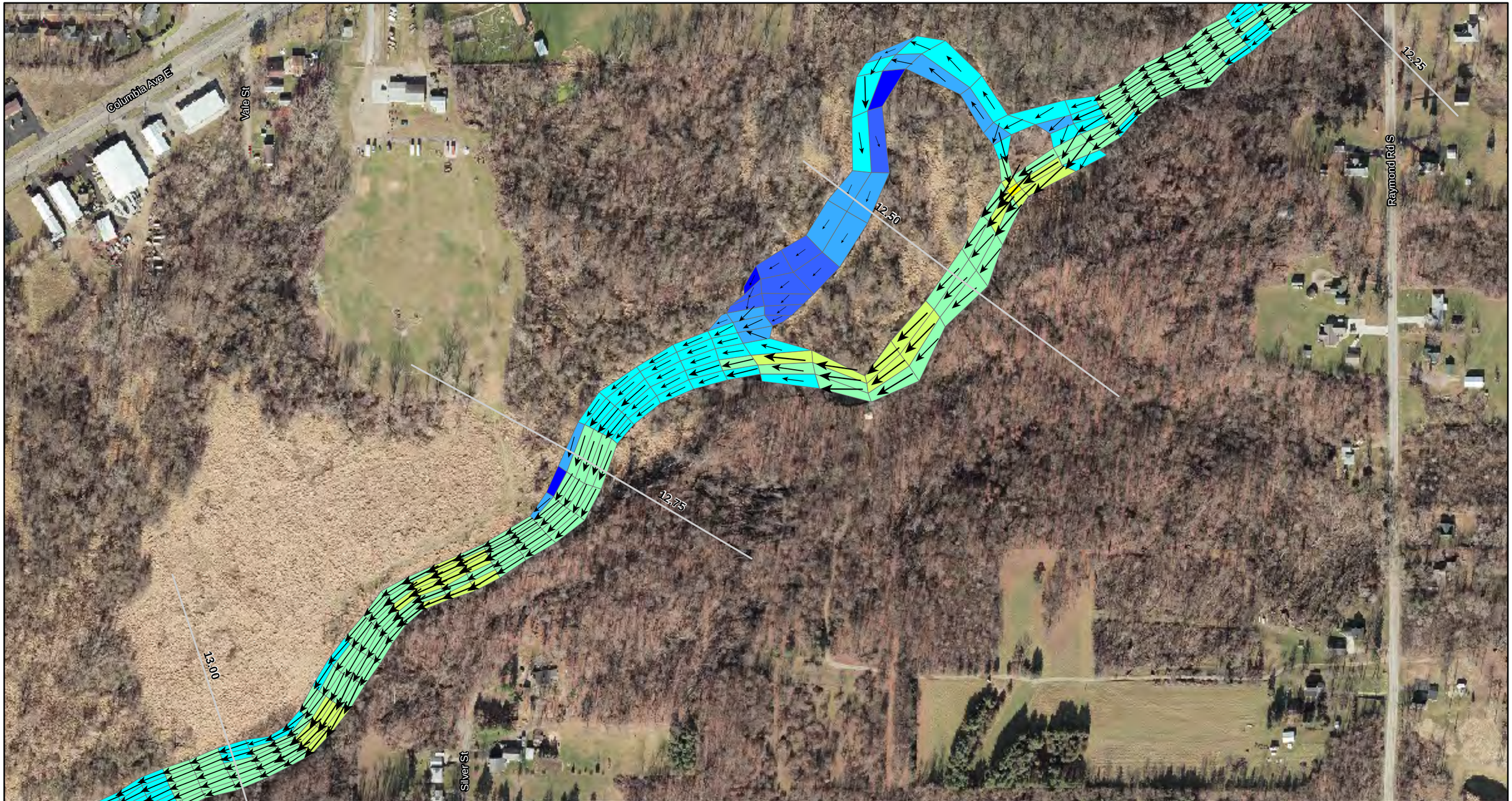
MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

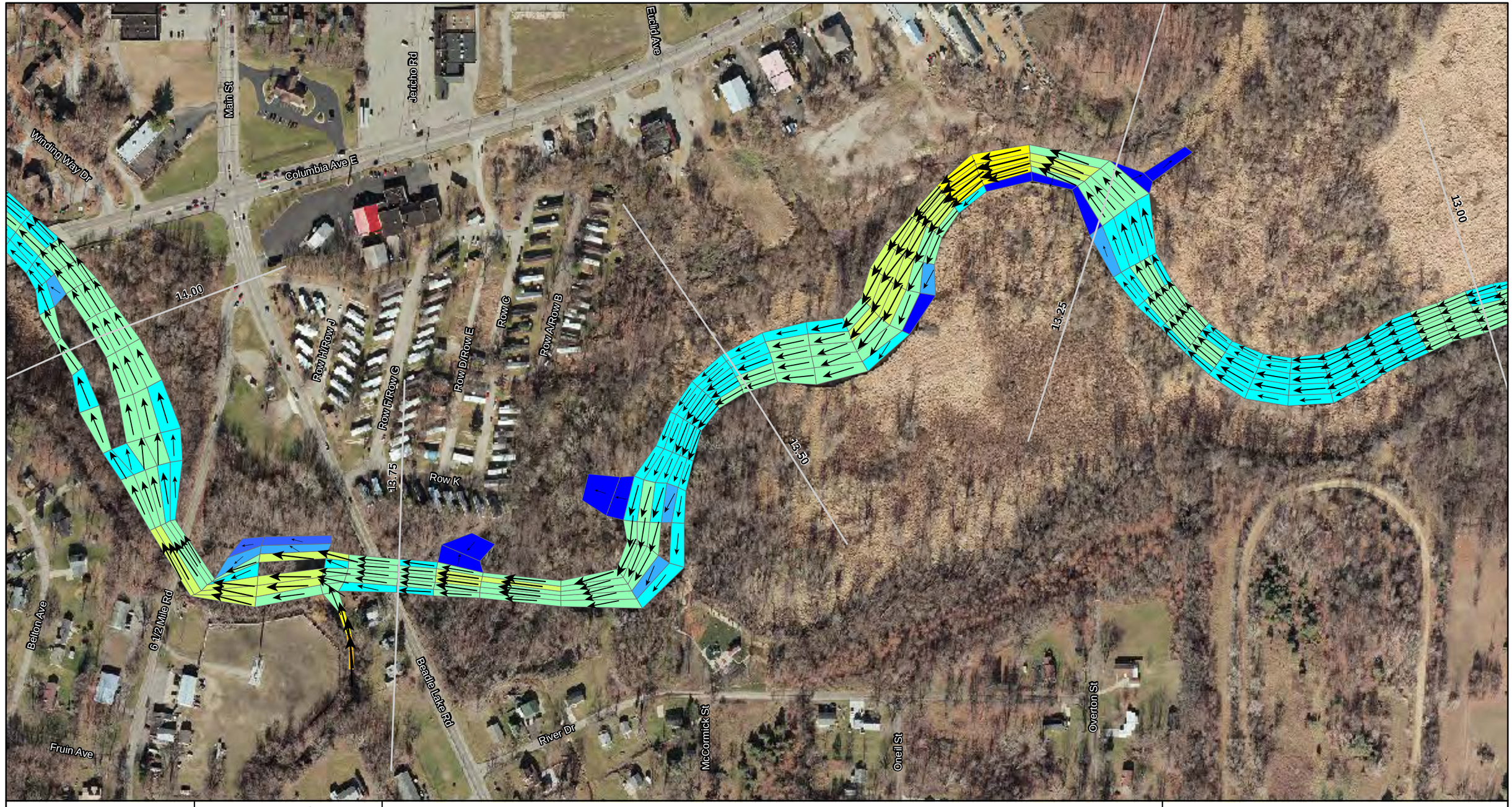
MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

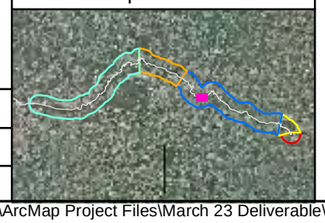
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

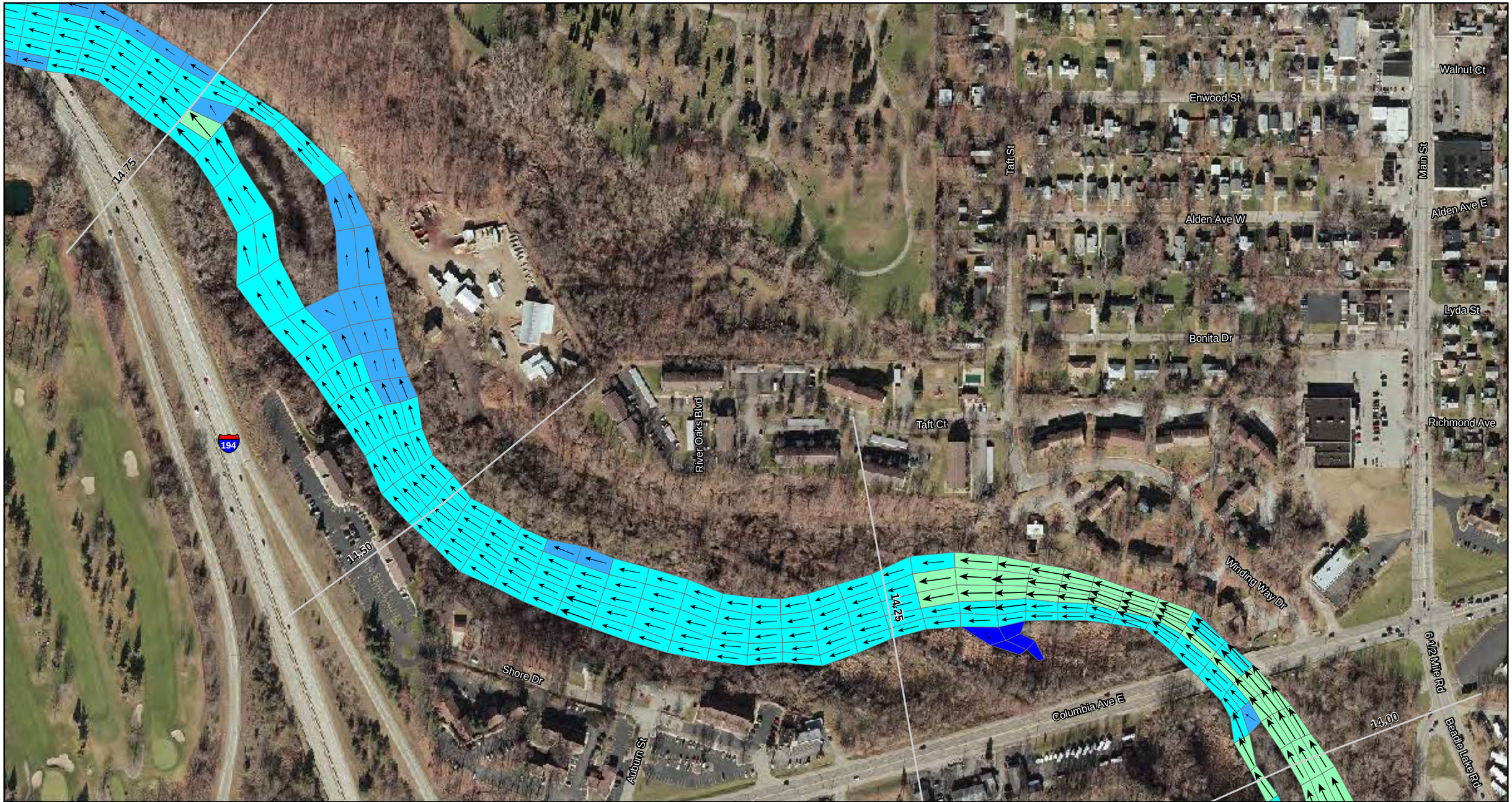
MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

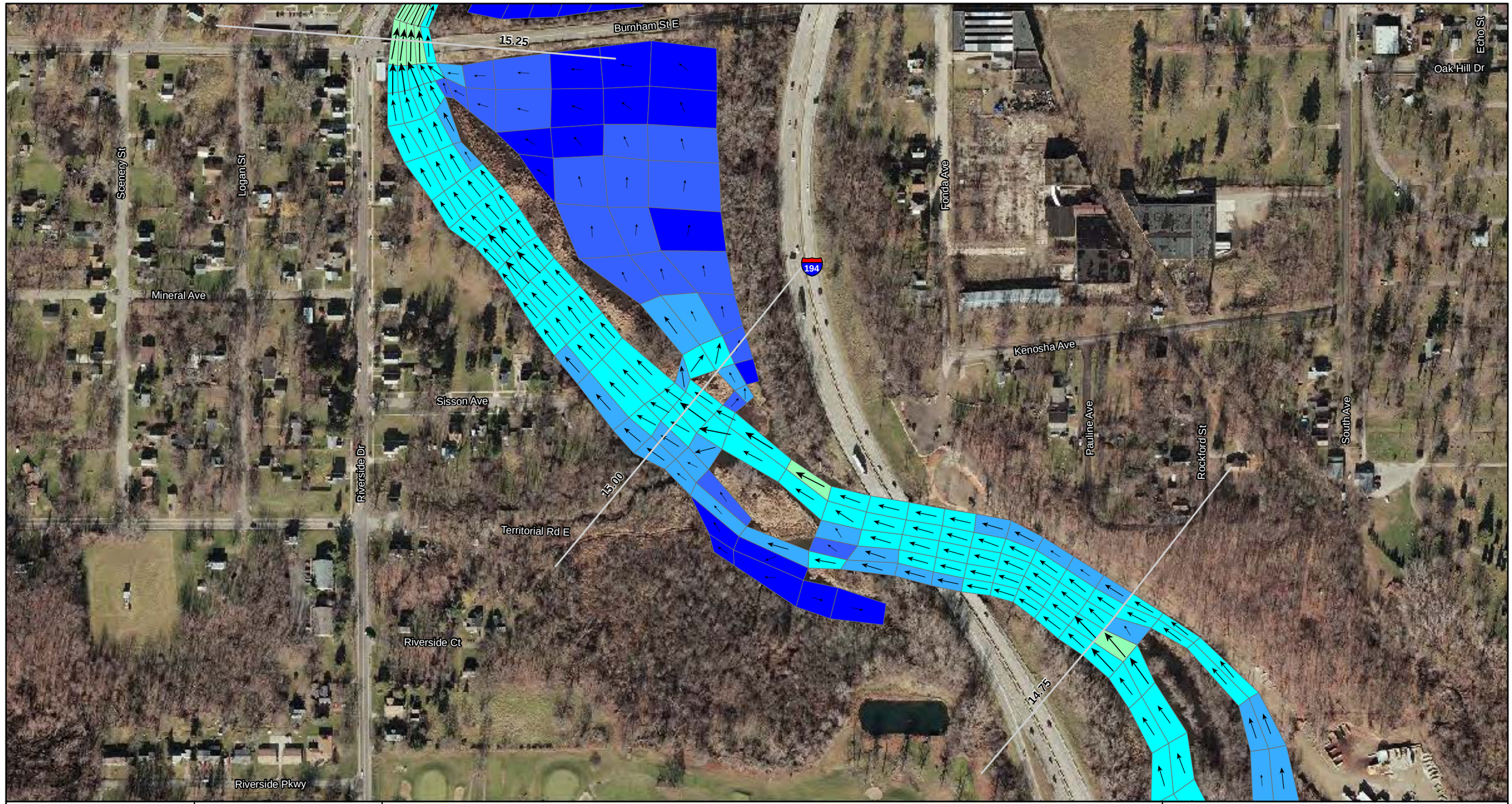
MP 14.00 - MP 14.85

SHEET 17 OF 56

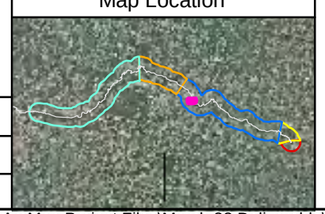
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

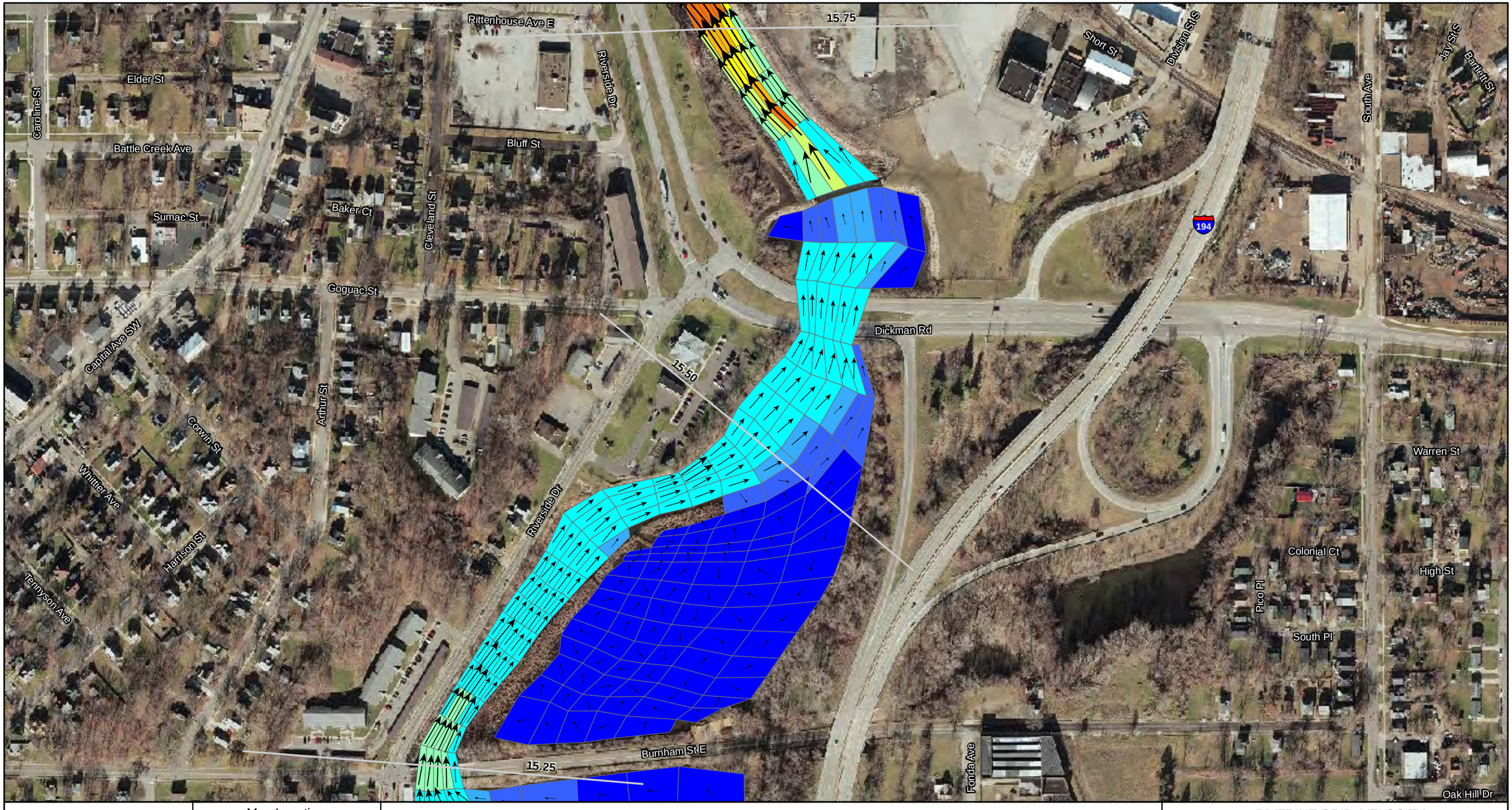
MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

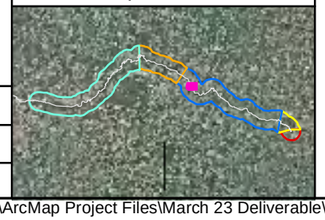
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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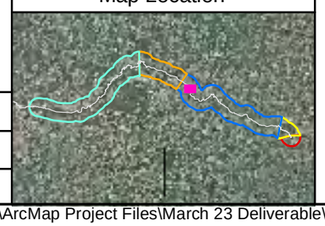
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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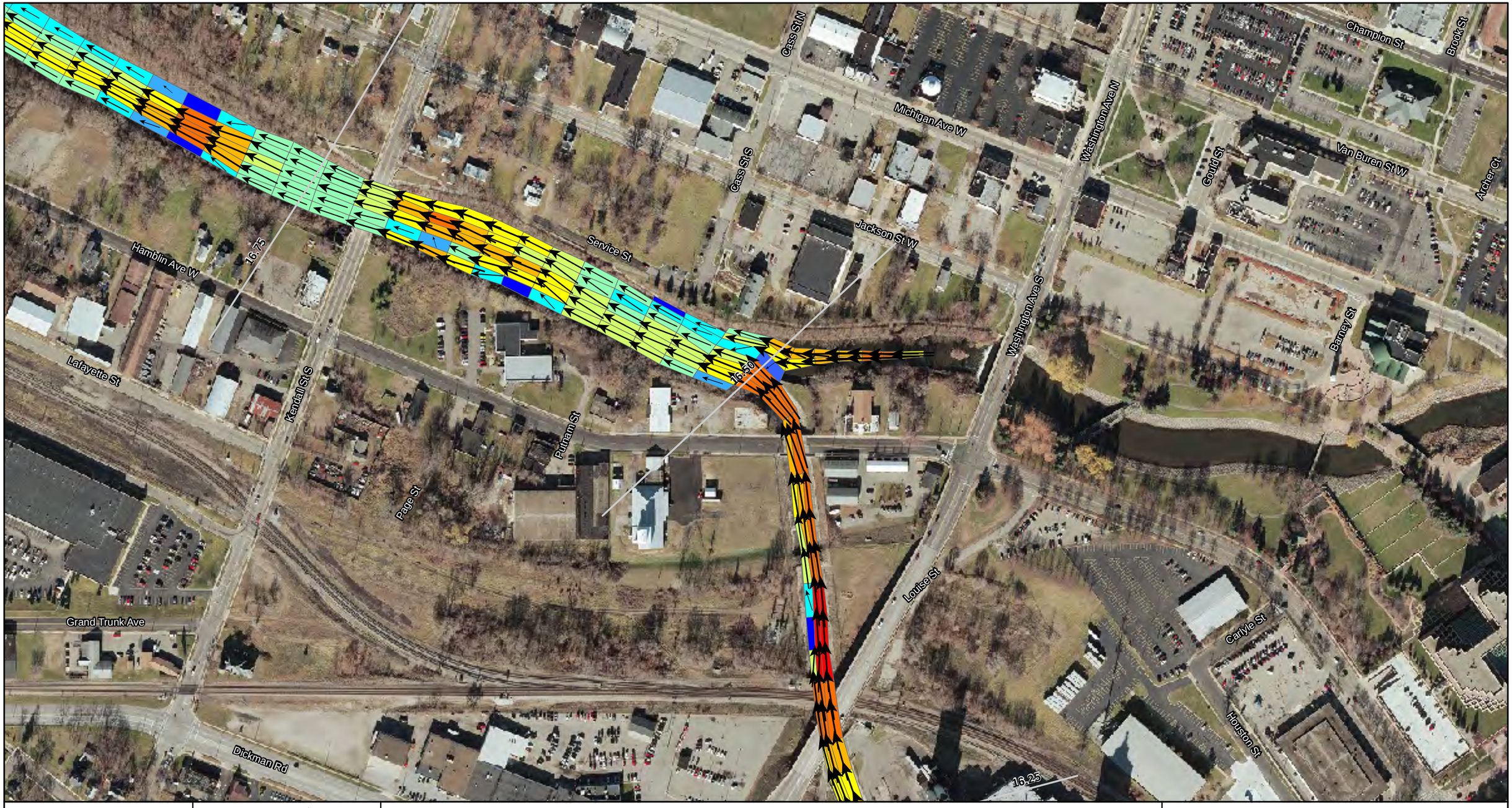
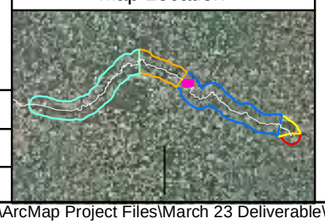
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

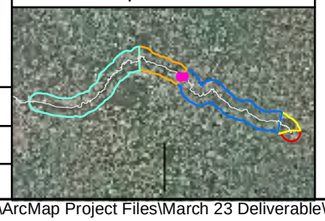
Aerial Photography Date: November 2011

Jackson St W
Grand Ave
Van Buren St W
Graves Ave
Graves Ave
Hubbard St
Manchester St W
Lemont St
17.30
17.25
15th St N
14th St N
12th St N
Jordan St
Turner St
Michigan Ave W
Thorne St
17.00
Wood St S
Lafayette Ave
14th St N
Butler St
Hamblin Ave W
Angell St
Parish St
Lafayette St
E Ave

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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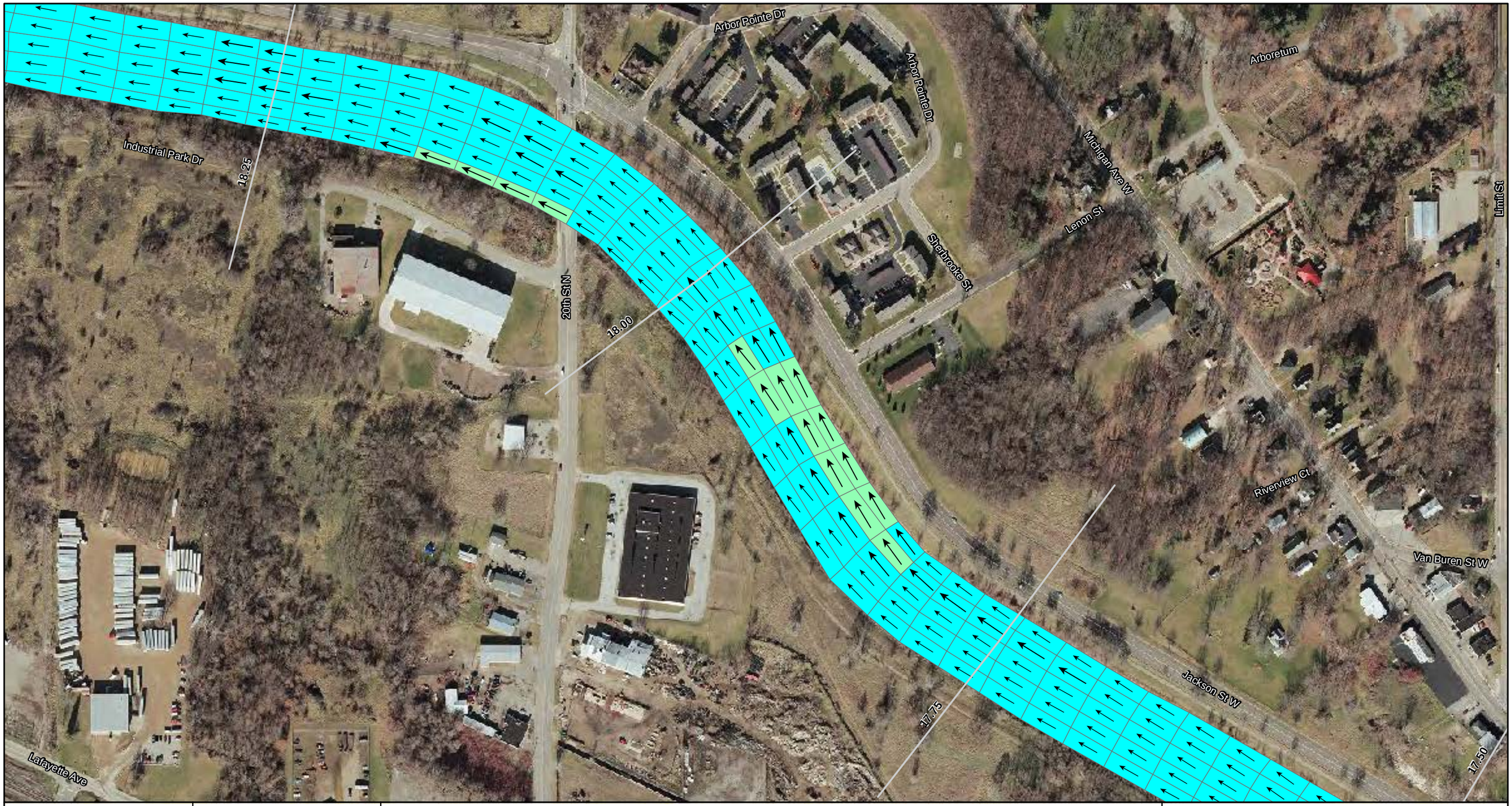
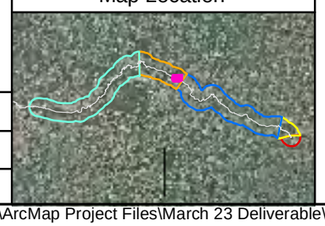
Aerial Photography Date: November 2011



Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

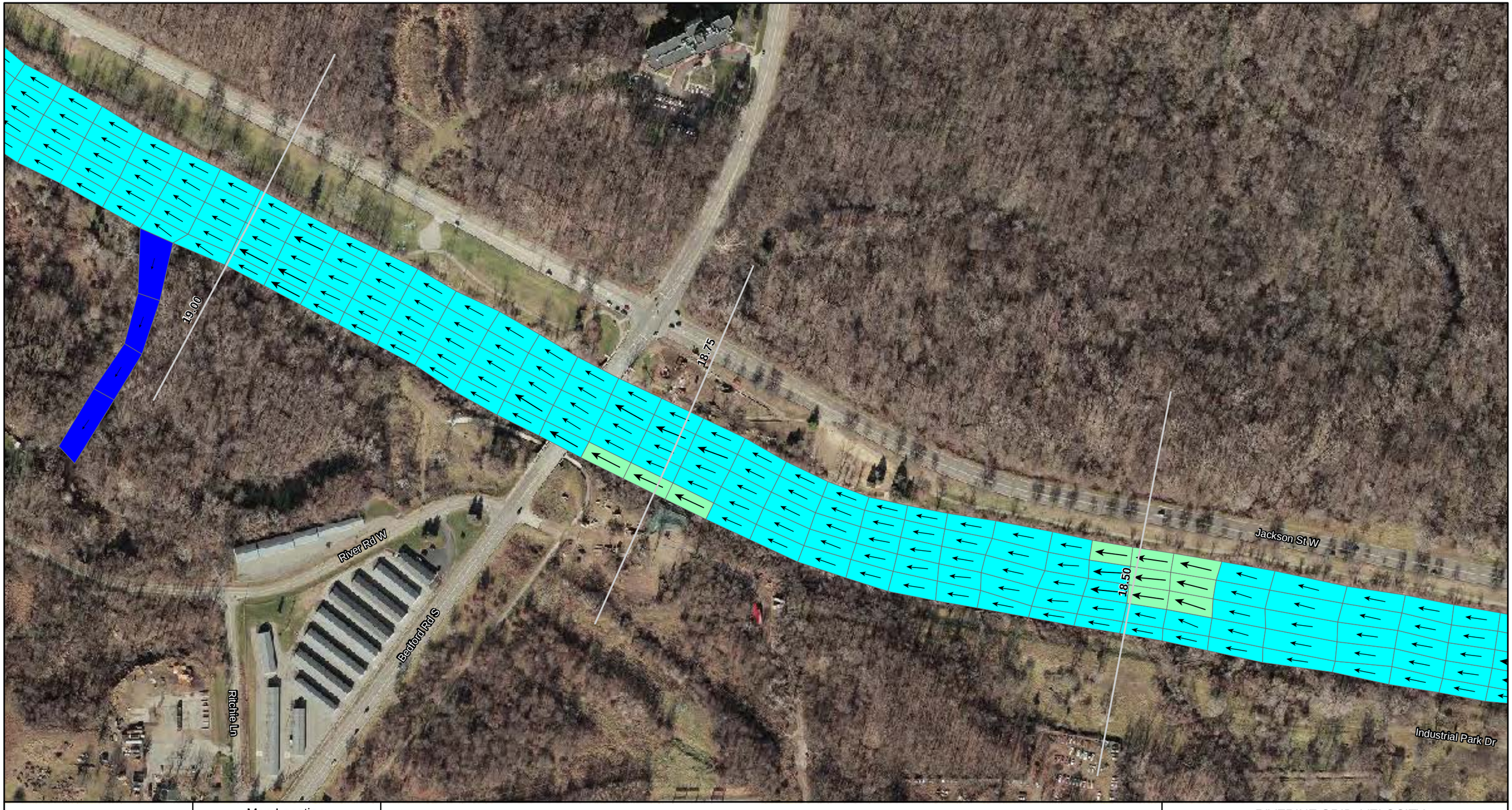
MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

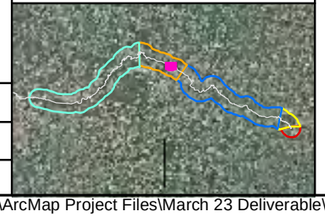
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

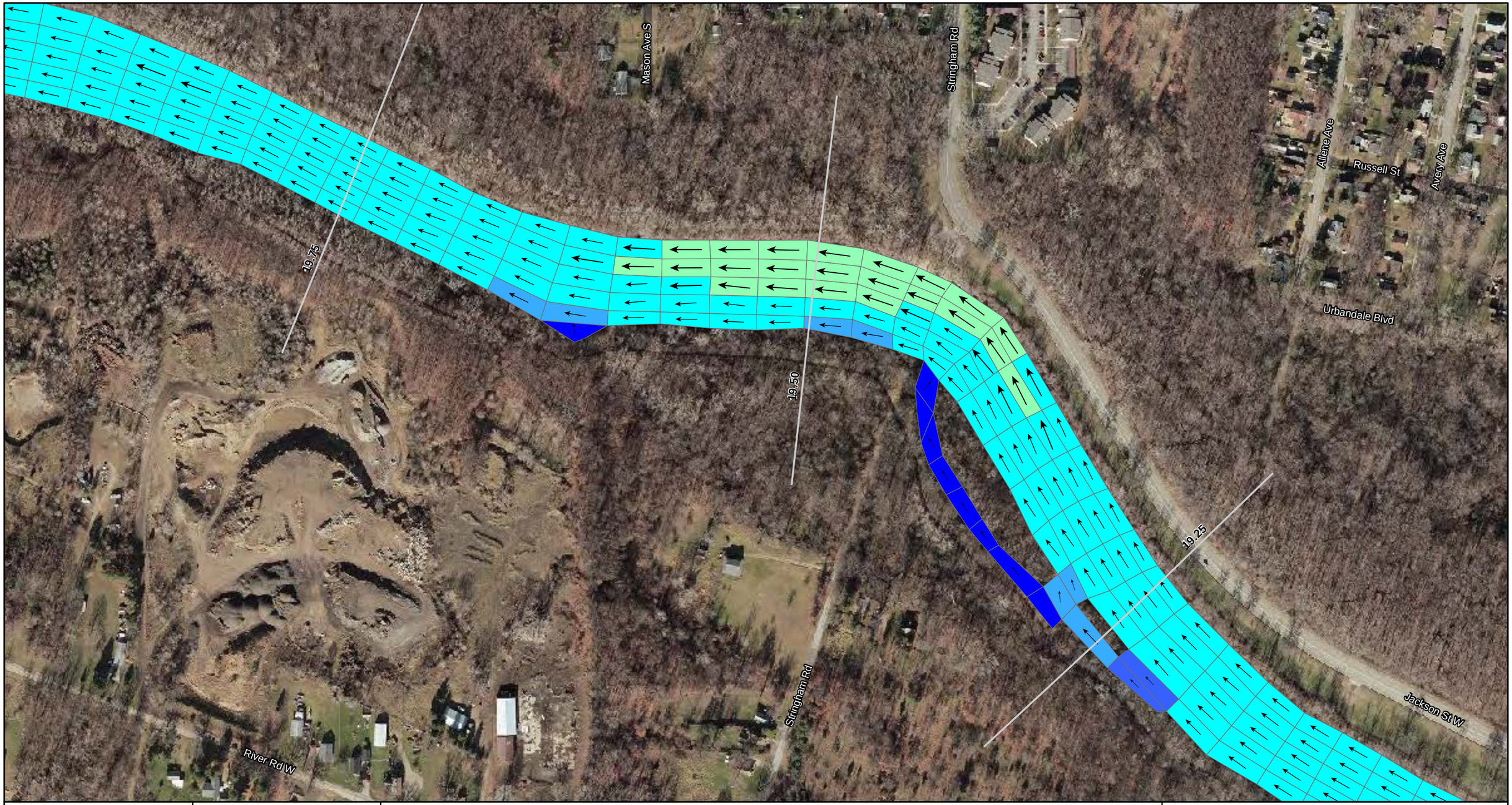
MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

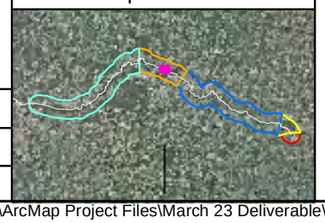
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

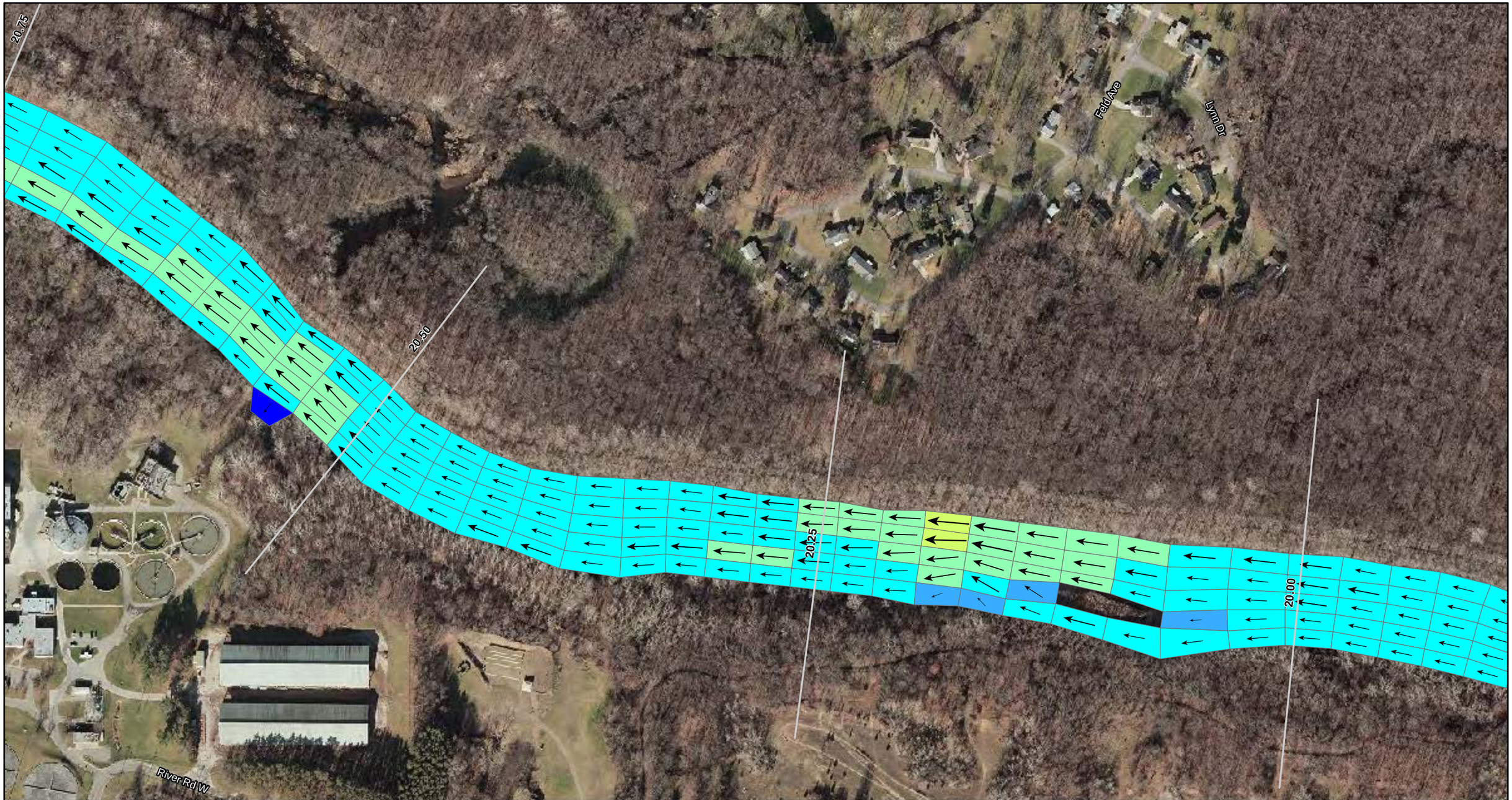
MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Coldwater Ave

Custer Dr

Stillson Blvd

21.25

21.00

20.75

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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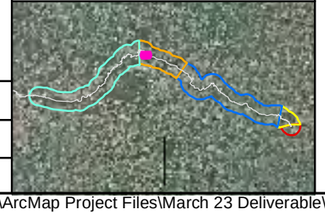
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

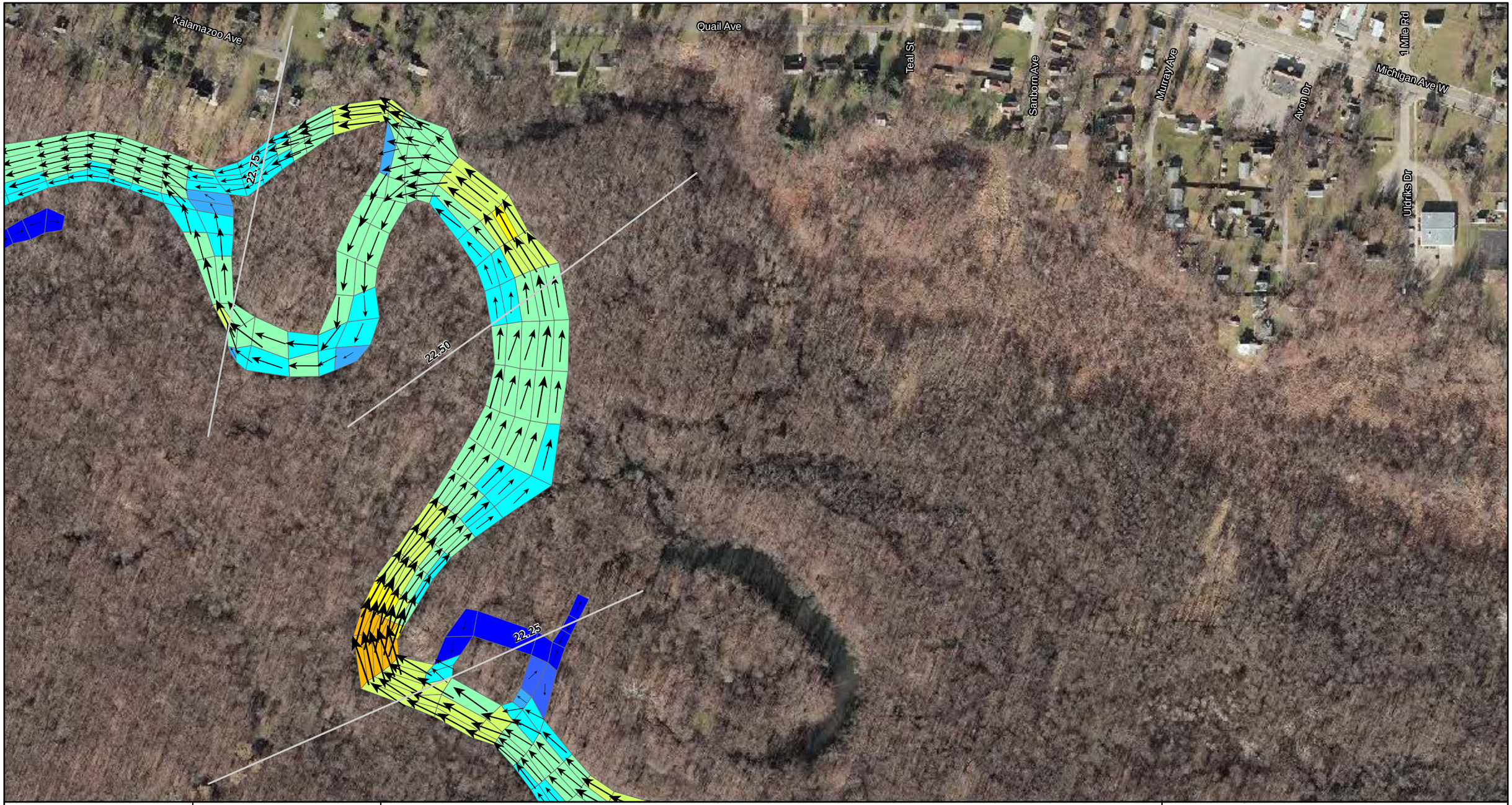
MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

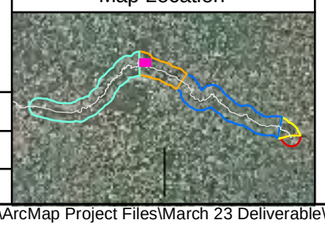
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

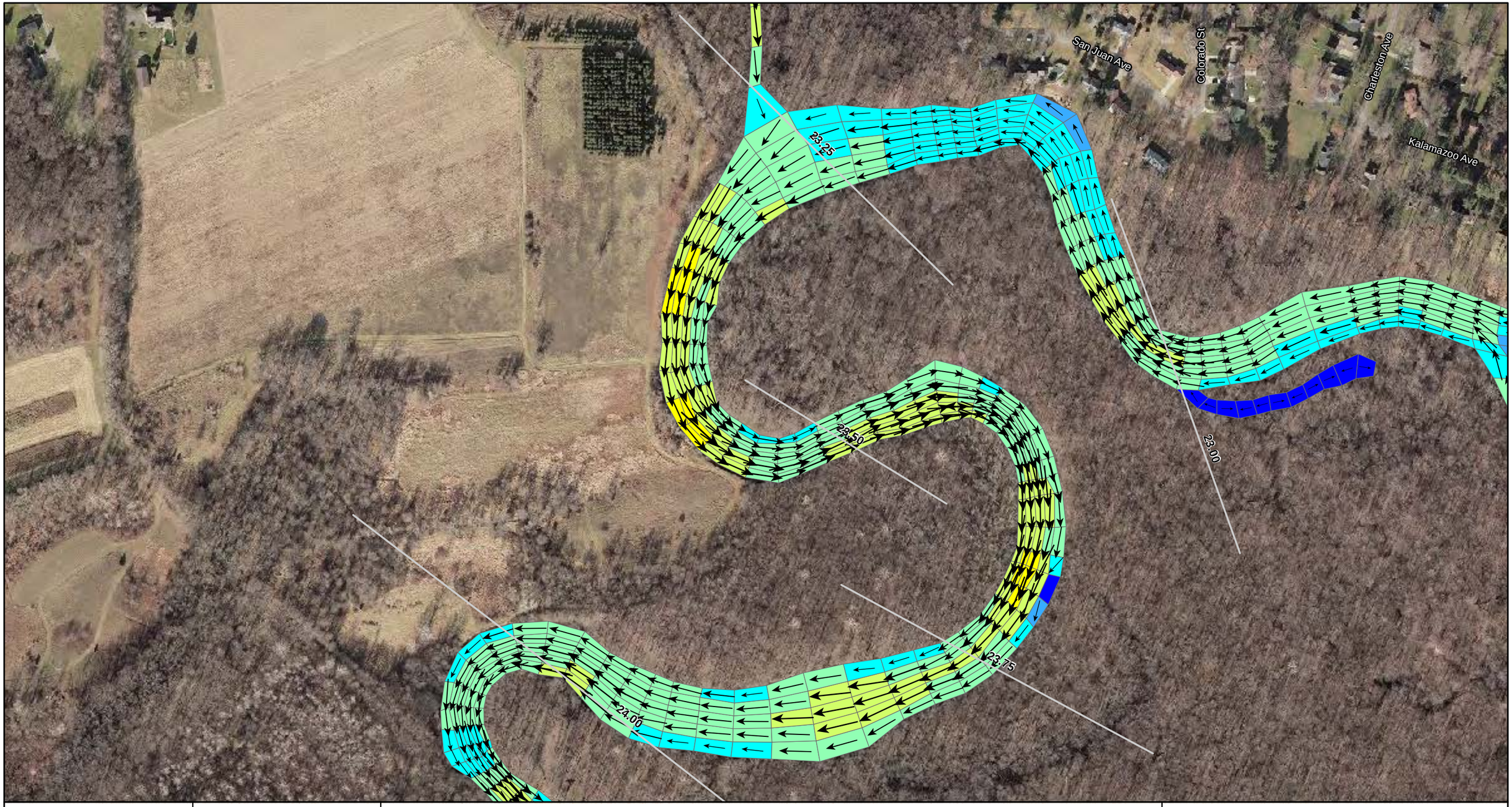
MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

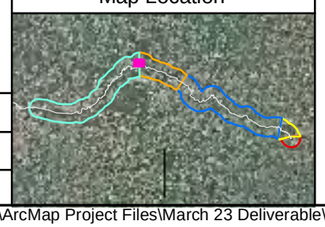
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011

24.00
24.25
24.50
24.75
River Rd W
Fort Custer Dr
County Line Rd

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

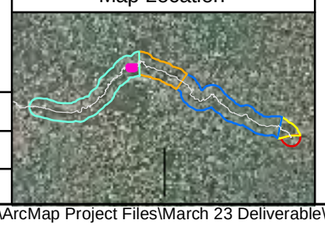
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

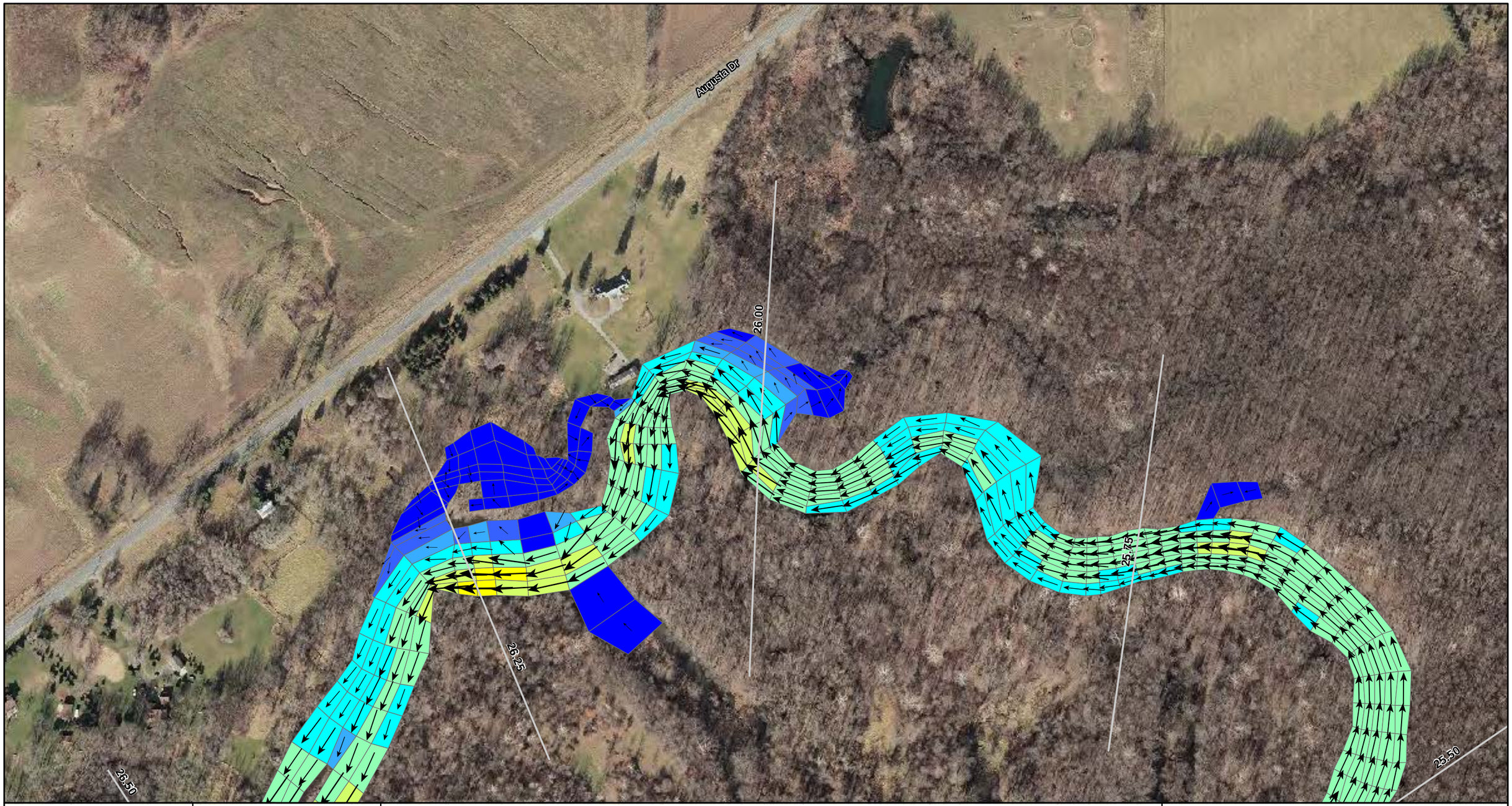
MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

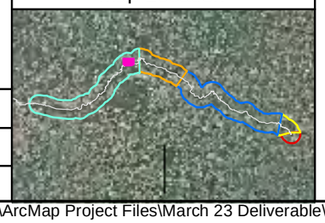
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

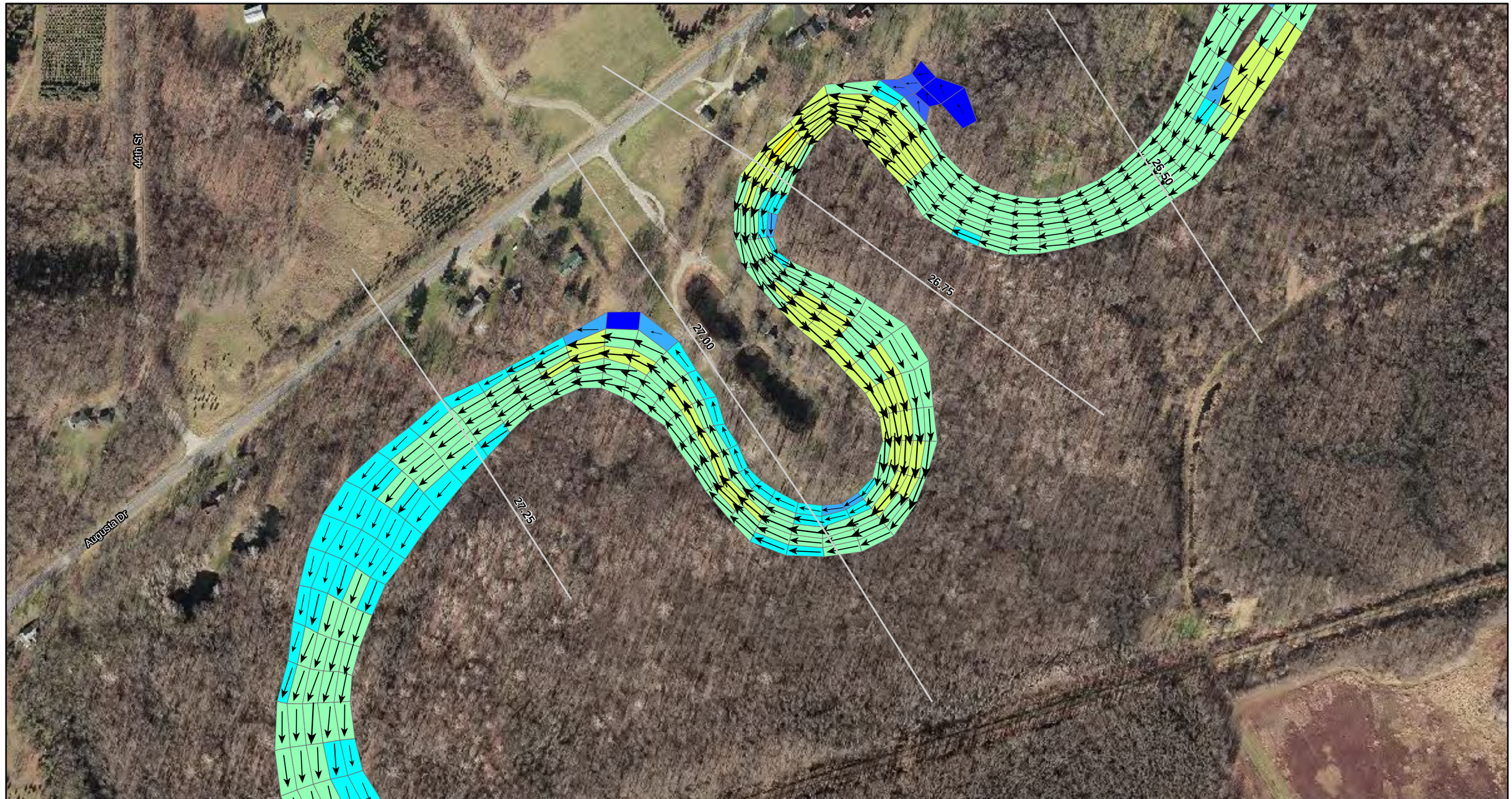
MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

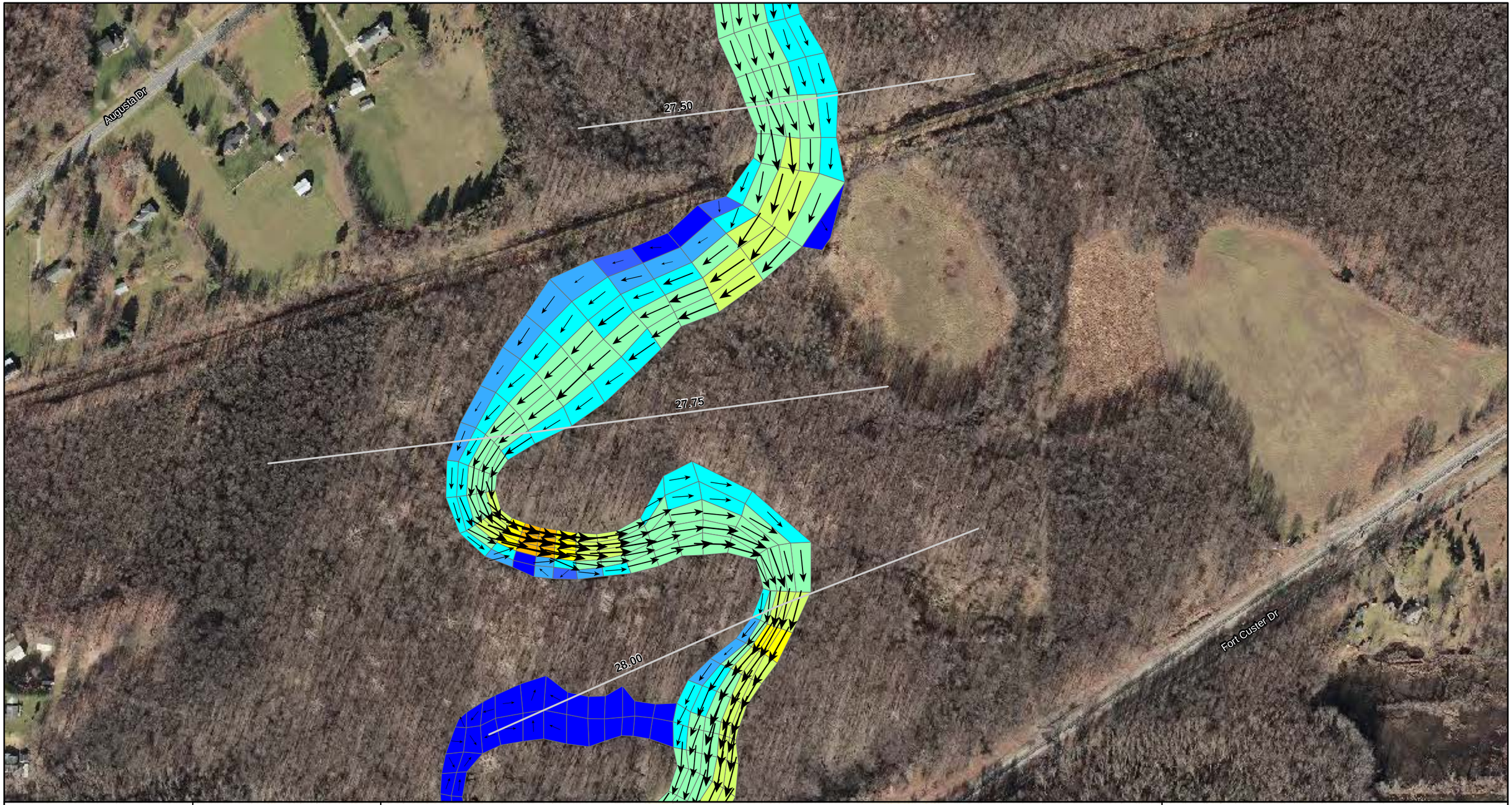
MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

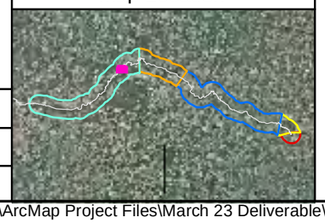
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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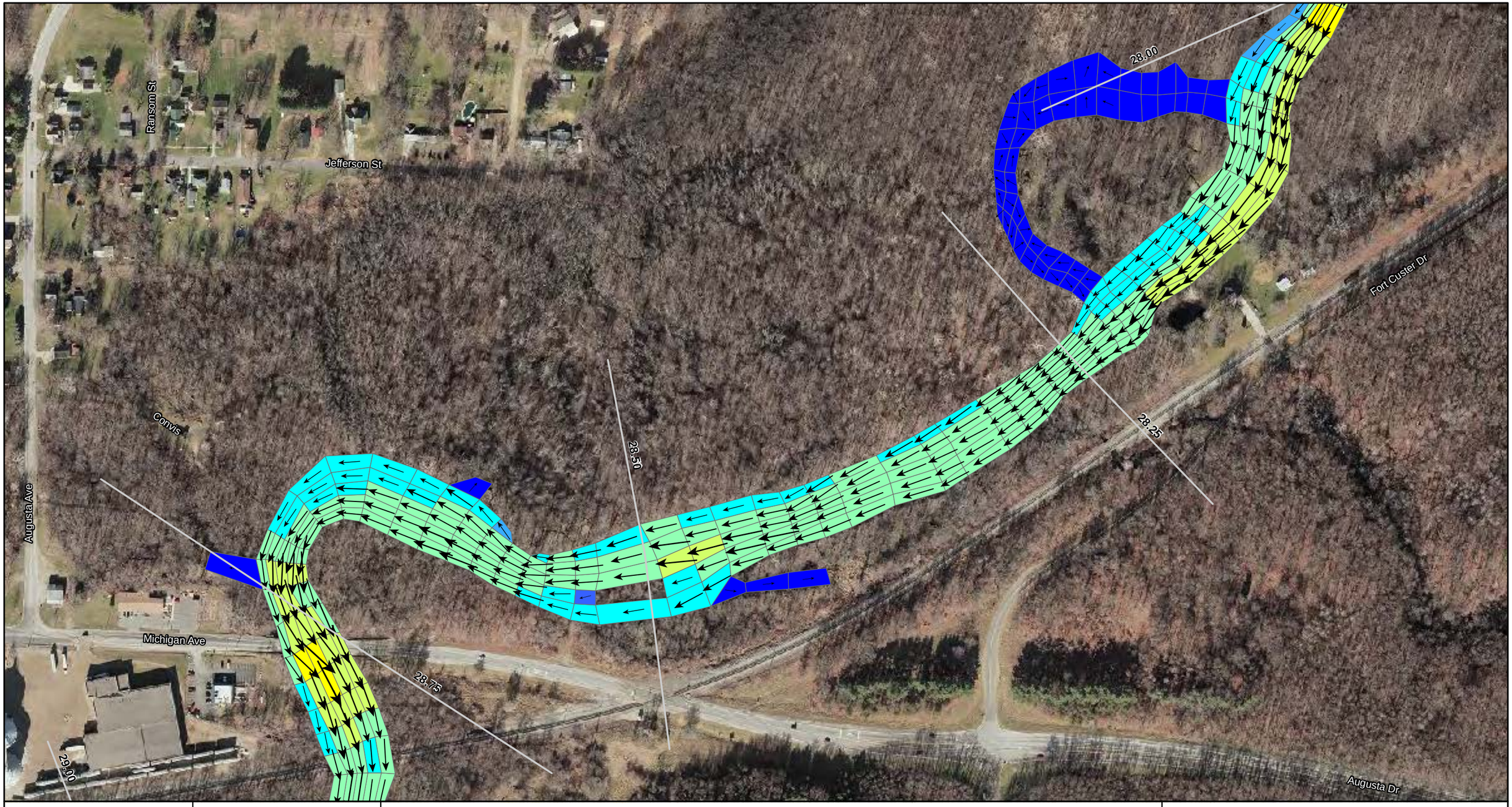
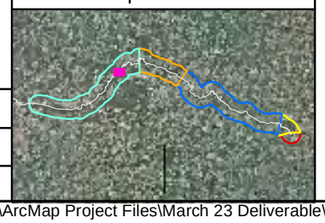
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Clinton St
Clinton St
Chestnut St
Webster St
Church St
Fayette St
Cass St
Cherry St
Lincoln St
28.75
29.00
29.25
29.50
Augusta Climax Rd
Fort Custer Rec Area Access

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

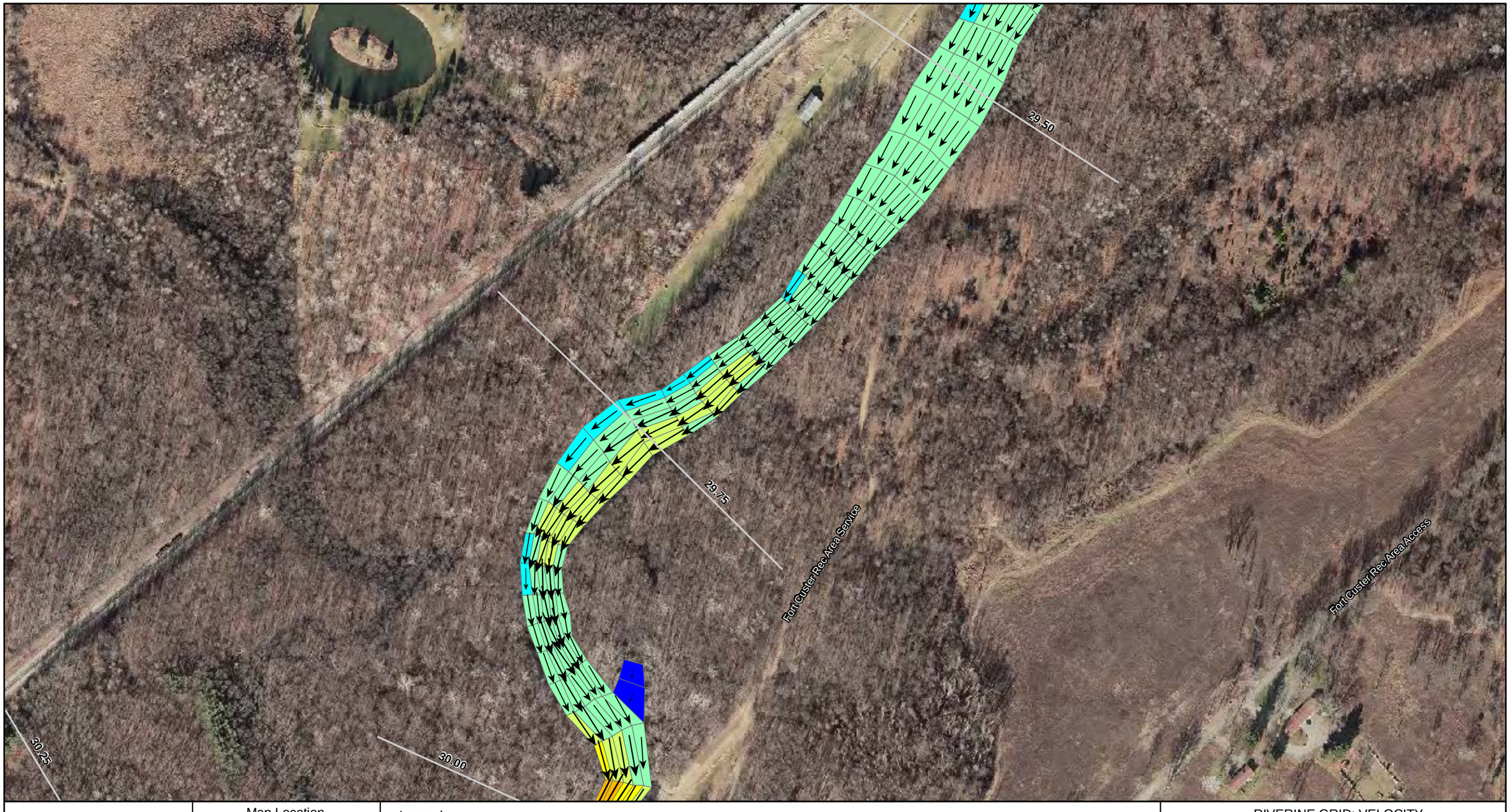
MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

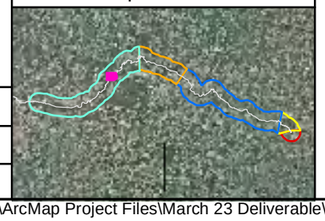
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

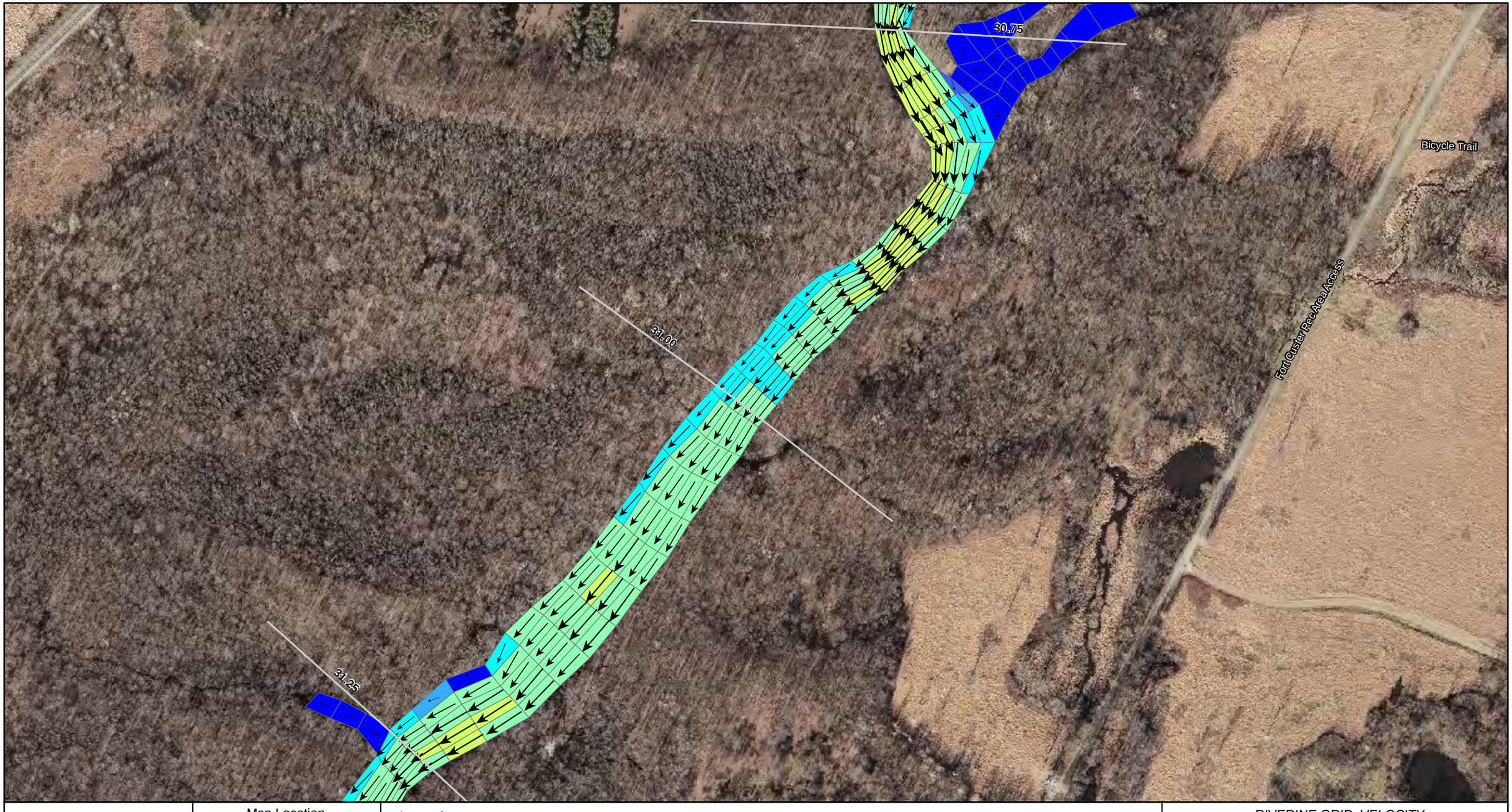
MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

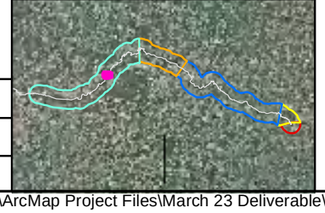
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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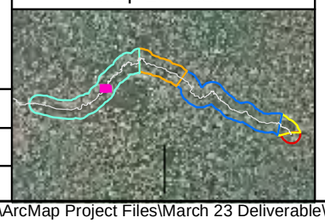
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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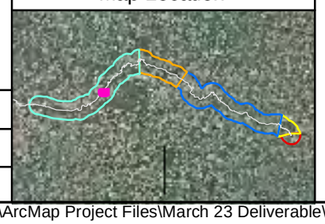
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

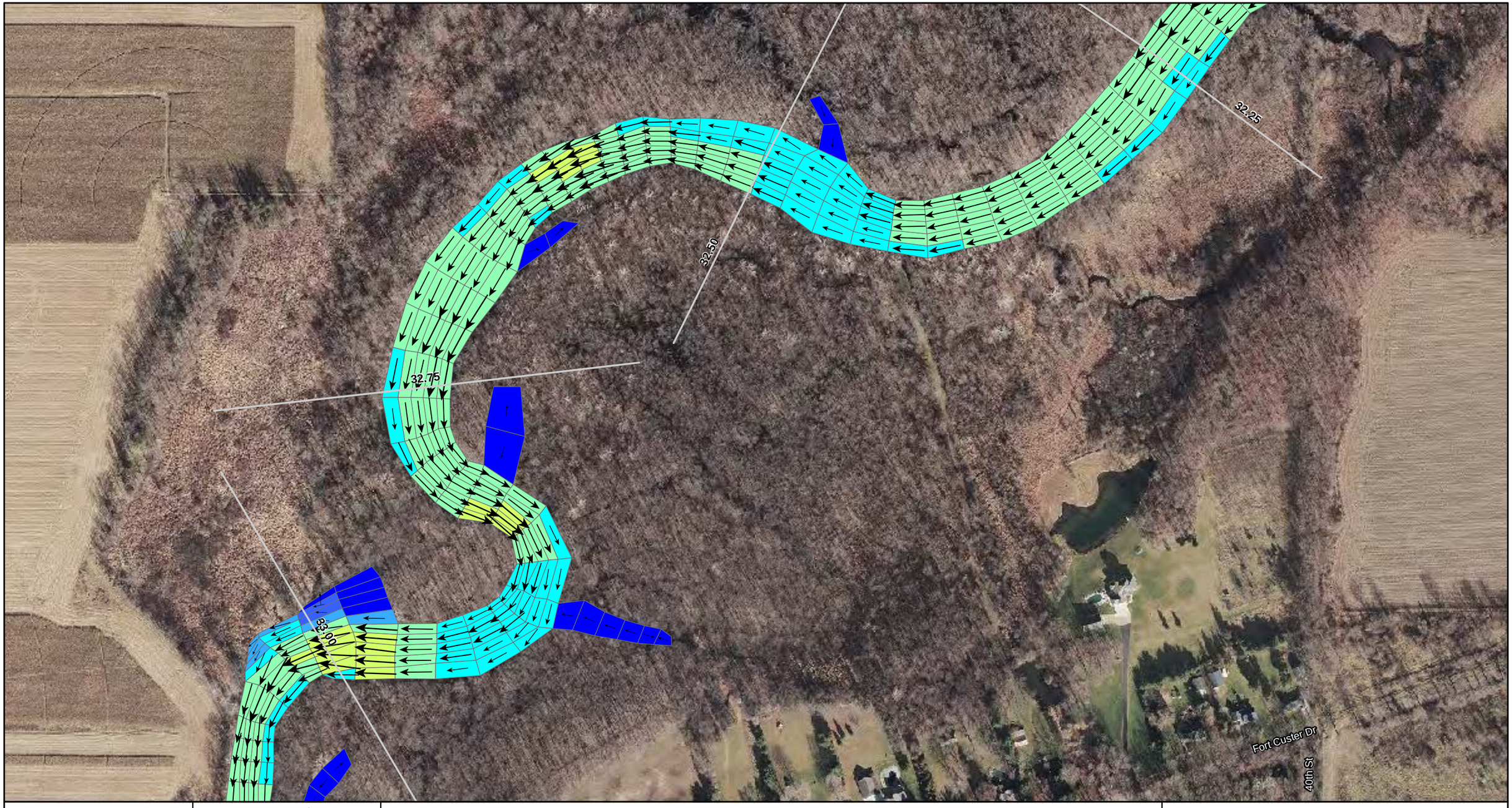
MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

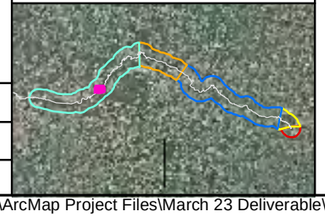
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

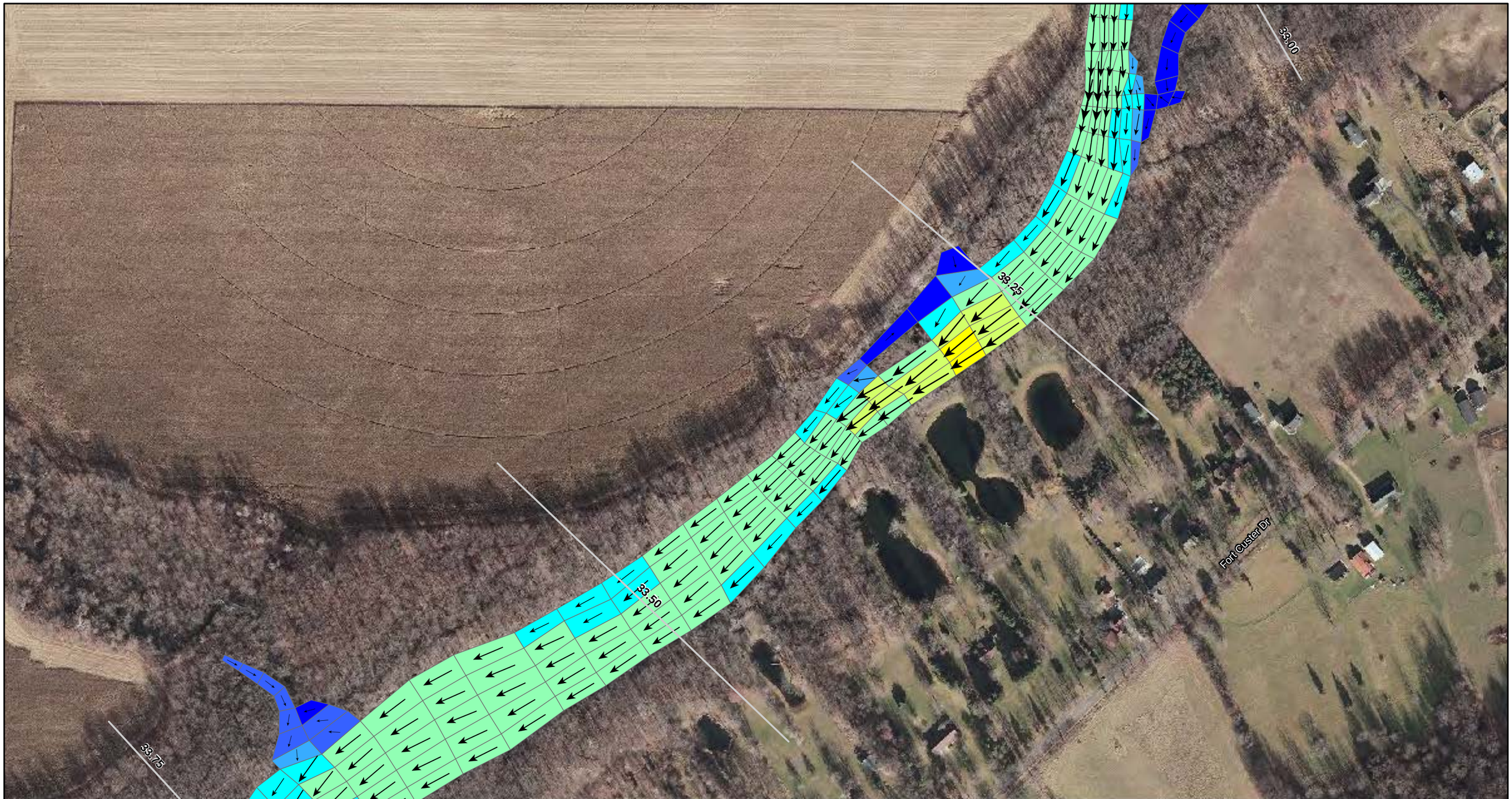
MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

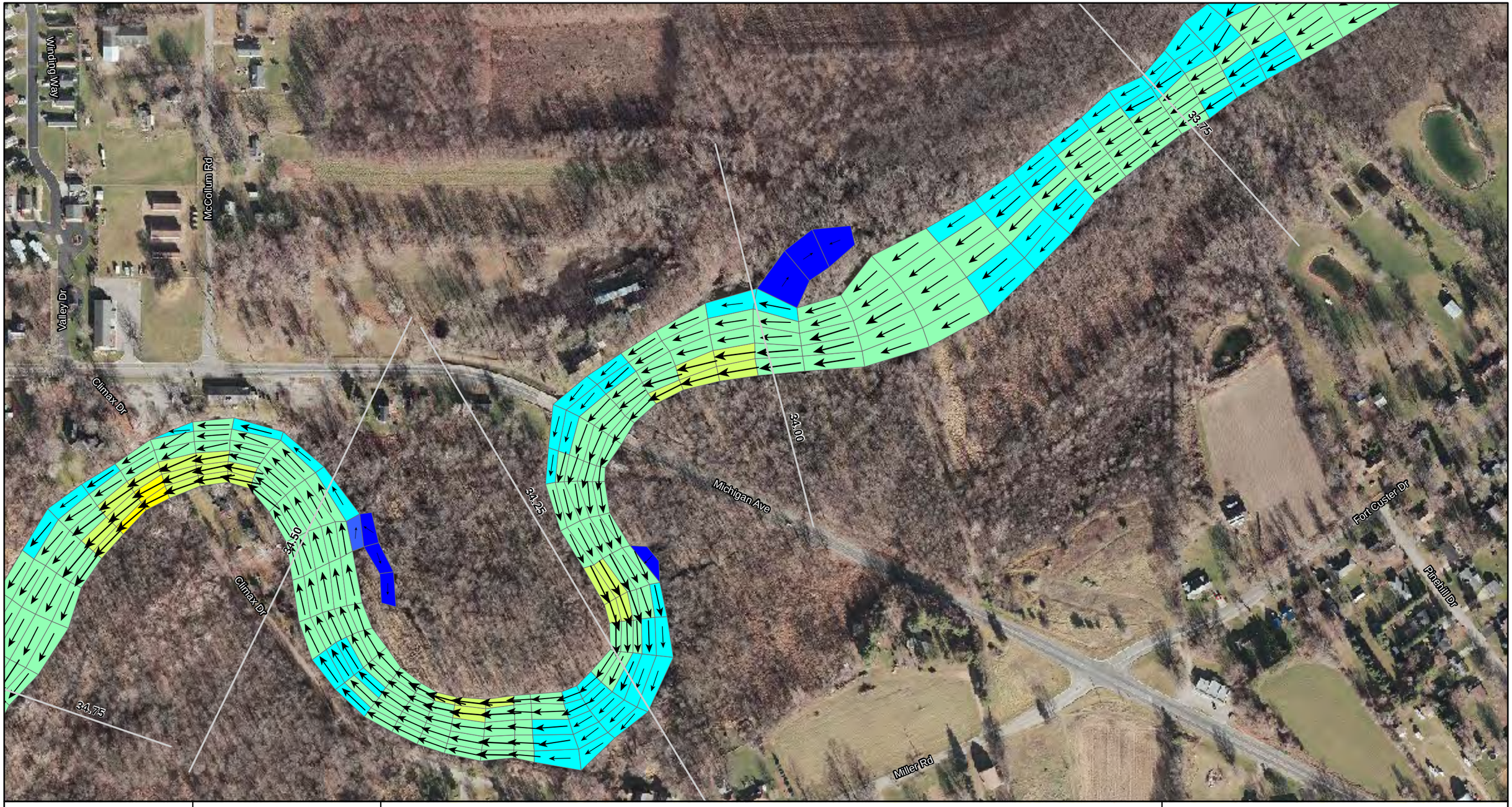
MP 33.10 - MP 33.70

SHEET 44 OF 56

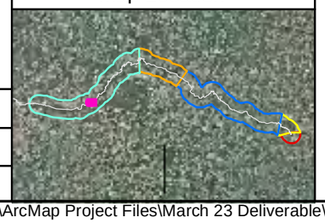
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 33.70 - MP 34.70

SHEET 45 OF 56

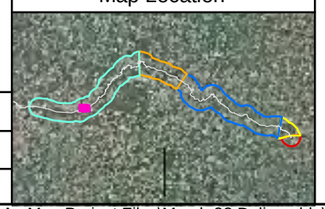
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

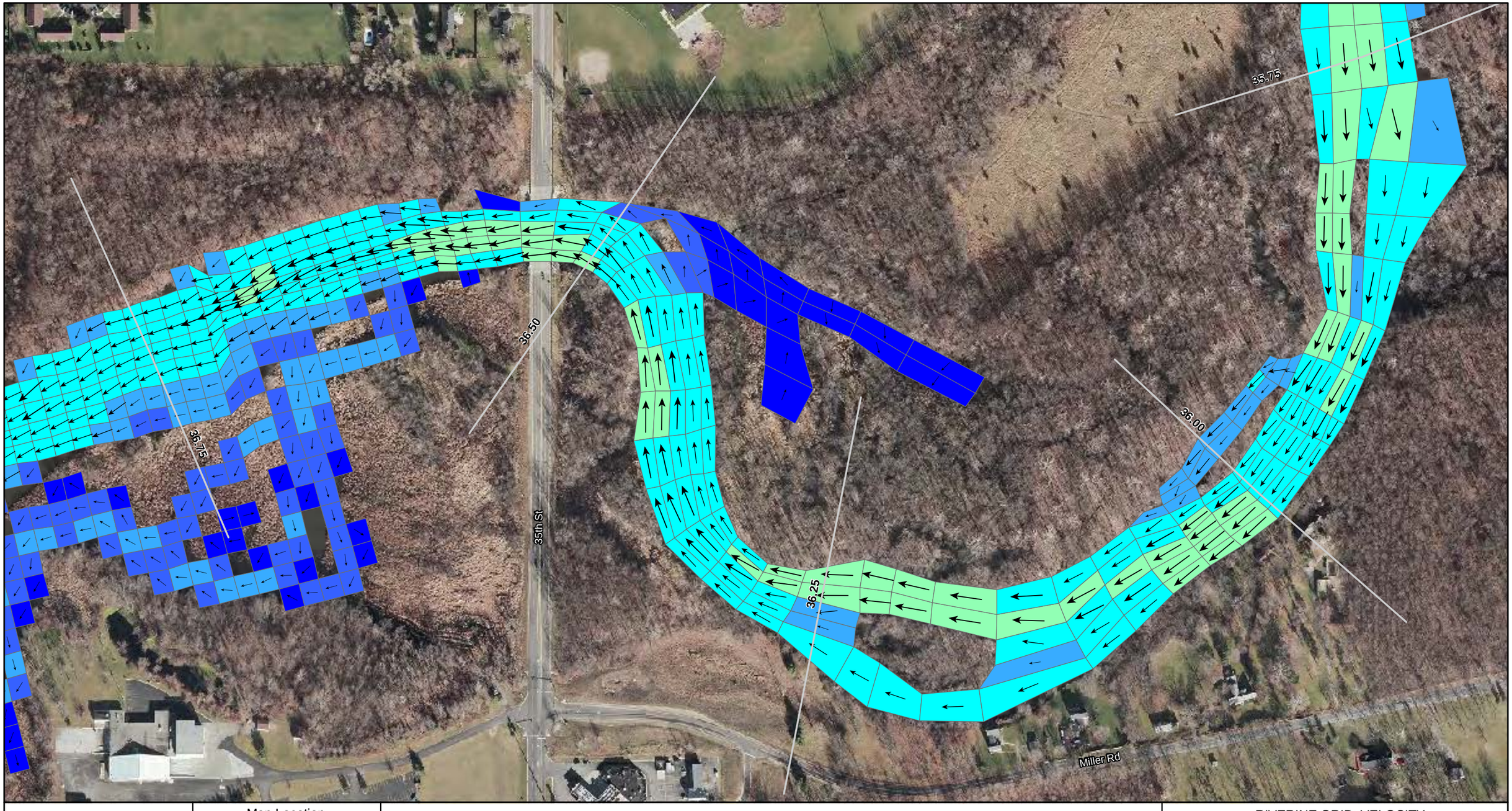
MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

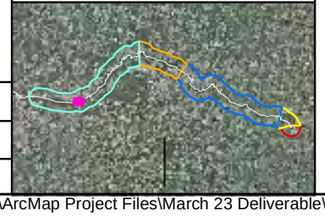
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

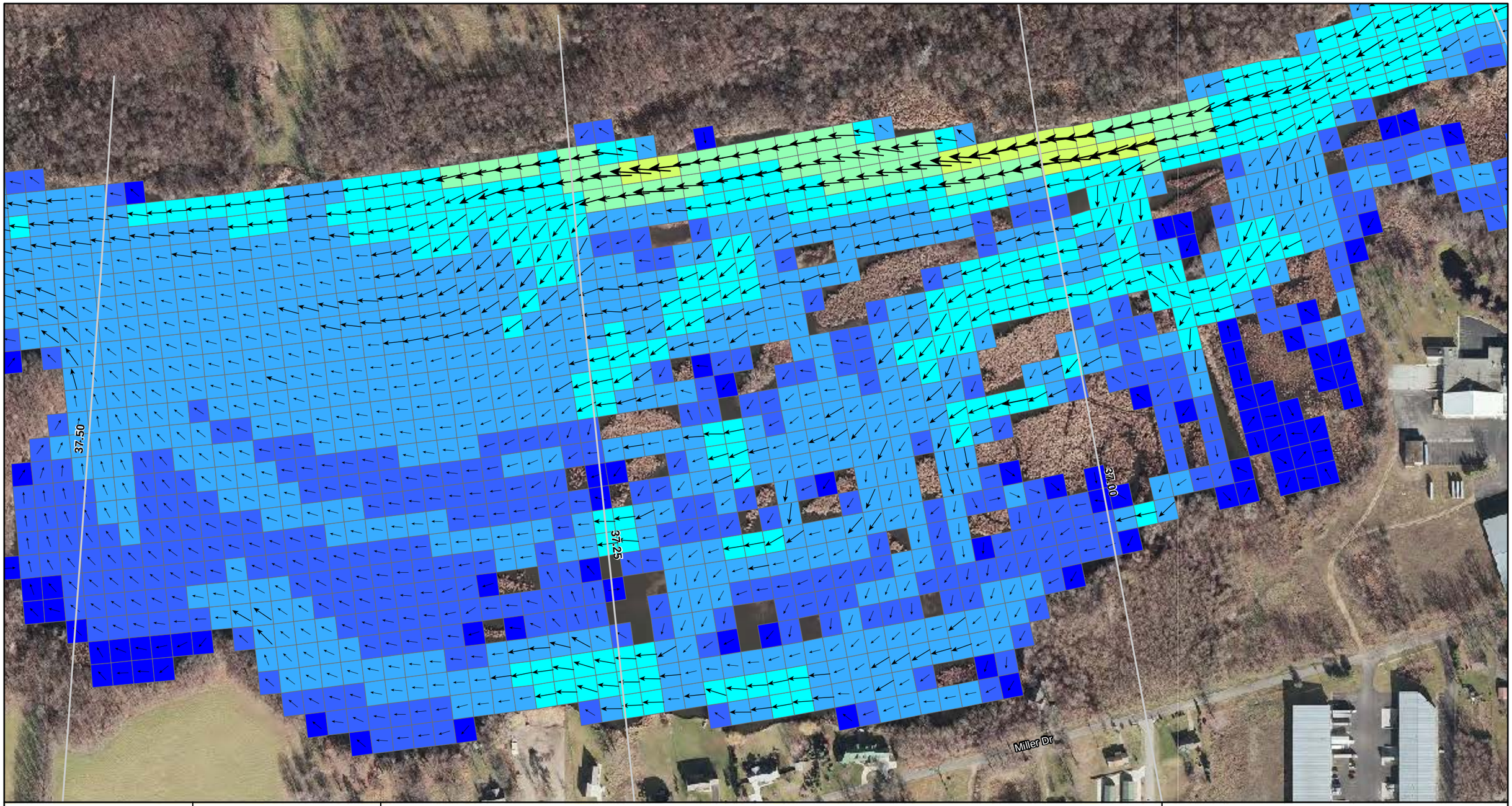
MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

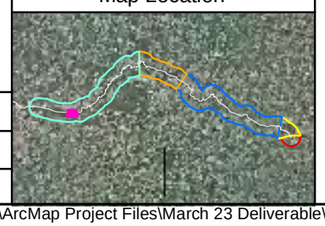
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

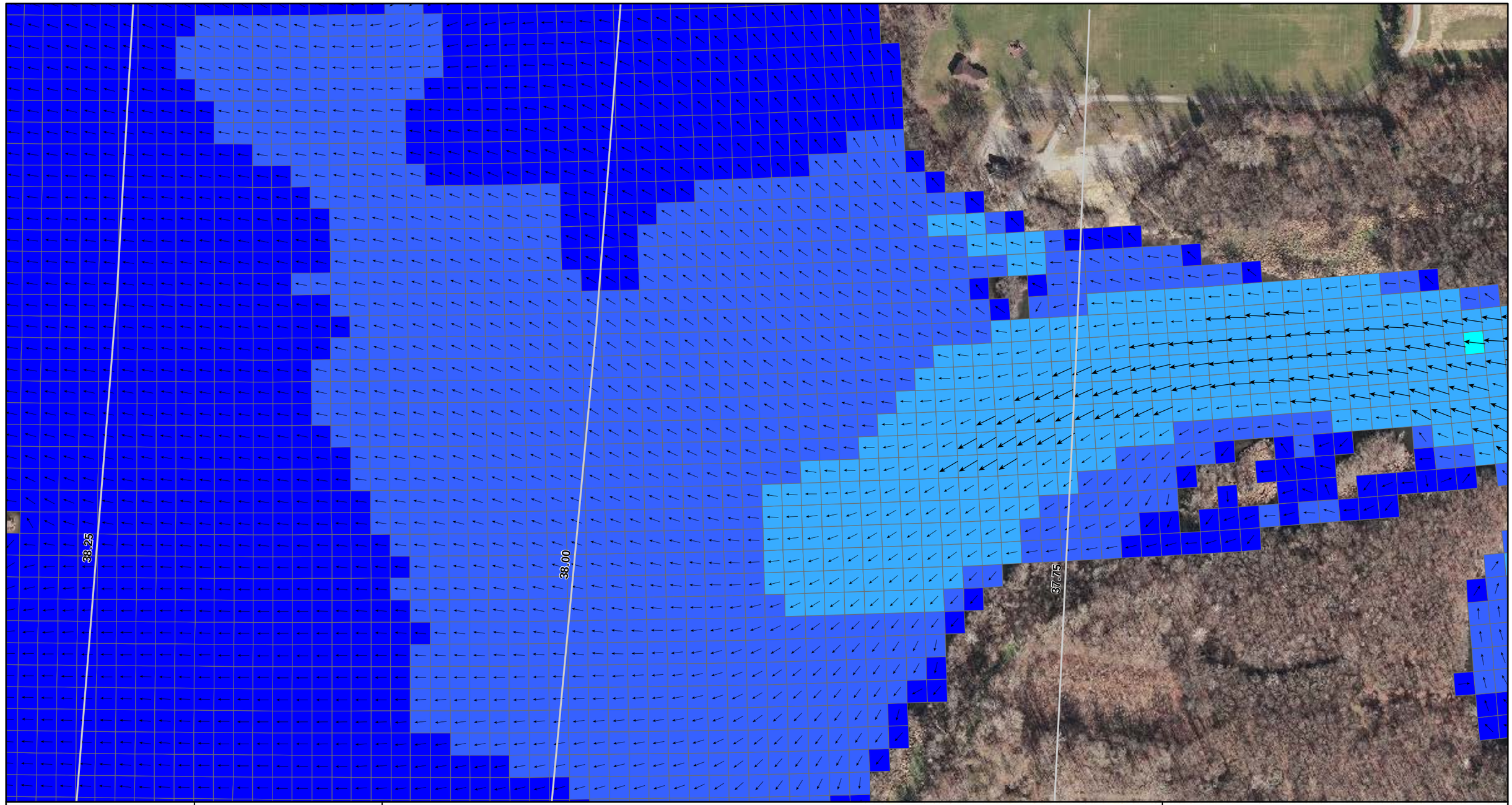
MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

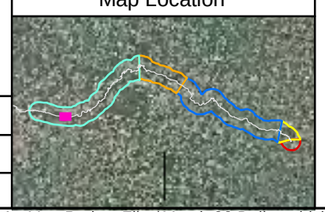
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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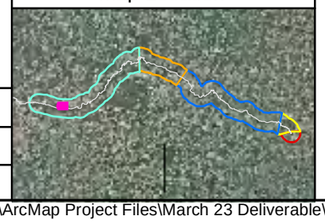
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

38.50

38.25

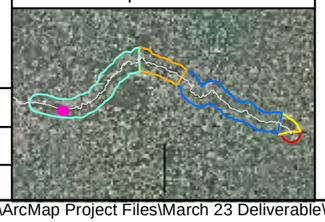
38.00

Lyth Rd

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

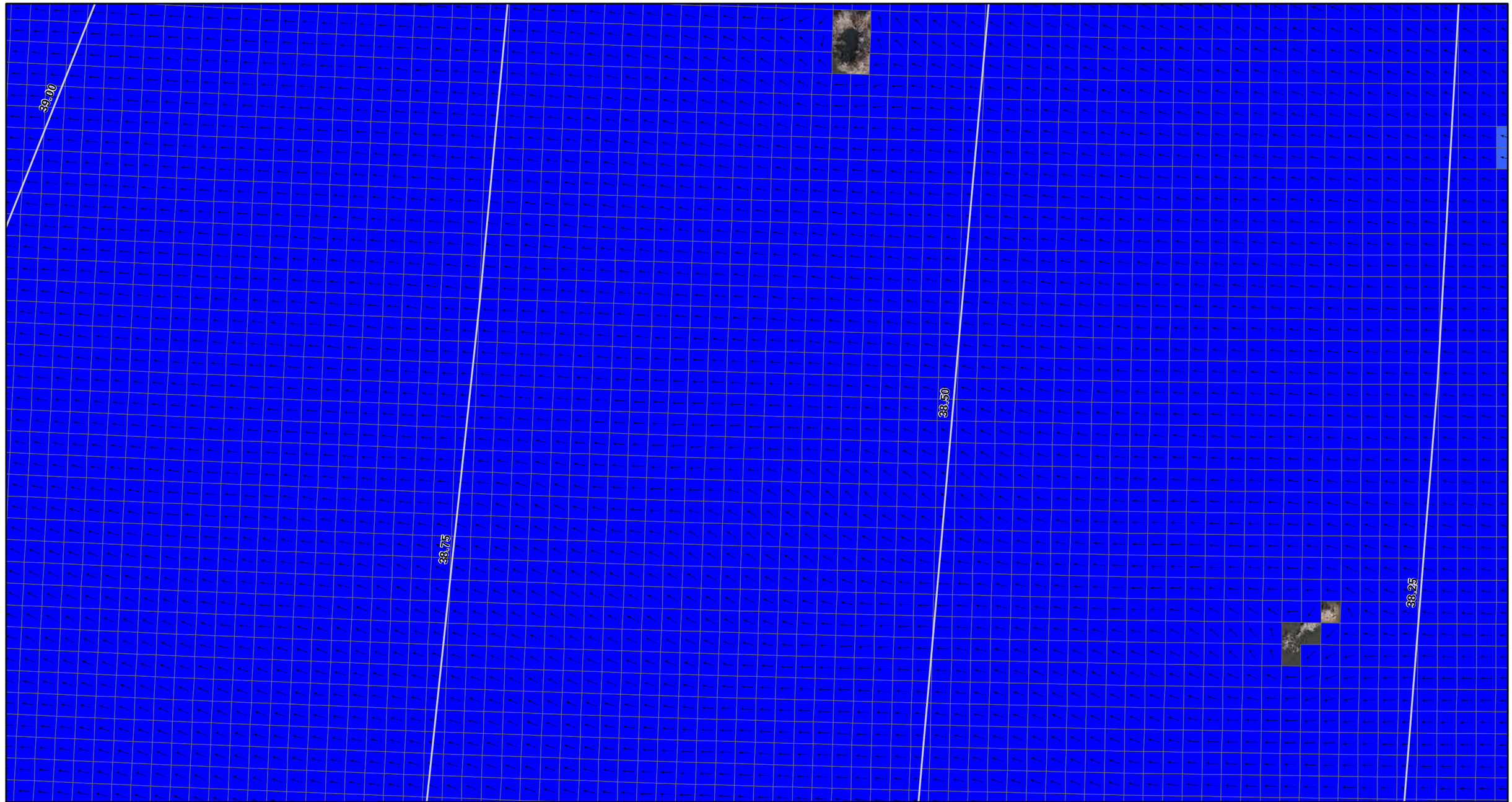
MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

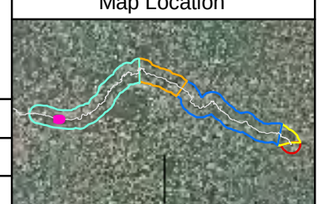
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

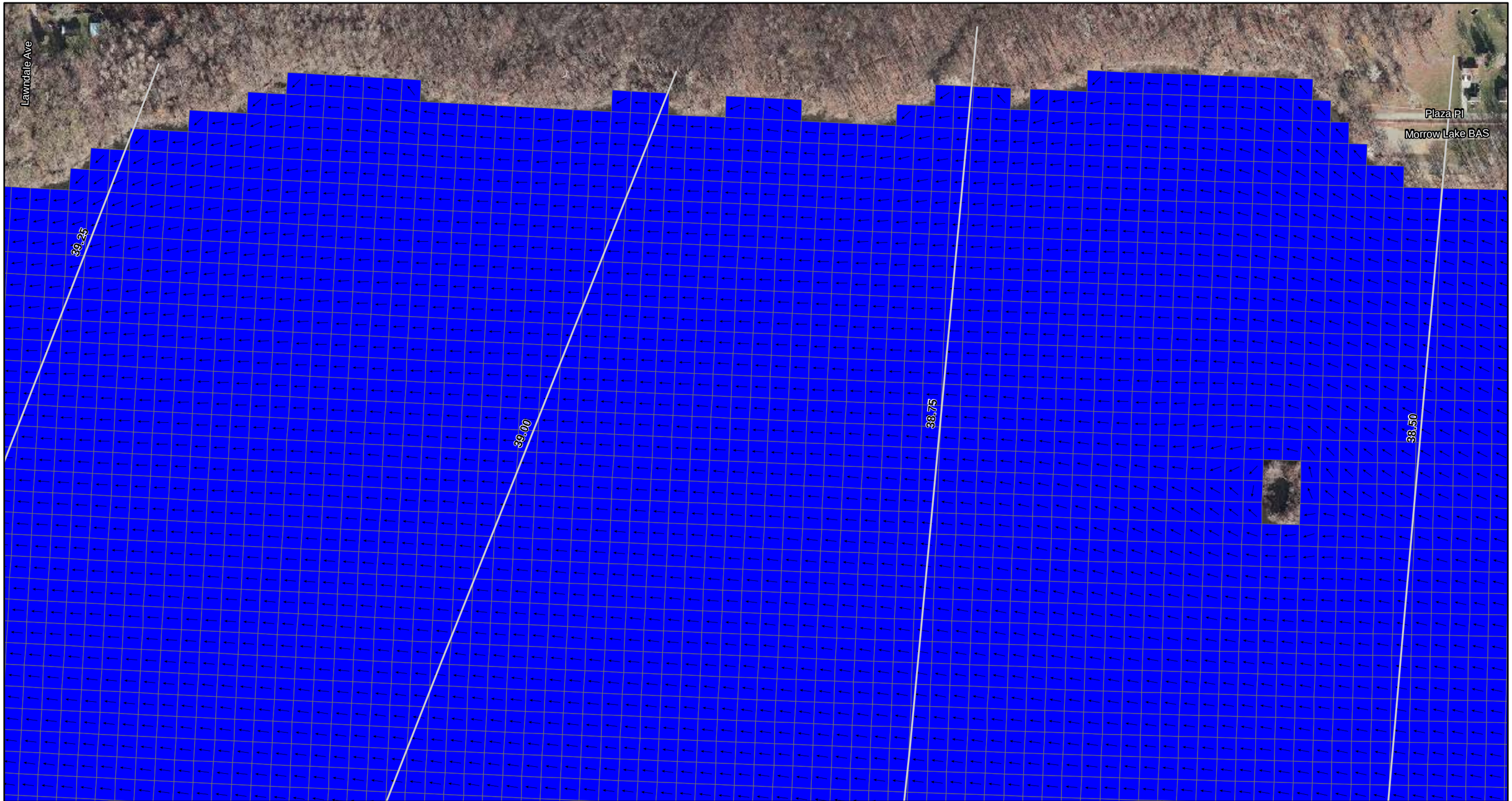
MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

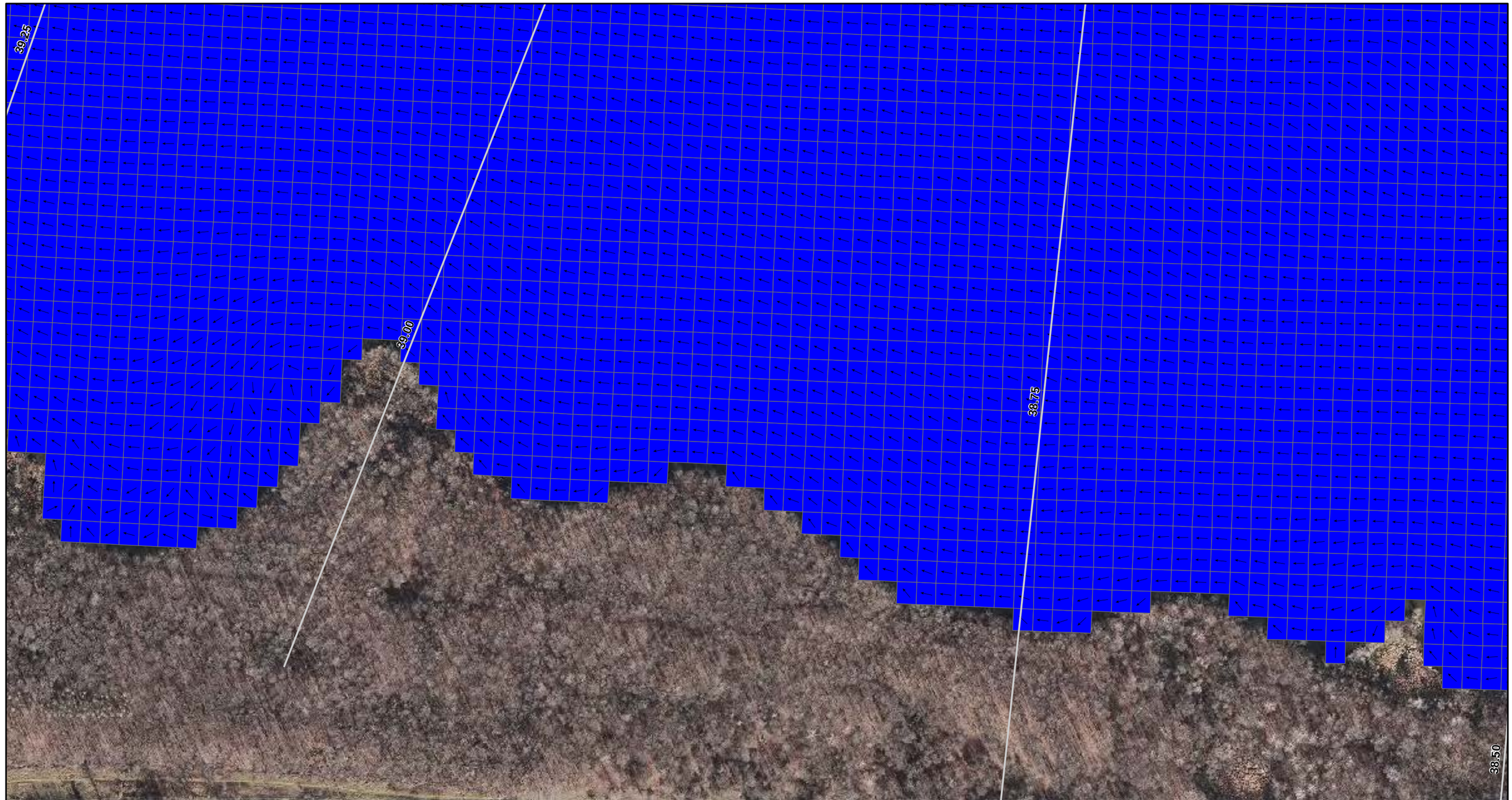
MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

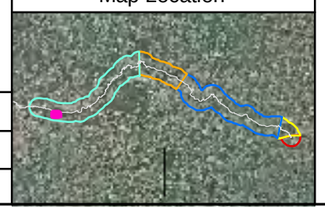
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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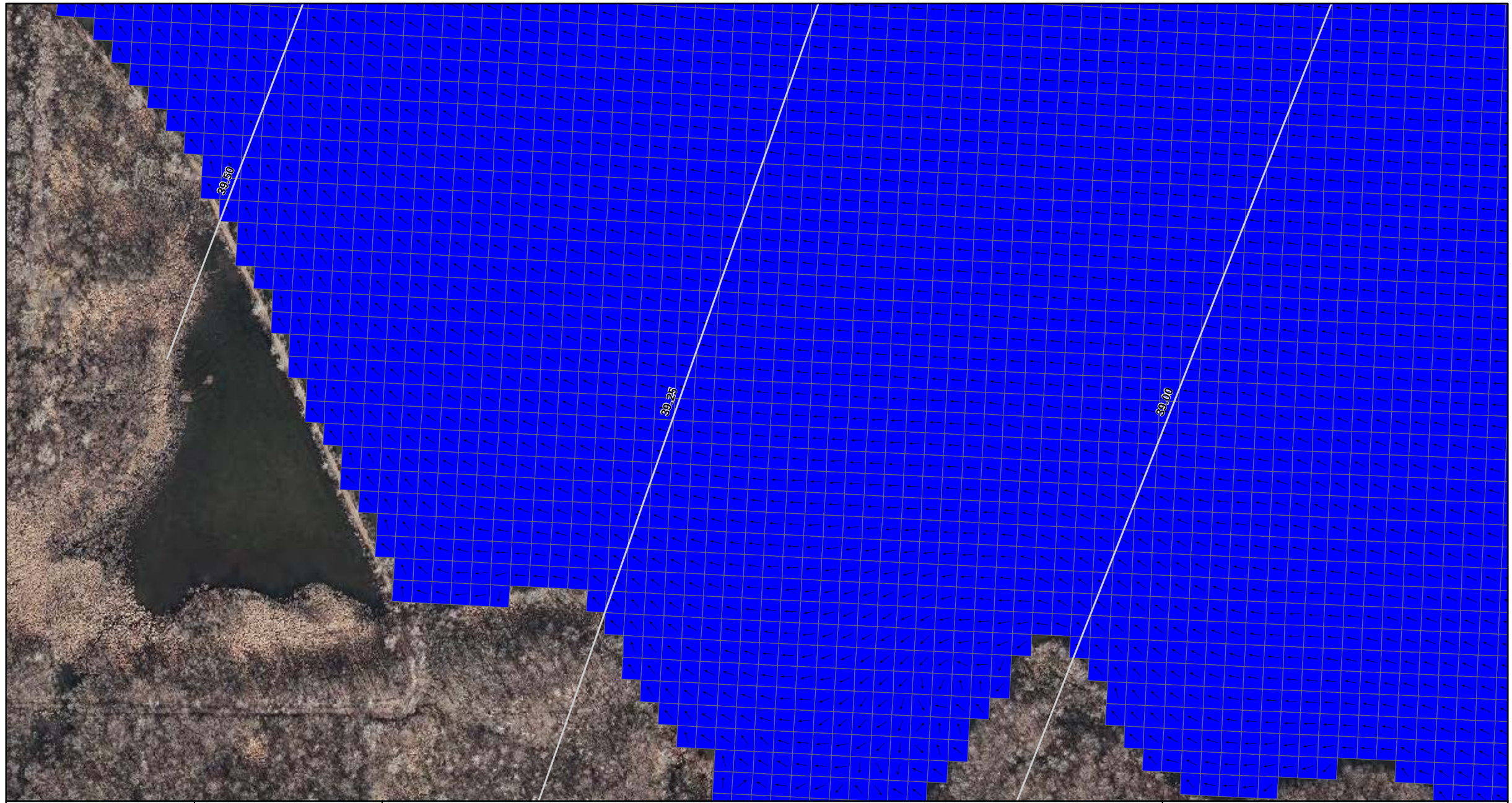
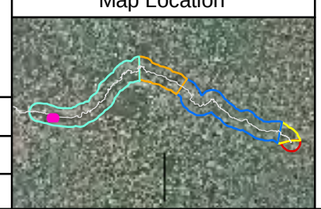
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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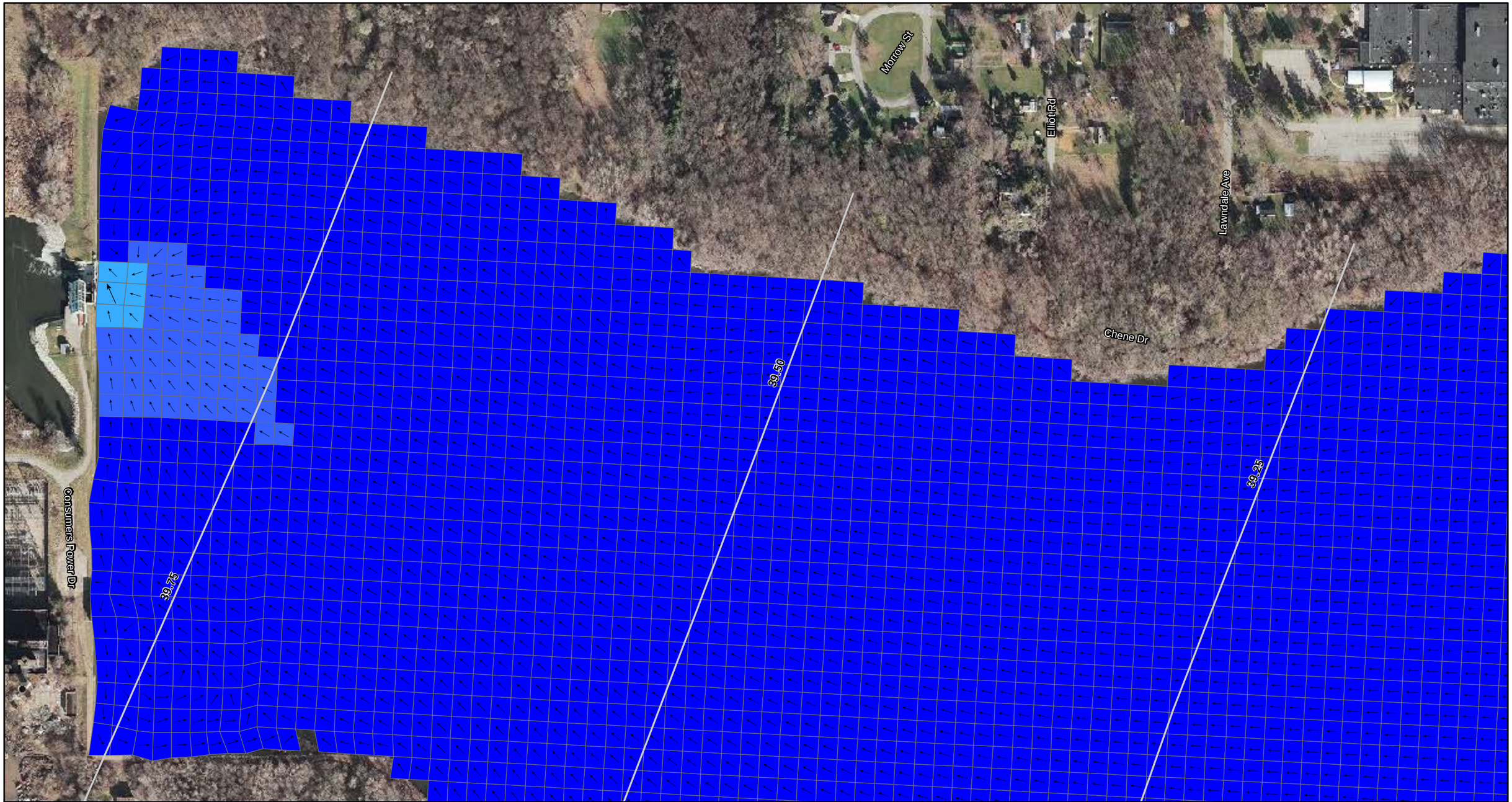
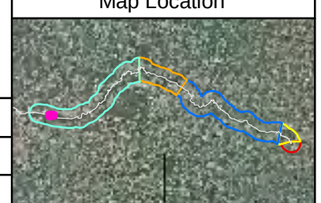
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec) - November 7, 2011

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

← Flow Direction and Relative Magnitude

Quarter Mile Grid Segment

ft/sec = Feet Per Second

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: VELOCITY
NOVEMBER 7, 2011

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Velocity_Nov7_2011.mxd

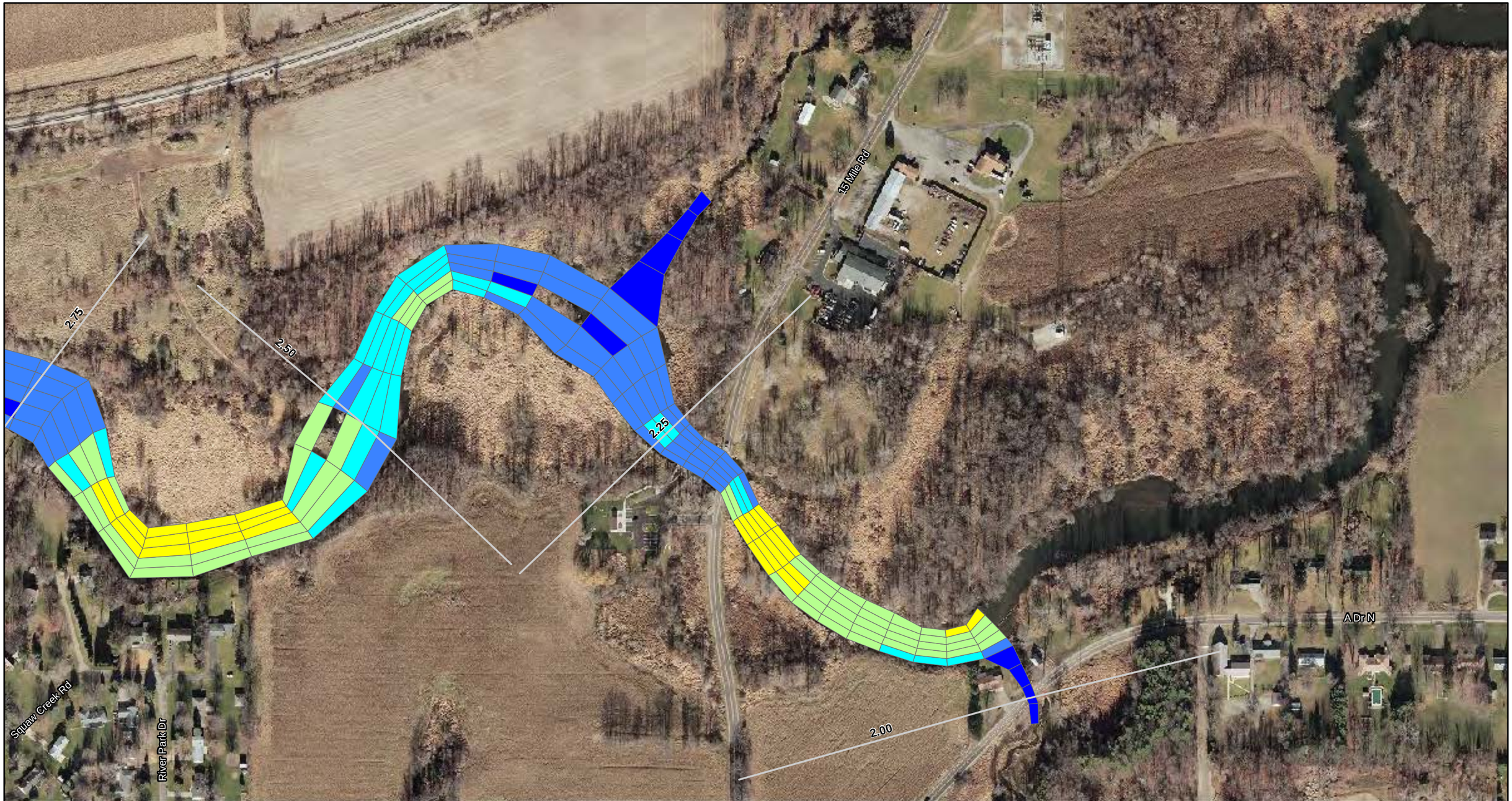
Aerial Photography Date: November 2011

Figure 4-16

Riverine Grid: Bed Shear Stress

October 31, 2011

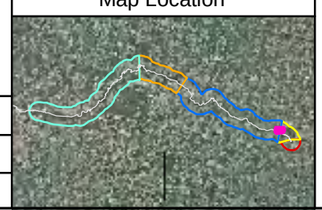
Sheets 1 through 56



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

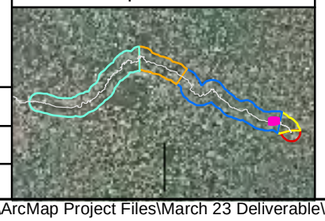
Aerial Photography Date: November 2011

3.25
3.00
2.75
2.50
Friendship Ln
Heather Dr
Peter Pan Ln
Kristen Dr
Squaw Creek Rd
River Park Dr

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

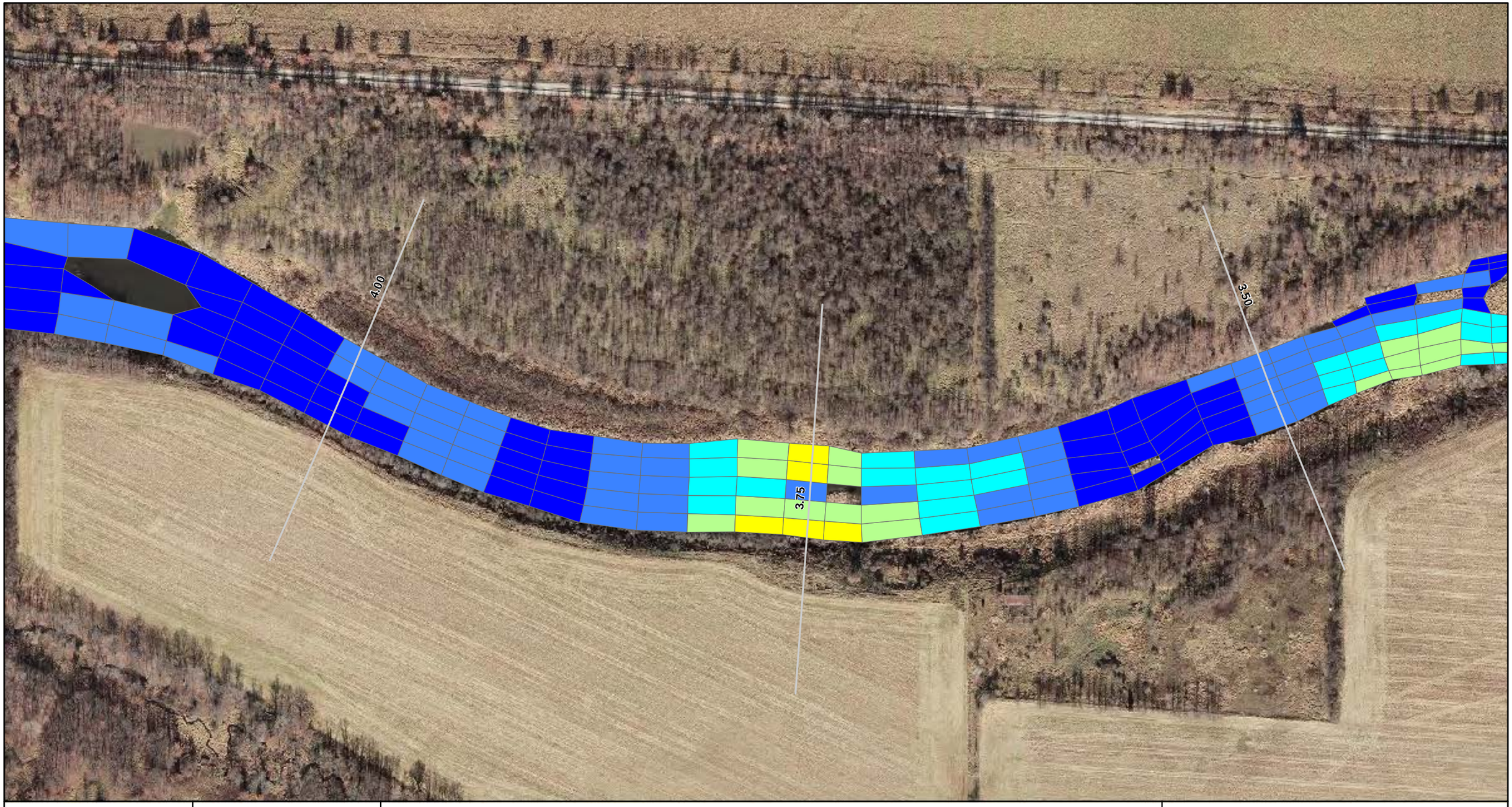
MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

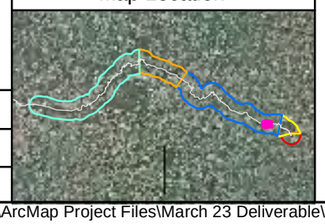
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

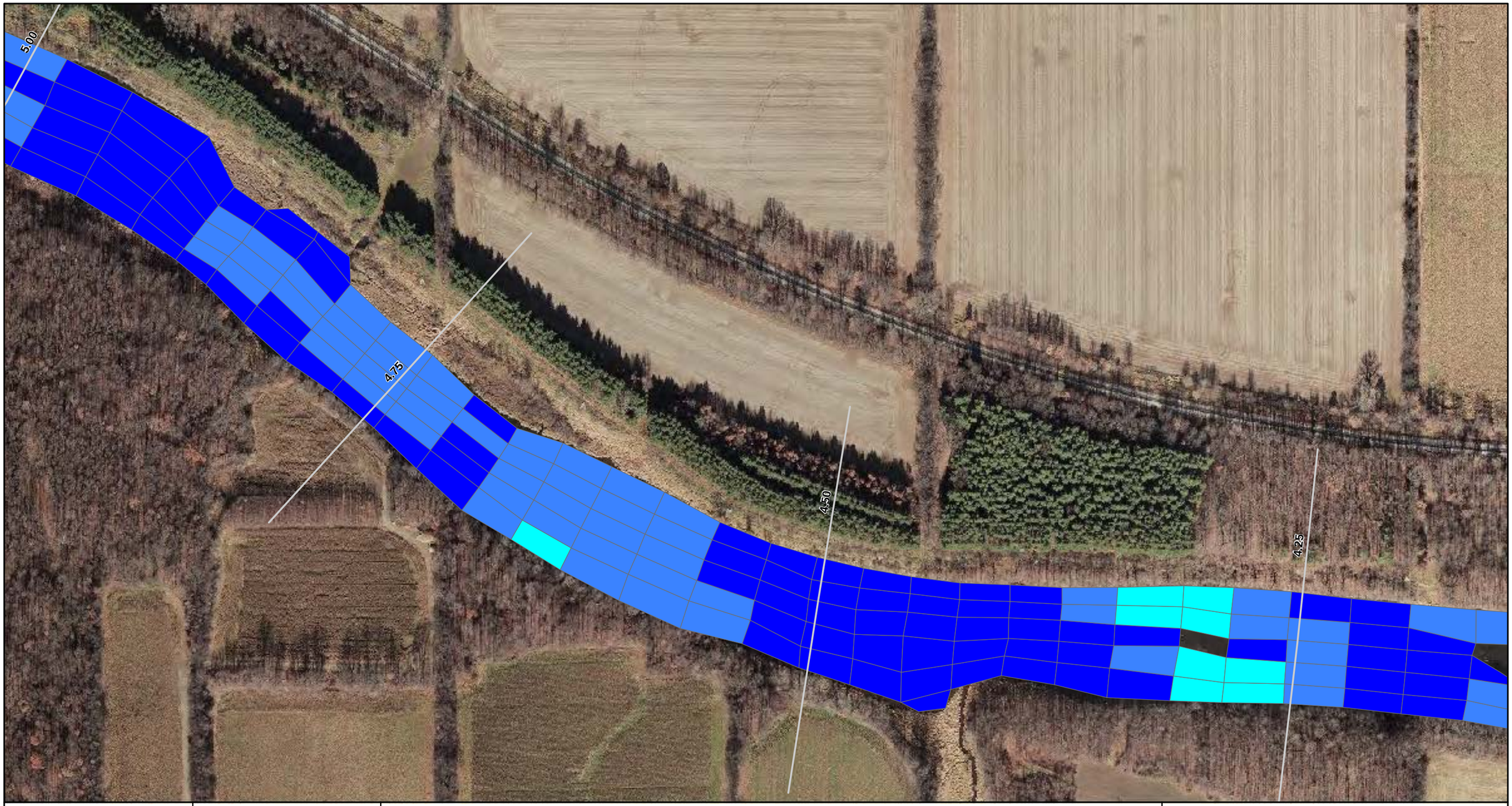
MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

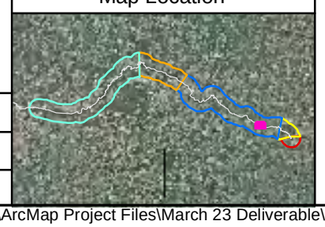
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011
- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

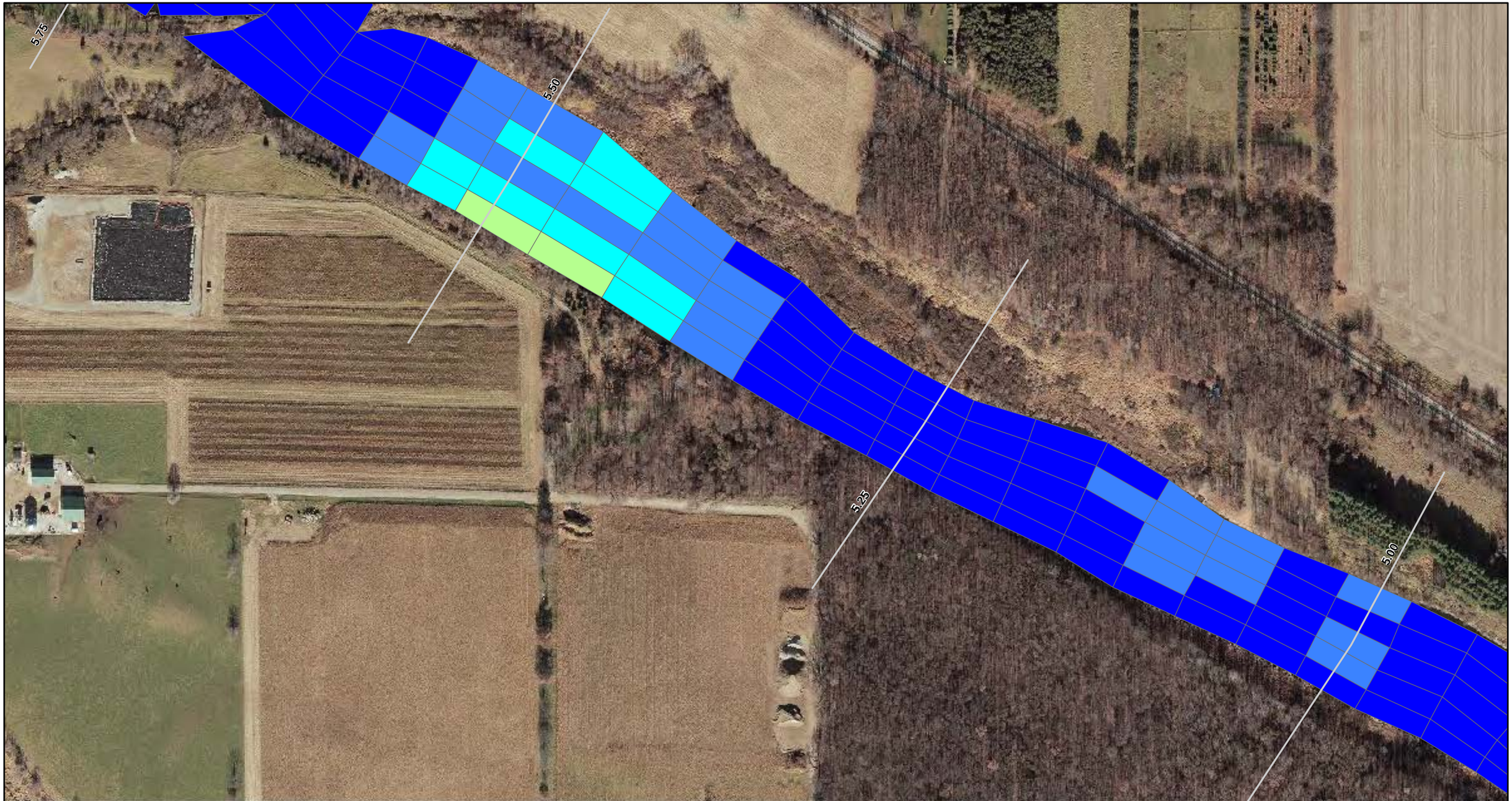
MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

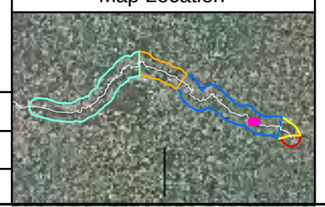
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011
- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

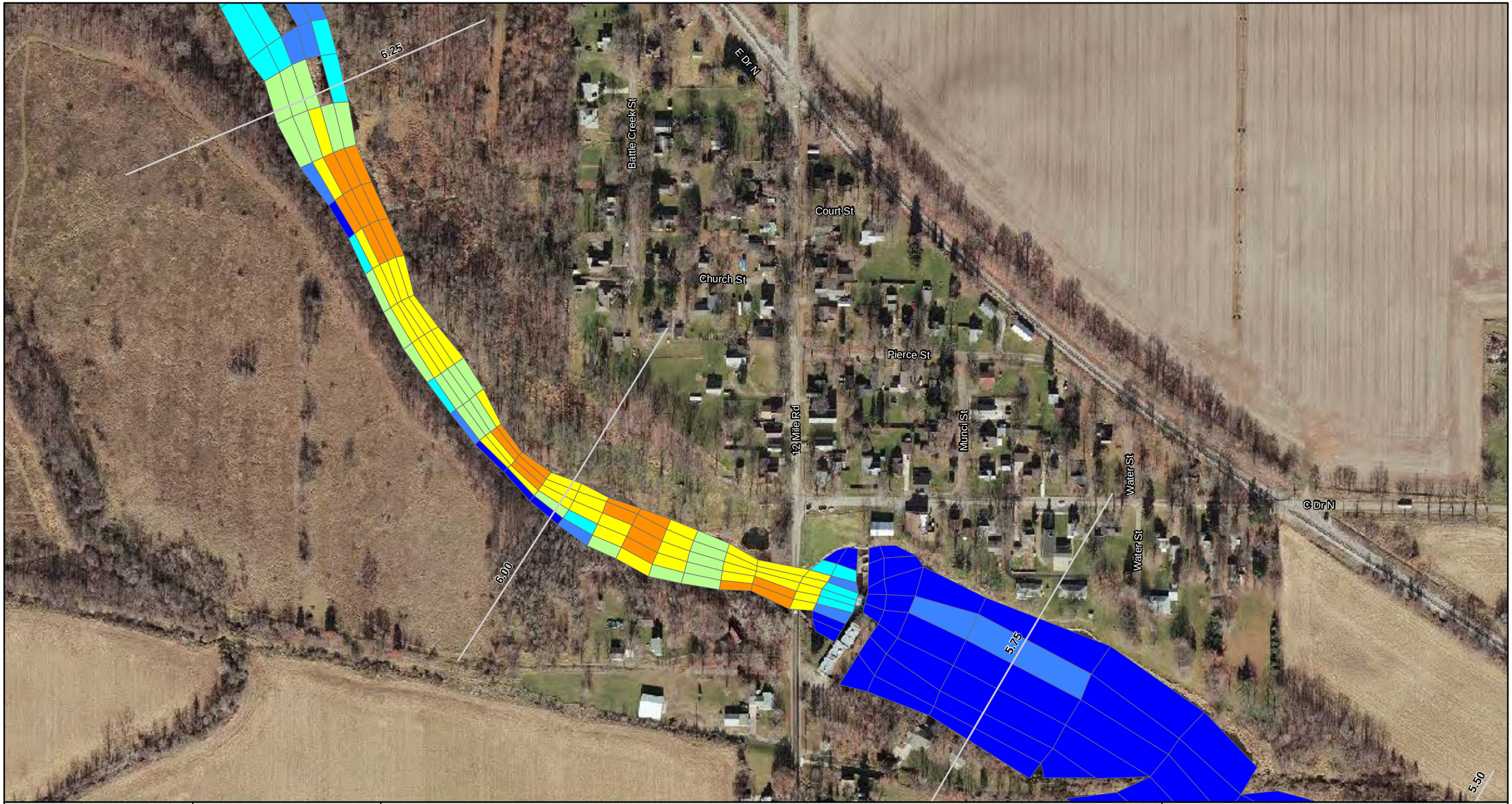
MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

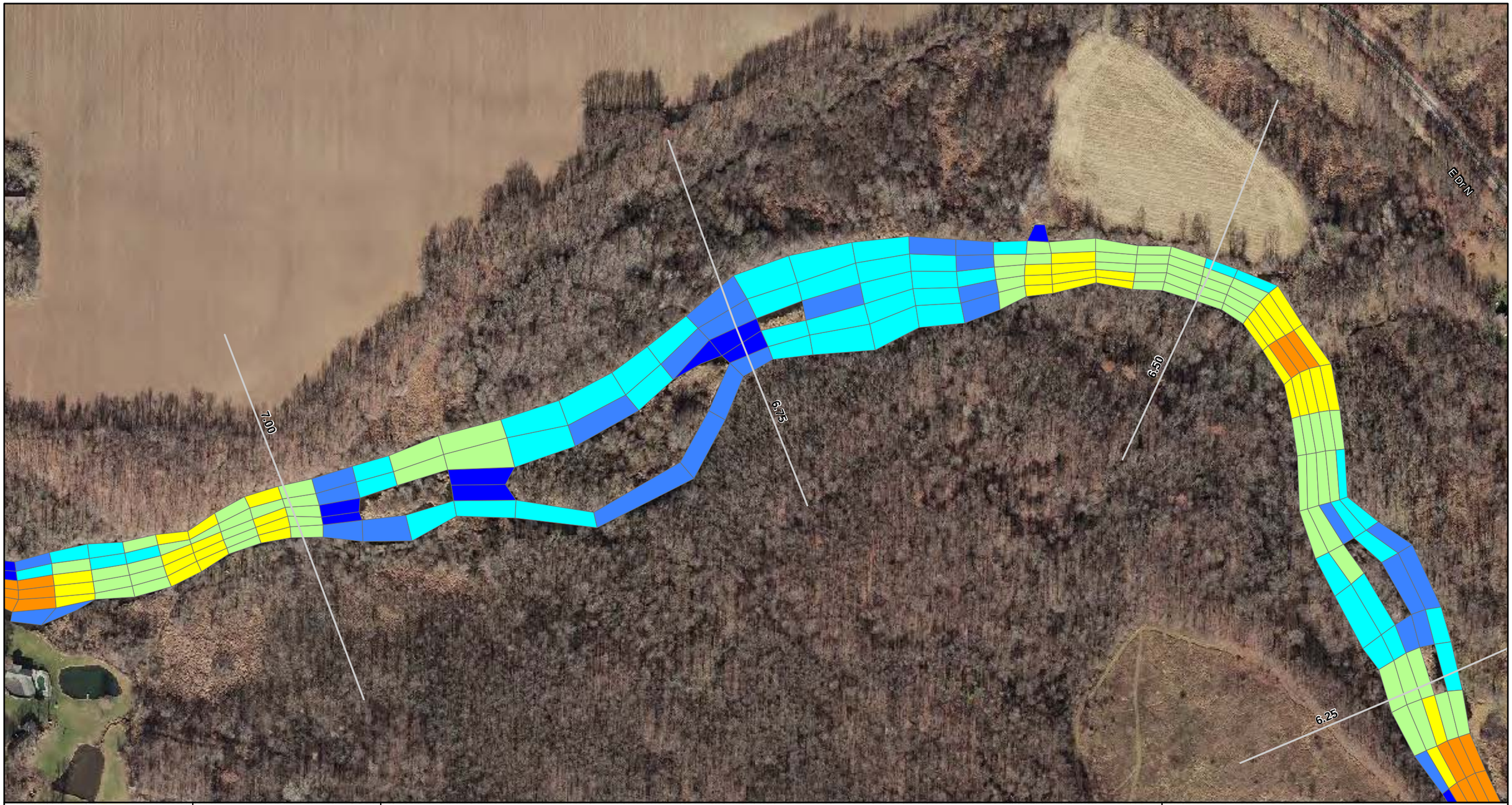
MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

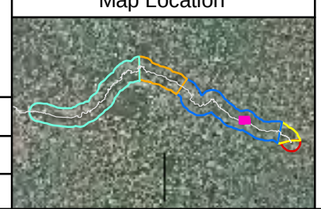
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011
- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

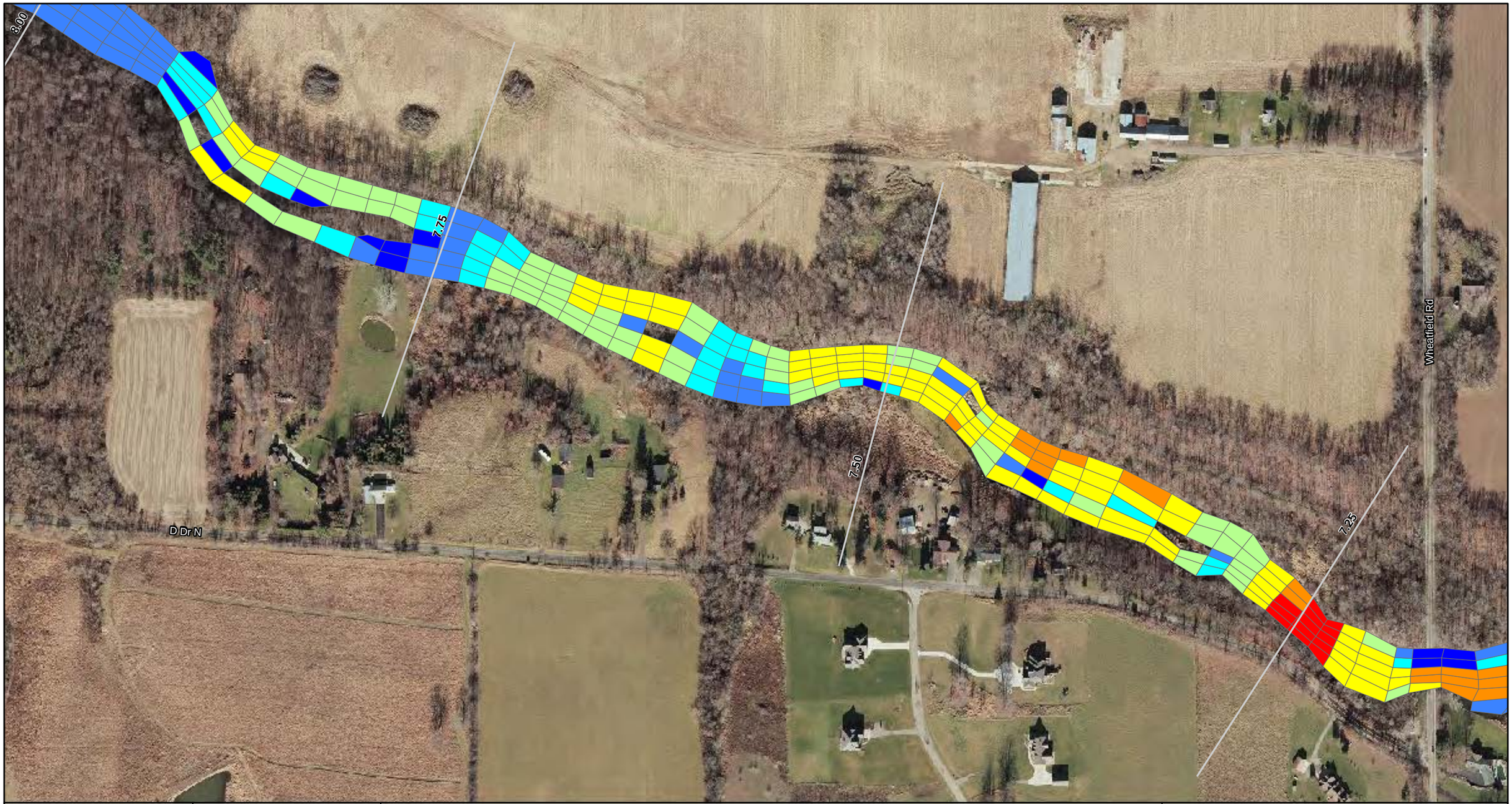
MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

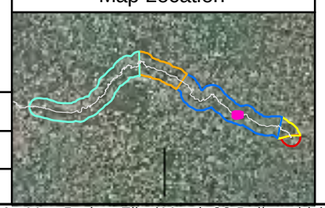
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

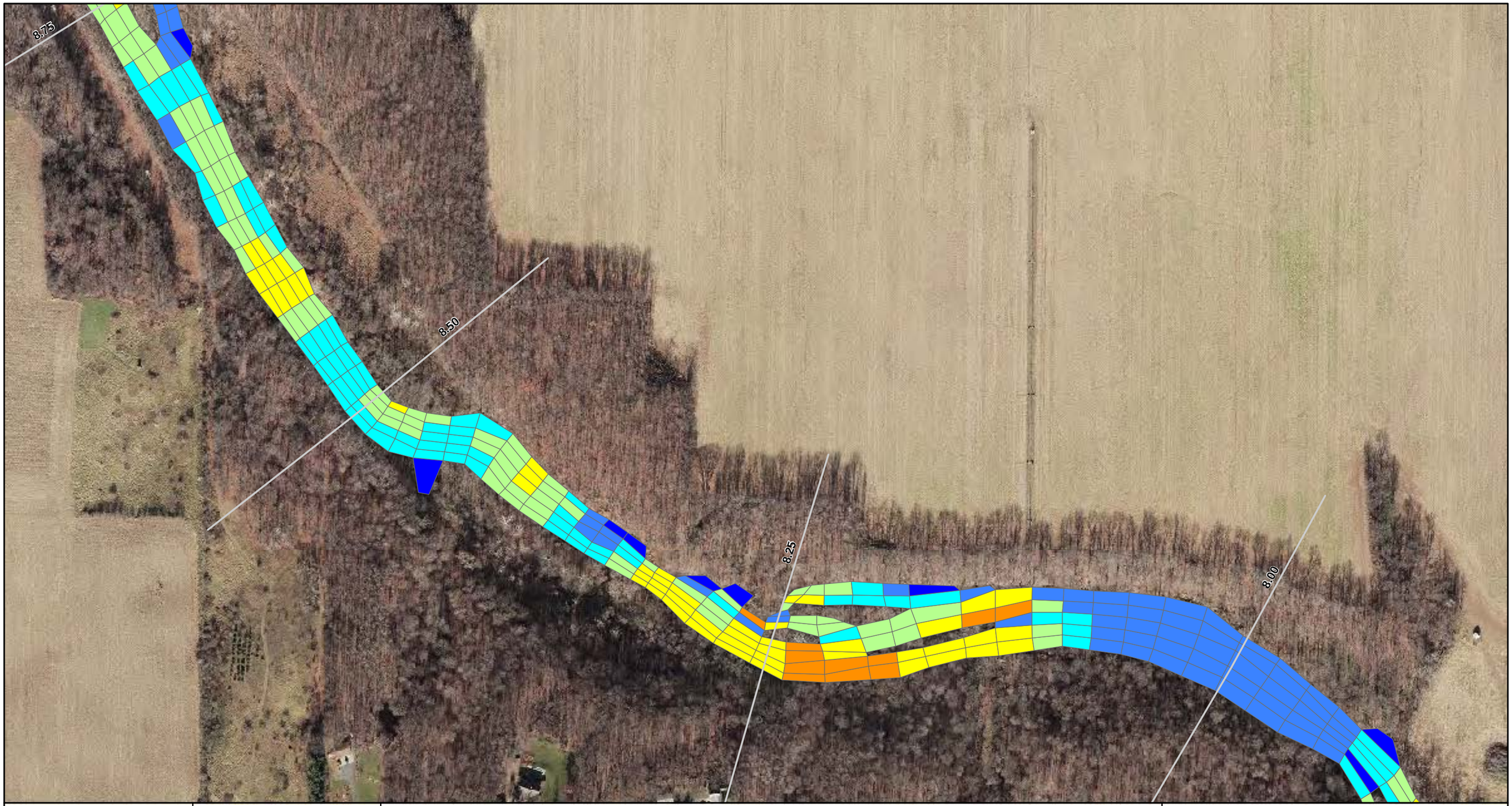
MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

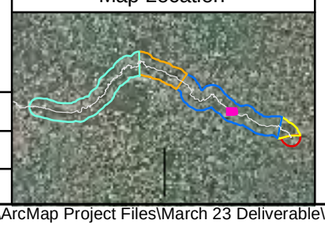
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

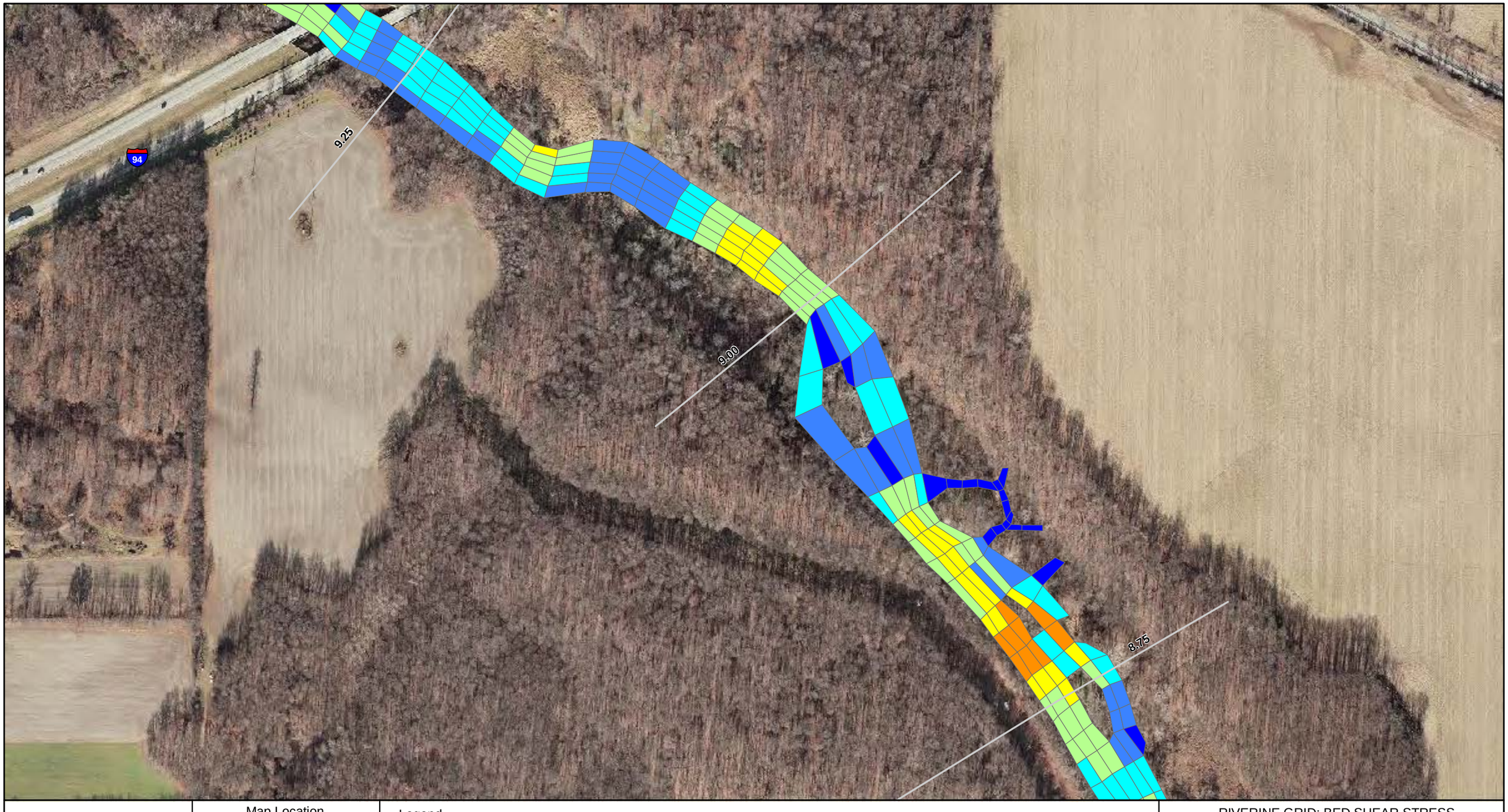
MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

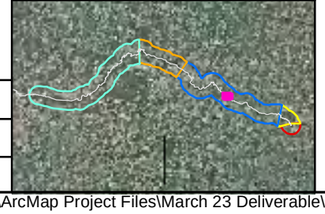
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

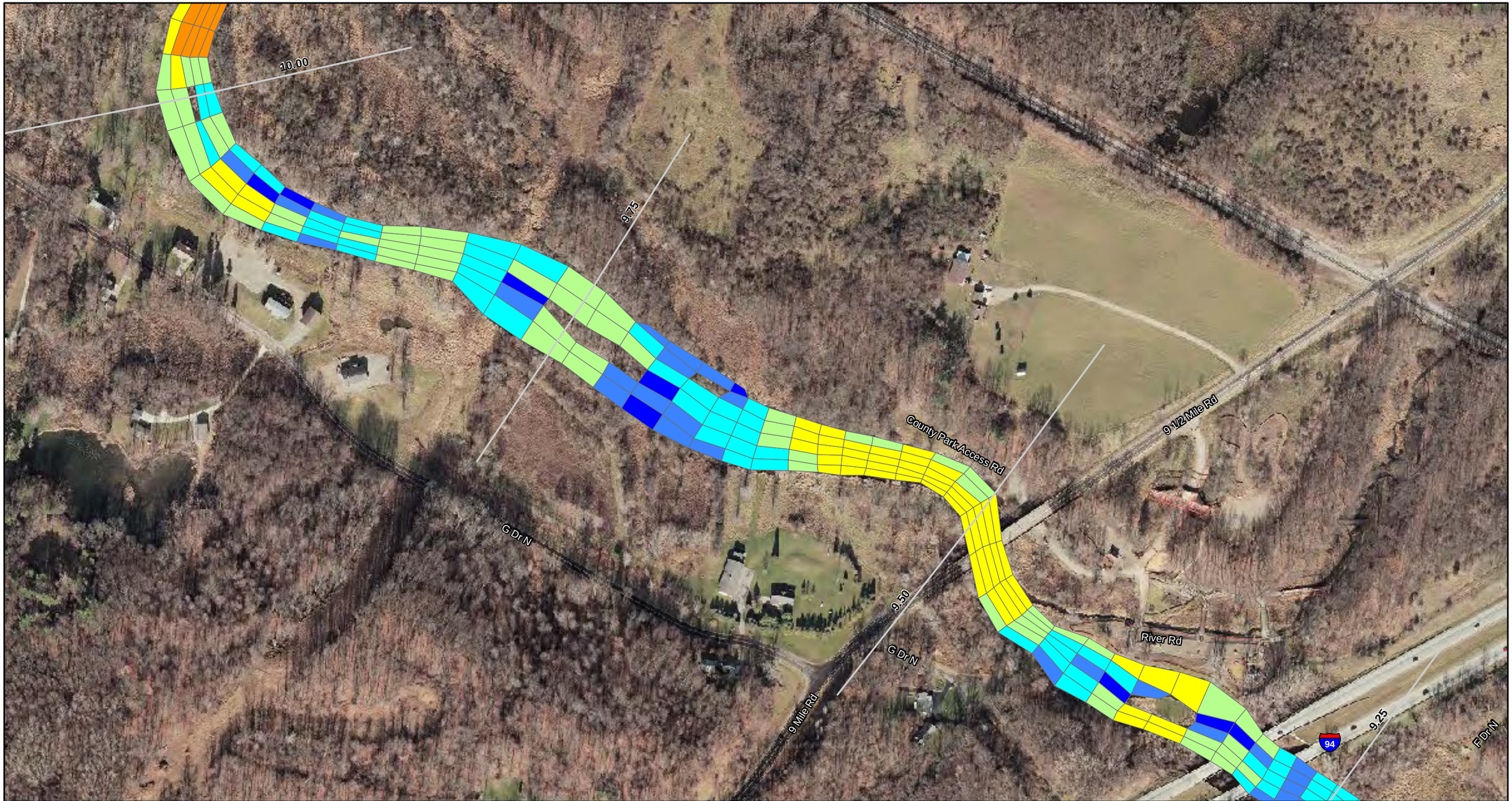
MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011

10.50

10.25

10.00

River Rd E

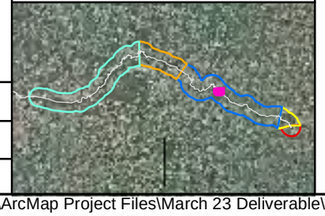
Golden Ave

G Dr N

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

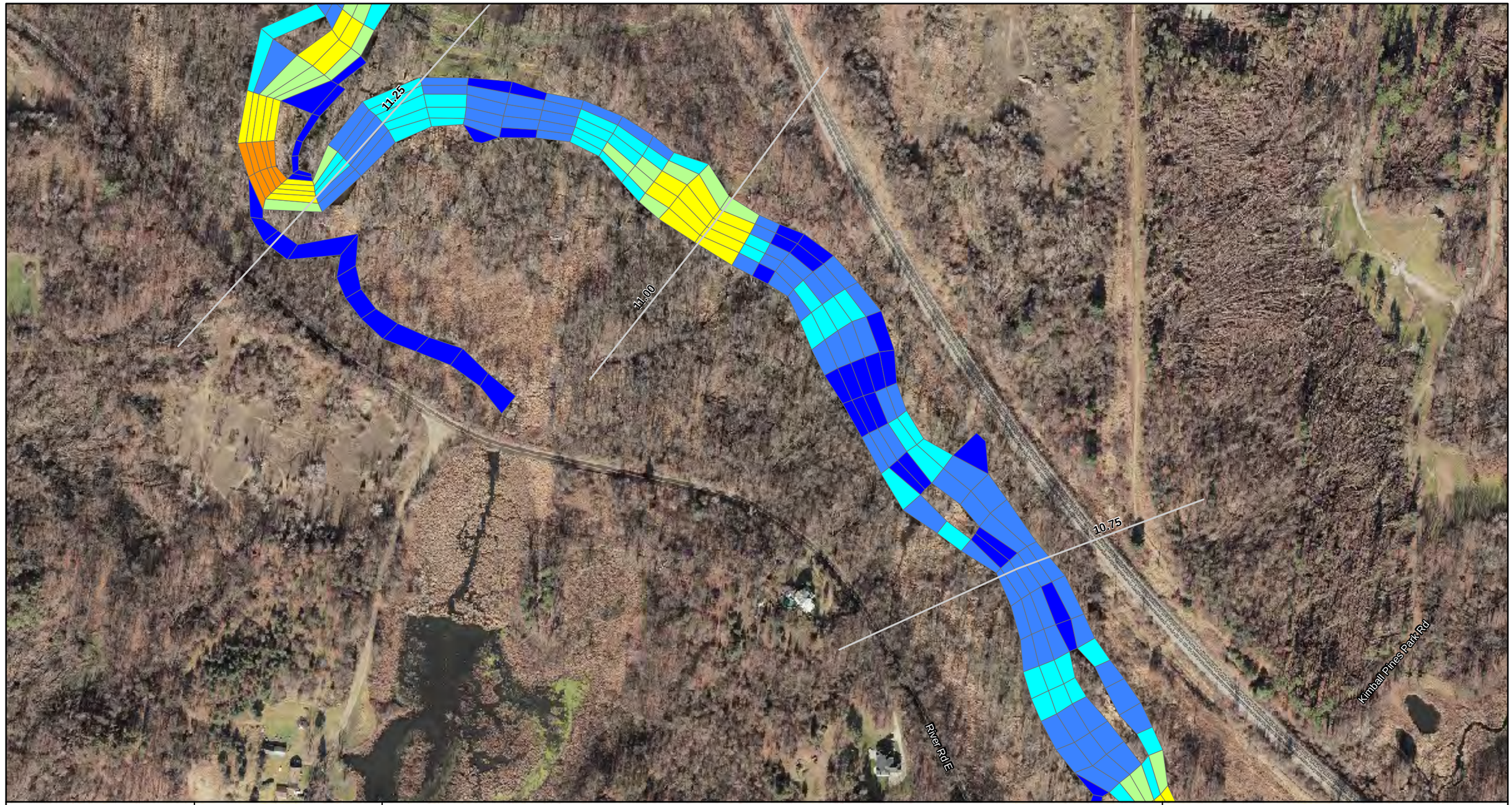
MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

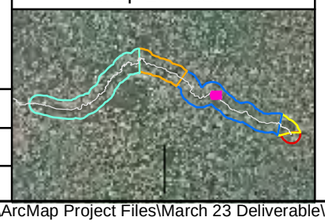
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011
- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

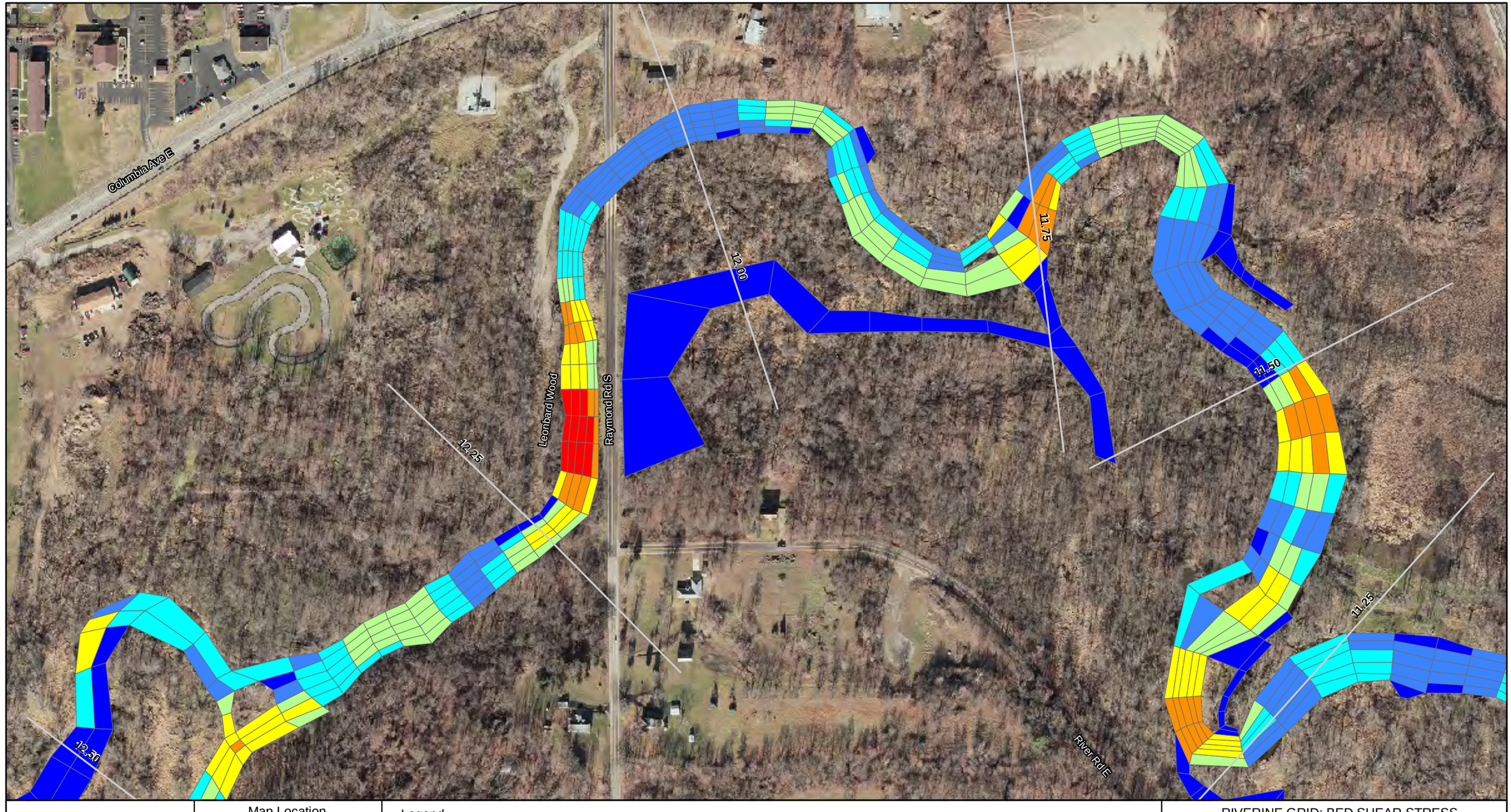
MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

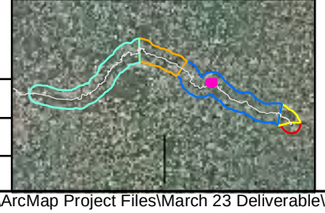
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

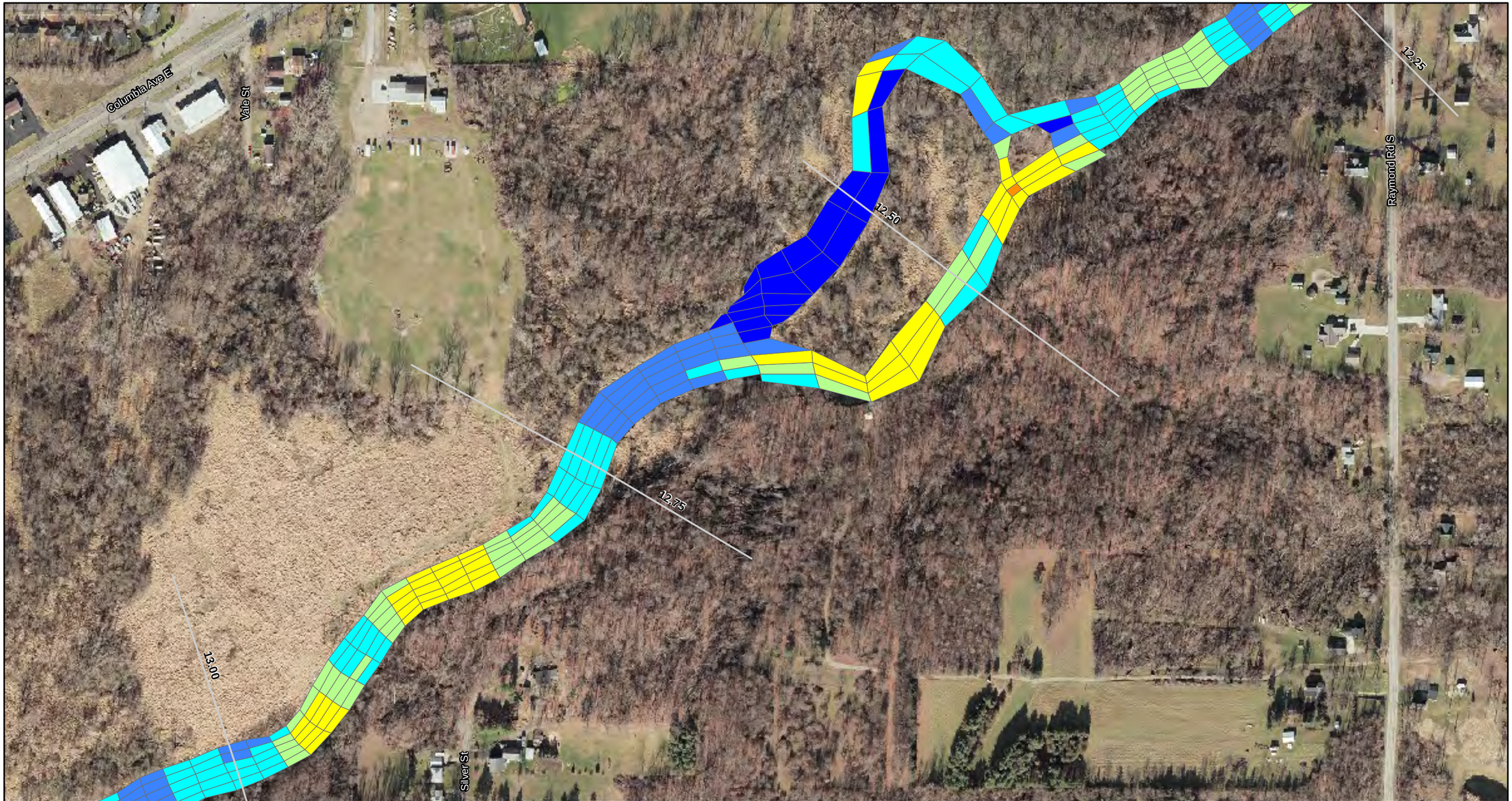
MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

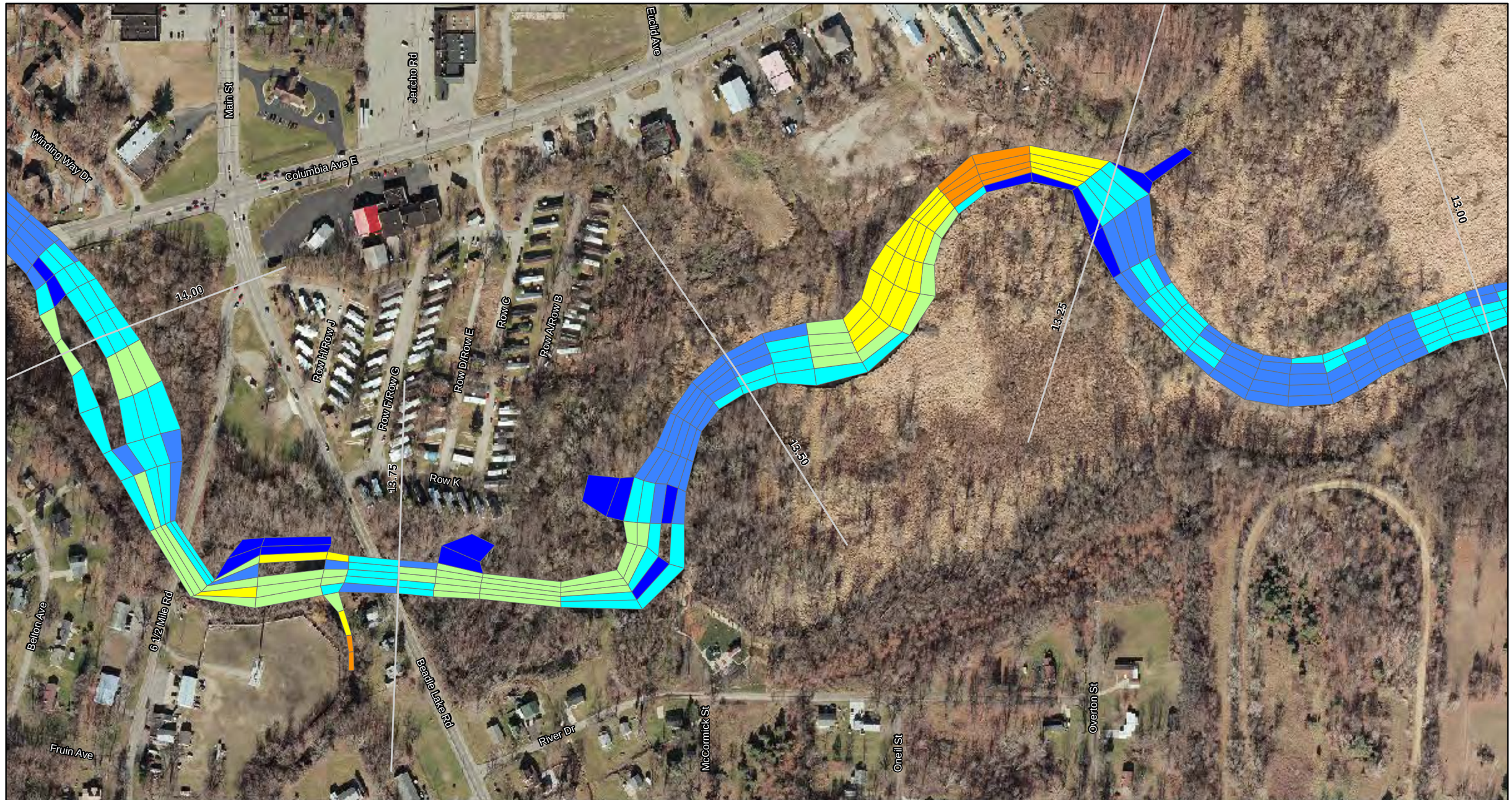
MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

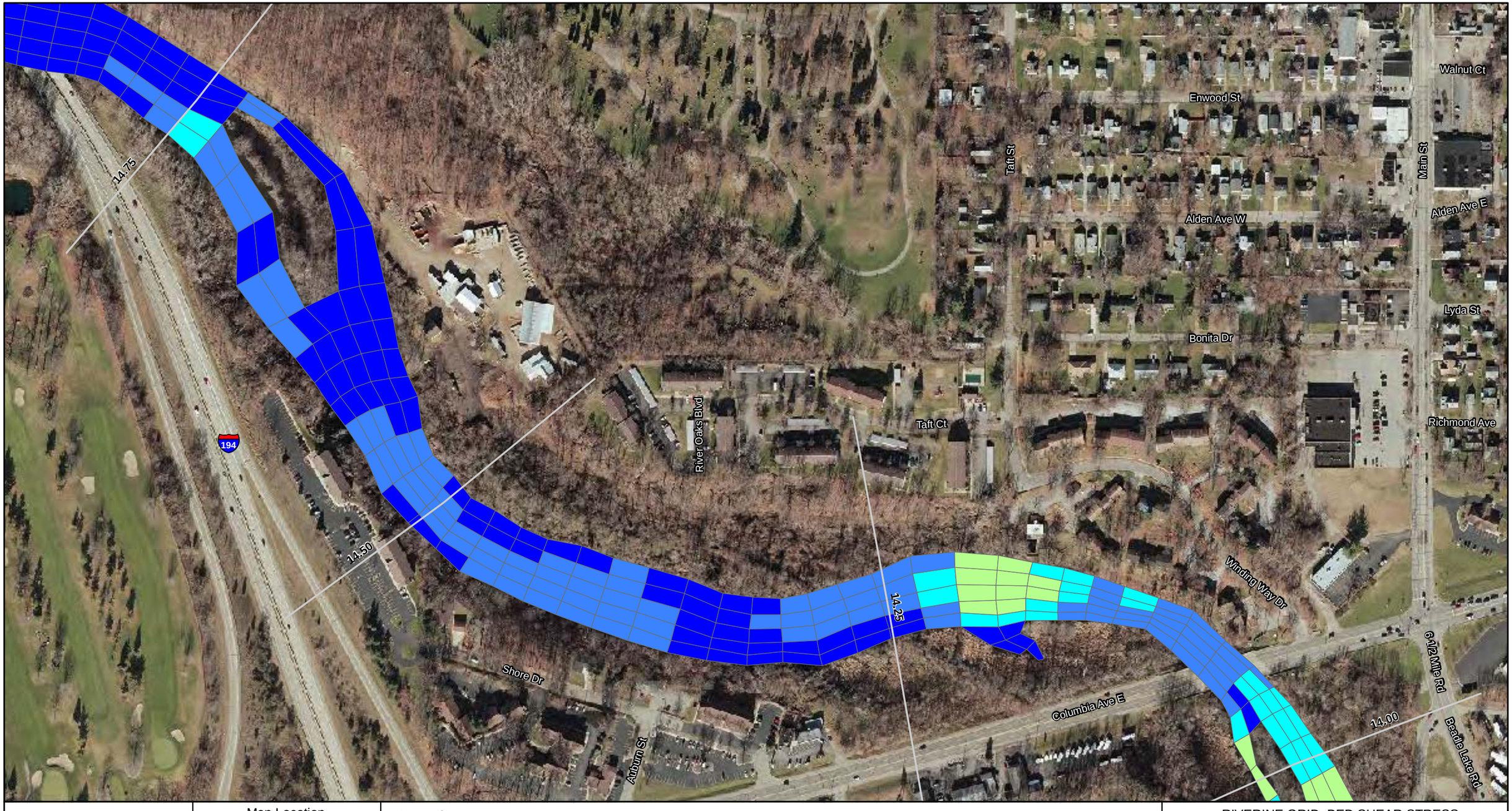
MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

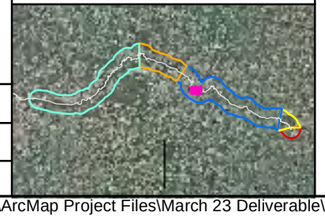
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011
- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

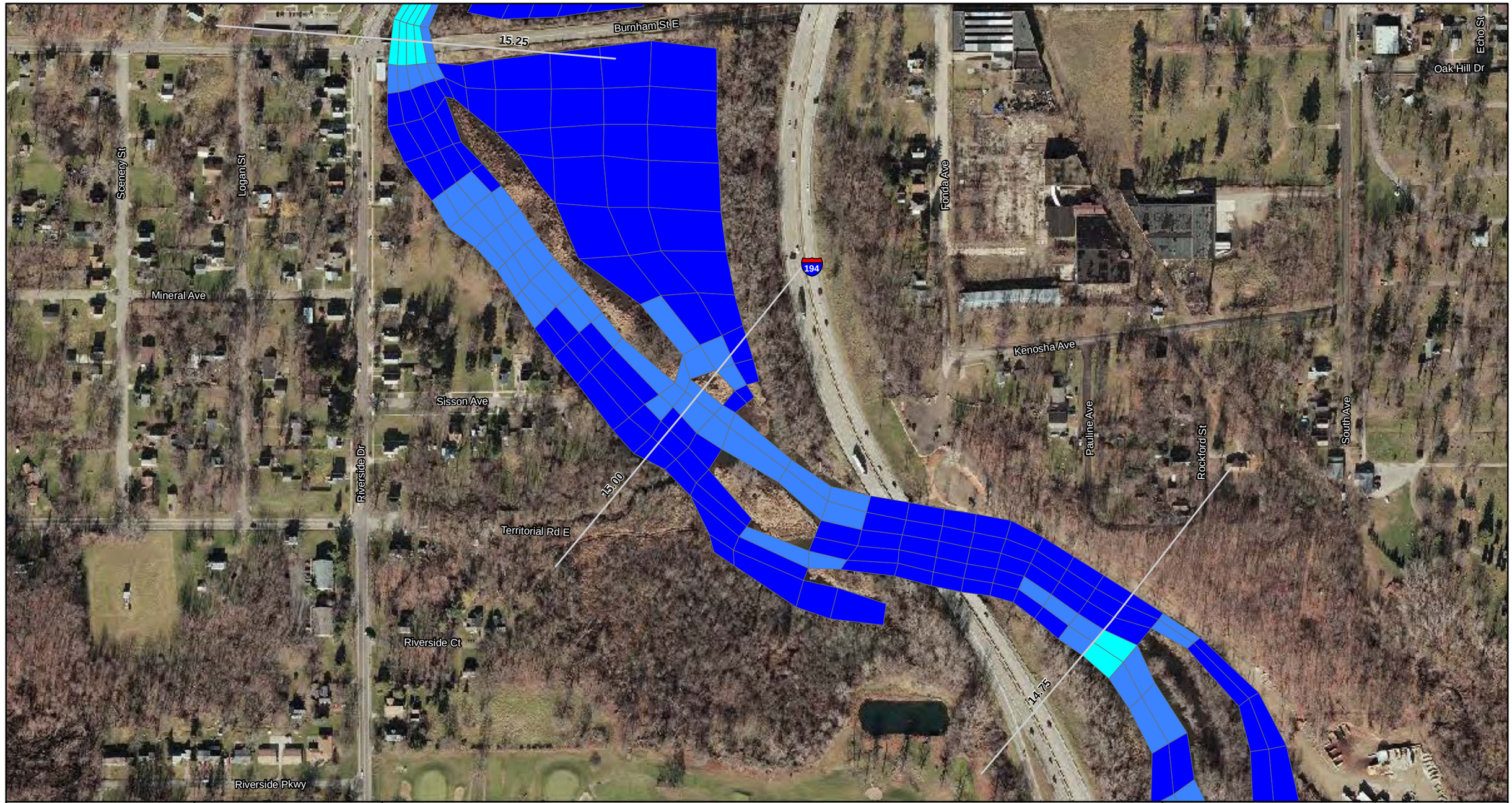
MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

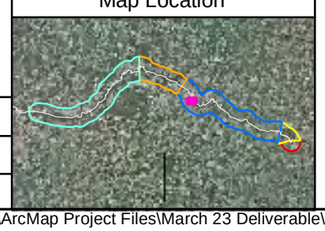
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

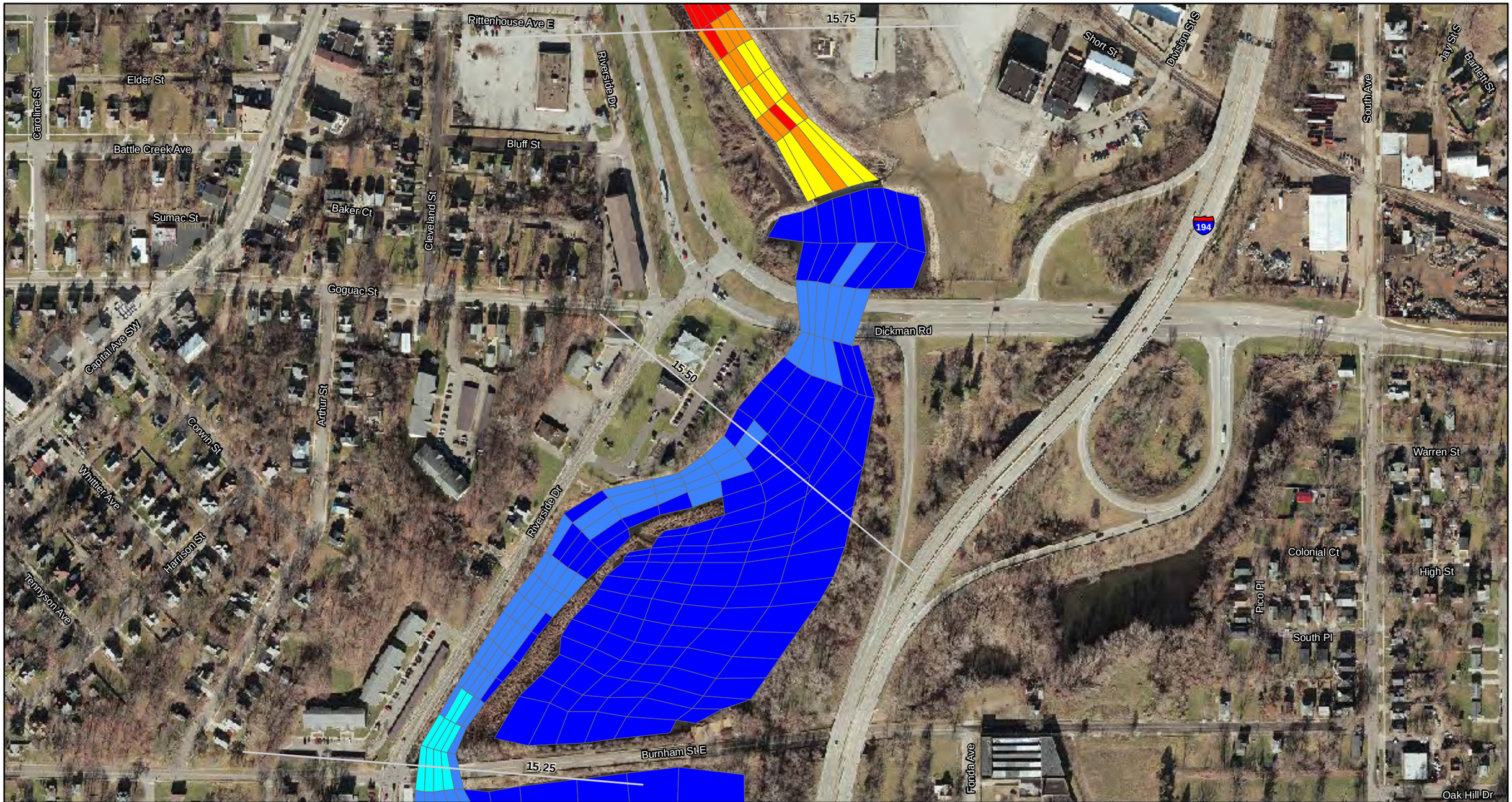
MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

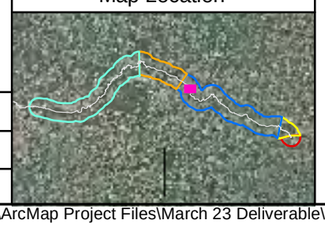
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

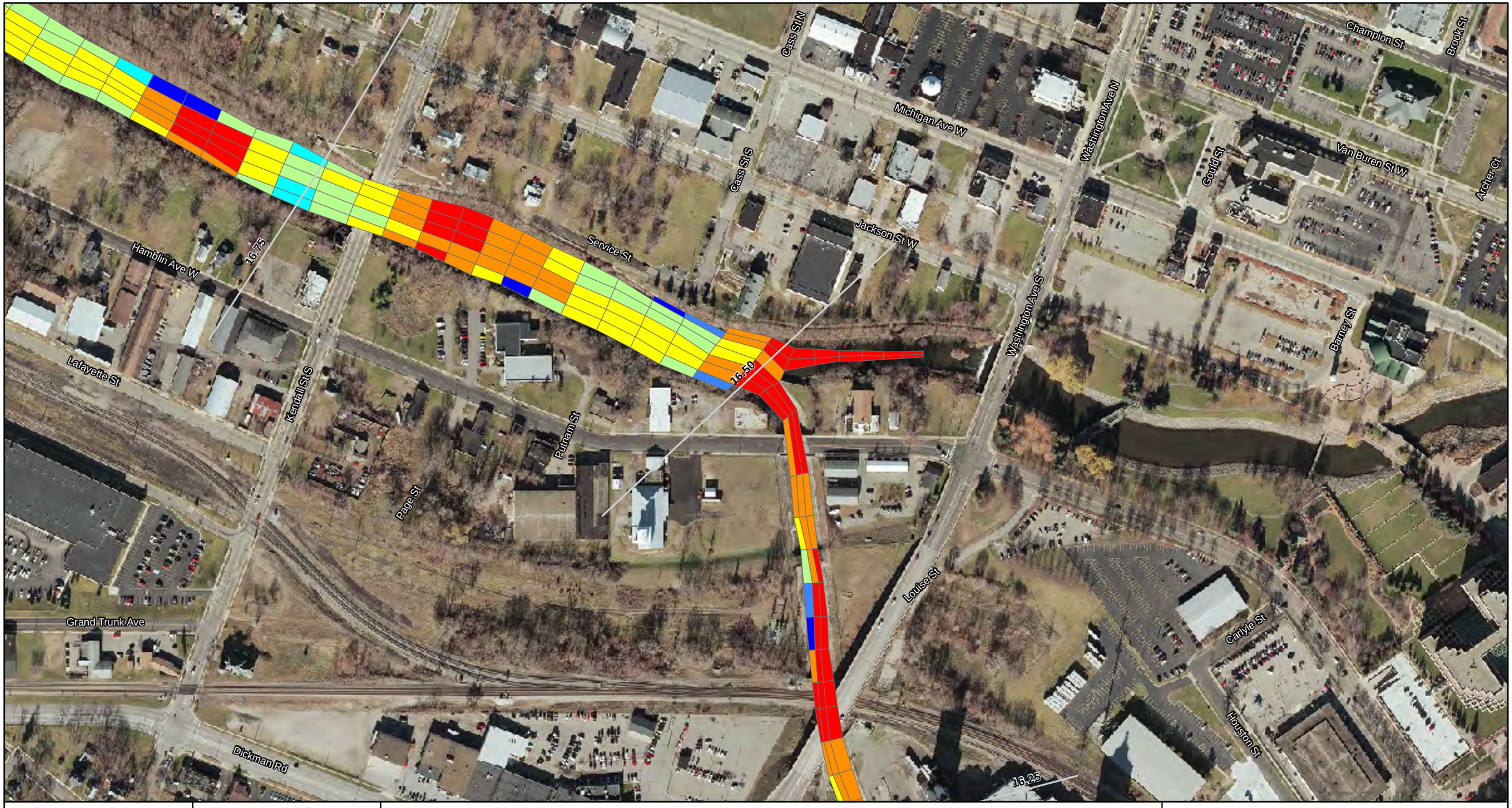
MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

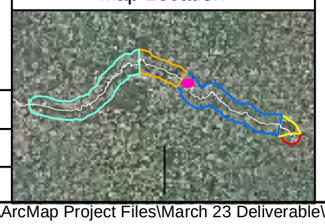
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

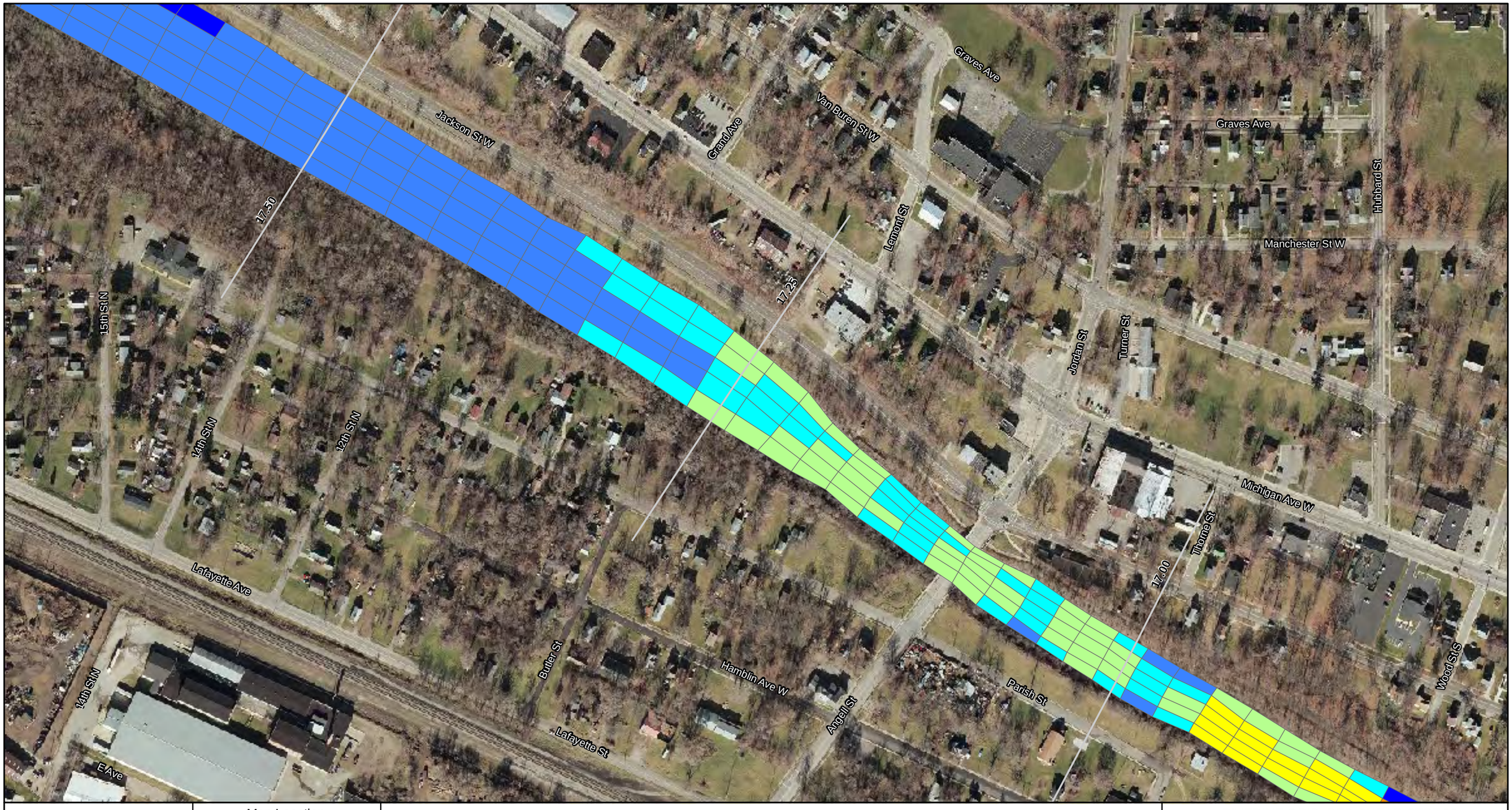
MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

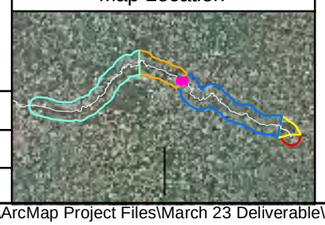
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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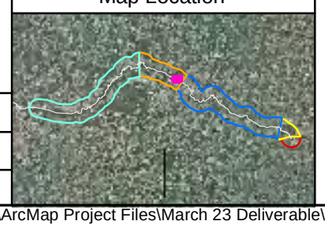
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

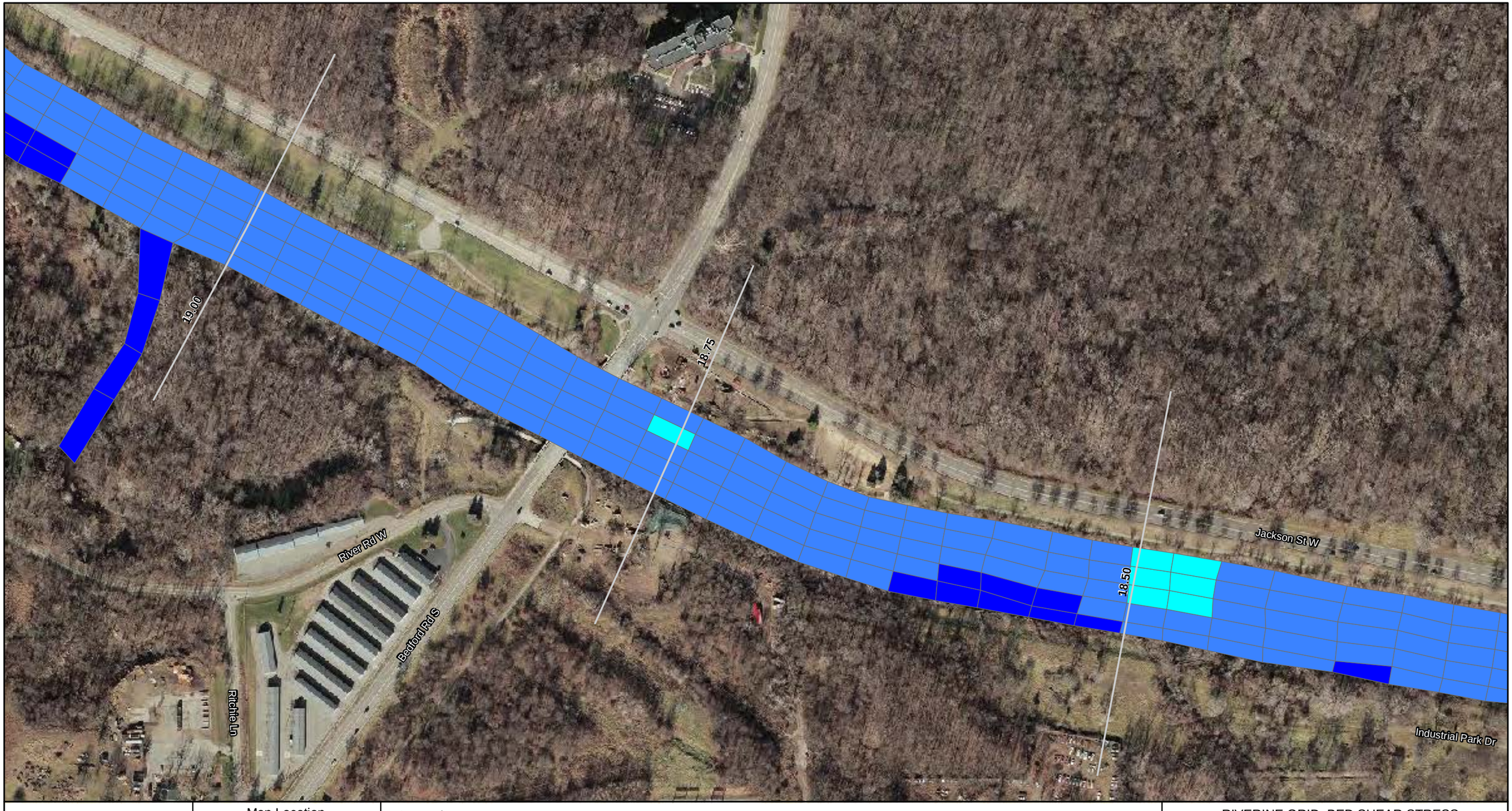
MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

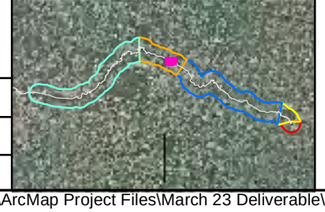
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

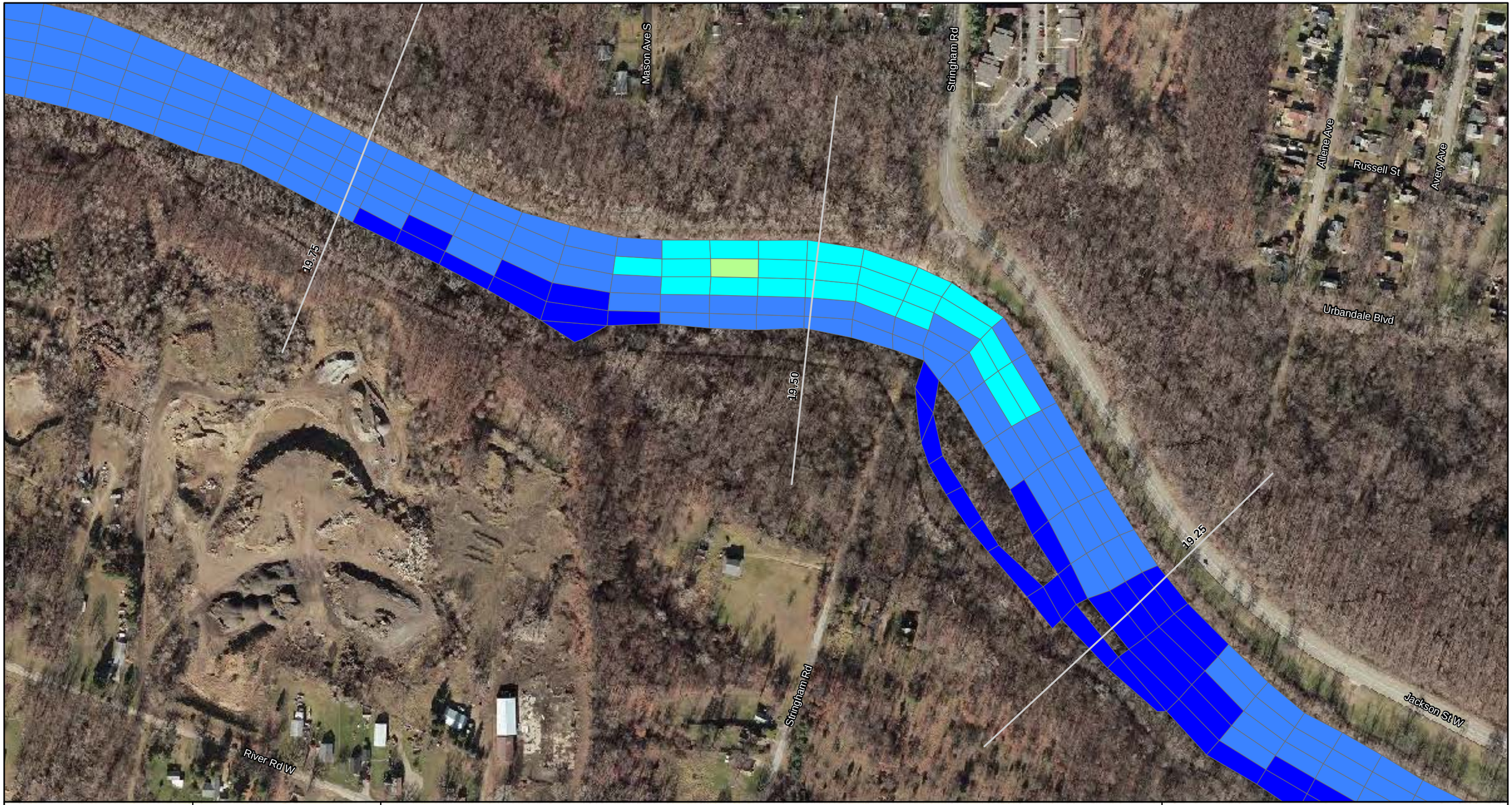
MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

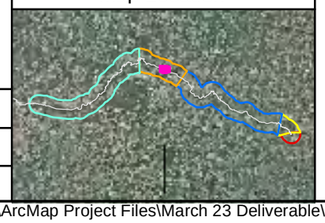
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

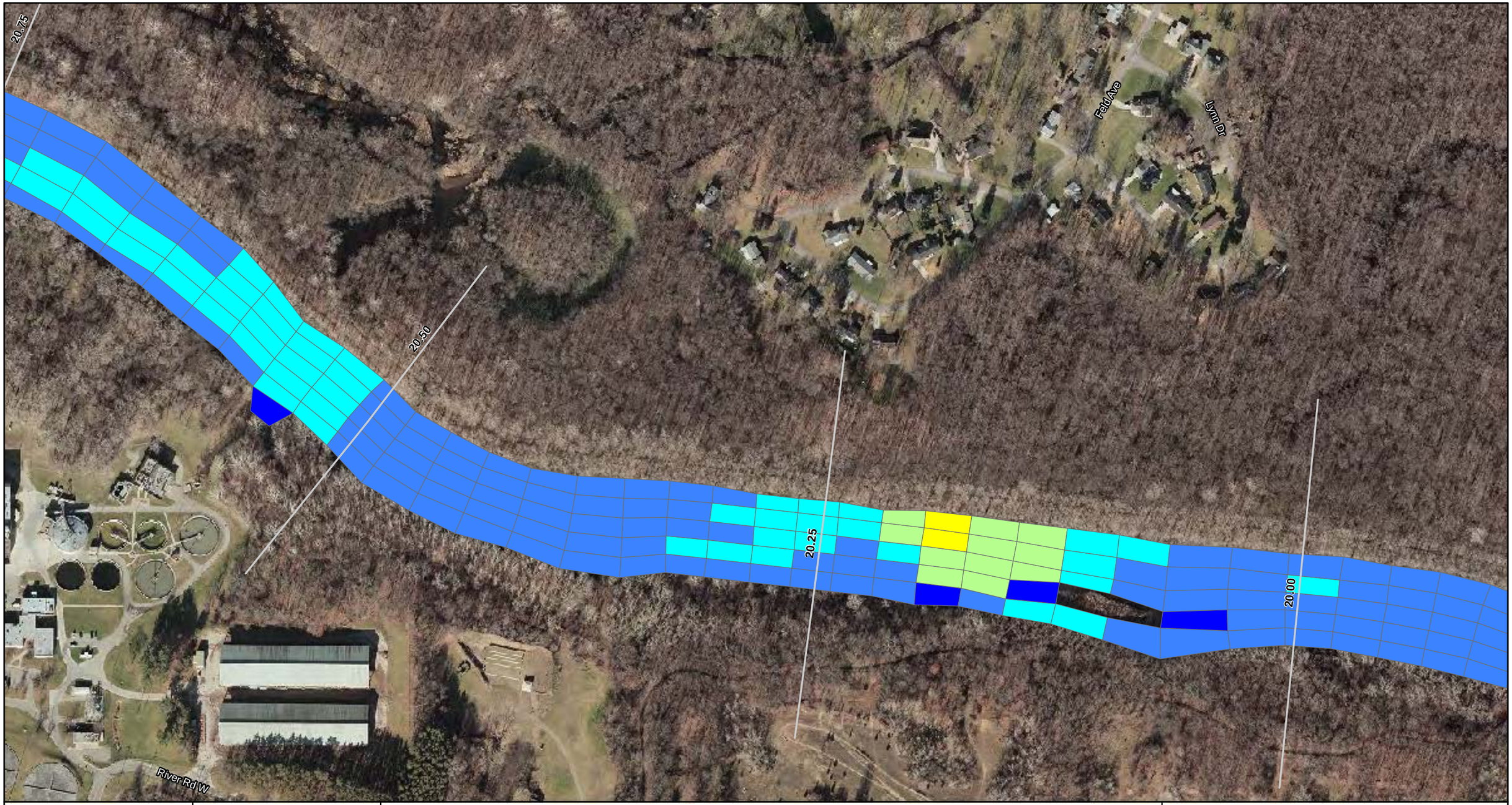
MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

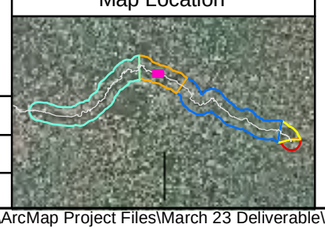
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

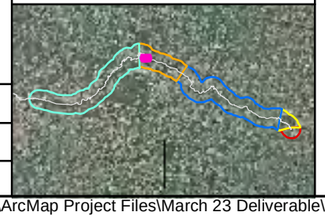
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

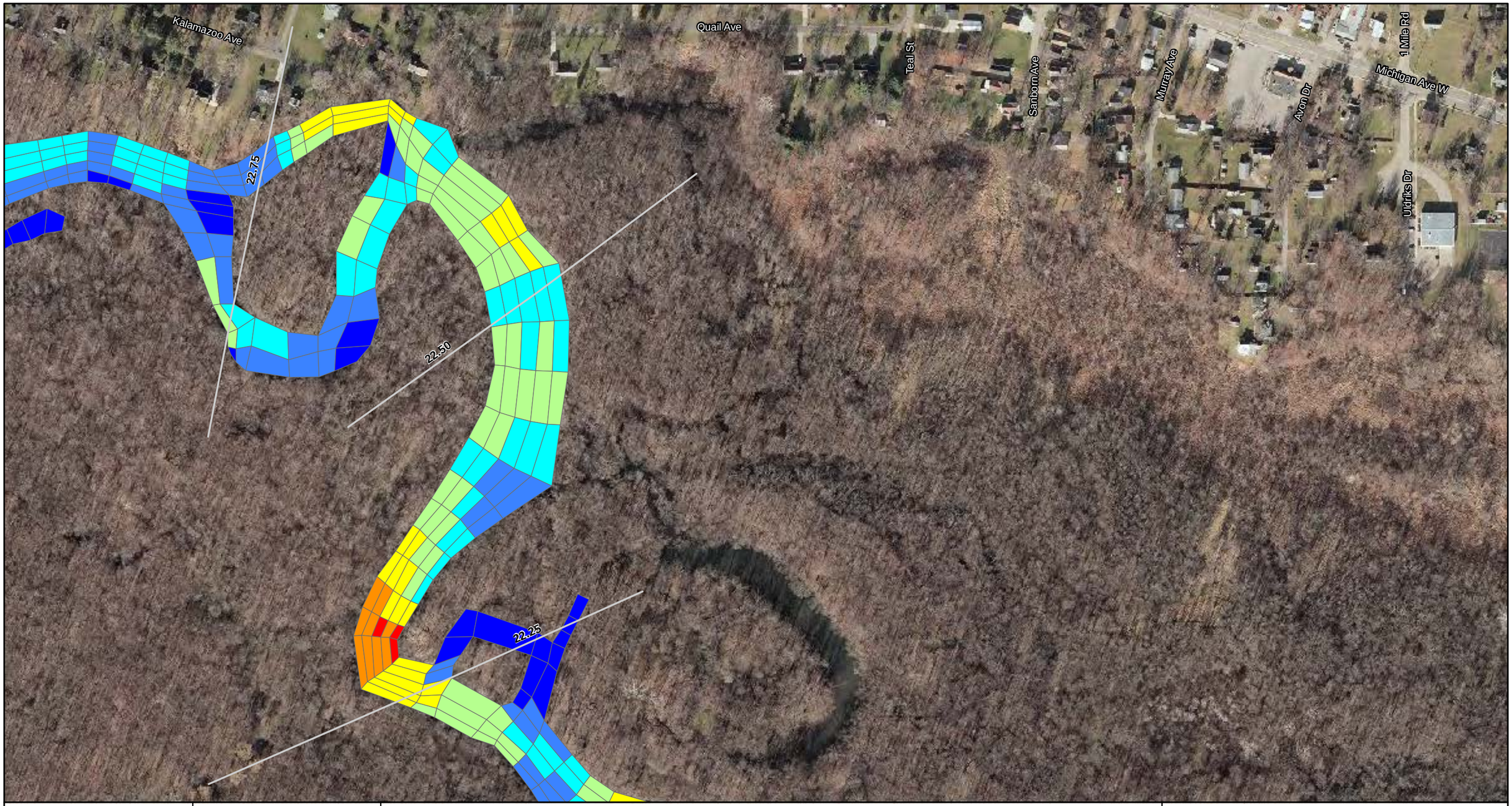
MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

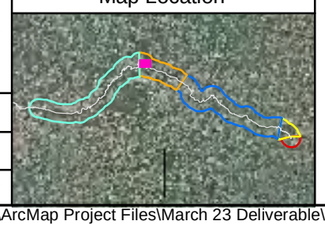
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

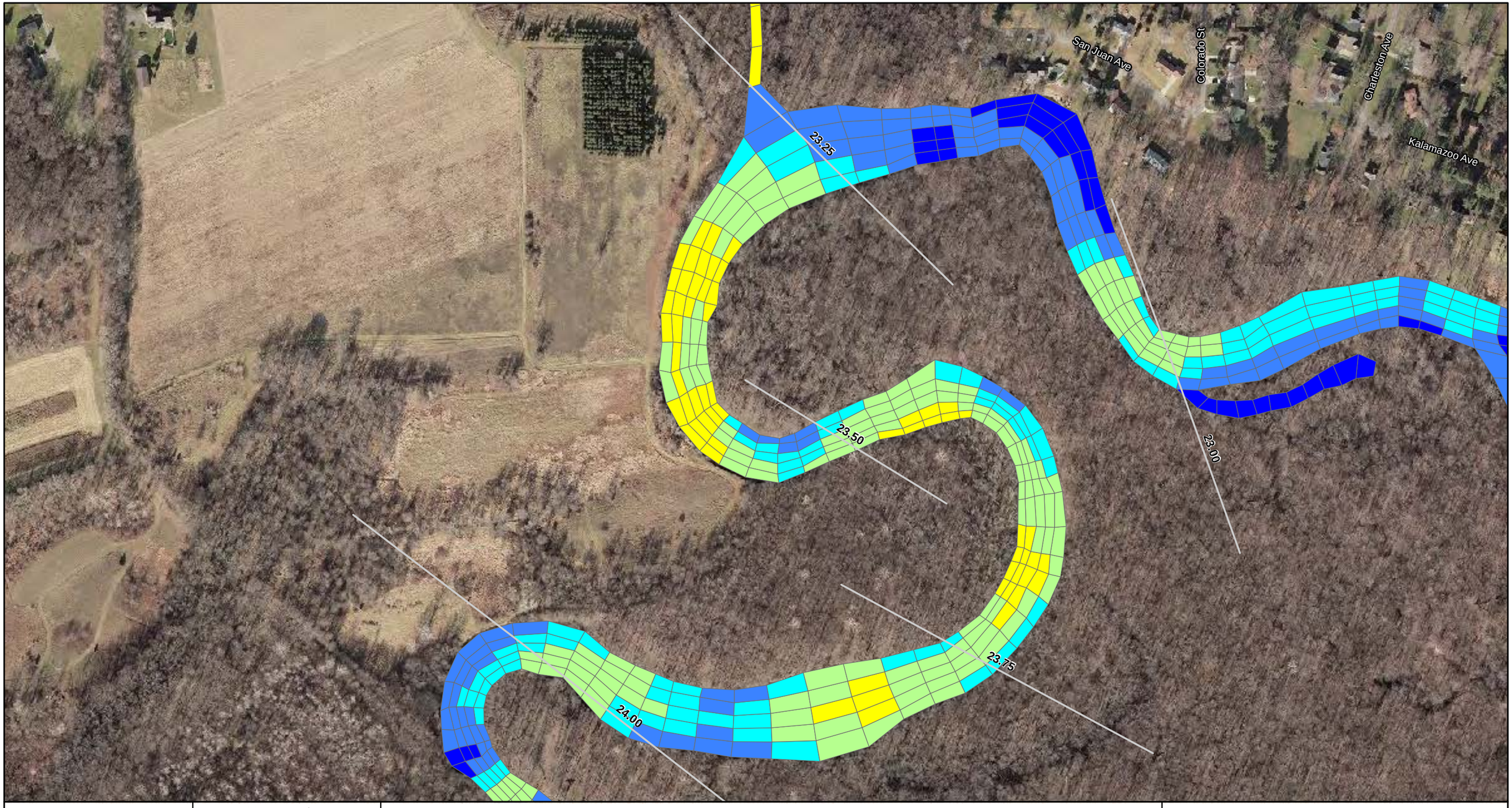
MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

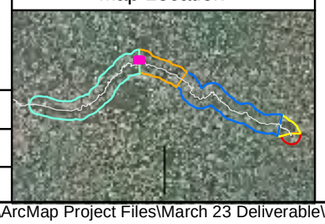
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

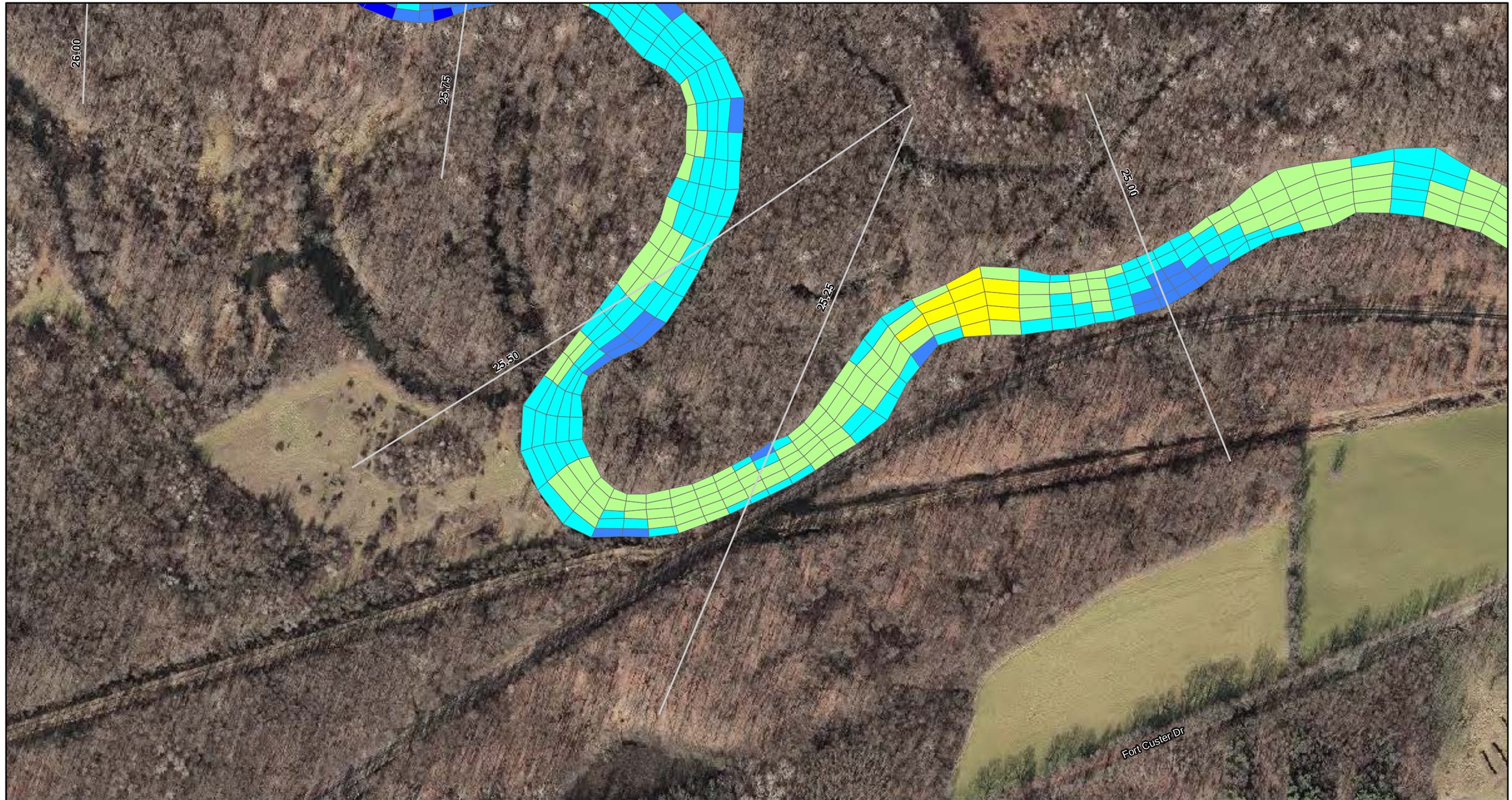
MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

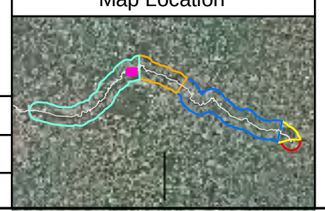
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

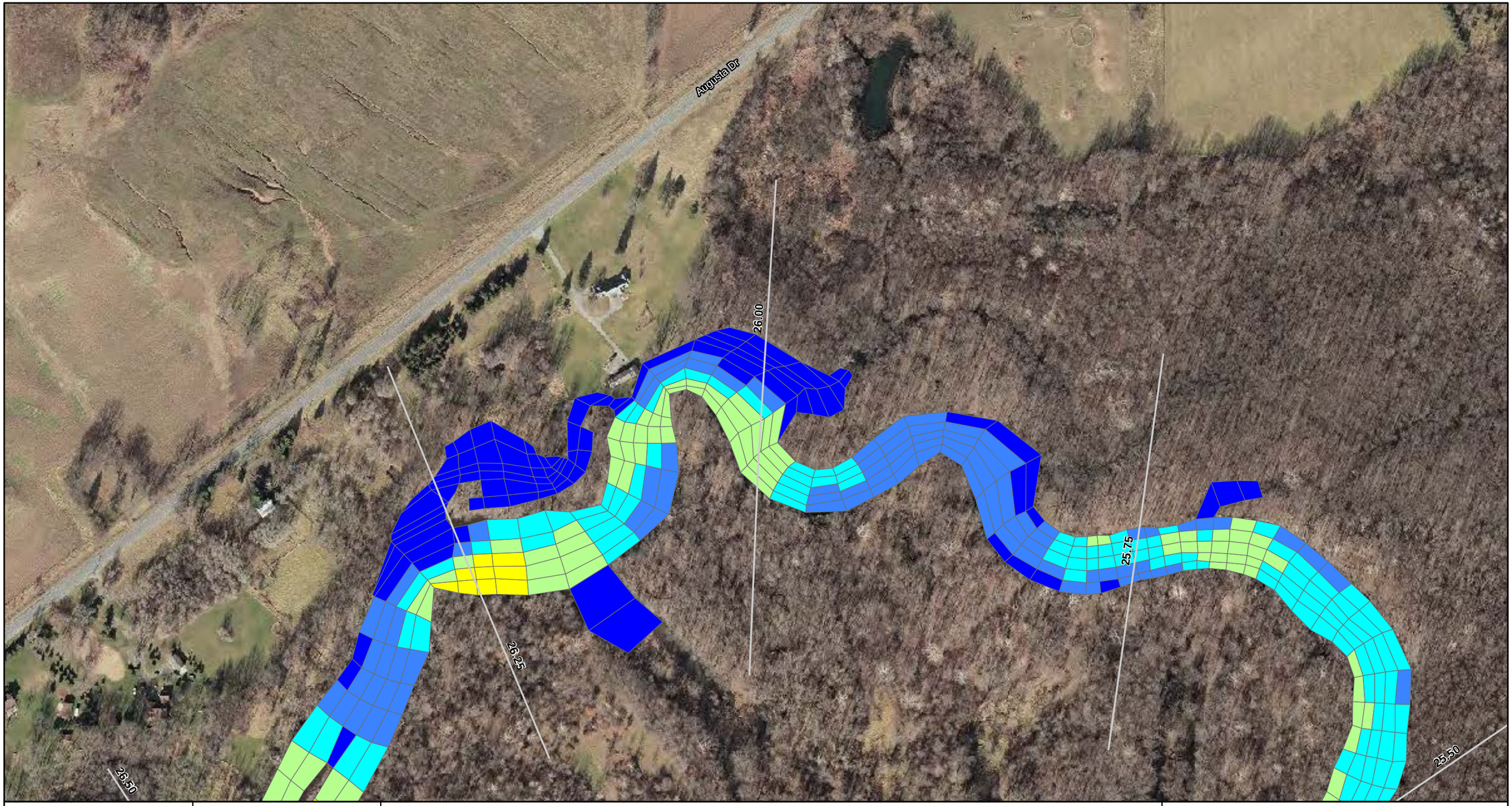
MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

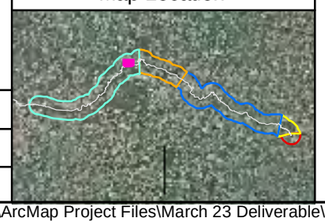
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

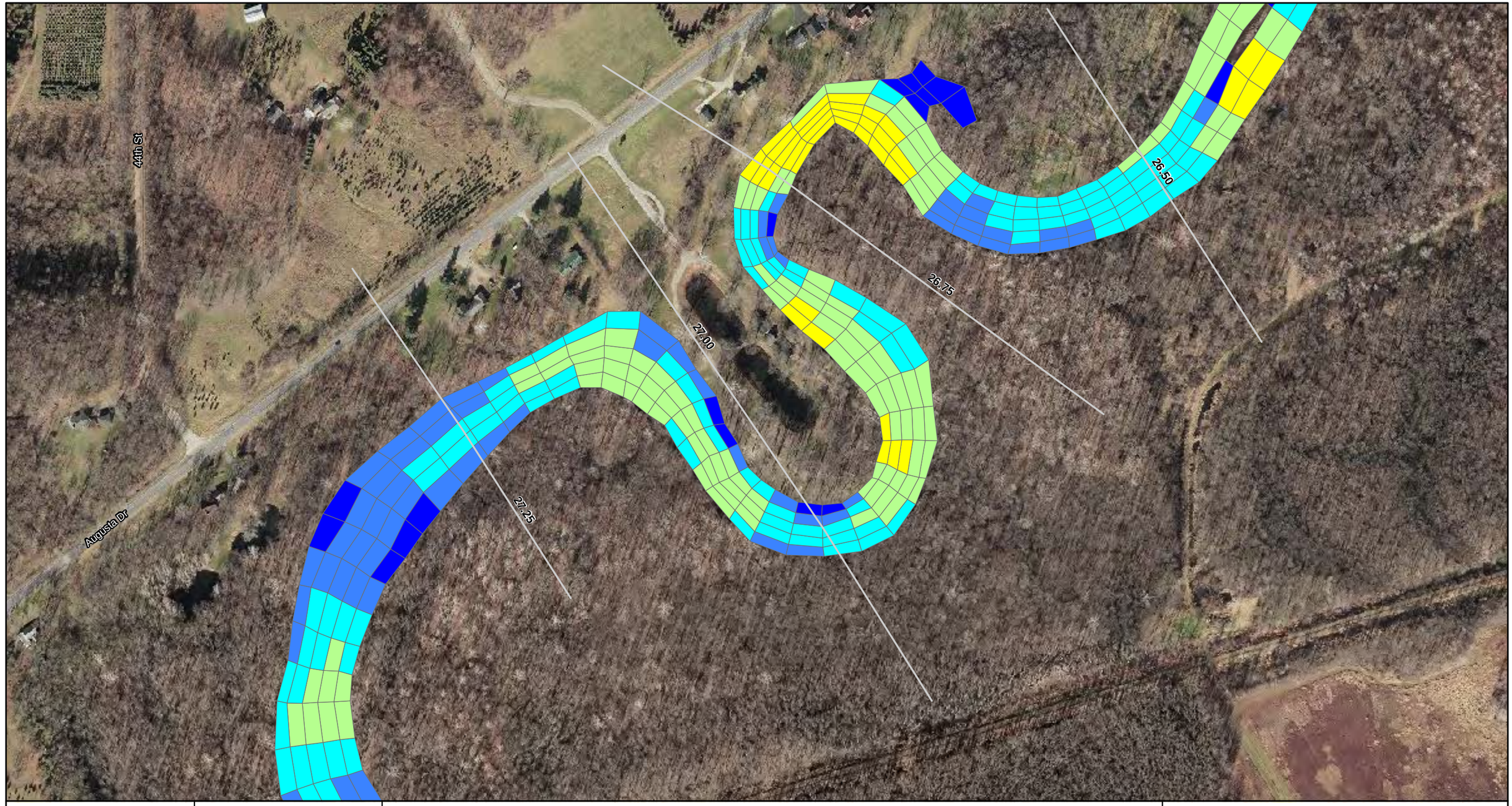
MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

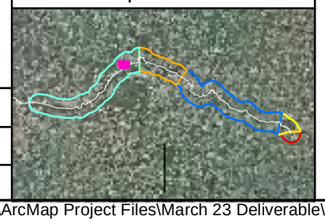
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

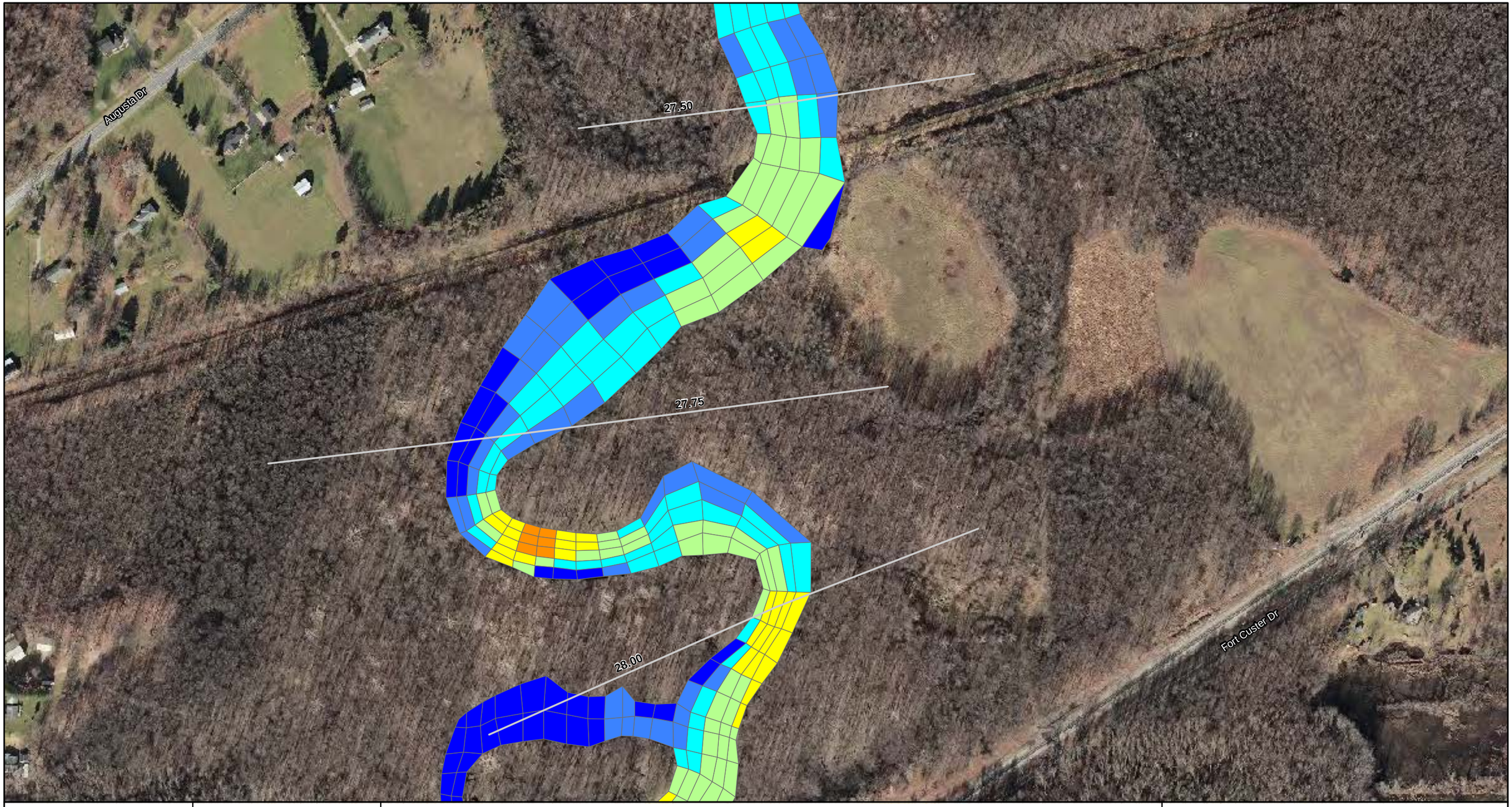
MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

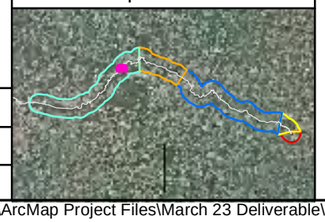
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

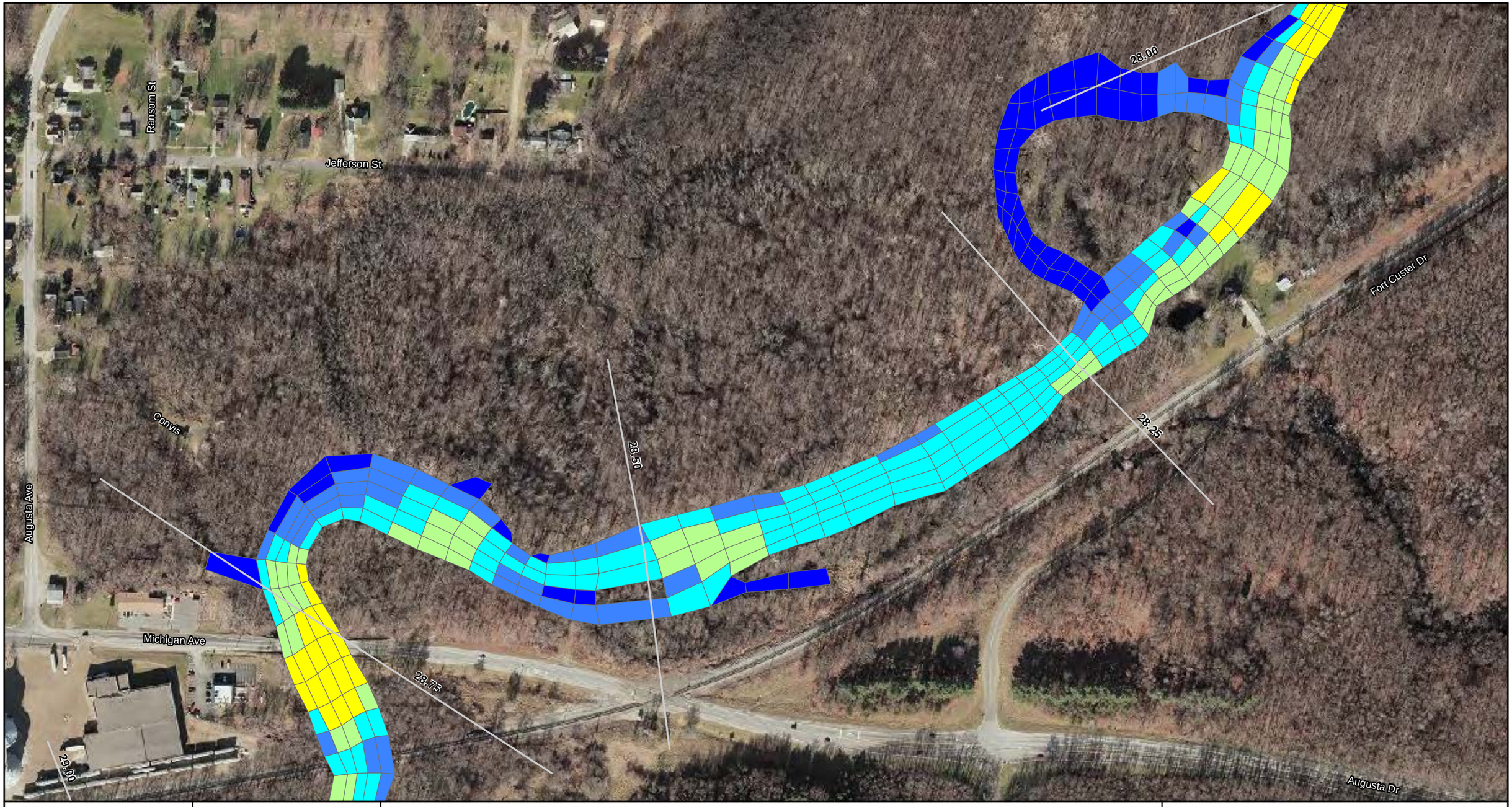
MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

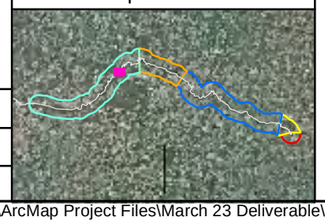
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011
- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Clinton St
Clinton St
Chestnut St
Webster St
Church St
Fayette St
Cass St
Cherry St
Lincoln St
28.75
29.00
29.25
29.50
Augusta Climax Rd
Fort Custer Rec Area Access

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

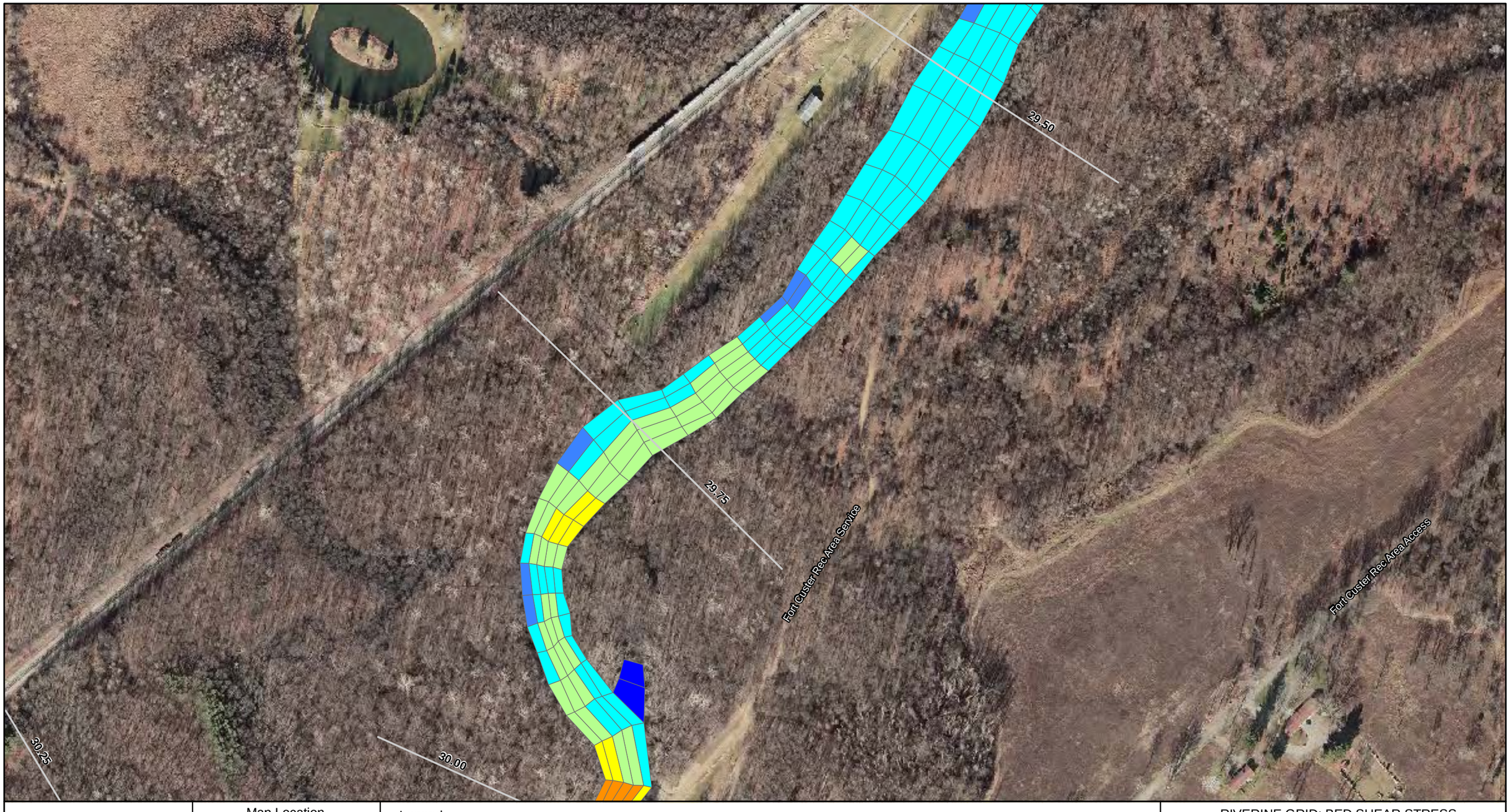
MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

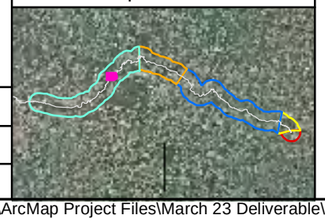
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

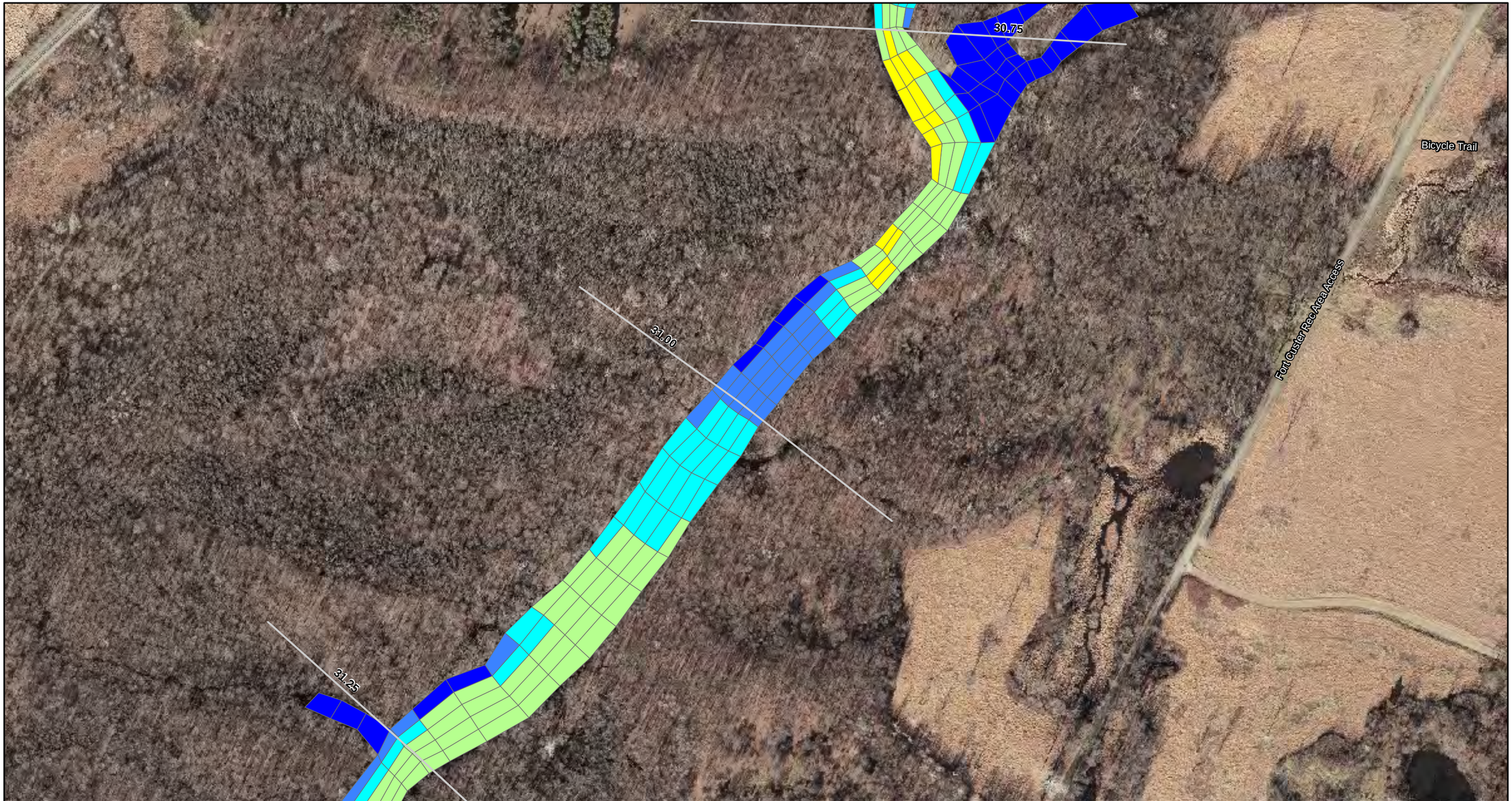
MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

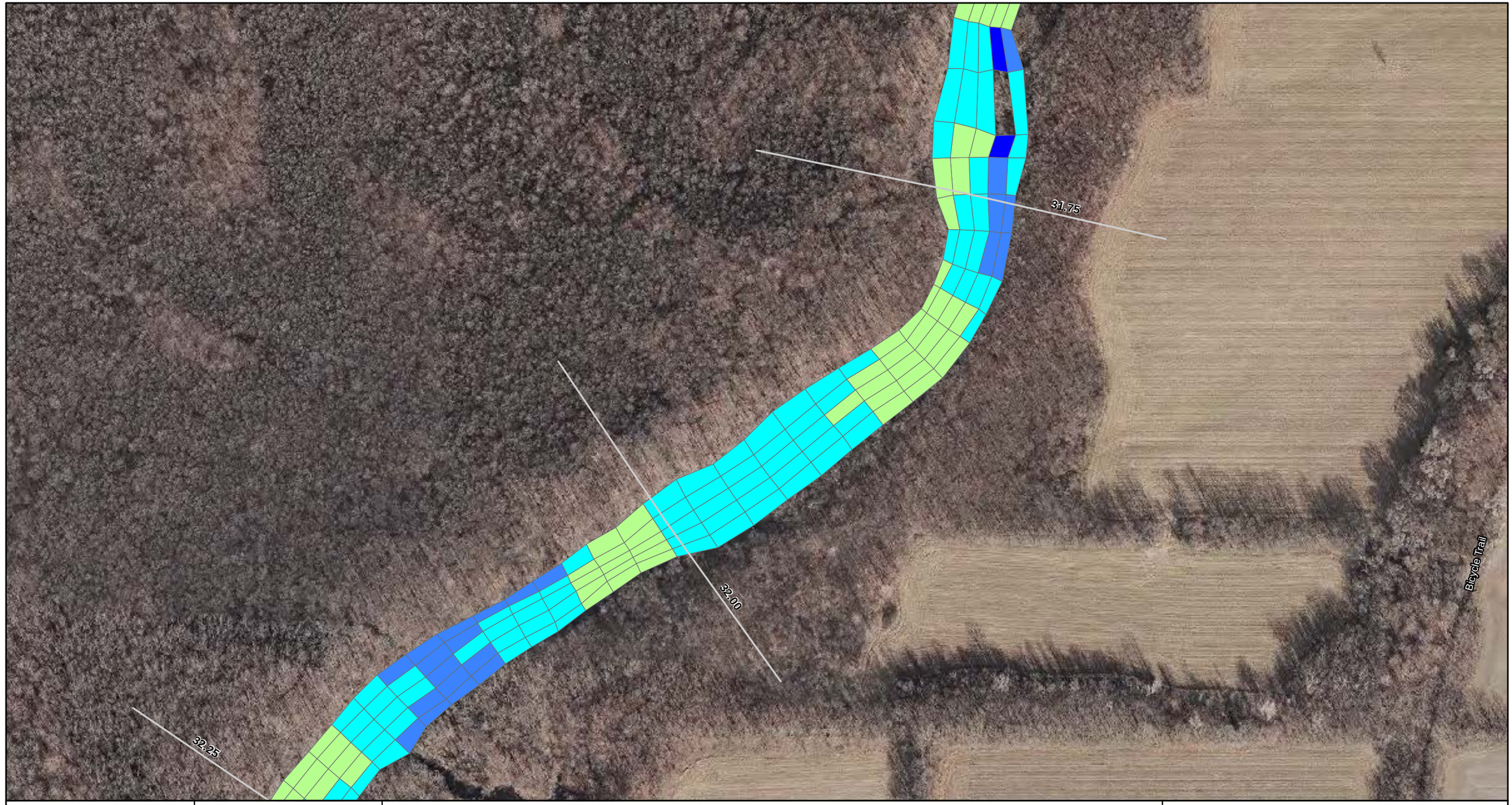
MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

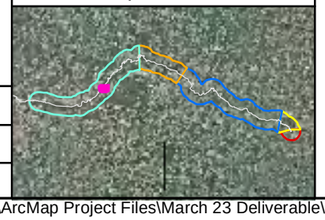
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011
- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

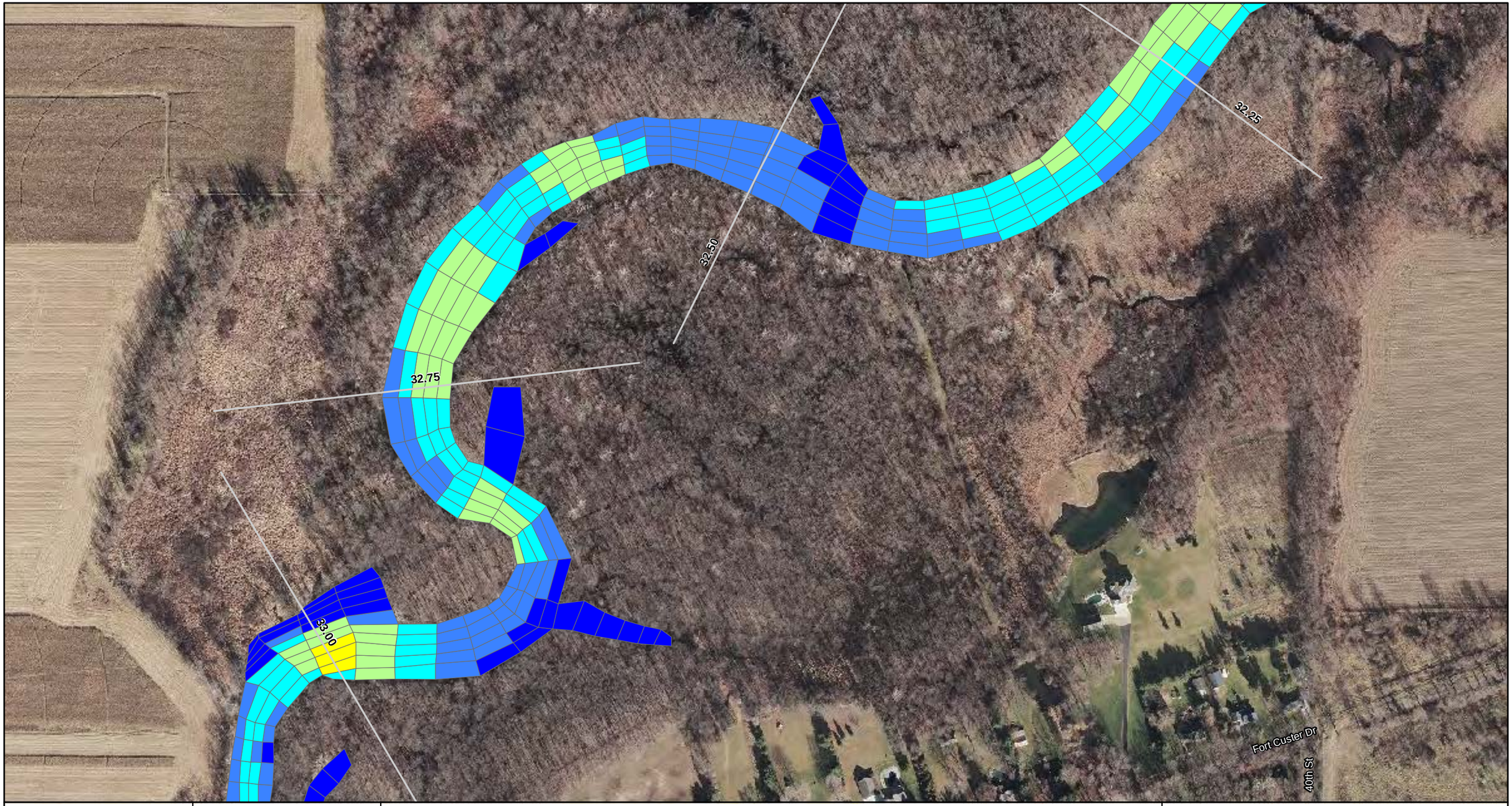
MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

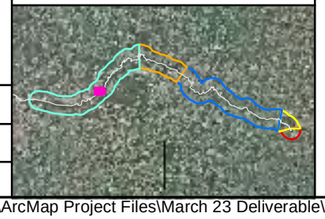
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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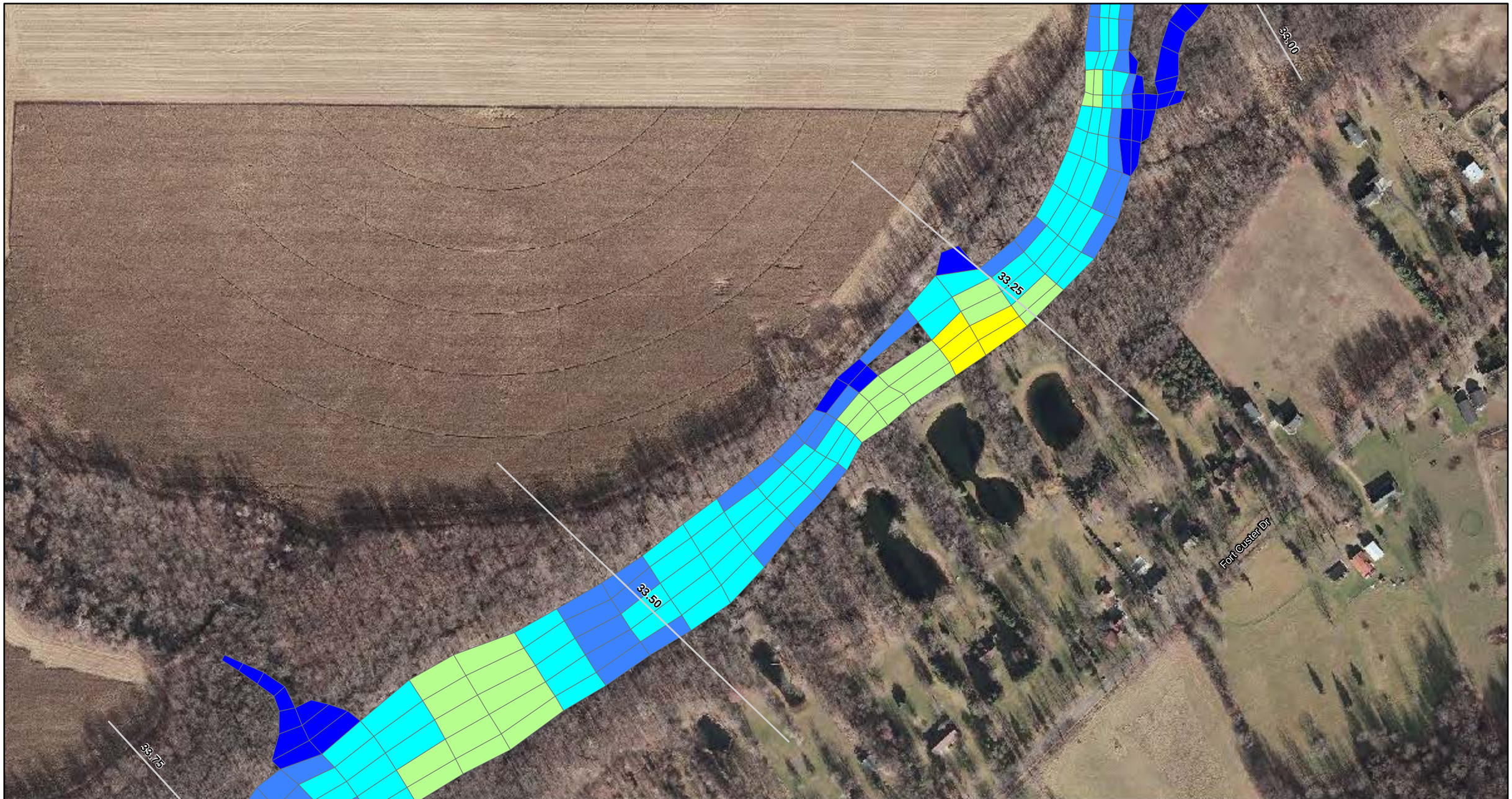
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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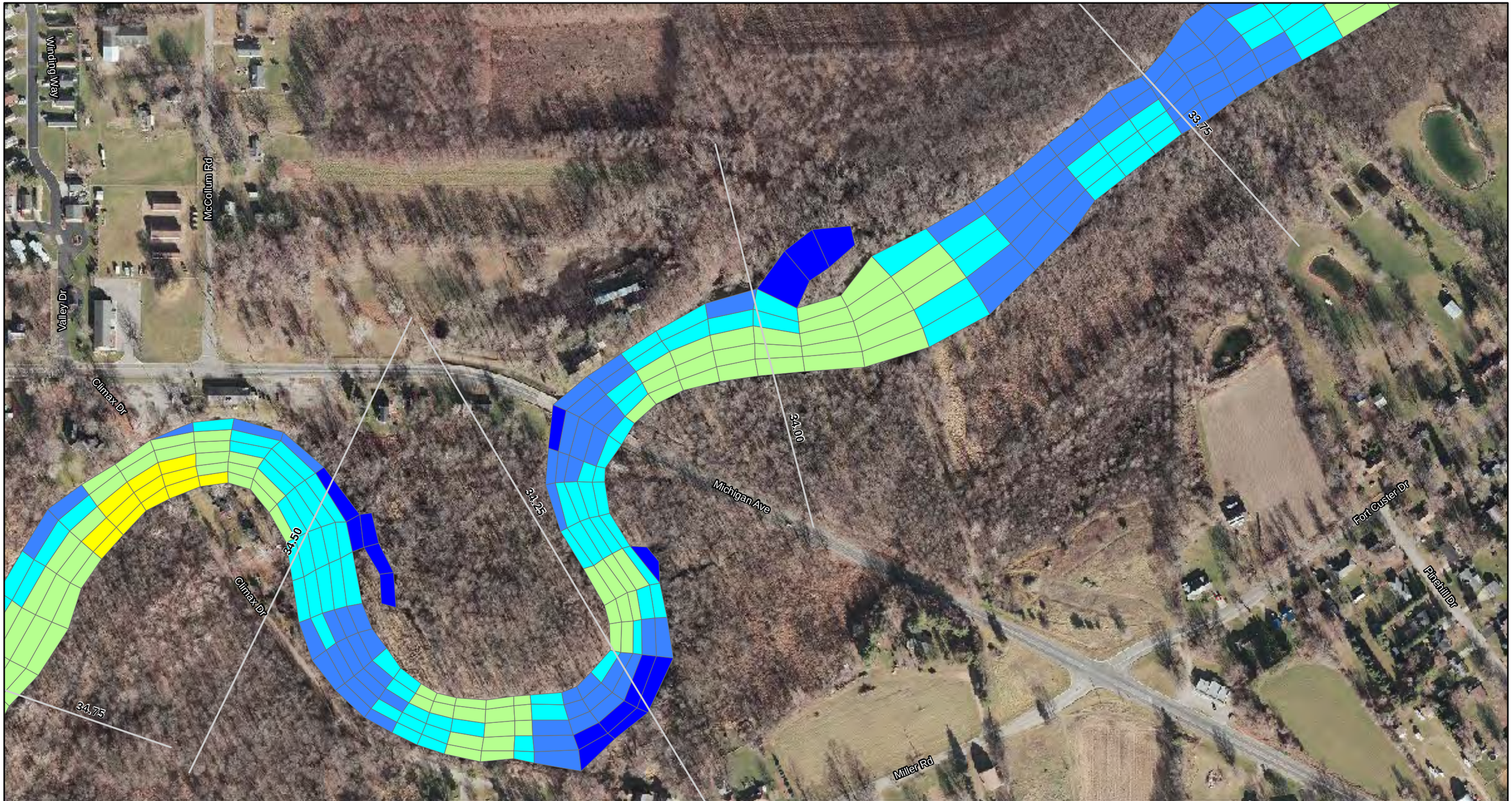
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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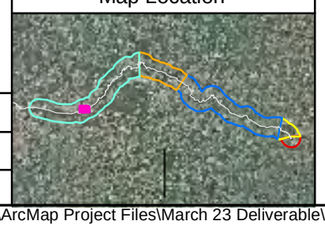
Aerial Photography Date: November 2011

Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

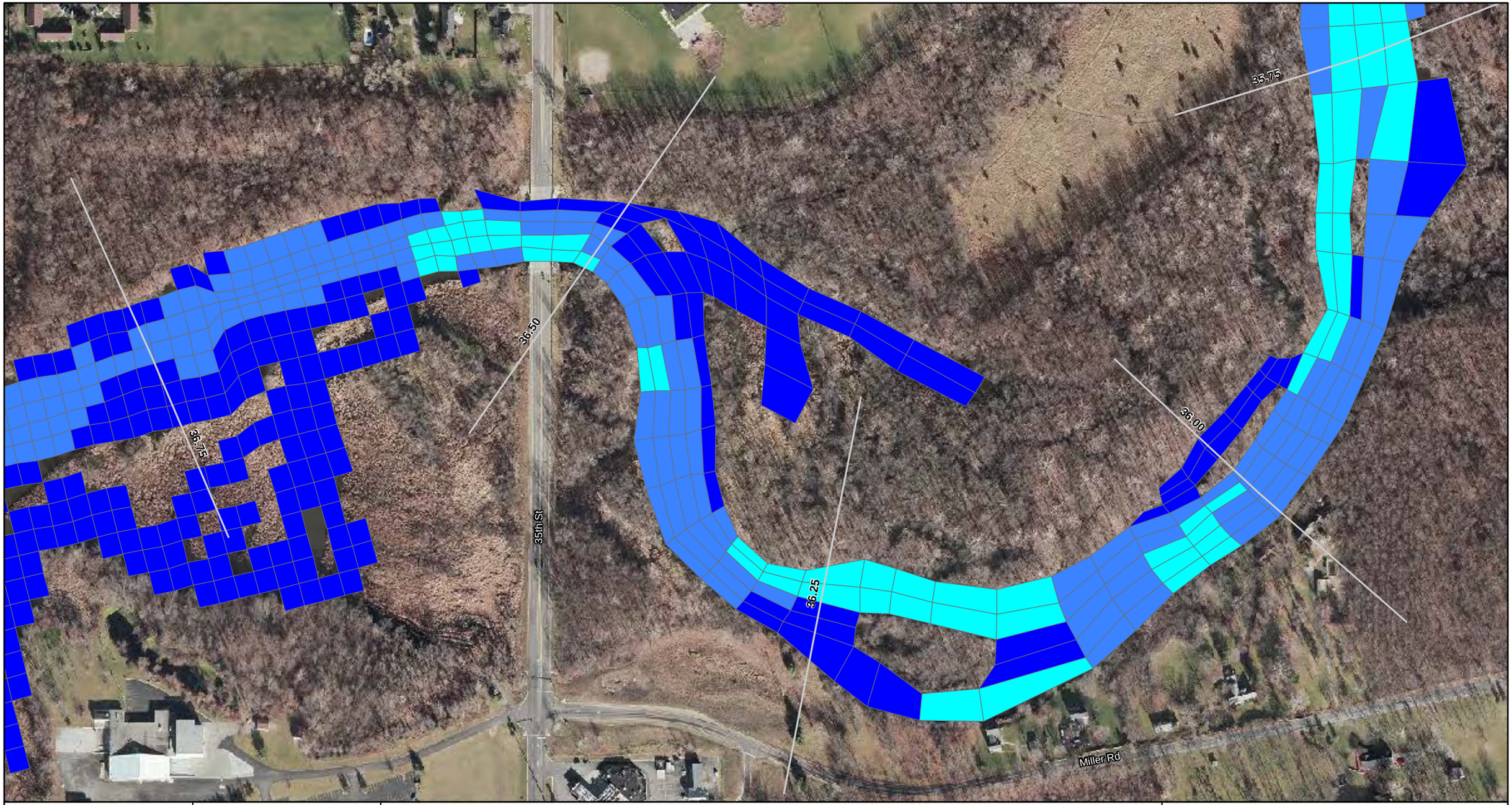
MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

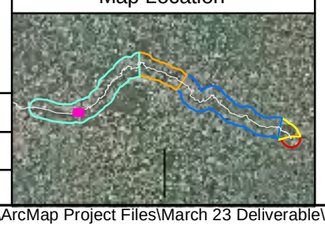
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

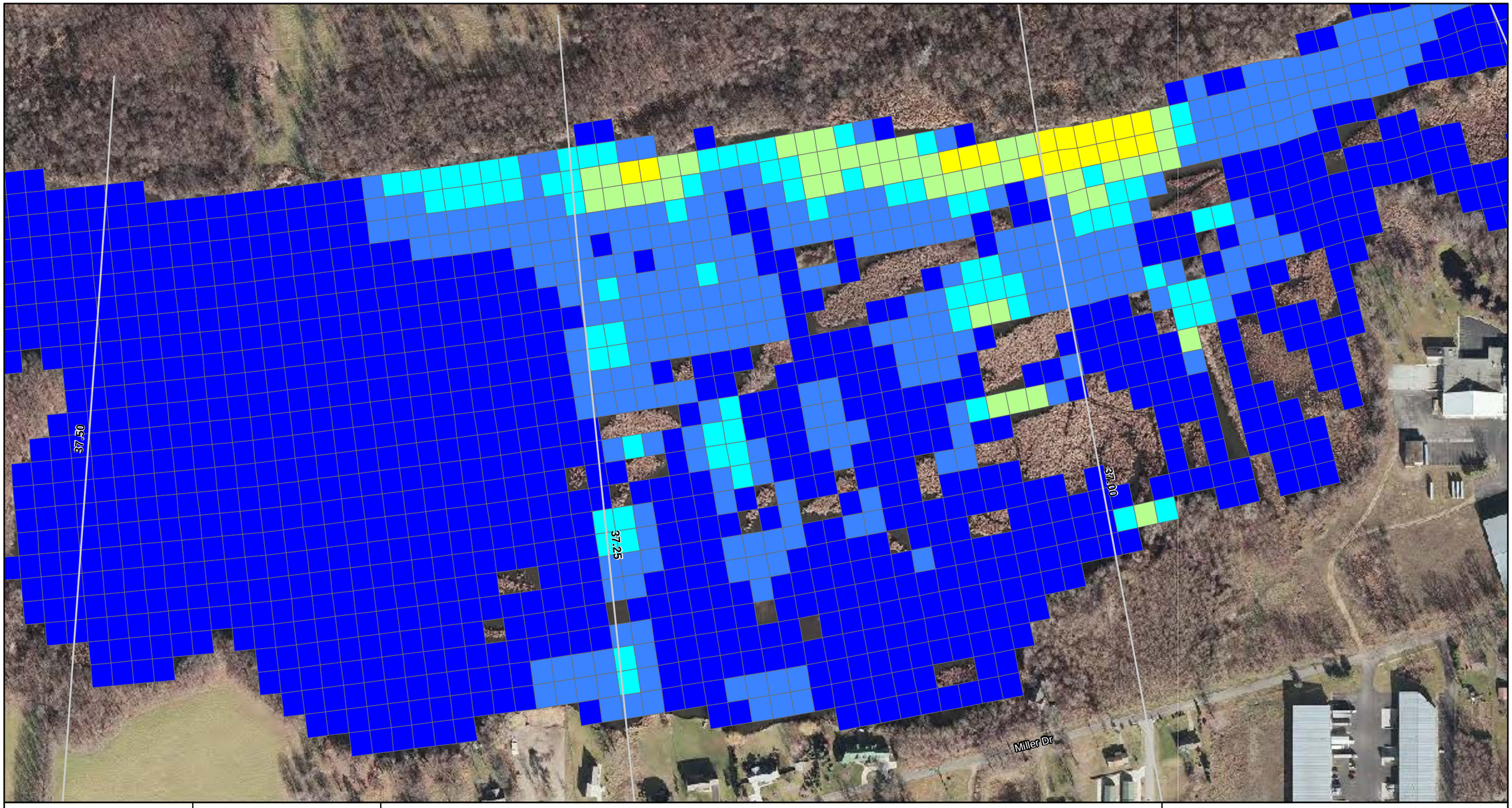
MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

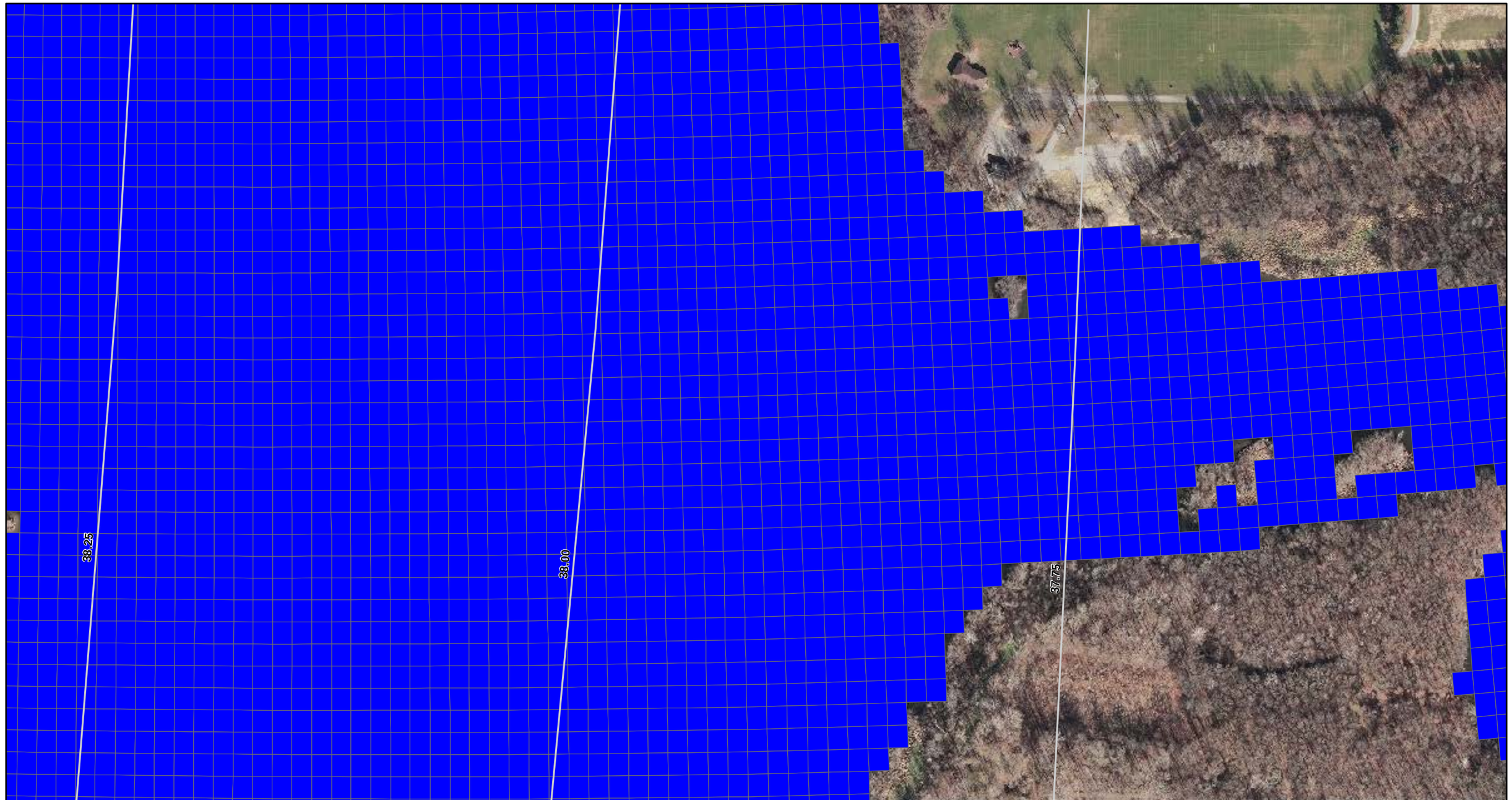
MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

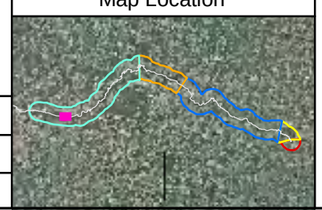
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

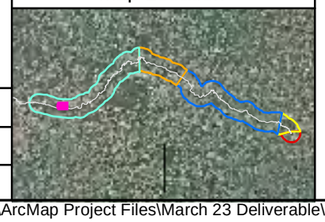
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

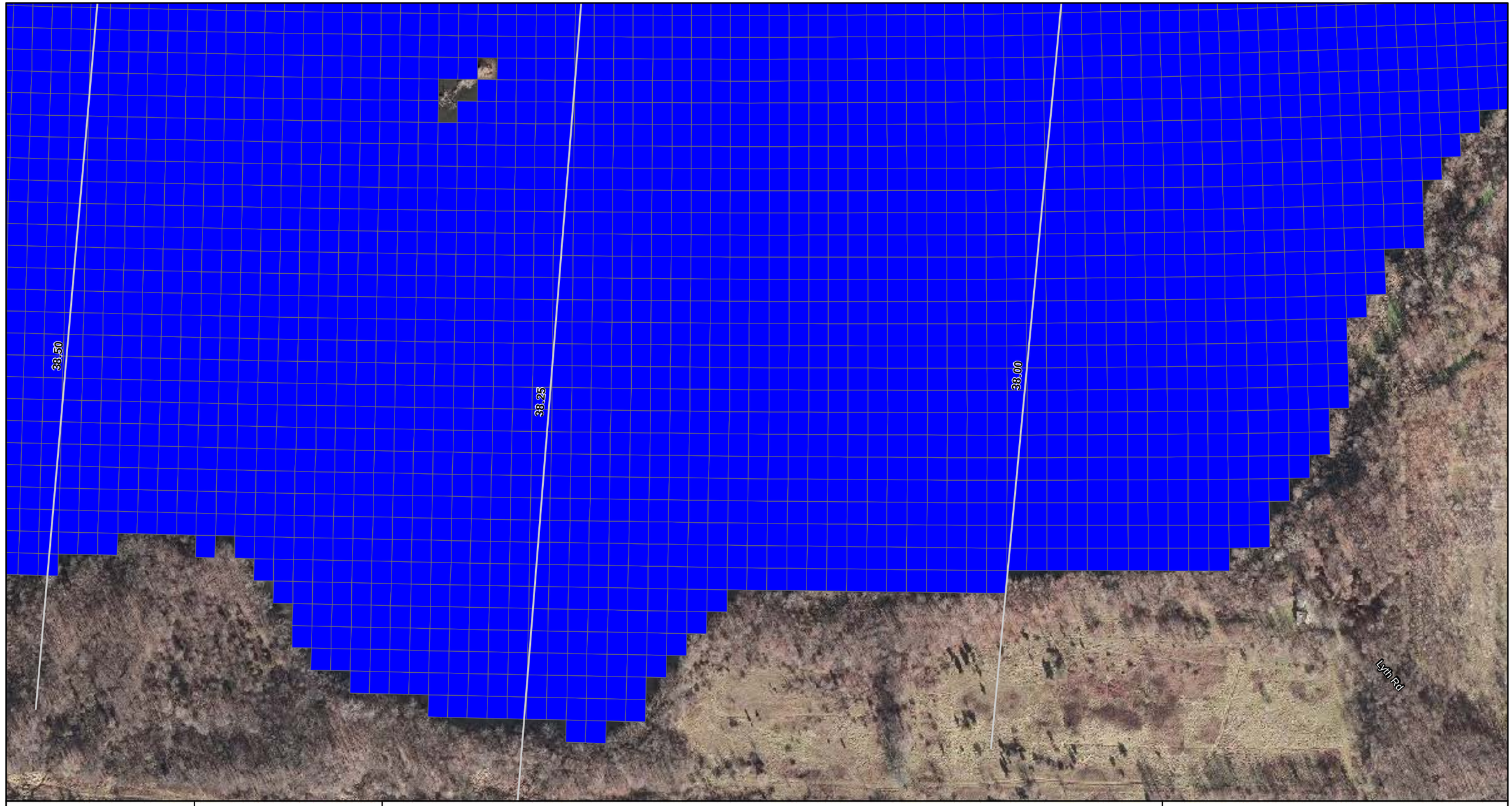
MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

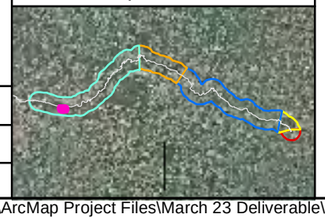
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

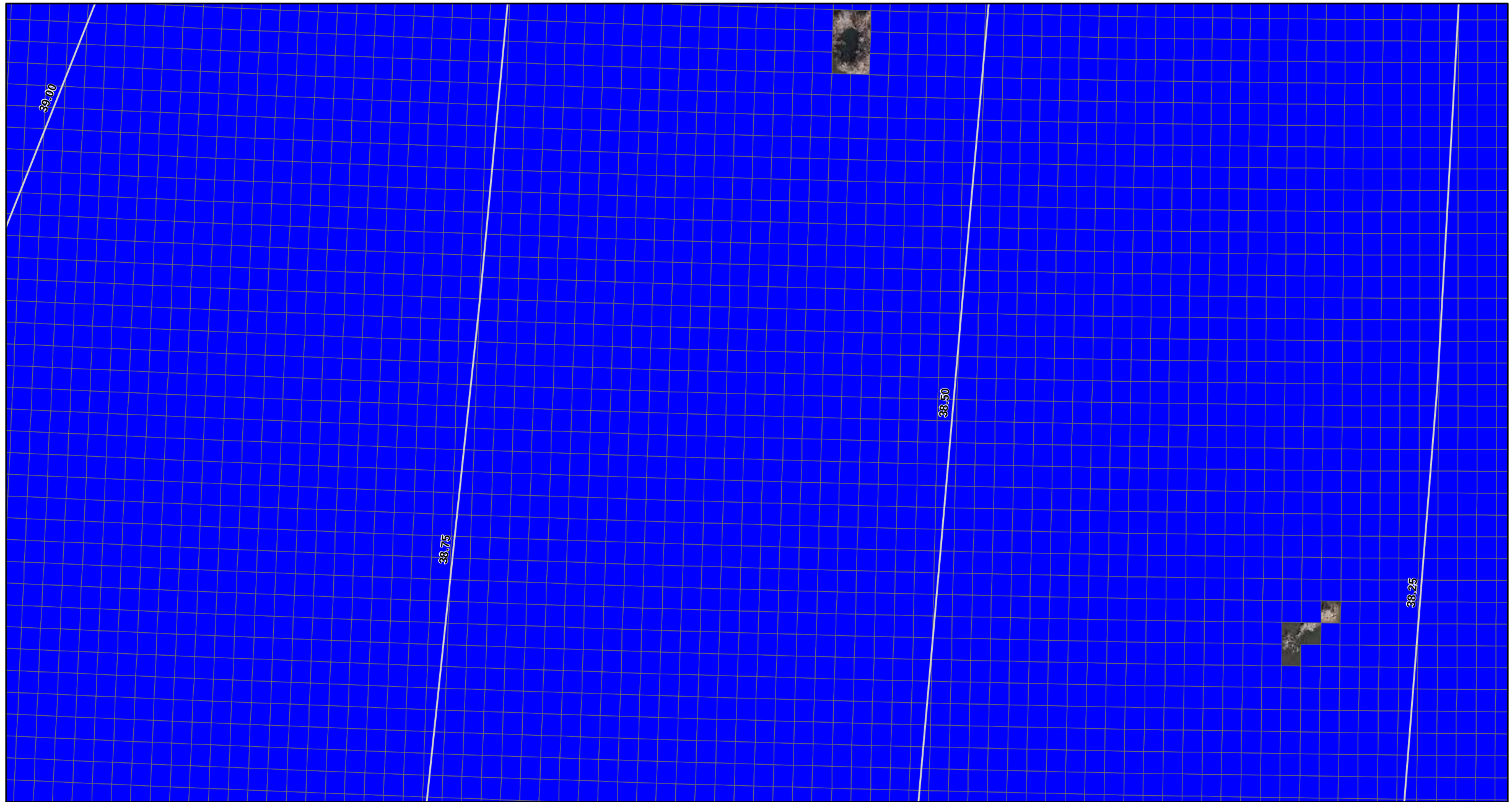
MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

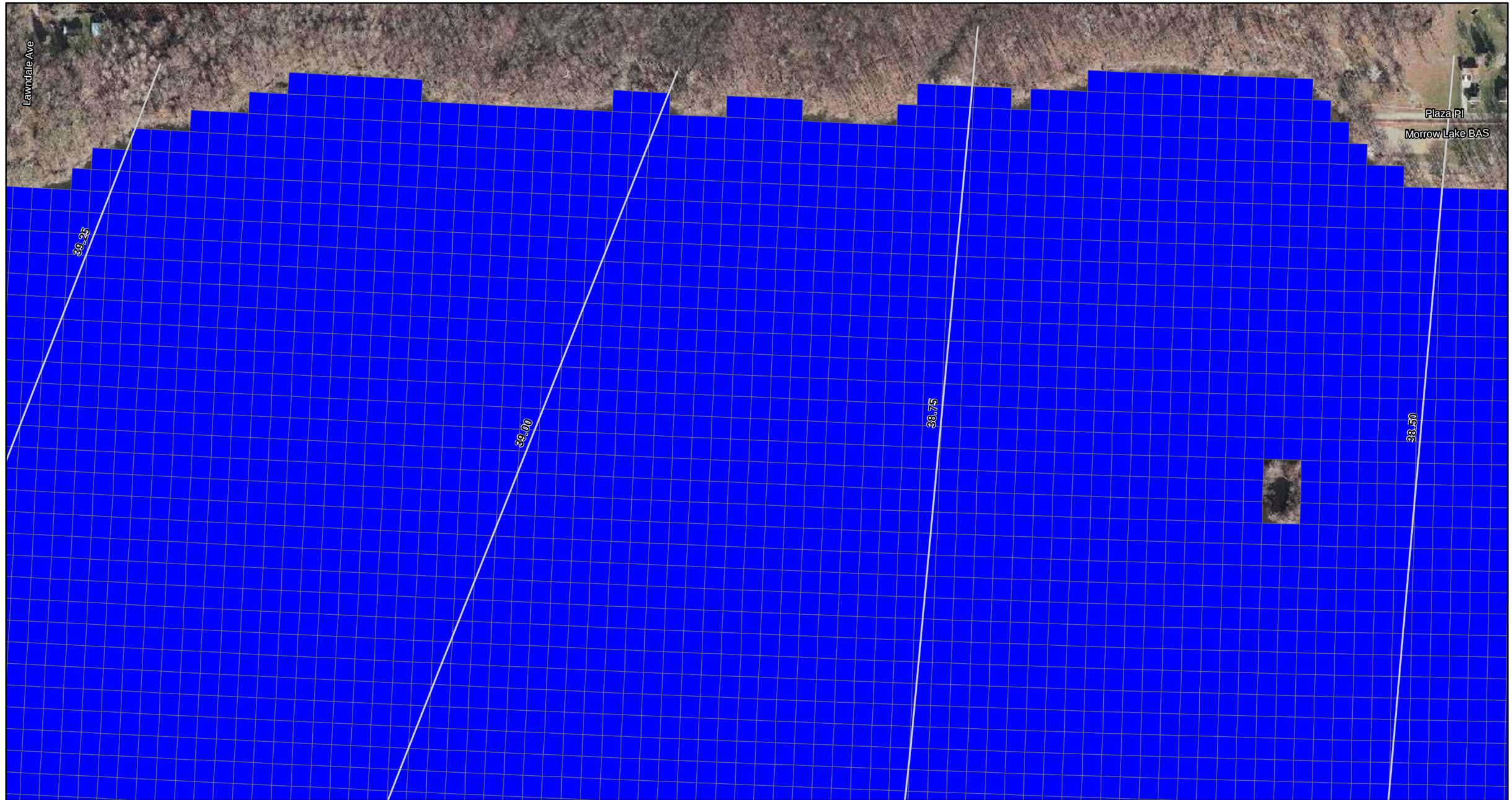
MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

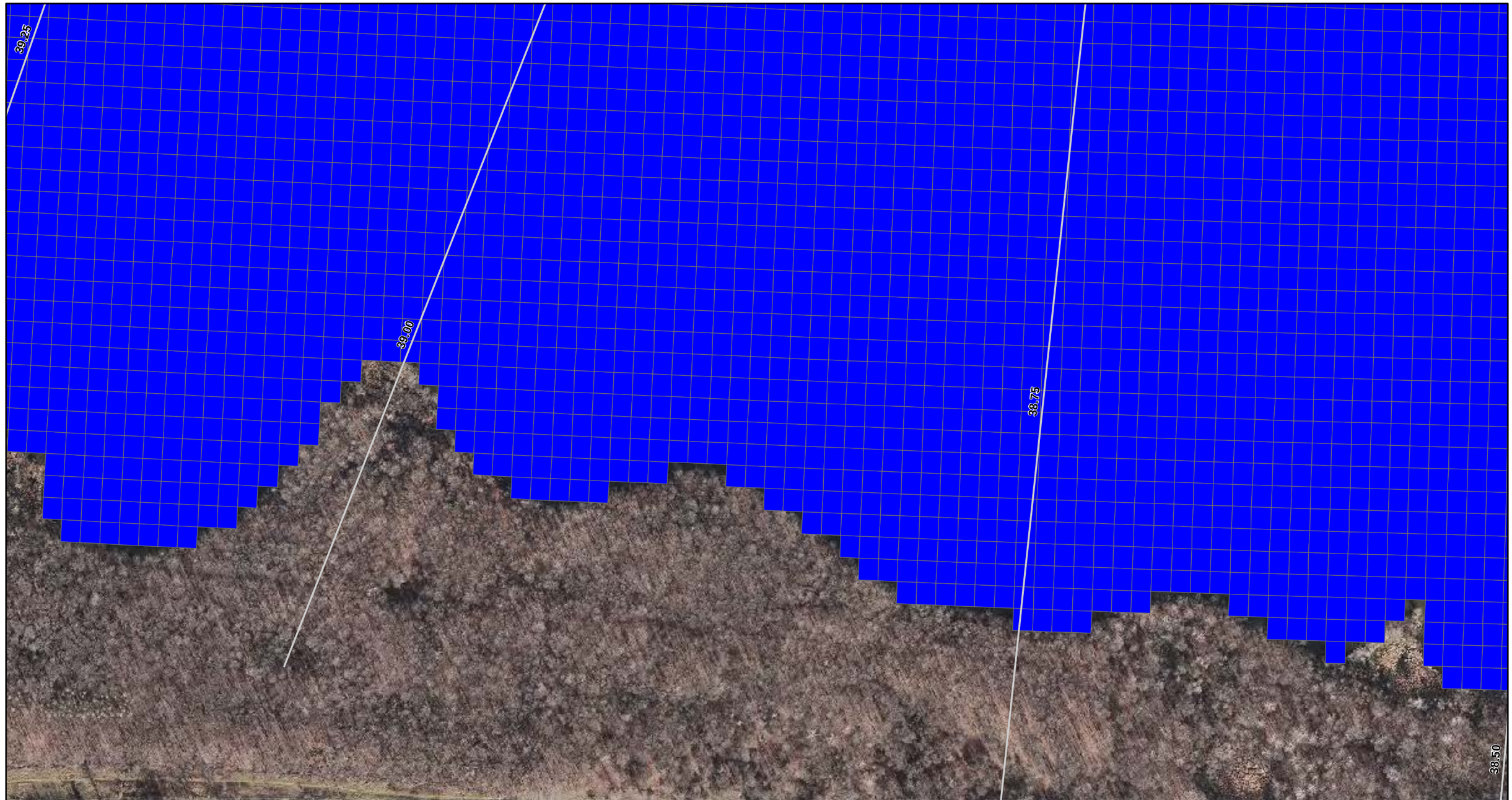
MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

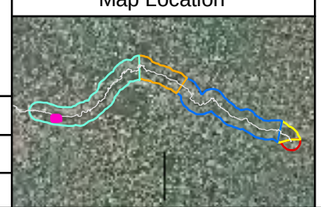
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

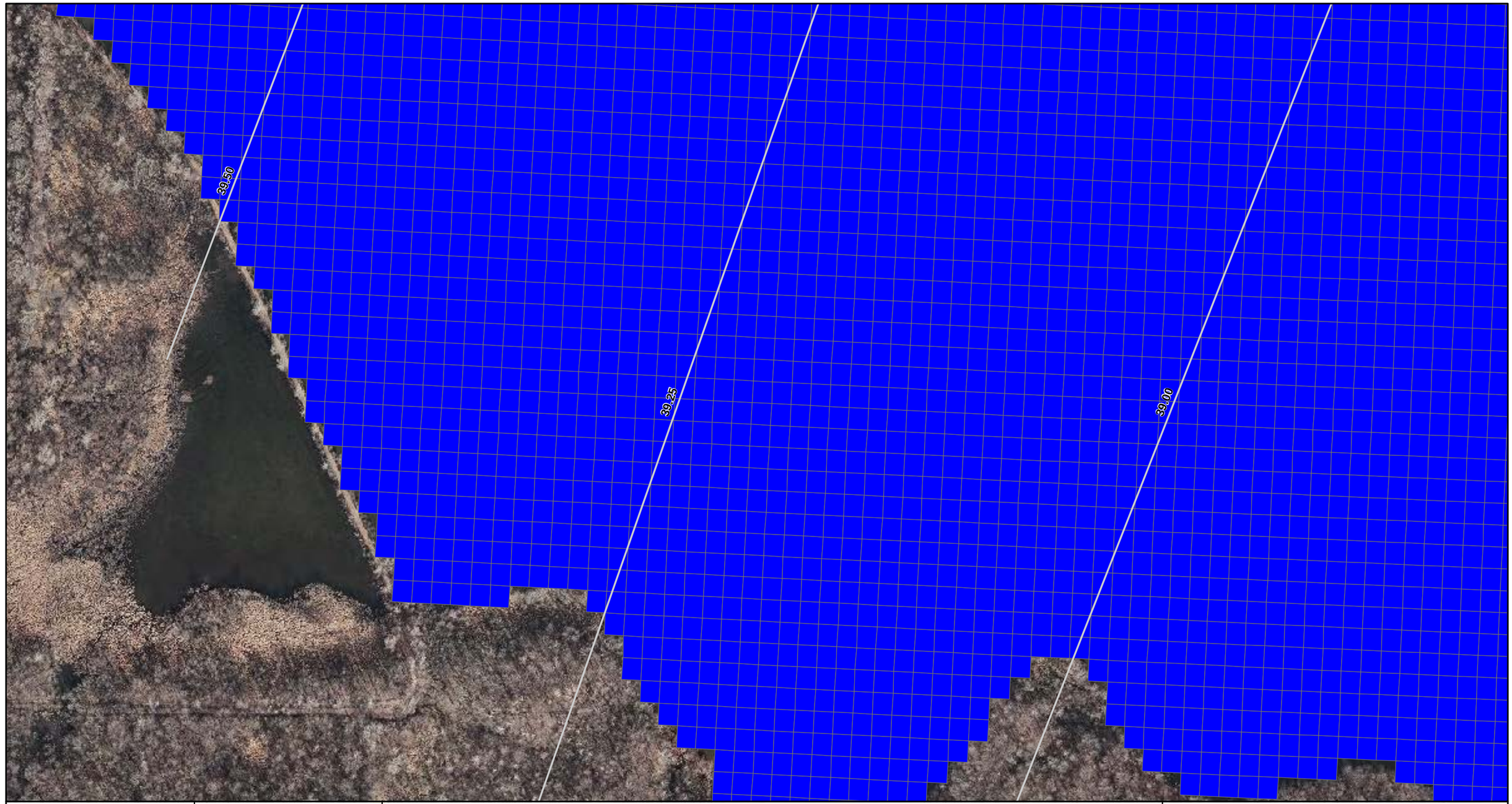
MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

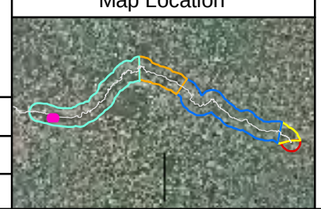
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

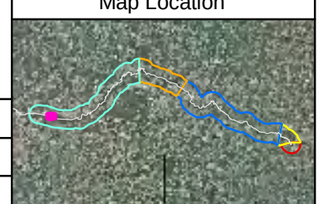
Aerial Photography Date: November 2011

Morrow St
Elliot Rd
Lawndale Ave
Chene Dr
Consumers Power Dr
39.50
39.75
39.25

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), October 31, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 718 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
OCTOBER 31, 2011

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

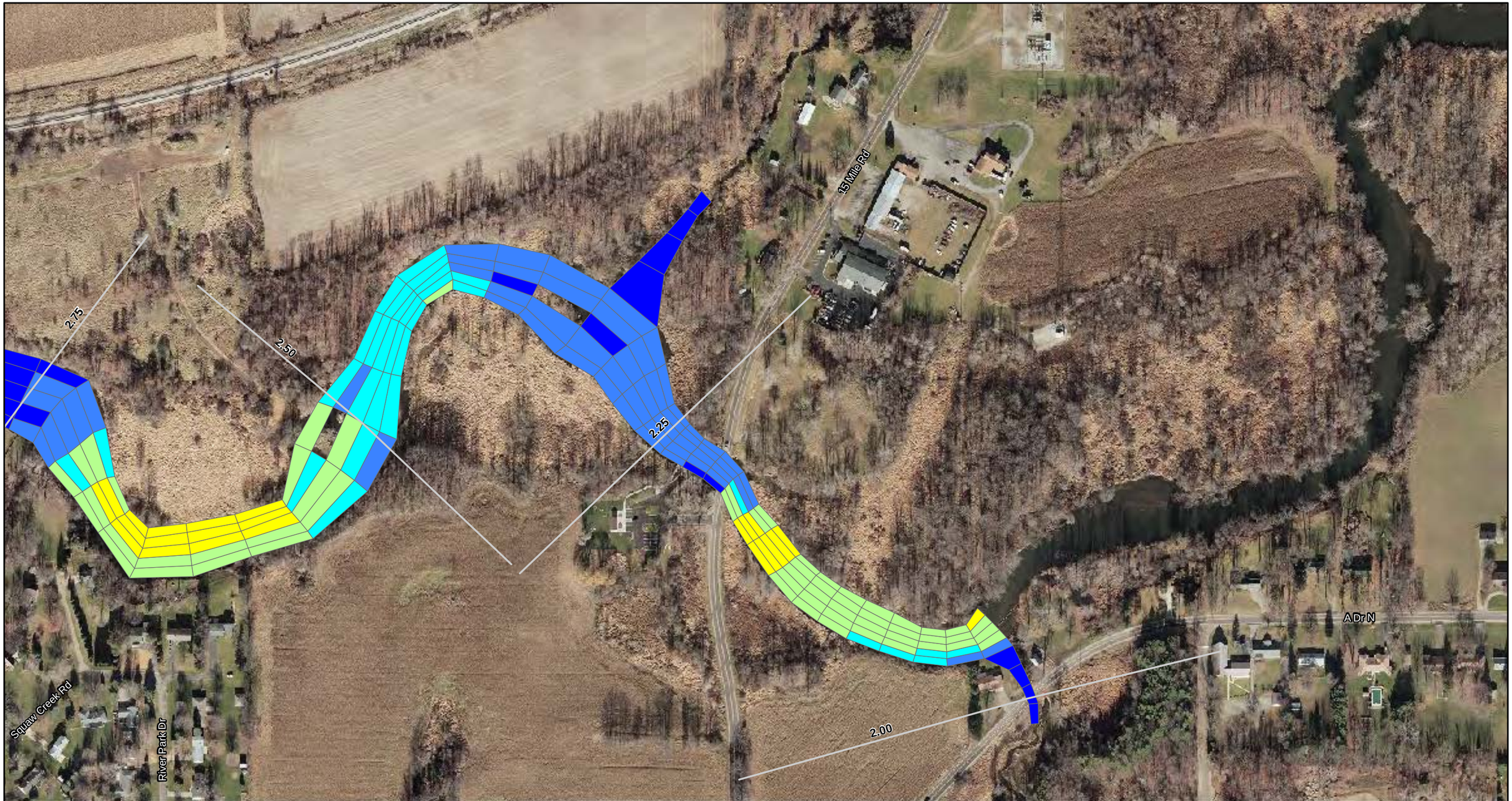
Aerial Photography Date: November 2011

Figure 4-17

Riverine Grid: Bed Shear Stress

November 3, 2011

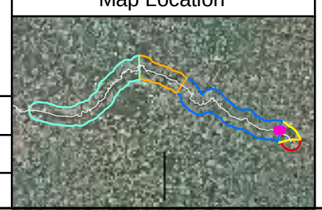
Sheets 1 through 56



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

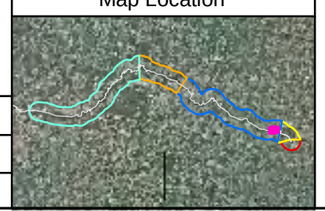
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

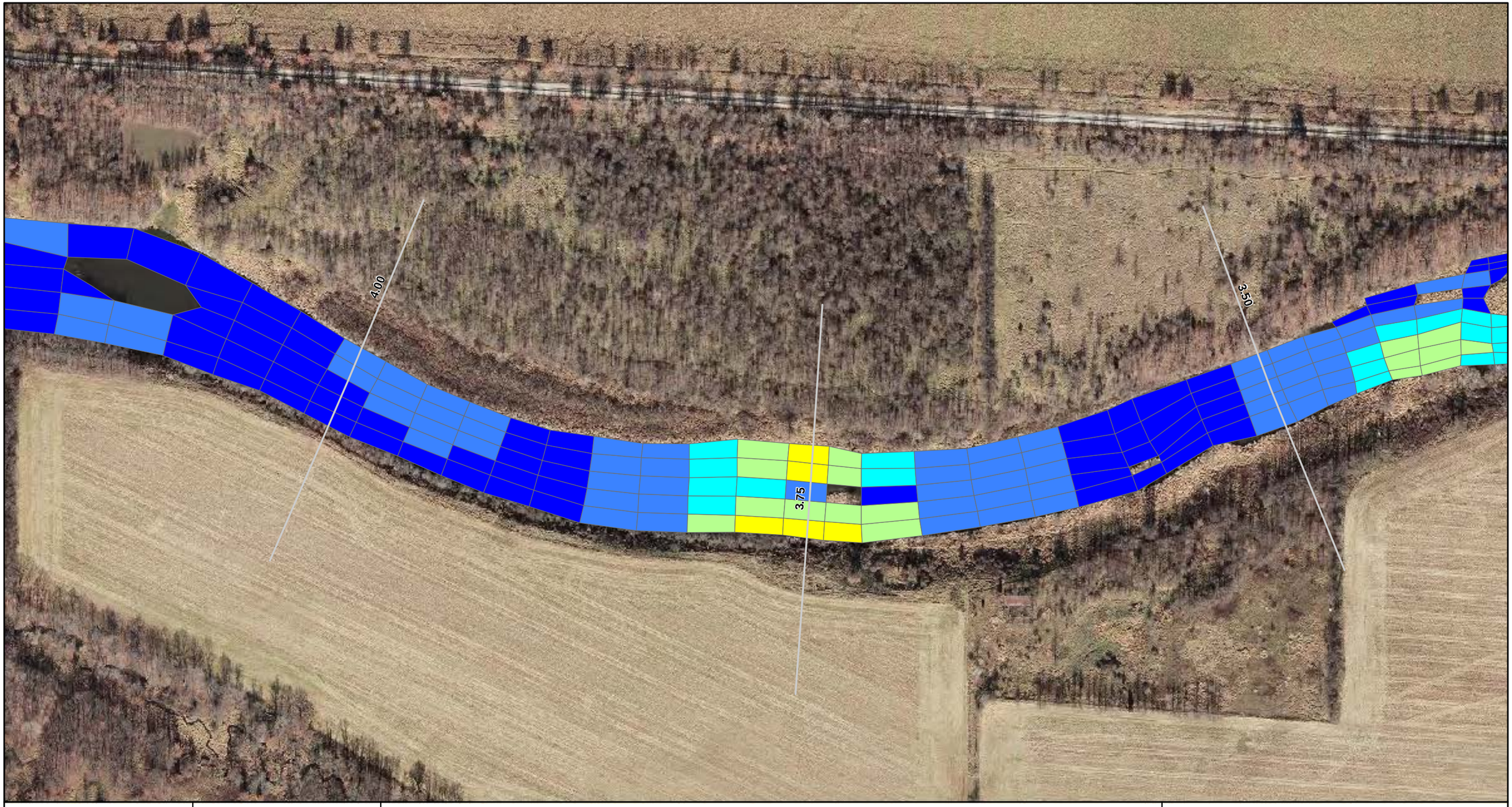
MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

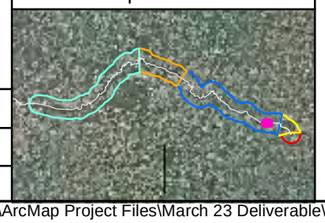
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

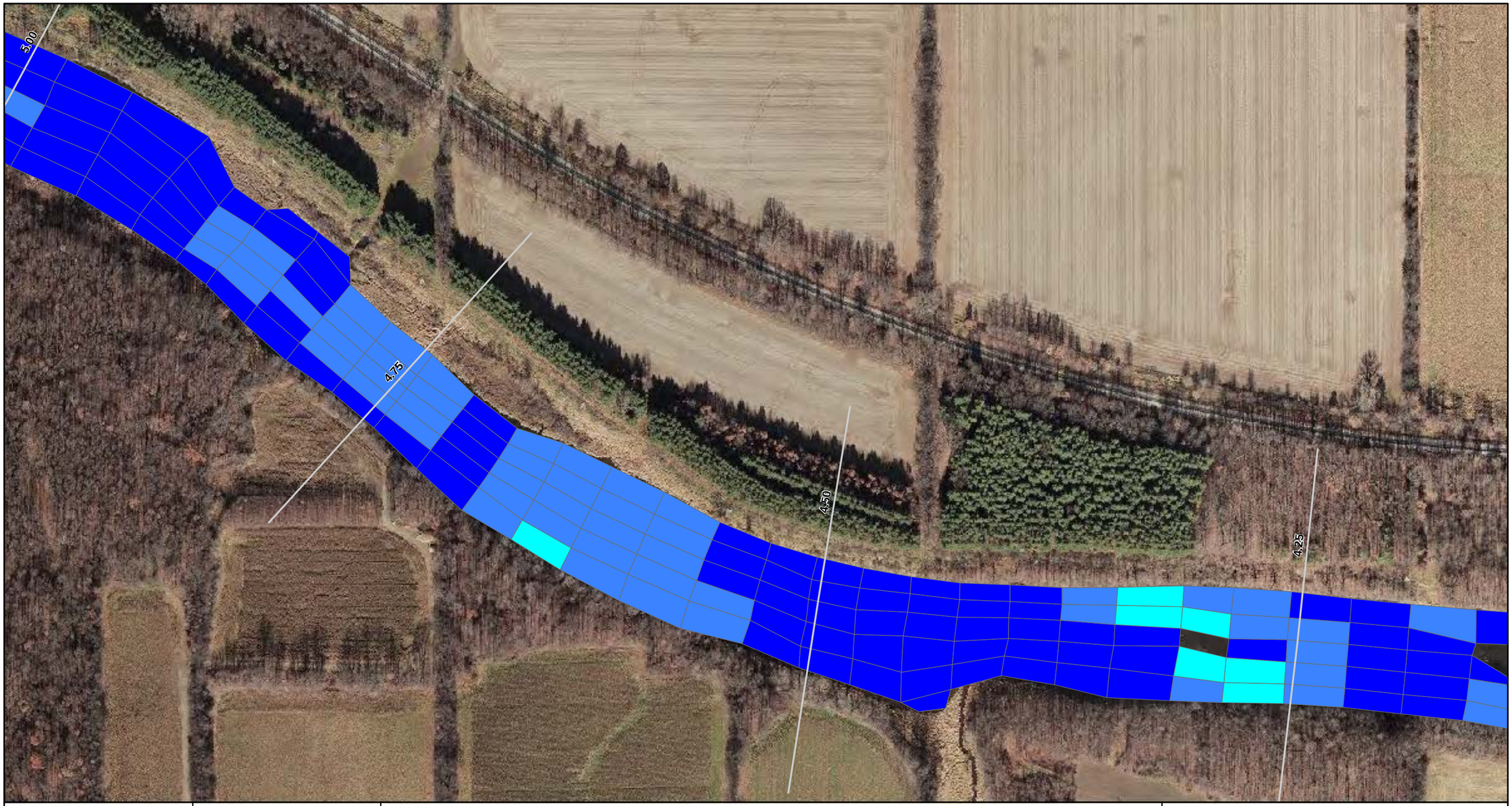
MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

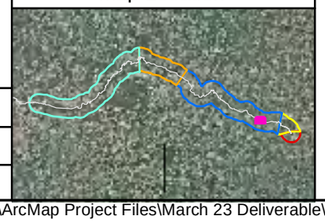
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

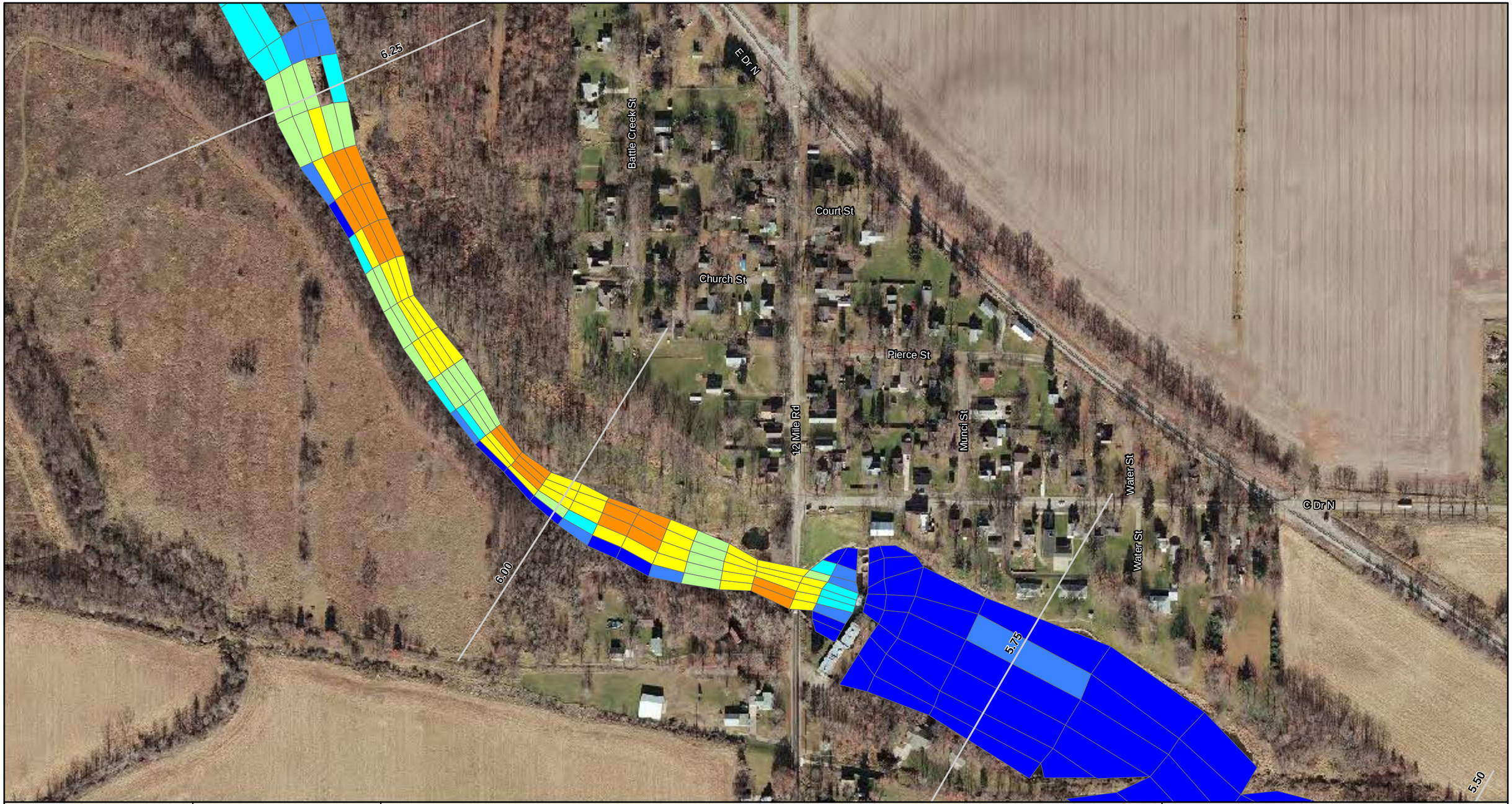
MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

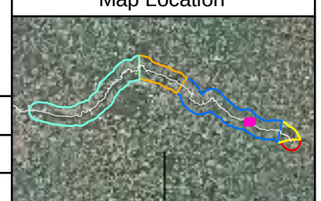
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

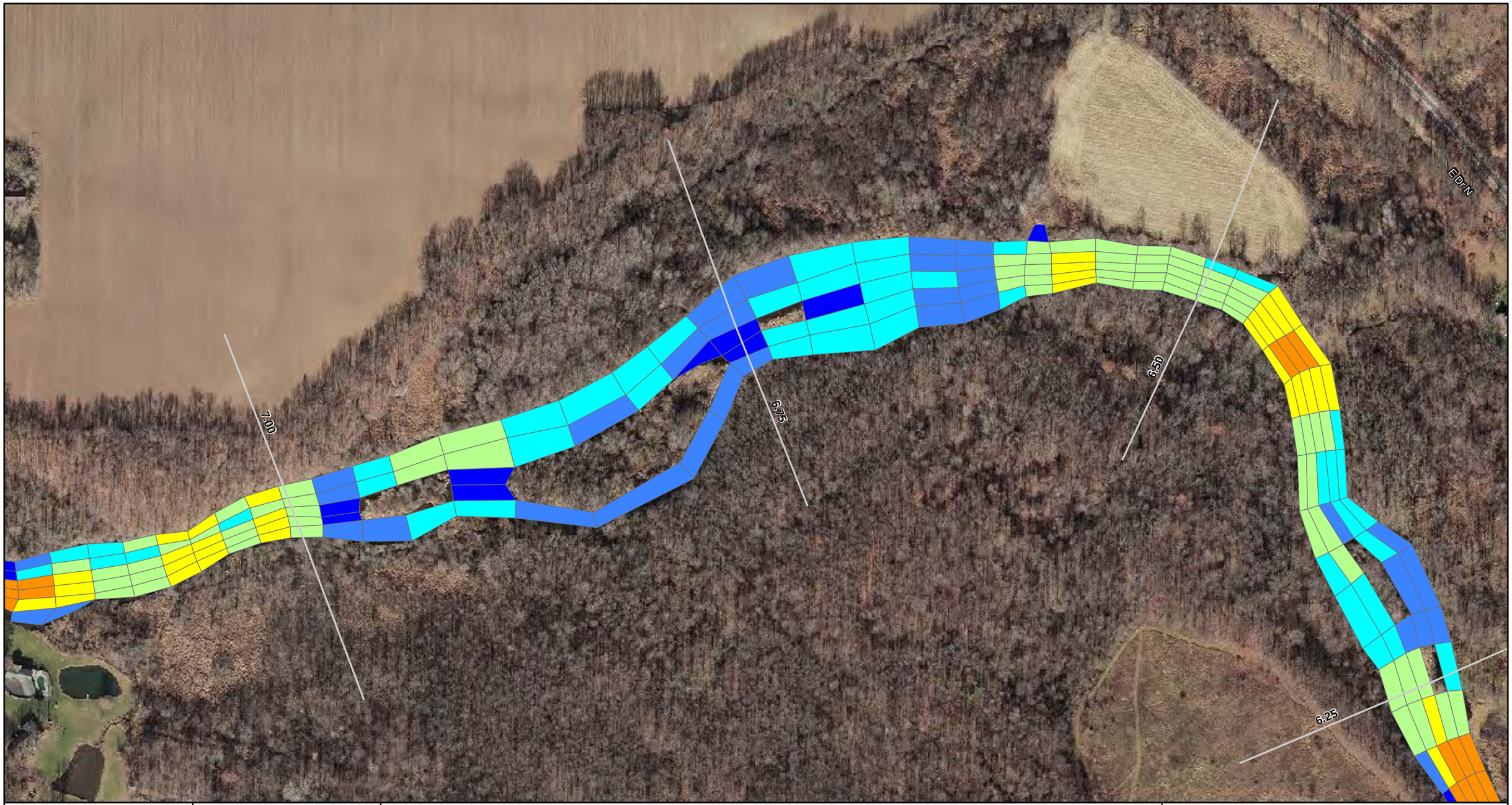
MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

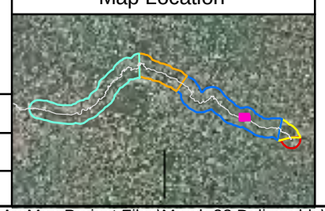
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

N

0 125 250 500

Scale in Feet

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

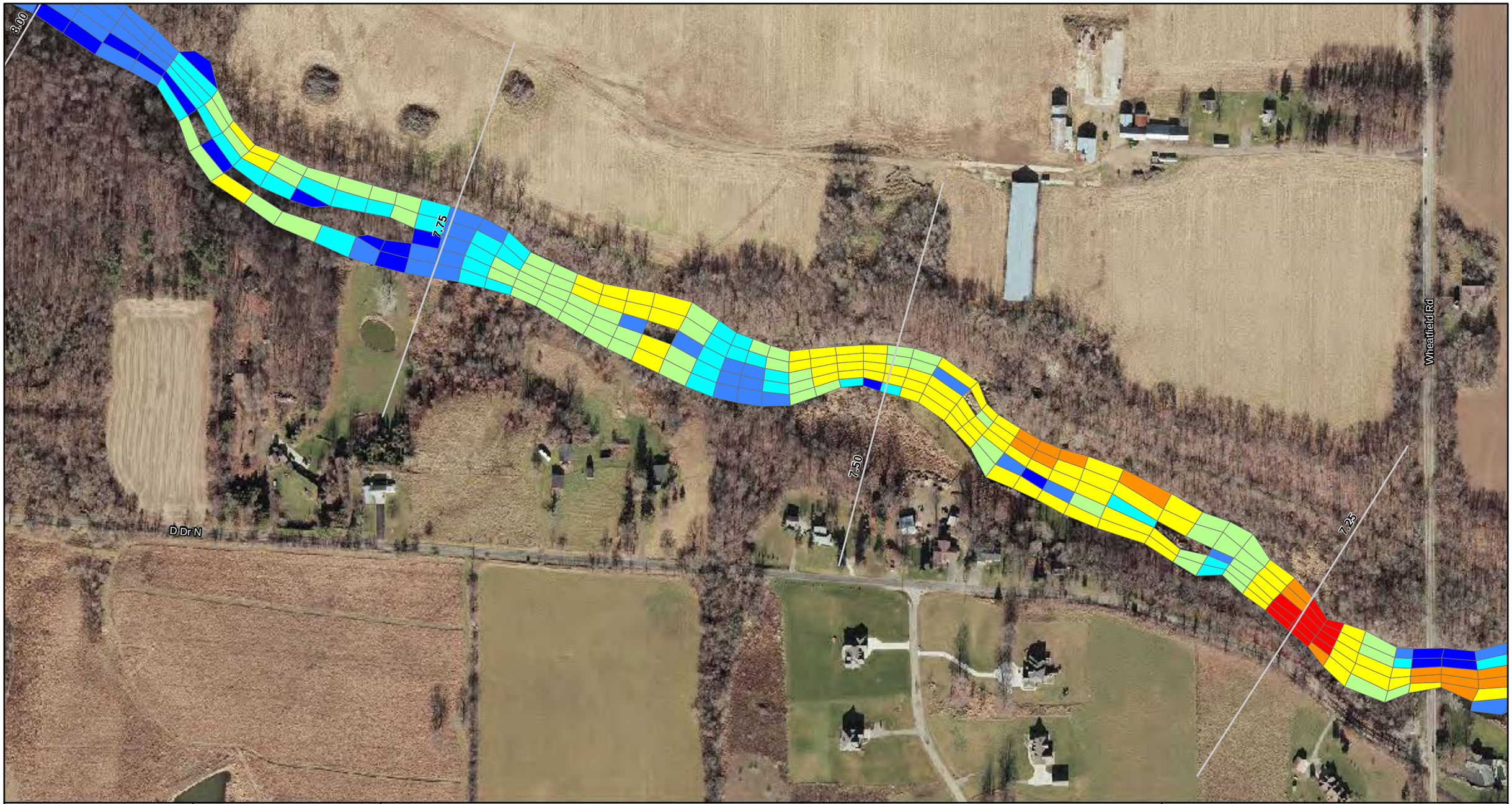
MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

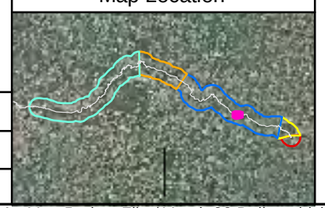
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011

8.75

8.50

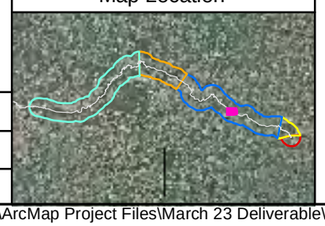
8.25

8.00

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

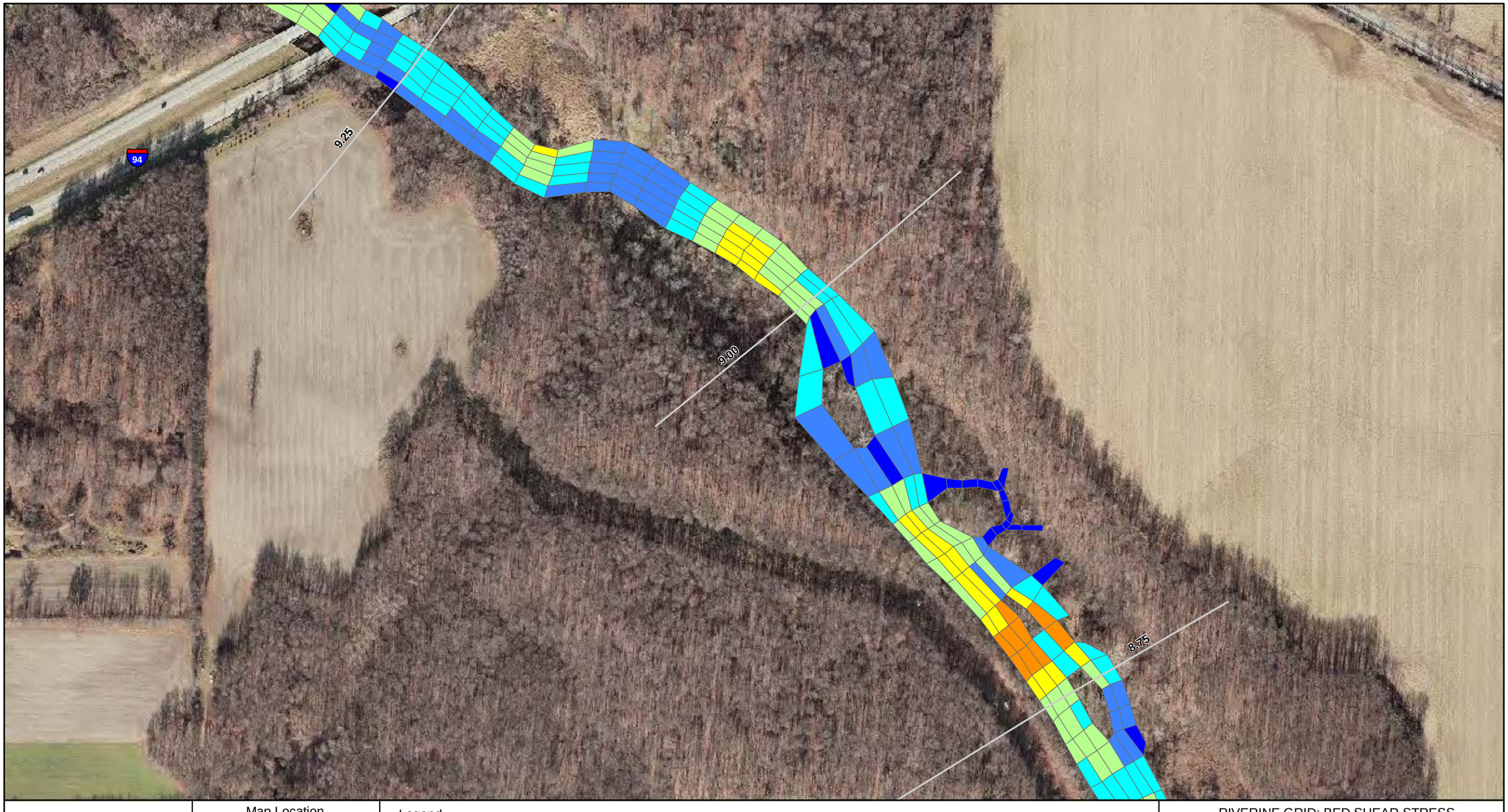
MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

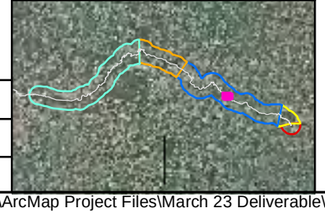
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

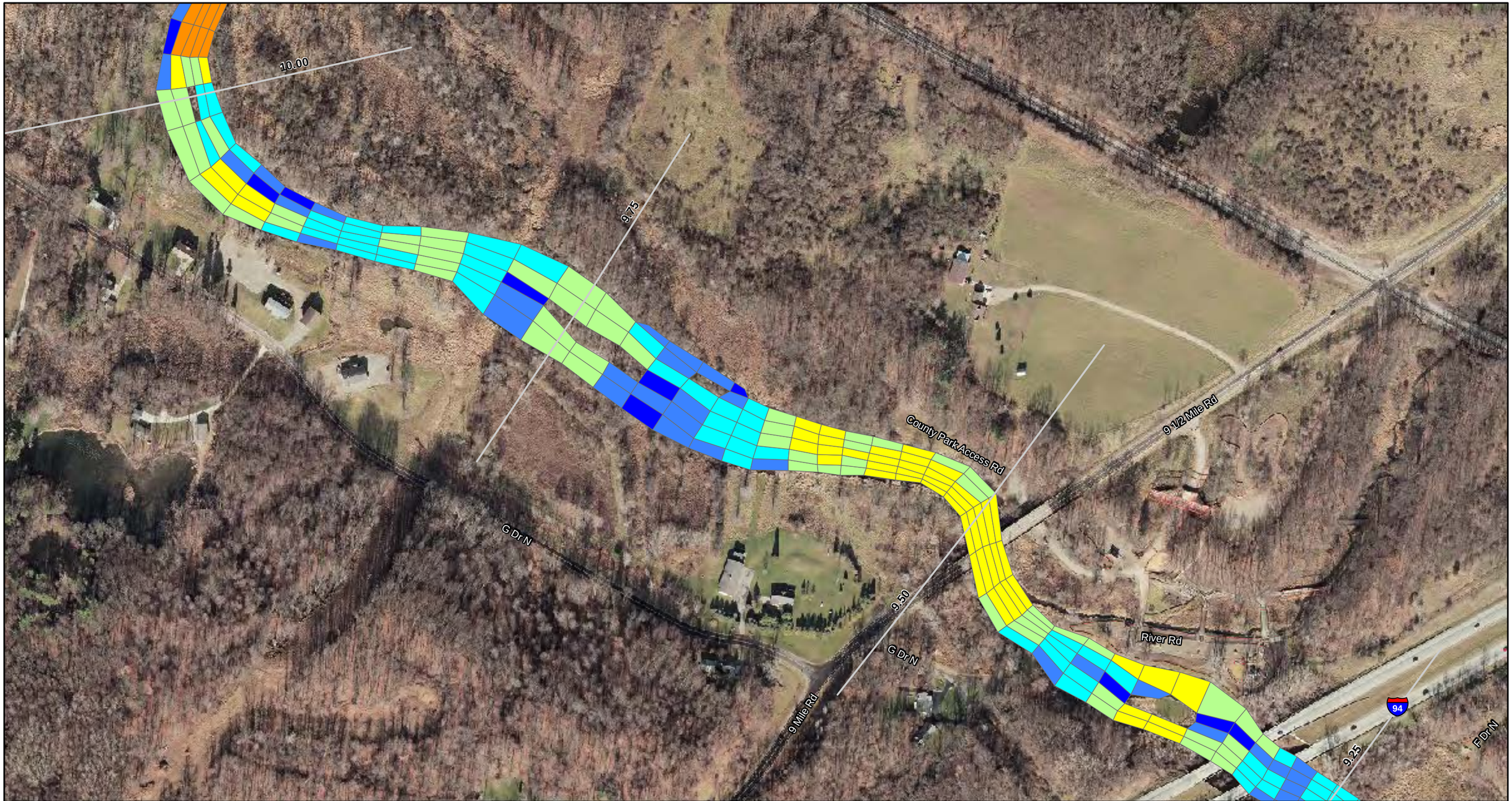
MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

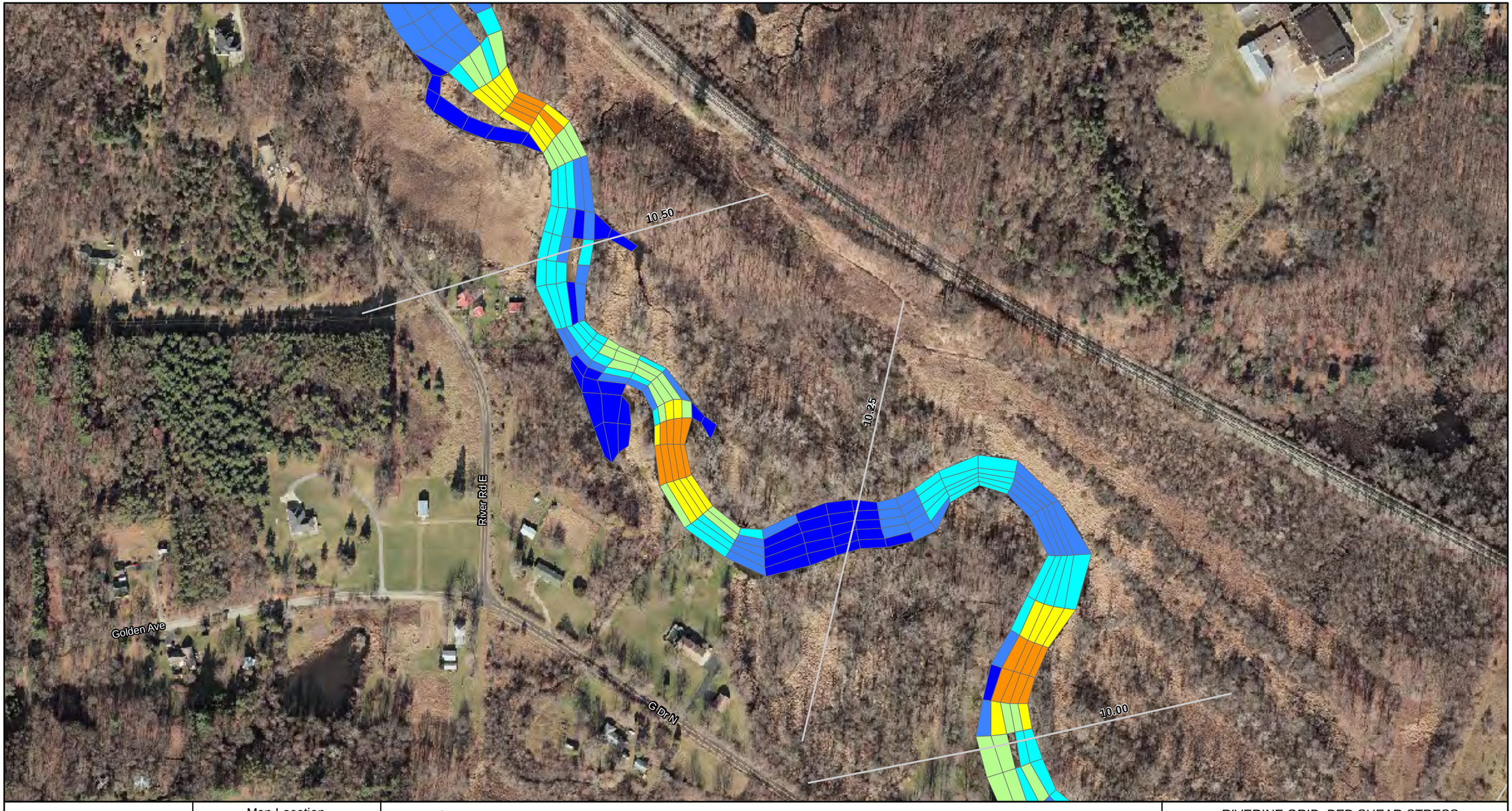
MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

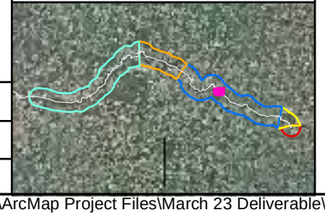
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

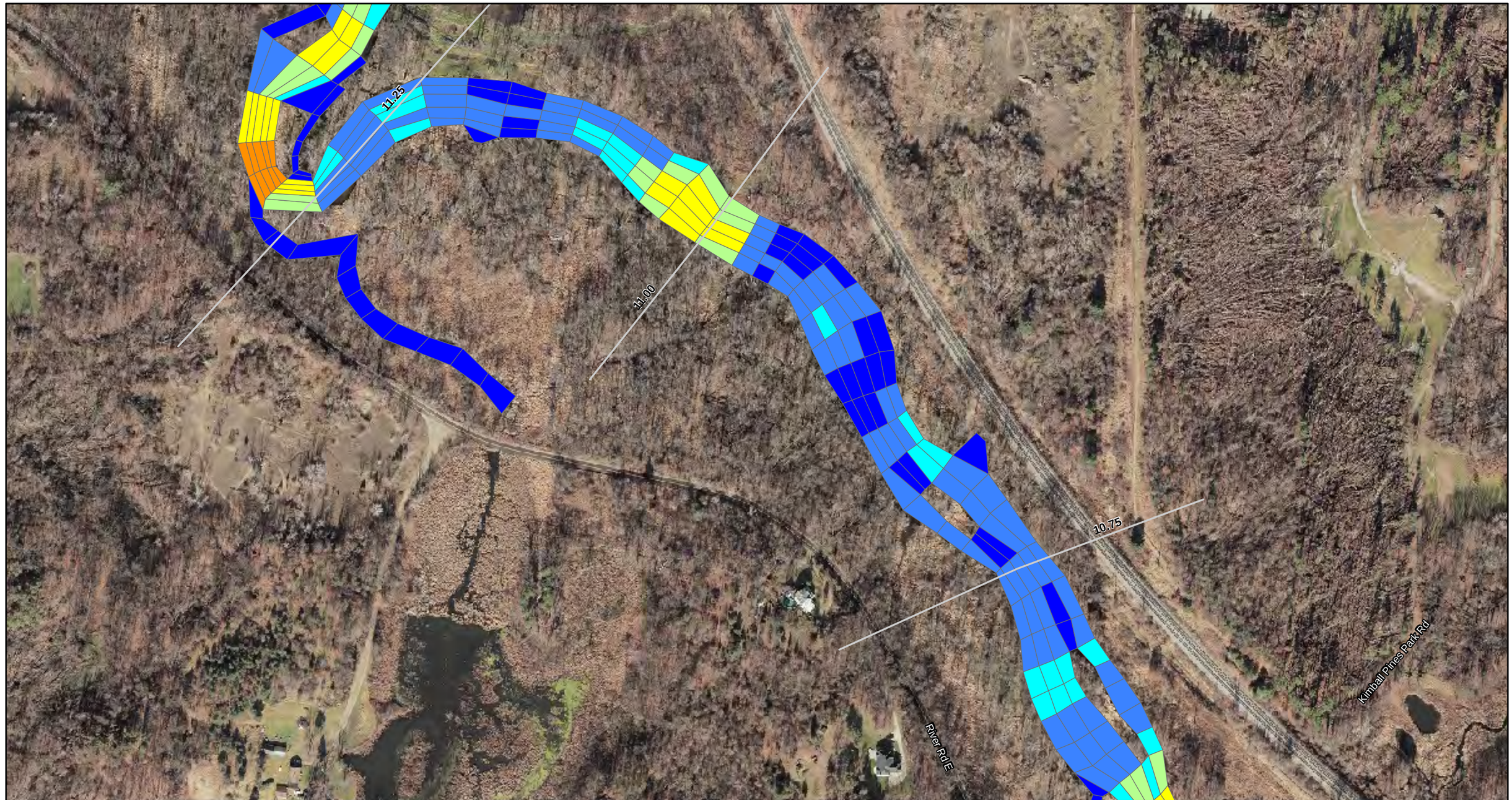
MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

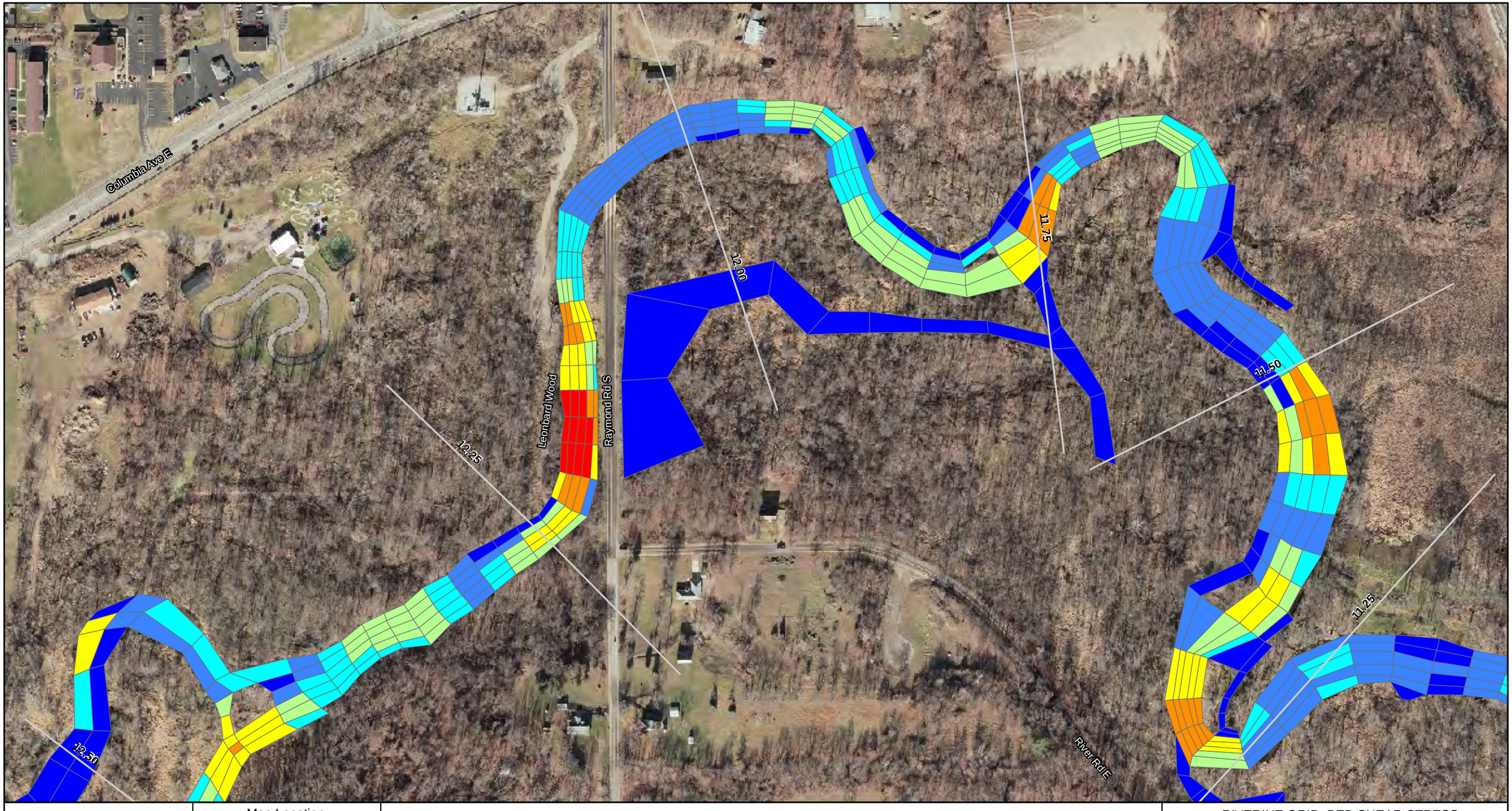
MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

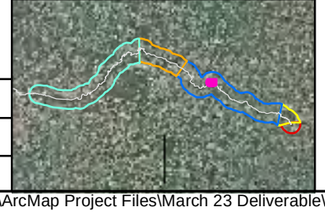
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

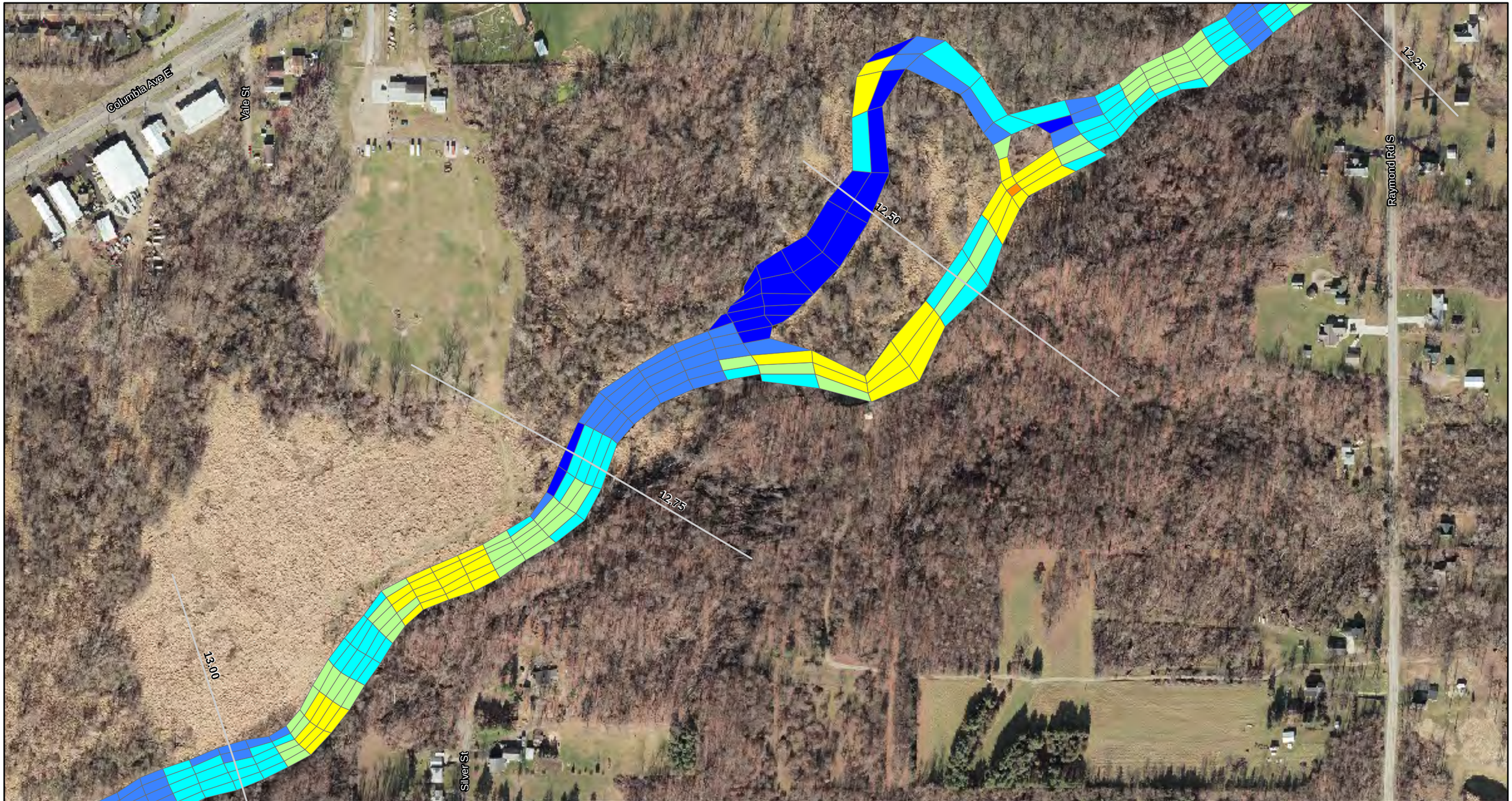
MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

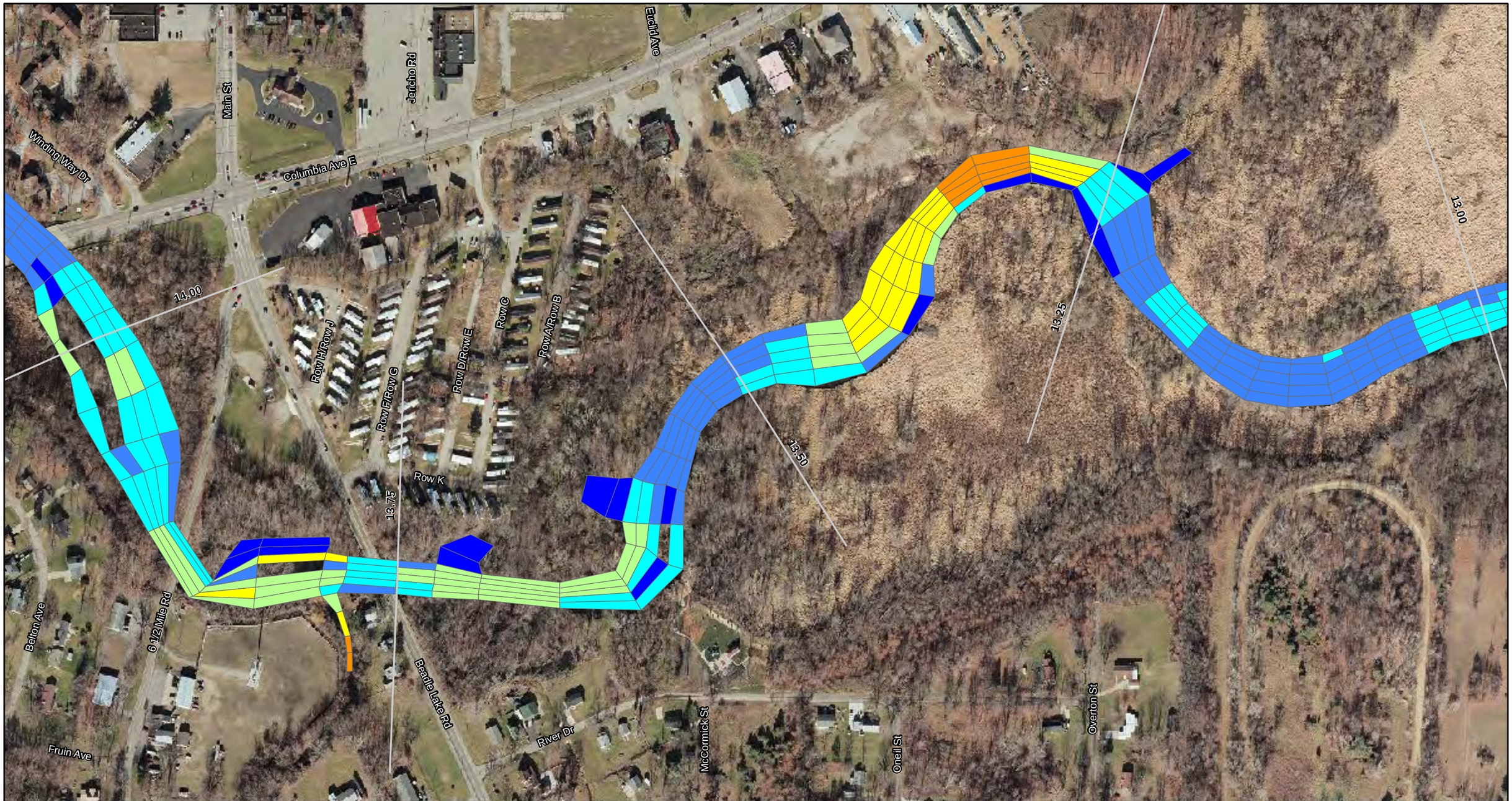
MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

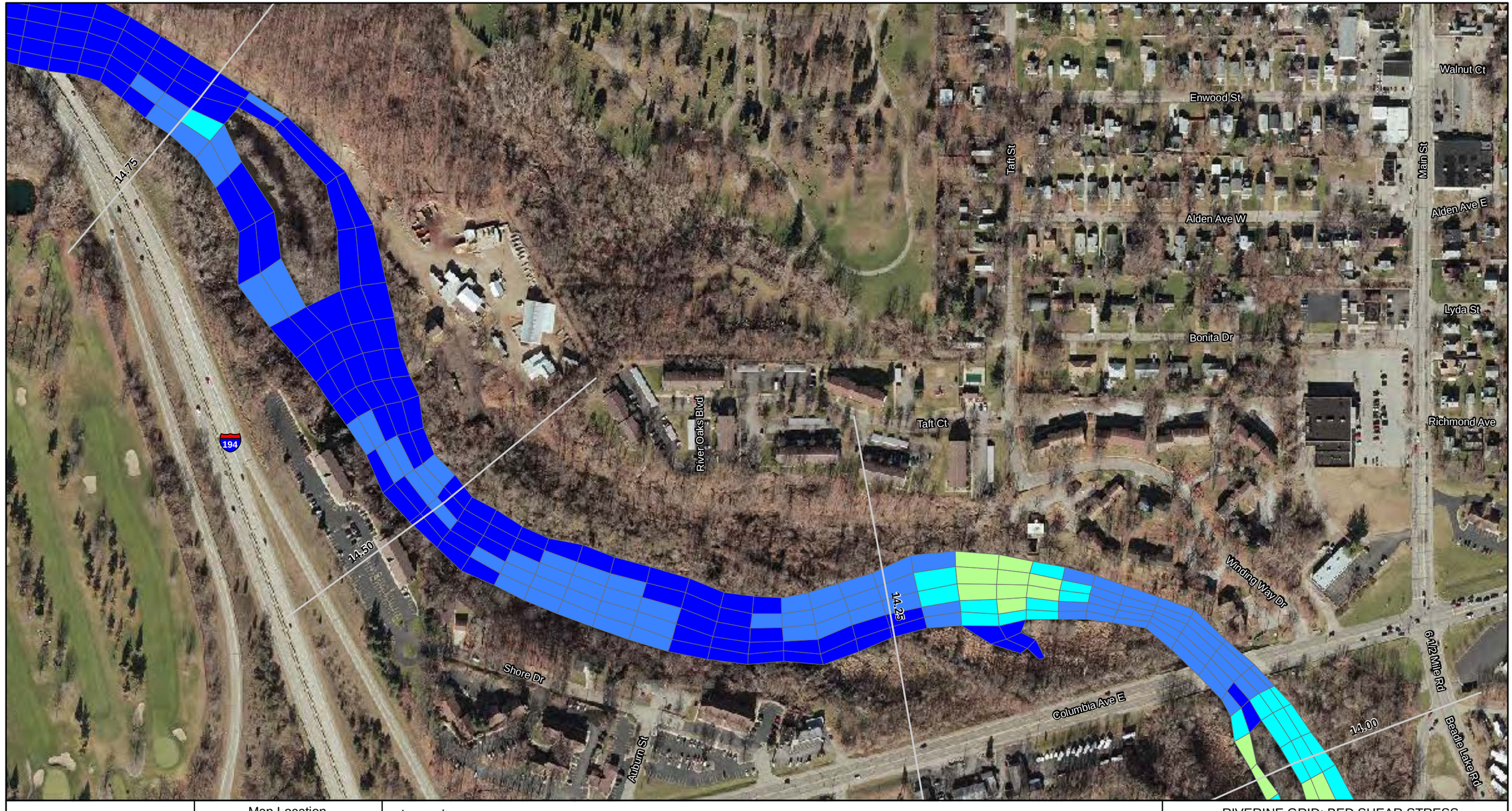
MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

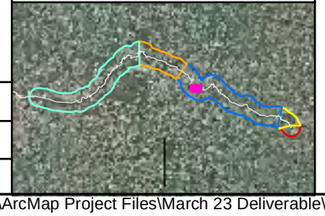
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

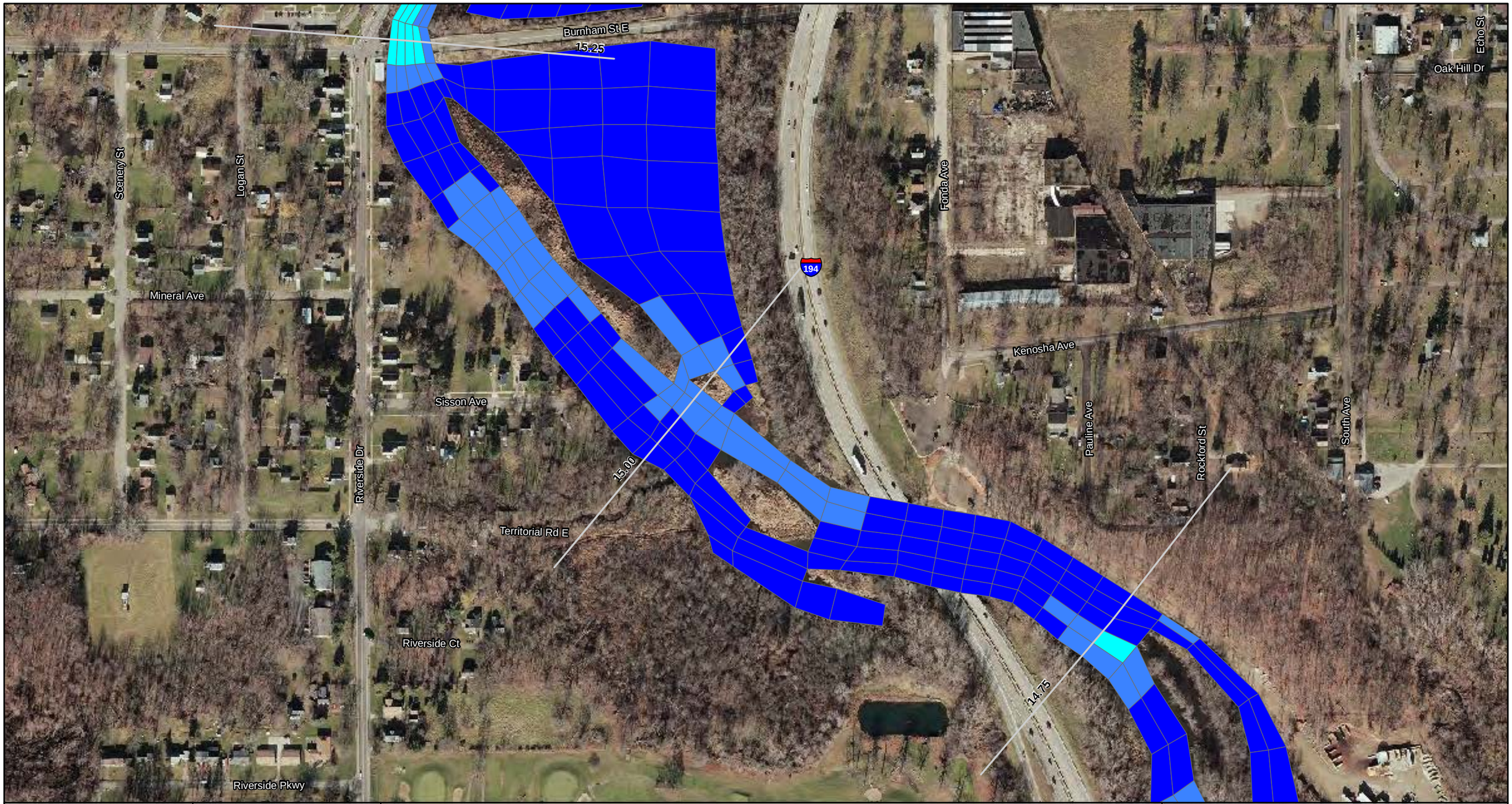
MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

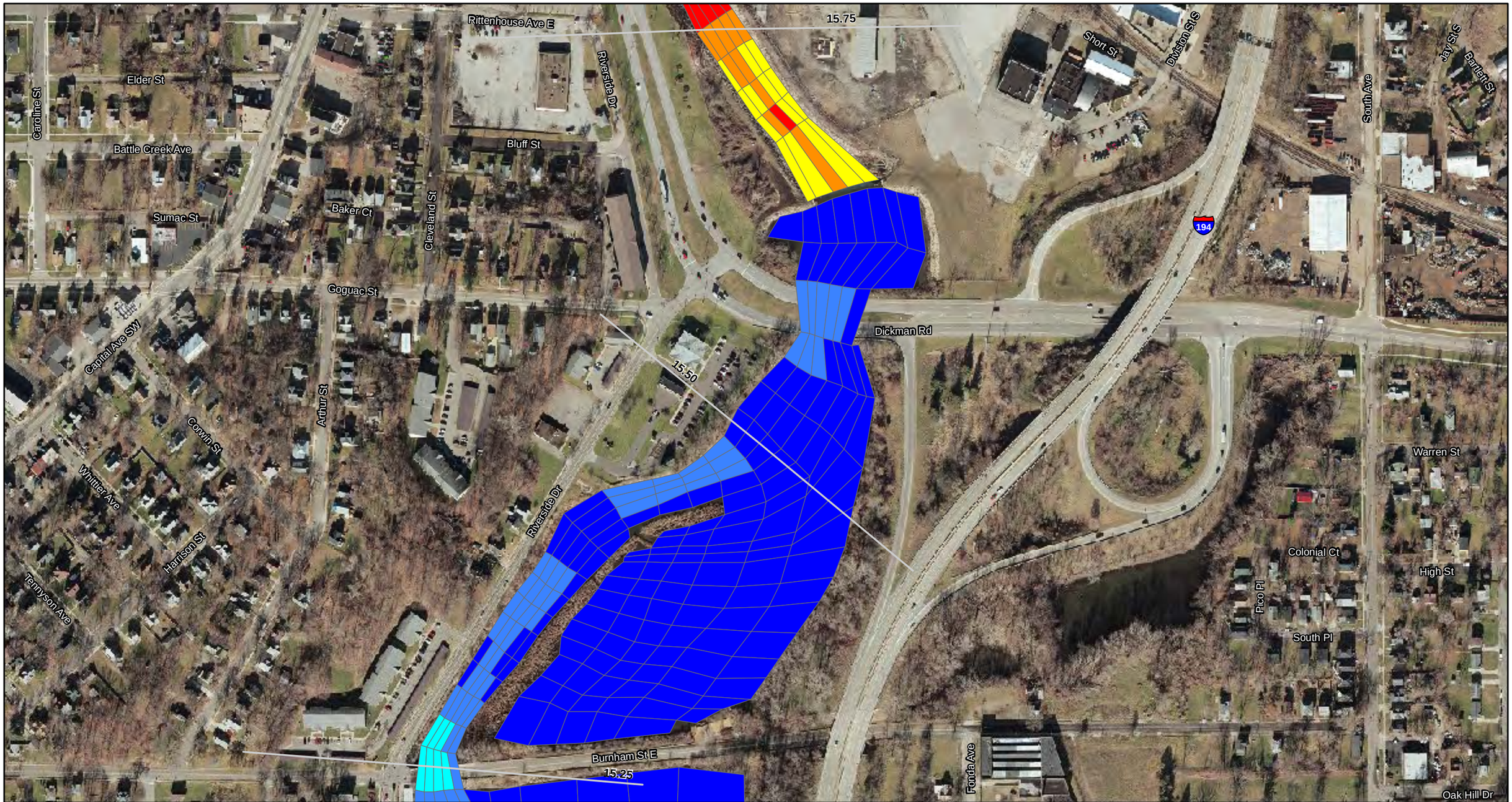
MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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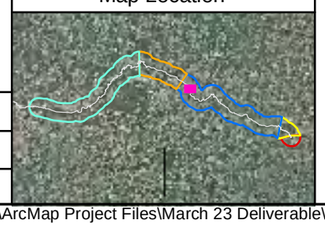
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

N

0 125 250 500

Scale in Feet

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

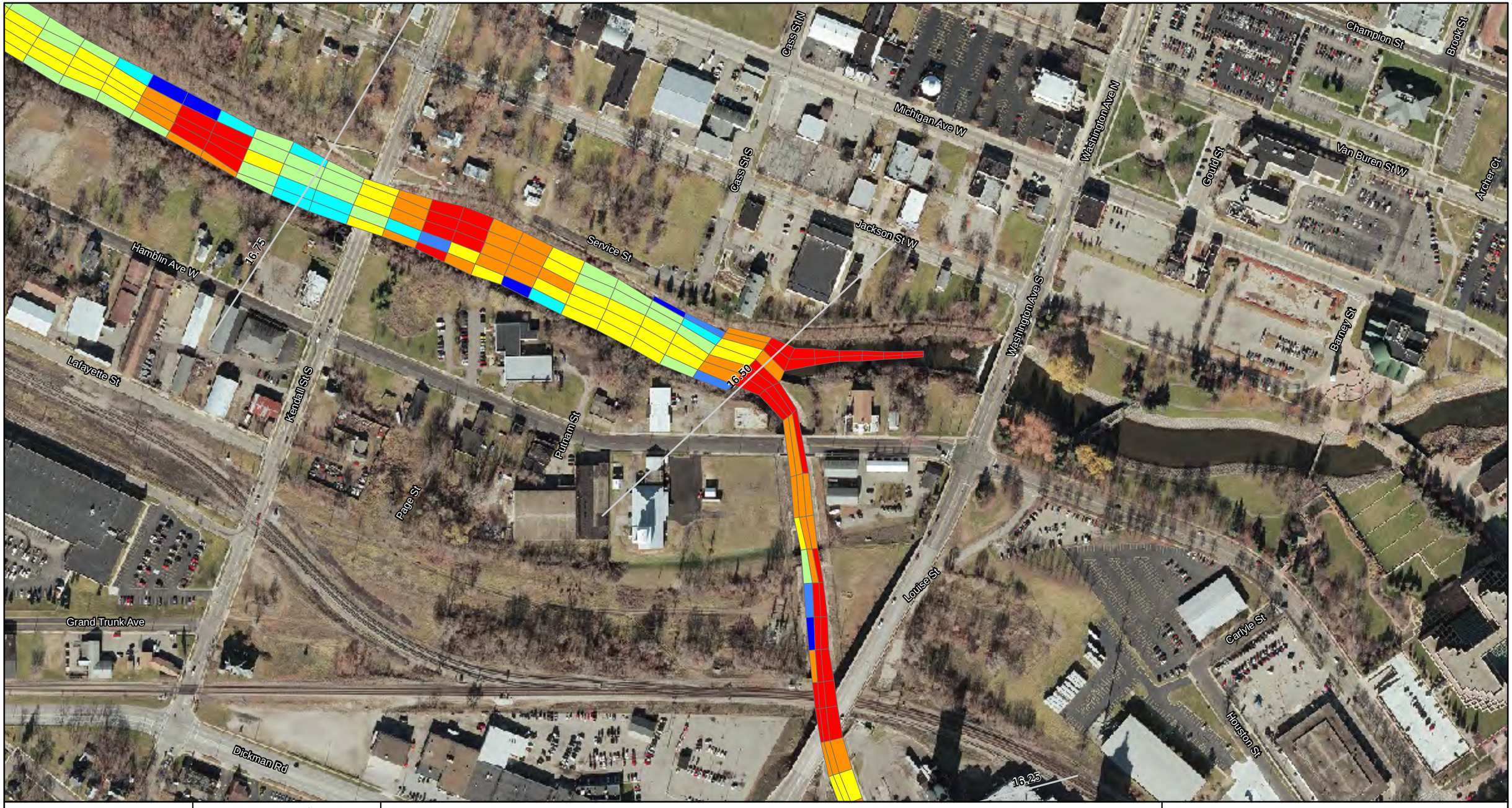
MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

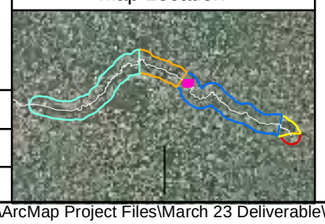
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

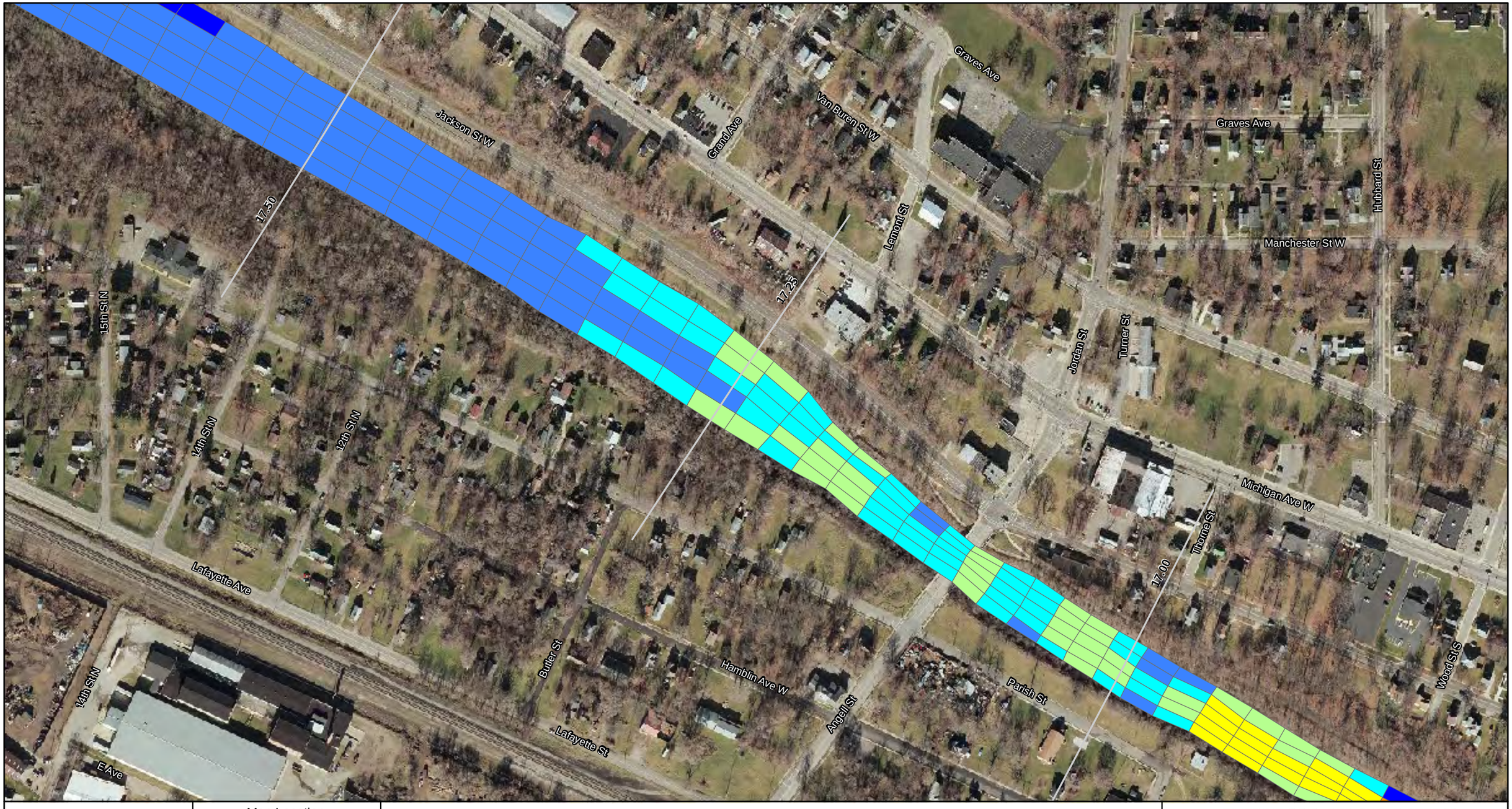
MP 16.30 - MP 16.95

SHEET 21 OF 56

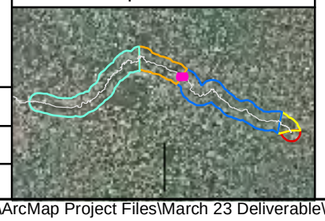
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

N

0 125 250 500

Scale in Feet

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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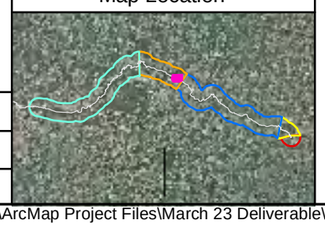
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

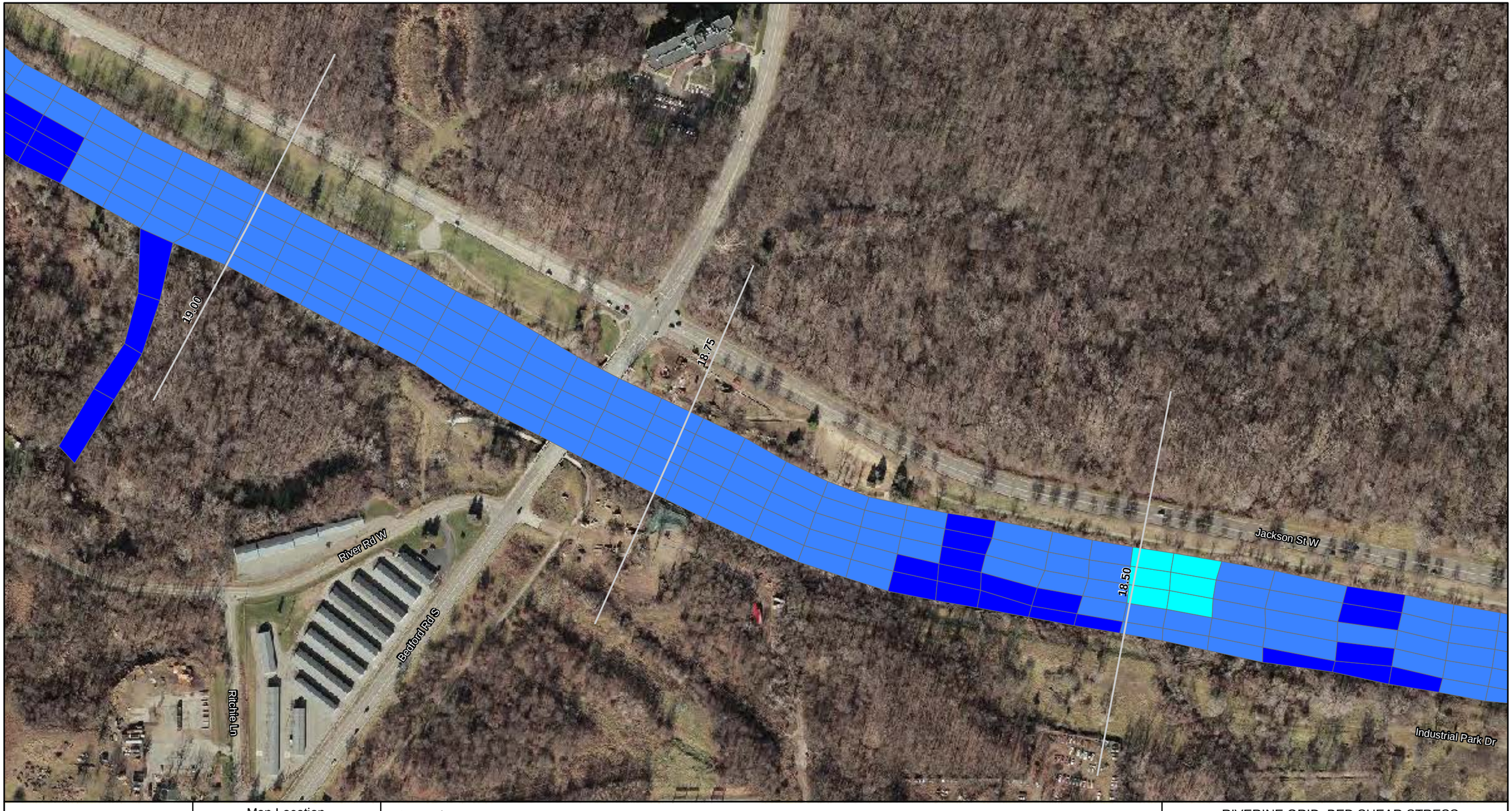
MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

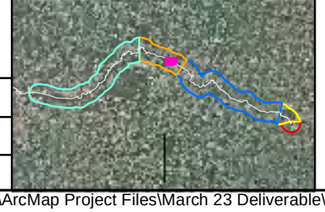
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

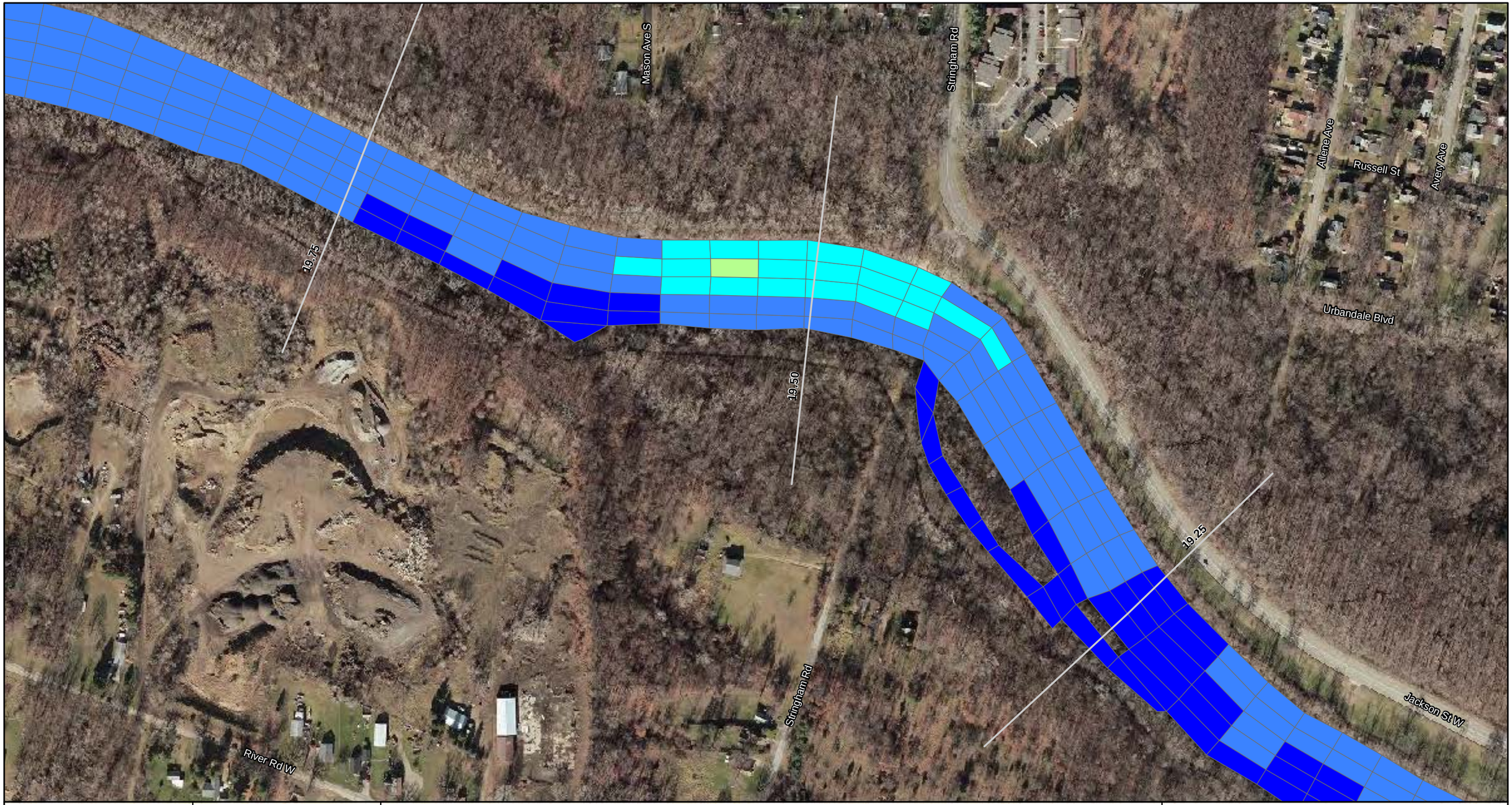
MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

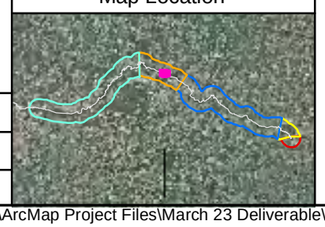
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

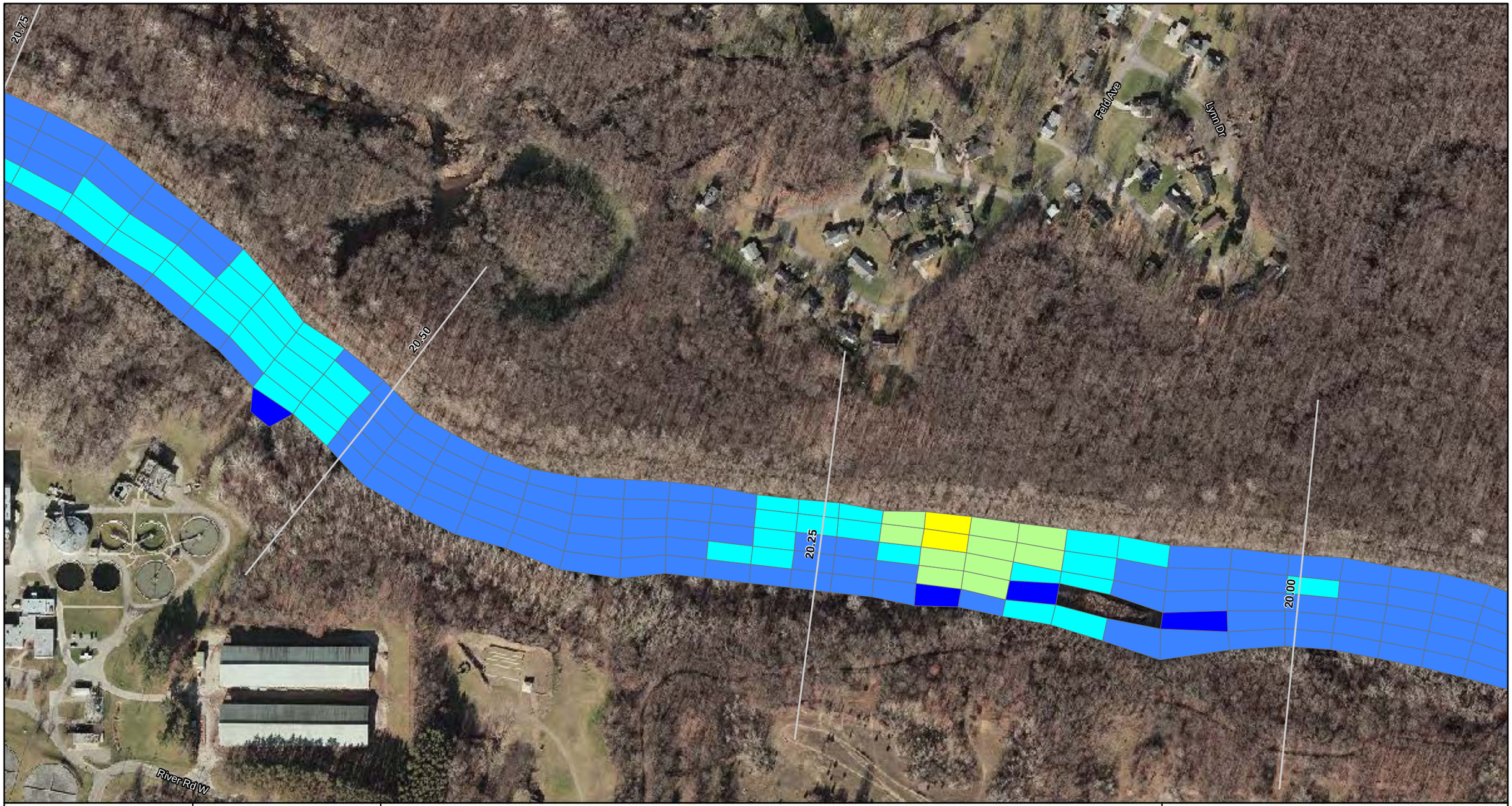
MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

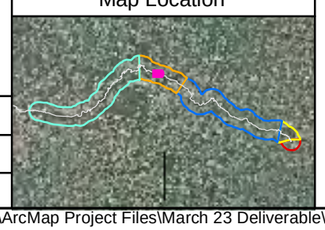
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

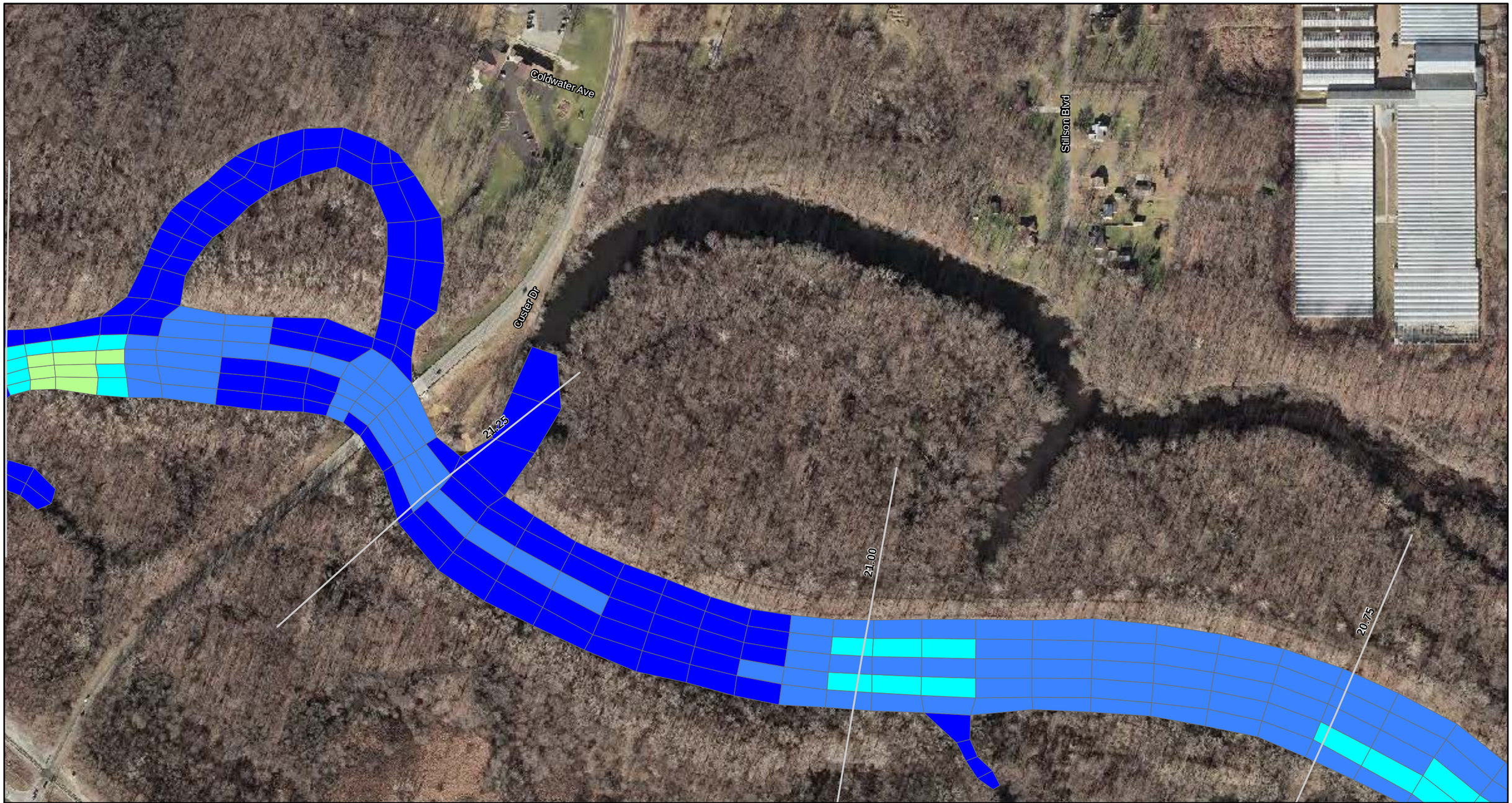
MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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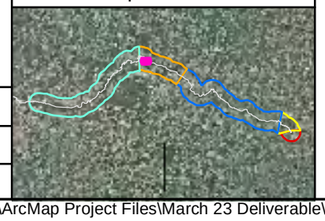
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

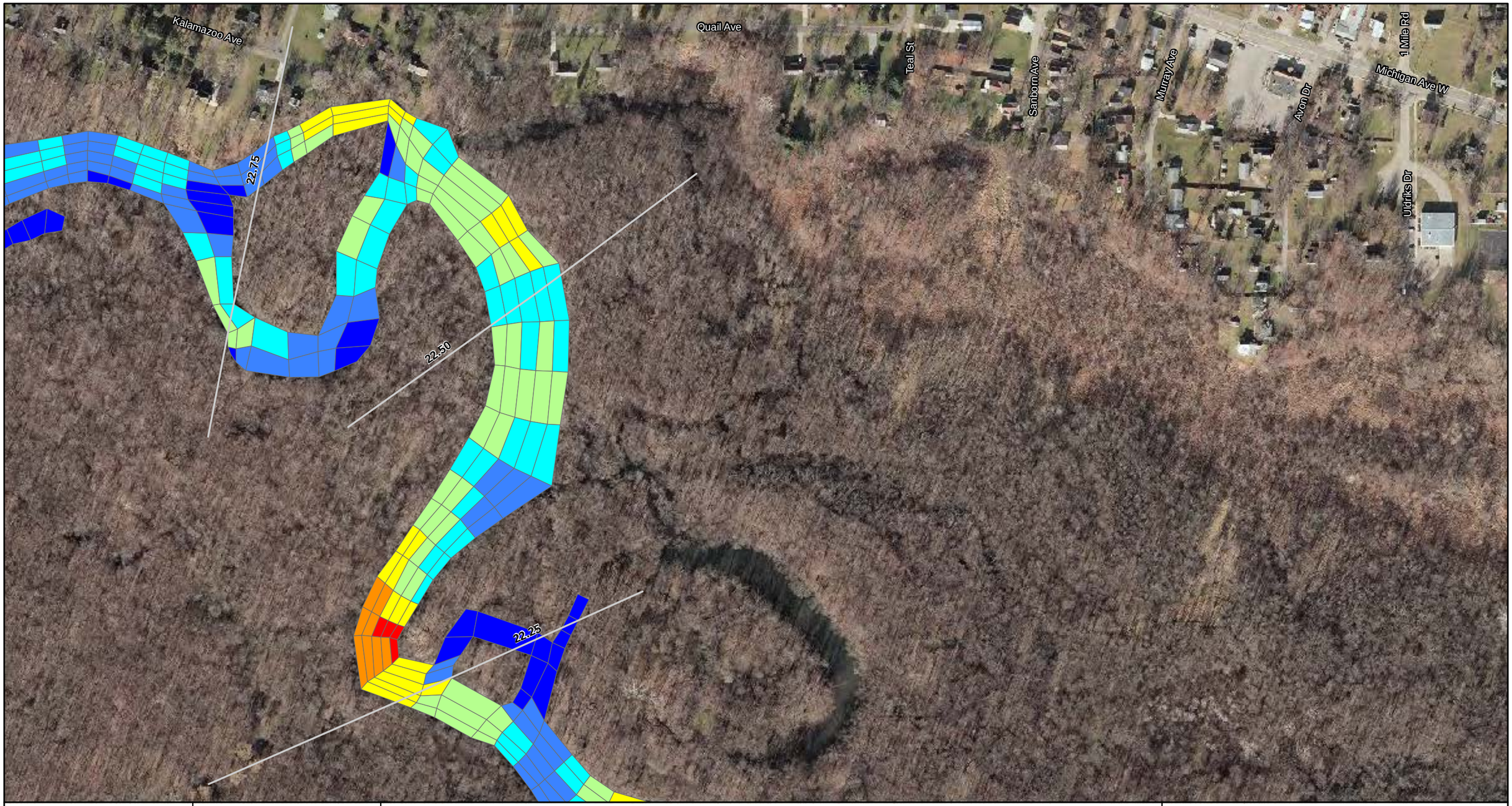
MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

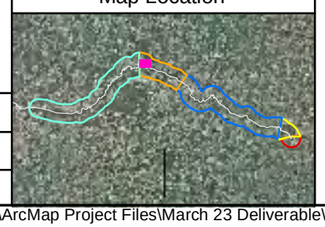
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

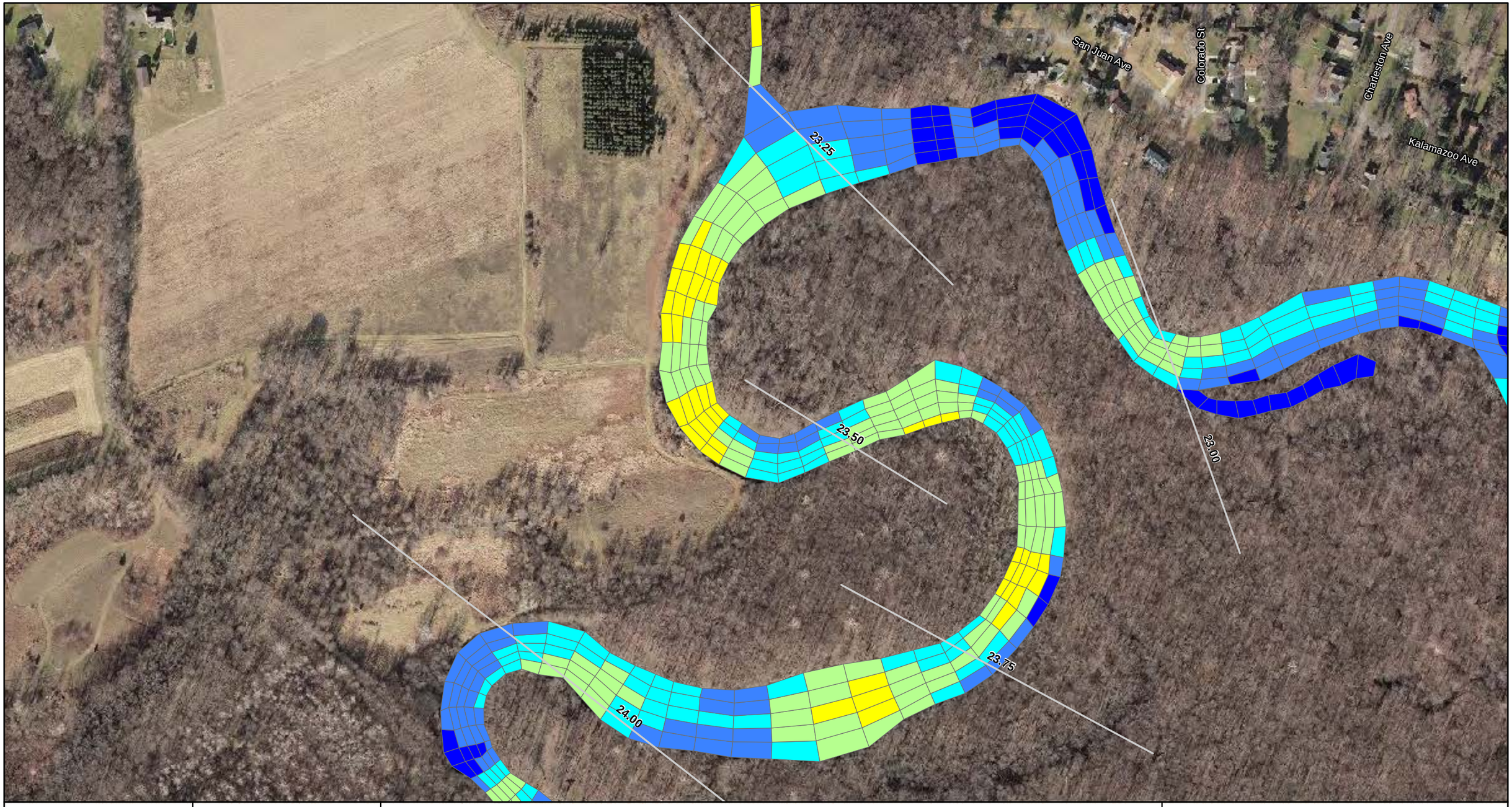
MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

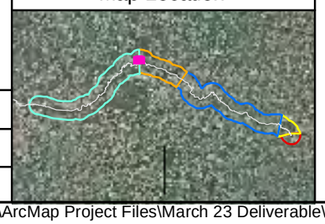
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011

24.00
24.25
24.50
24.75
River Rd W
Fort Custer Dr
County Line Rd

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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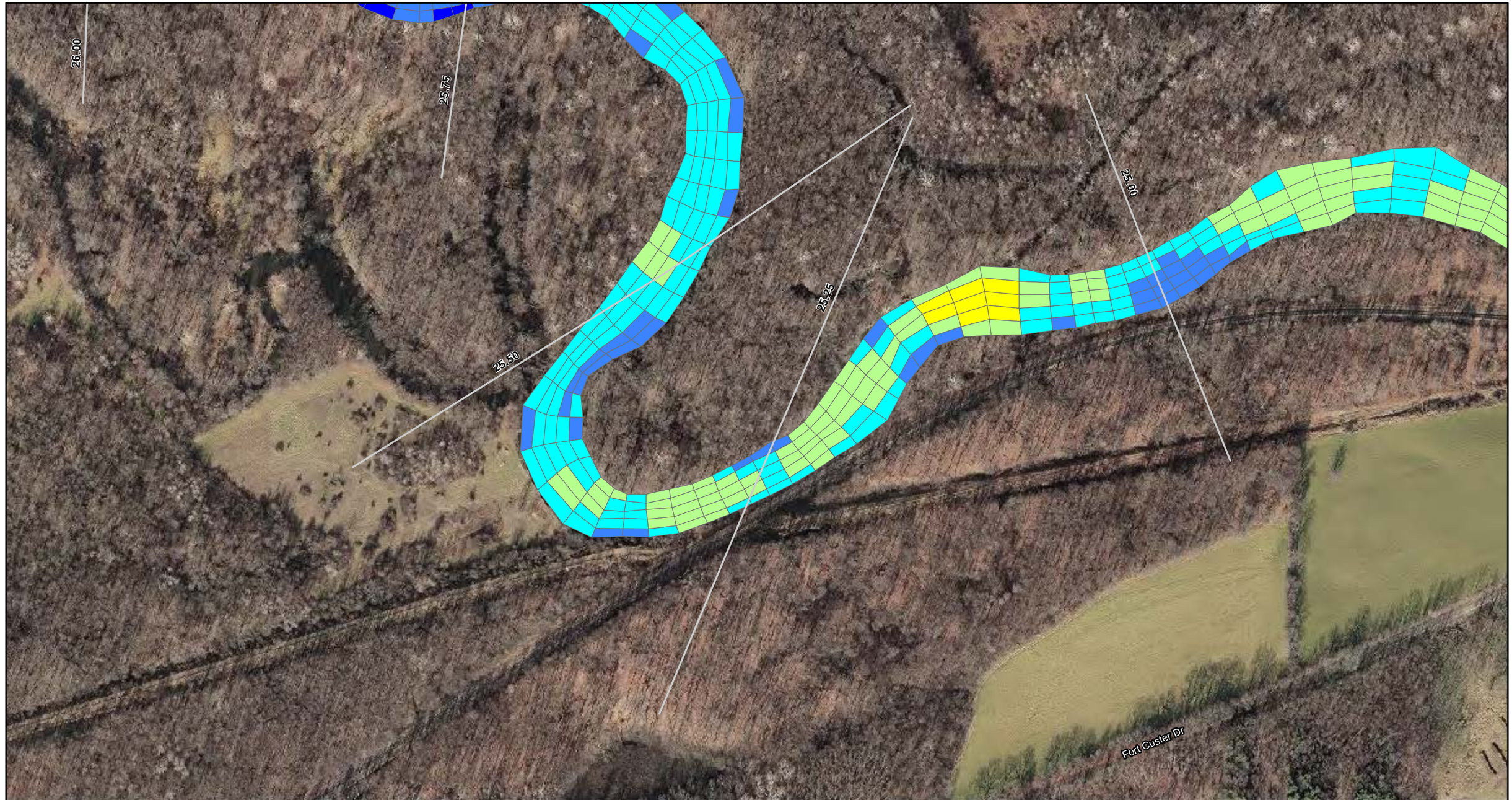
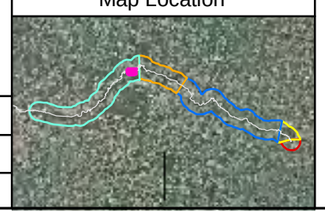
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

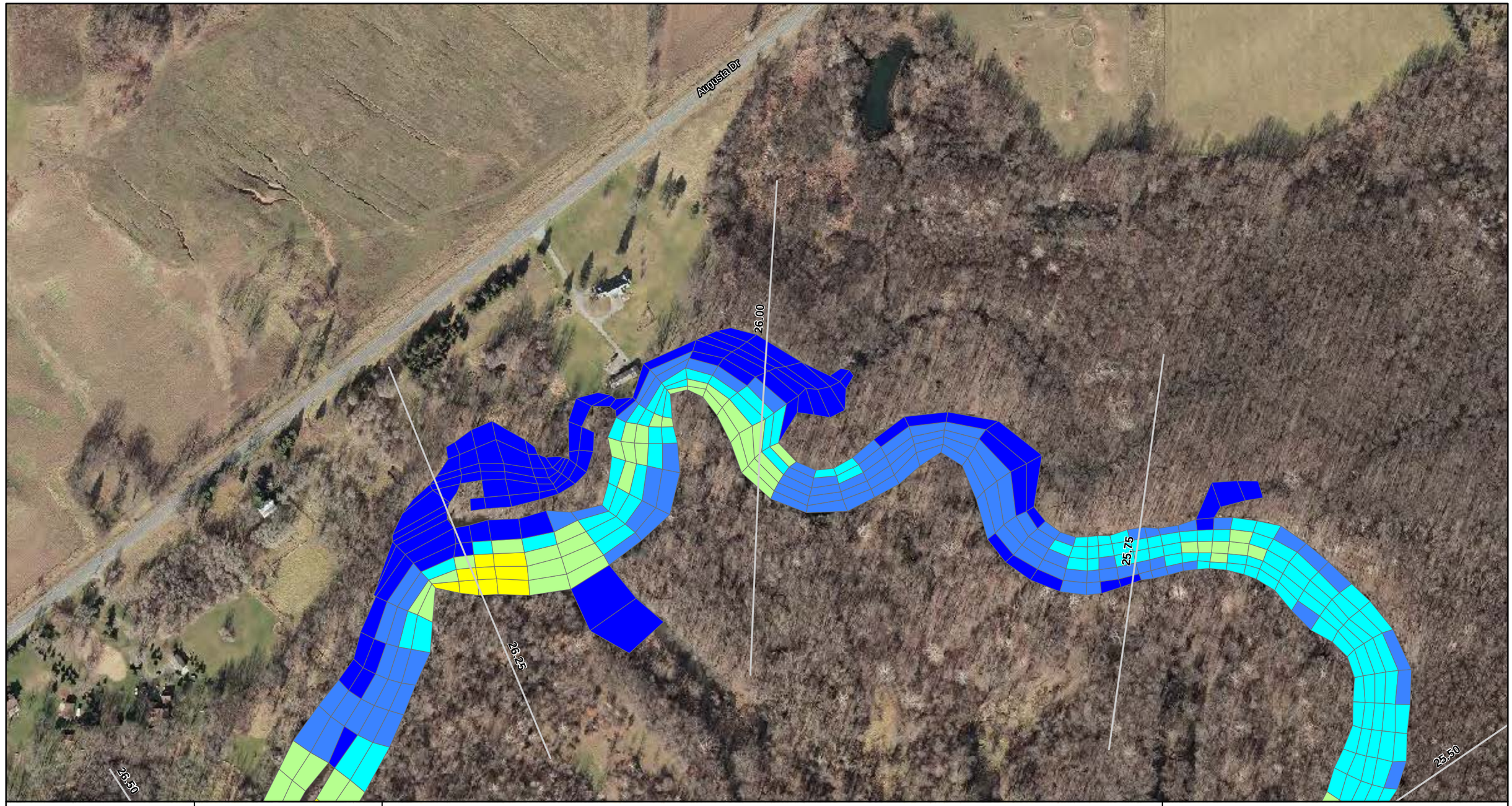
MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

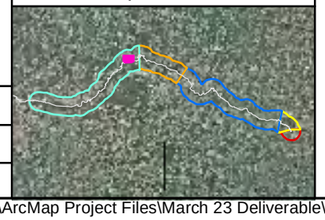
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

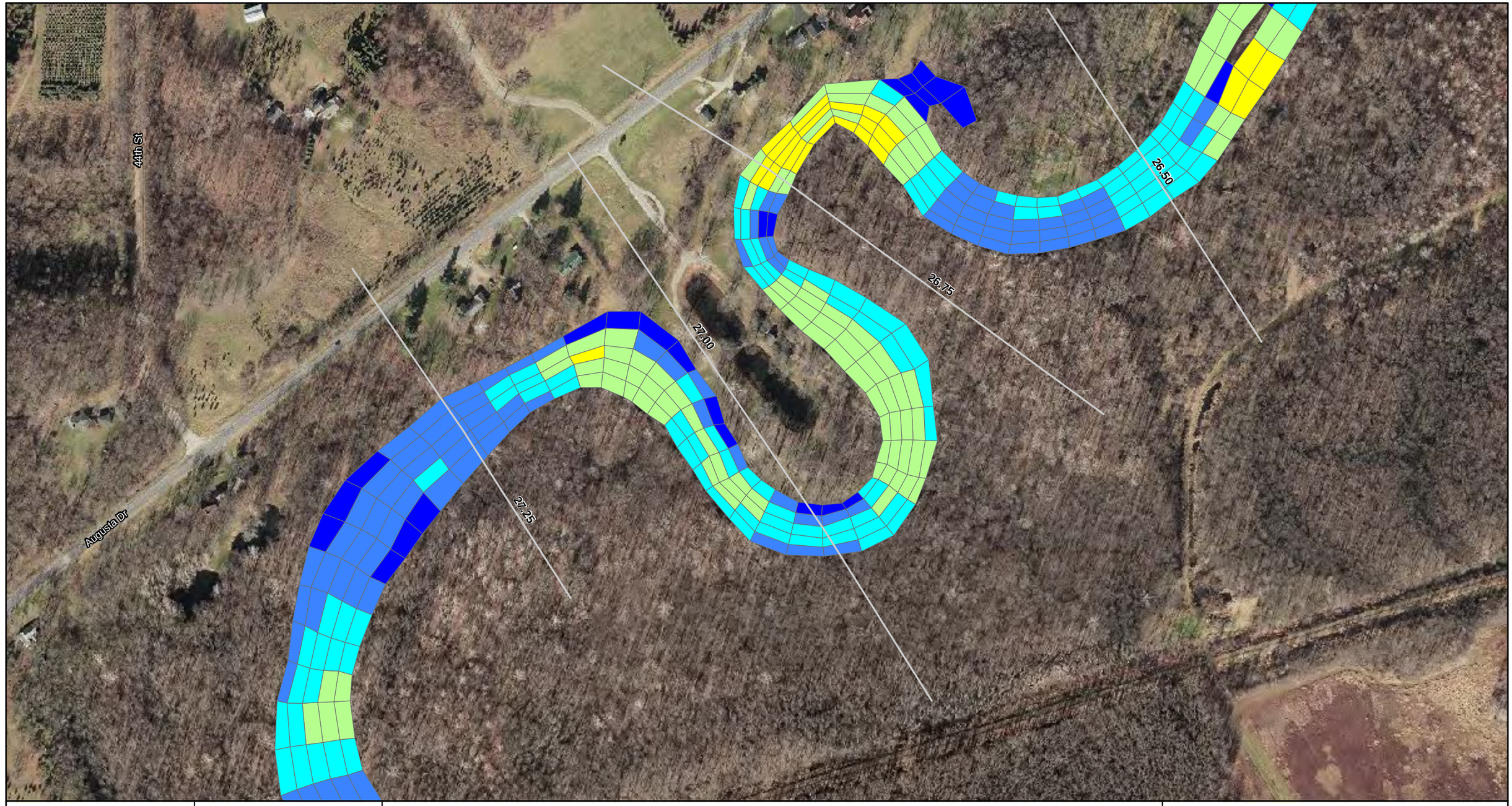
MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

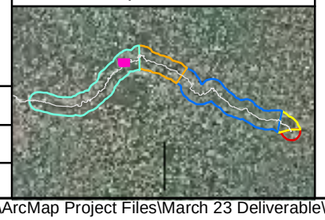
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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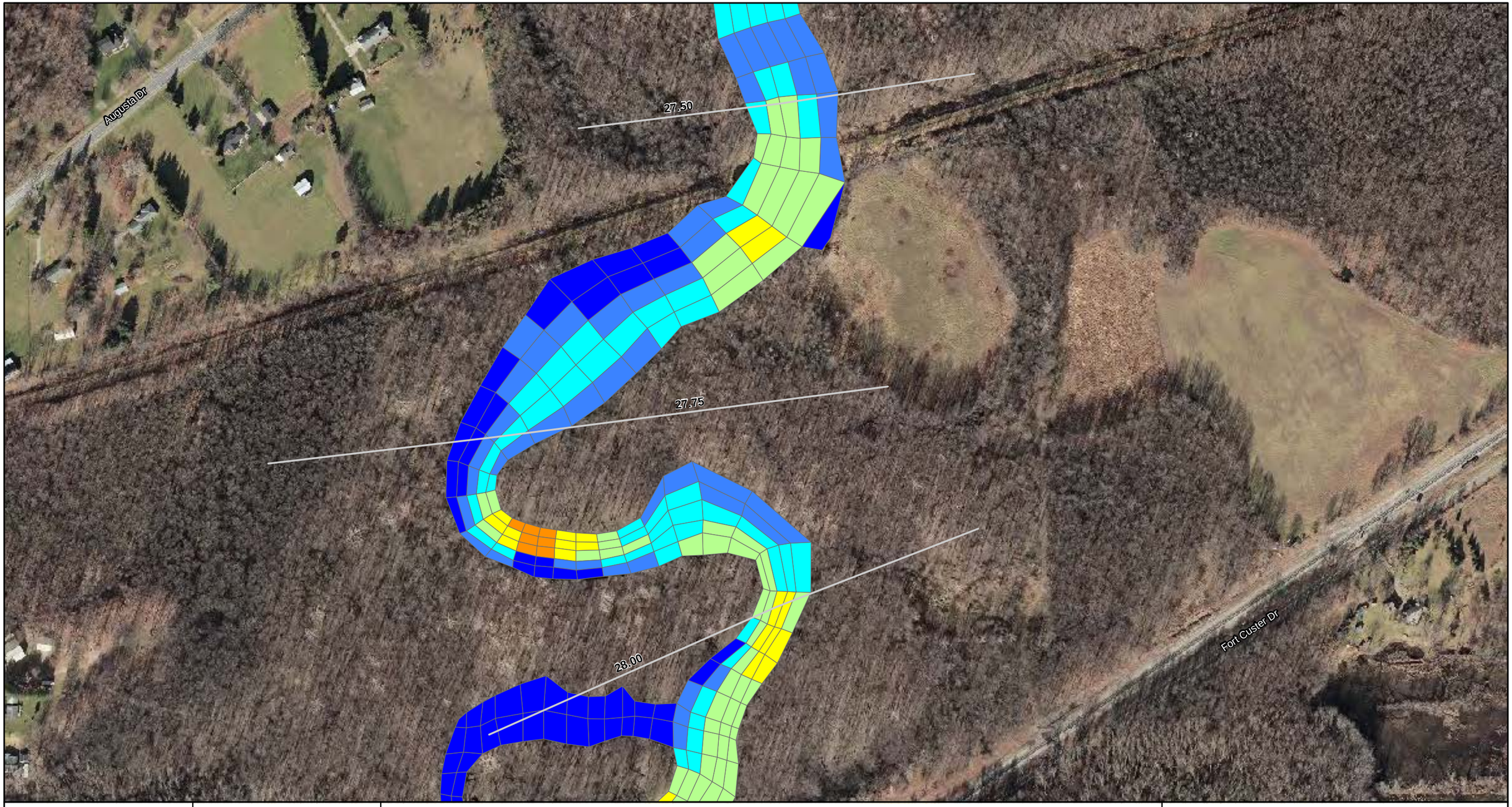
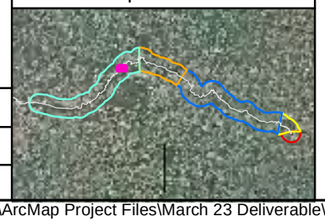
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

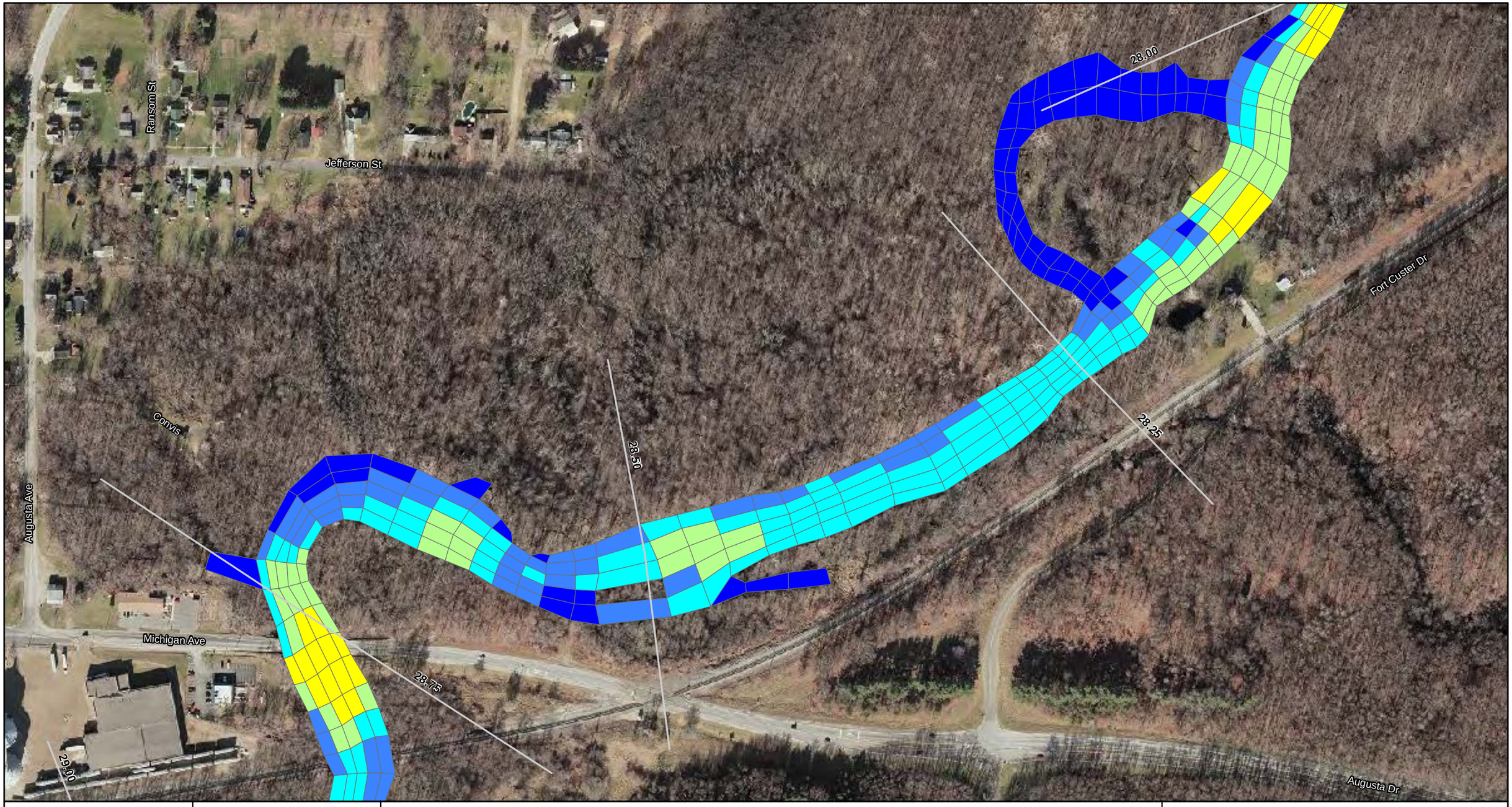
MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

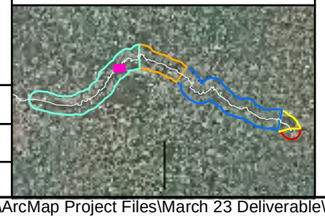
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011

Clinton St
Clinton St
Chestnut St
Webster St
Church St
Fayette St
Cass St
Cherry St
Lincoln St
28.75
29.00
29.25
29.50
Augusta Climax Rd
Fort Custer Rec Area Access

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

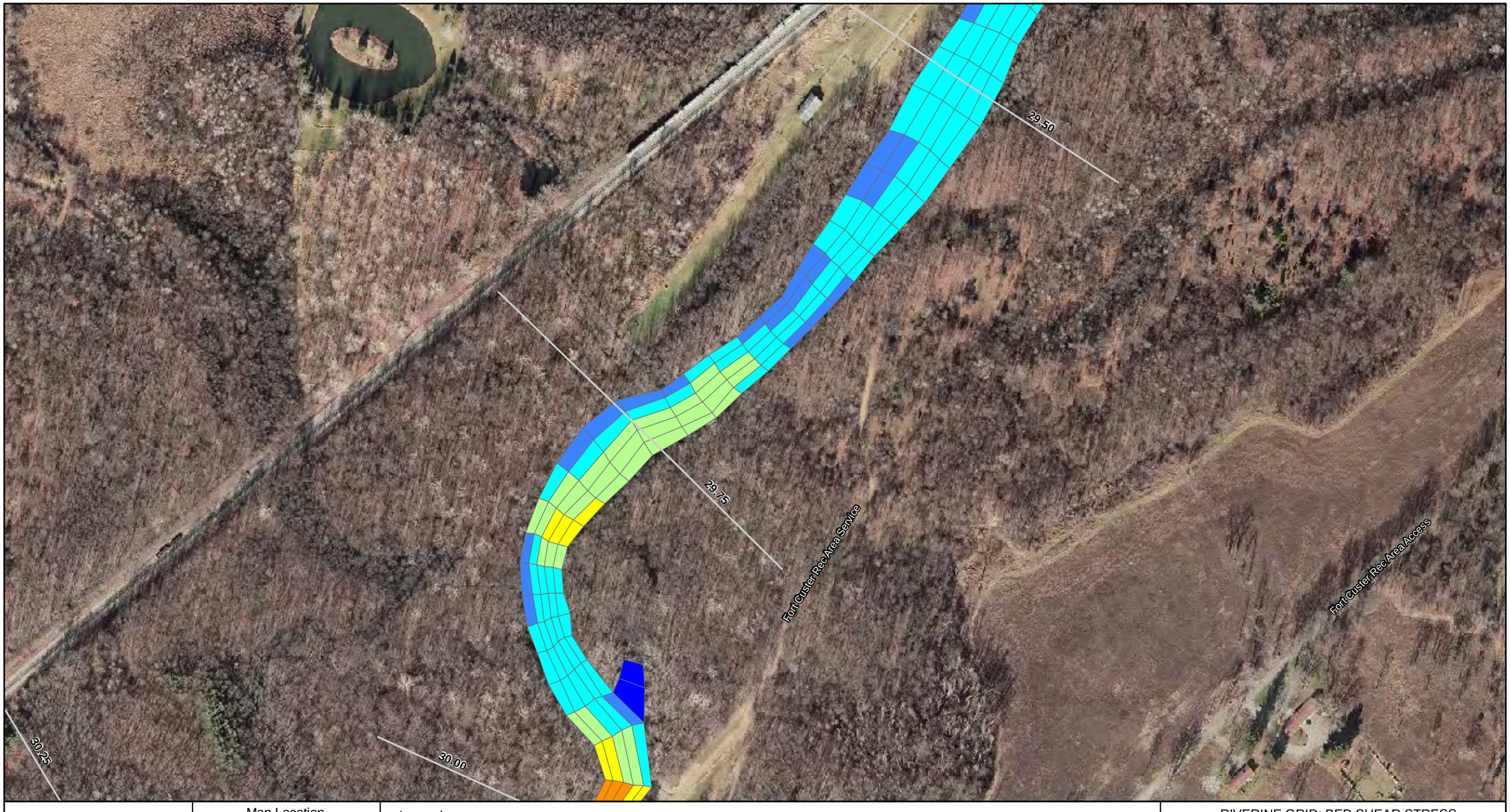
MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

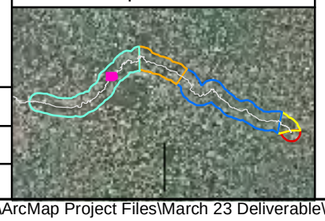
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

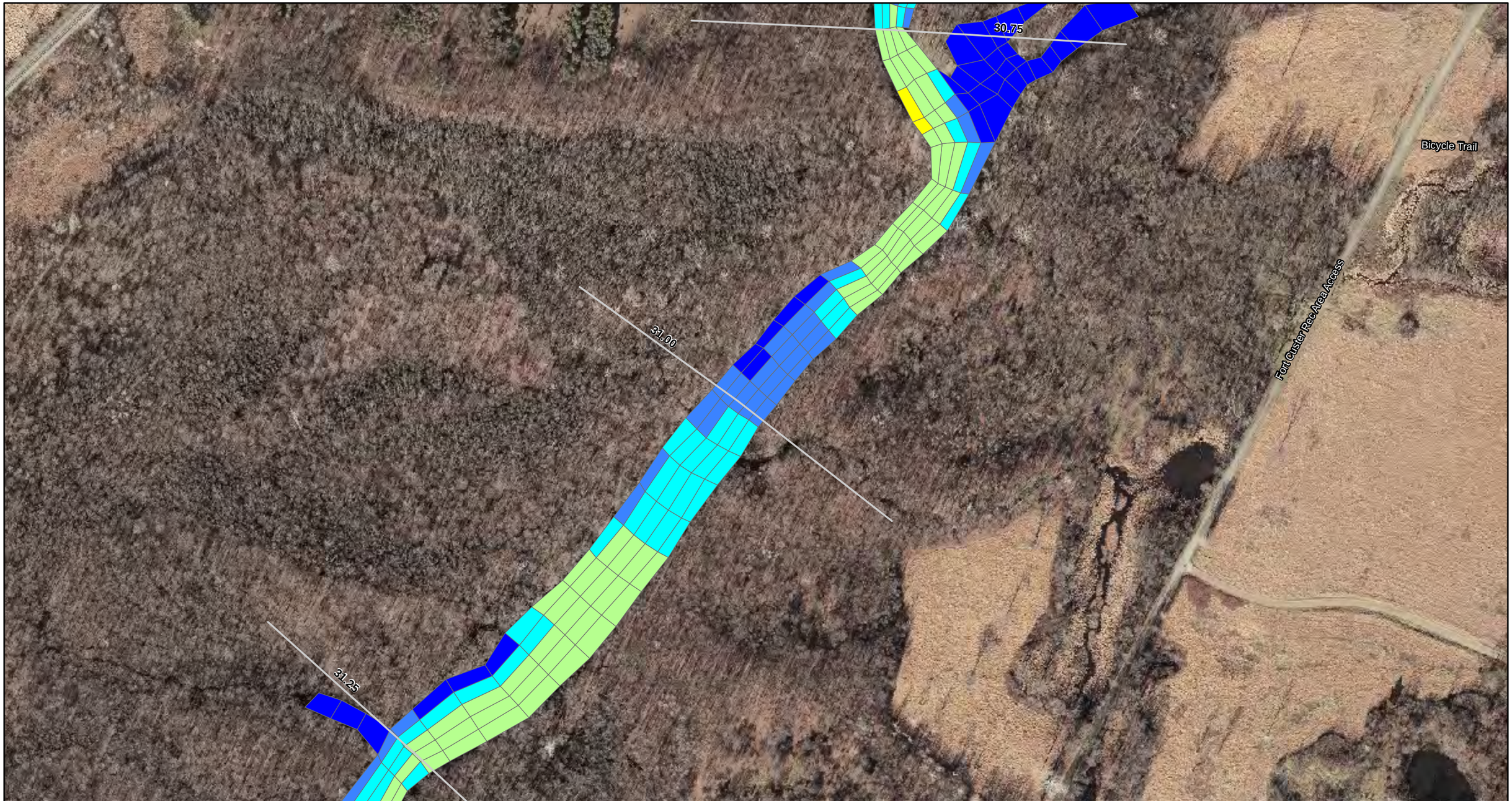
MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

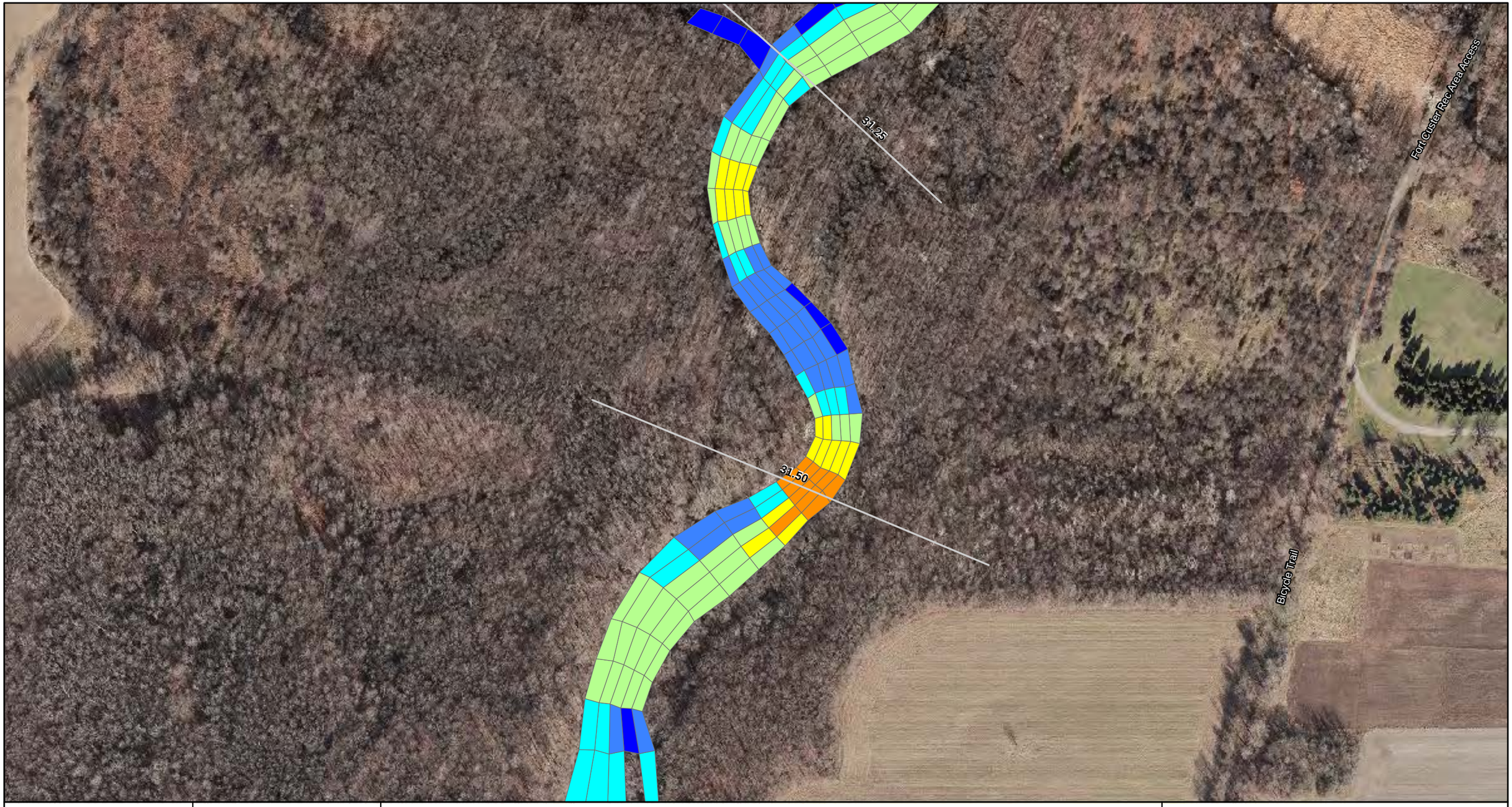
MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

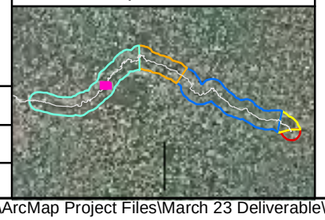
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

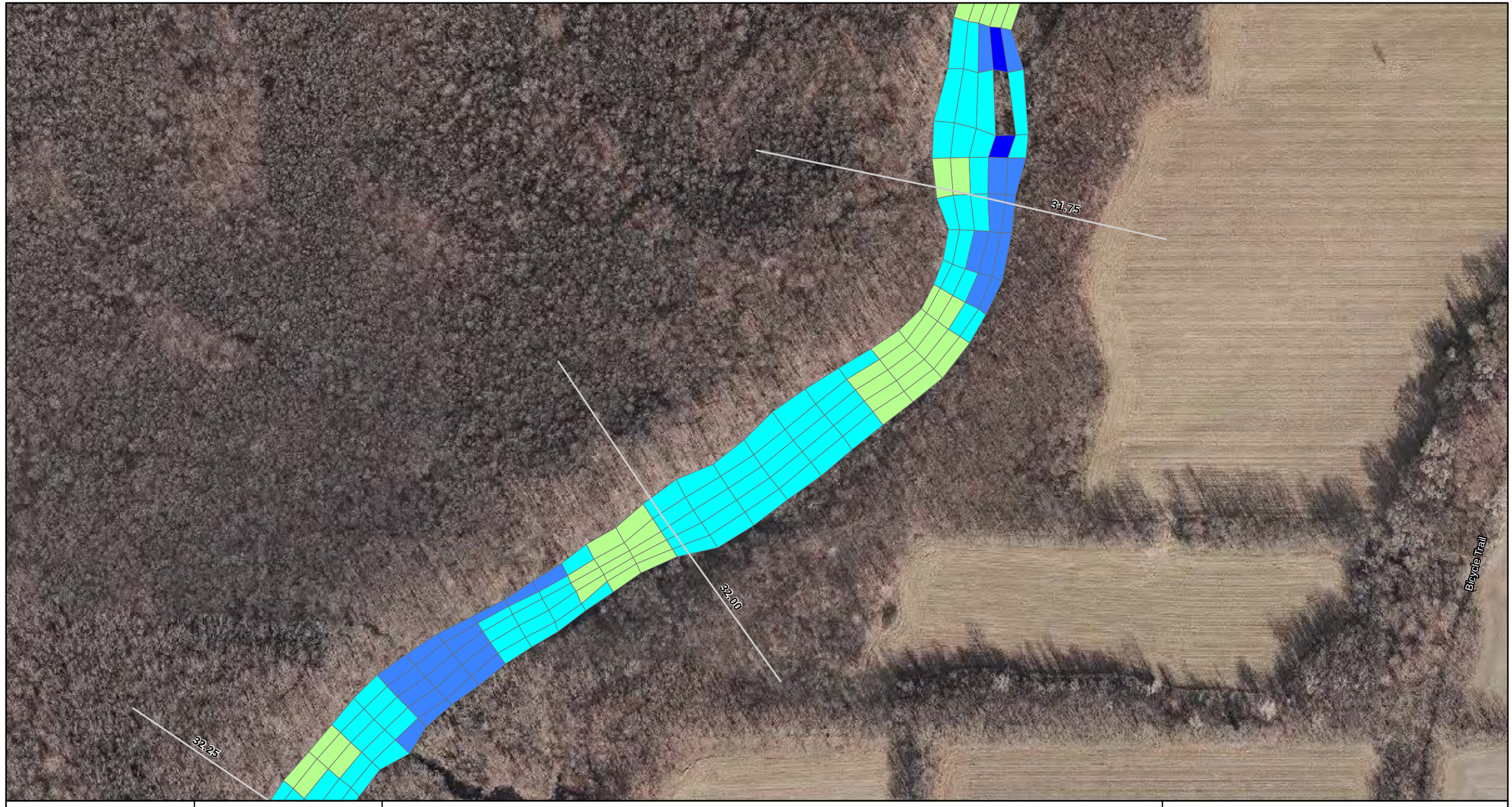
MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

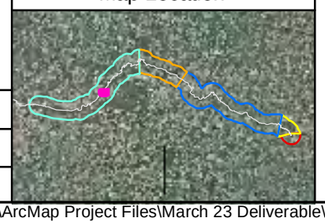
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

N

0 125 250 500

Scale in Feet

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

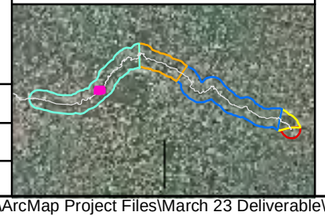
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

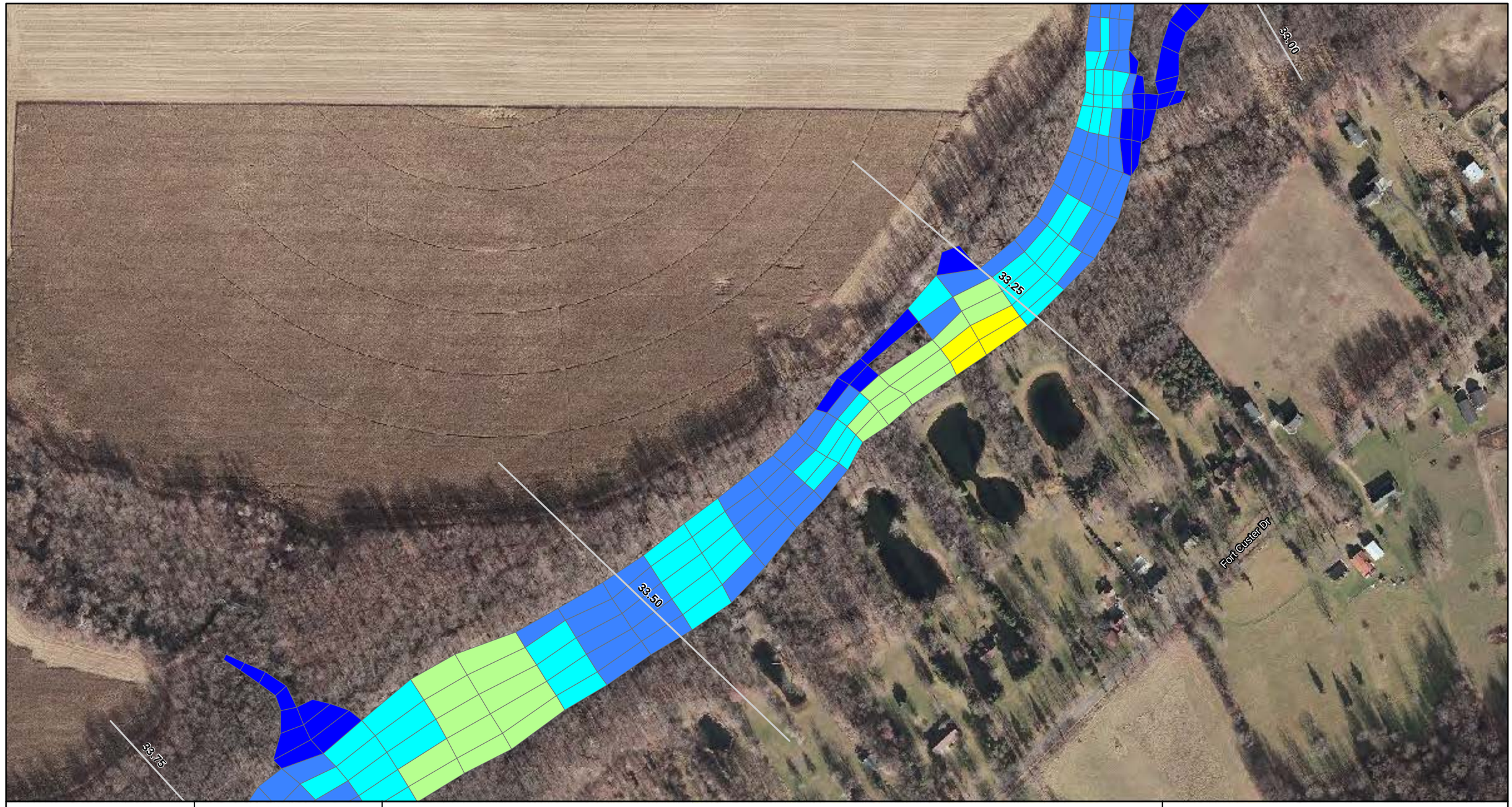
MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

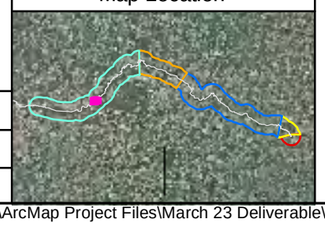
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

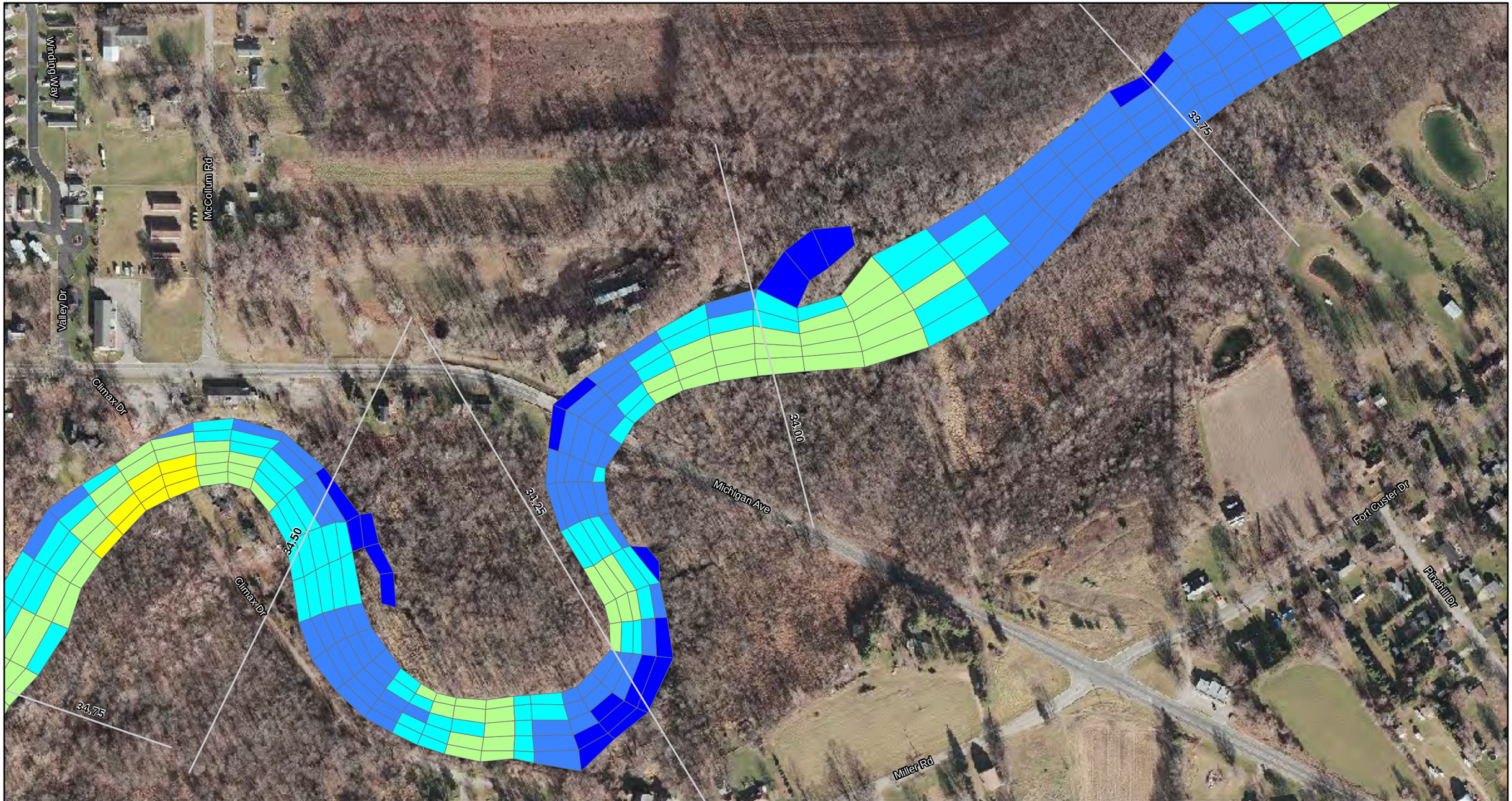
MP 32.25 - MP 33.10

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

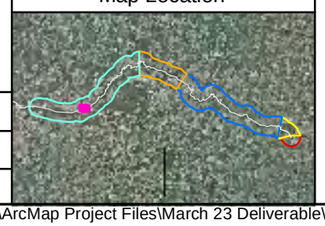
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

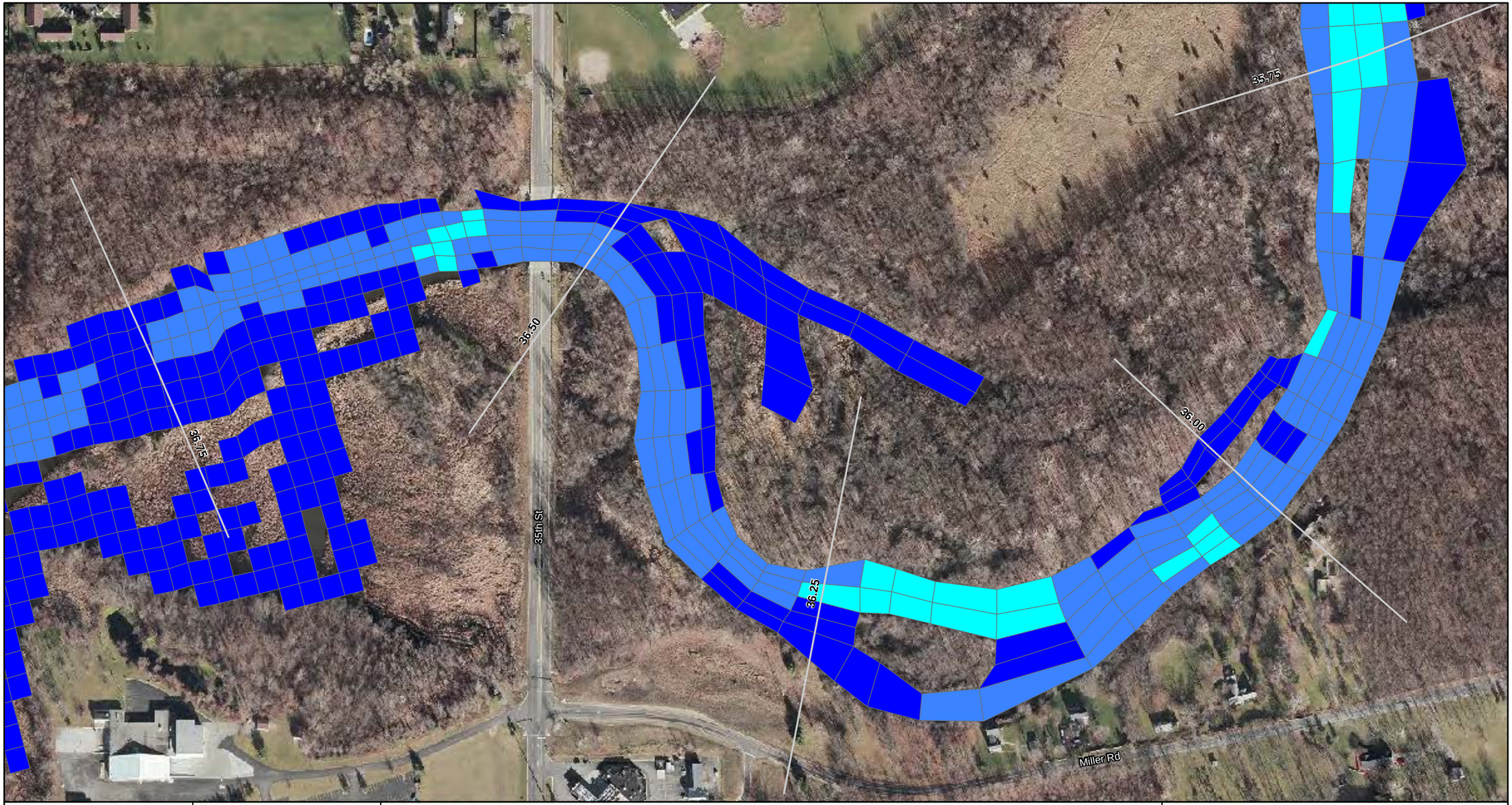
MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

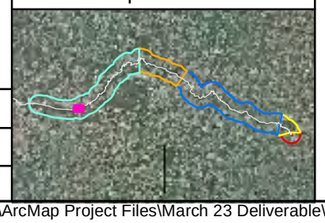
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

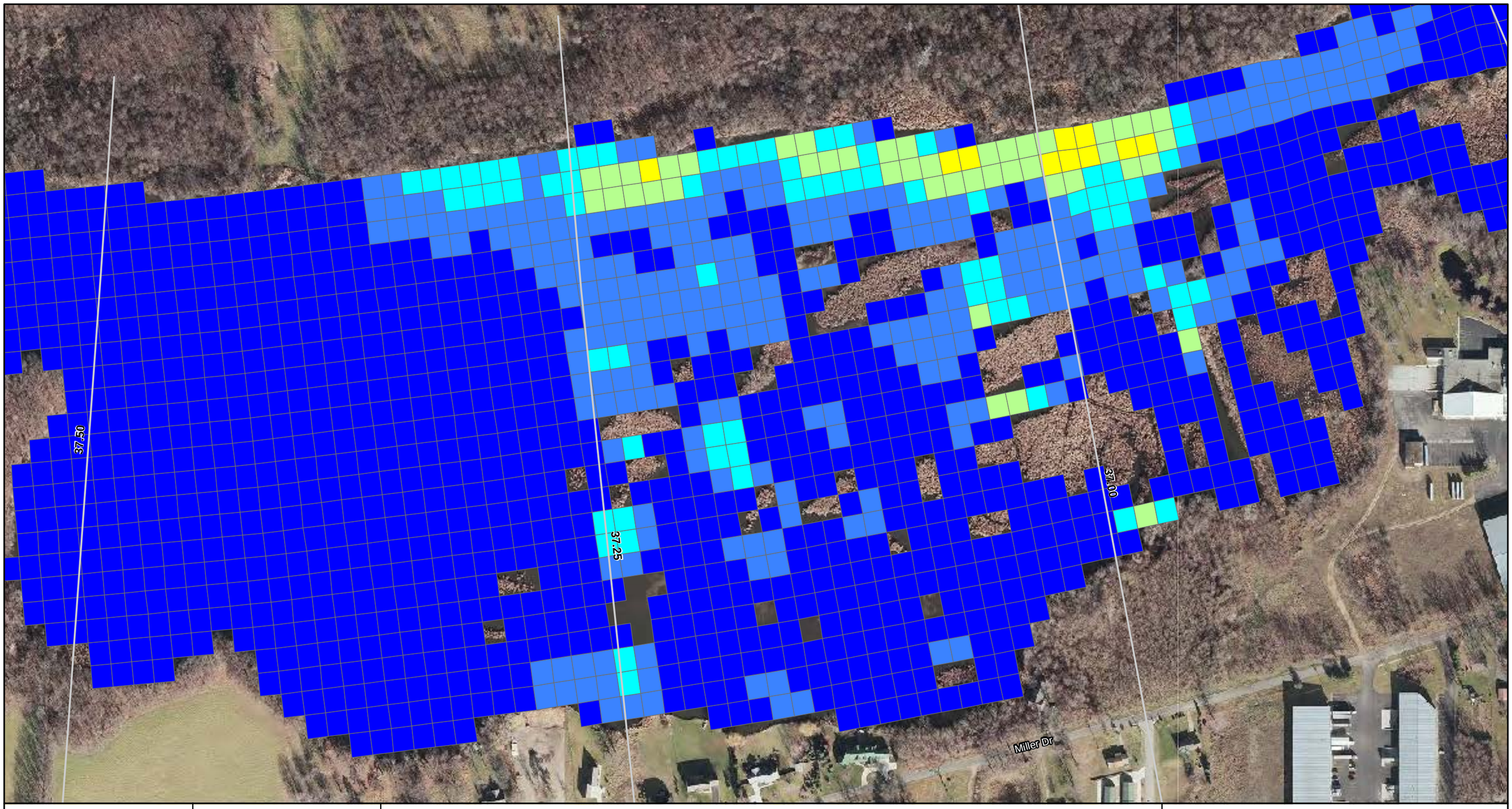
MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

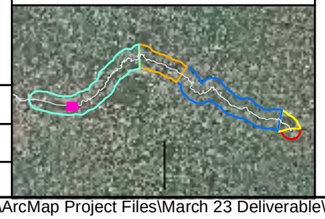
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

38.25

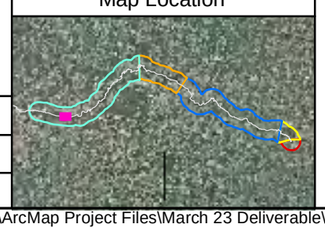
38.00

37.75

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

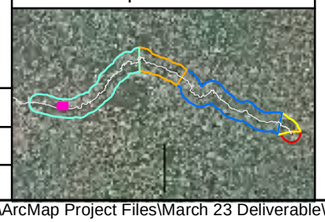
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011

38.50

38.25

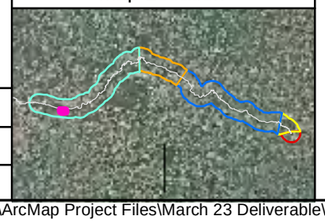
38.00

Lyth Rd

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

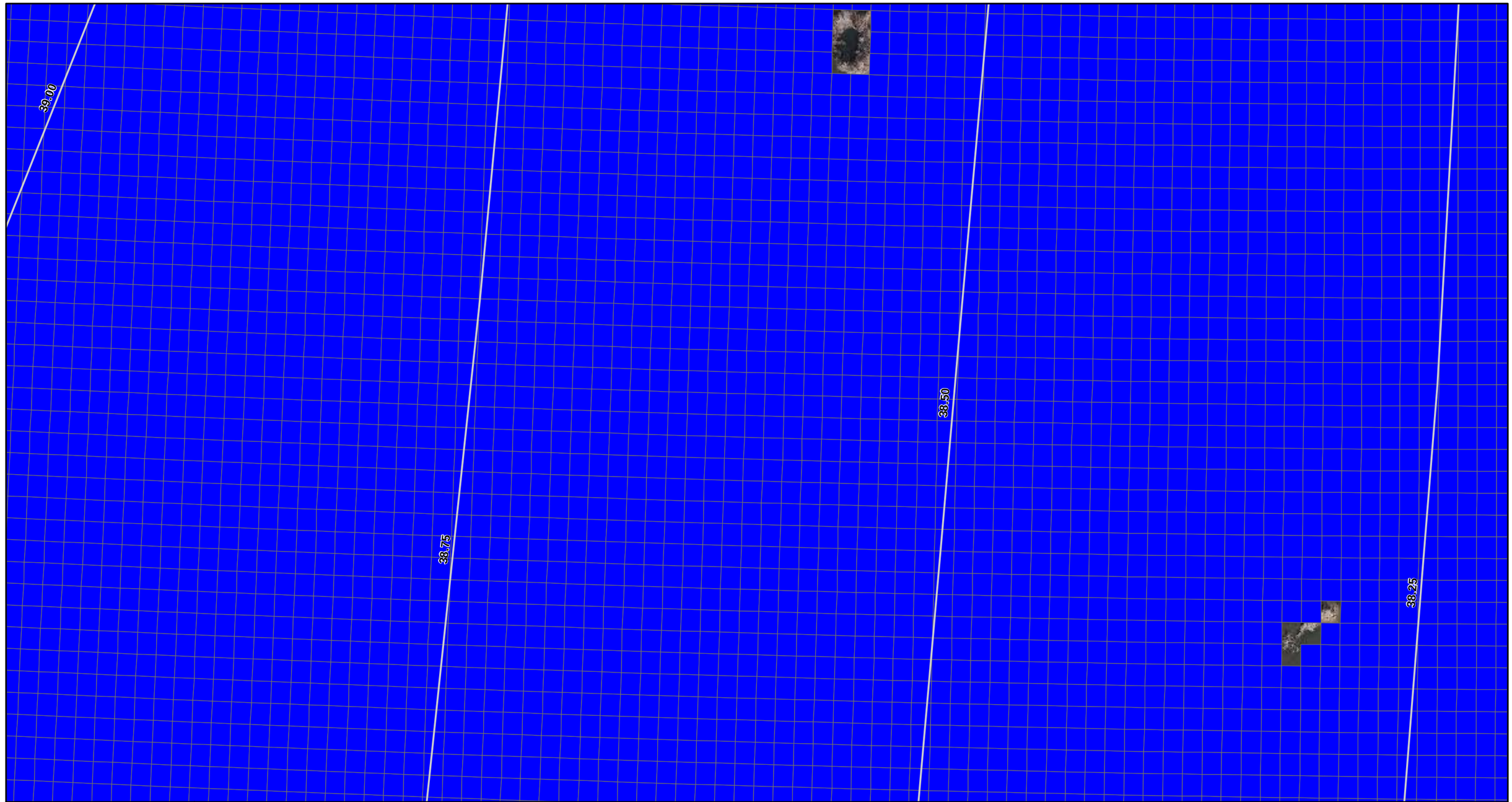
MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

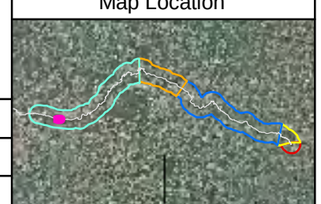
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

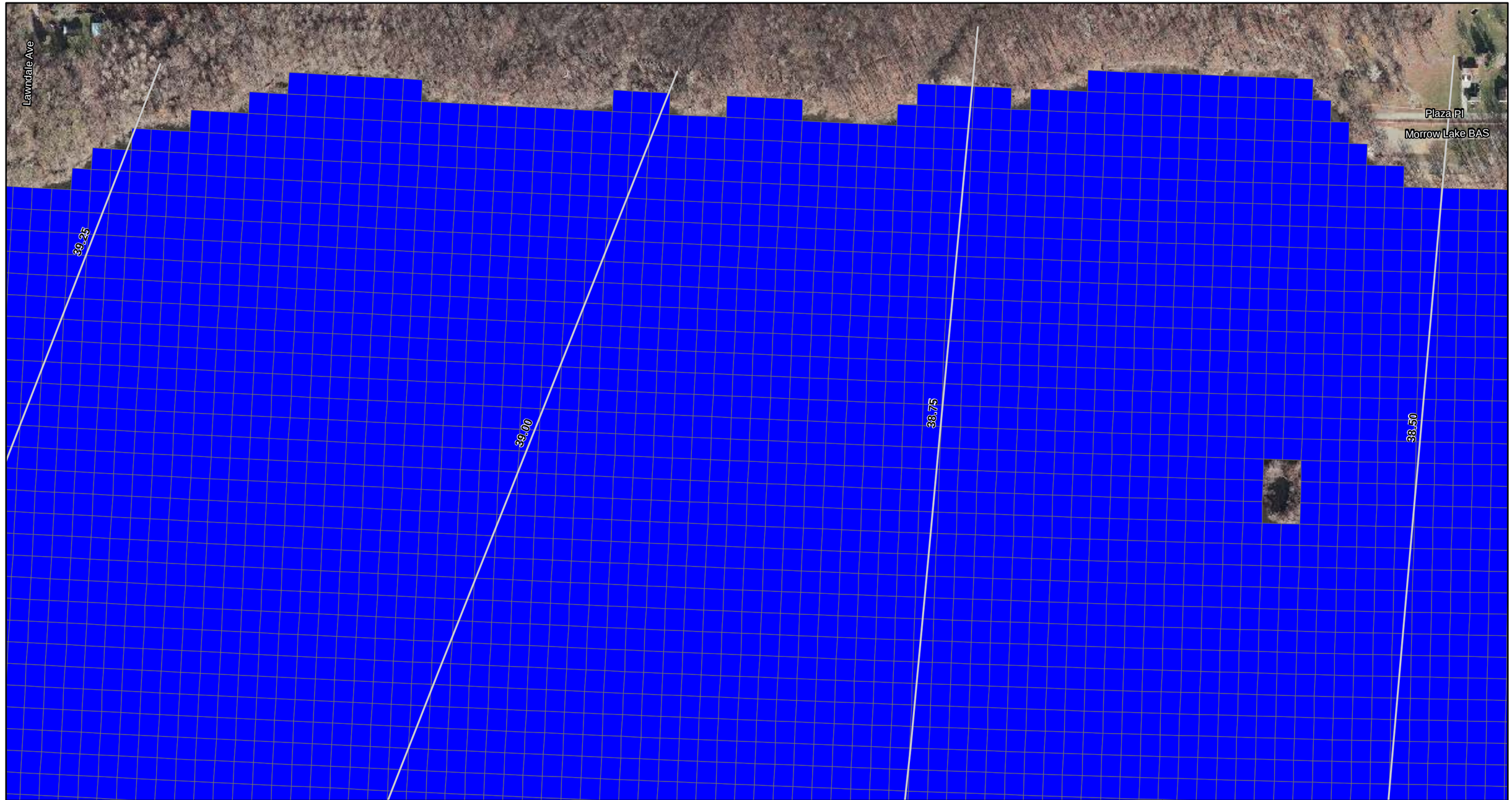
MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

N

0 125 250 500

Scale in Feet

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

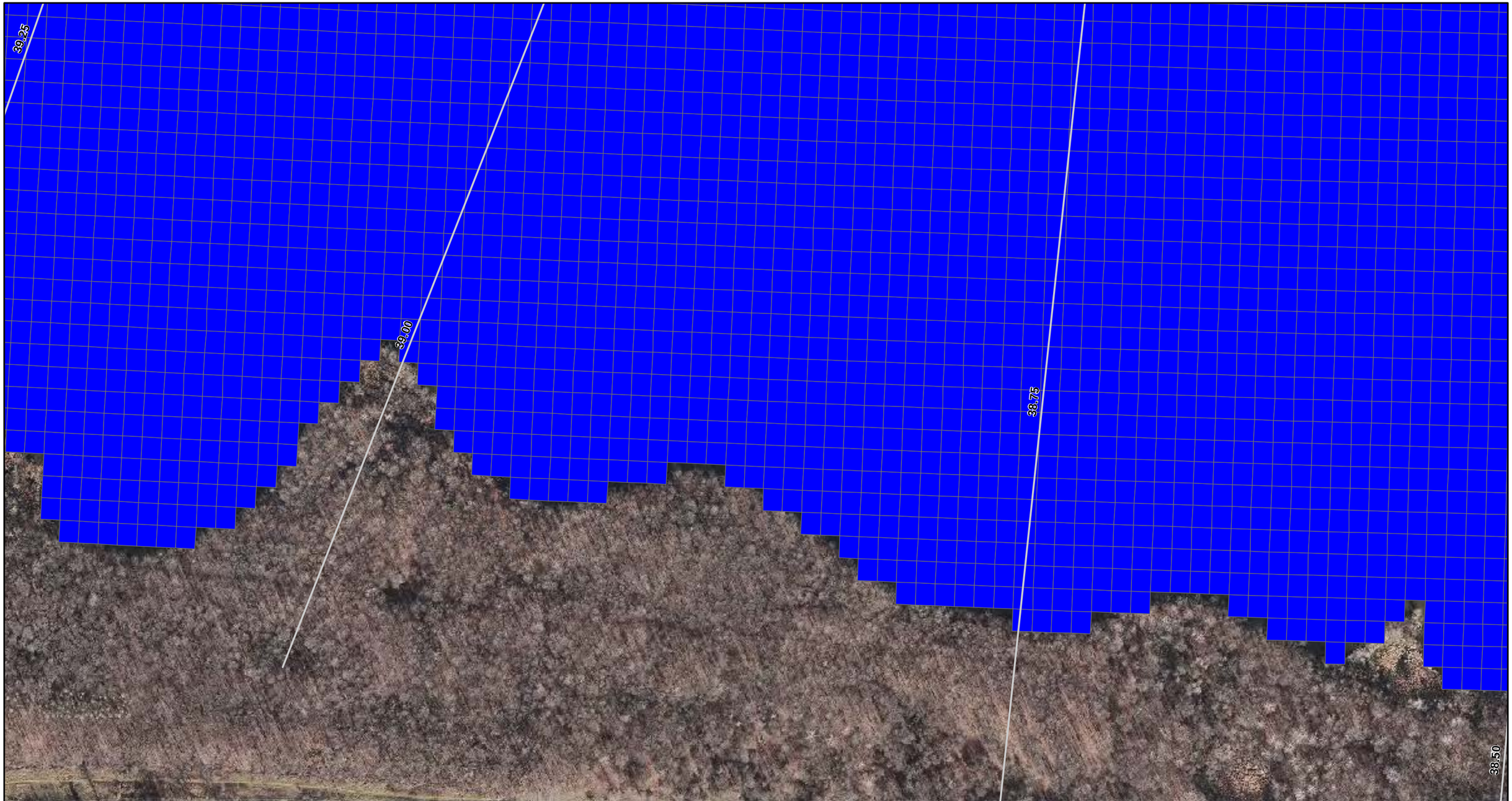
MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

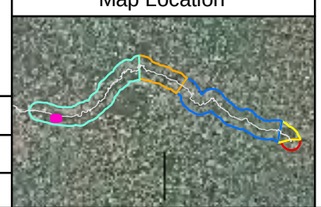
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

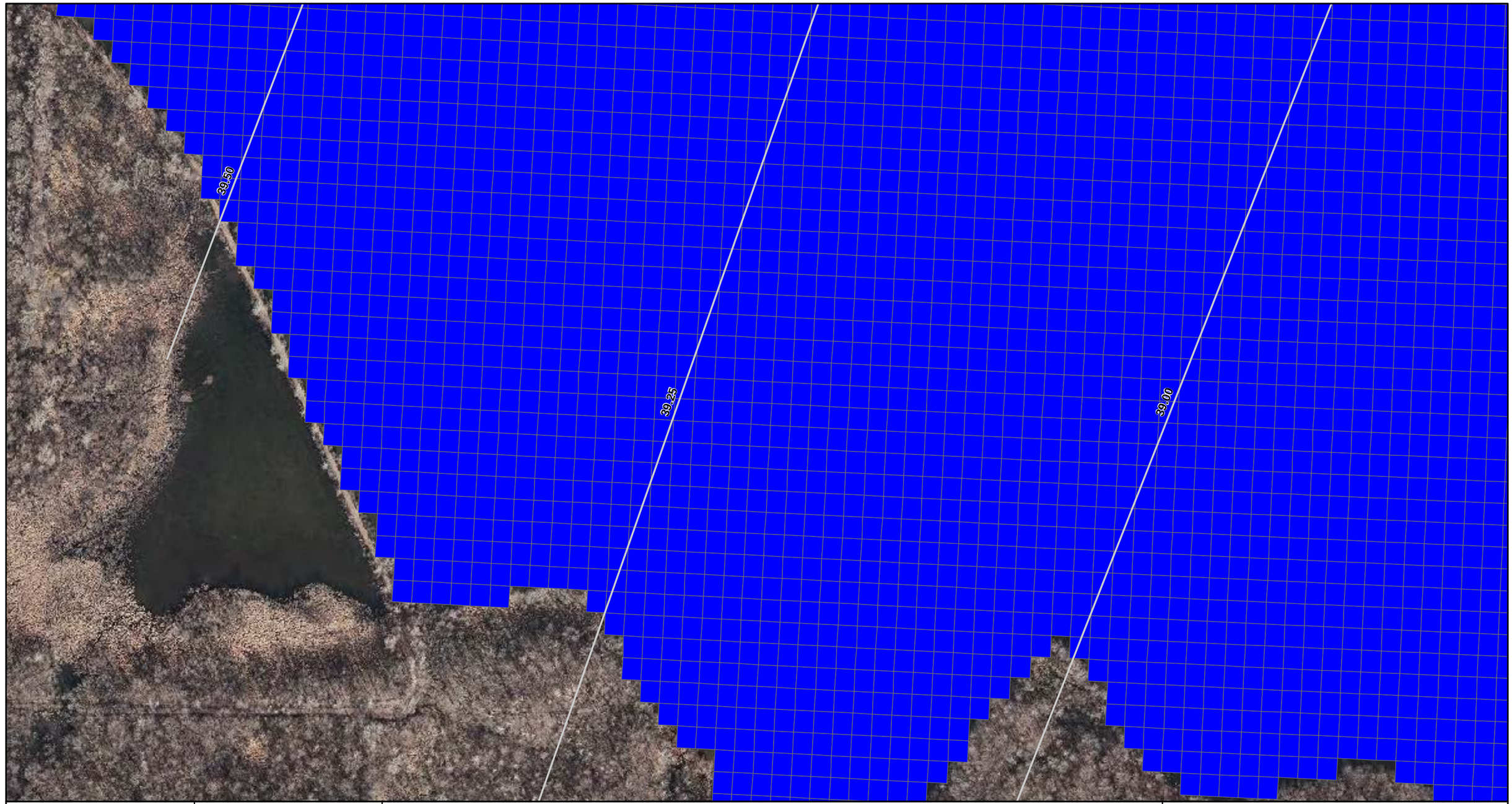
MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

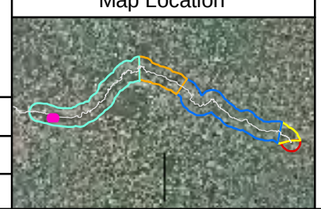
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

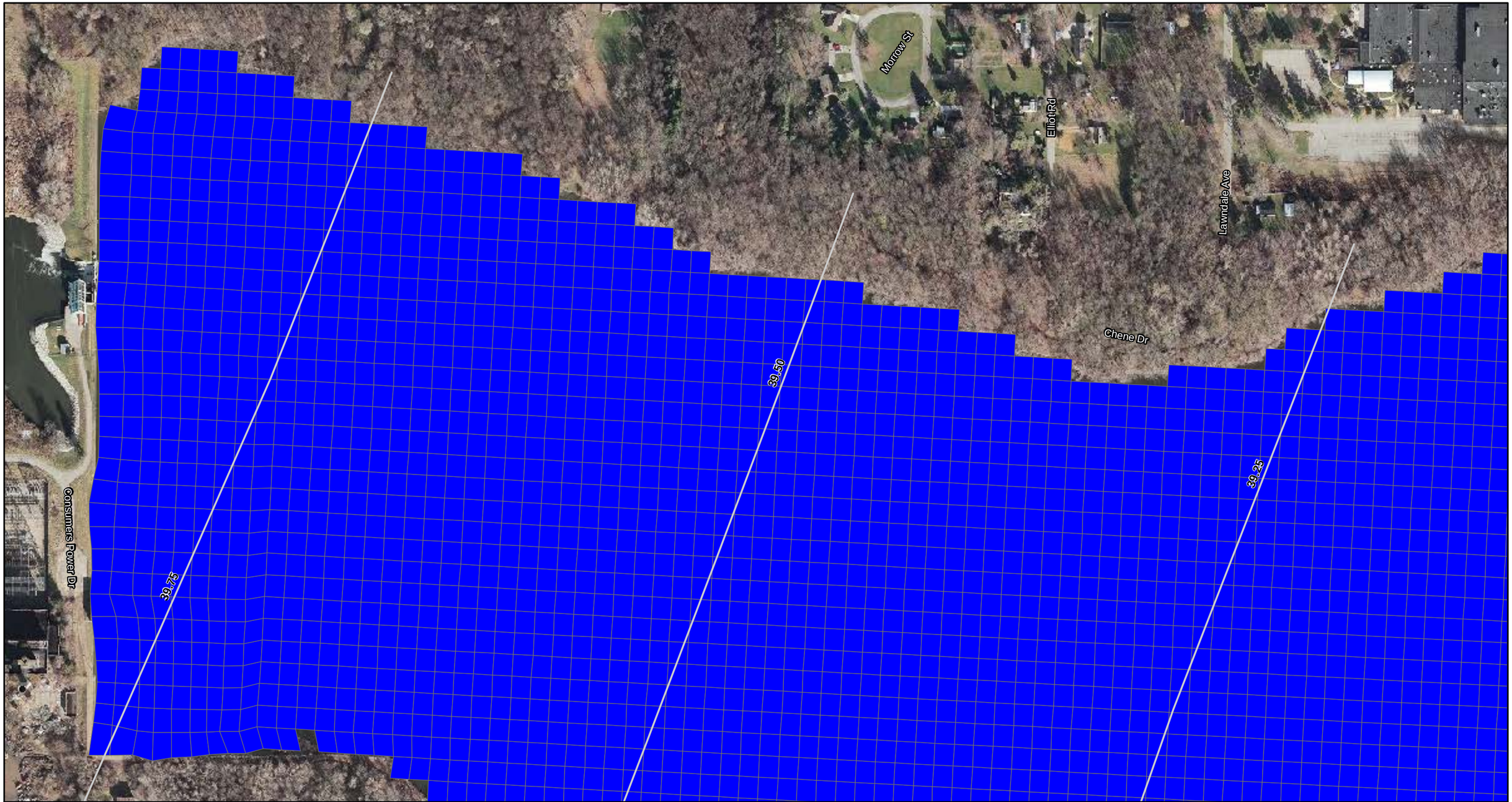
MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Nov3_2011.mxd

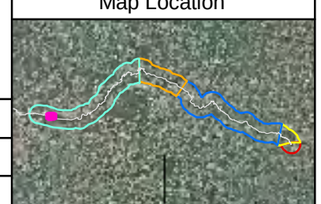
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 3, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 642 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 3, 2011

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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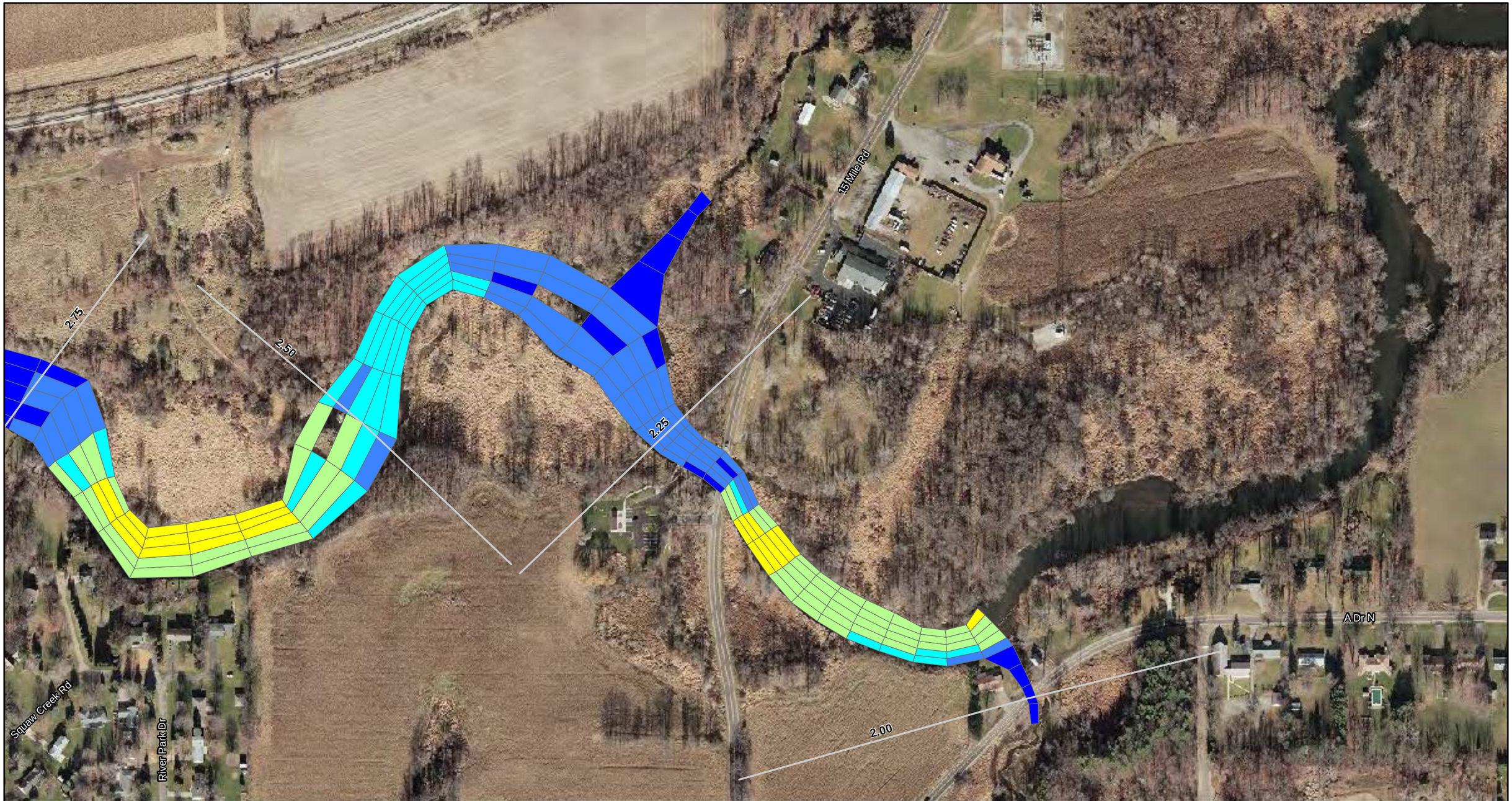
Aerial Photography Date: November 2011

Figure 4-18

Riverine Grid: Bed Shear Stress

November 7, 2011

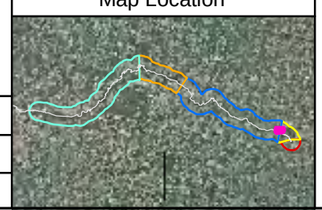
Sheets 1 through 56



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

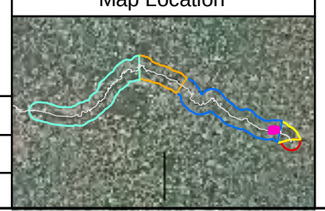
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

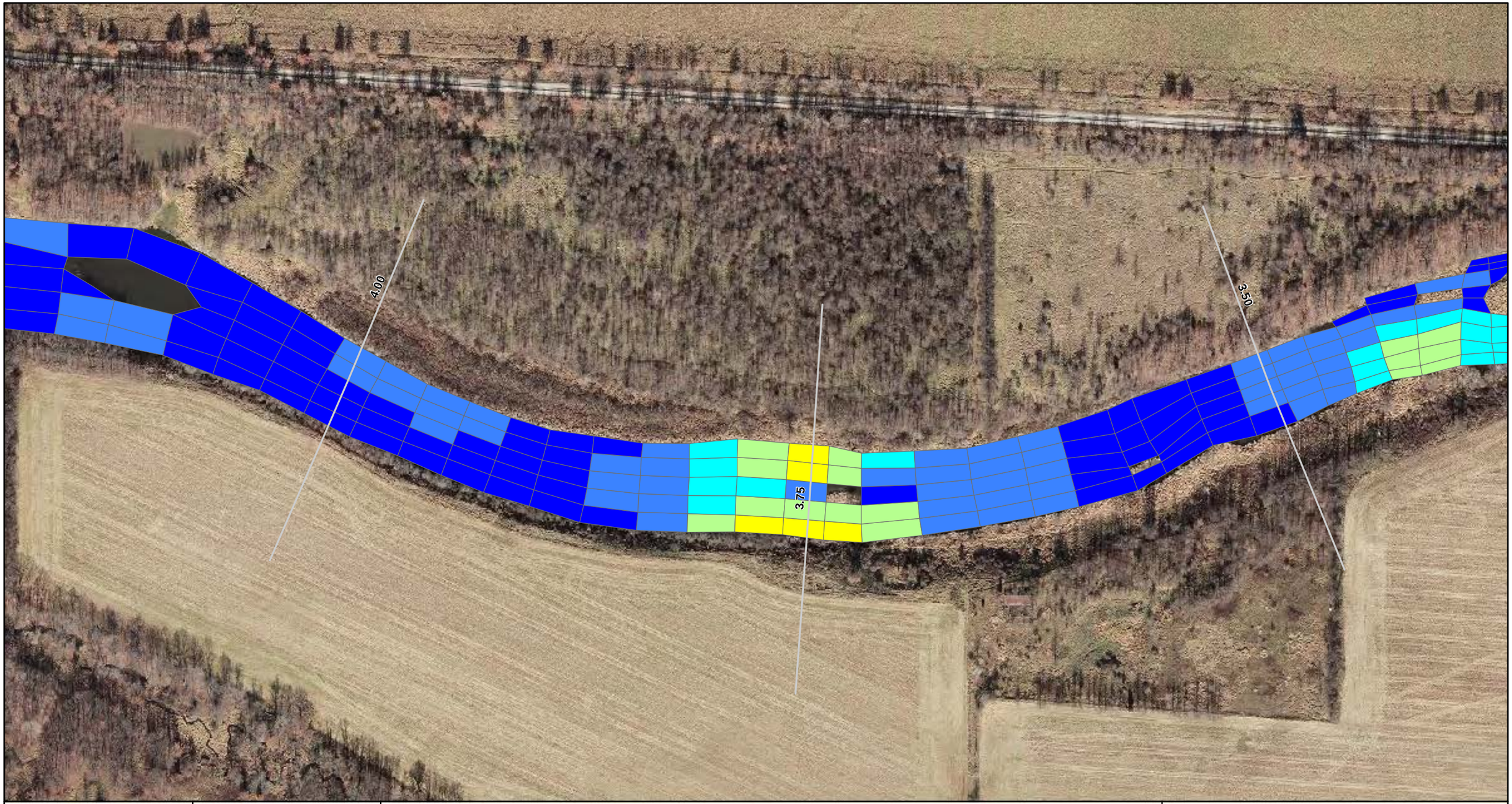
MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

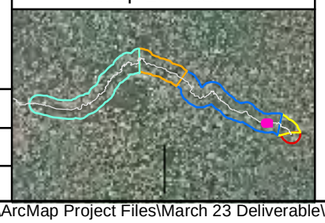
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

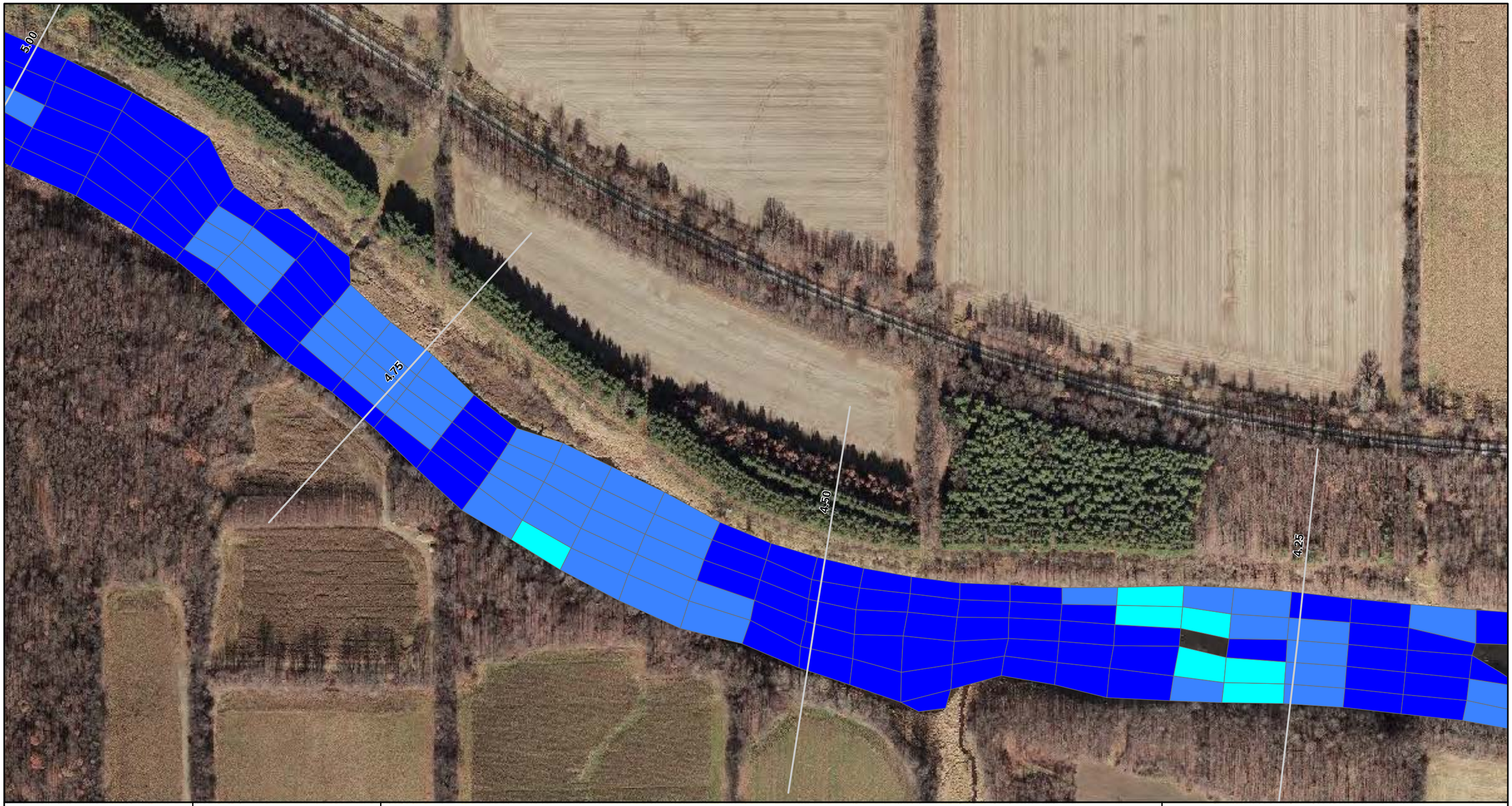
MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

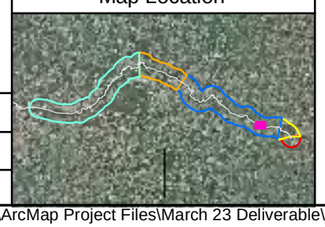
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011
- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

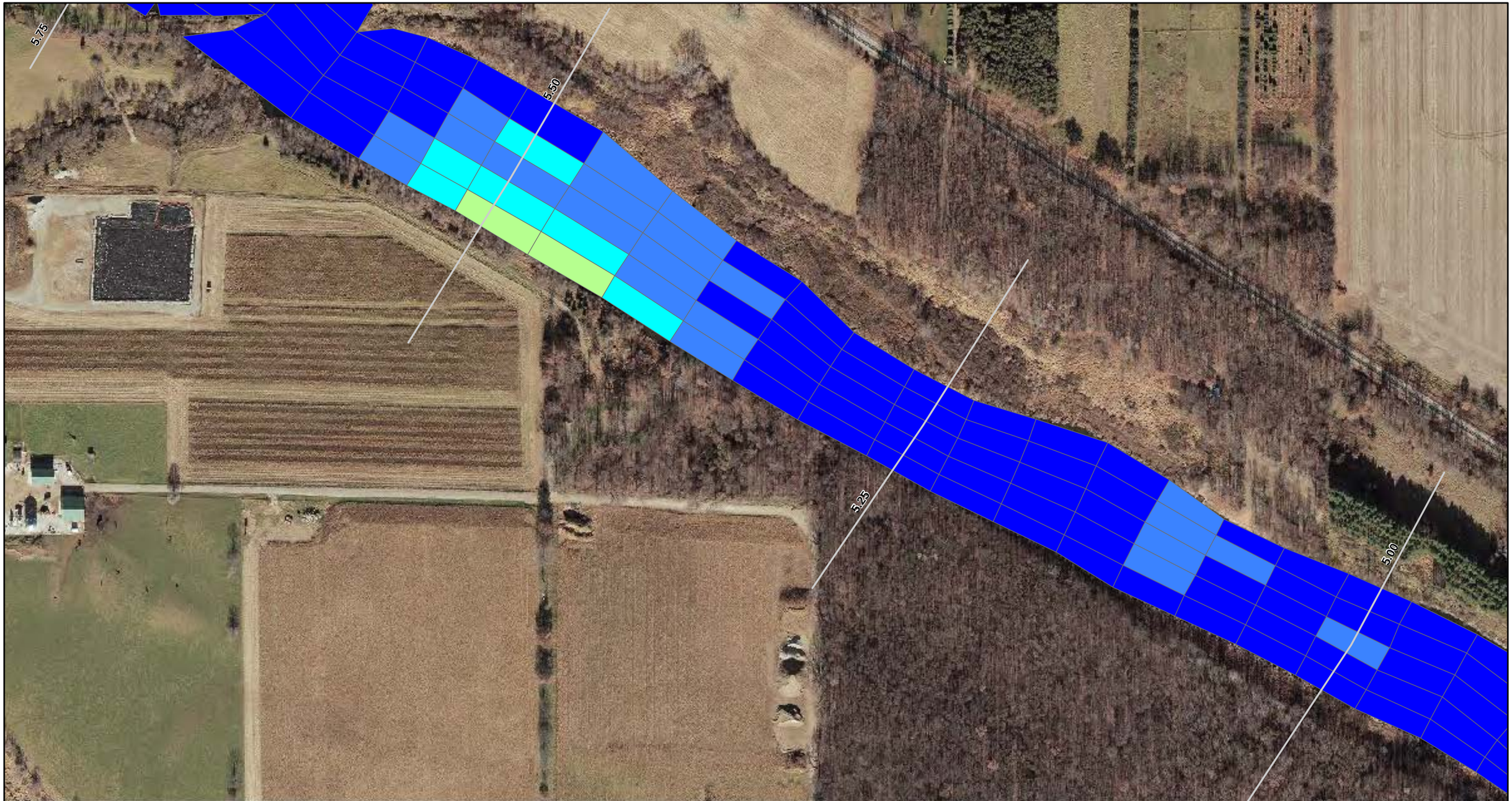
MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

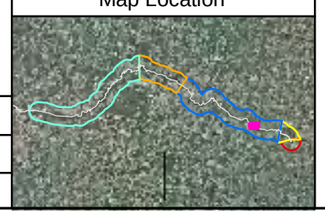
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011
- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

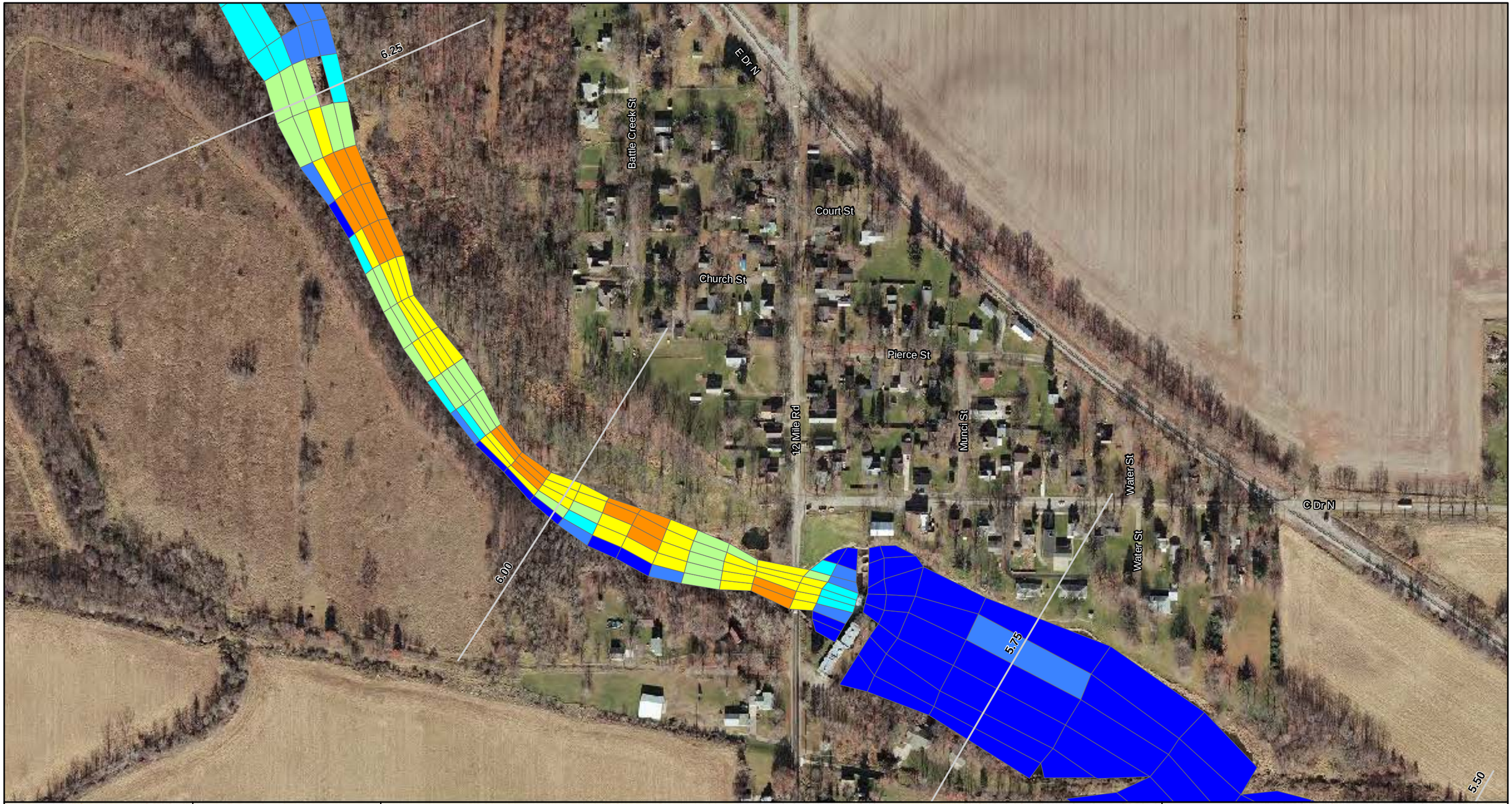
MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

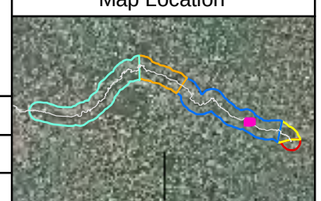
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

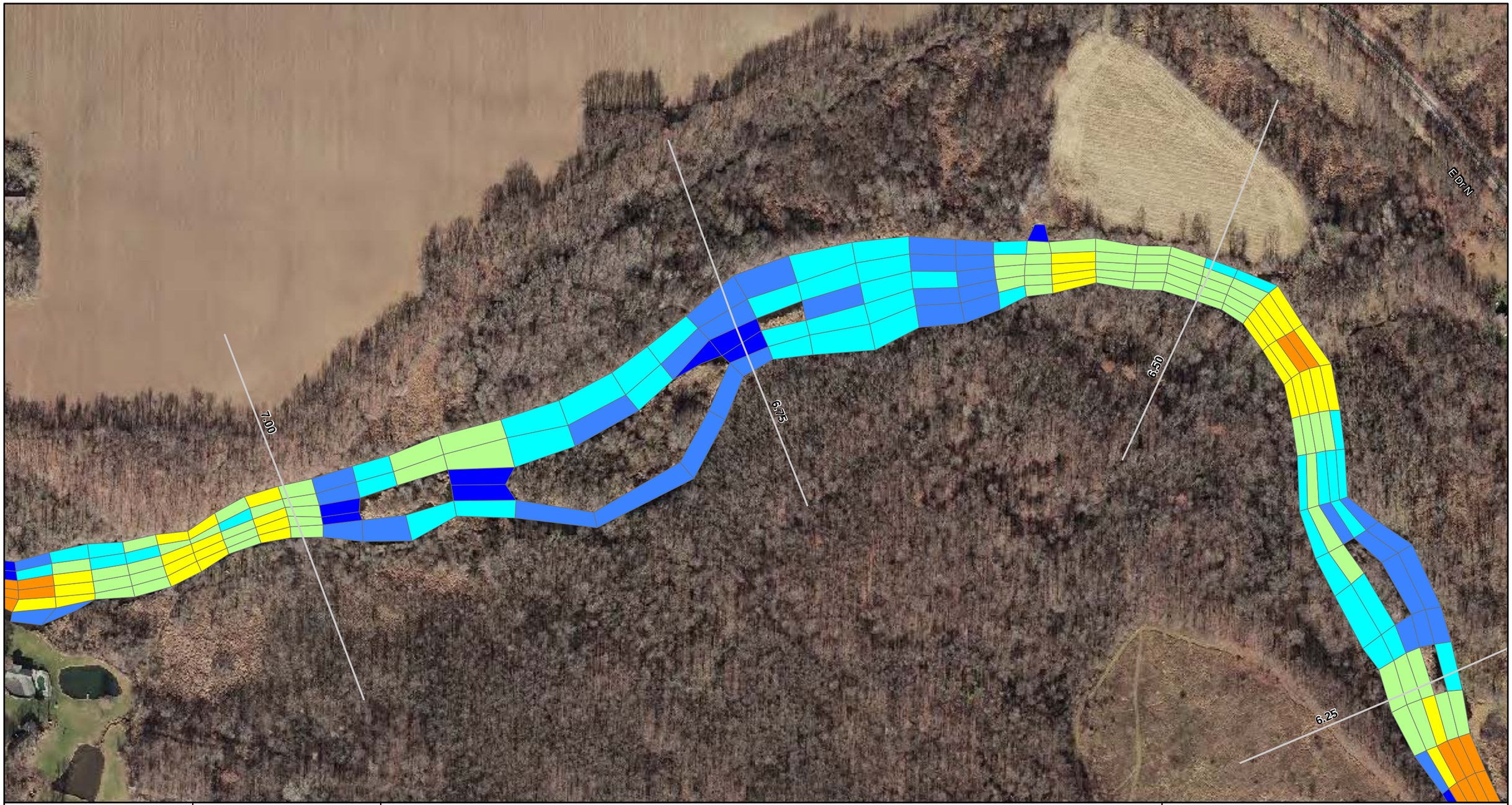
MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

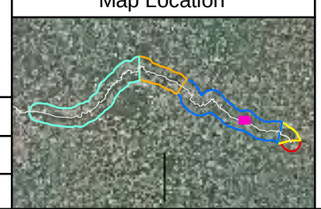
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

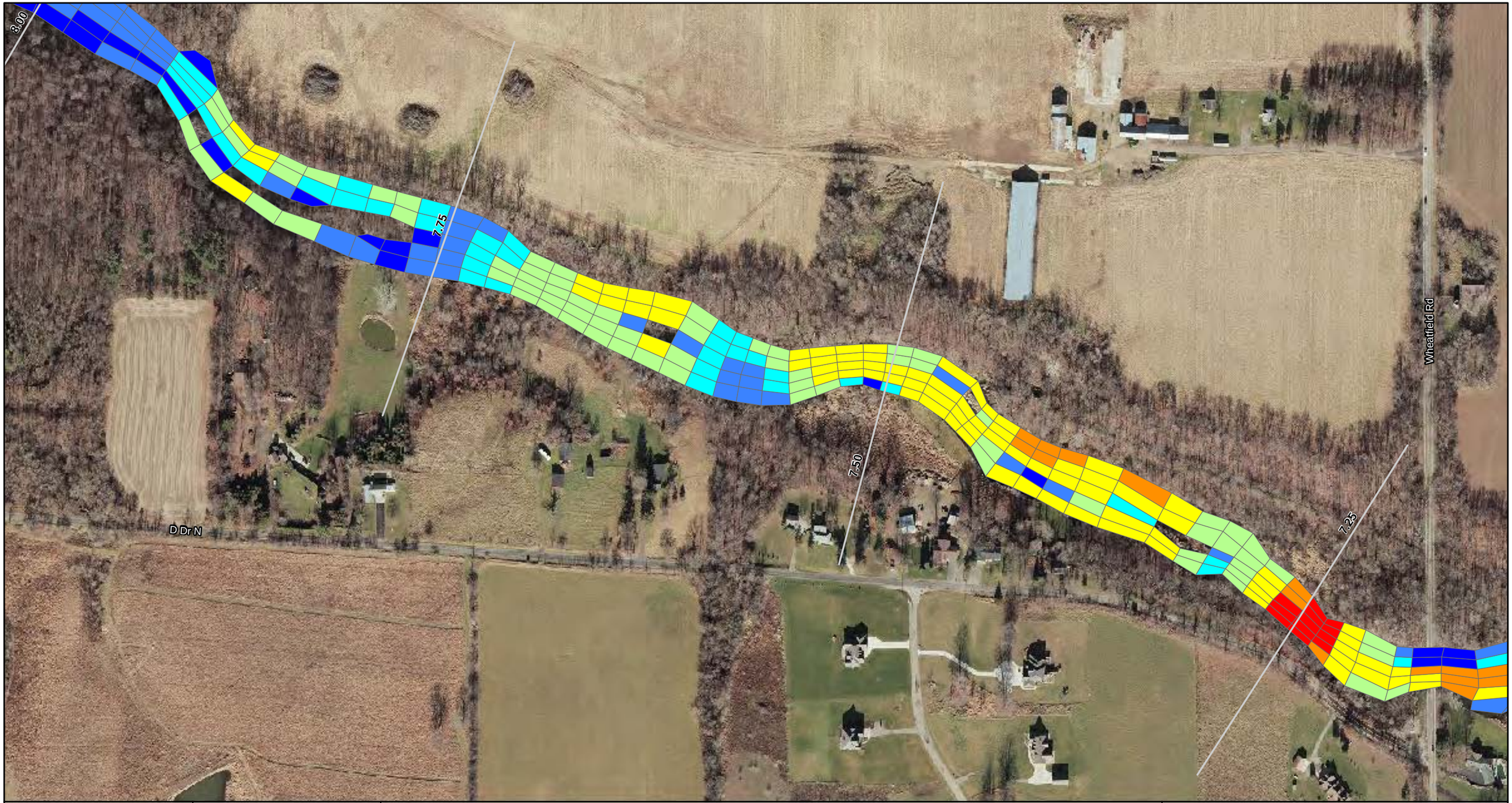
MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

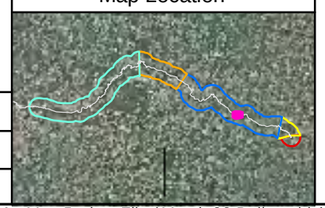
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

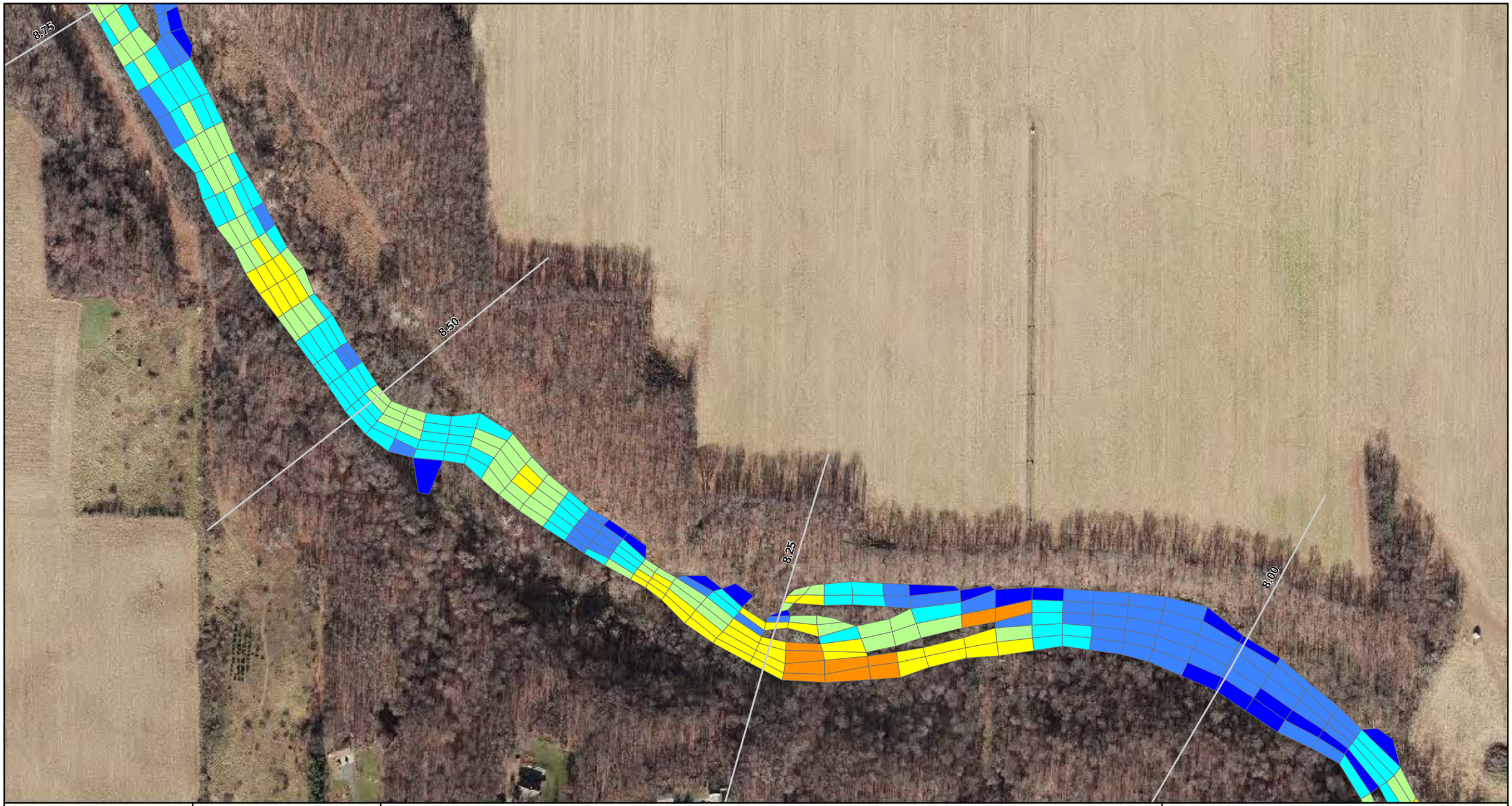
MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

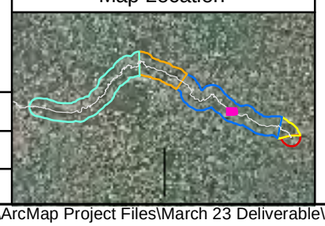
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

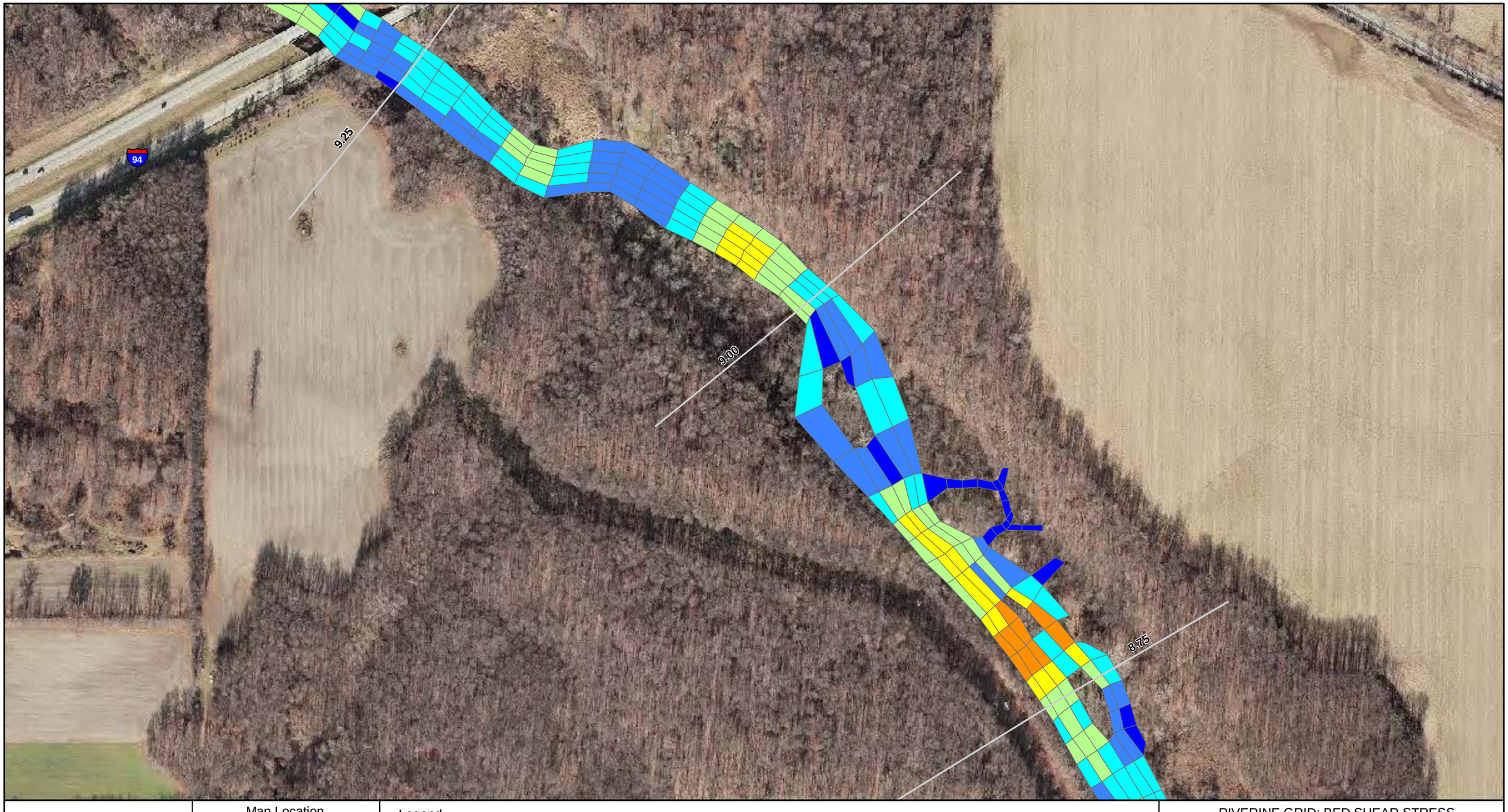
MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

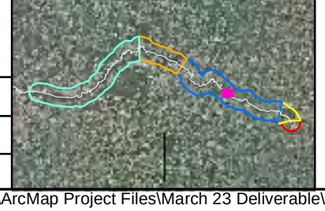
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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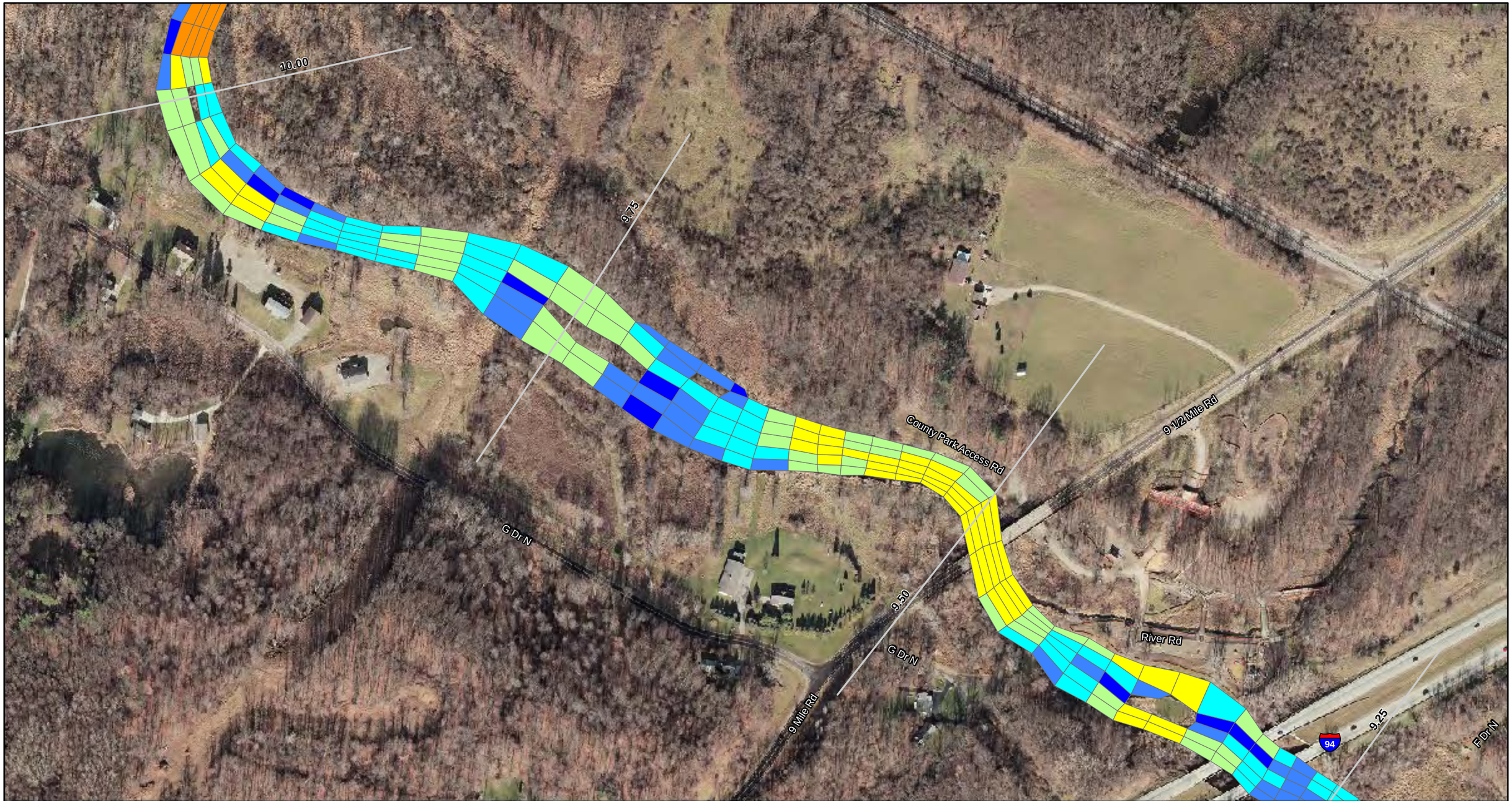
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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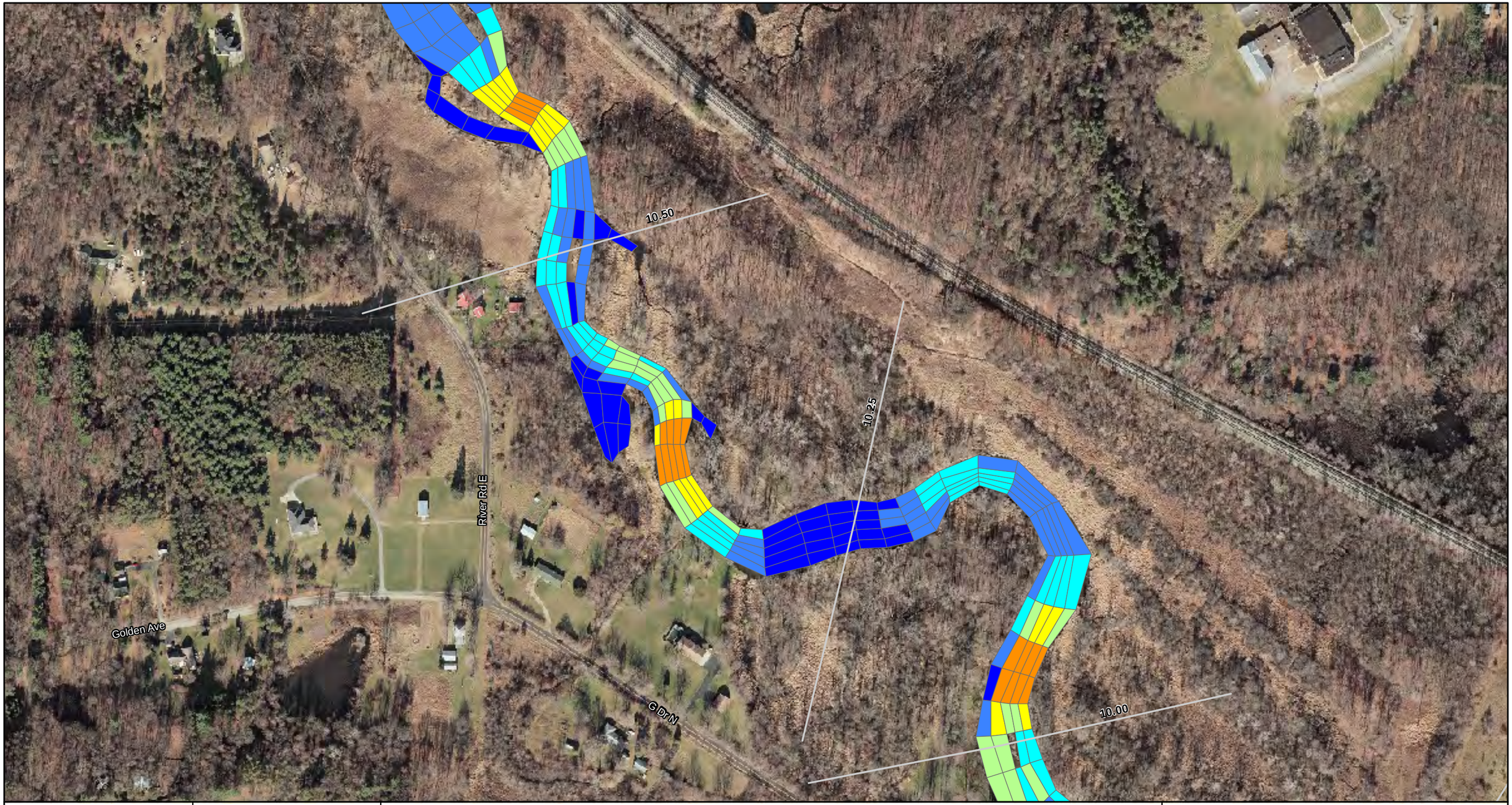
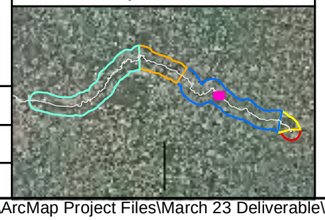
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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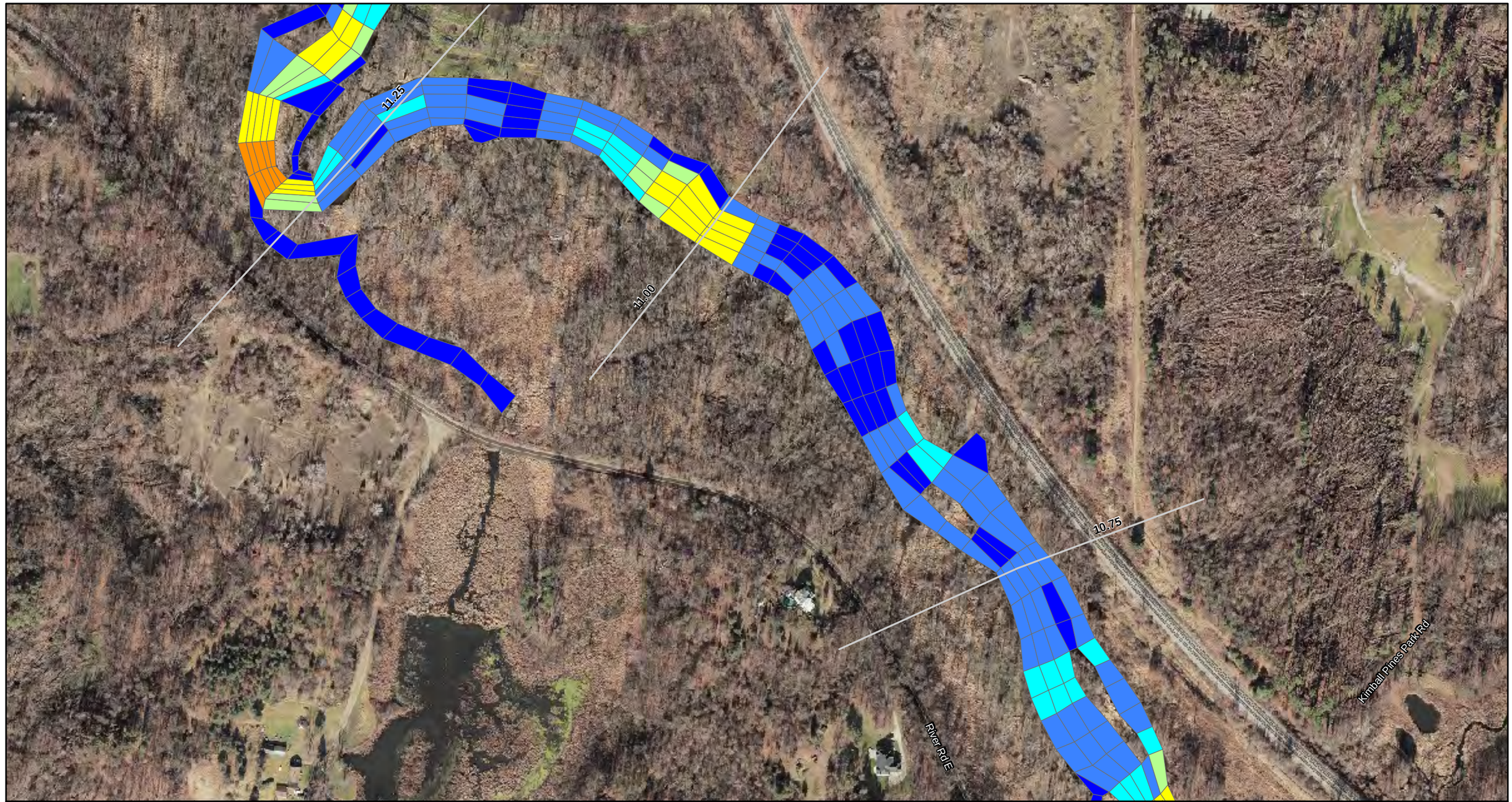
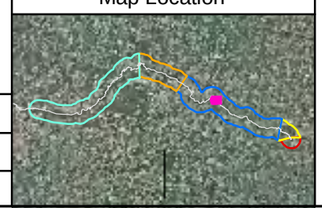
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

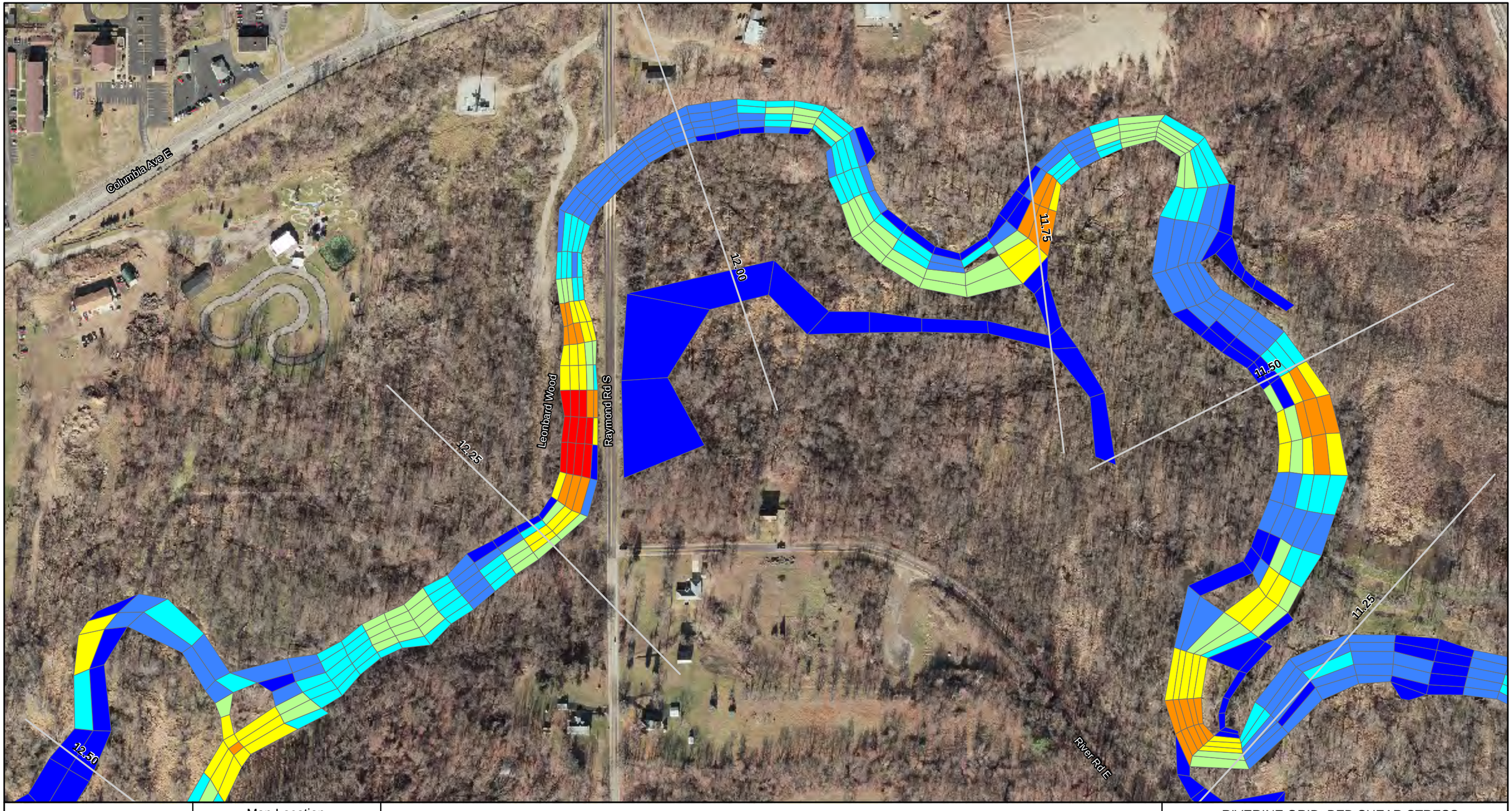
MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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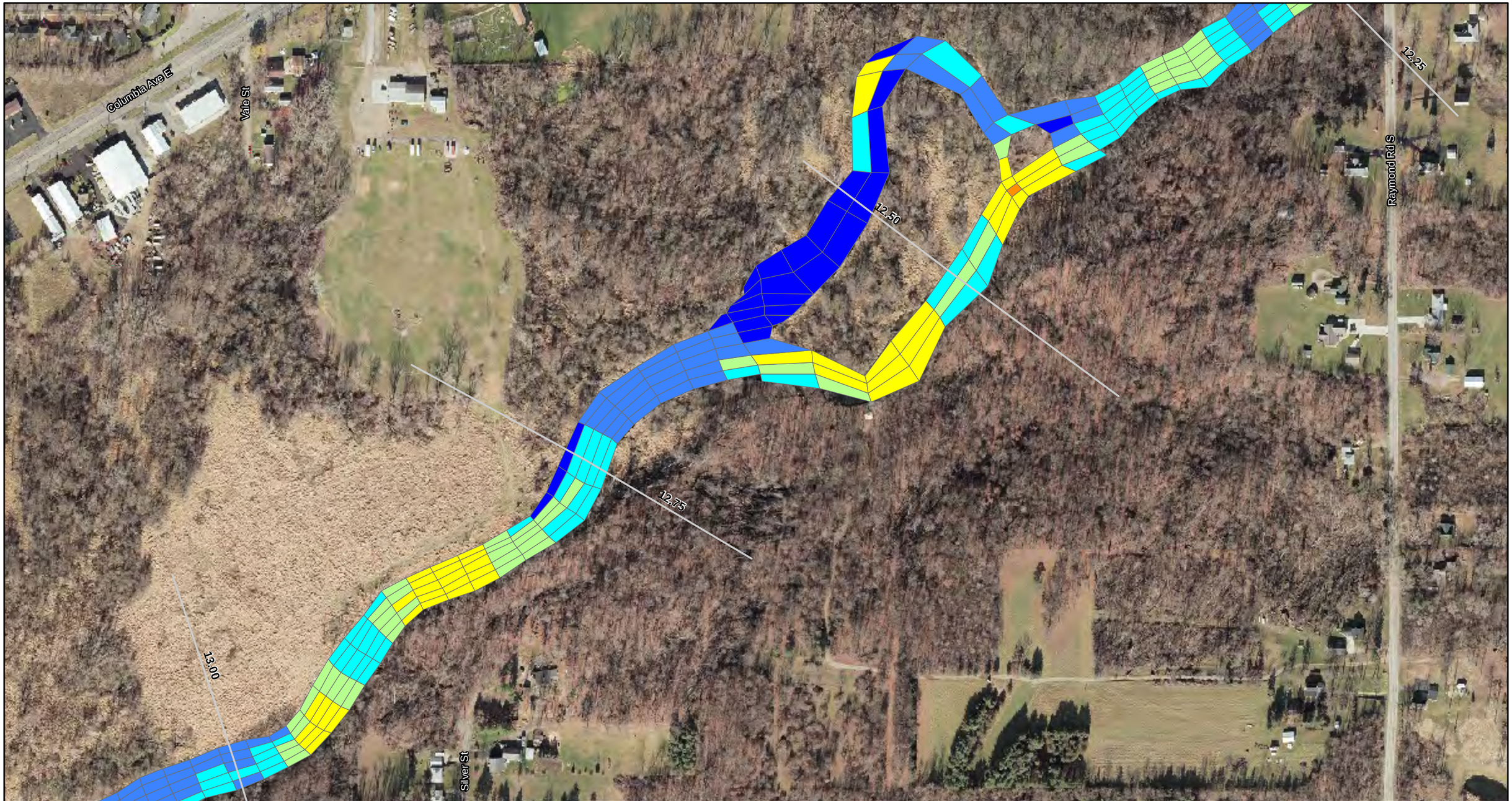
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

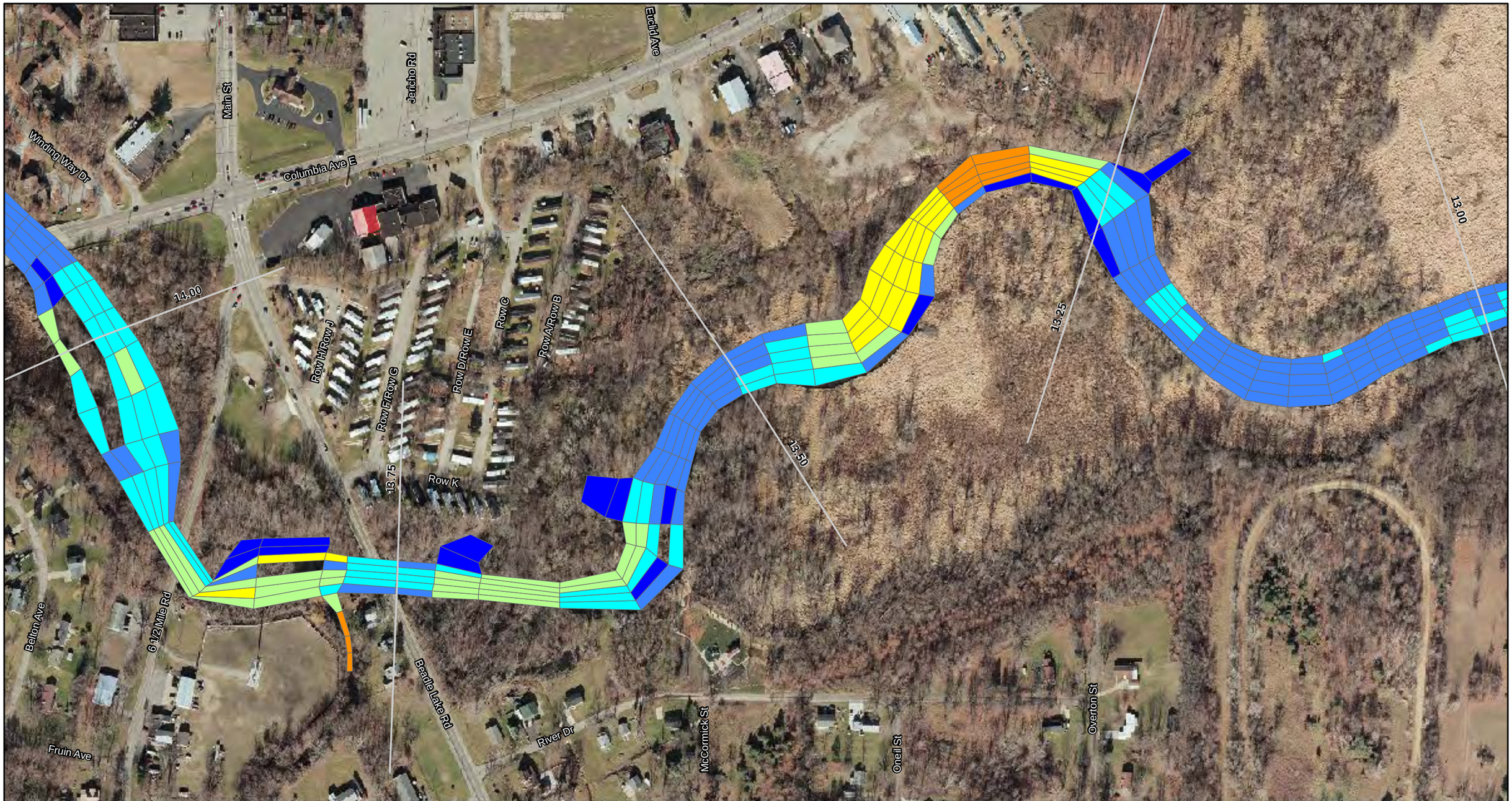
MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

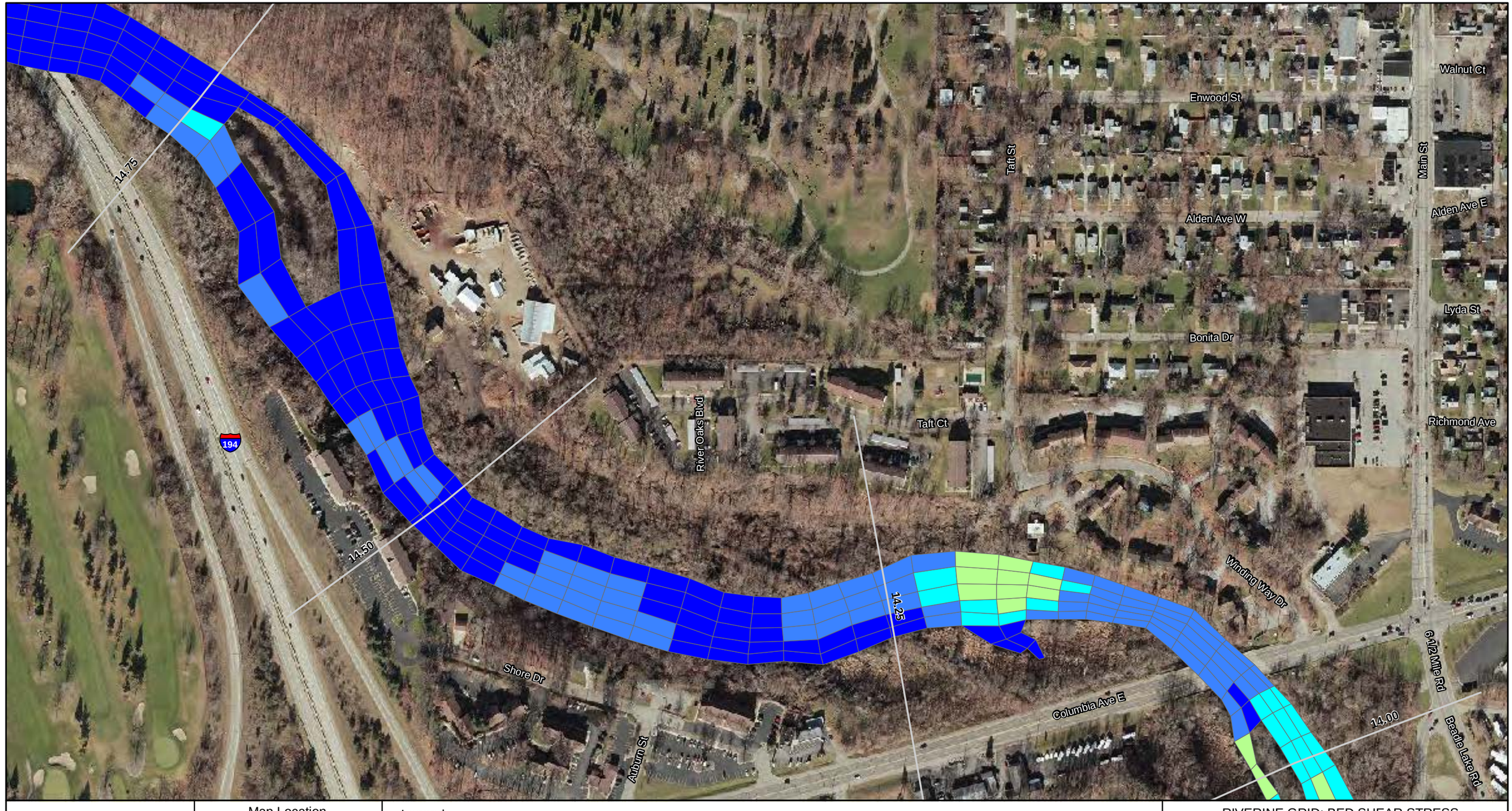
MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

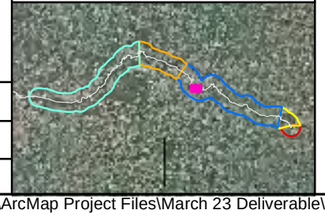
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

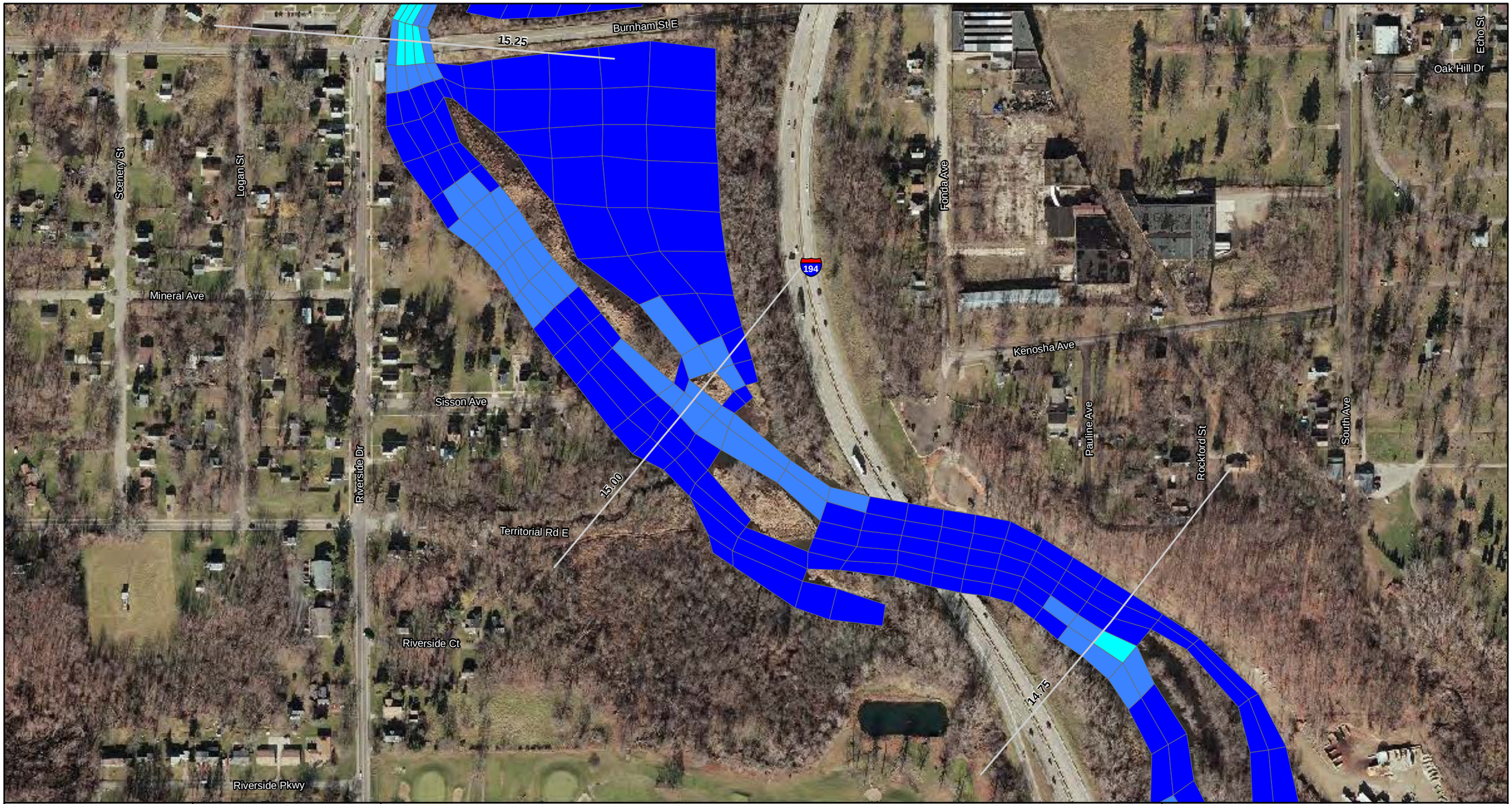
MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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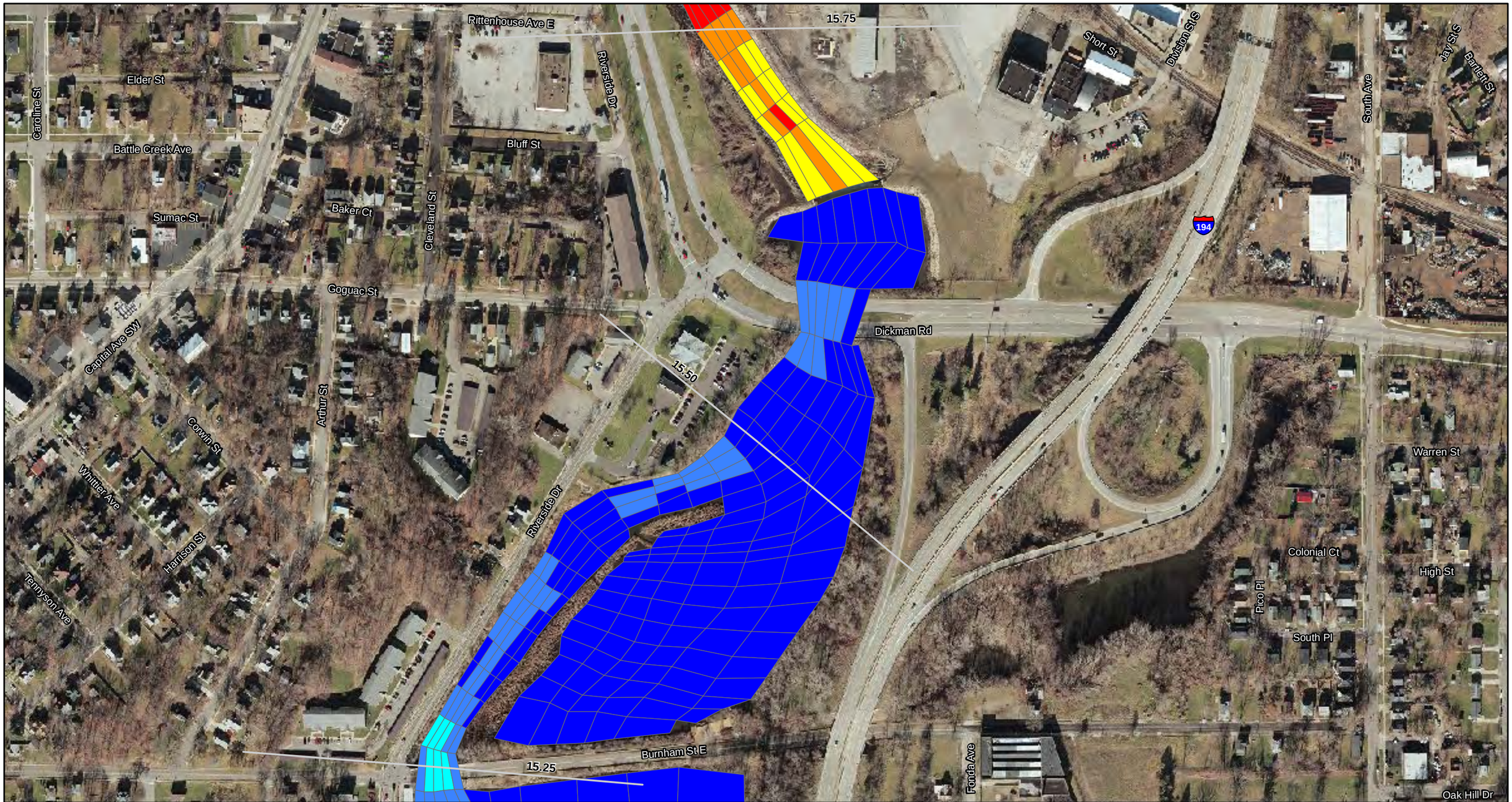
Aerial Photography Date: November 2011



Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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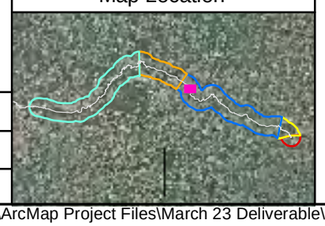
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

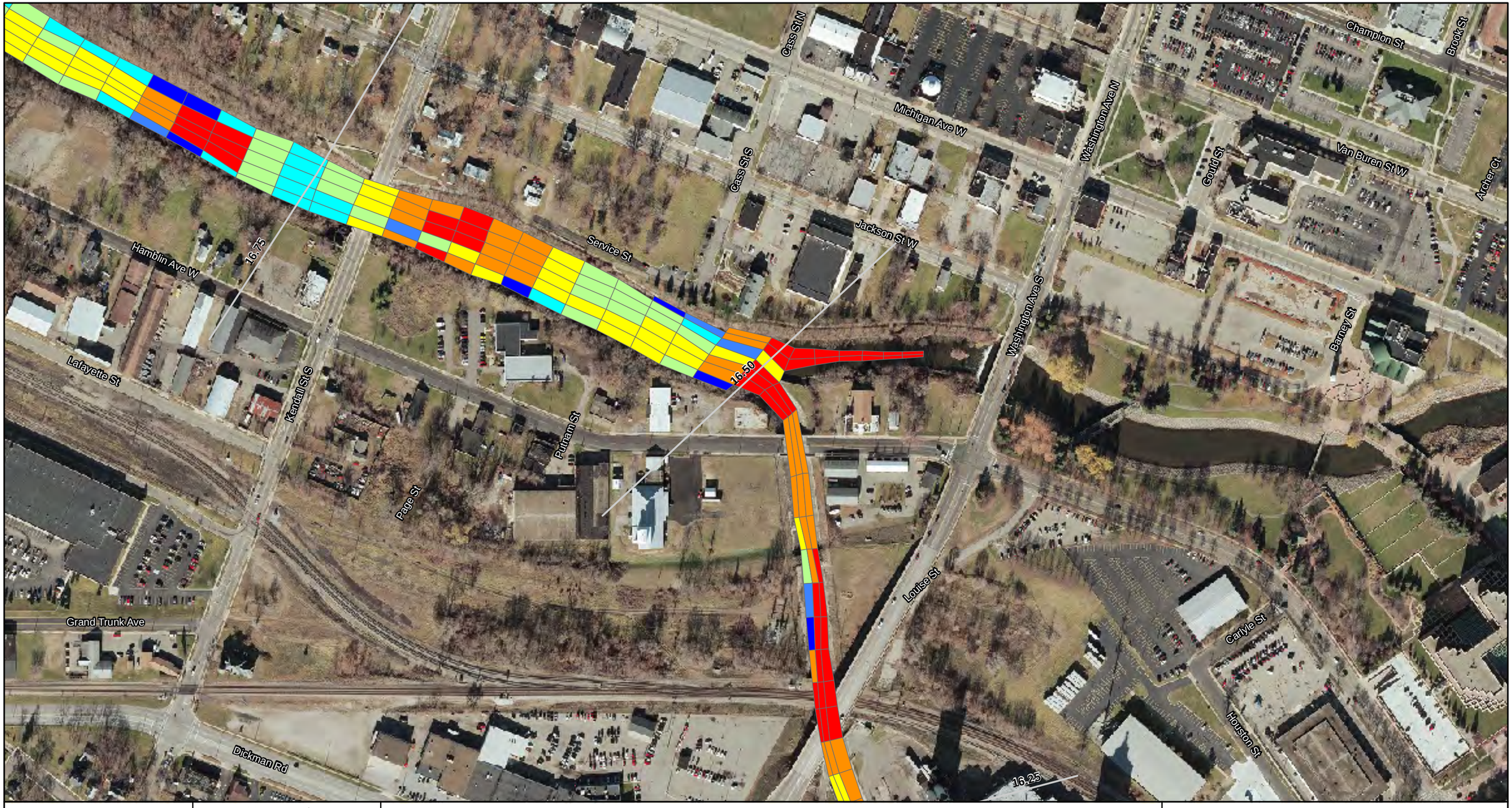
MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

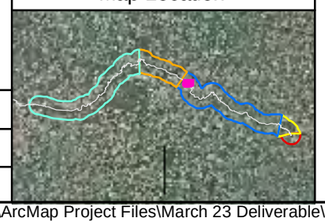
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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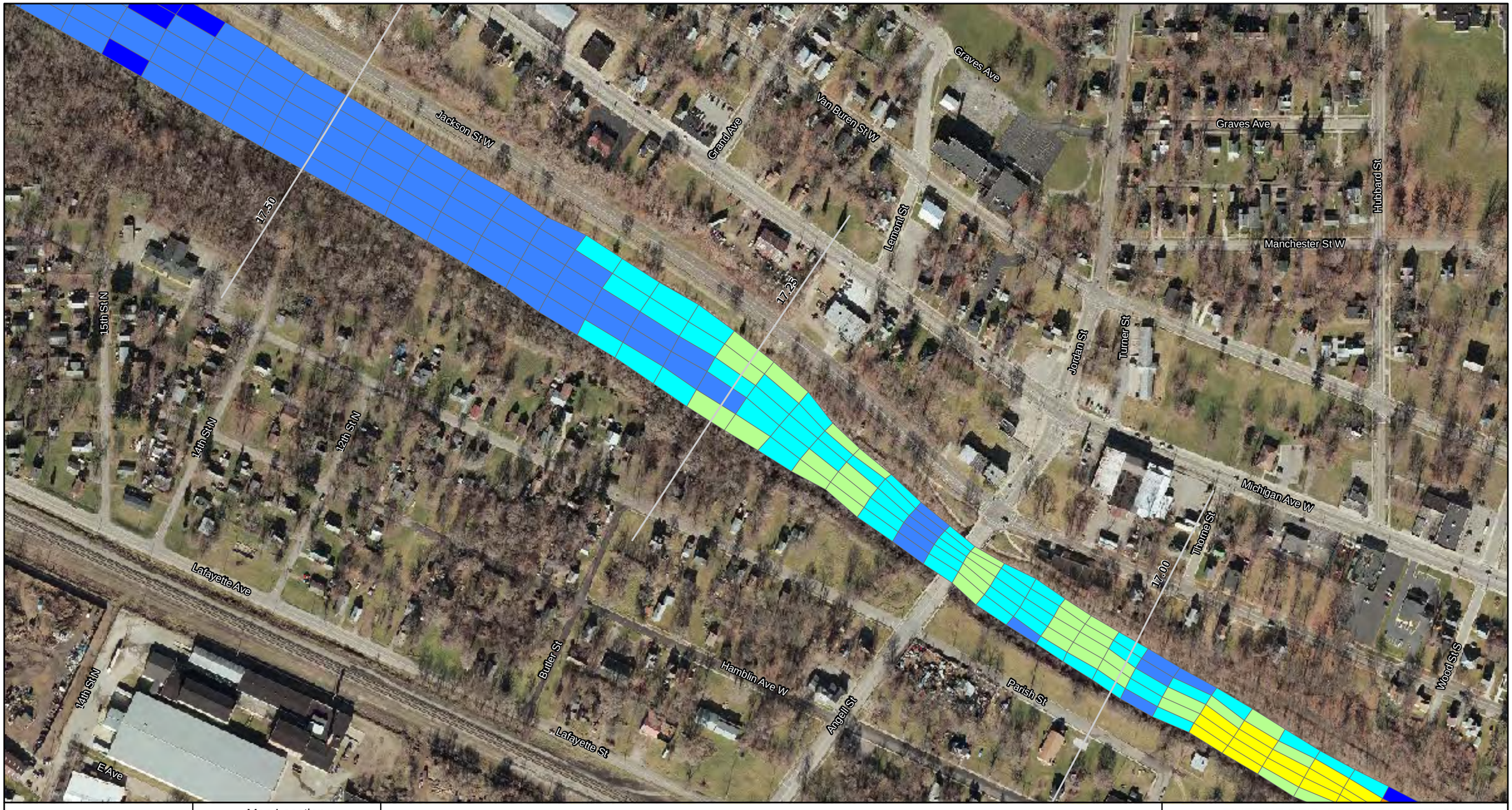
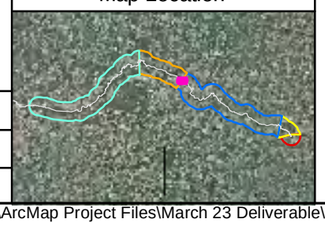
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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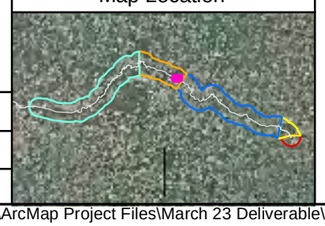
Aerial Photography Date: November 2011

ENBRIDGE	
Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

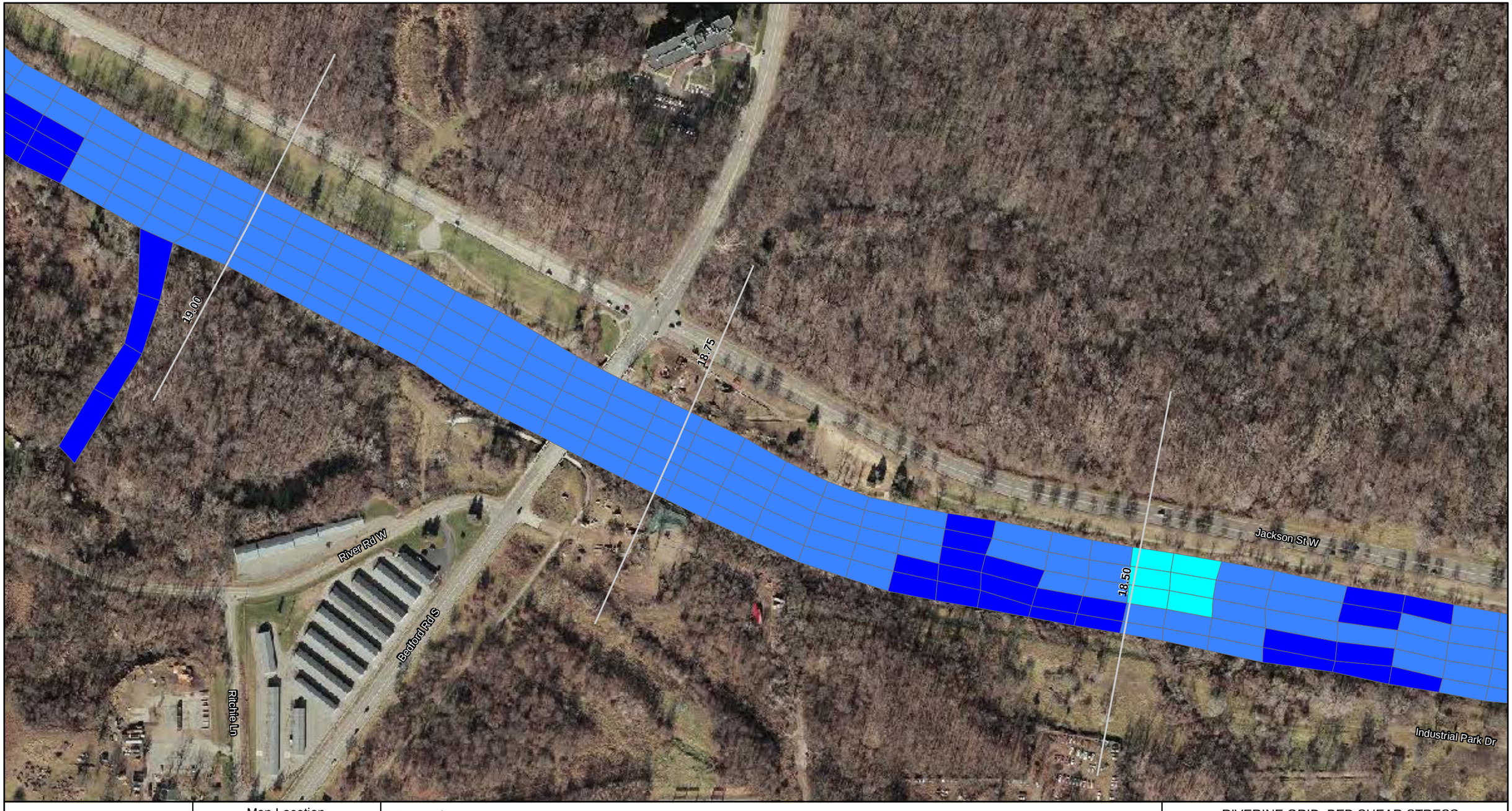
MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

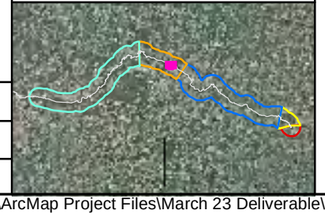
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

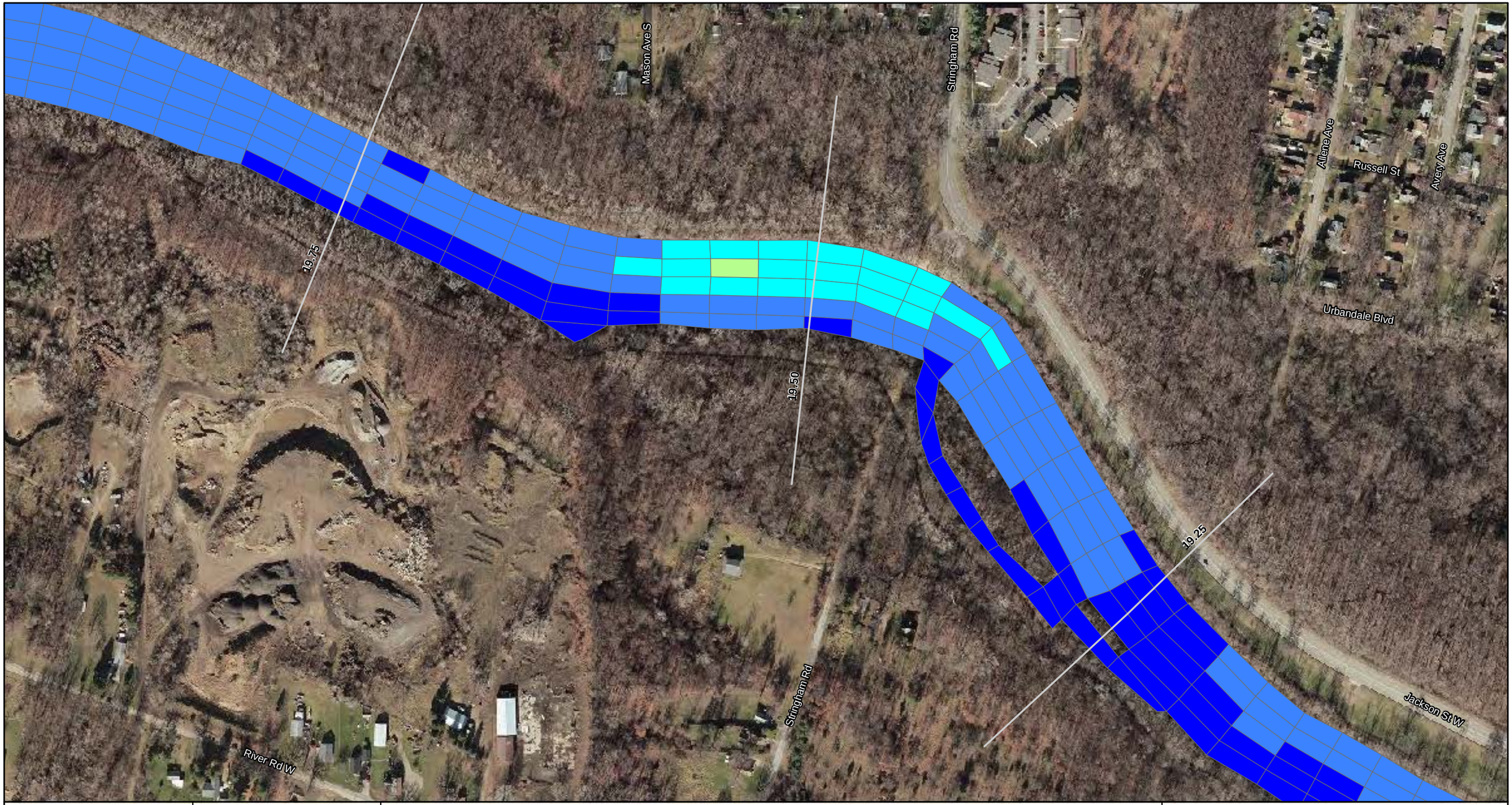
MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

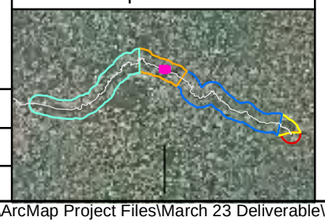
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

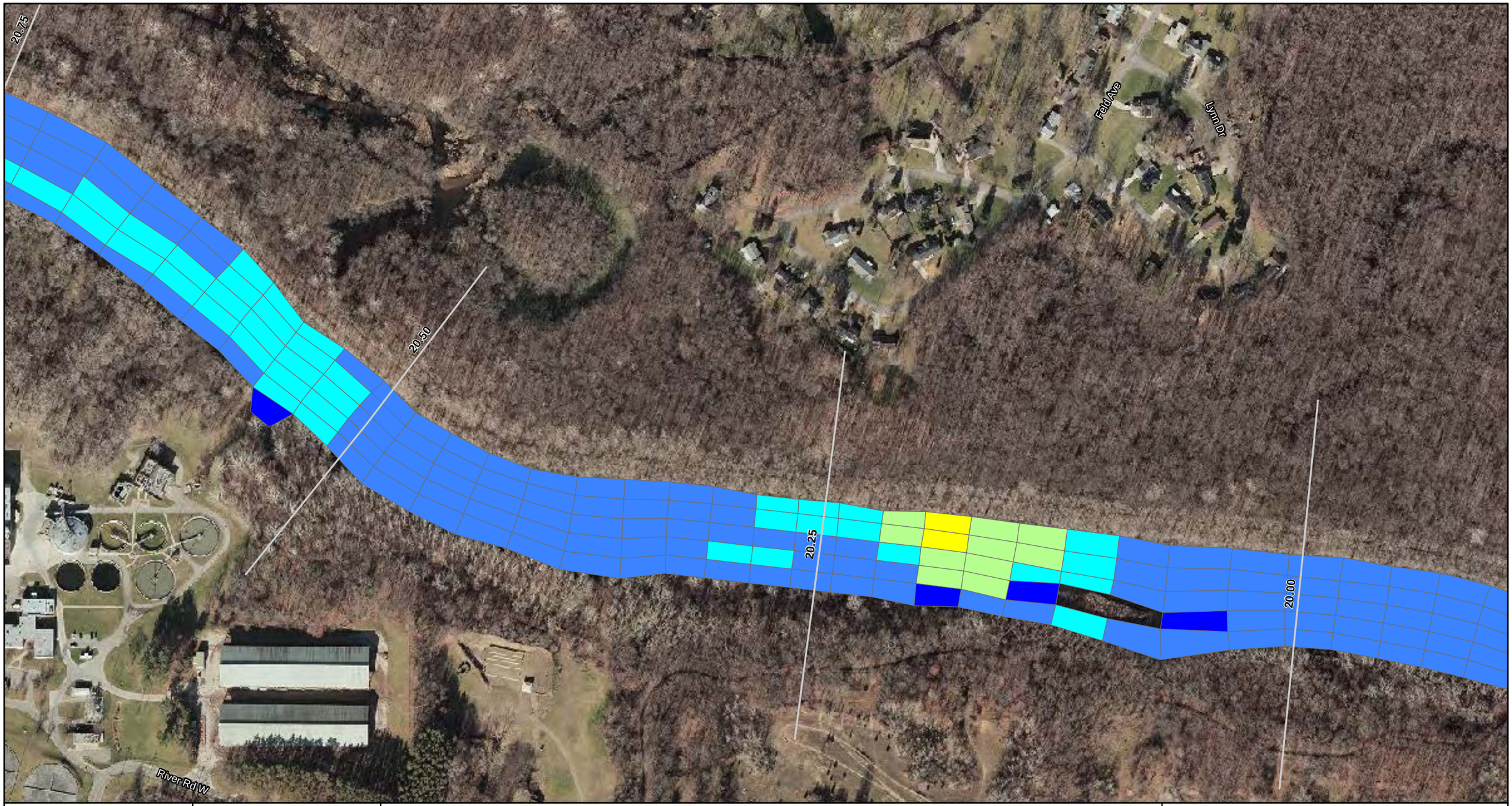
MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

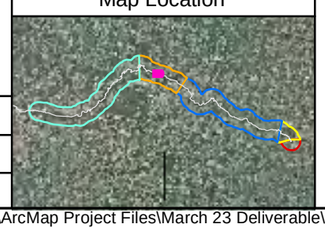
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

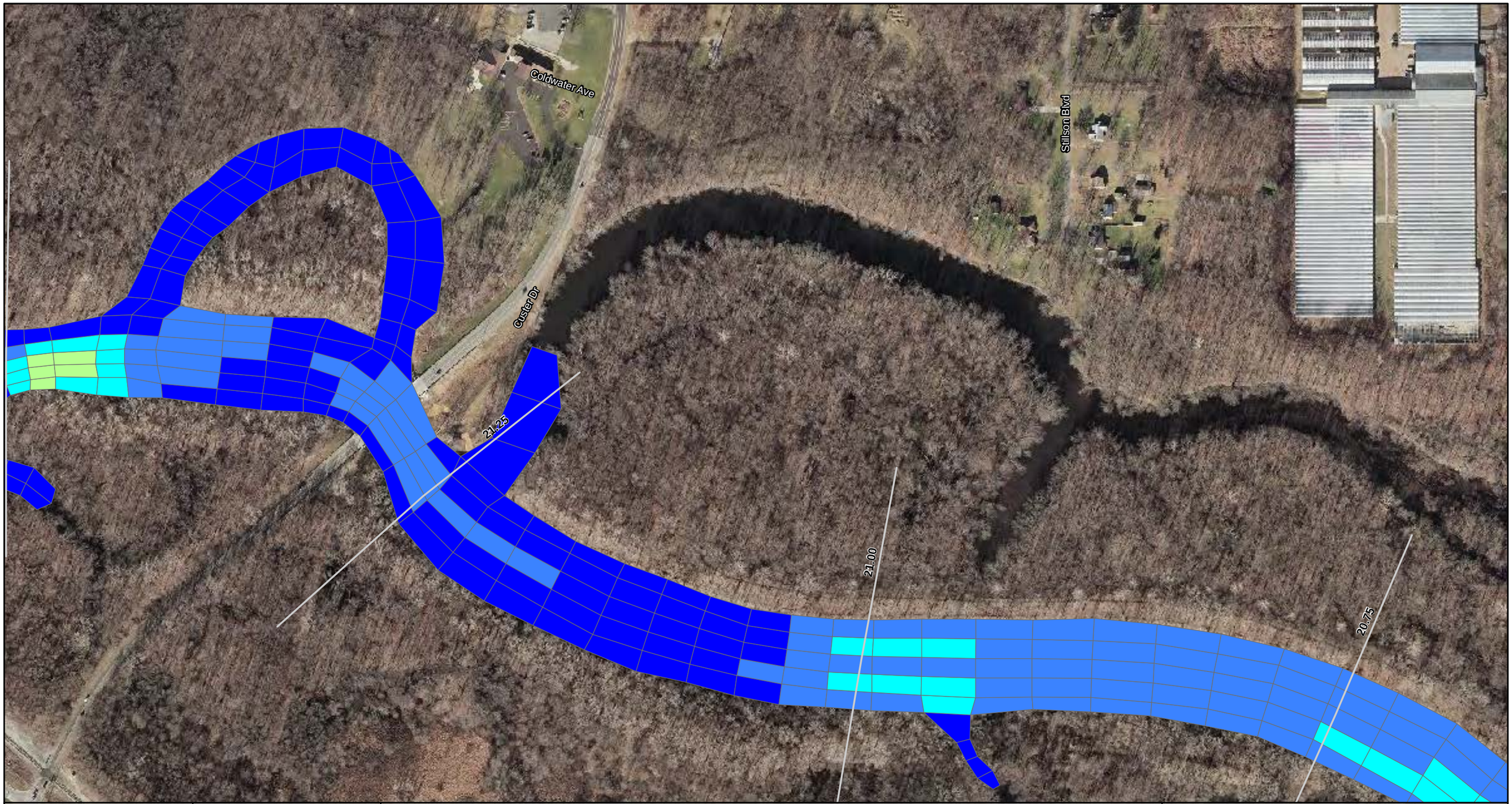
MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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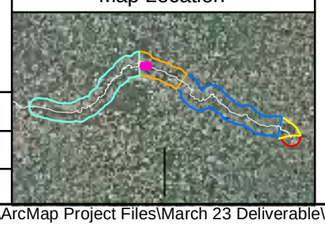
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

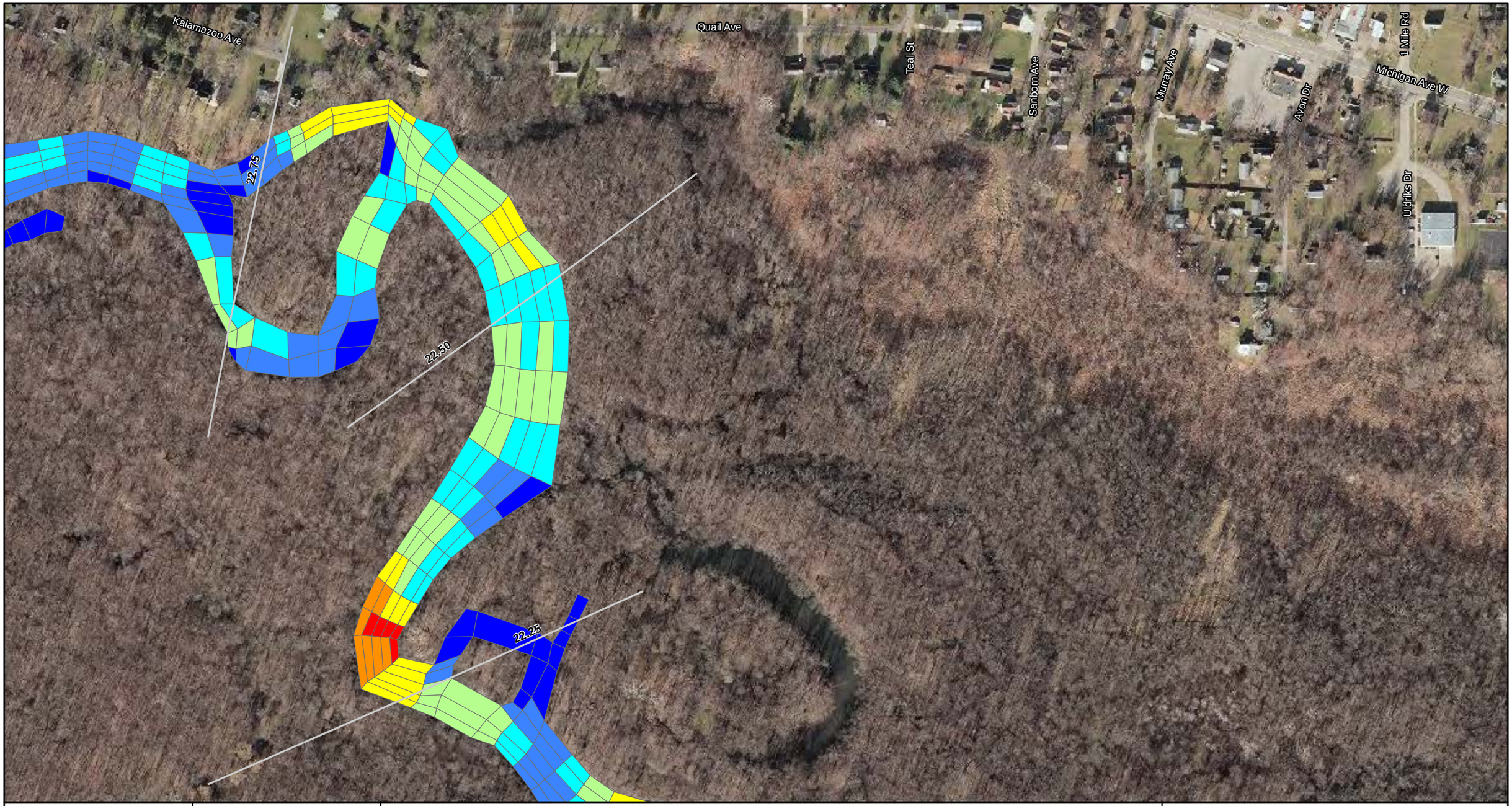
MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

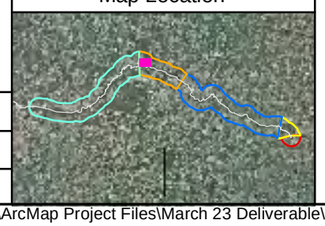
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

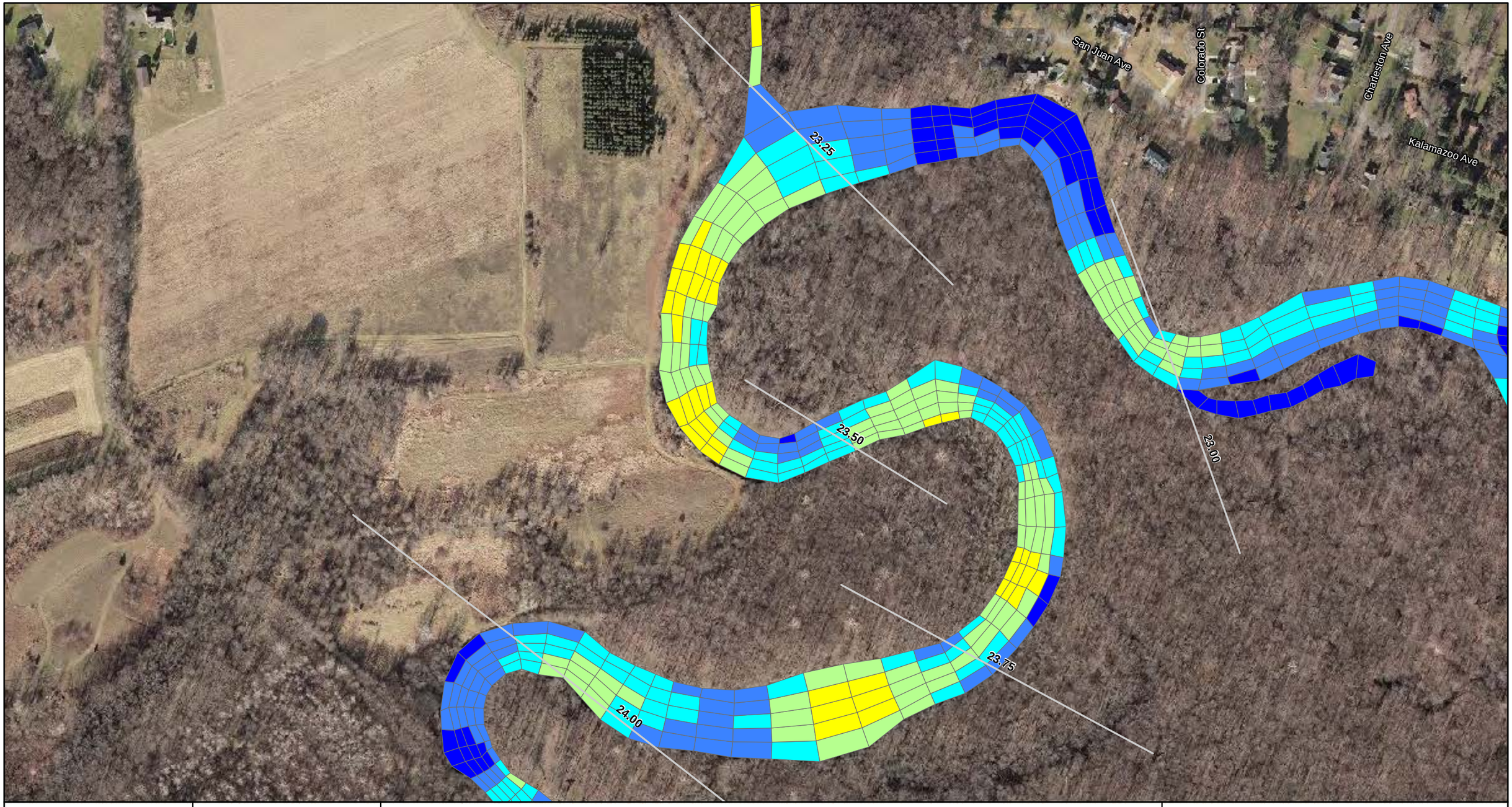
MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

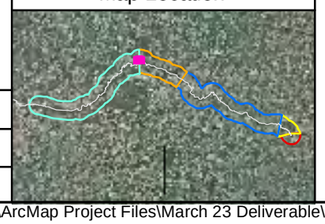
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

24.00

24.25

24.50

24.75

River Rd W

Fort Custer Dr

County Line Rd

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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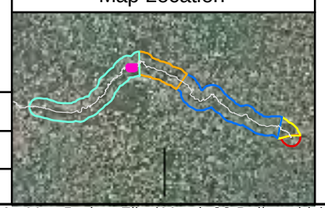
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

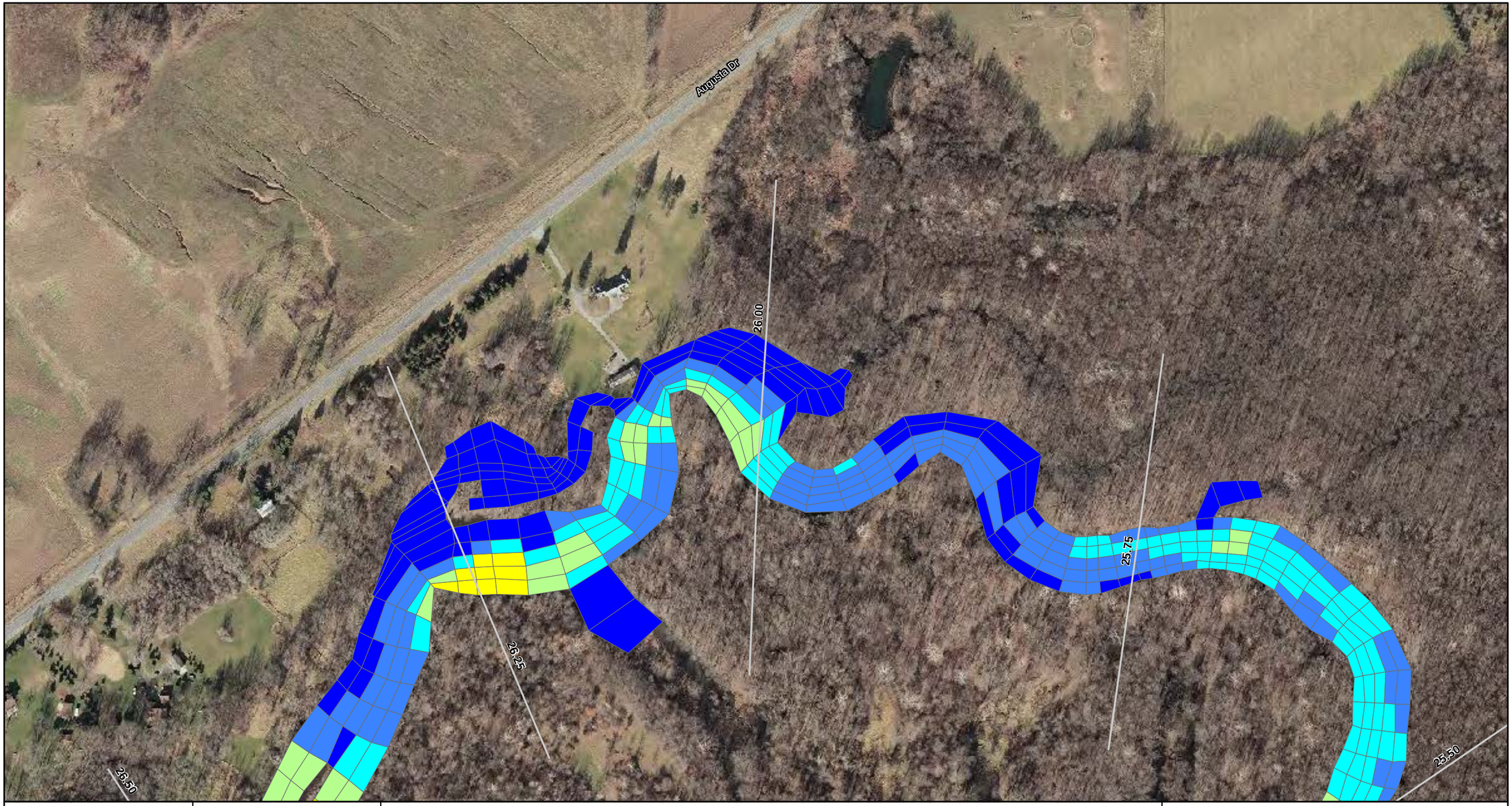
MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

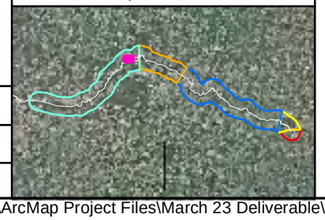
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

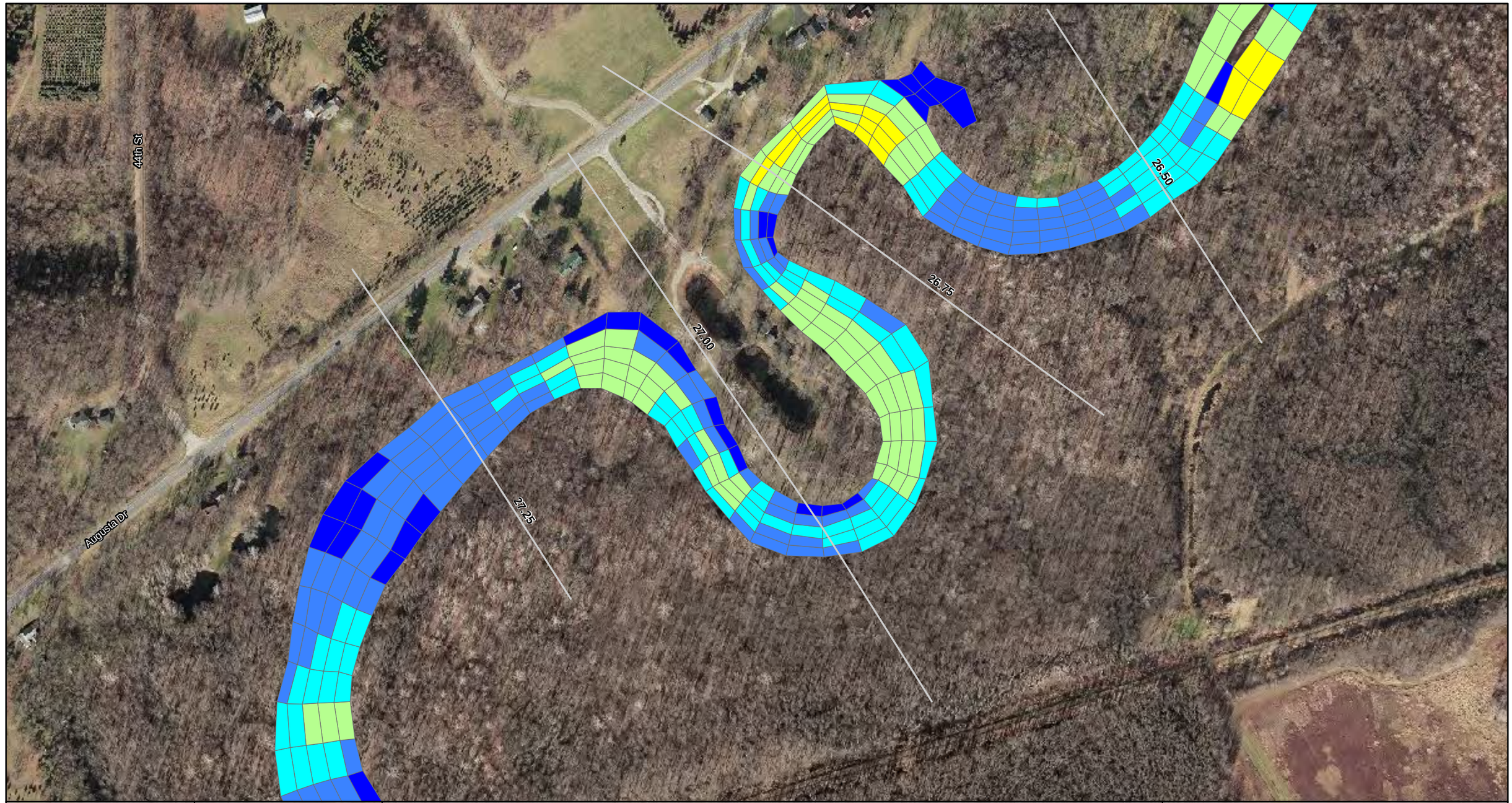
MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

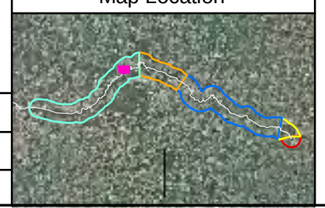
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

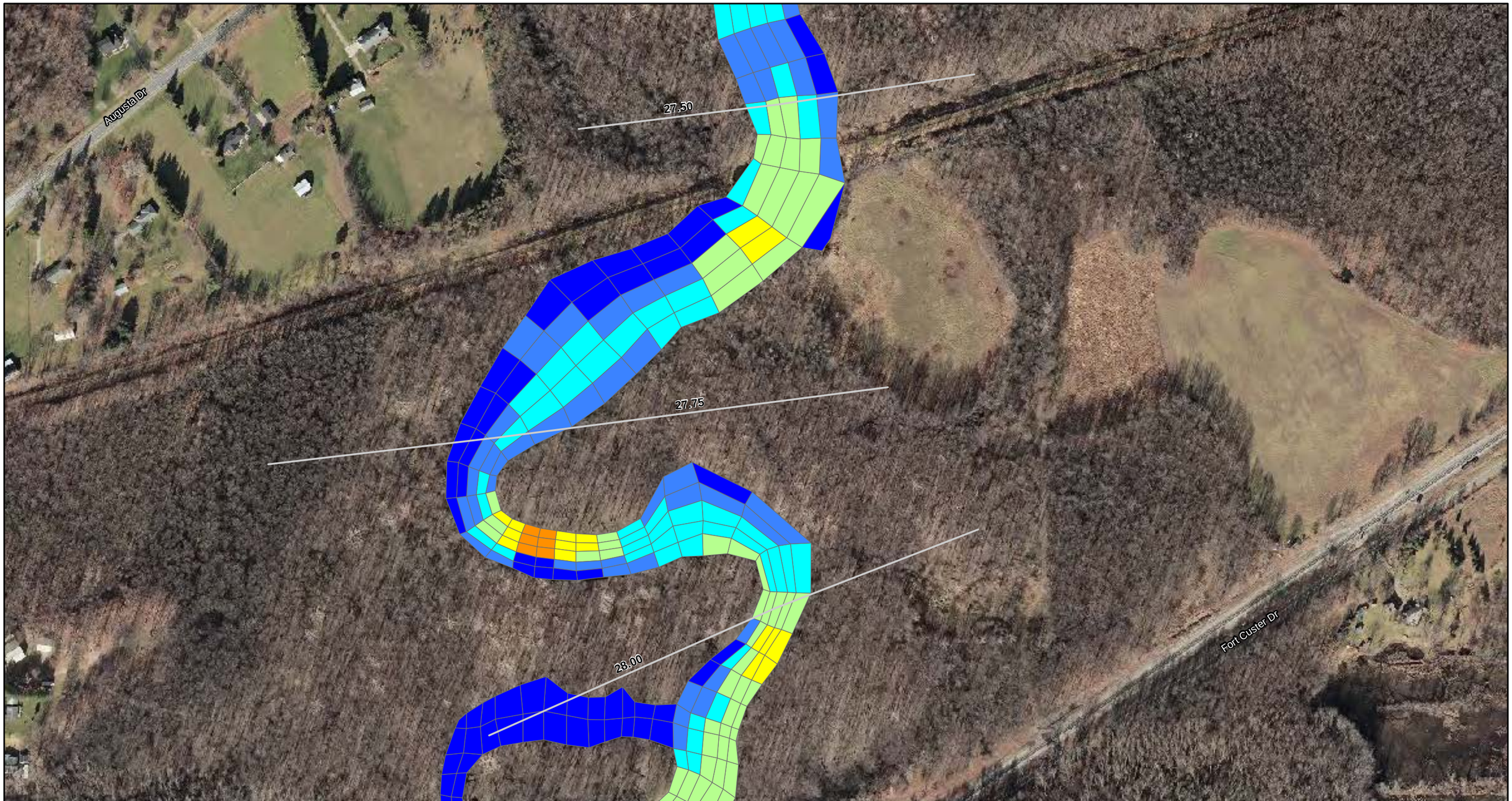
MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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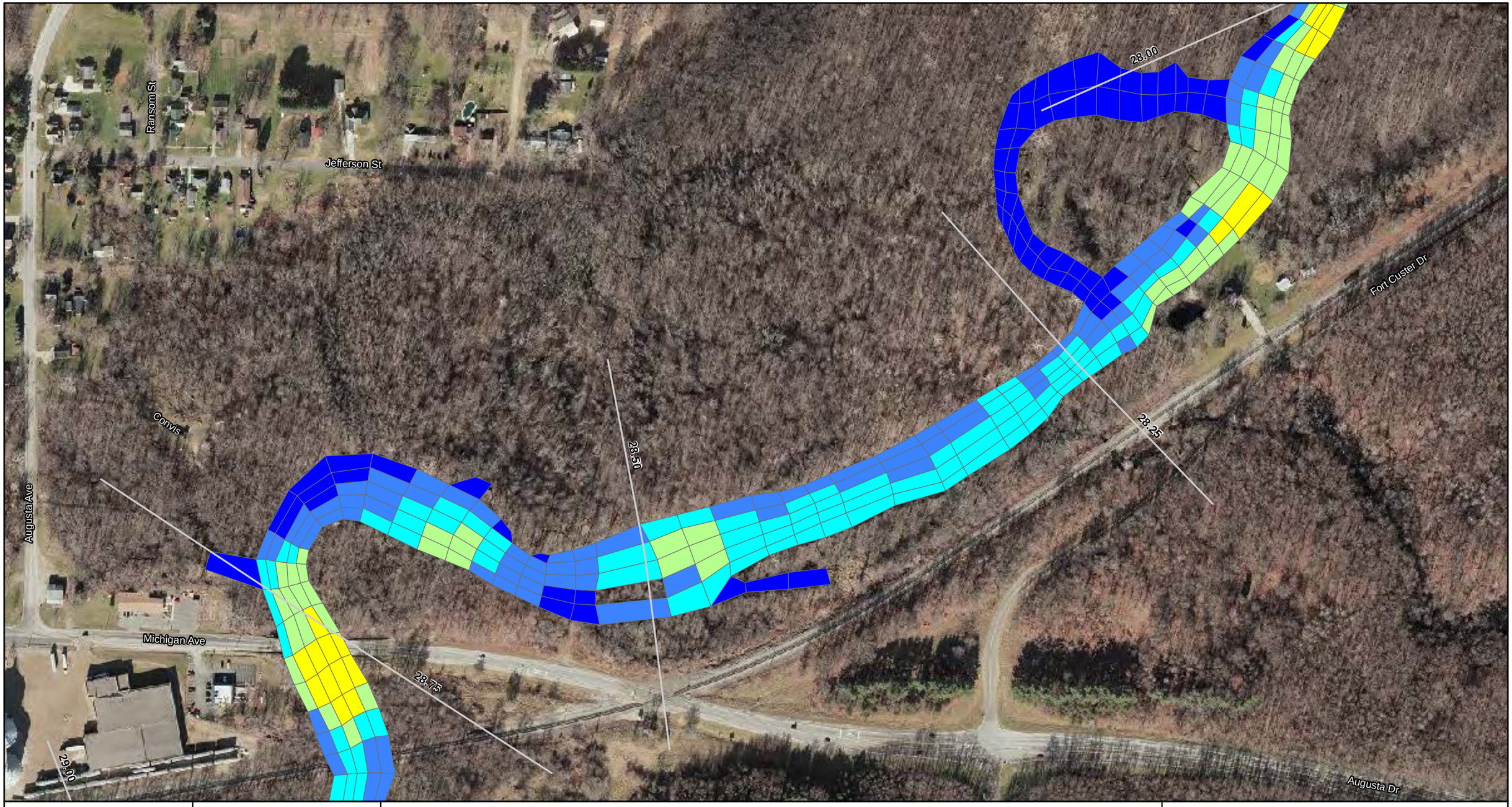
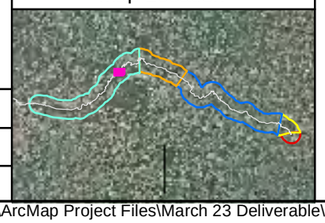
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Clinton St
Clinton St
Chestnut St
Webster St
Church St
Fayette St
Cass St
Cherry St
Lincoln St
28.75
29.00
29.25
29.50
Augusta Climax Rd
Fort Custer Rec Area Access

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

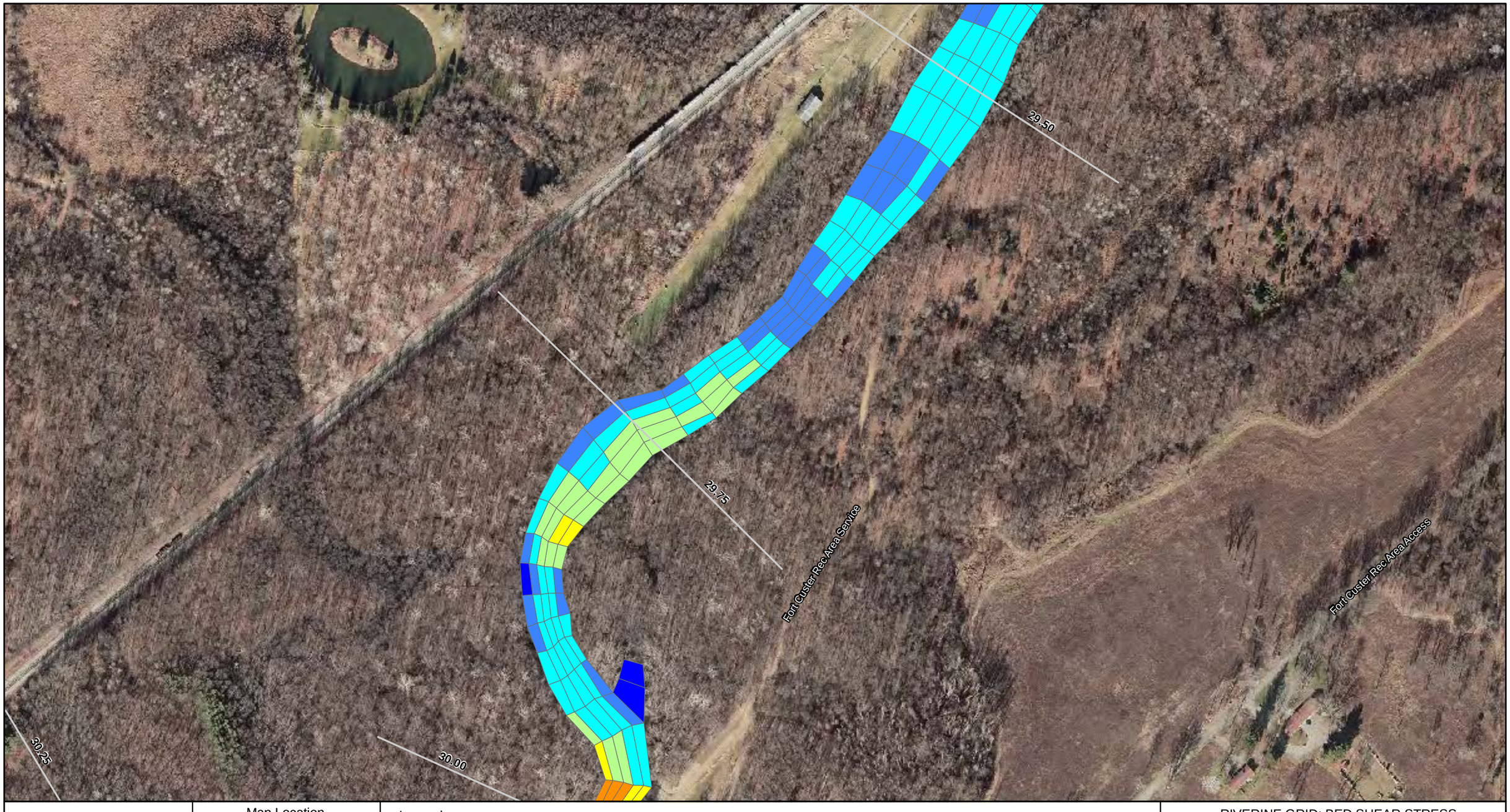
MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

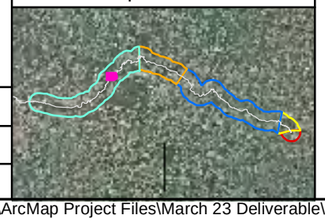
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

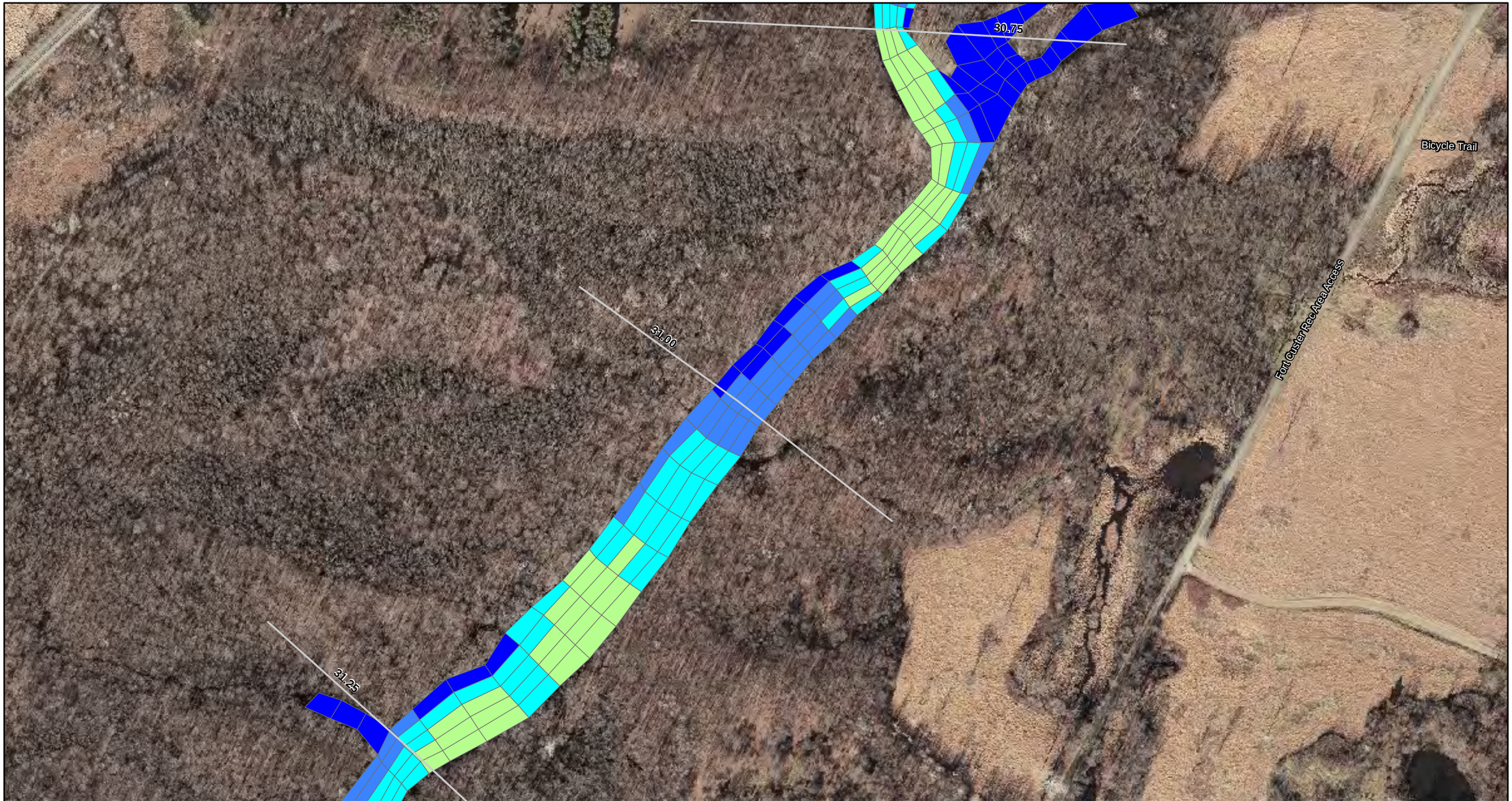
MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

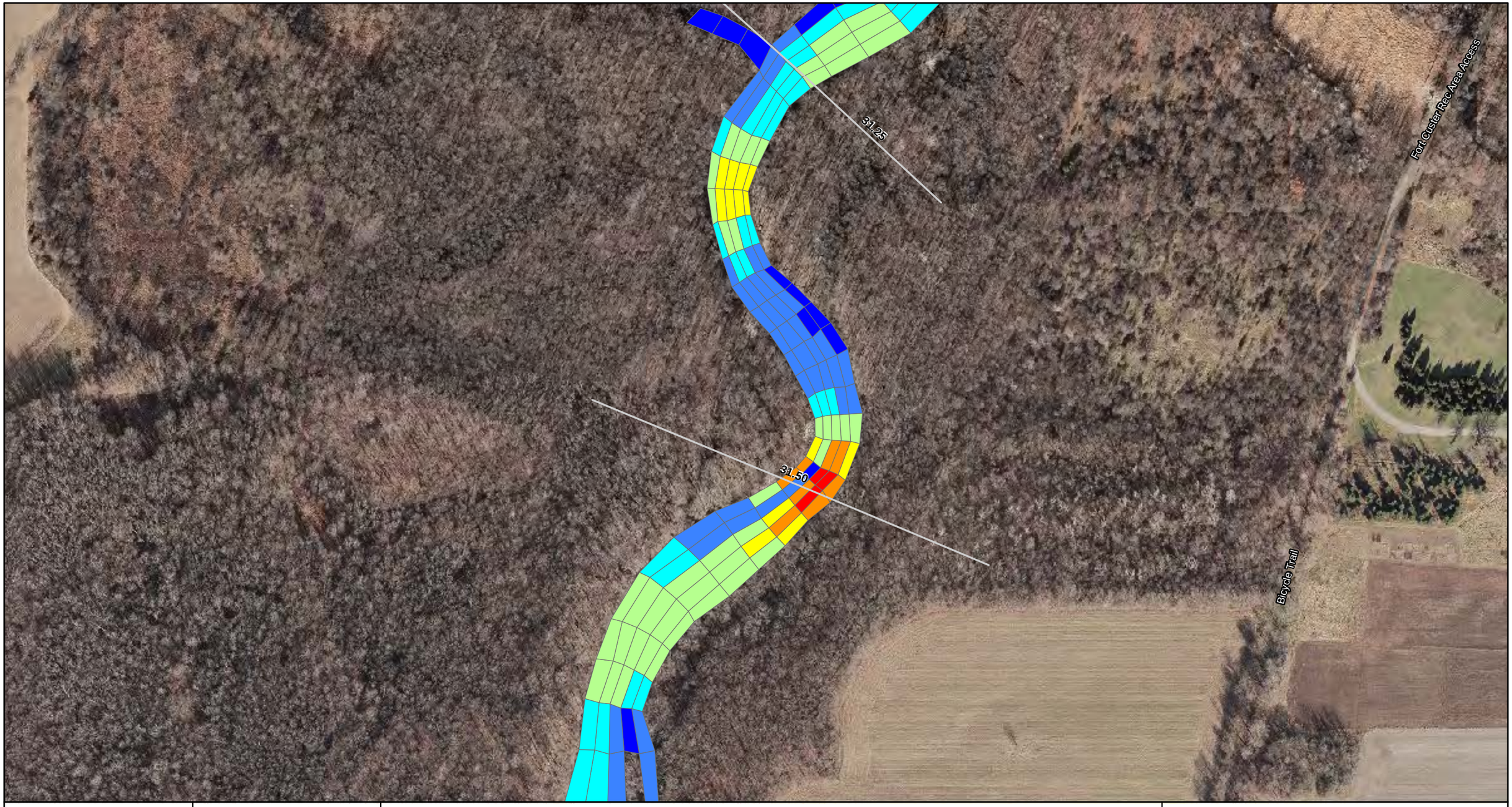
MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

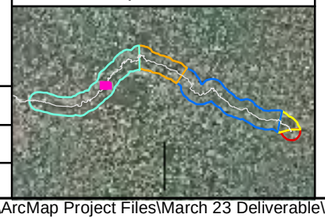
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



Drawn:	BRS 3/22/2012
Approved:	DBR 3/22/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

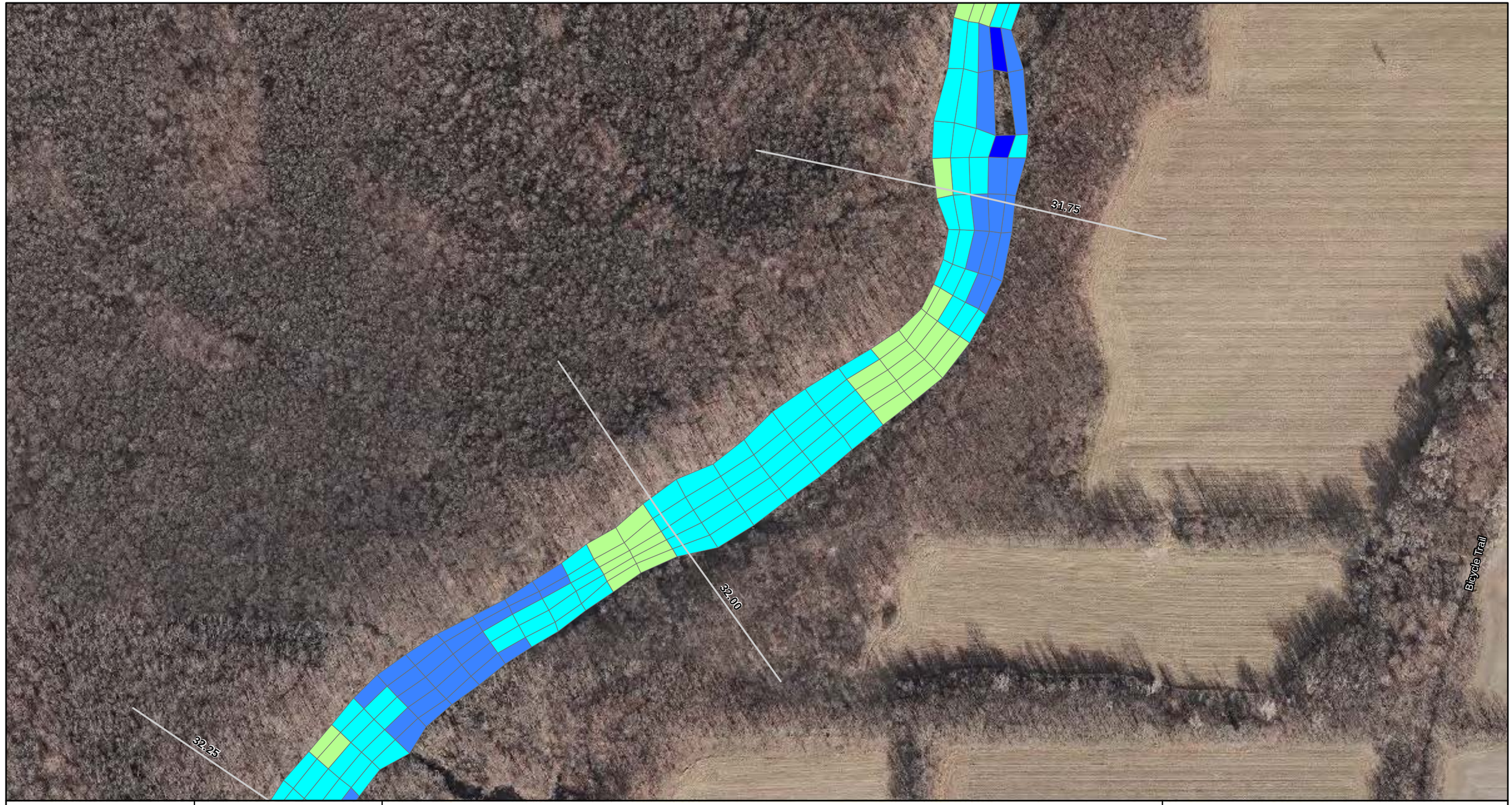
MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

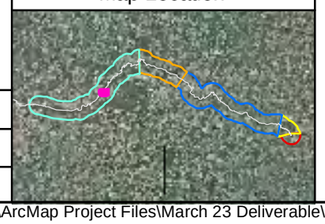
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

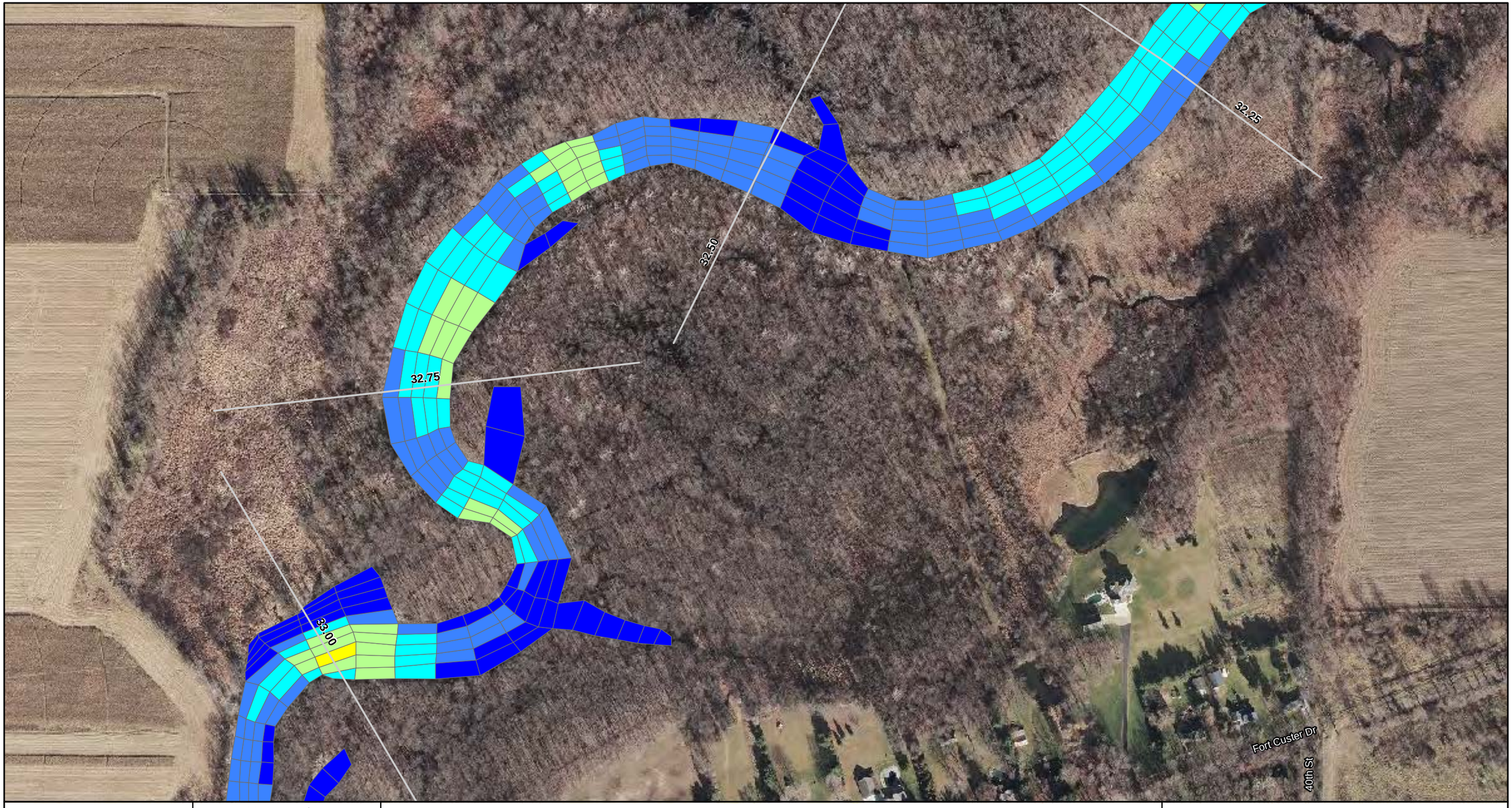
MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

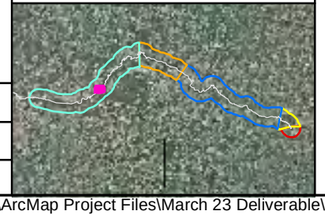
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

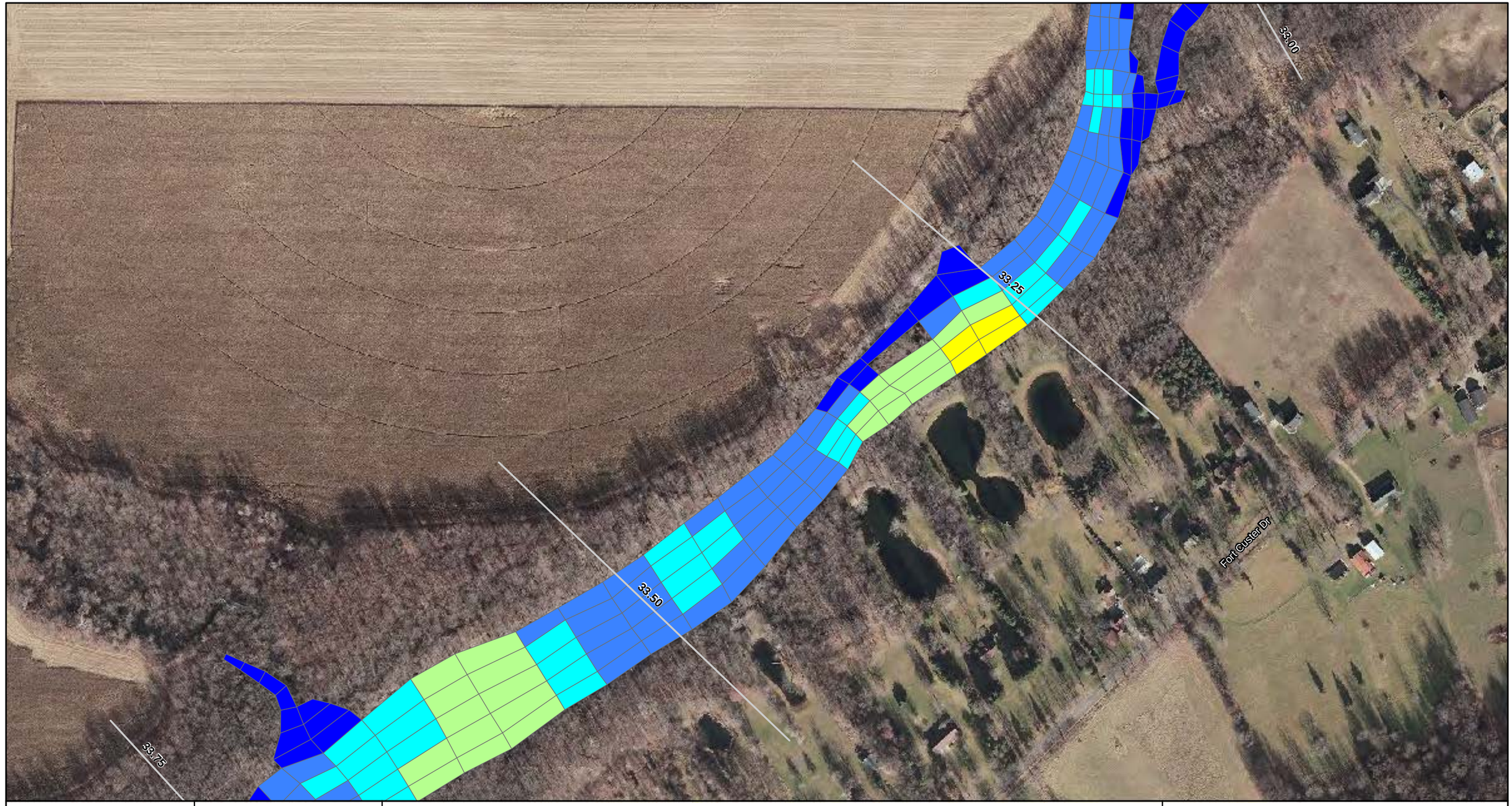
MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

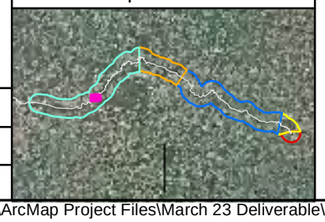
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

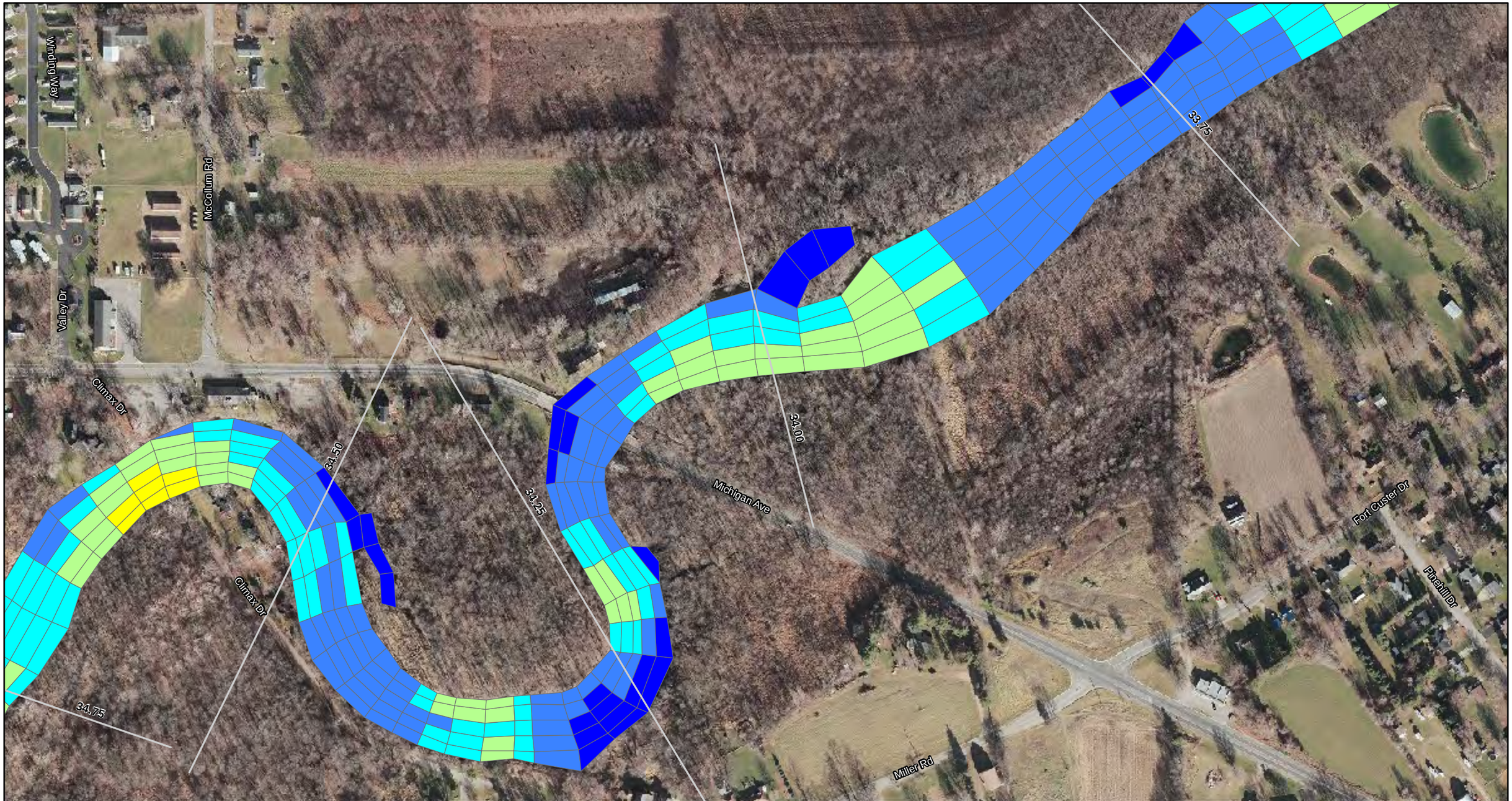
MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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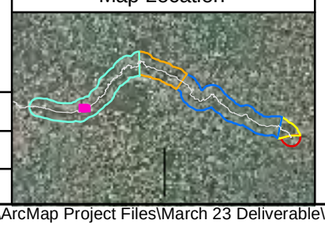
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

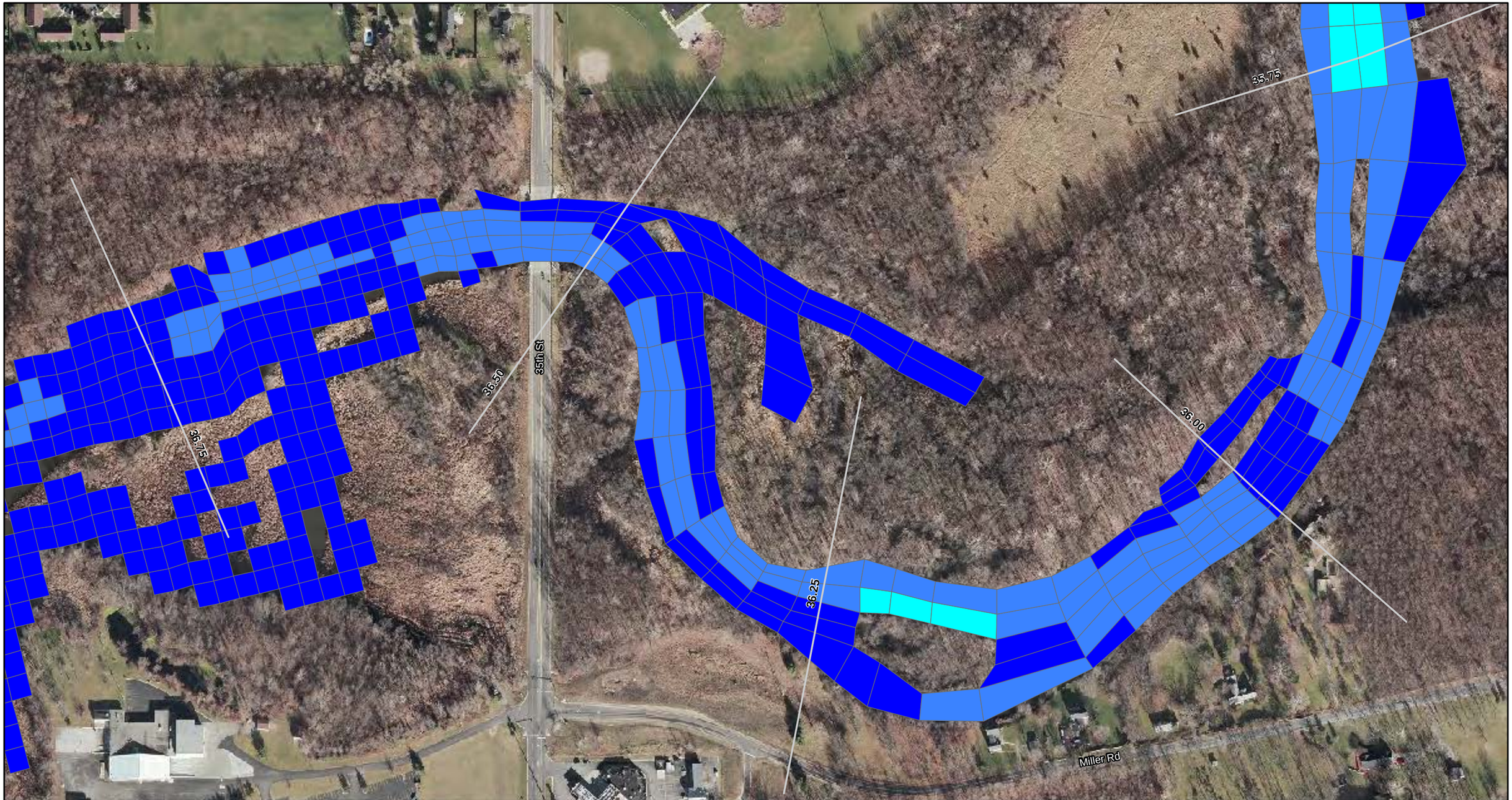
MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

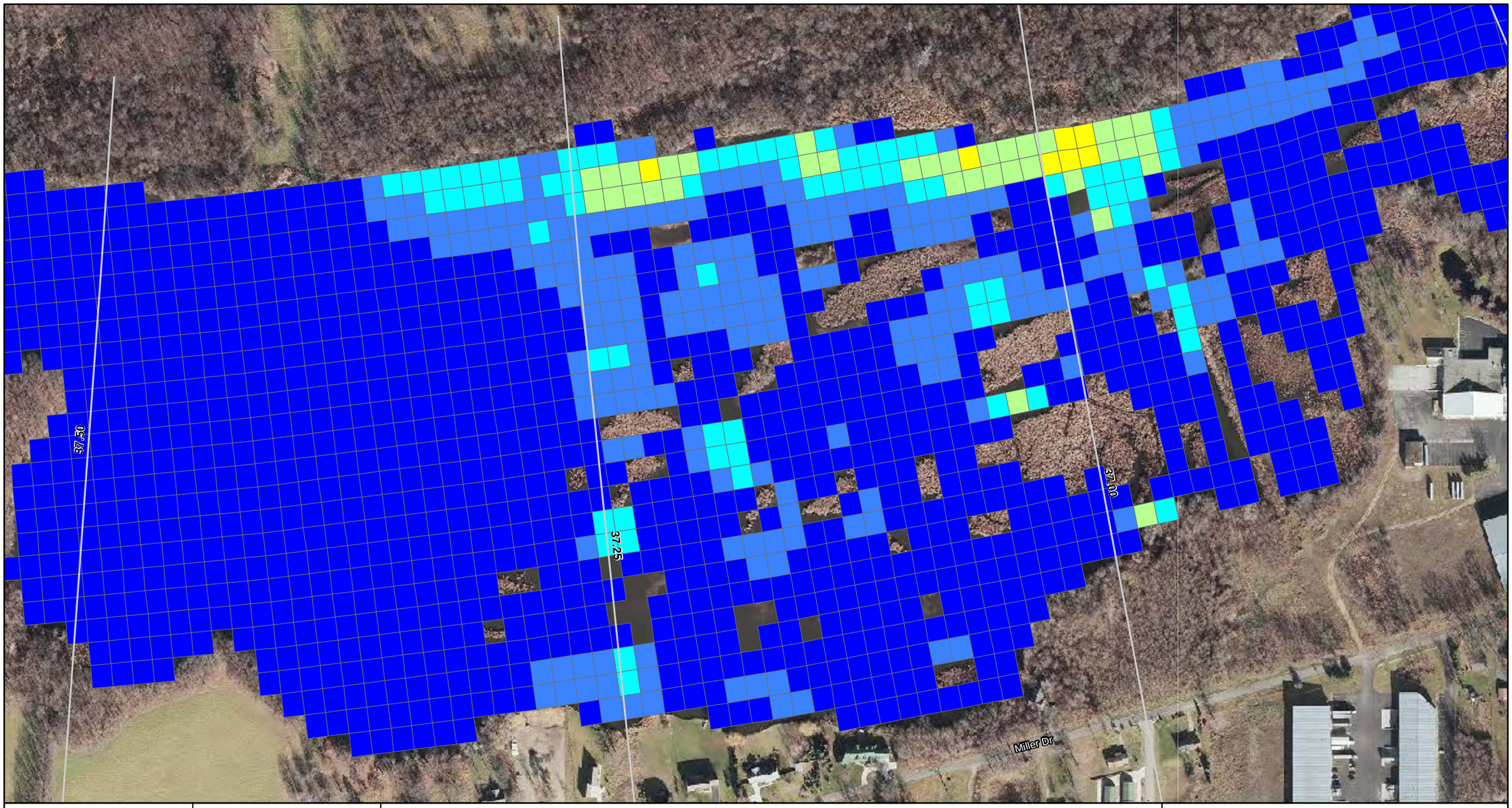
MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

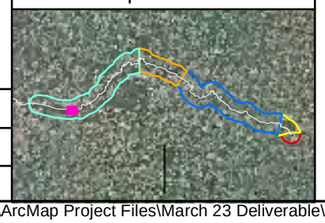
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

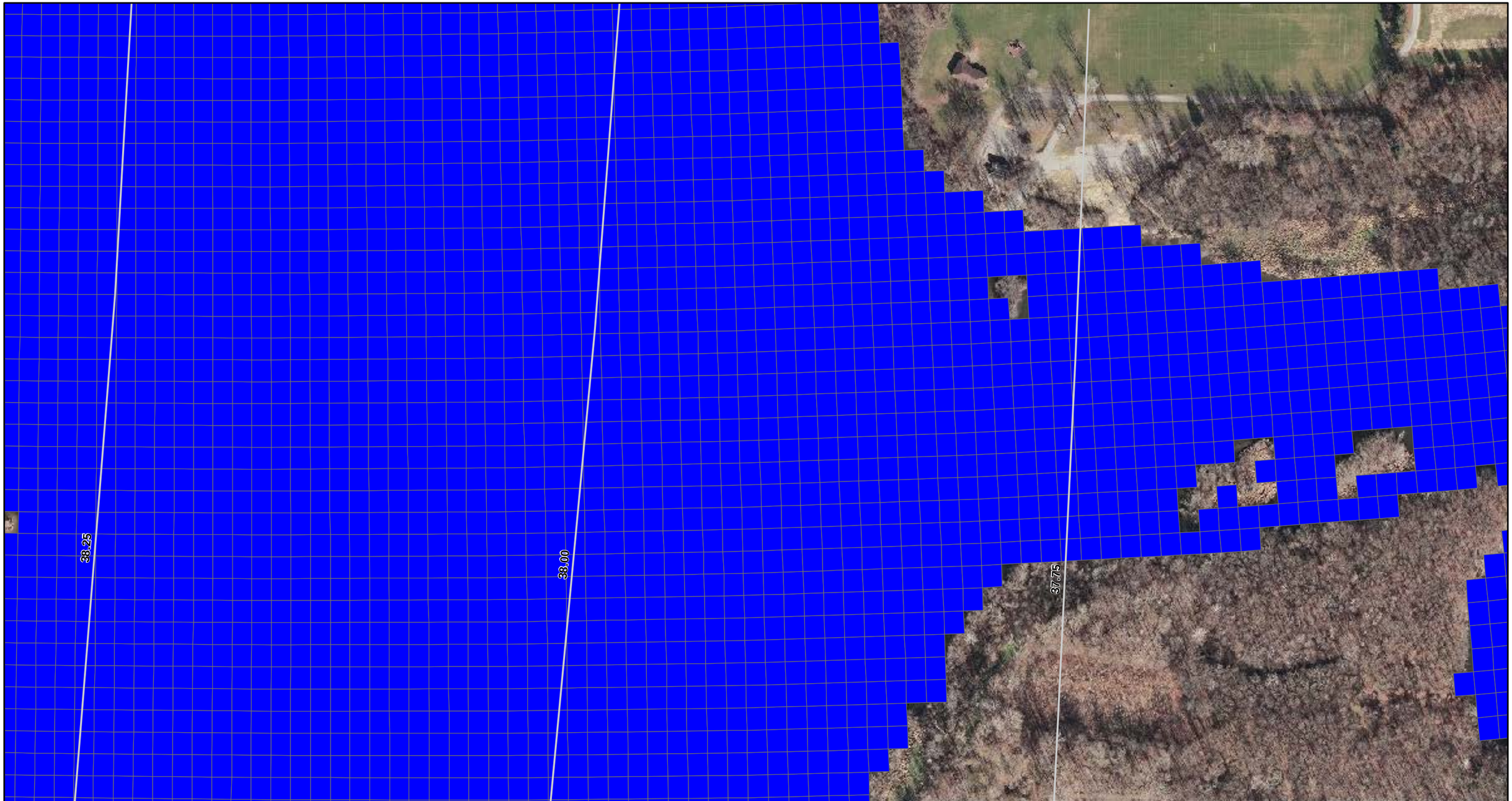
MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

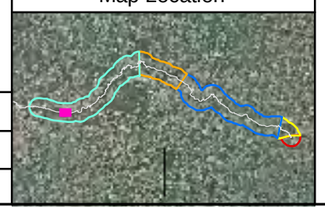
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

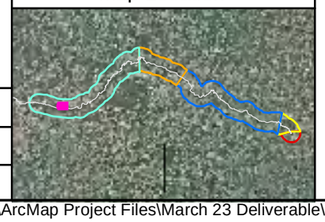
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

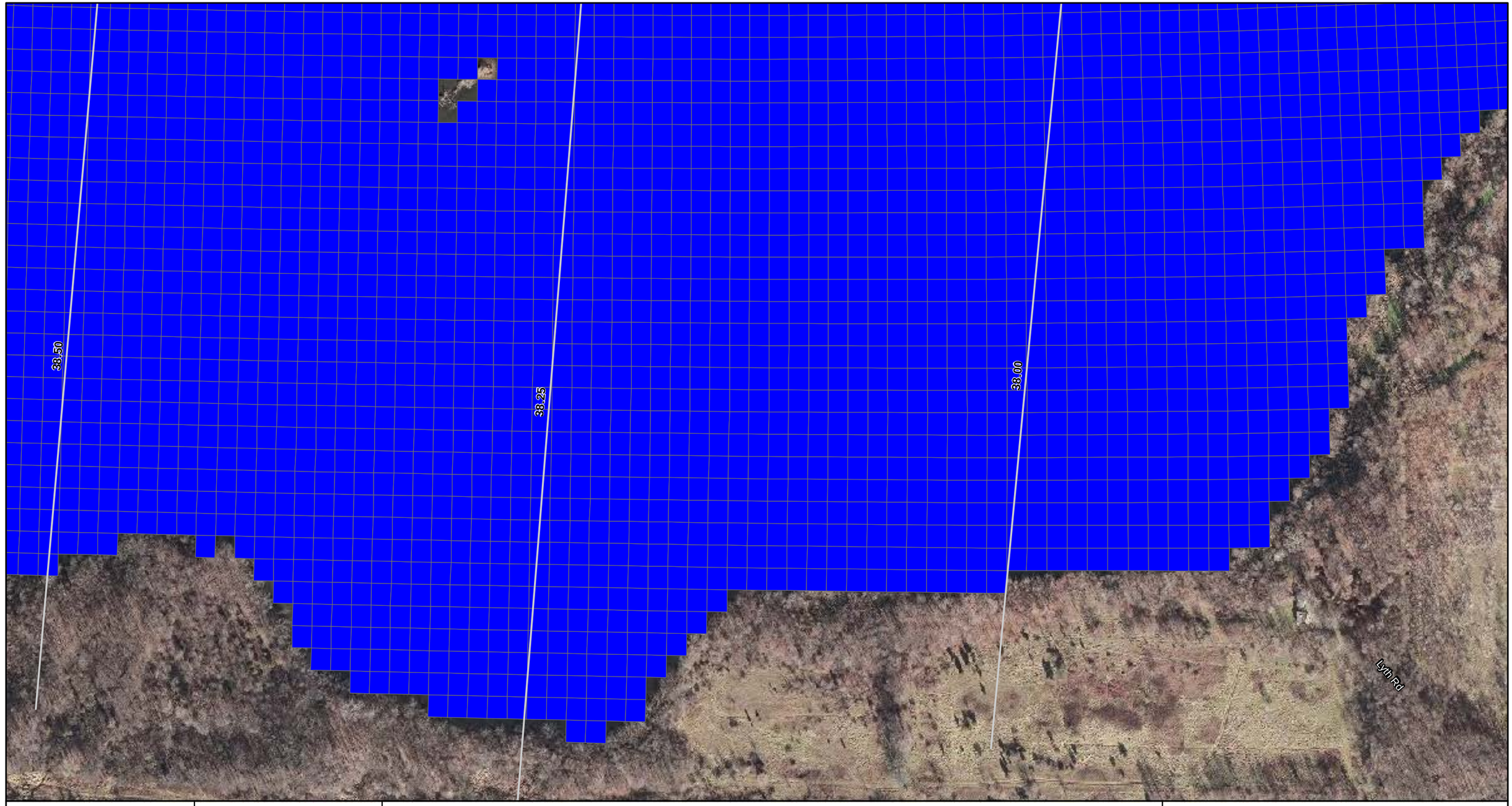
MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

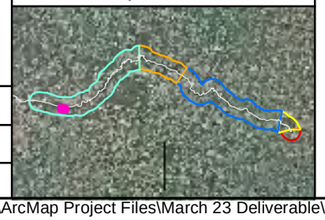
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

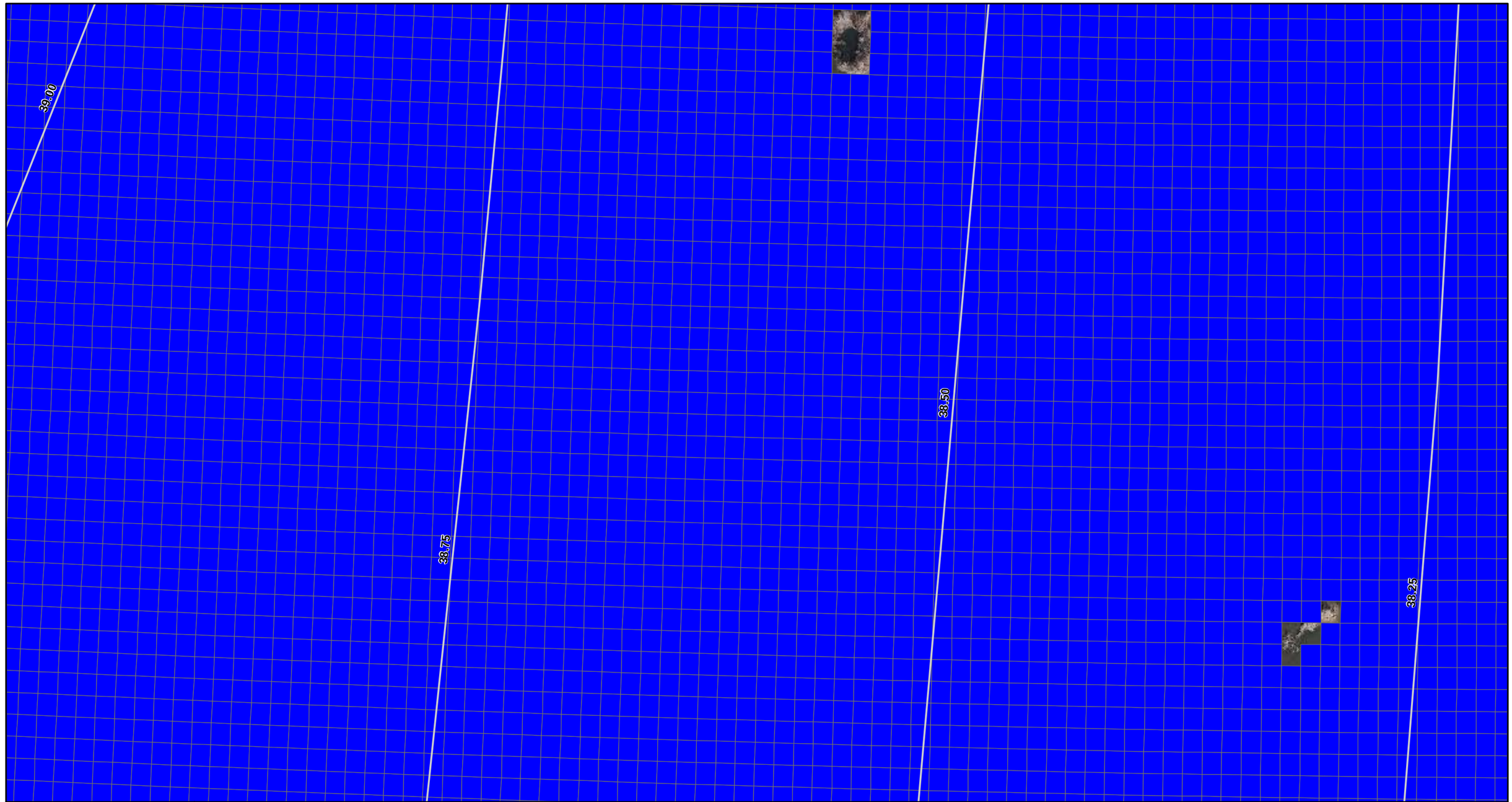
MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

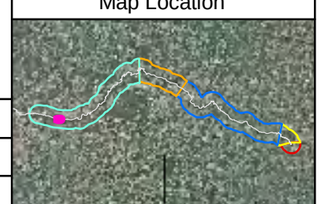
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

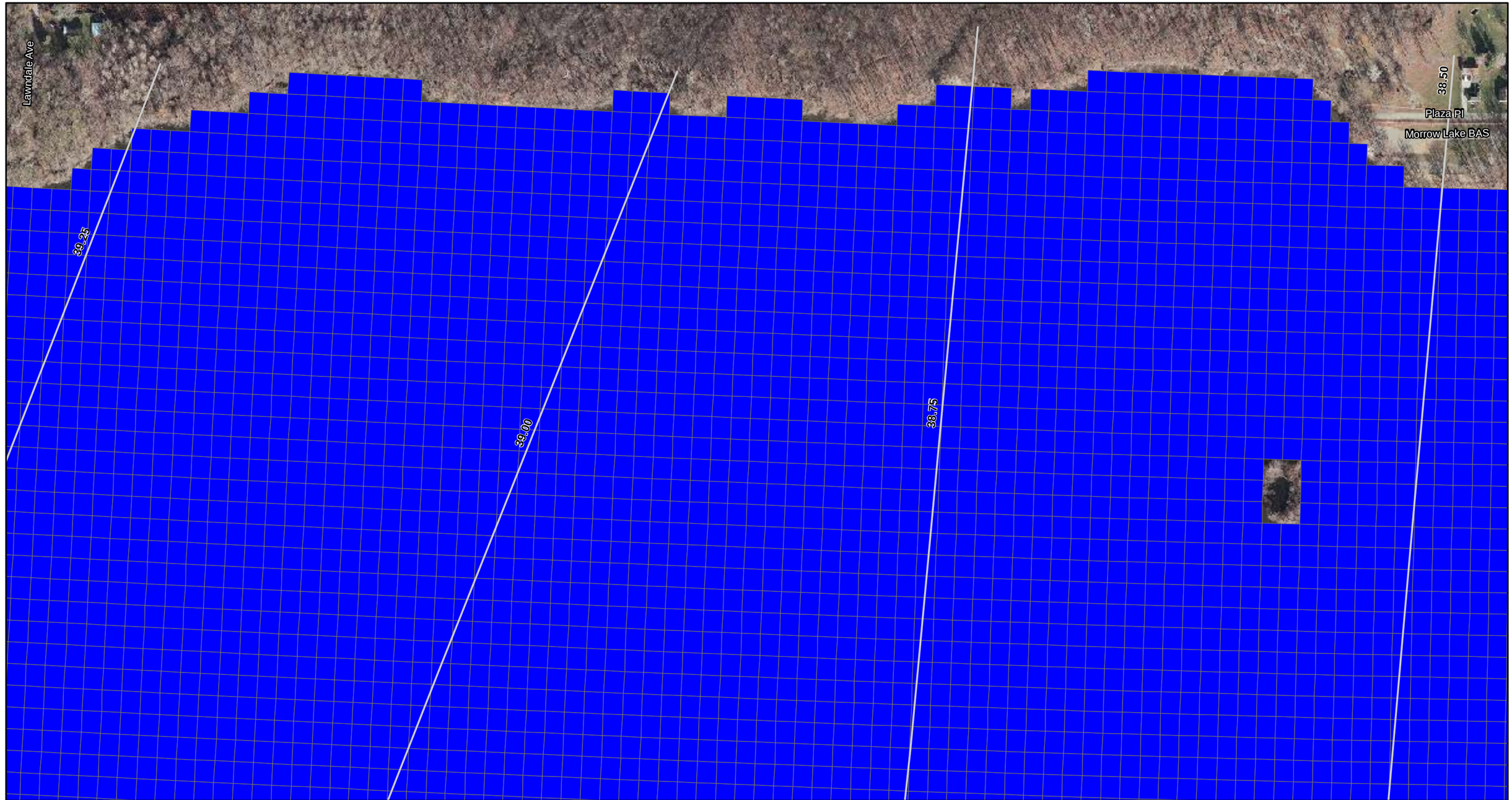
MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals

cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500

Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

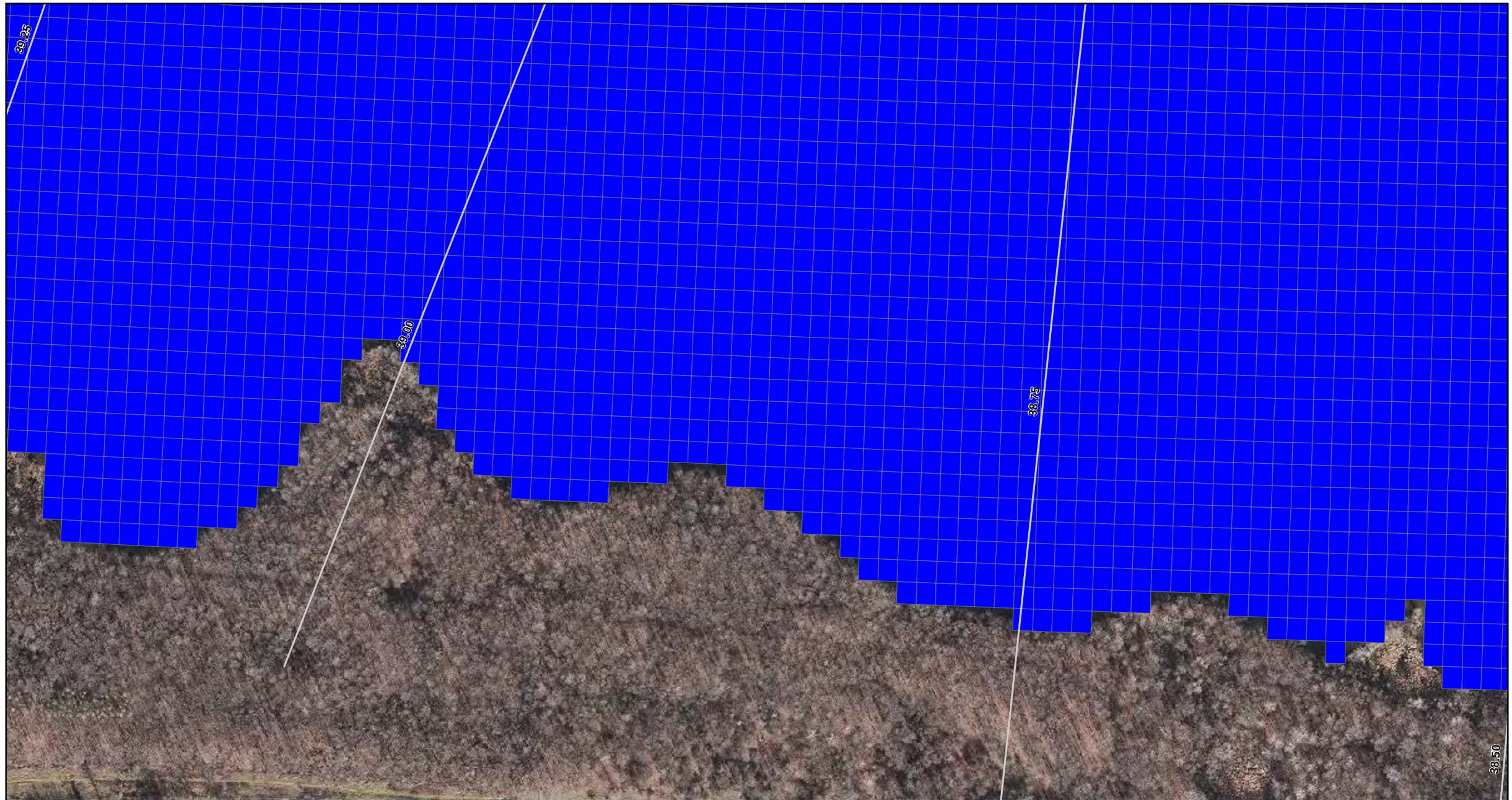
MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

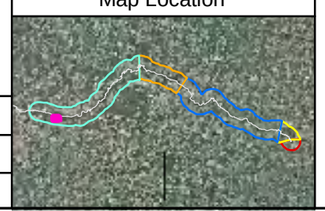
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

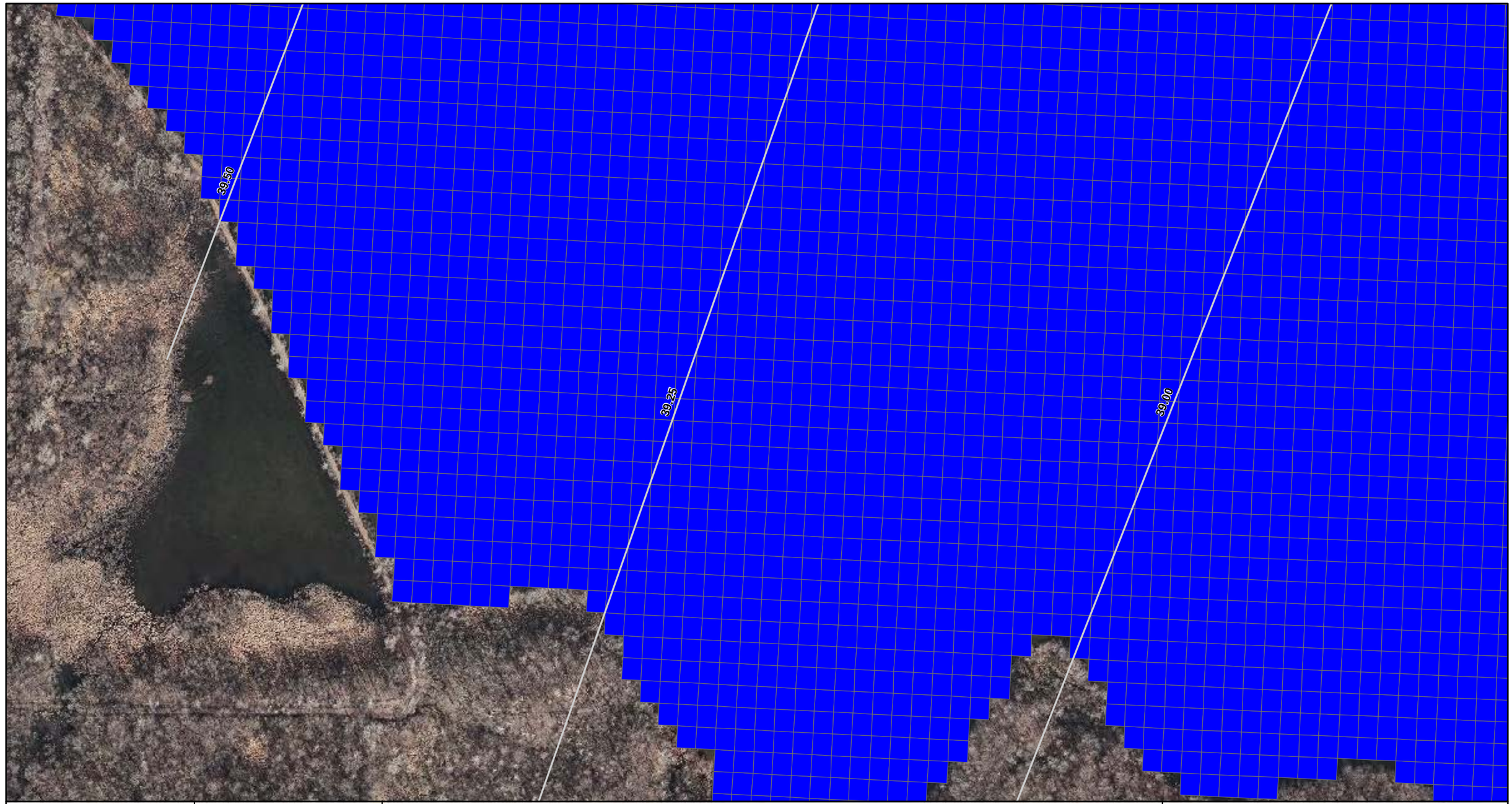
MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

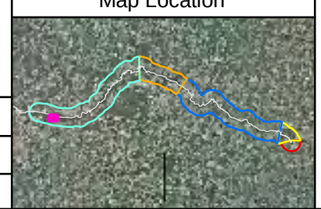
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

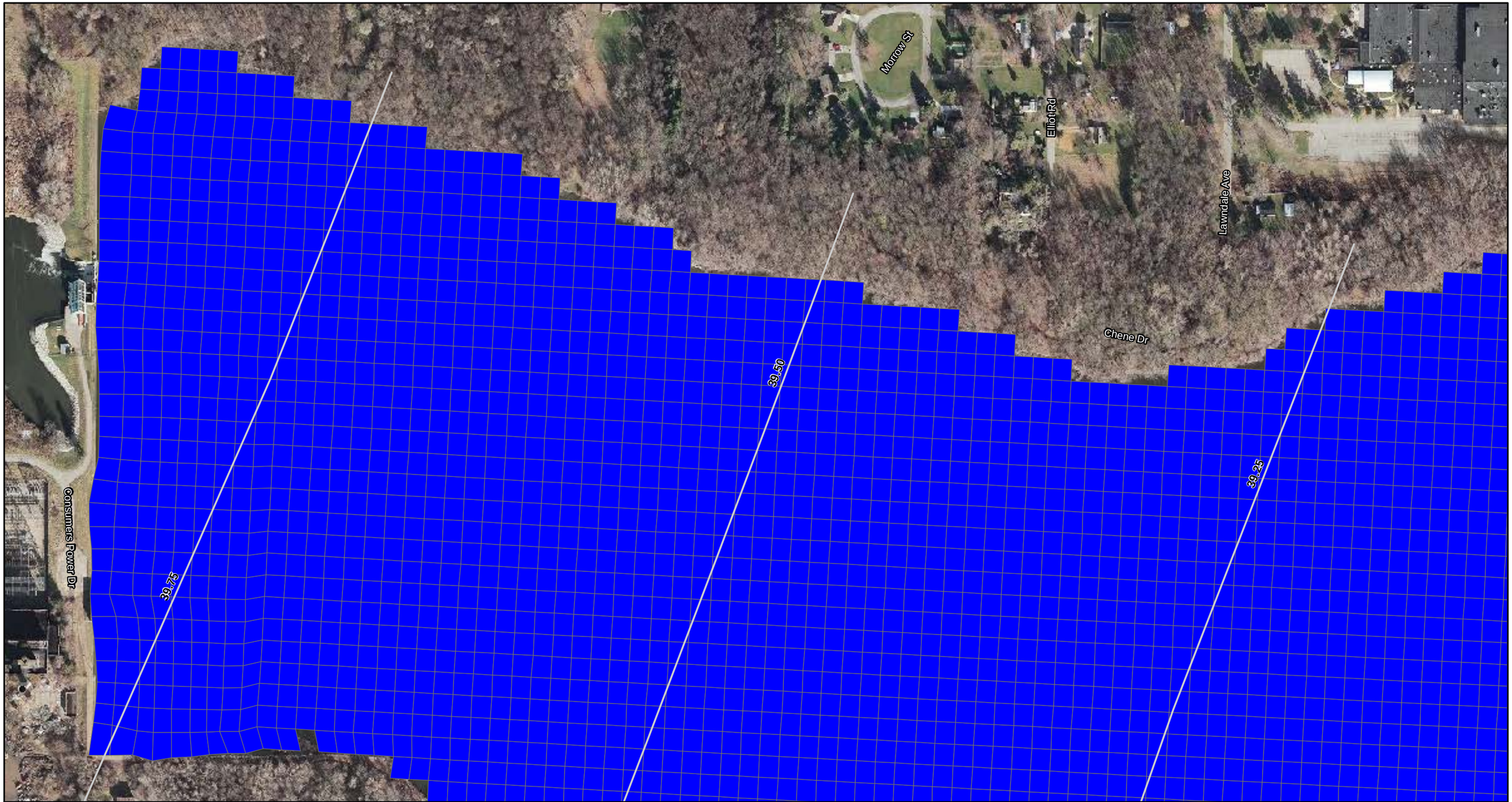
MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Bed_Shear_Stress_Oct31_2011.mxd

Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/22/2012
Approved:	DBR	3/22/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), November 7, 2011

- < 1.000001
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 20.000000
- > 20.000000

Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 560 cfs

N

0 125 250 500
Scale in Feet

RIVERINE GRID: BED SHEAR STRESS
NOVEMBER 7, 2011

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Figure 4-19

Riverine Grid: Sedimentation Rate

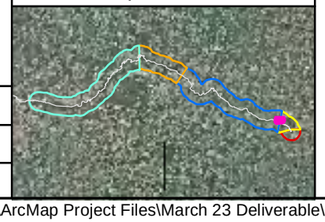
All Grid Cells

October 31 – November 7, 2011

Sheets 1 through 56

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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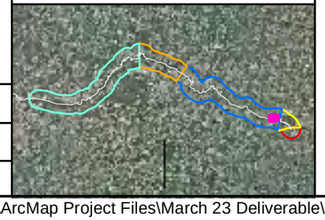
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

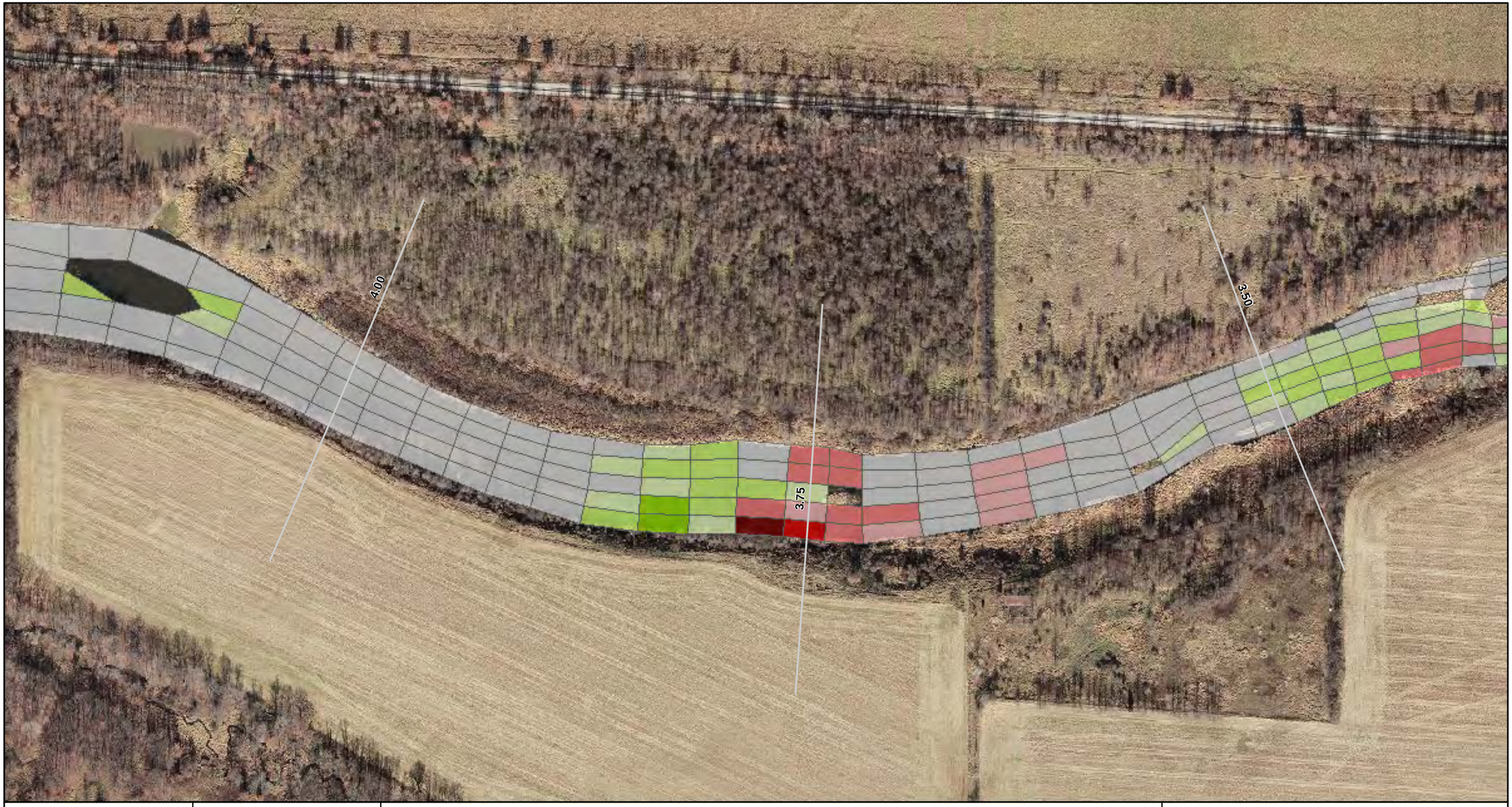
MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Sedimentation_Rate_Oct-Nov_2011.mxd

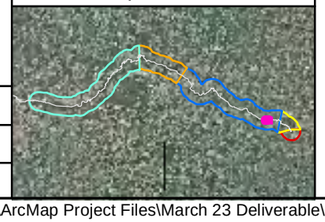
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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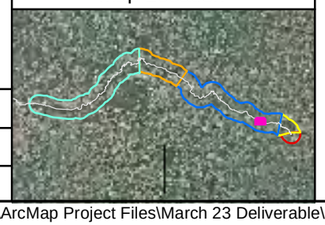
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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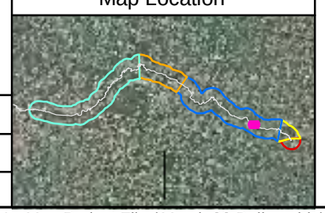
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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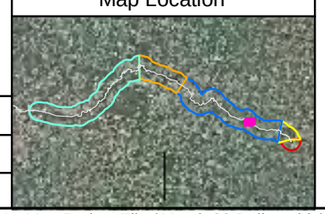
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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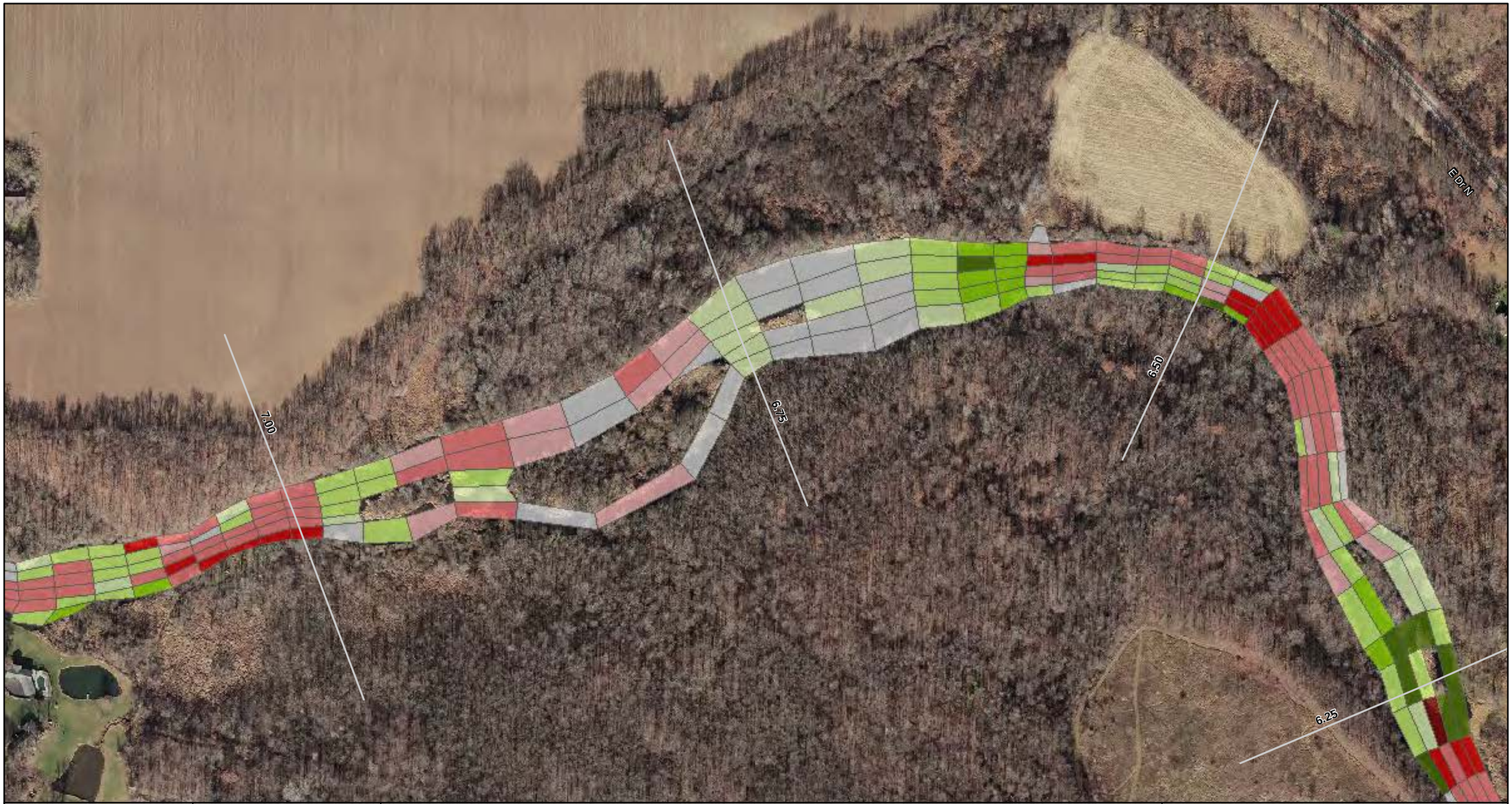
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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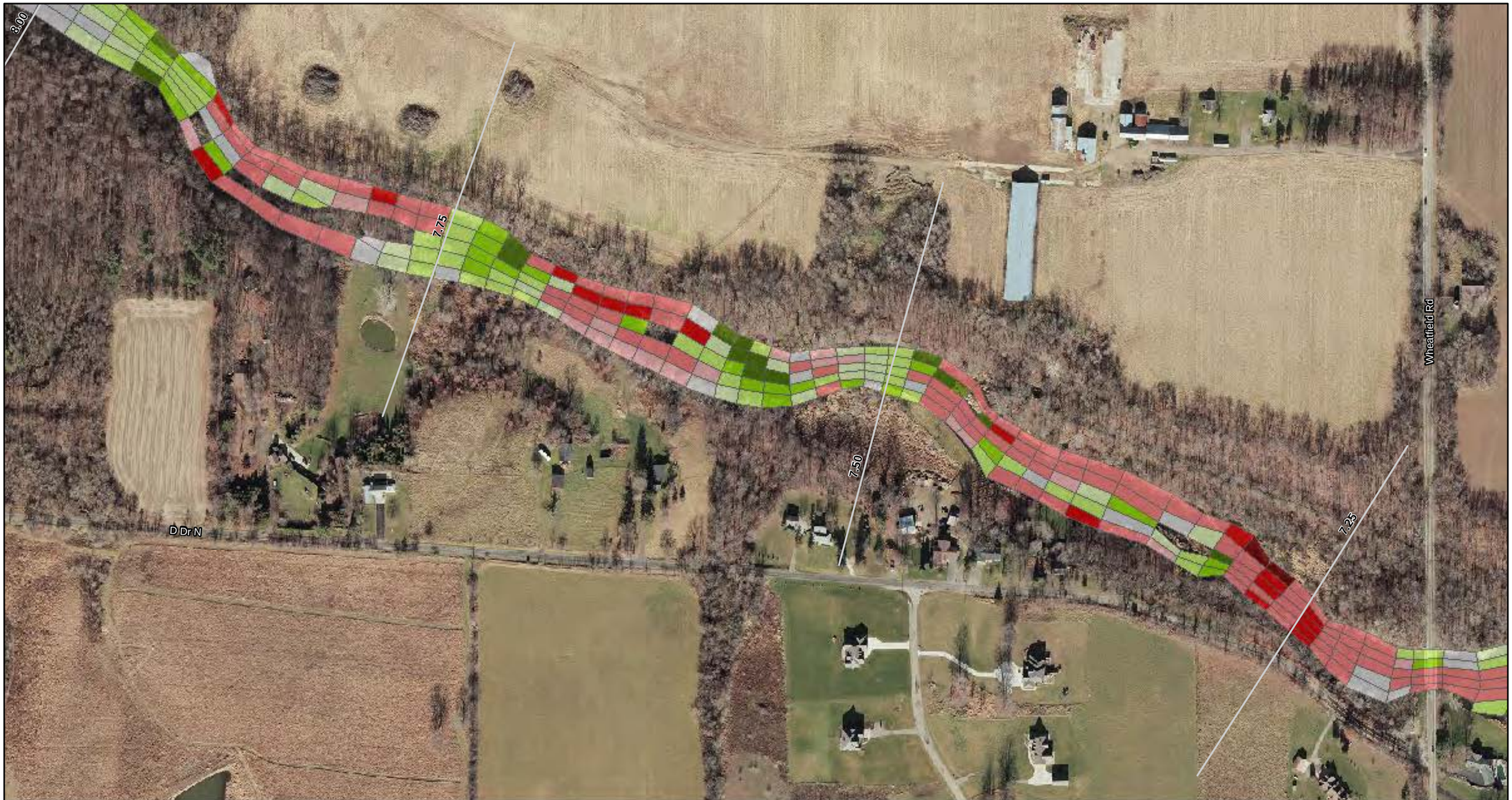
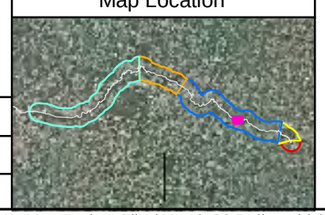
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

8.75

8.50

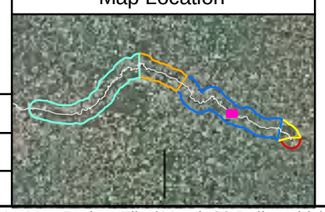
8.25

8.00

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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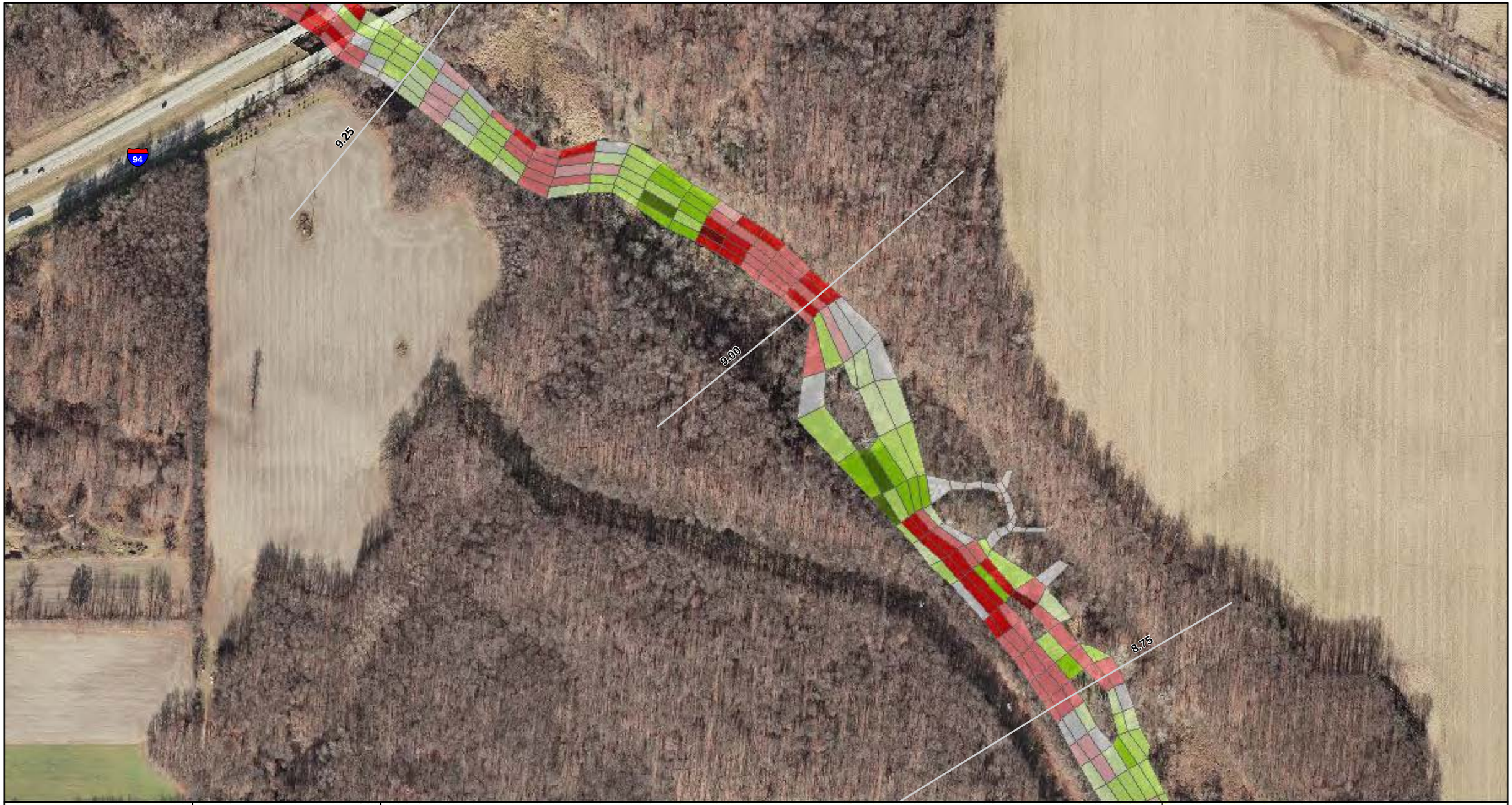
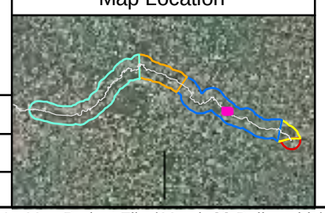
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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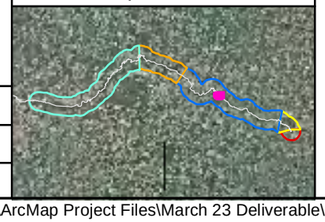
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)
All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500
Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Sedimentation_Rate_Oct-Nov_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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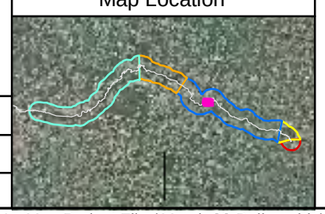
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

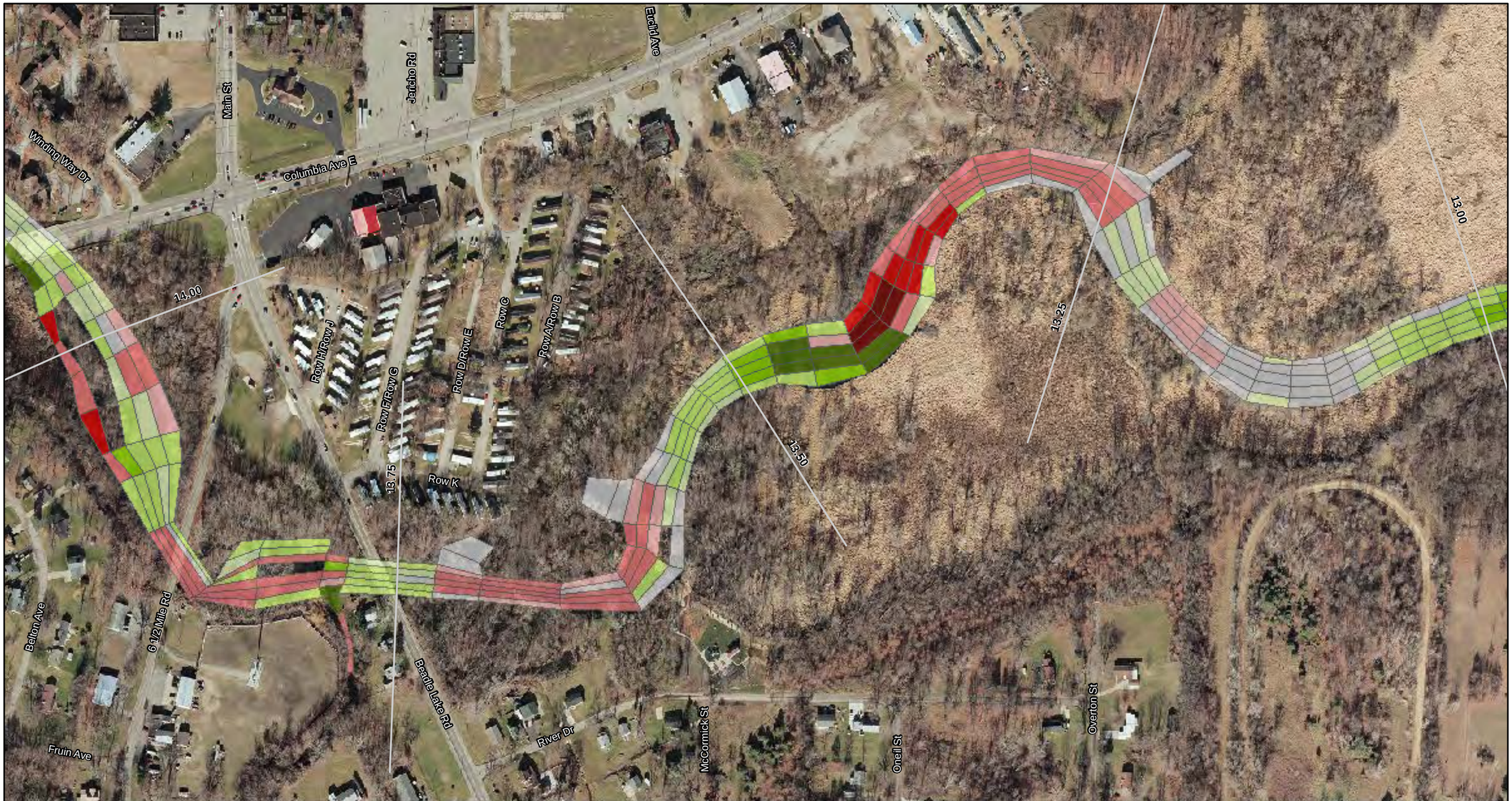
MP 12.30 - MP 13.05

SHEET 15 OF 56

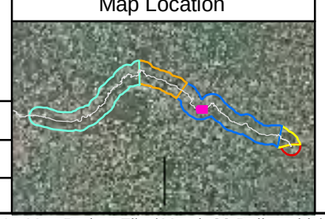
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Sedimentation_Rate_Oct-Nov_2011.mxd

Aerial Photography Date: November 2011



Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

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Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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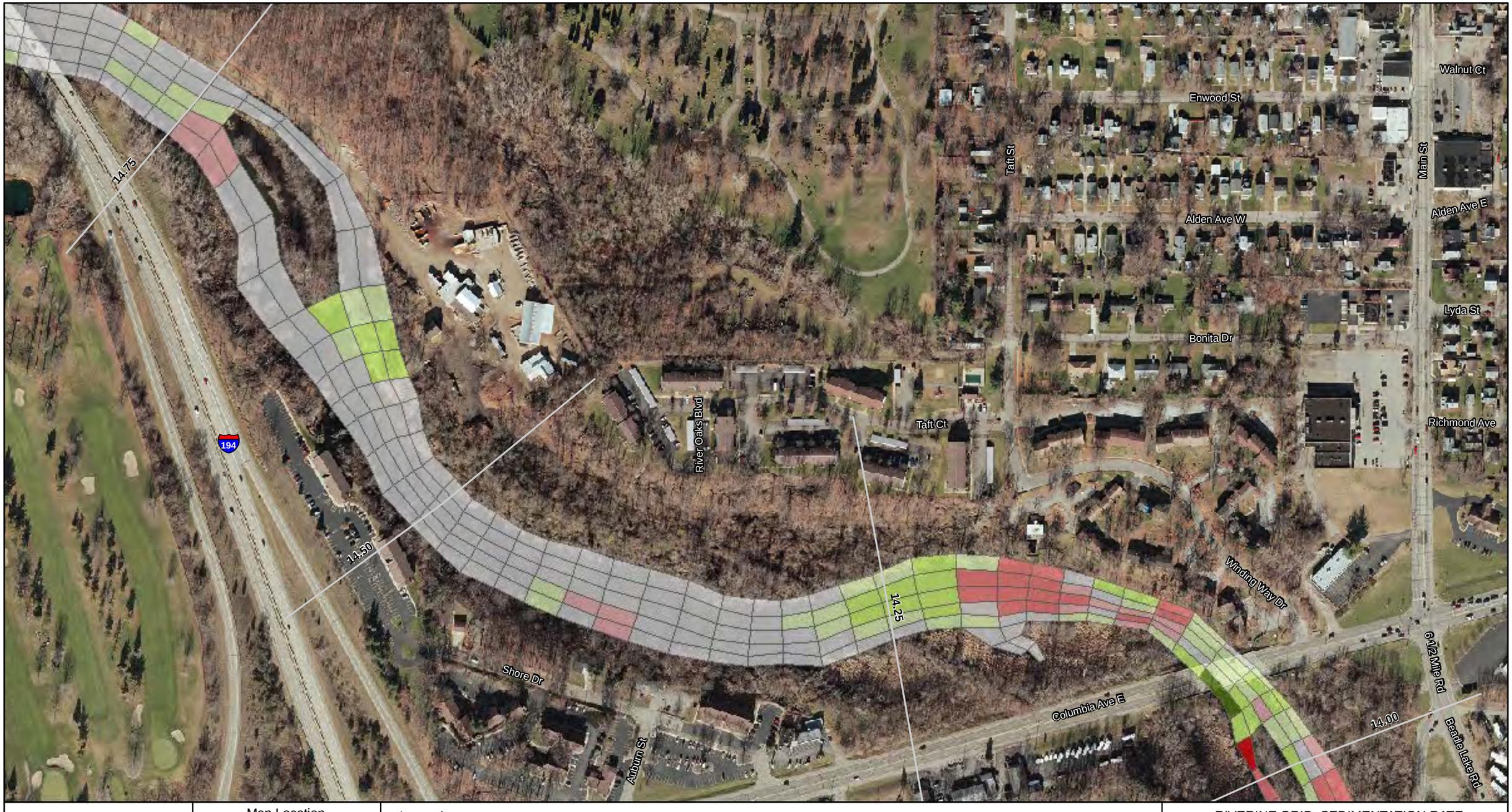
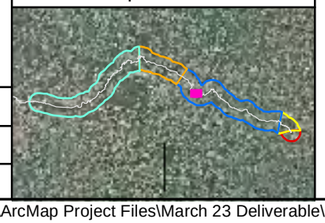
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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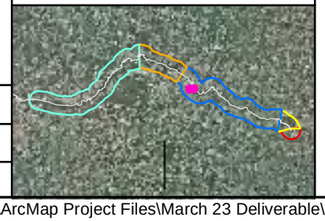
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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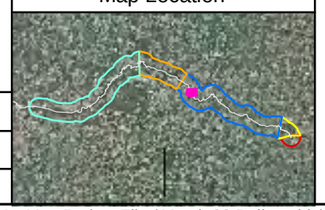
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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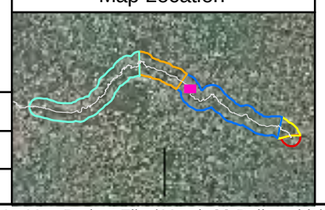
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
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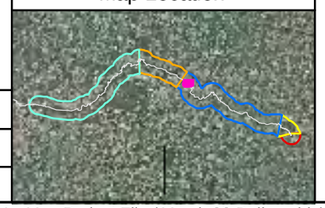
Aerial Photography Date: November 2011

Cass St N
Michigan Ave W
Washington Ave N
Champion St
Brook St
Cass St S
Could St
Van Buren St W
Archer Ct
Jackson St W
Service St
Hamblin Ave W
16.75
Barney St
Washington Ave S
16.50
Lafayette St
Kendall St S
Putnam St
Page St
Louise St
Carlyle St
Houston St
Grand Trunk Ave
Dickman Rd
16.25

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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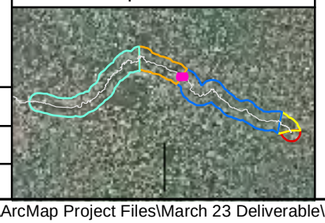
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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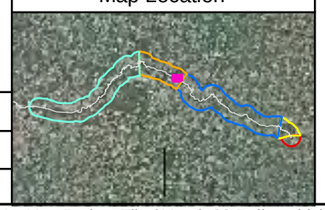
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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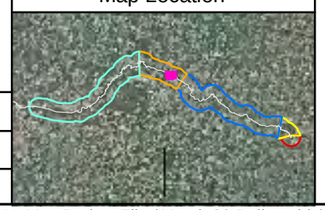
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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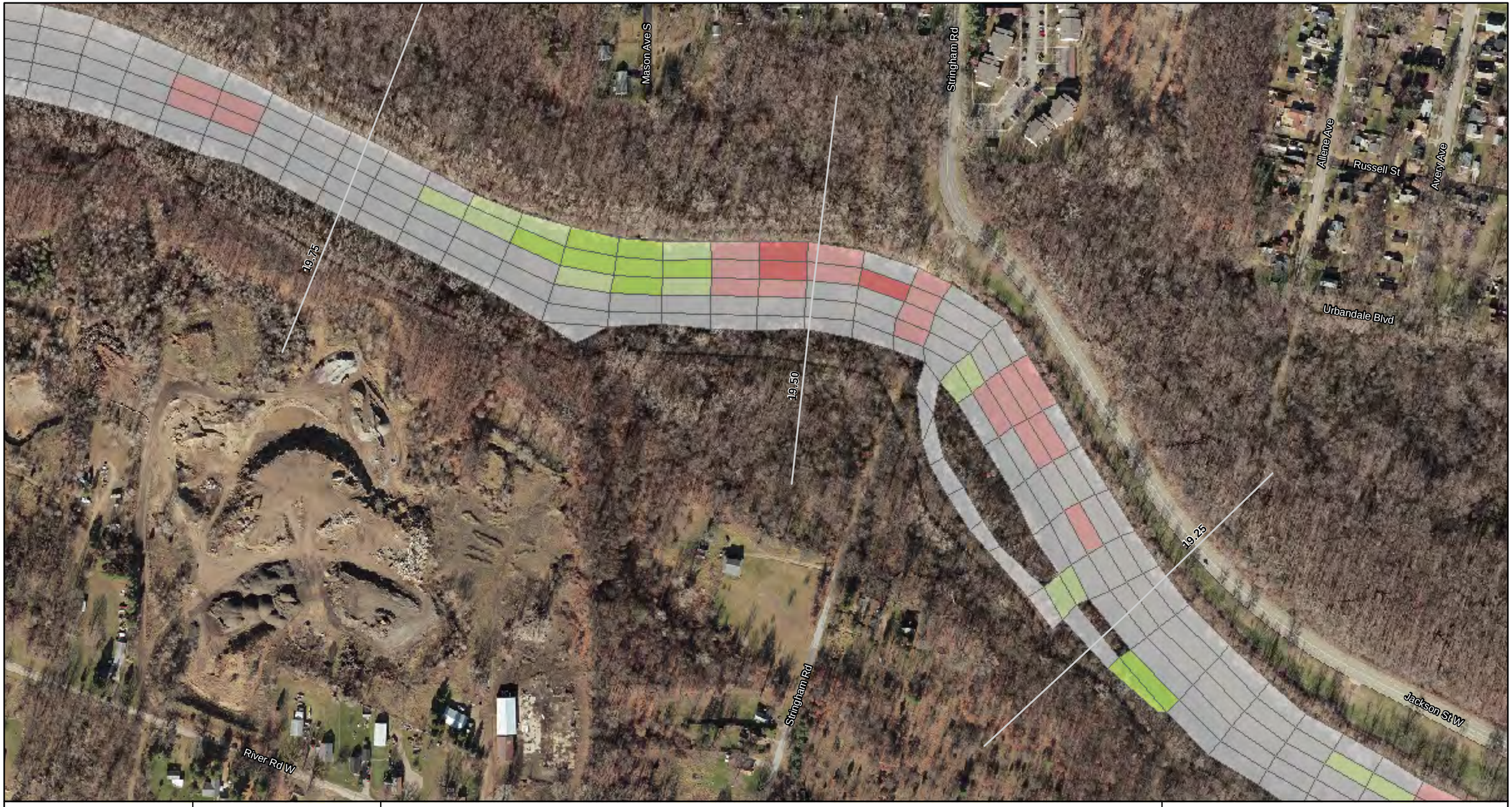
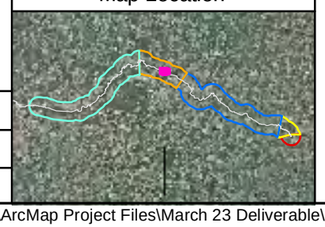
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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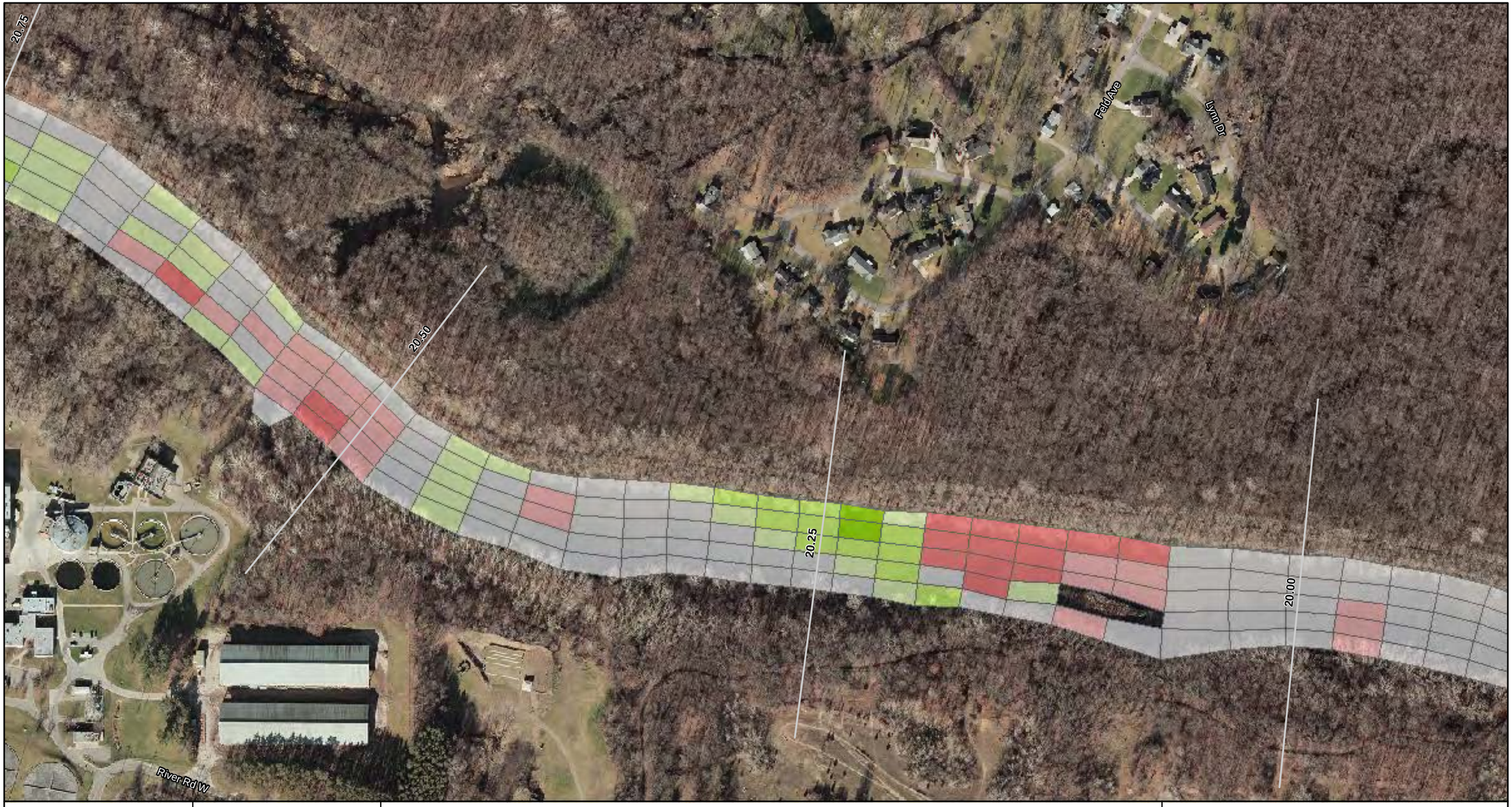
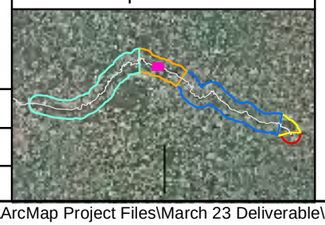
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Coldwater Ave

Custer Dr

Stillson Blvd

21.25

21.00

20.75

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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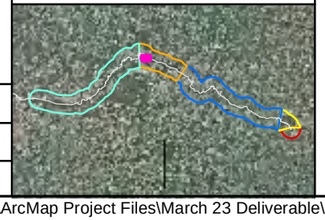
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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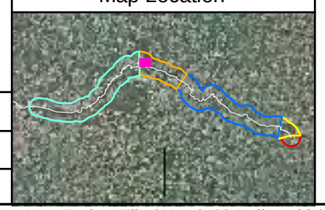
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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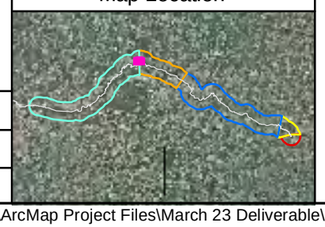
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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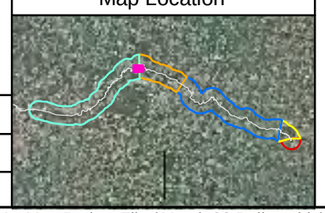
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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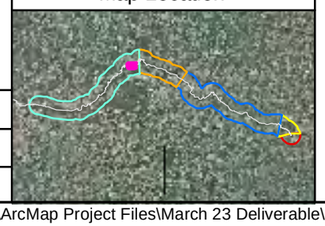
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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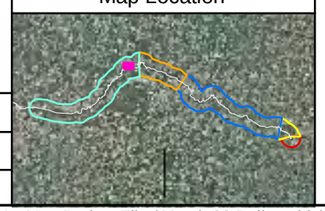
Aerial Photography Date: November 2011

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

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Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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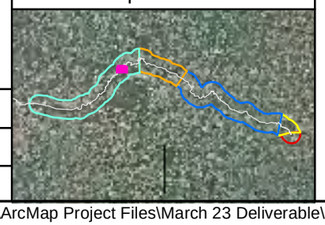
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)
All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500
Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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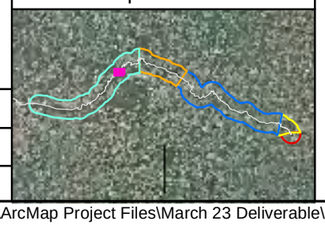
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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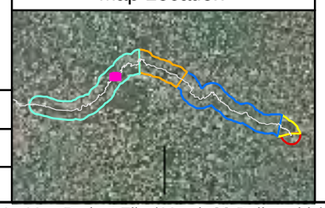
Aerial Photography Date: November 2011

Clinton St
Clinton St
Chestnut St
Webster St
Church St
Fayette St
Cass St
Cherry St
Lincoln St
28.75
29.00
29.25
29.50
Augusta Climax Rd
Fort Custer Rec Area Access

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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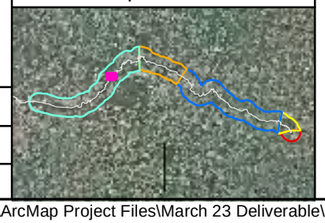
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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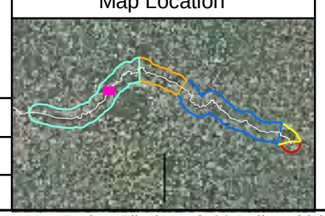
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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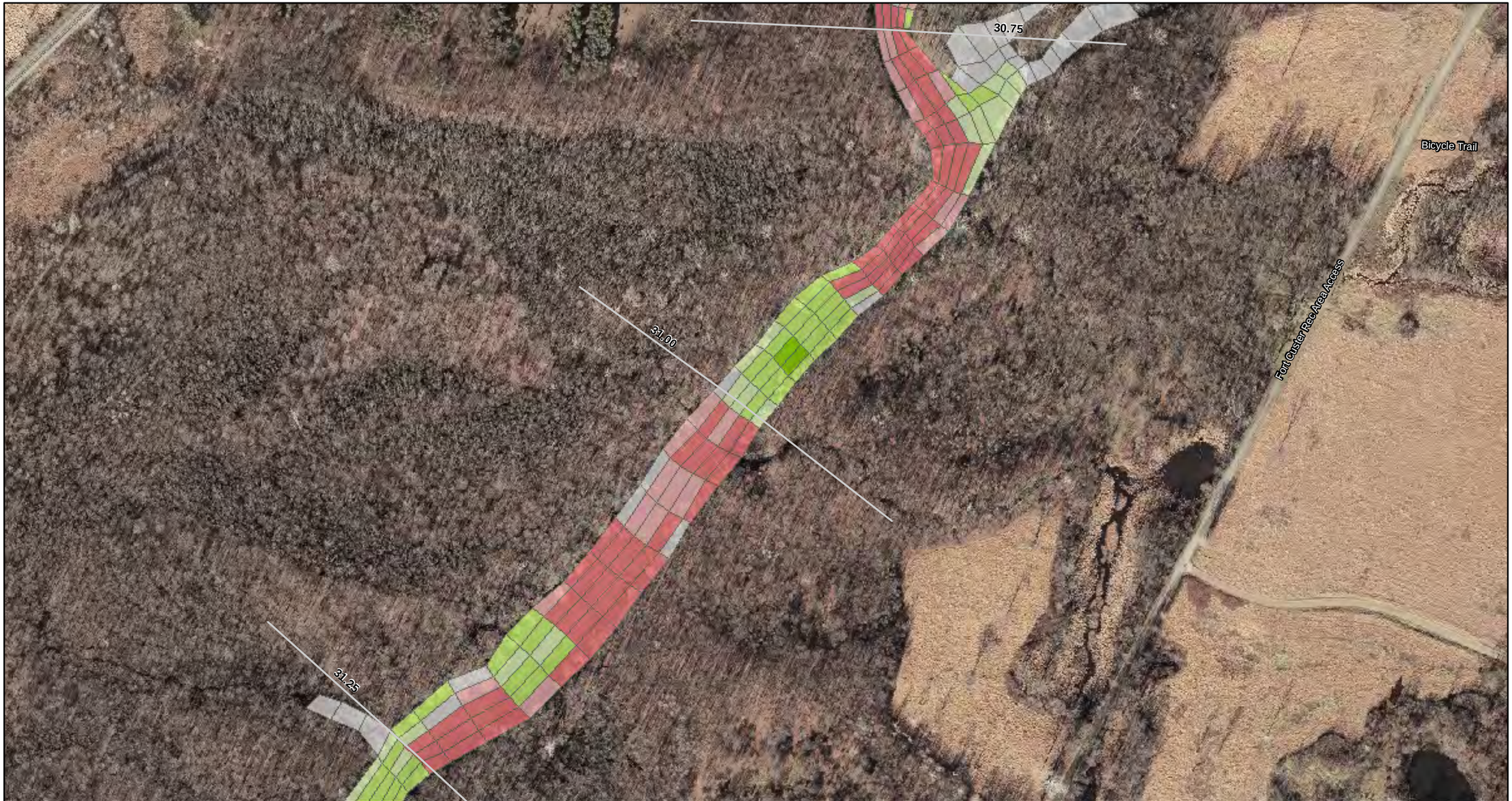
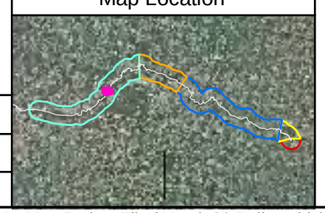
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

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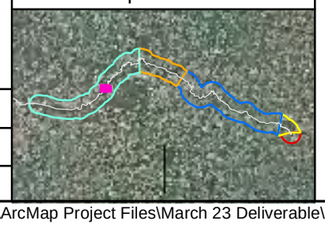
Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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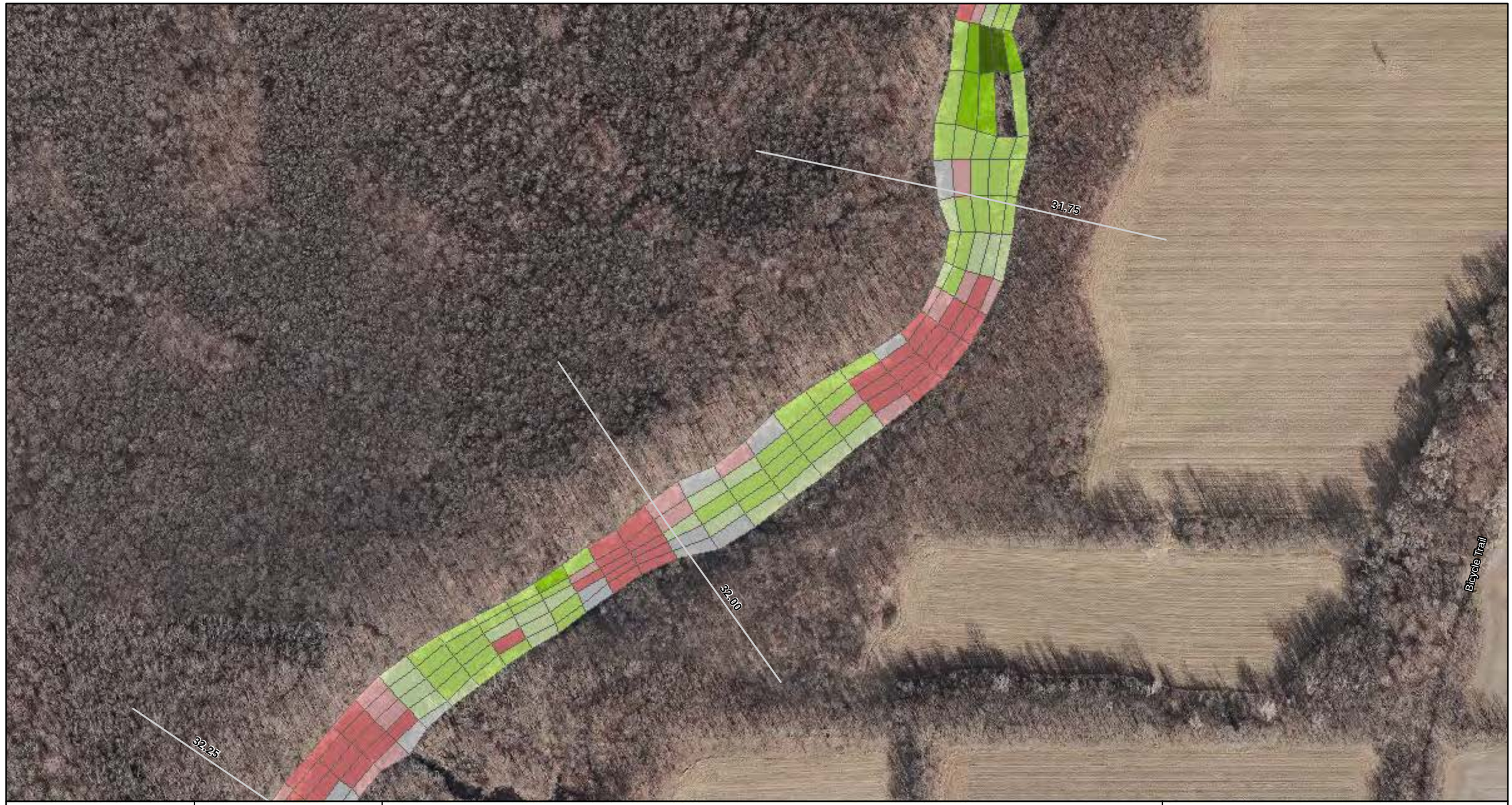
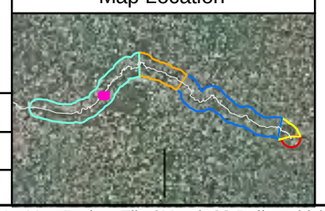
Aerial Photography Date: November 2011



Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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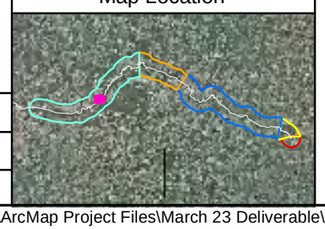
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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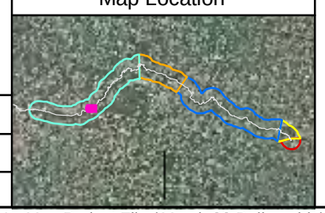
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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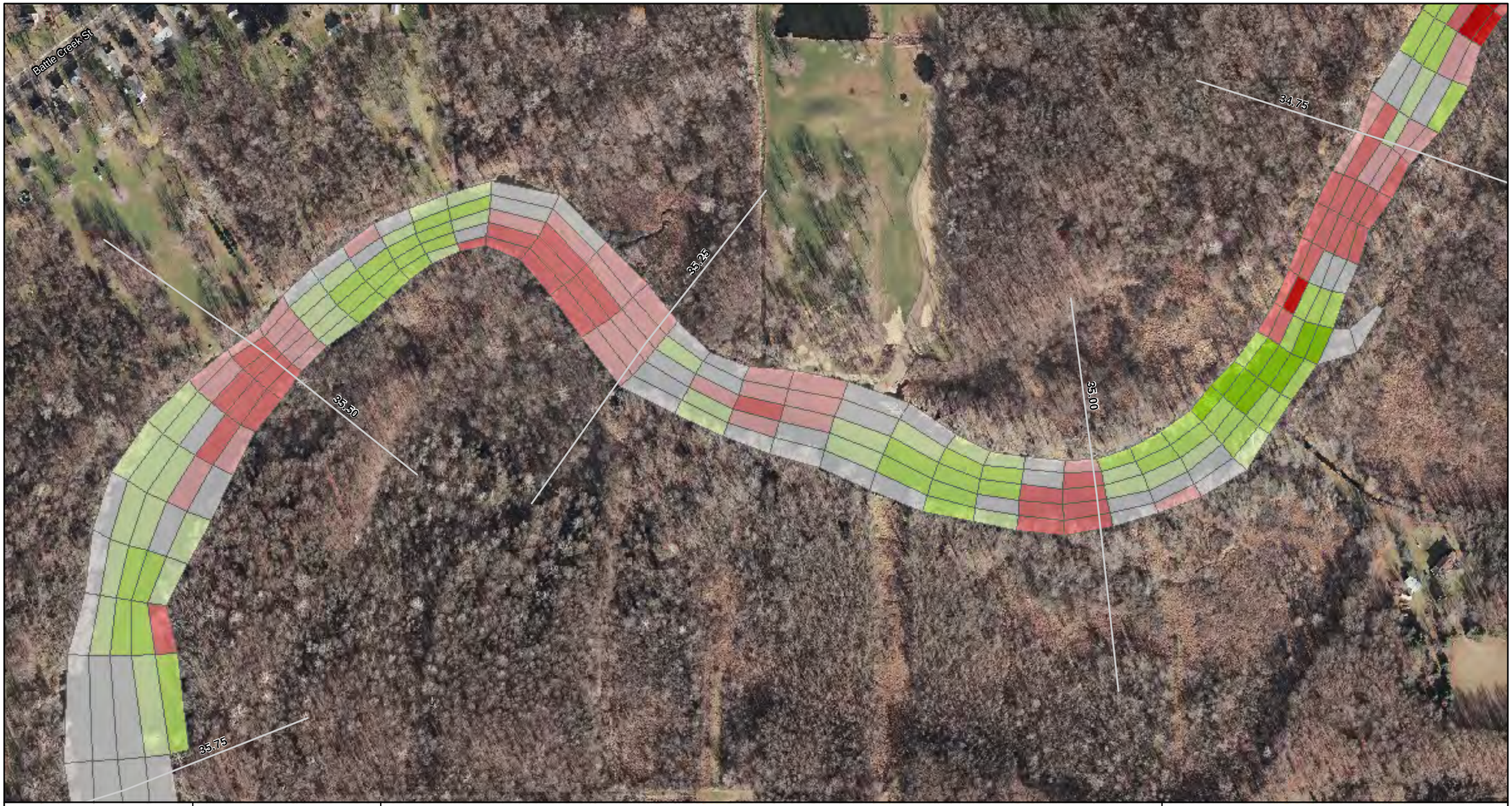
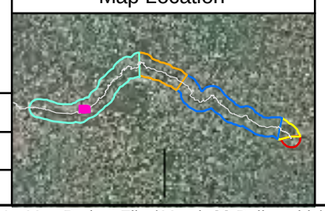
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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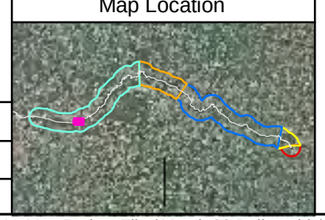
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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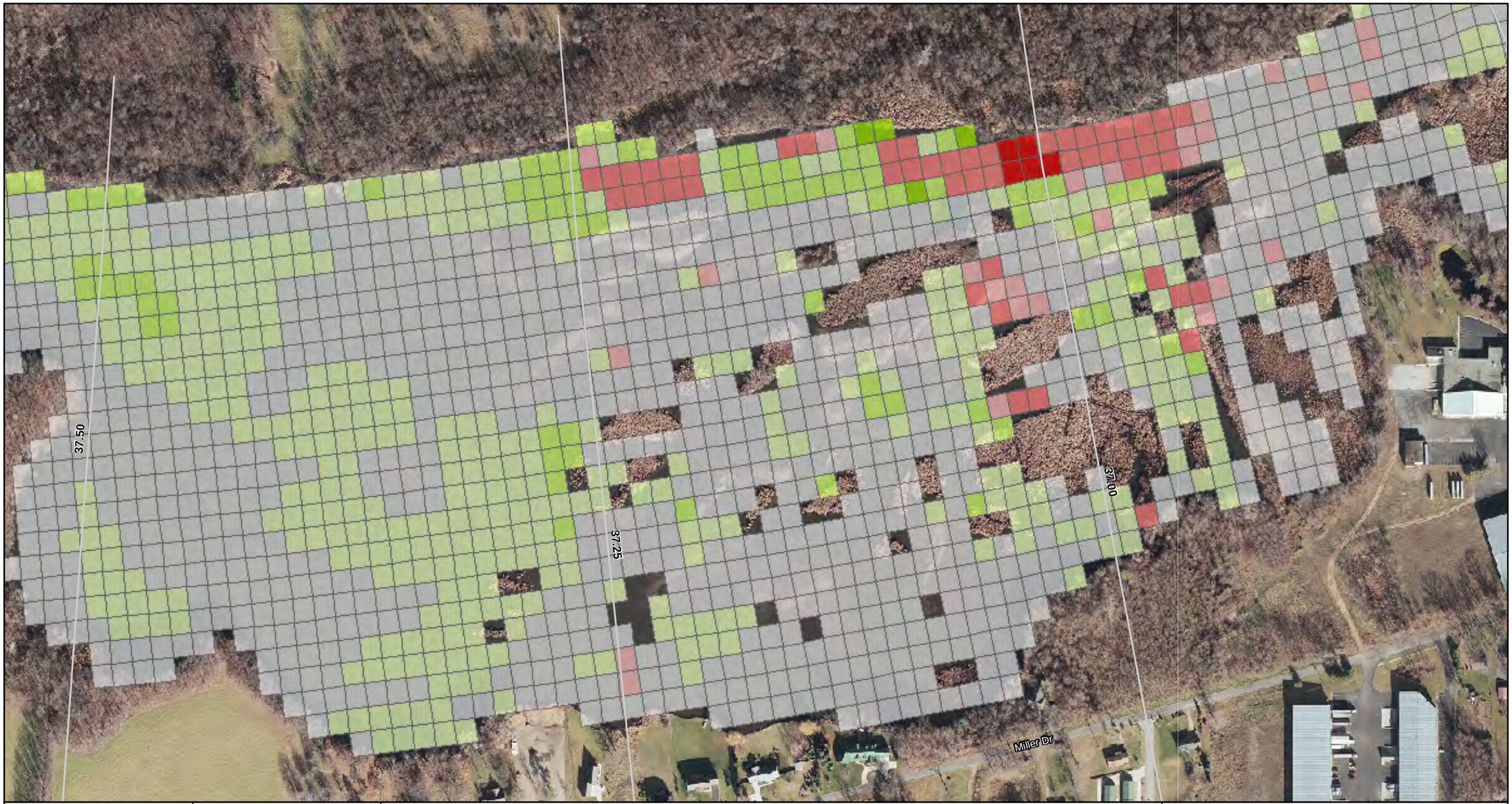
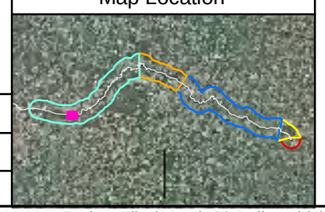
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

38.25

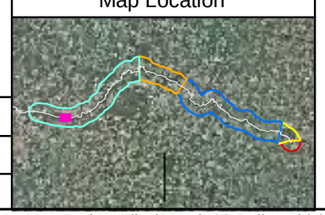
38.00

37.75

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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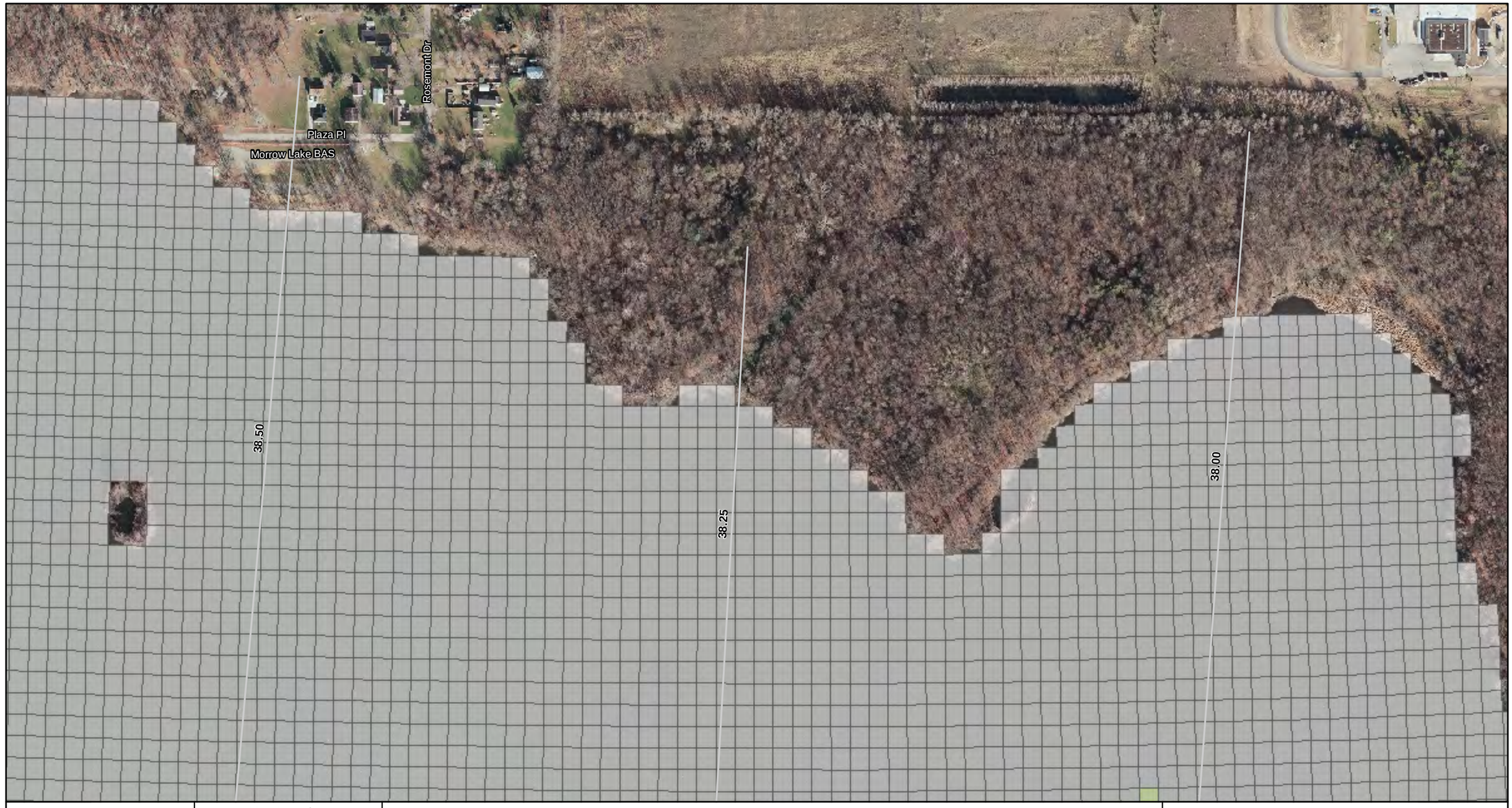
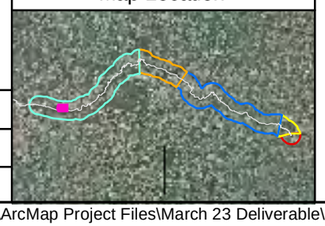
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

38.50

38.25

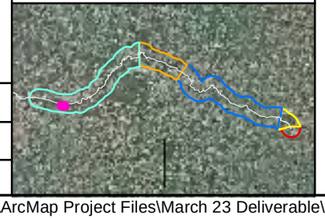
38.00

Lyth Rd

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

39.00

38.50

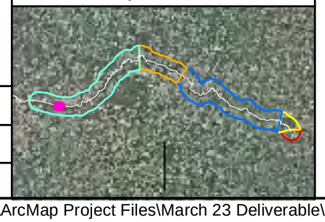
38.75

38.25

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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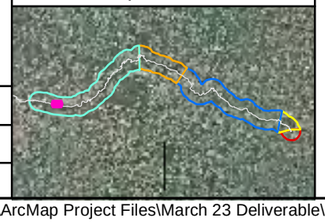
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

39.25

39.00

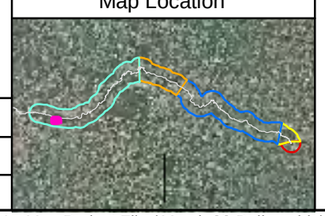
38.75

38.50

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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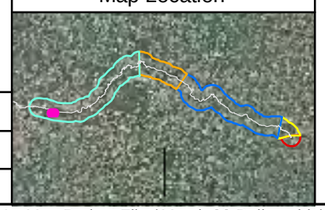
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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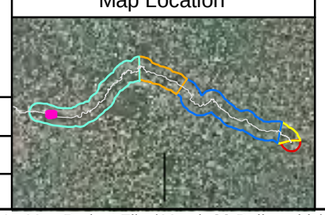
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
ALL GRID CELLS
OCTOBER 31 - NOVEMBER 7, 2011

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: November 2011

Figure 4-20

Riverine Grid: Sedimentation Rate

Cells with Net Change in Silt or Clay Mass

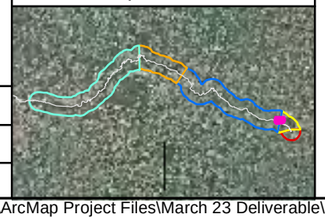
October 31 – November 7, 2011

Sheets 1 through 56

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 01.95 - MP 02.75

SHEET 1 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: November 2011

3.25

3.00

2.75

2.50

Friendship Ln

Heather Dr

Peter Pan Ln

Kristen Dr

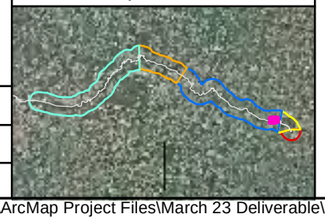
Squaw Creek Rd

River Park Dr

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 02.60 - MP 03.40

SHEET 2 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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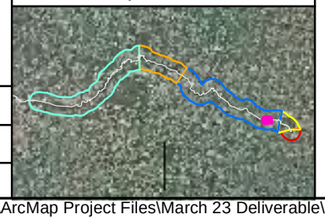
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 03.40 - MP 04.20

SHEET 3 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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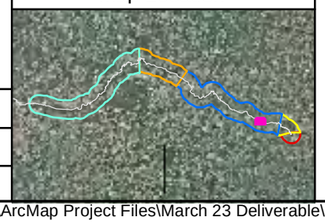
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 04.15 - MP 05.00

SHEET 4 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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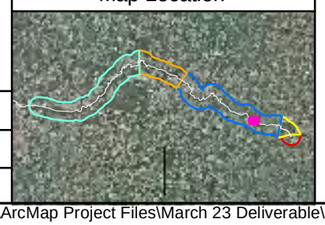
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 04.90 - MP 05.65

SHEET 5 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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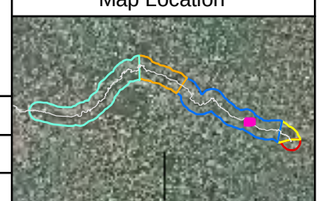
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 05.65 - MP 06.30

SHEET 6 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 06.20 - MP 07.15

SHEET 7 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Drawn:	BRS 3/26/2012
Approved:	DBR 3/26/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 07.15 - MP 07.95

SHEET 8 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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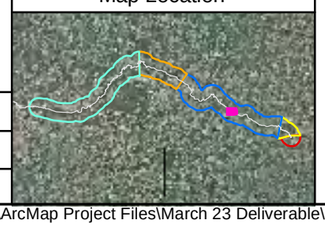
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 07.90 - MP 08.75

SHEET 9 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 08.70 - MP 09.30

SHEET 10 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 09.25 - MP 10.05

SHEET 11 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

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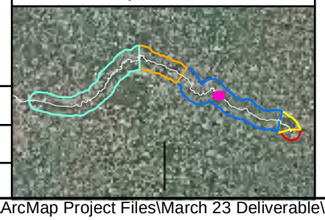
Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 10.00 - MP 10.65

SHEET 12 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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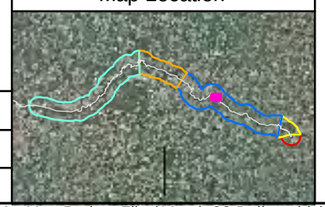
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 10.60 - MP 11.40

SHEET 13 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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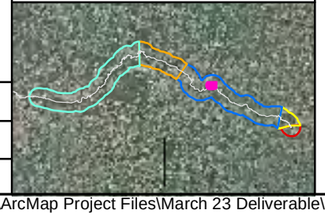
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 11.10 - MP 12.45

SHEET 14 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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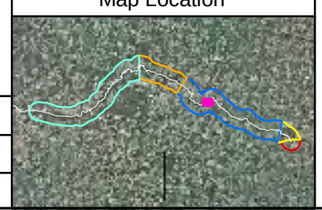
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 12.30 - MP 13.05

SHEET 15 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 13.00 - MP 14.10

SHEET 16 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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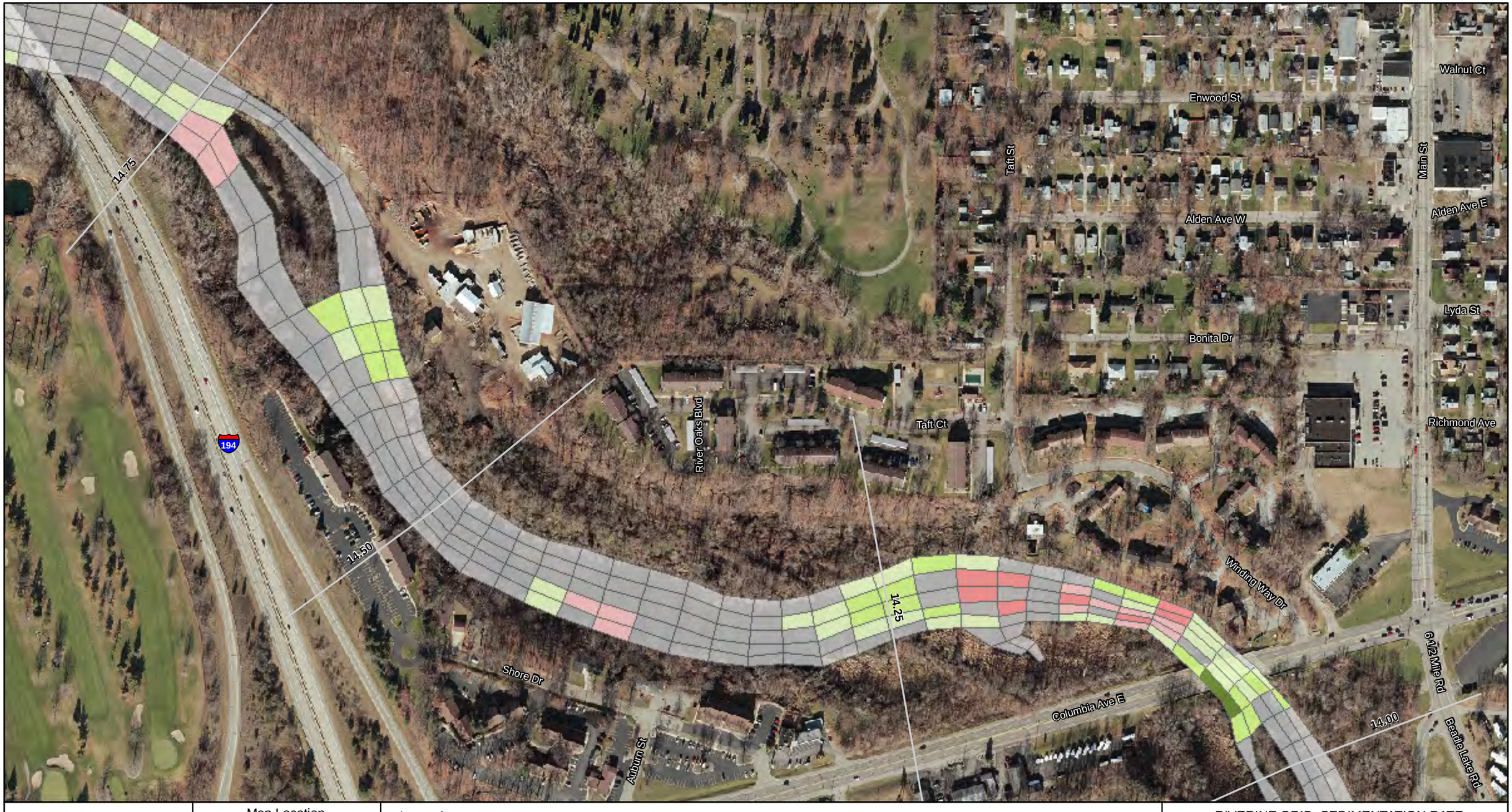
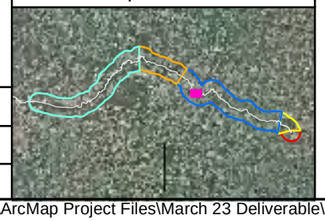
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 14.00 - MP 14.85

SHEET 17 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Drawn:	BRS 3/26/2012
Approved:	DBR 3/26/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 14.65 - MP 15.25

SHEET 18 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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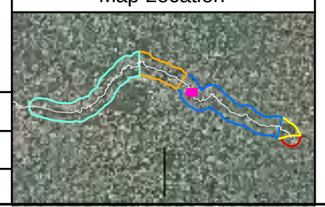
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 15.25 - MP 15.75

SHEET 19 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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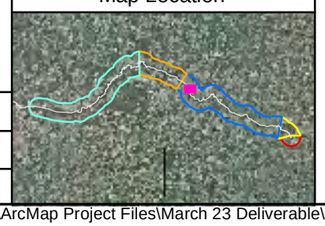
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 15.75 - MP 16.30

SHEET 20 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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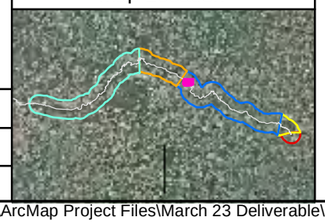
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 16.30 - MP 16.95

SHEET 21 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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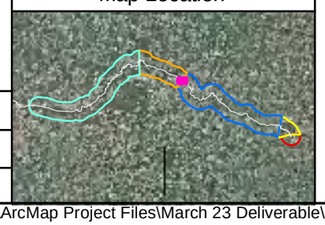
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 16.85 - MP 17.60

SHEET 22 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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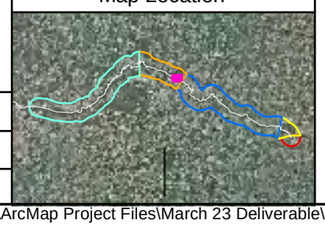
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 17.60 - MP 18.40

SHEET 23 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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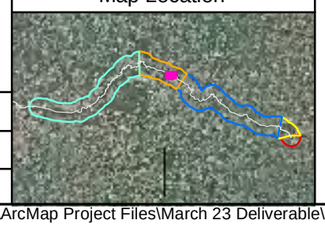
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 18.30 - MP 19.15

SHEET 24 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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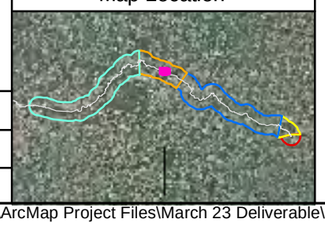
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 19.10 - MP 19.95

SHEET 25 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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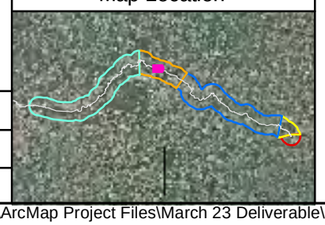
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 19.90 - MP 20.75

SHEET 26 OF 56

ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 20.70 - MP 21.50

SHEET 27 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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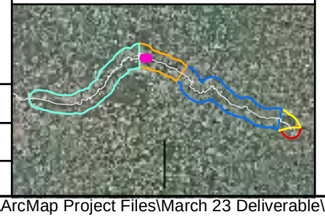
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 21.35 - MP 22.15

SHEET 28 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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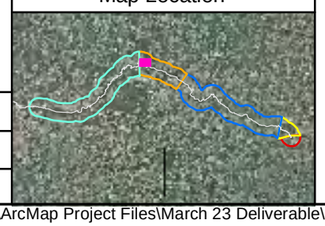
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 22.15 - MP 22.90

SHEET 29 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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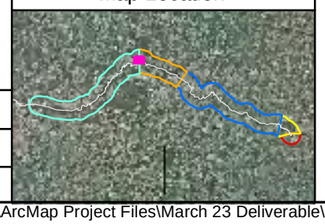
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 22.80 - MP 24.10

SHEET 30 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: November 2011

24.00

24.25

24.75

24.50

River Rd W

Fort Custer Dr

County Line Rd

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 24.10 - MP 24.85

SHEET 31 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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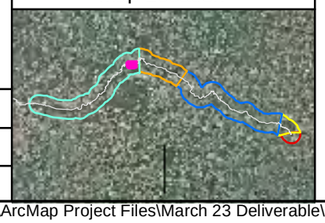
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 24.80 - MP 25.65

SHEET 32 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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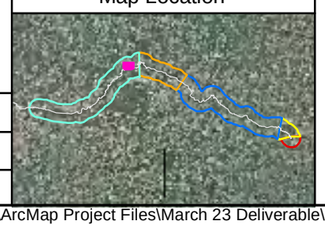
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 25.55 - MP 26.40

SHEET 33 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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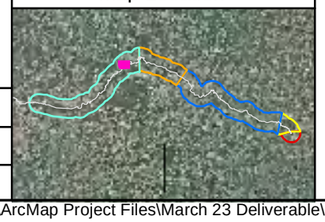
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 26.40 - MP 27.45

SHEET 34 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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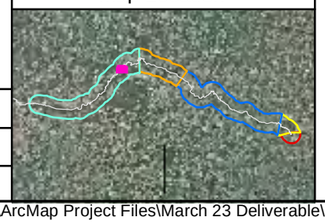
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 27.45 - MP 28.10

SHEET 35 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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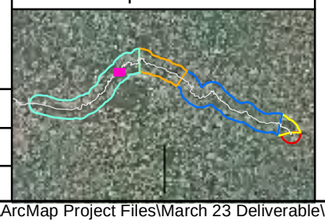
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 28.05 - MP 28.85

SHEET 36 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 28.85 - MP29.55

SHEET 37 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

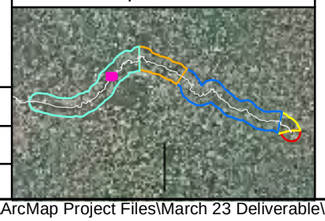
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Sedimentation_Rate_Oct-Nov_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 29.50 - MP29.95

SHEET 38 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 29.95 - MP 30.80

SHEET 39 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

30.75

31.00

31.25

Bicycle Trail

Fort Custer Rec Area Access

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Drawn:	BRS	3/26/2012
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Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 30.75 - MP 31.25

SHEET 40 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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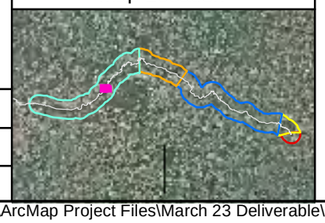
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 31.25 - MP 31.70

SHEET 41 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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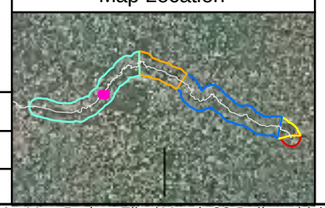
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 31.65 - MP 32.25

SHEET 42 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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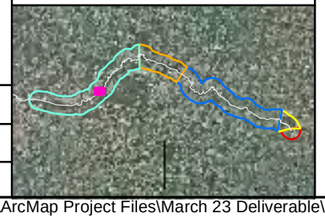
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 32.25 - MP 33.10

SHEET 43 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 33.10 - MP 33.70

SHEET 44 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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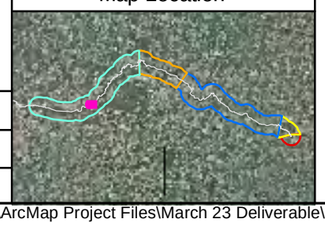
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 33.70 - MP 34.70

SHEET 45 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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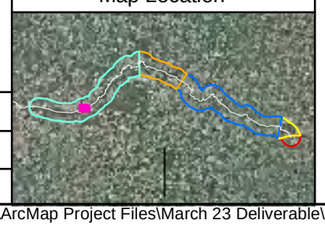
Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 34.70 - MP 35.75

SHEET 46 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 35.75 - MP 36.80

SHEET 47 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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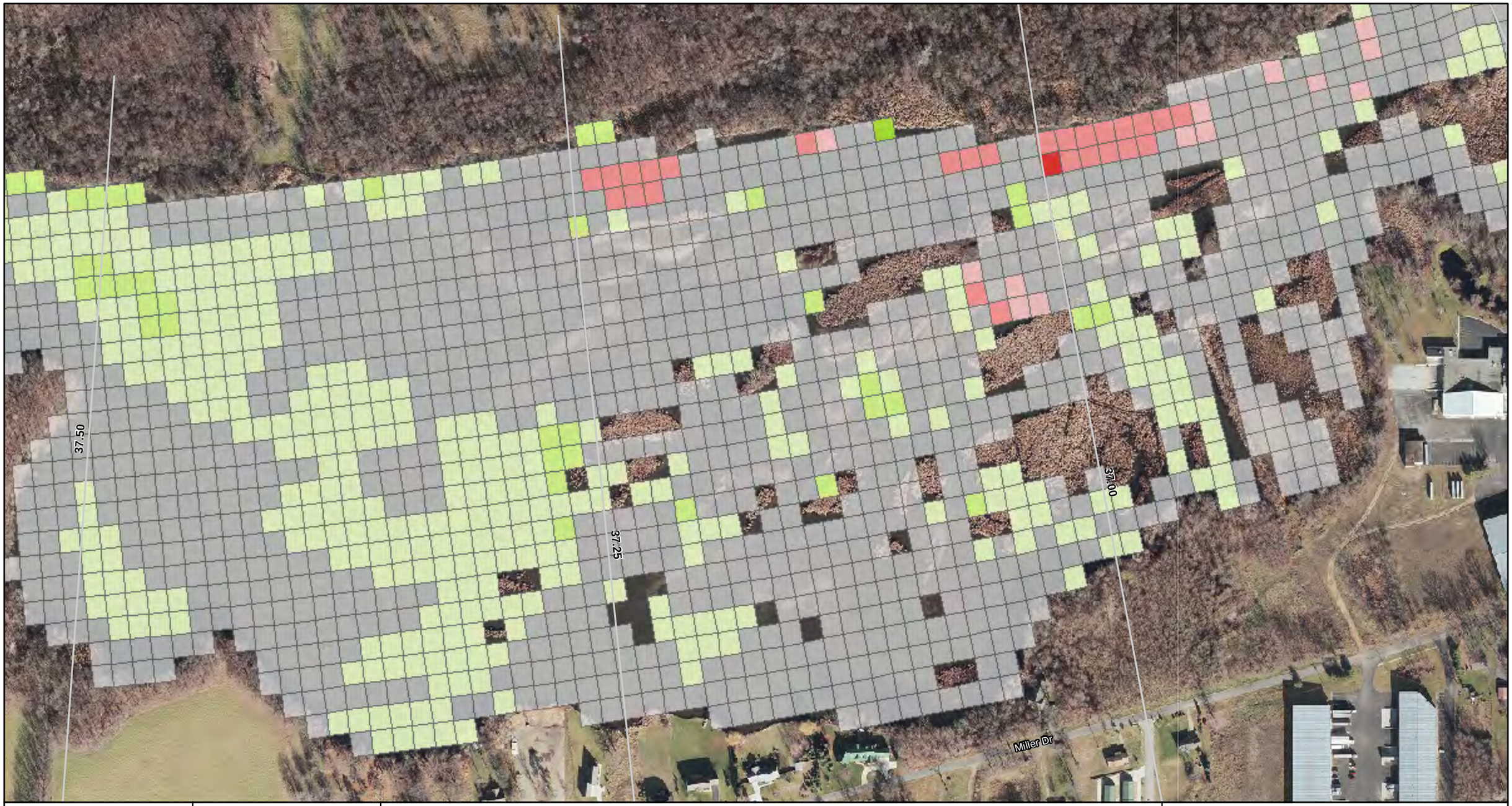
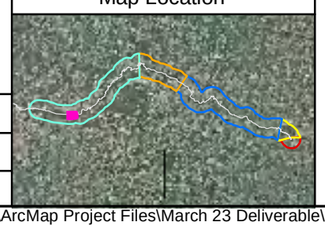
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 36.80 - MP 37.55

SHEET 48 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

38.25

38.00

37.75

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 37.55 - MP 38.30

SHEET 49 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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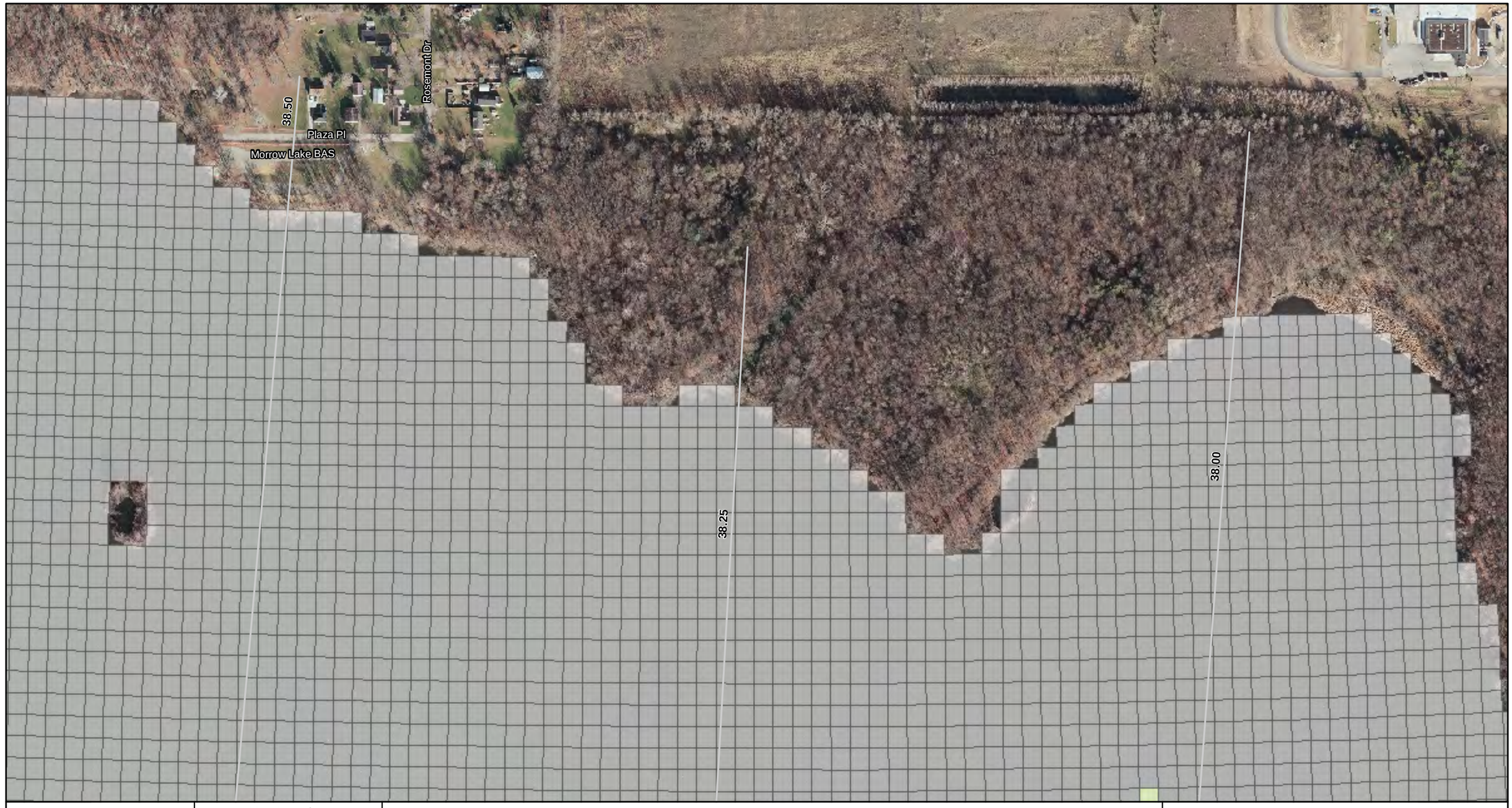
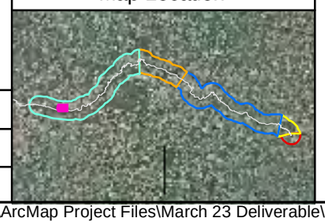
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 37.80 - MP 38.60N

SHEET 50 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

38.50

38.25

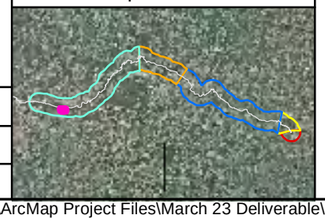
38.00

Lyth Rd

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 37.80 - MP 38.60S

SHEET 51 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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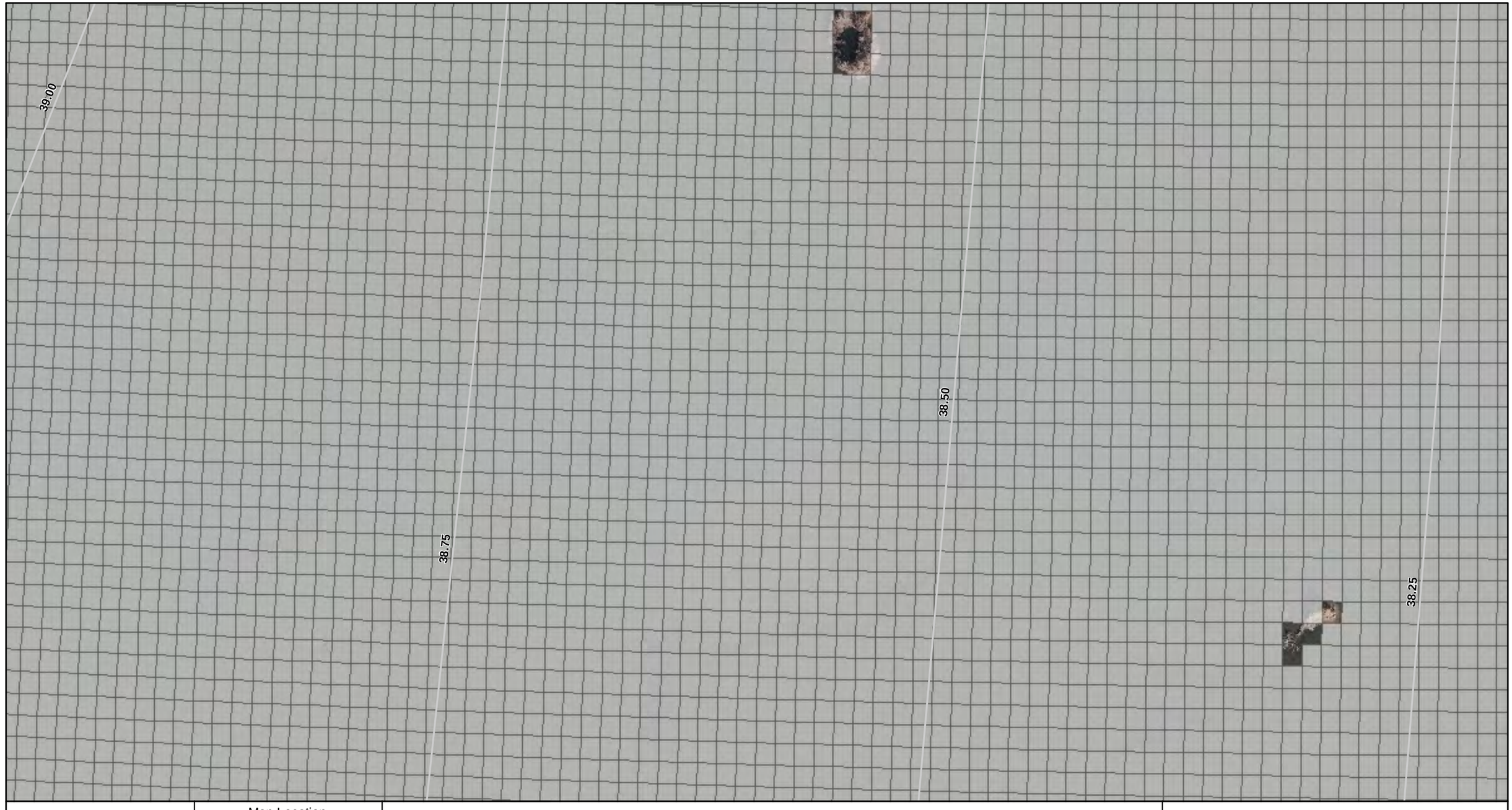
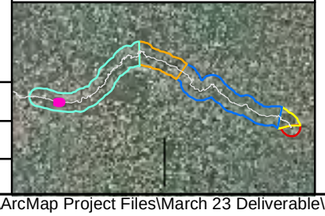
Aerial Photography Date: November 2011



ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 38.25 - MP 39.00C

SHEET 52 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Lawndale Ave

39.25

39.00

38.75

38.50

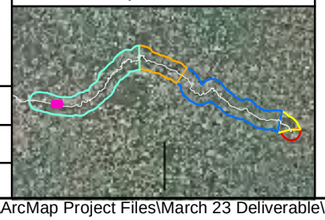
Plaza Pl

Morrow Lake BAS

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 38.50 - MP 39.25N

SHEET 53 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Sedimentation_Rate_Oct-Nov_2011.mxd

Aerial Photography Date: November 2011

39.25

39.00

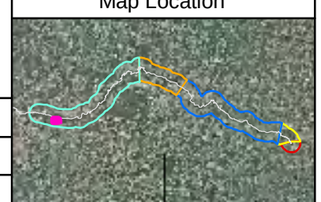
38.75

38.50

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 38.50 - MP 39.25S

SHEET 54 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

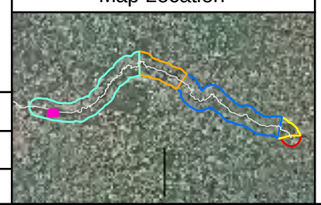
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Sedimentation_Rate_Oct-Nov_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 38.90 - MP 39.60S

SHEET 55 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

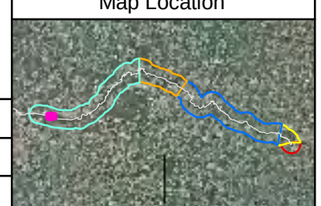
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Riverine_Sedimentation_Rate_Oct-Nov_2011.mxd

Aerial Photography Date: November 2011

ENBRIDGE

Drawn:	BRS	3/26/2012
Approved:	DBR	3/26/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

Quarter Mile Grid Segment

N

0 125 250 500

Scale in Feet

RIVERINE GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
OCTOBER 31 - NOVEMBER 7, 2011

MP 39.15 - MP 39.85

SHEET 56 OF 56

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: November 2011

Figure 4-21

Floodplain Grid: Velocity

July 24, 2010

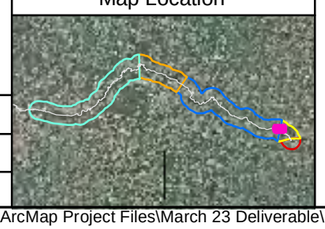
Sheets 1 through 45

2.50
2.75
2.25
2.00
Friendship Ln
Peter Pan Ln
Squaw Creek Rd
Brook Dr
River Park Dr
15 Mile Rd
A Dr N
15 1/2 Mile Rd

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

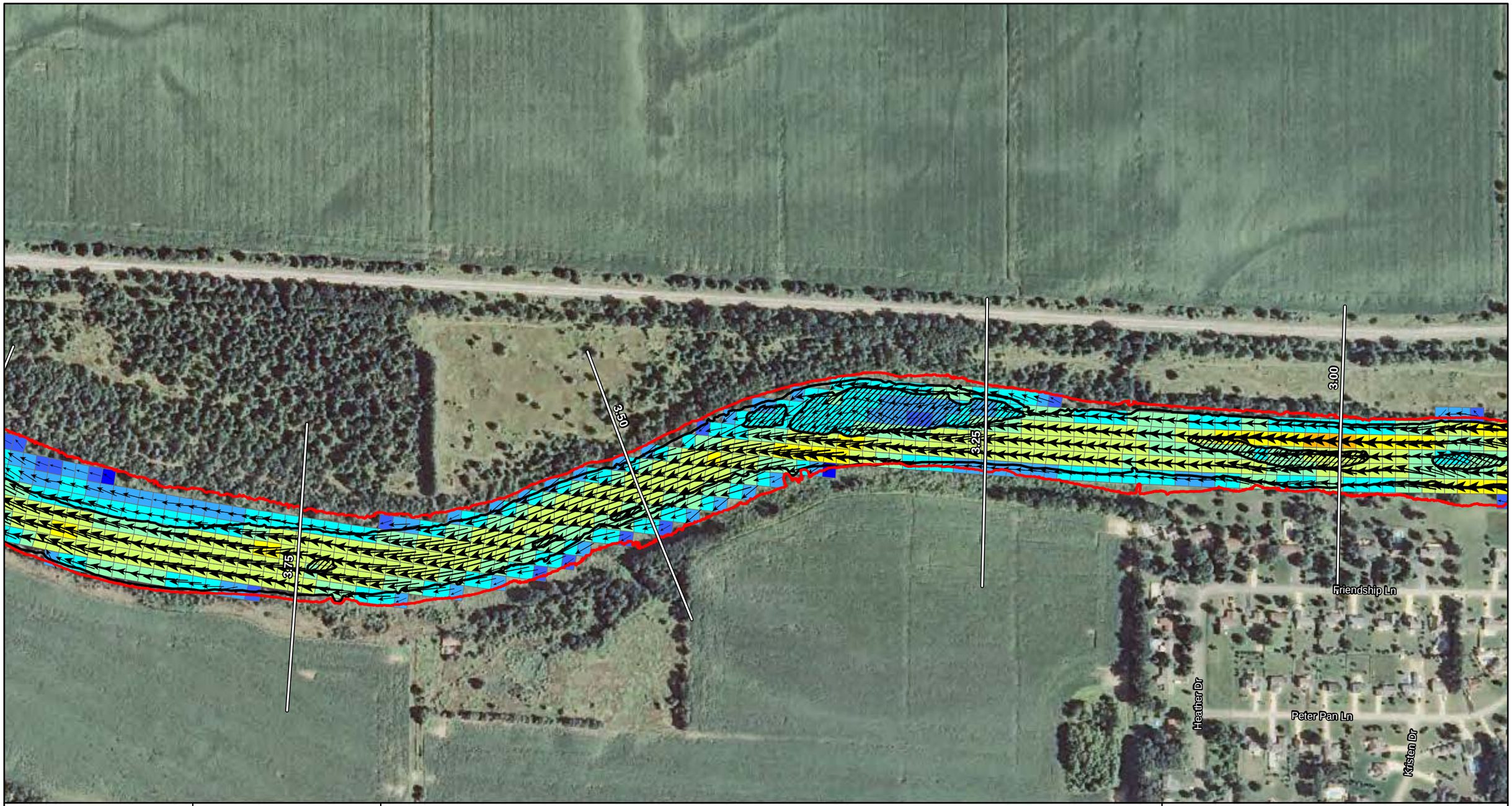
MP 01.88 - MP 02.91

SHEET 1 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

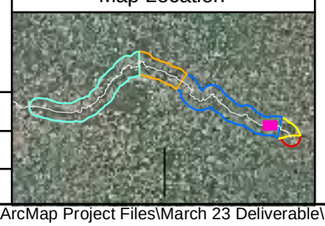
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

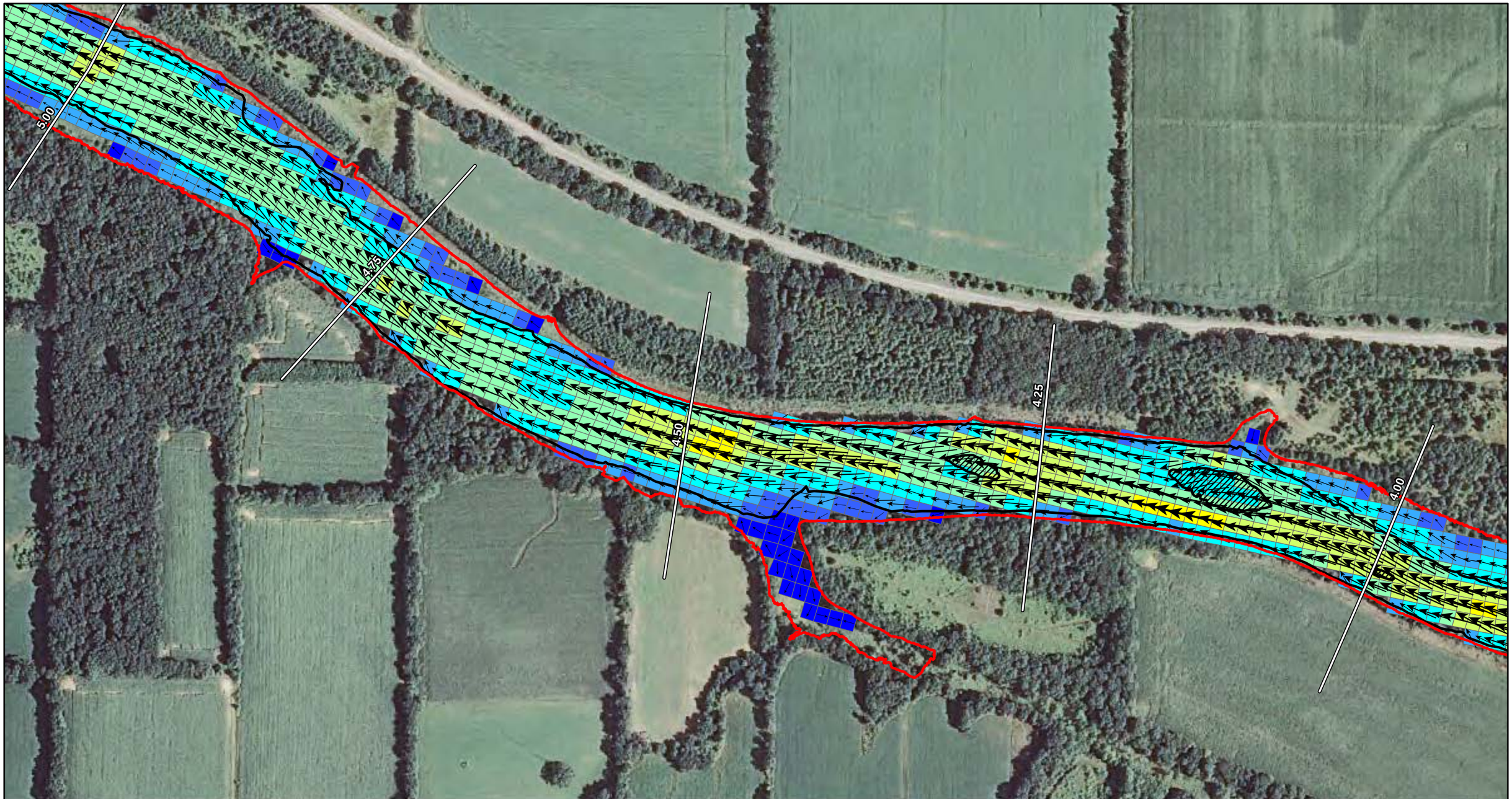
MP 02.91 - MP 03.93

SHEET 2 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

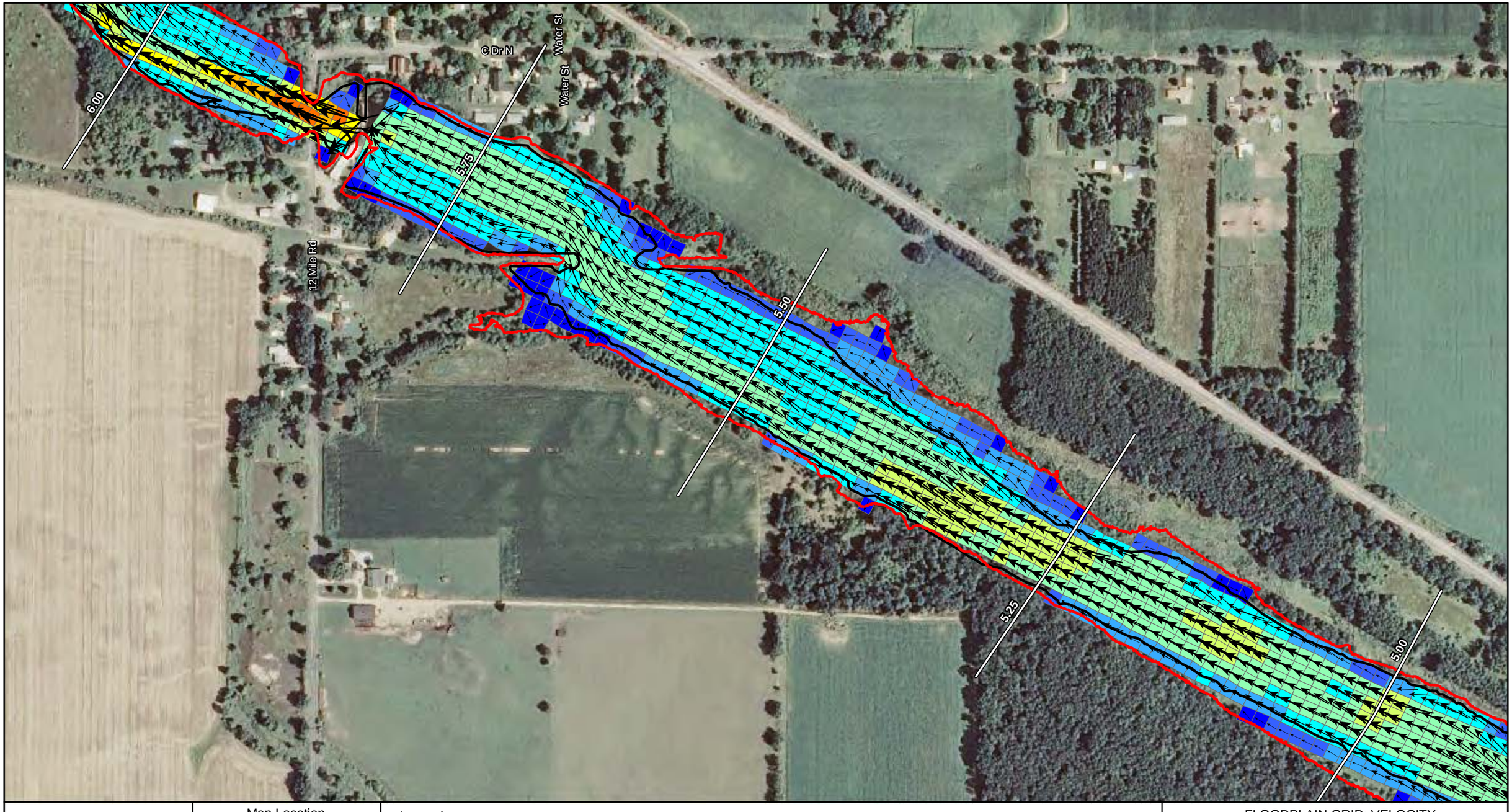
MP 03.93 - MP 04.98

SHEET 3 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

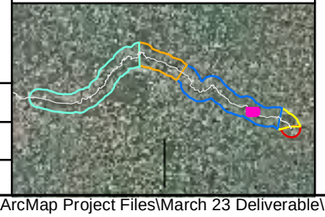
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 04.98 - MP 06.03

SHEET 4 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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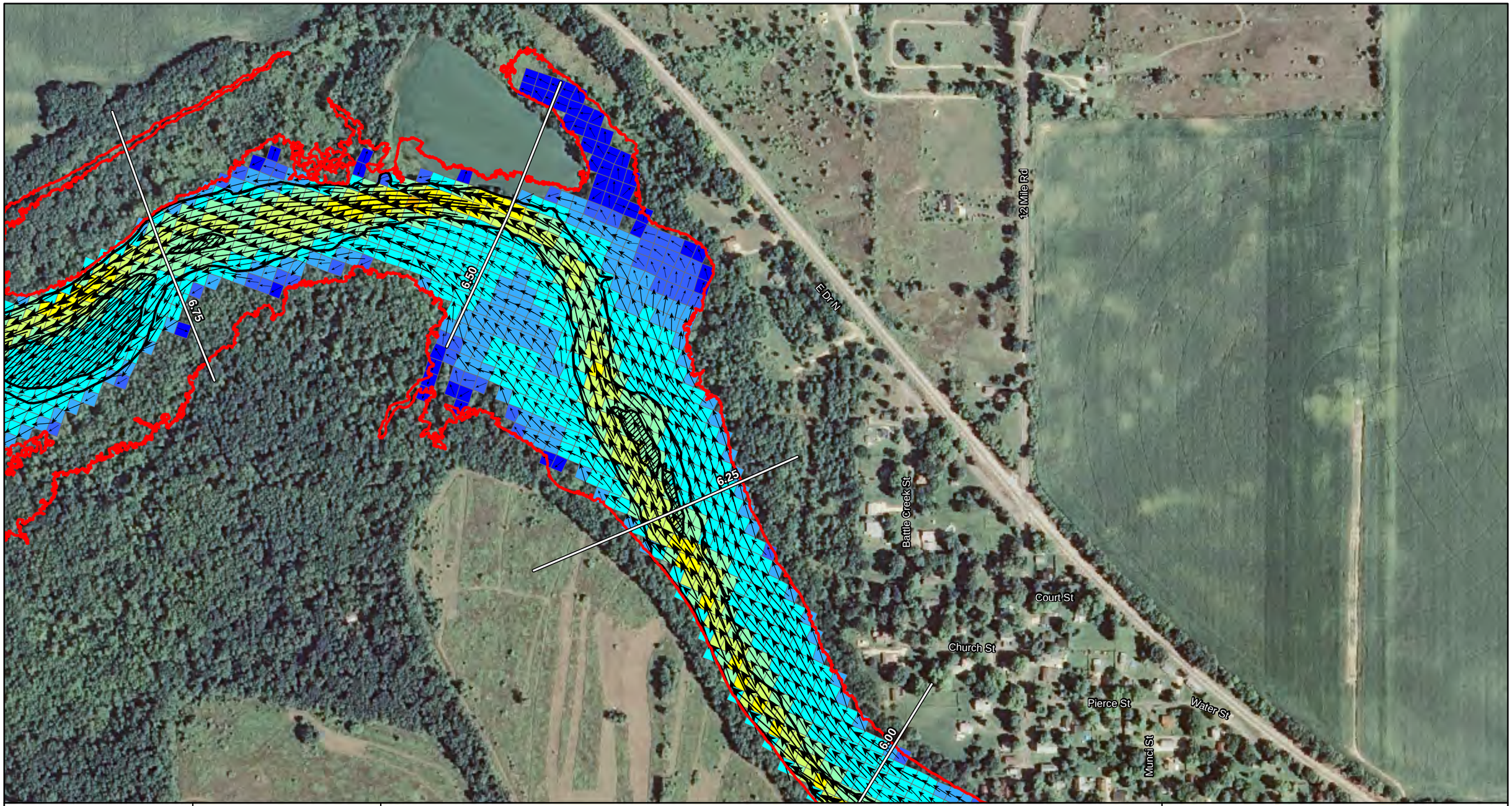
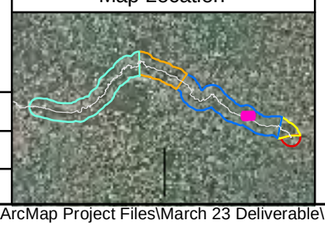
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 06.03 - MP 06.85

SHEET 5 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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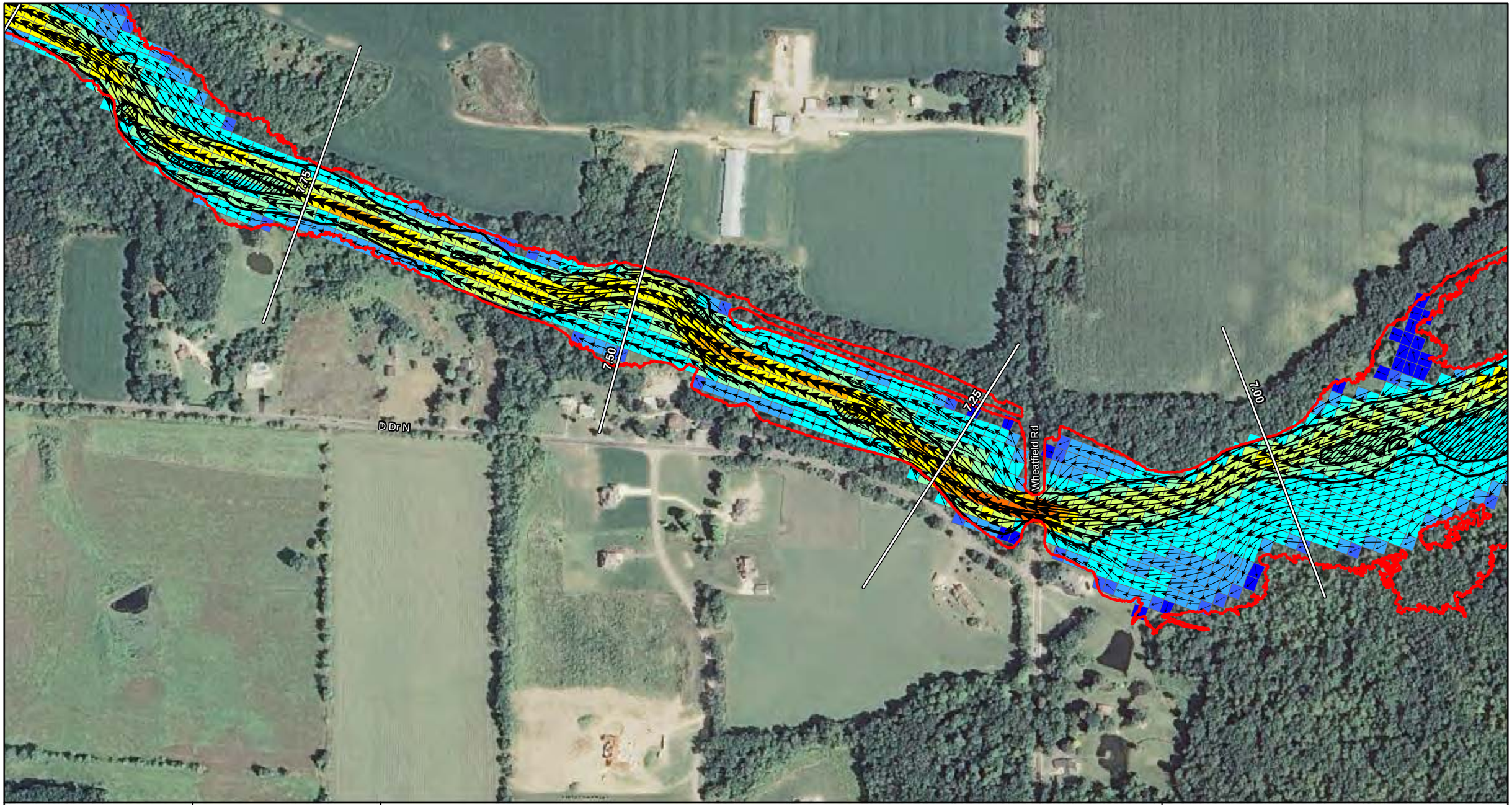
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 06.85 - MP 07.95

SHEET 6 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

9.00

8.75

8.50

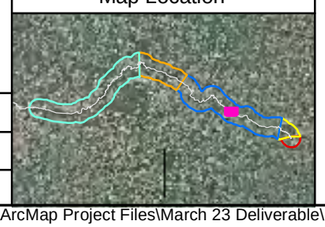
8.25

8.00

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

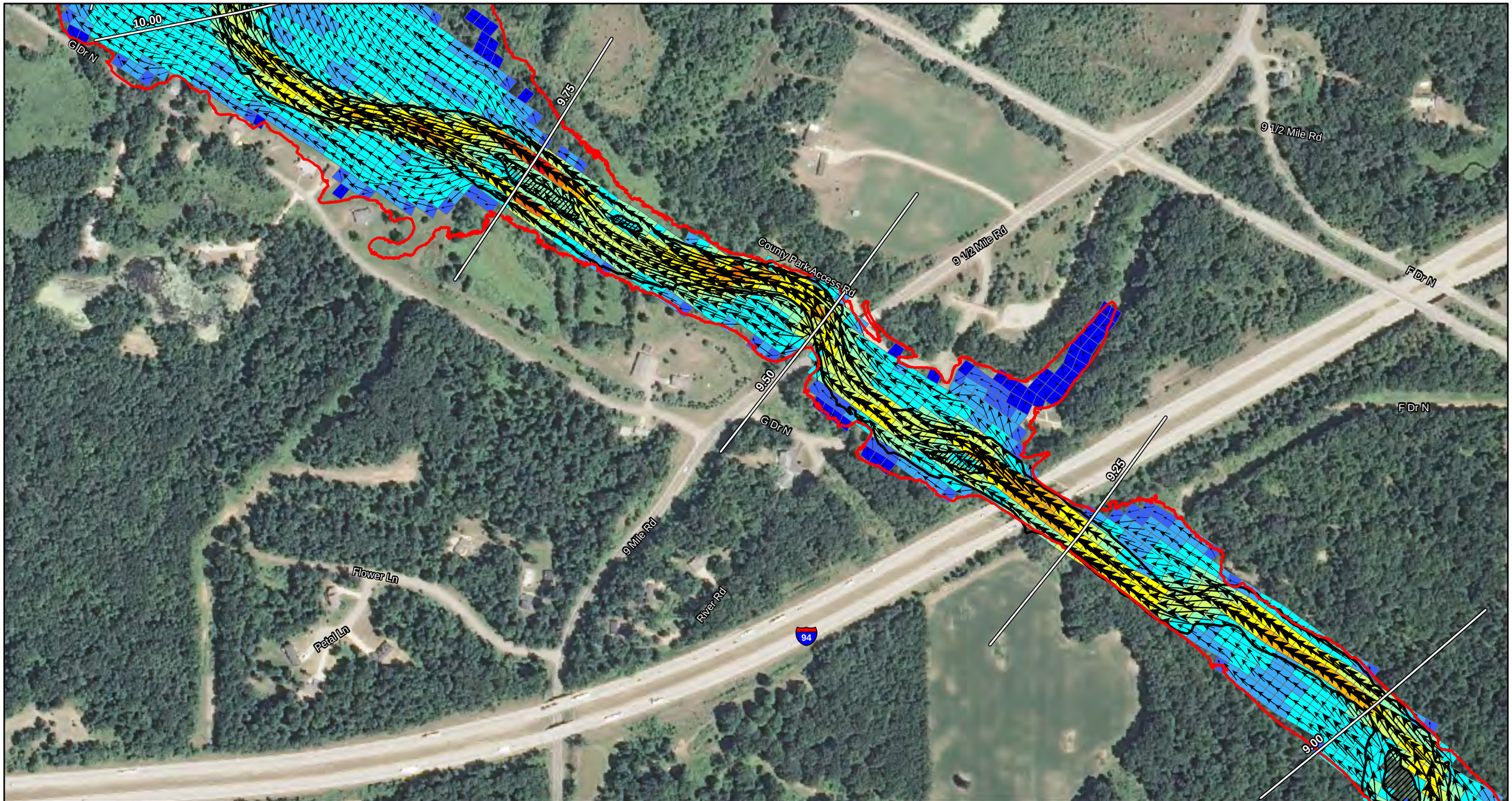
MP 07.95 - MP 08.93

SHEET 7 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 08.93 - MP 10.00

SHEET 8 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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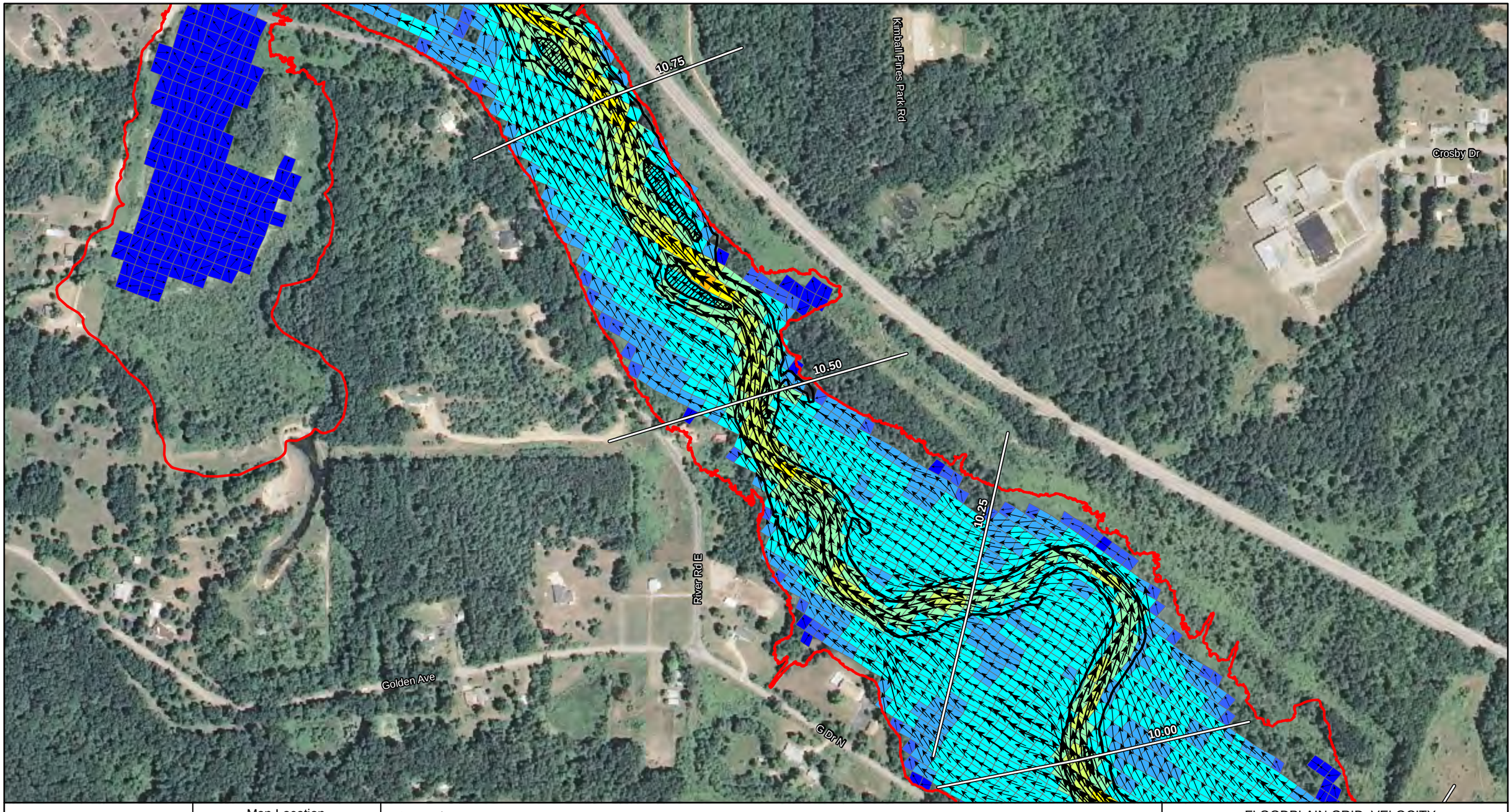
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 10.00 - MP 10.80

SHEET 9 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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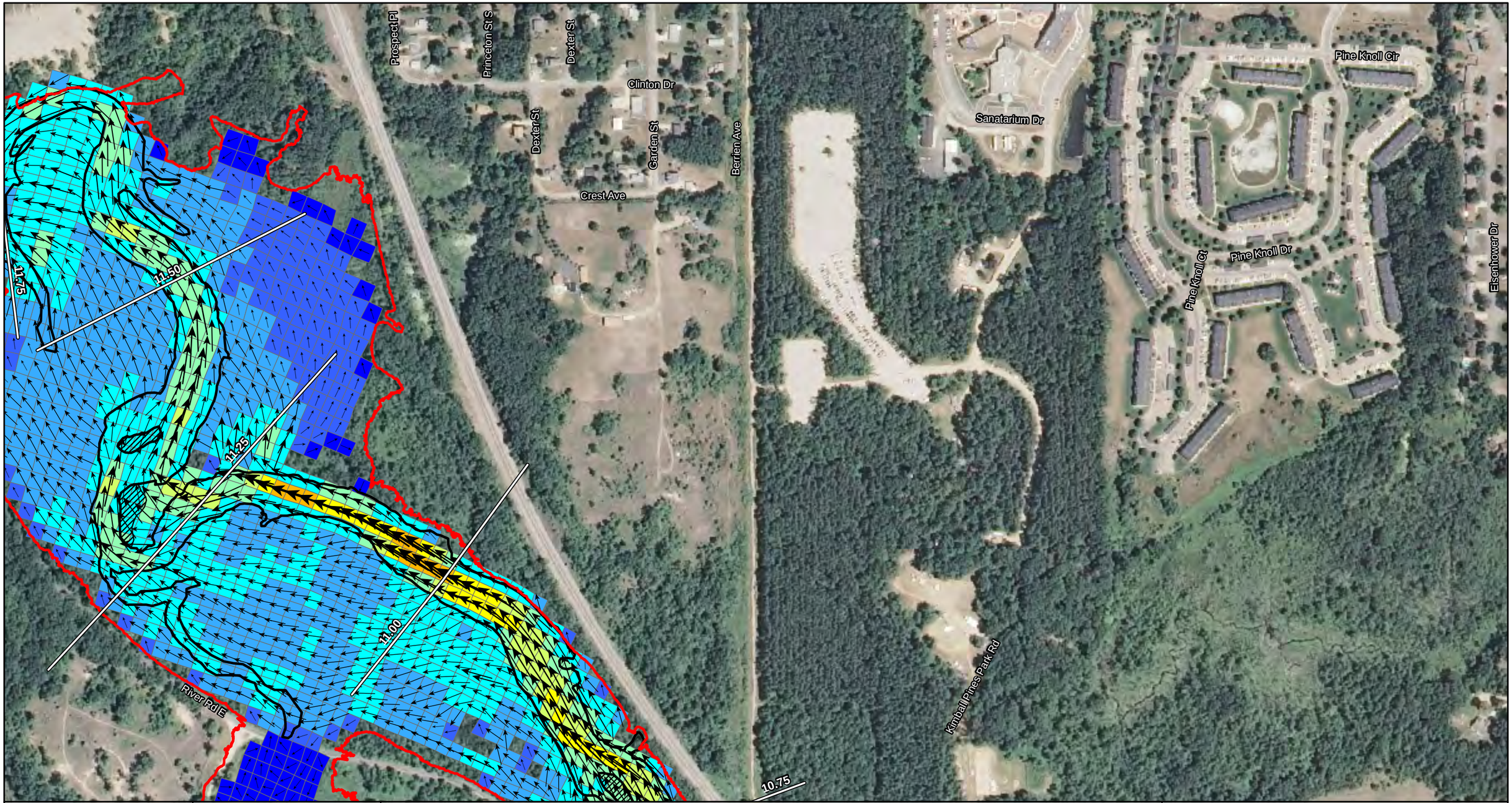
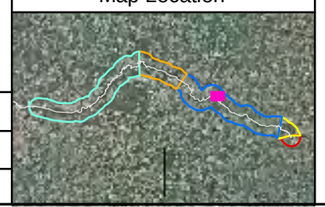
Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 10.80 - MP 11.70

SHEET 10 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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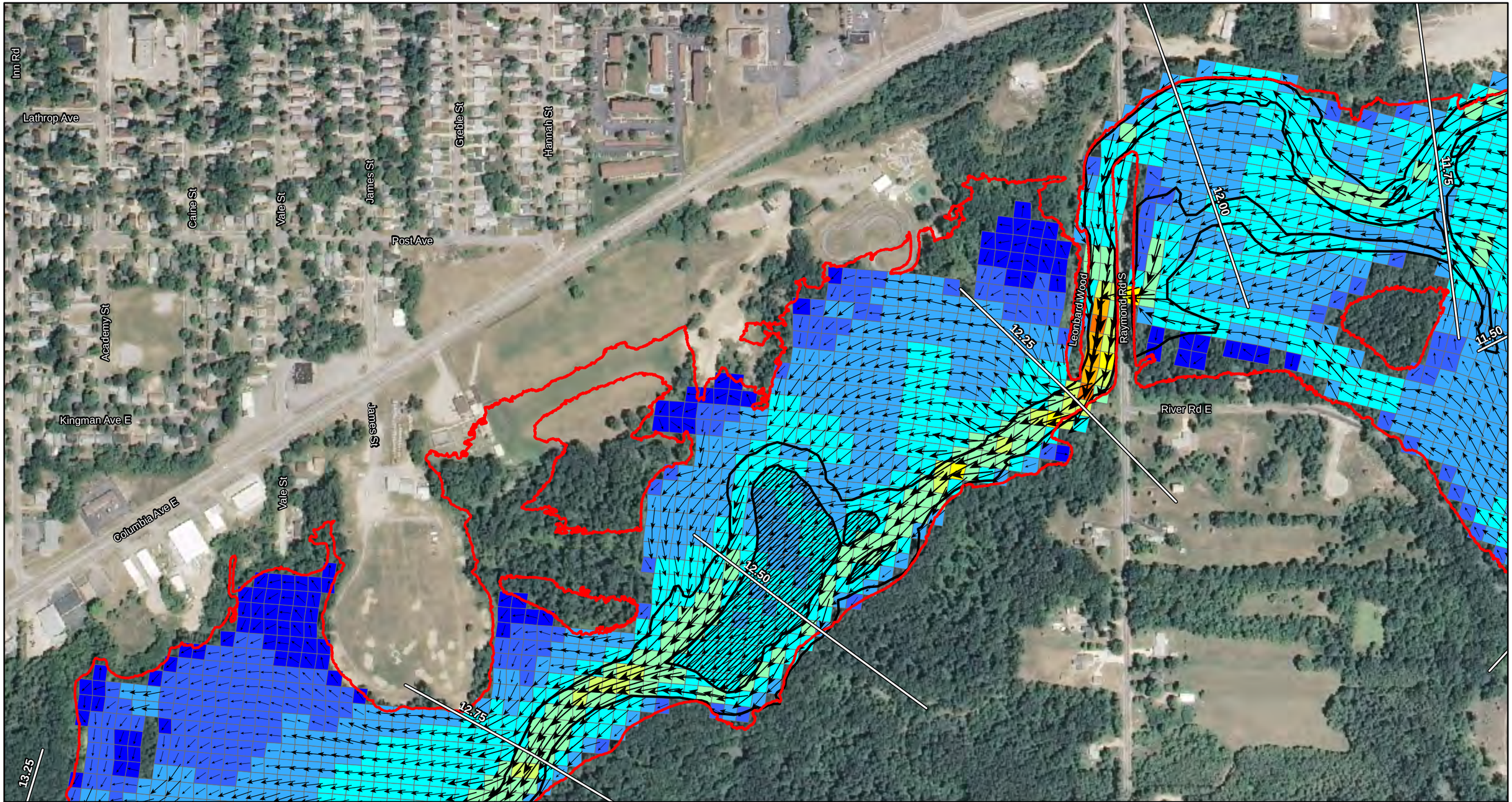
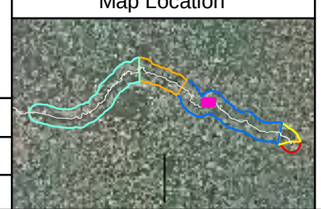
Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

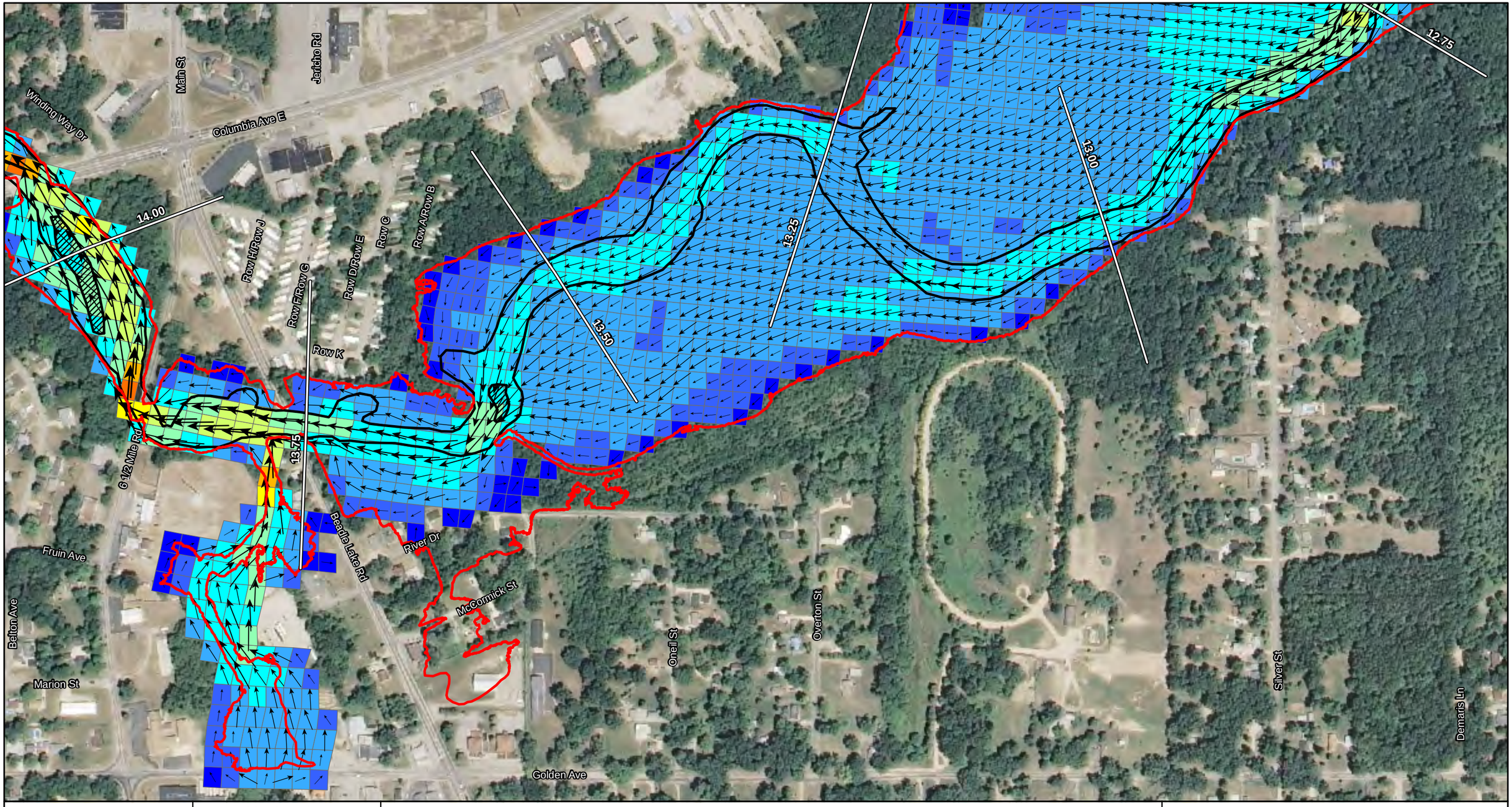
MP 11.70 - MP 12.77

SHEET 11 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

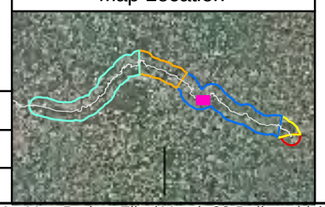
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

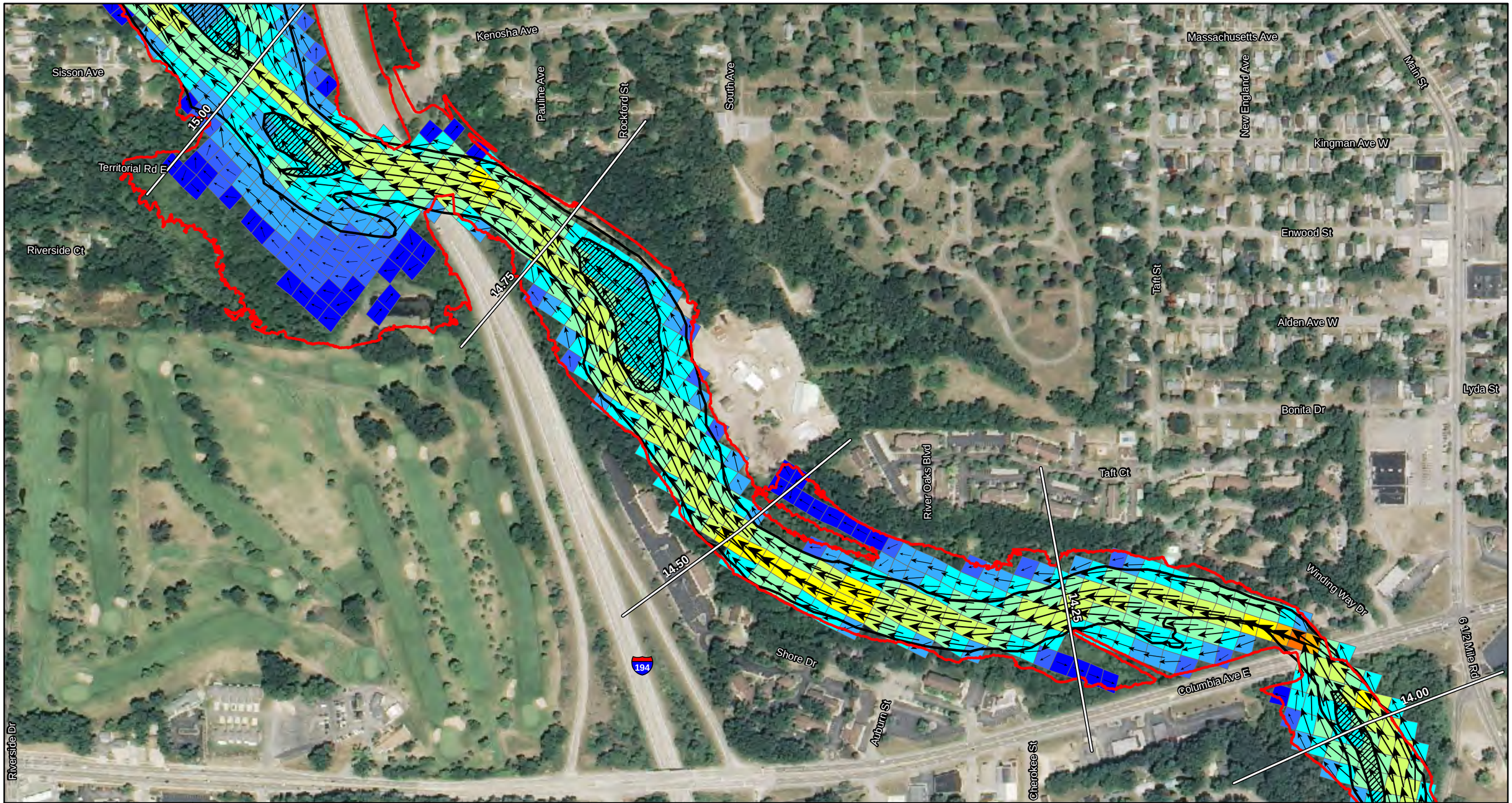
MP 12.77 - MP 14.00

SHEET 12 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 14.00 - MP 15.05

SHEET 13 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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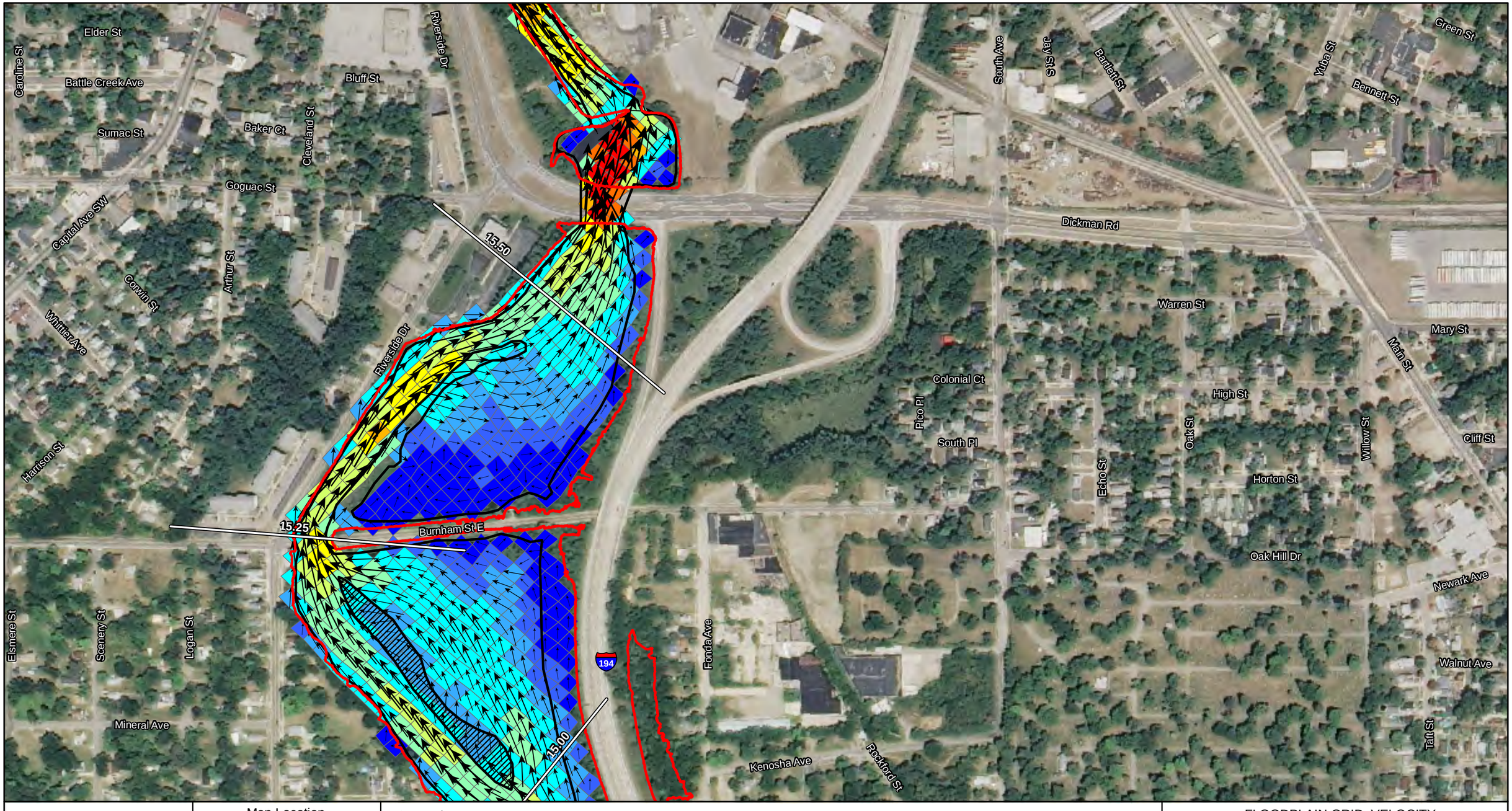
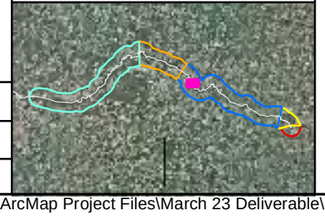
Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 15.05 - MP 15.71

SHEET 14 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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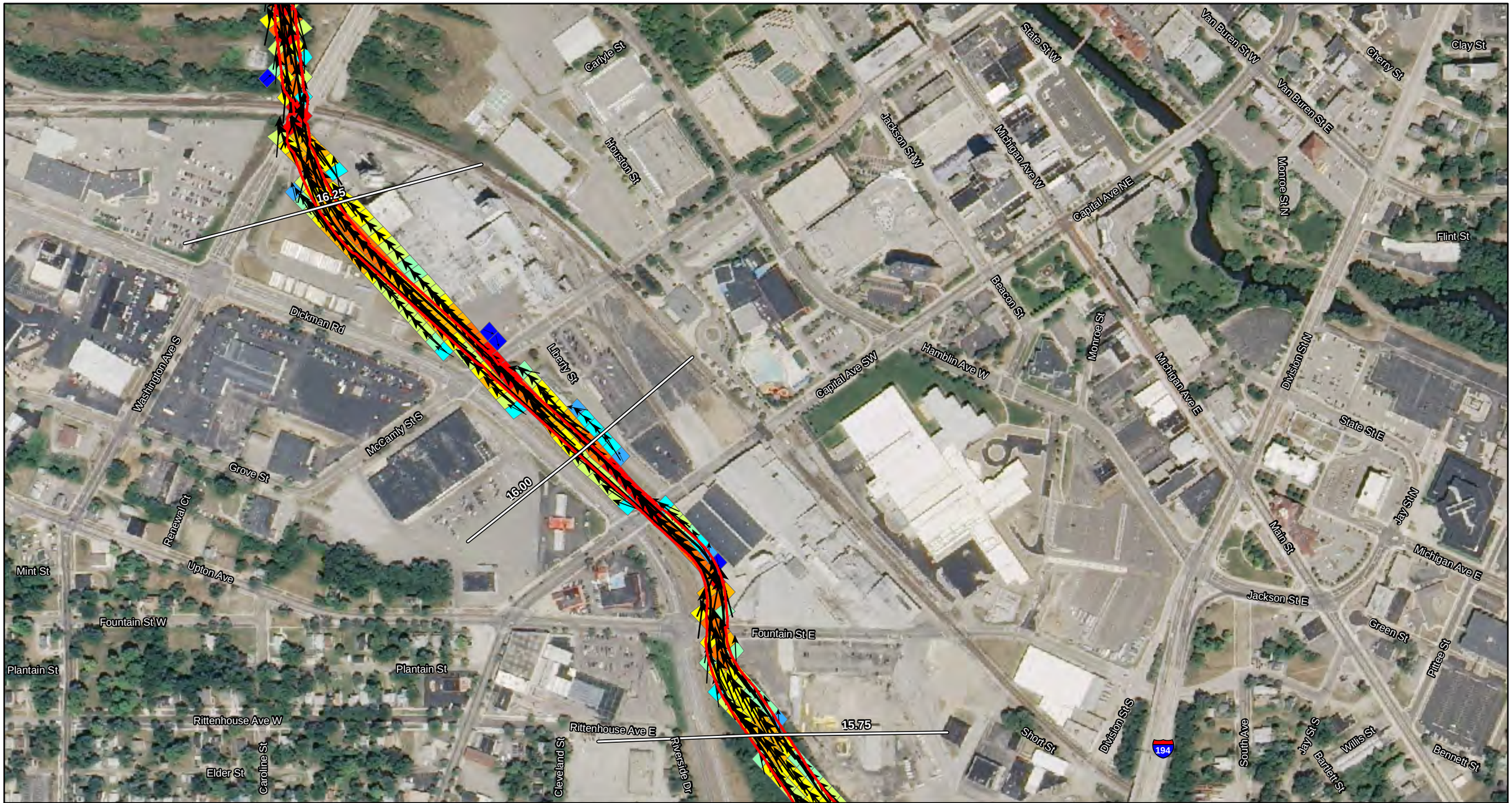
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 15.71 - MP 16.38

SHEET 15 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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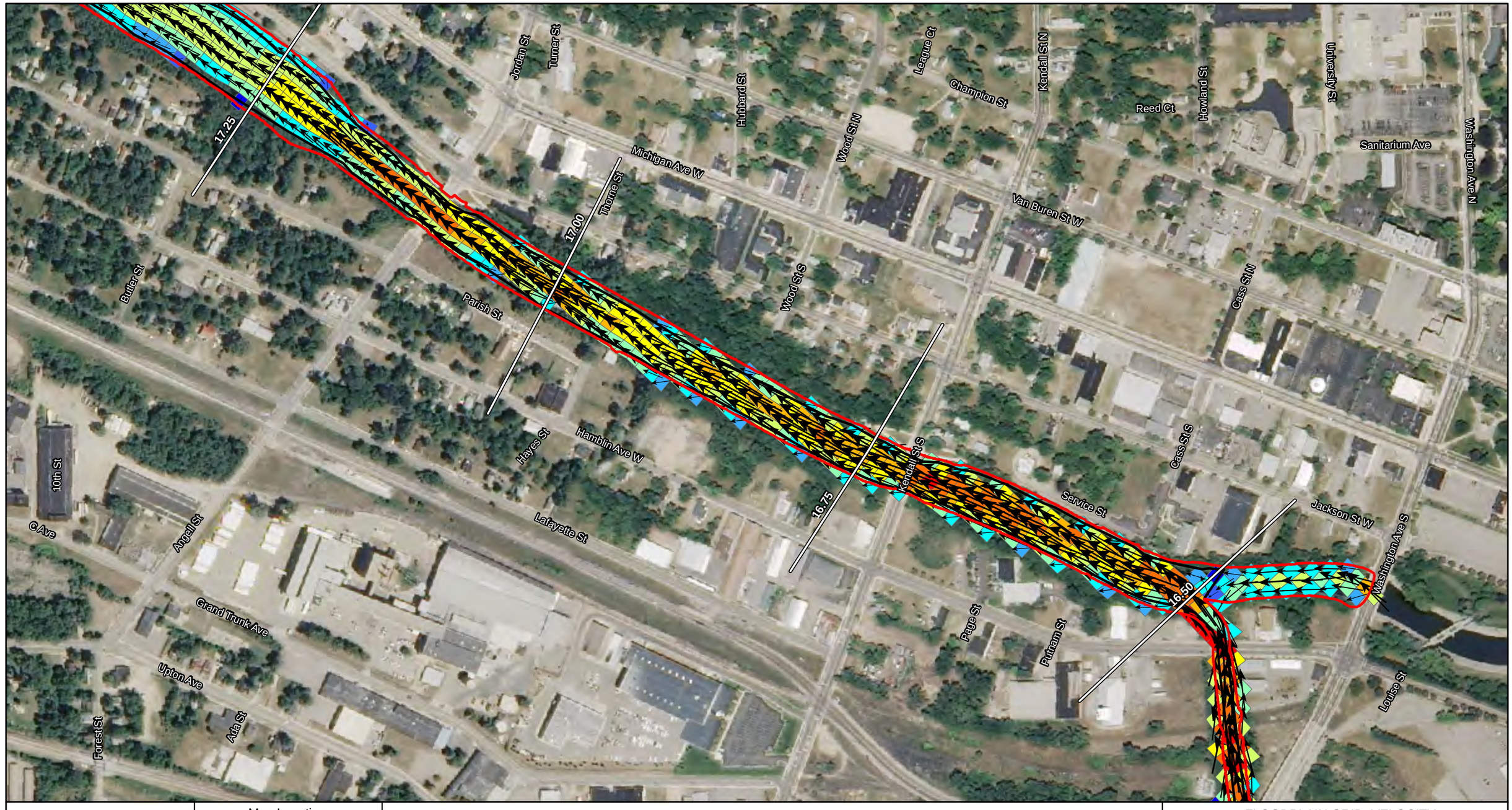
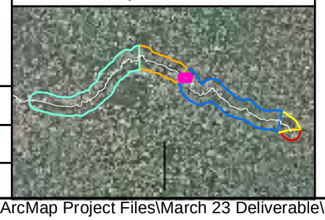
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 16.38 - MP 17.30

SHEET 16 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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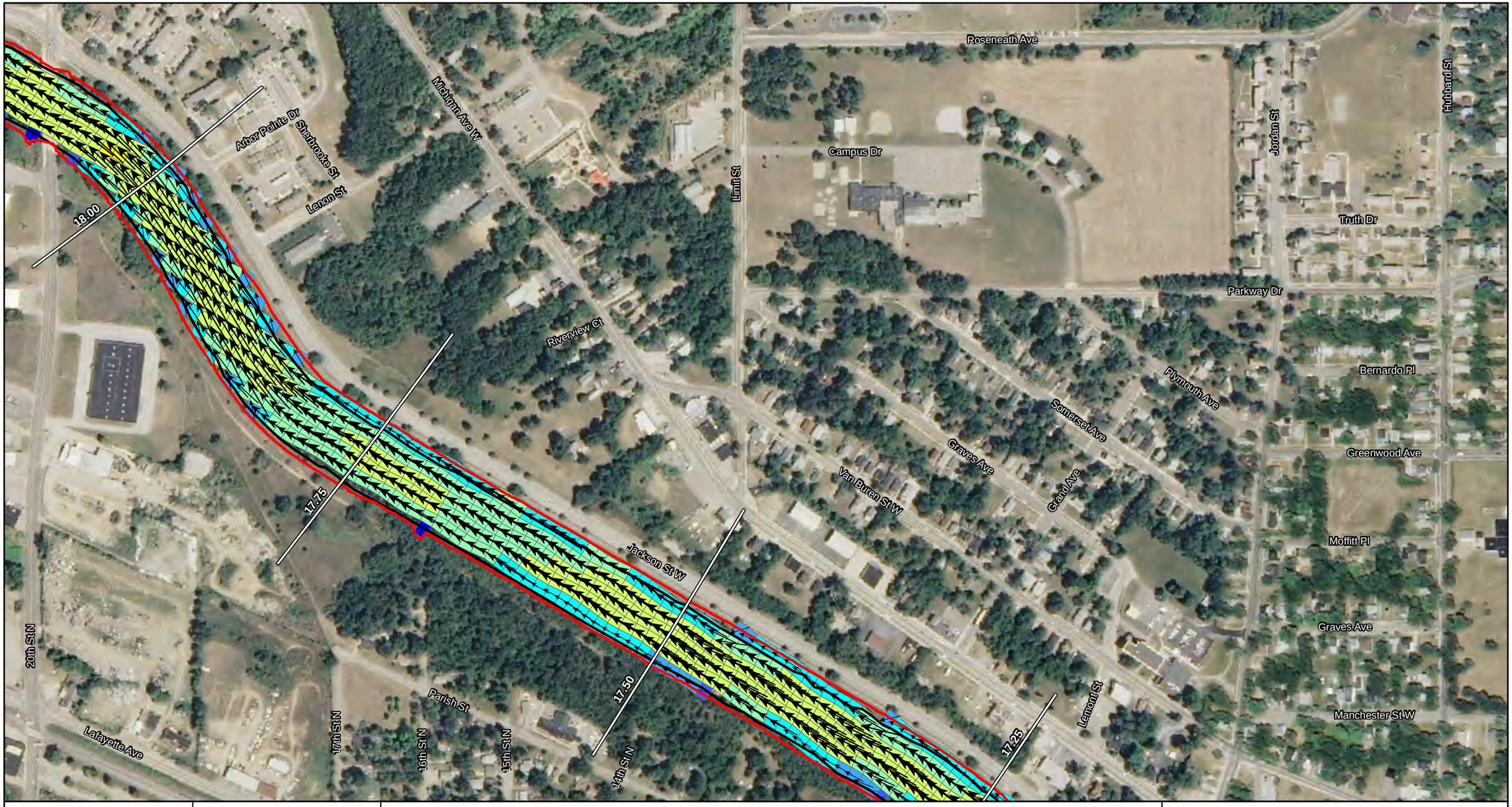
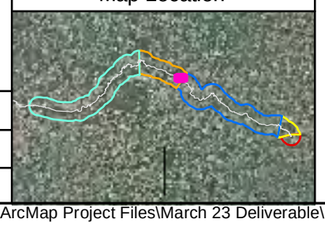
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 17.30 - MP 18.11

SHEET 17 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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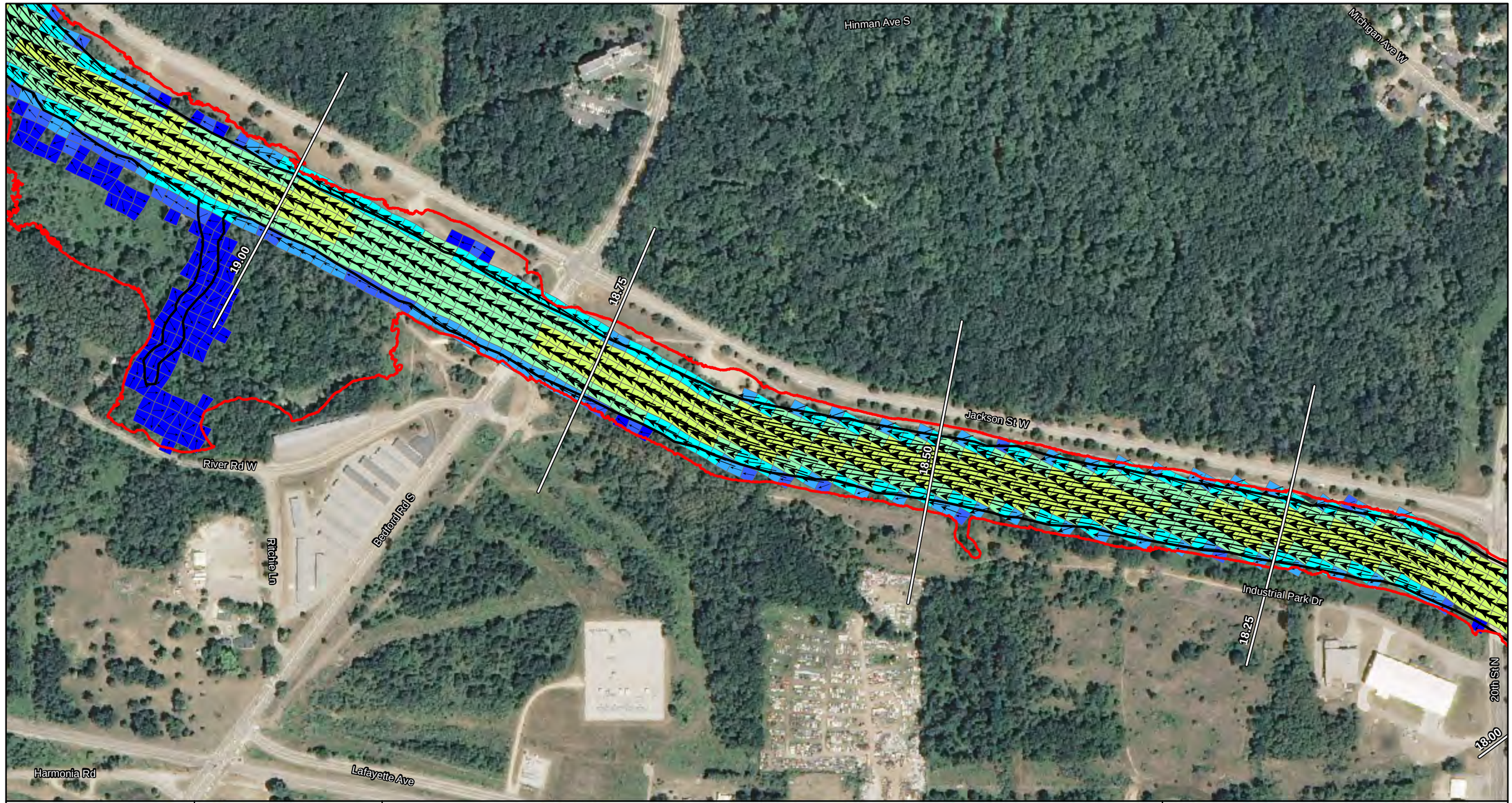
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 18.11 - MP 19.18

SHEET 18 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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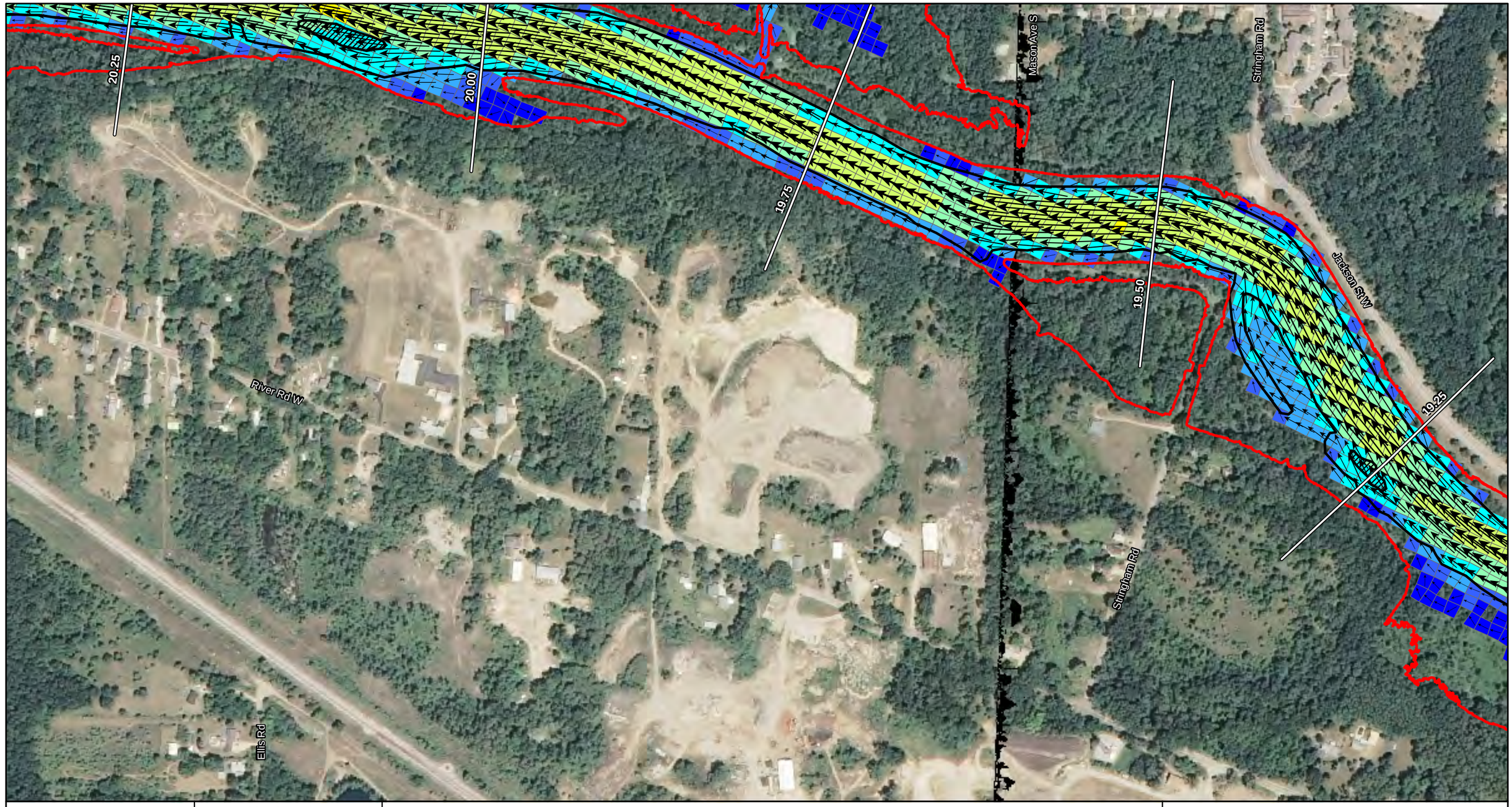
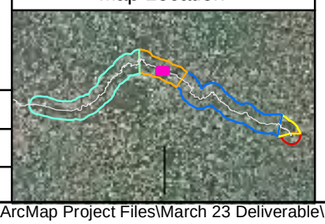
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 19.18 - MP 20.00

SHEET 19 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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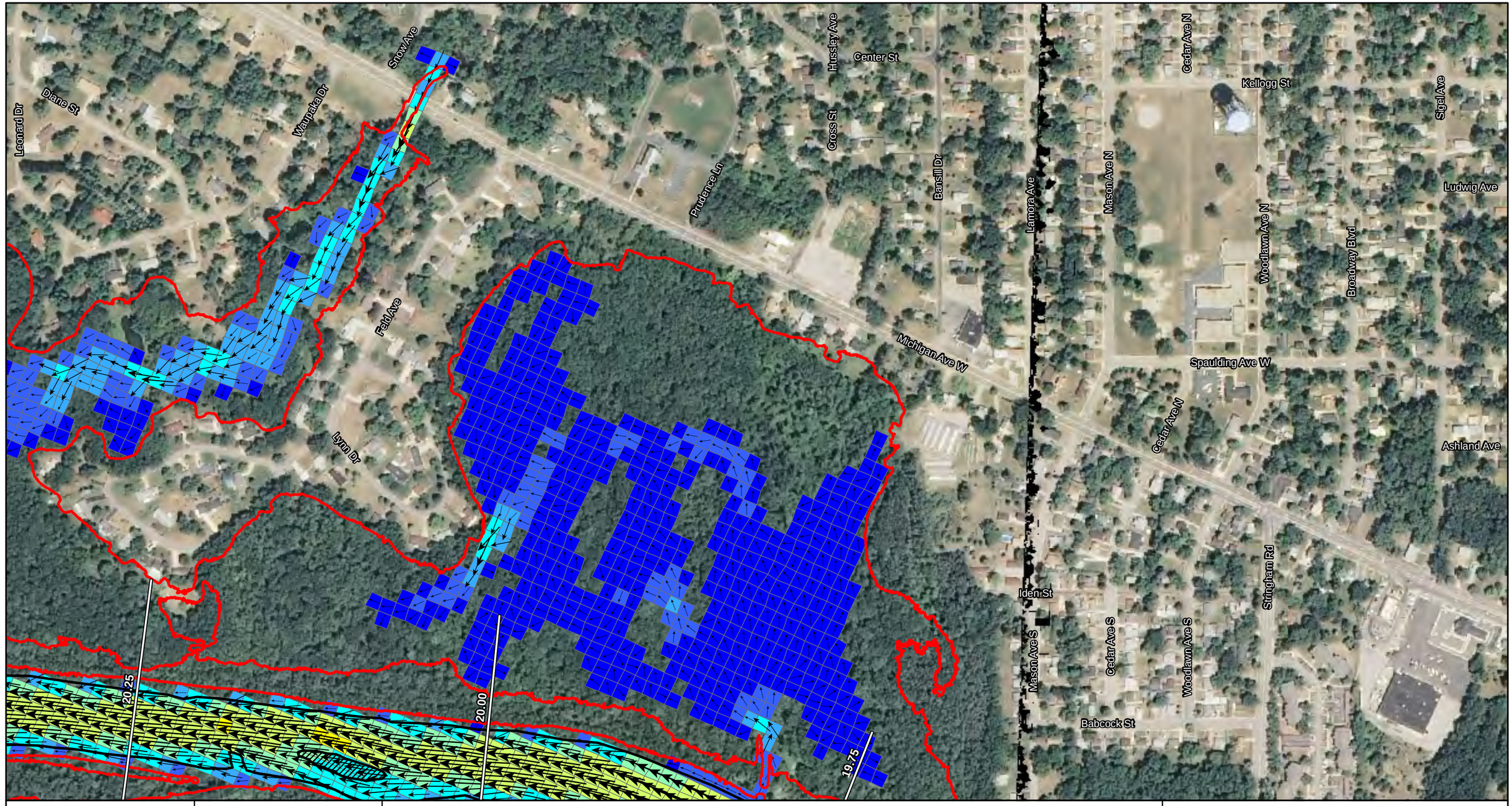
Aerial Photography Date: July & August 2009



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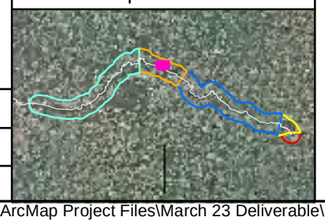

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 20.00 - MP 20.32

SHEET 20 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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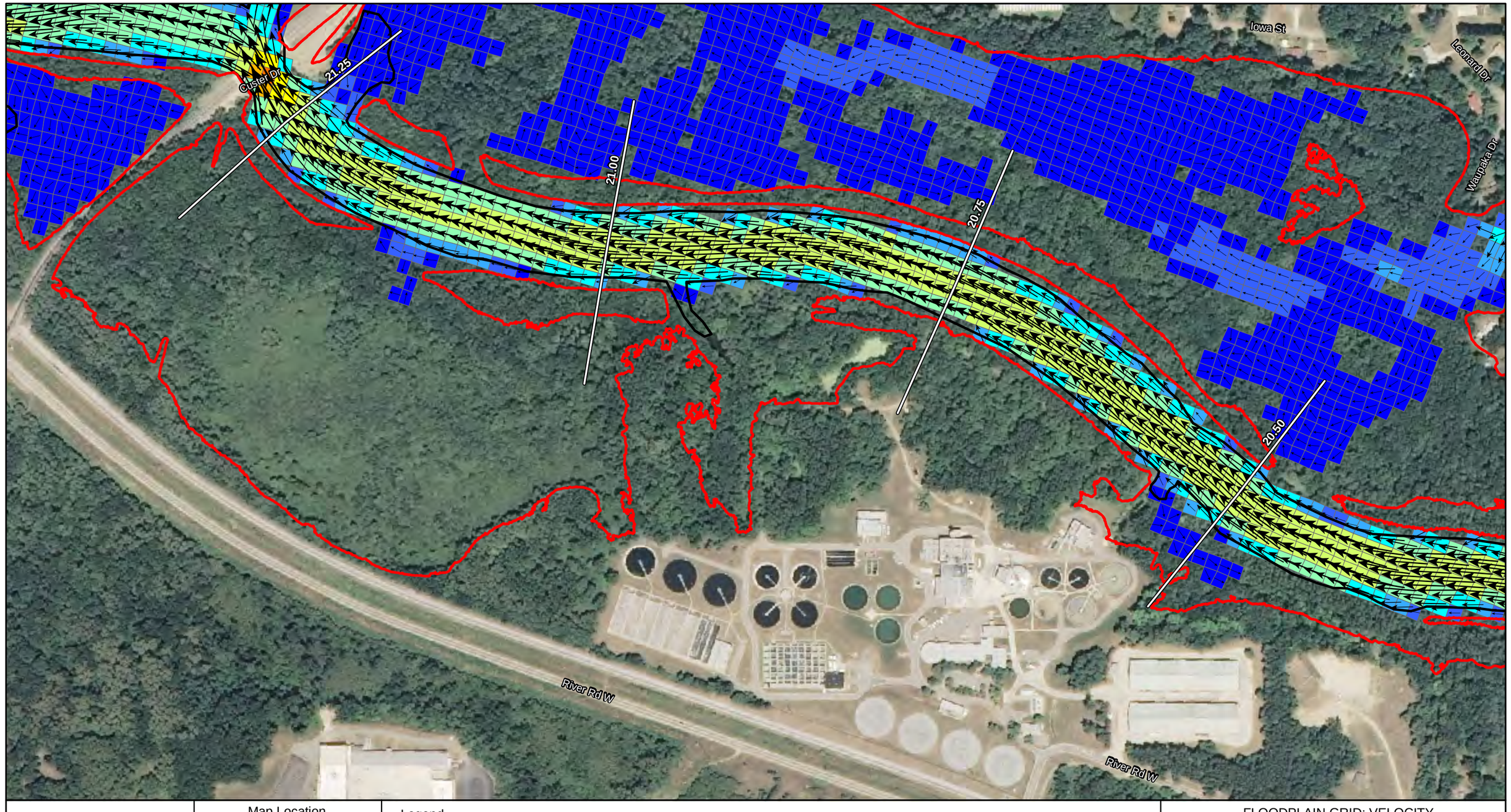
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 20.32 - MP 21.36

SHEET 21 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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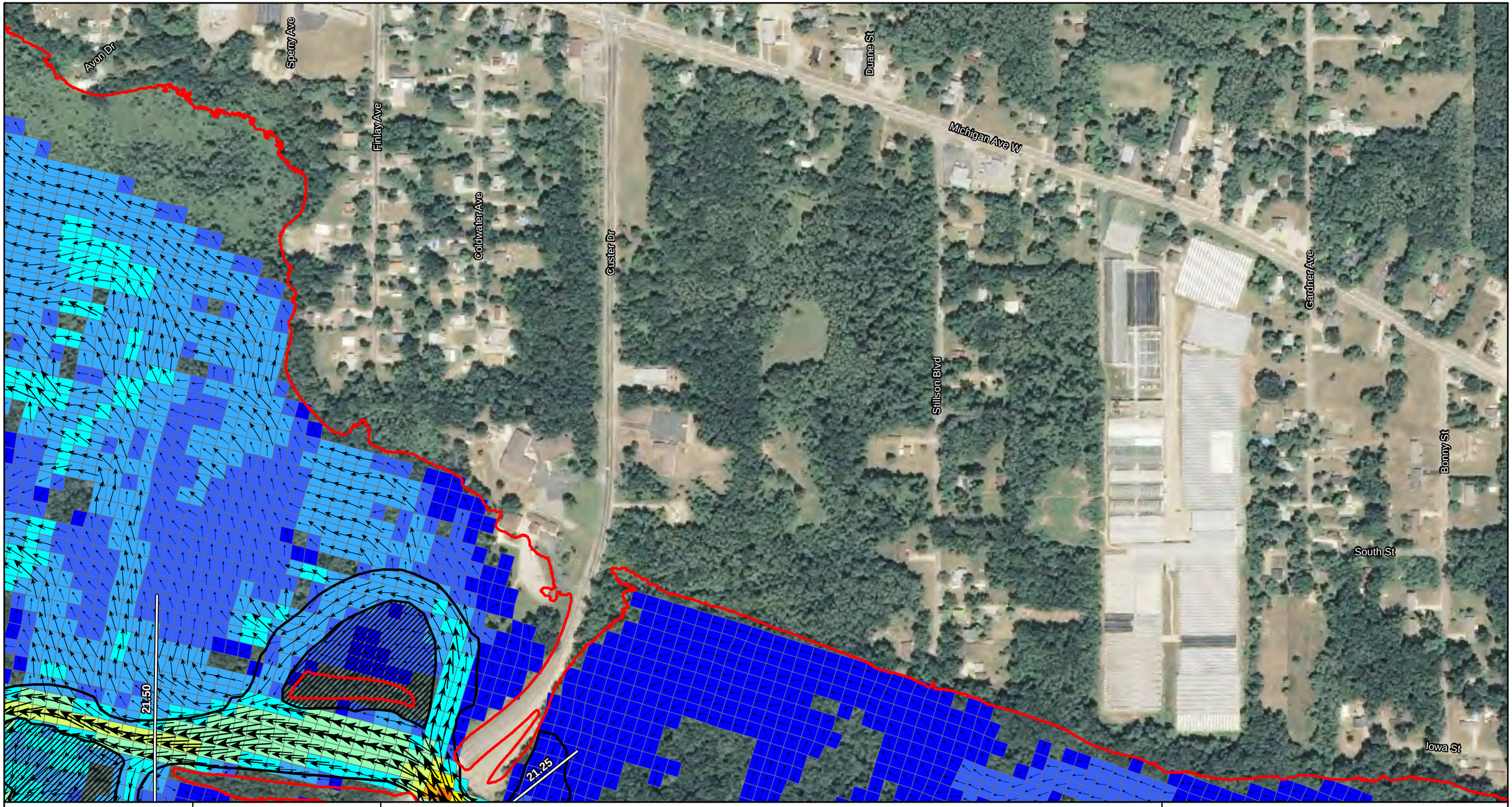
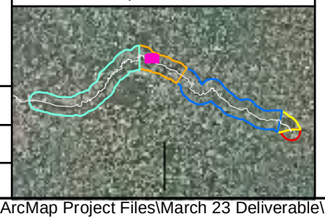
Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 21.36 - MP 21.59

SHEET 22 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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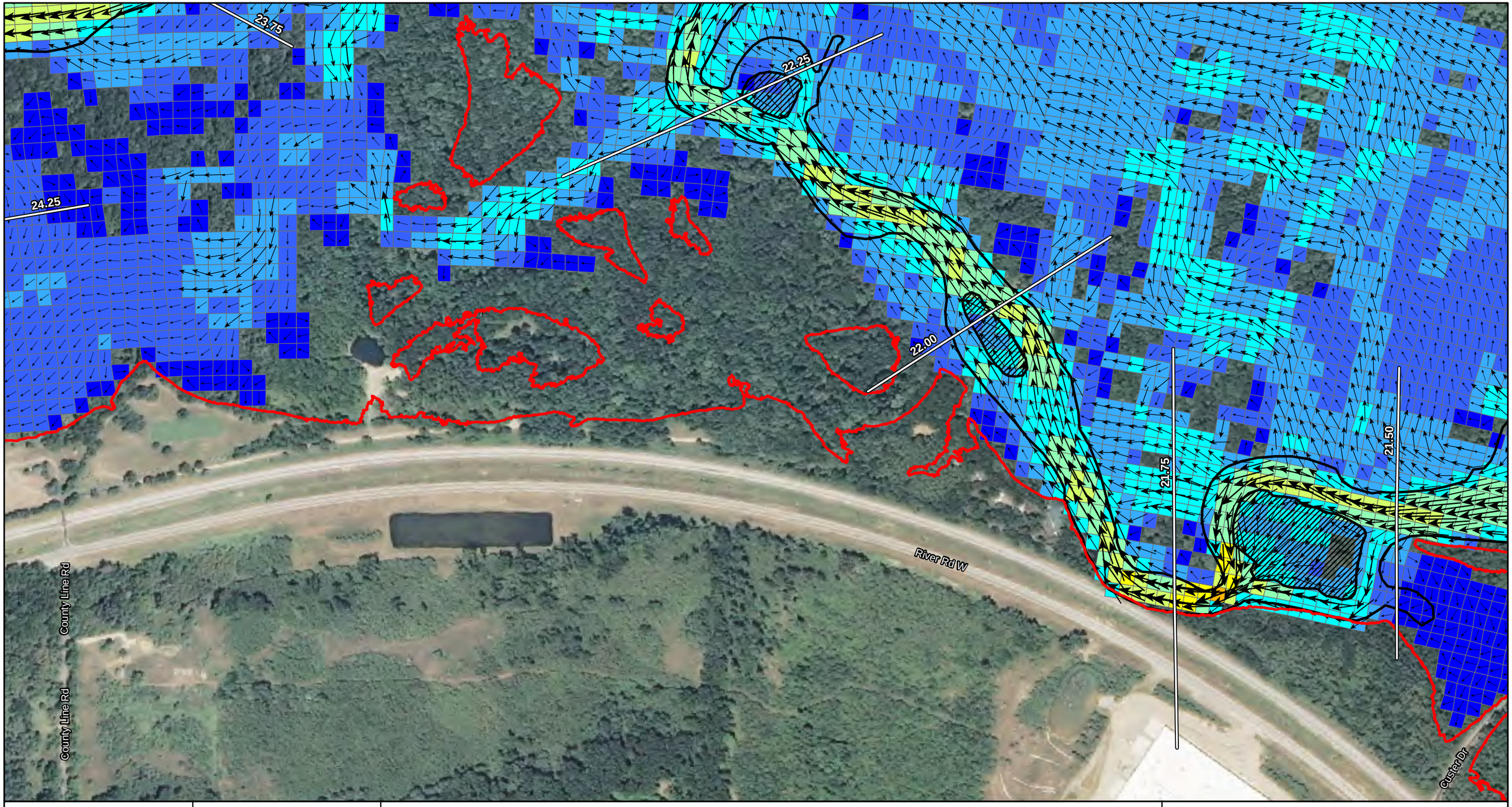
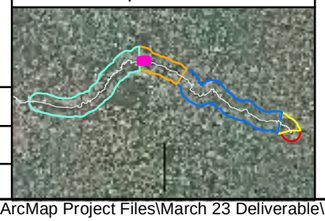
Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

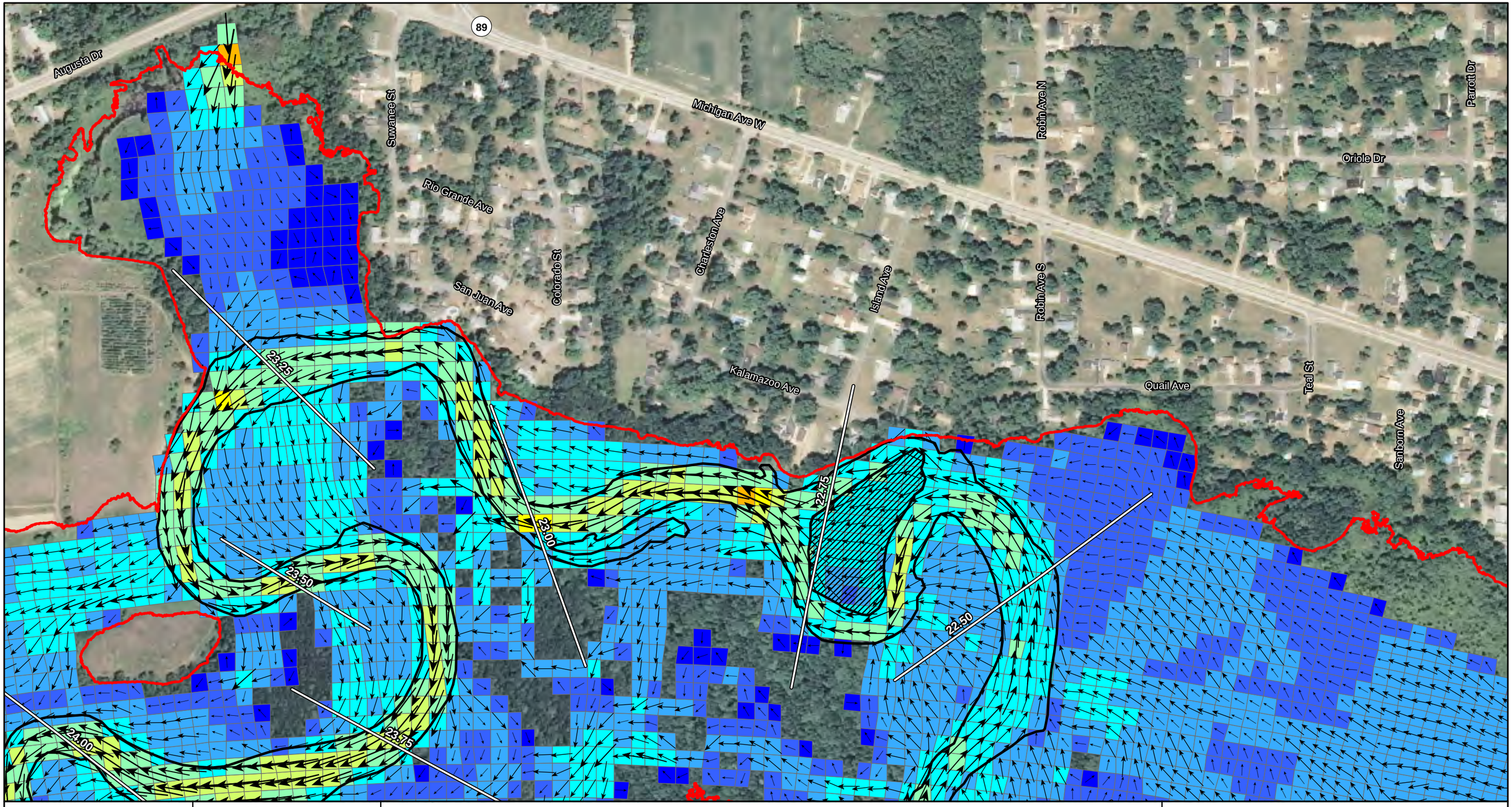
MP 21.59 - MP 22.33

SHEET 23 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

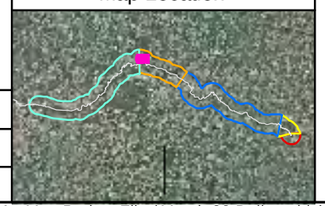
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

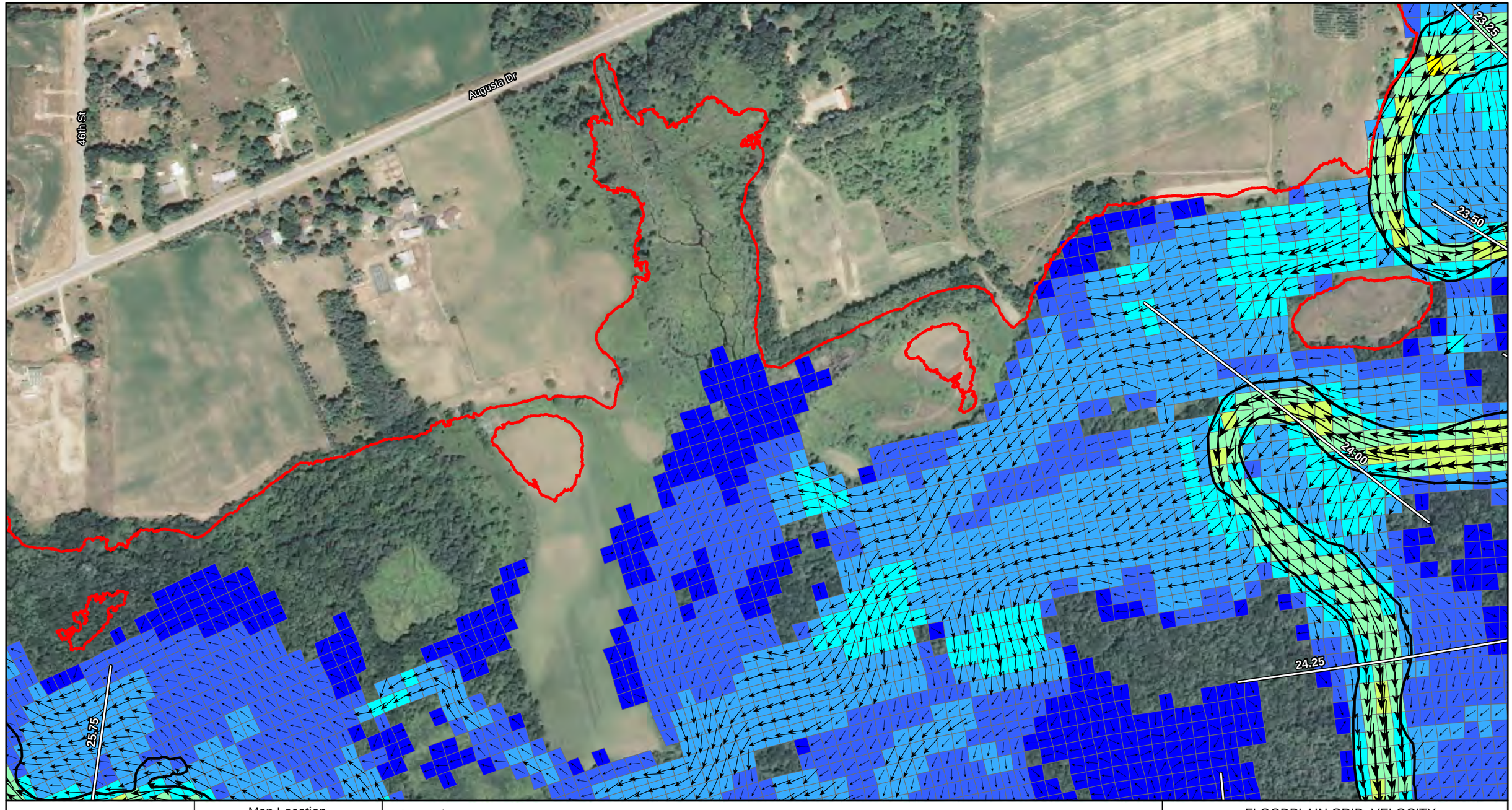
MP 22.33 - MP 24.01

SHEET 24 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

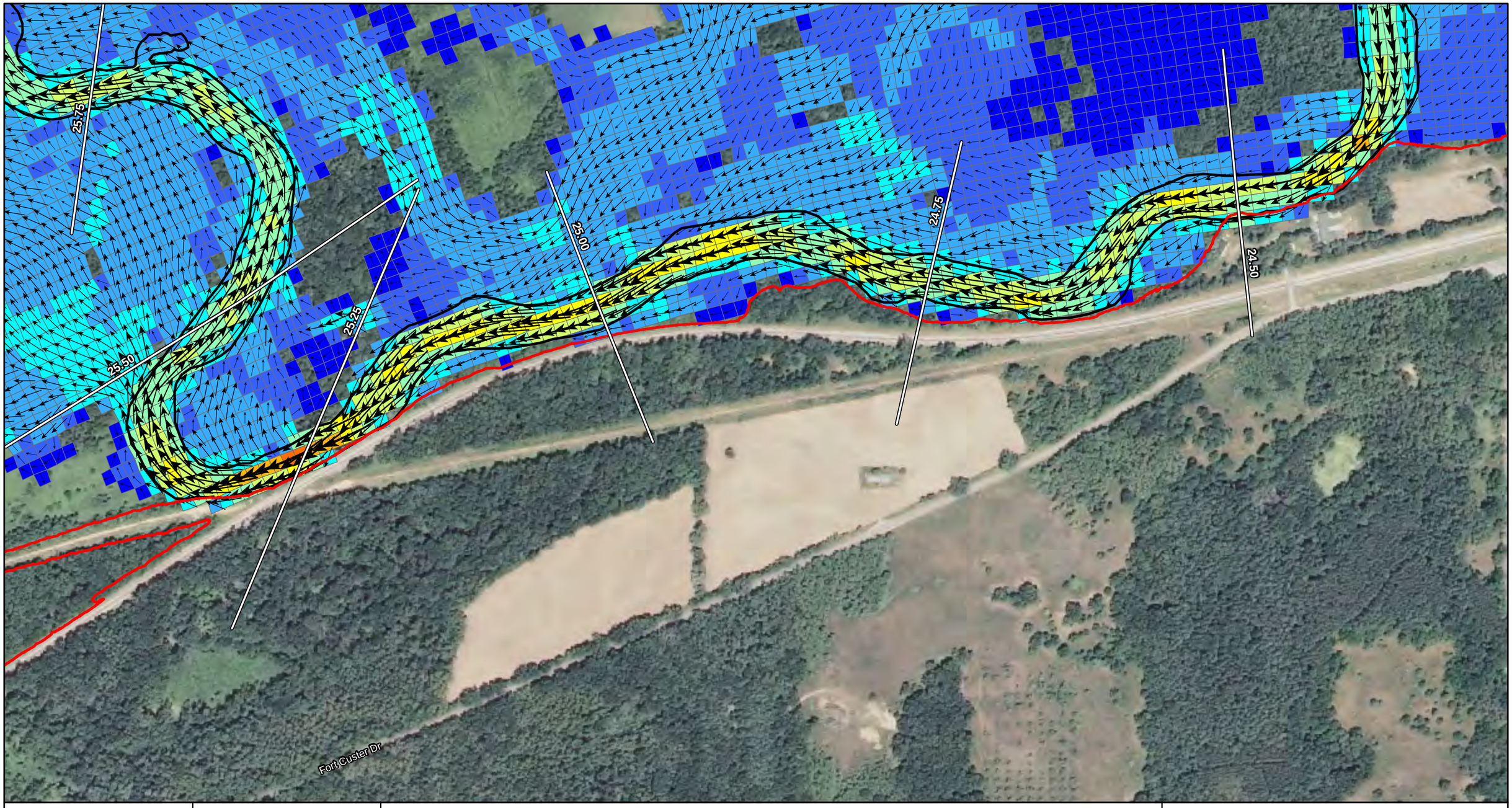
MP 24.01 - MP 24.33

SHEET 25 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

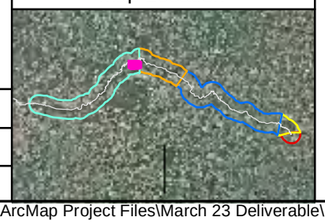
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

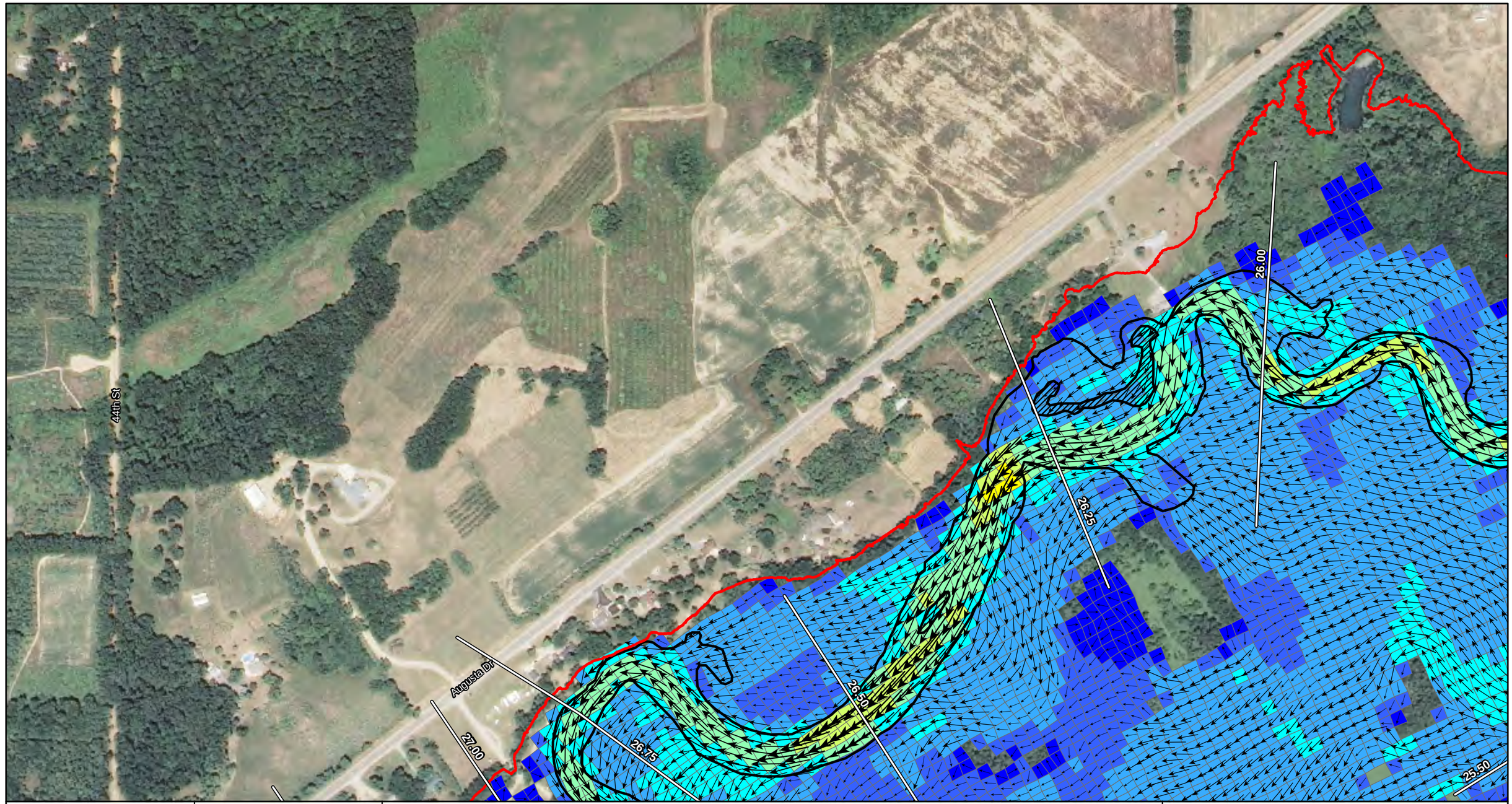
MP 24.33 - MP 25.79

SHEET 26 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

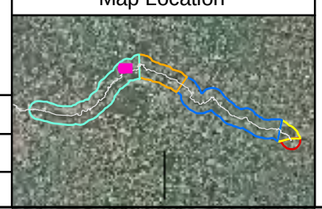
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

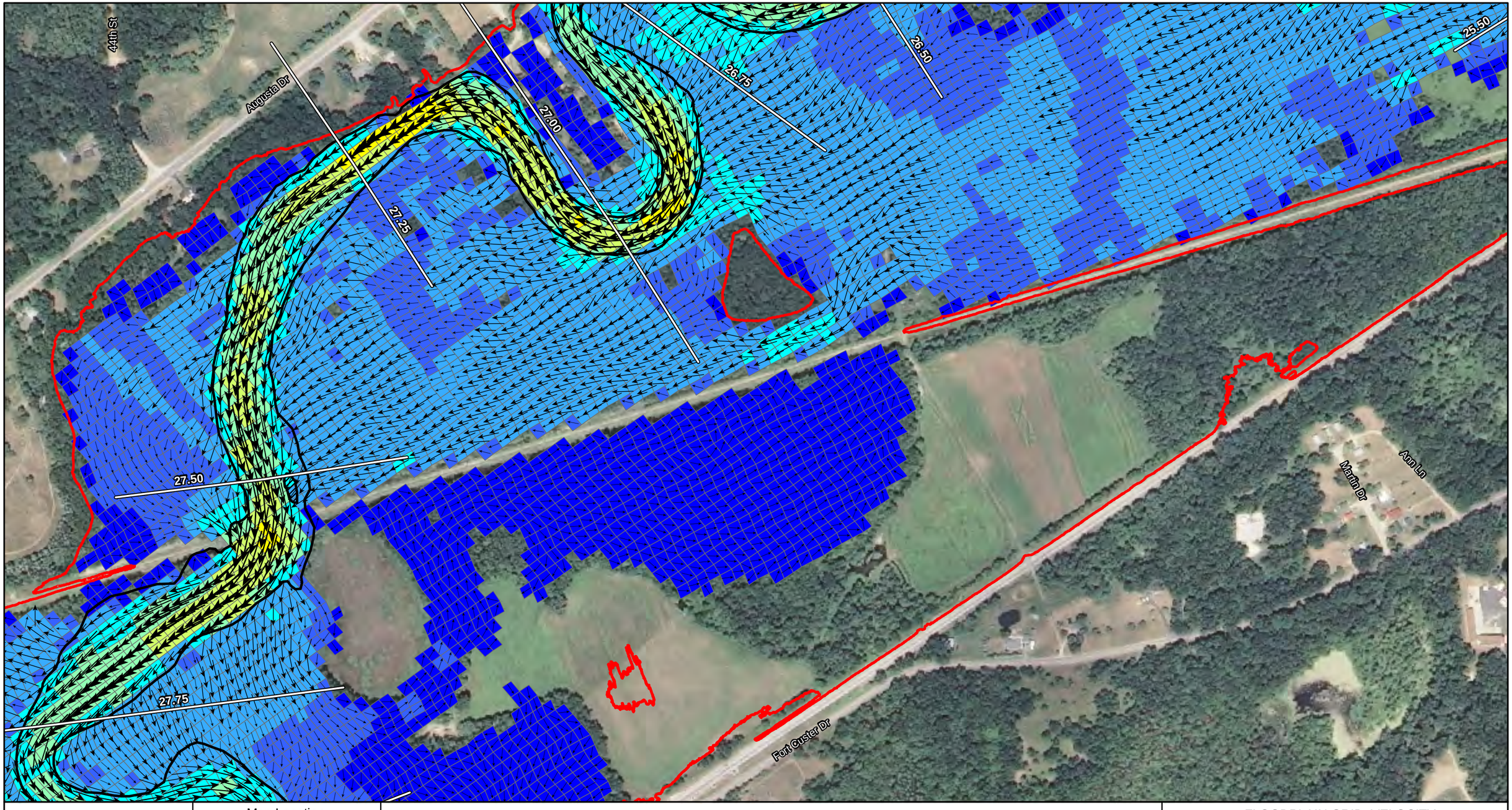
MP 25.79 - MP 26.80

SHEET 27 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

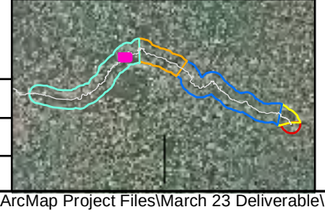
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

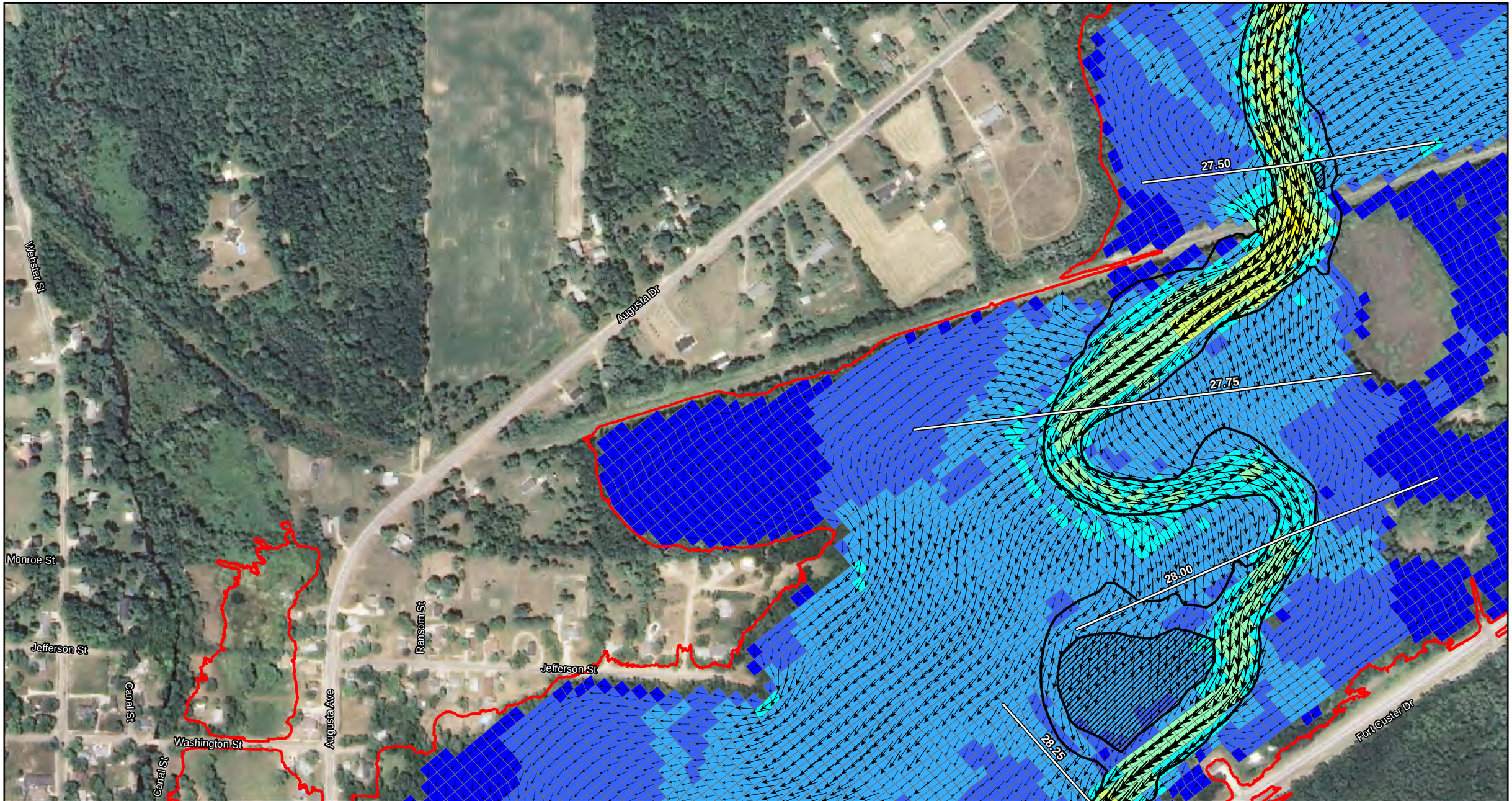
MP 26.80 - MP 27.80

SHEET 28 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

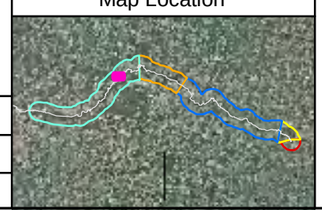
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 26.80 - MP 27.80

SHEET 29 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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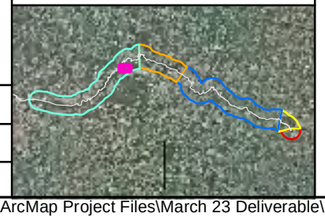
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 27.80SE - MP 28.22SE

SHEET 30 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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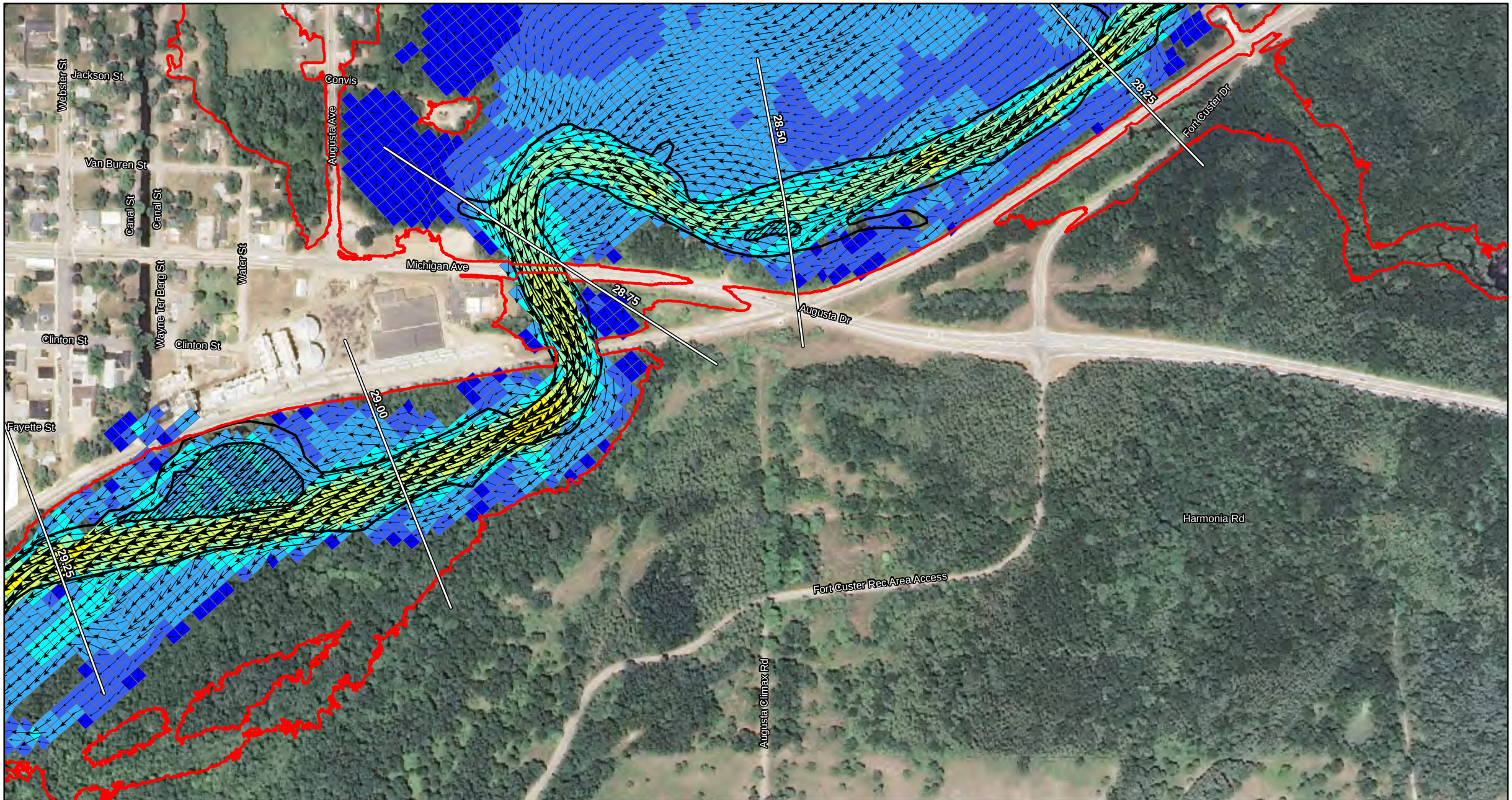
Aerial Photography Date: July & August 2009



Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 28.22 - MP 29.20

SHEET 31 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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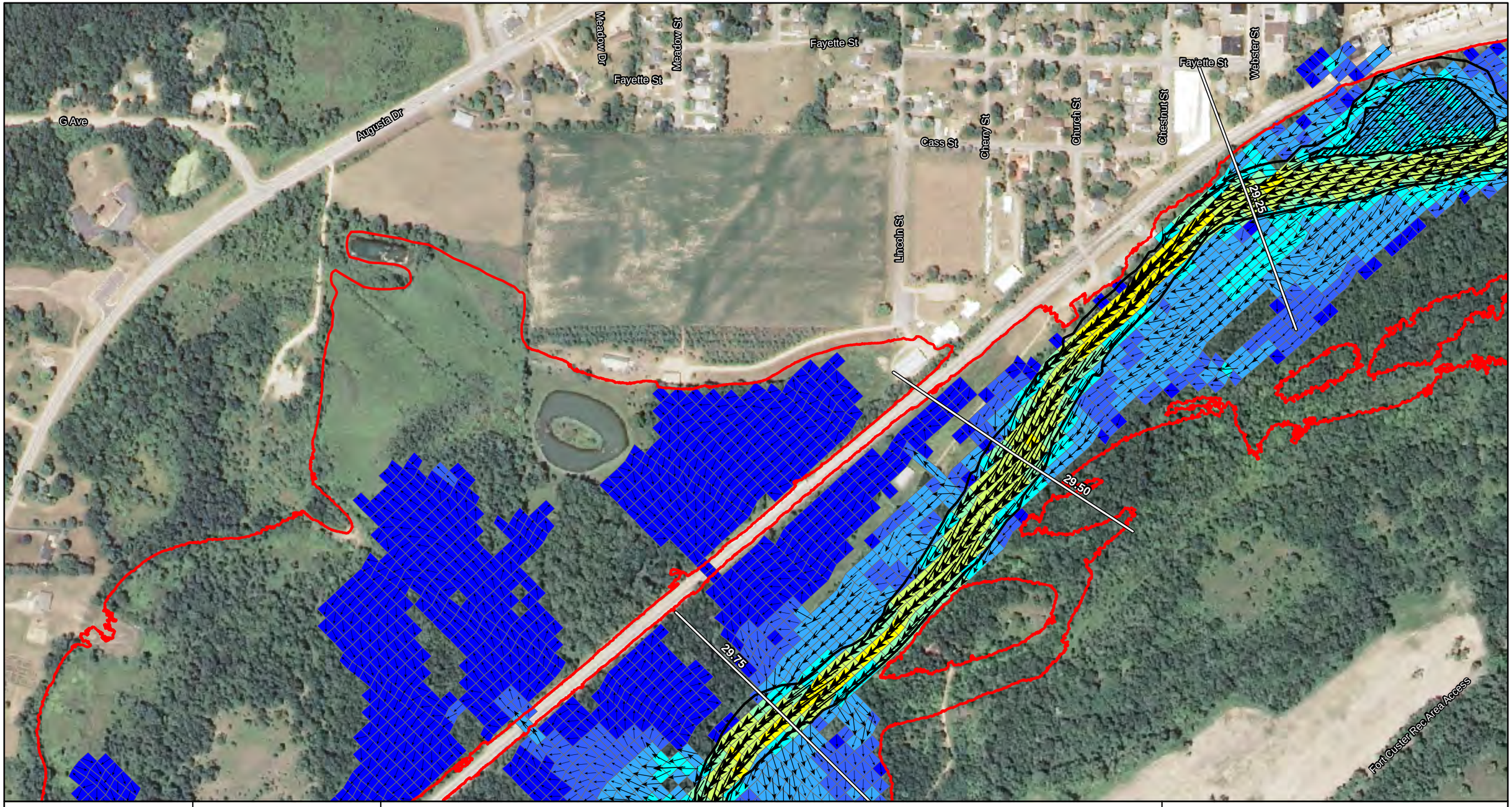
Aerial Photography Date: July & August 2009



Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 29.20 - MP 29.82

SHEET 32 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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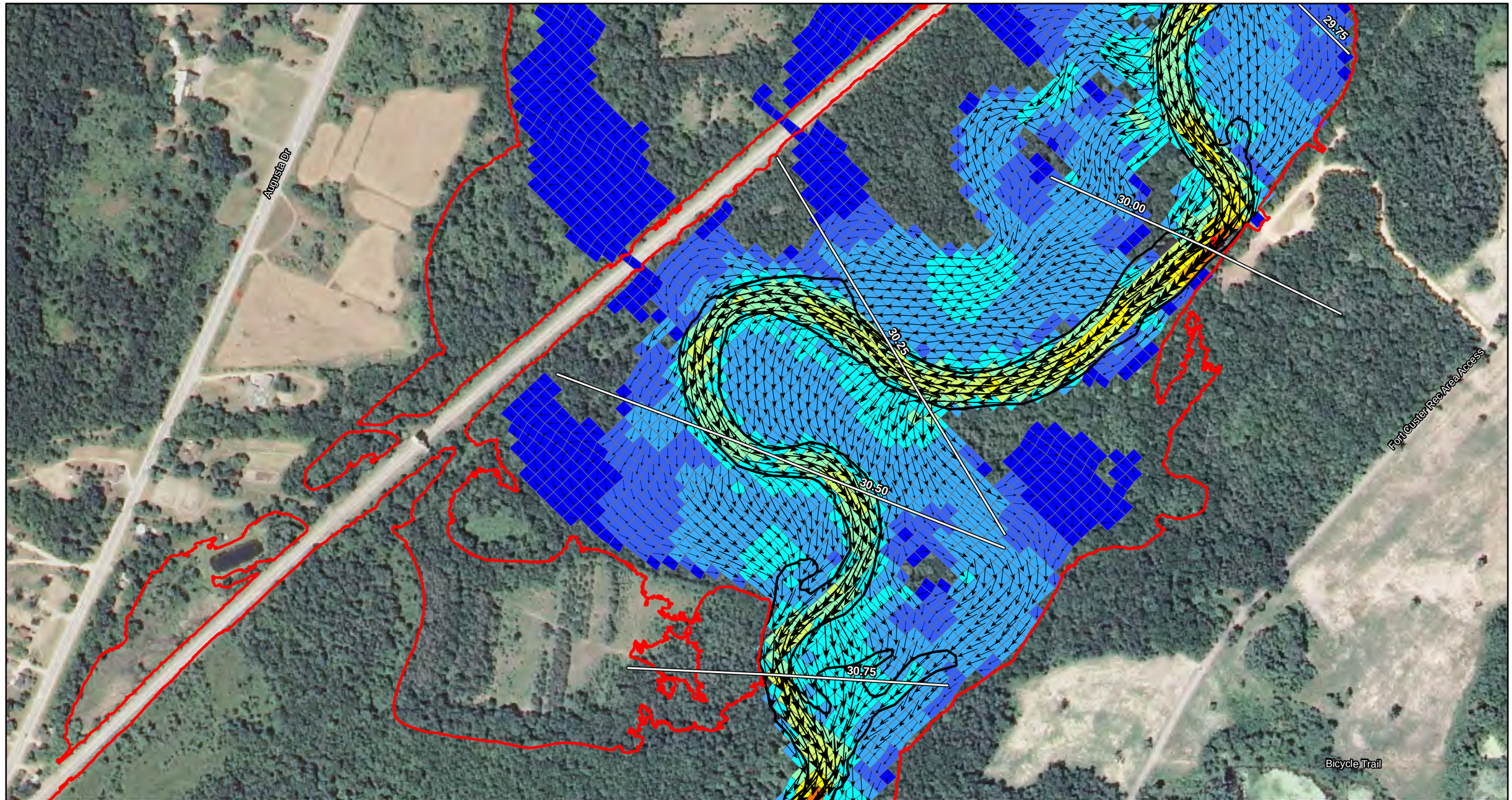
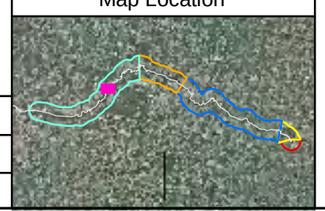
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 29.82 - MP 30.84

SHEET 33 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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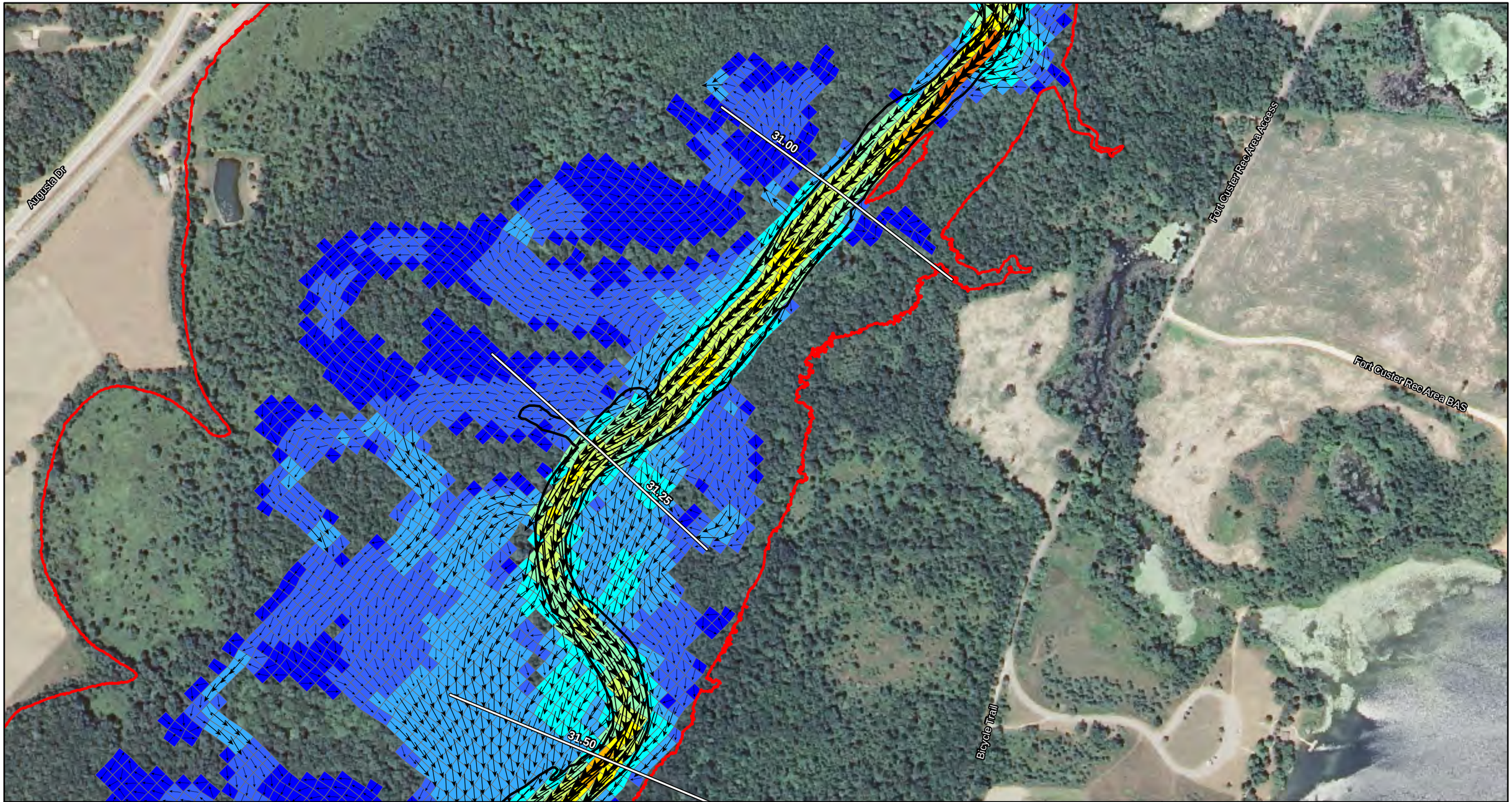
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 30.84 - MP 31.40

SHEET 34 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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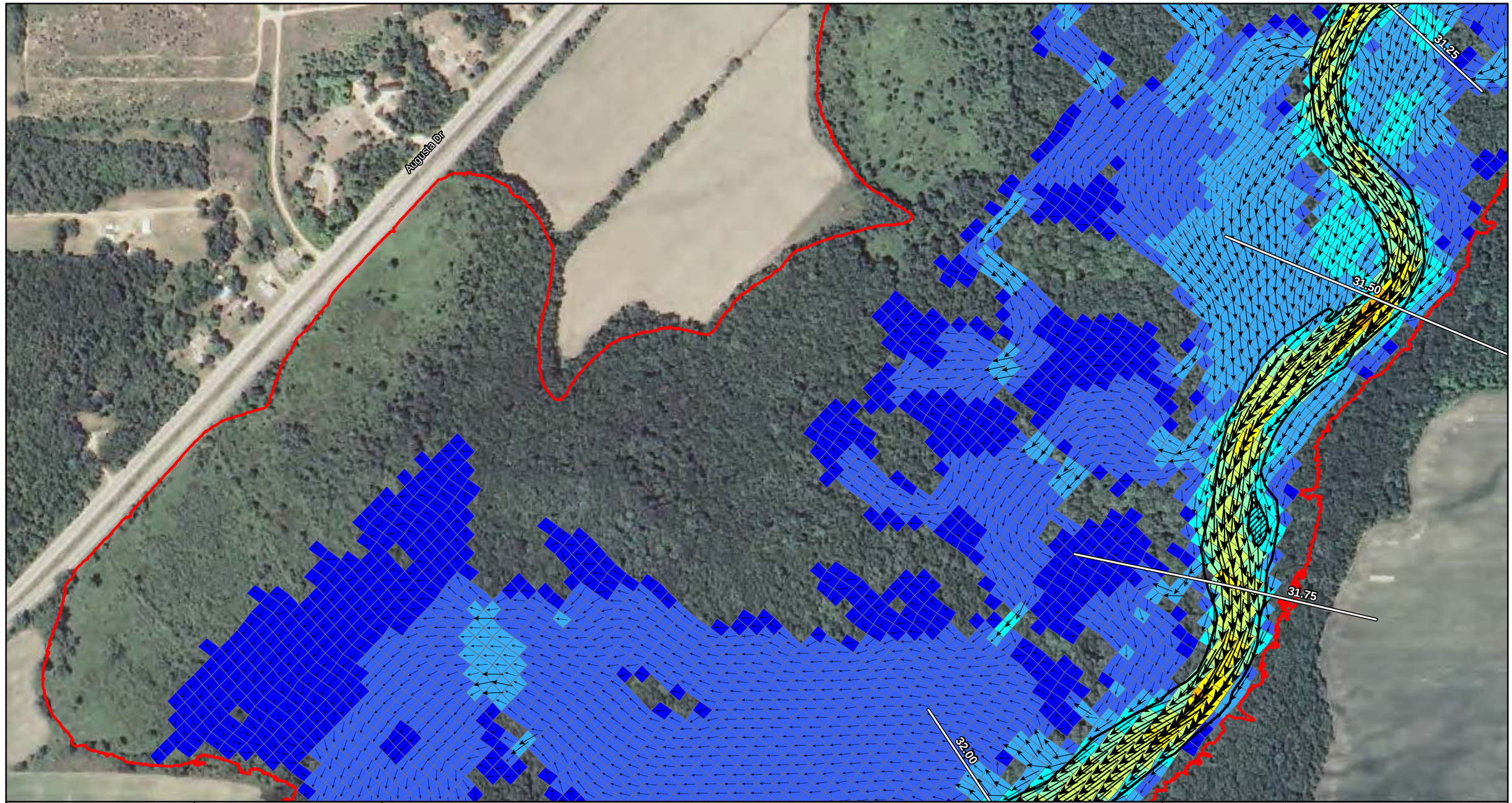
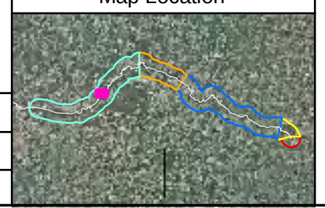
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 31.40 - MP 31.94

SHEET 35 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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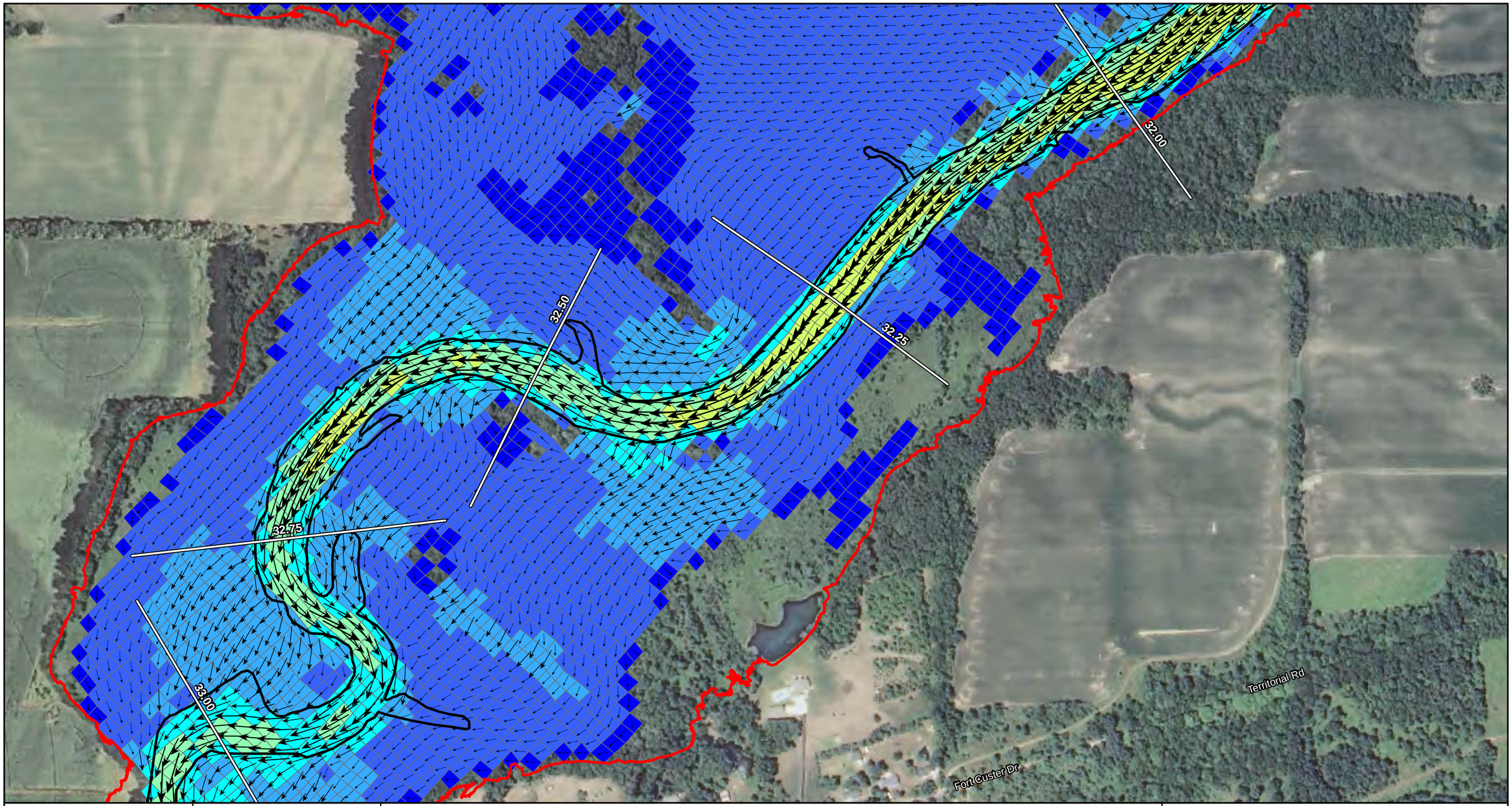
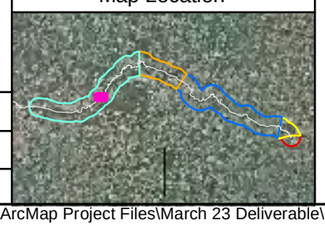
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

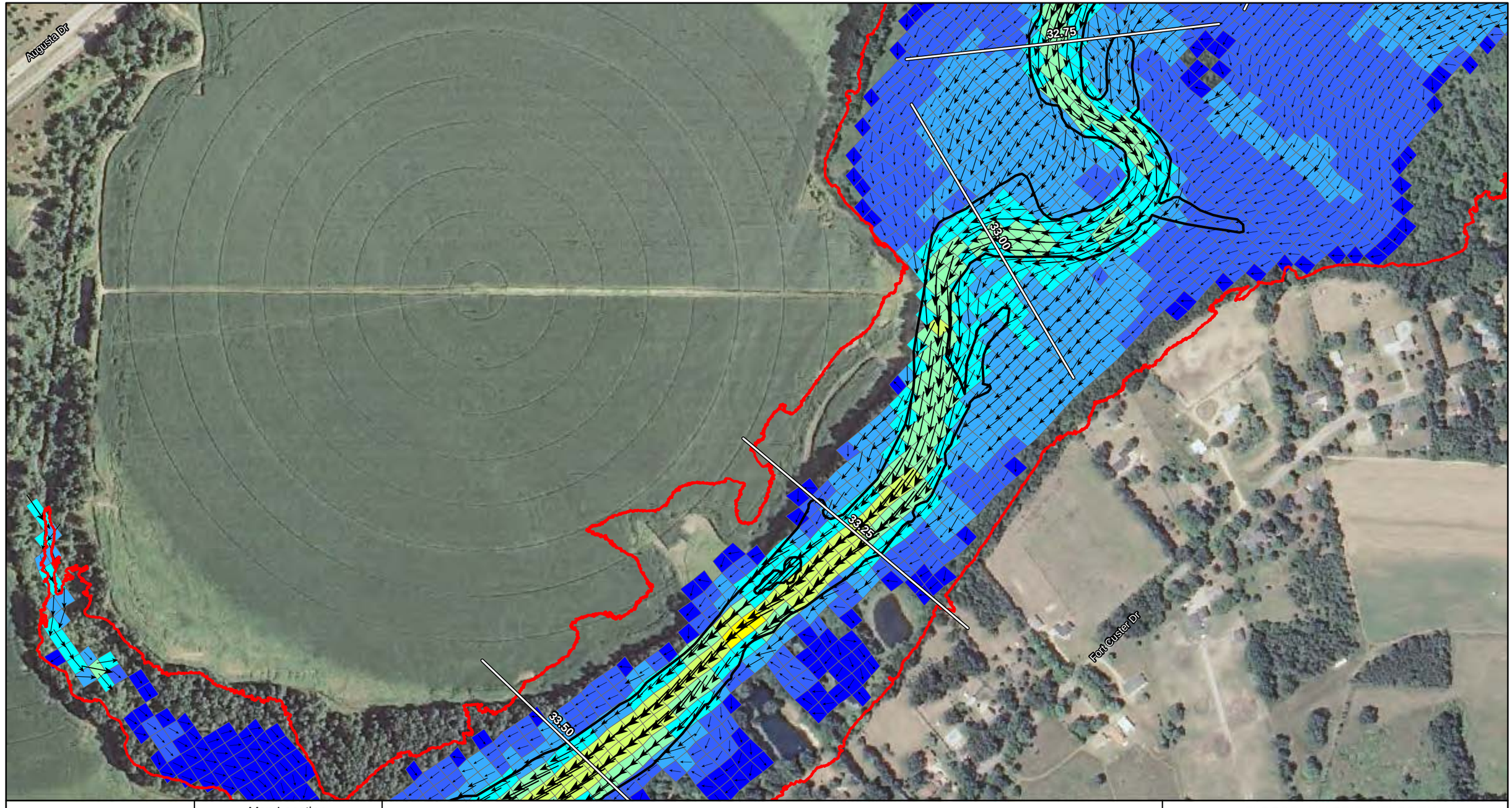
MP 31.94 - MP 33.00

SHEET 36 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

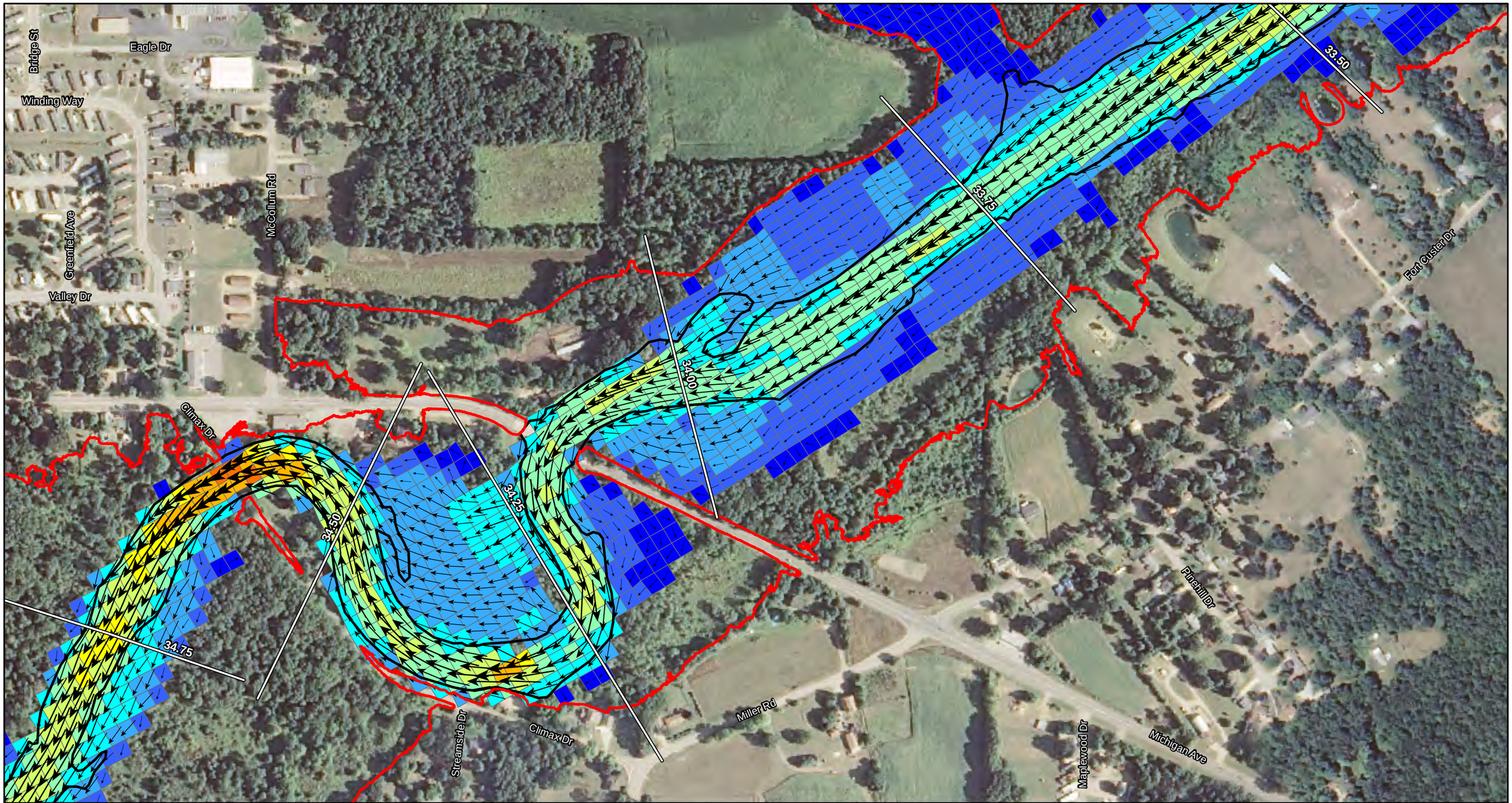
MP 33.00 - MP 33.52

SHEET 37 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

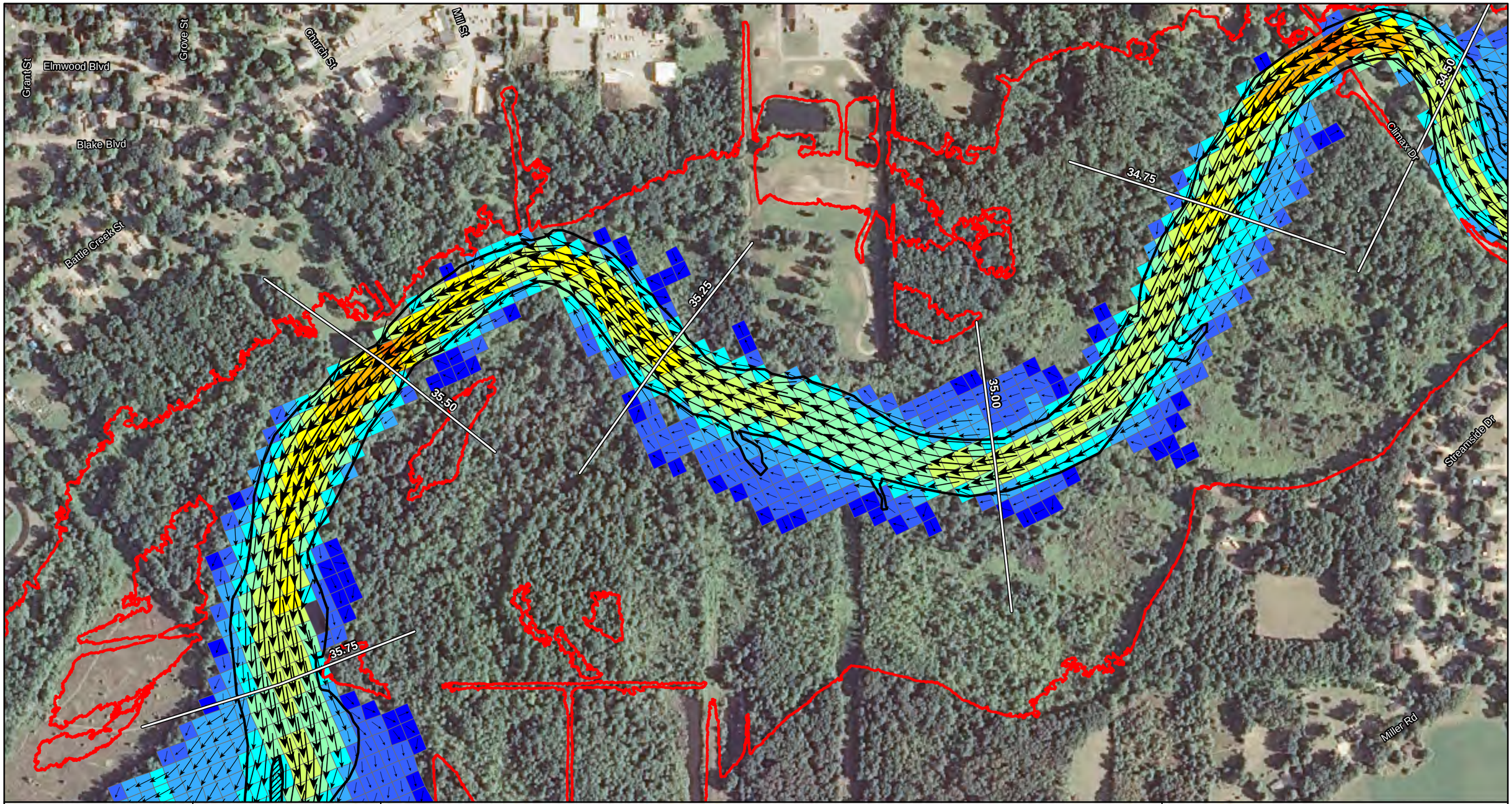
MP 33.52 - MP 34.70

SHEET 38 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

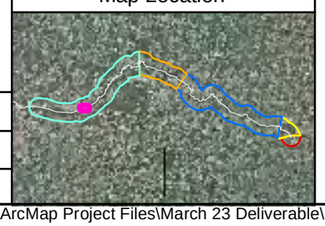
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

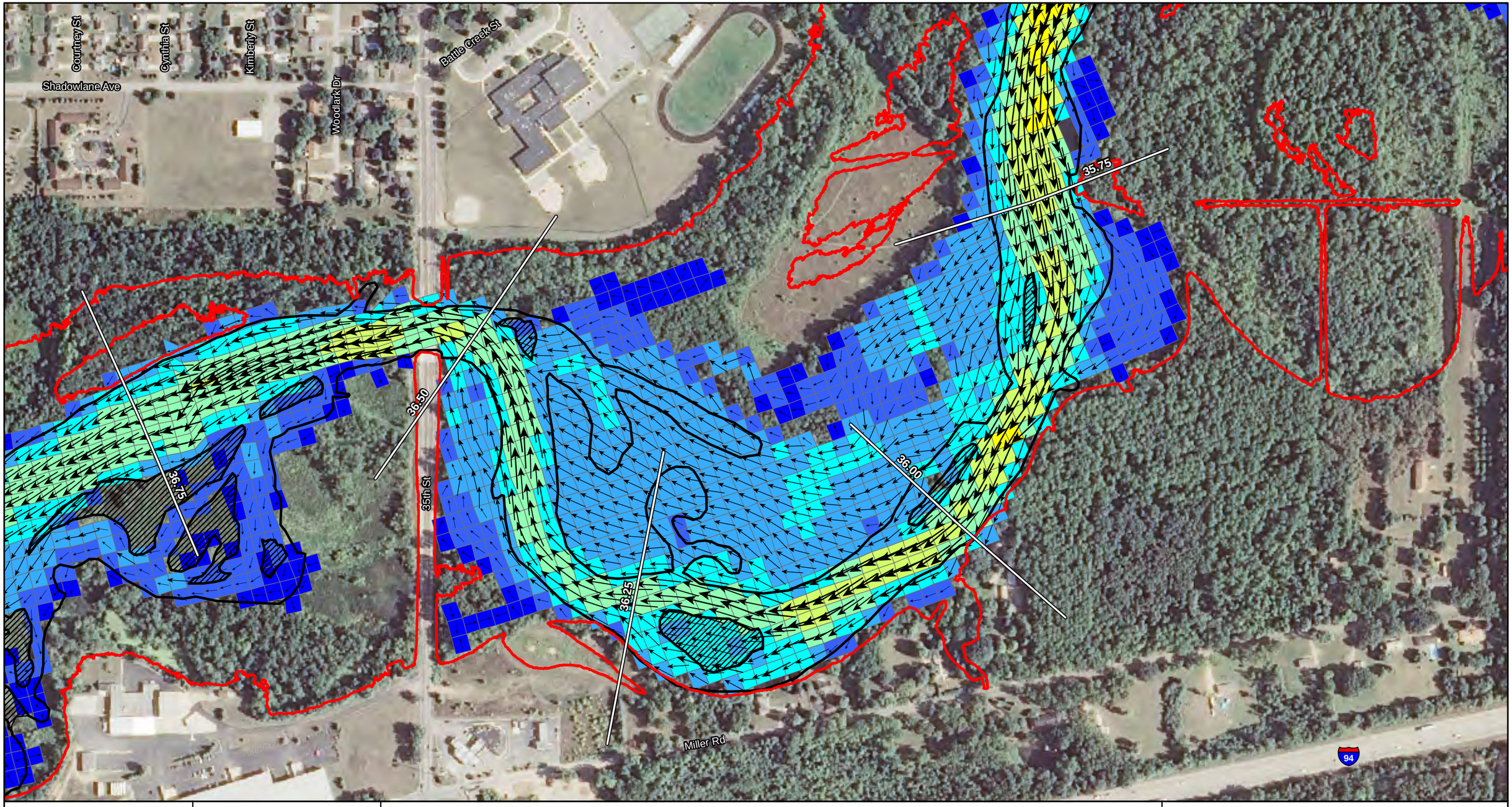
MP 34.70 - MP 35.75

SHEET 39 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

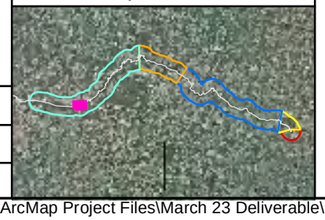
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

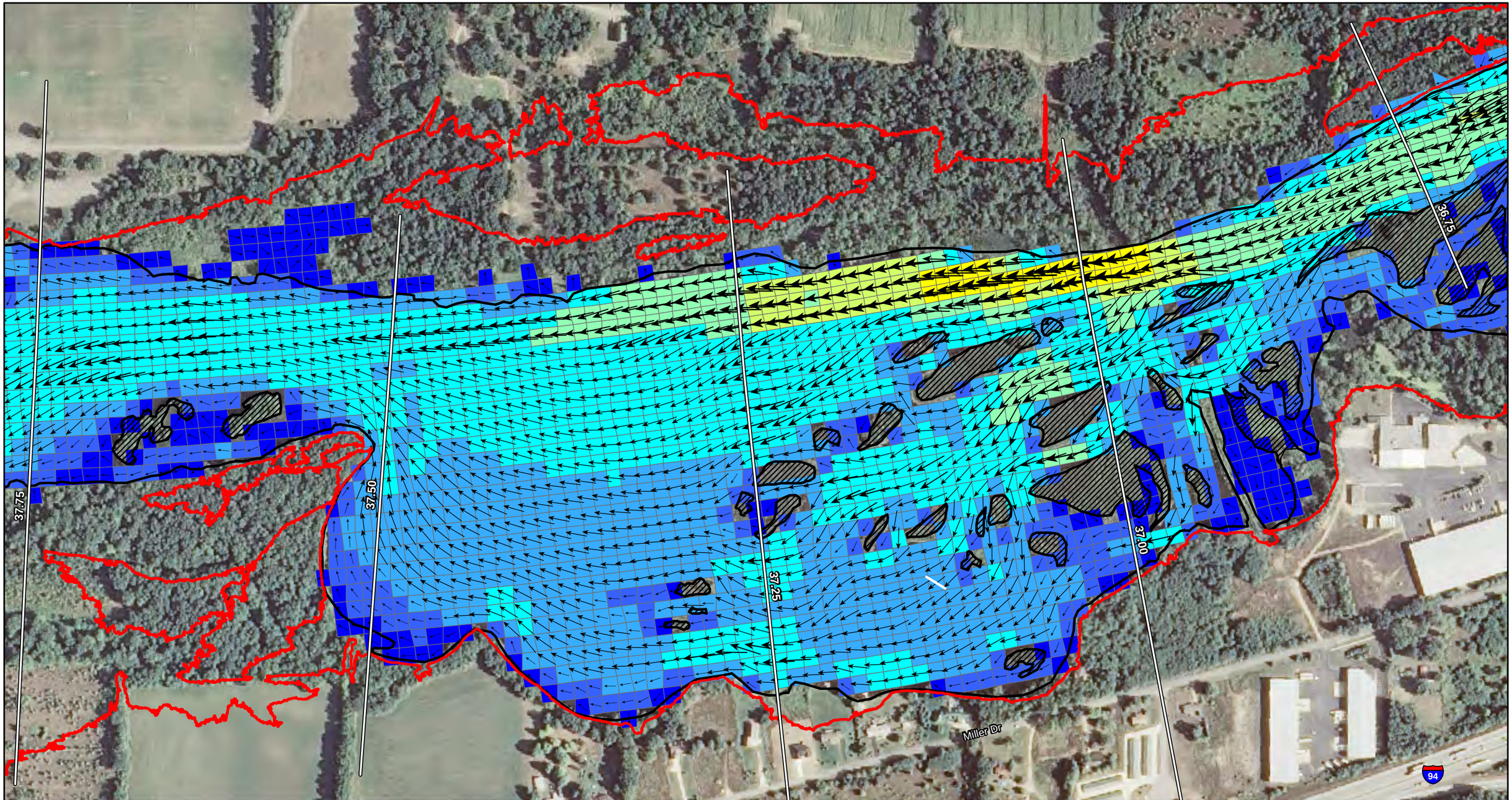
MP 35.75 - MP 36.75

SHEET 40 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

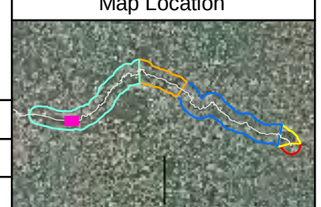
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 36.75 - MP 37.75

SHEET 41 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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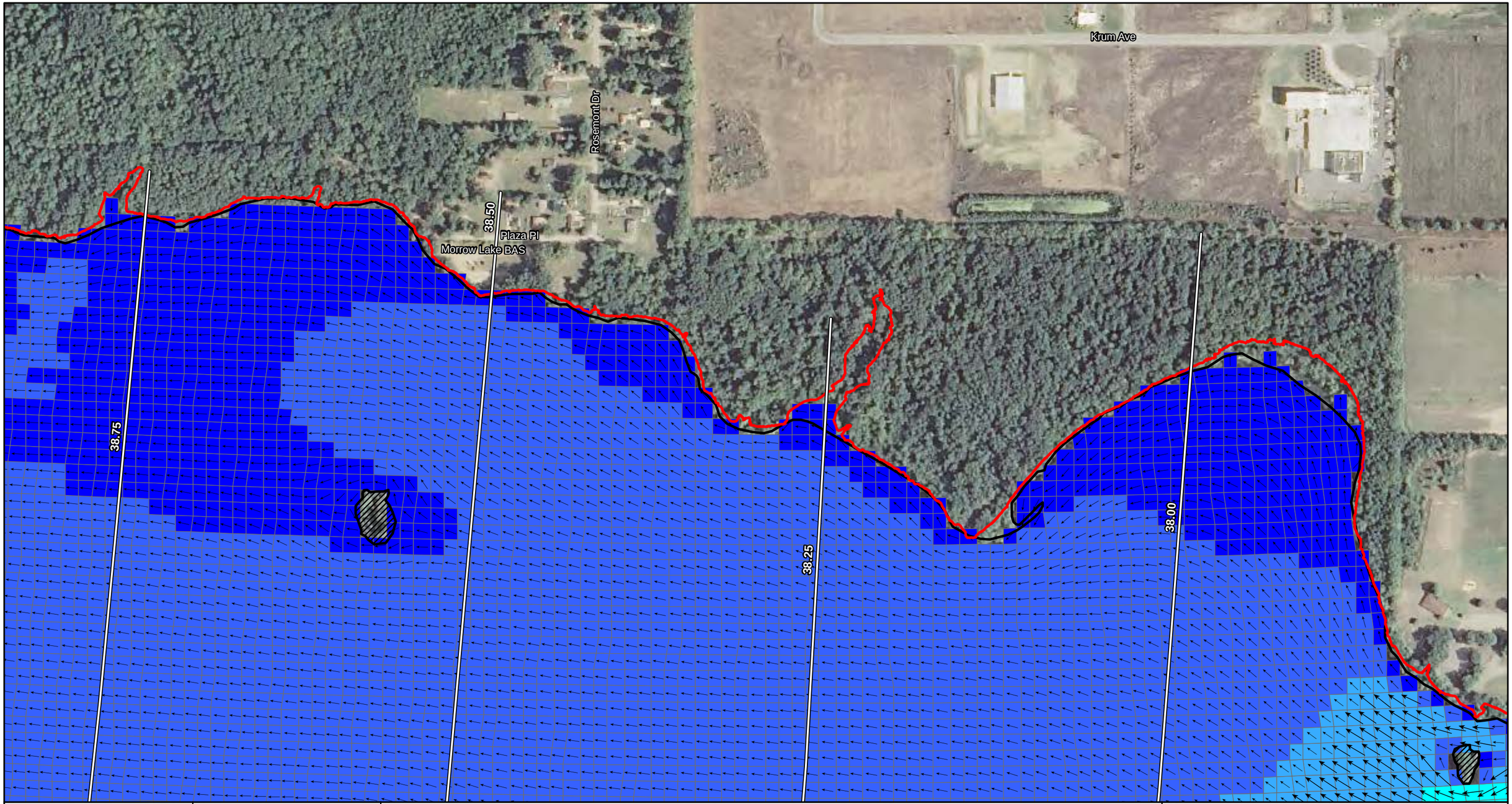
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 37.75N - MP 38.80N

SHEET 42 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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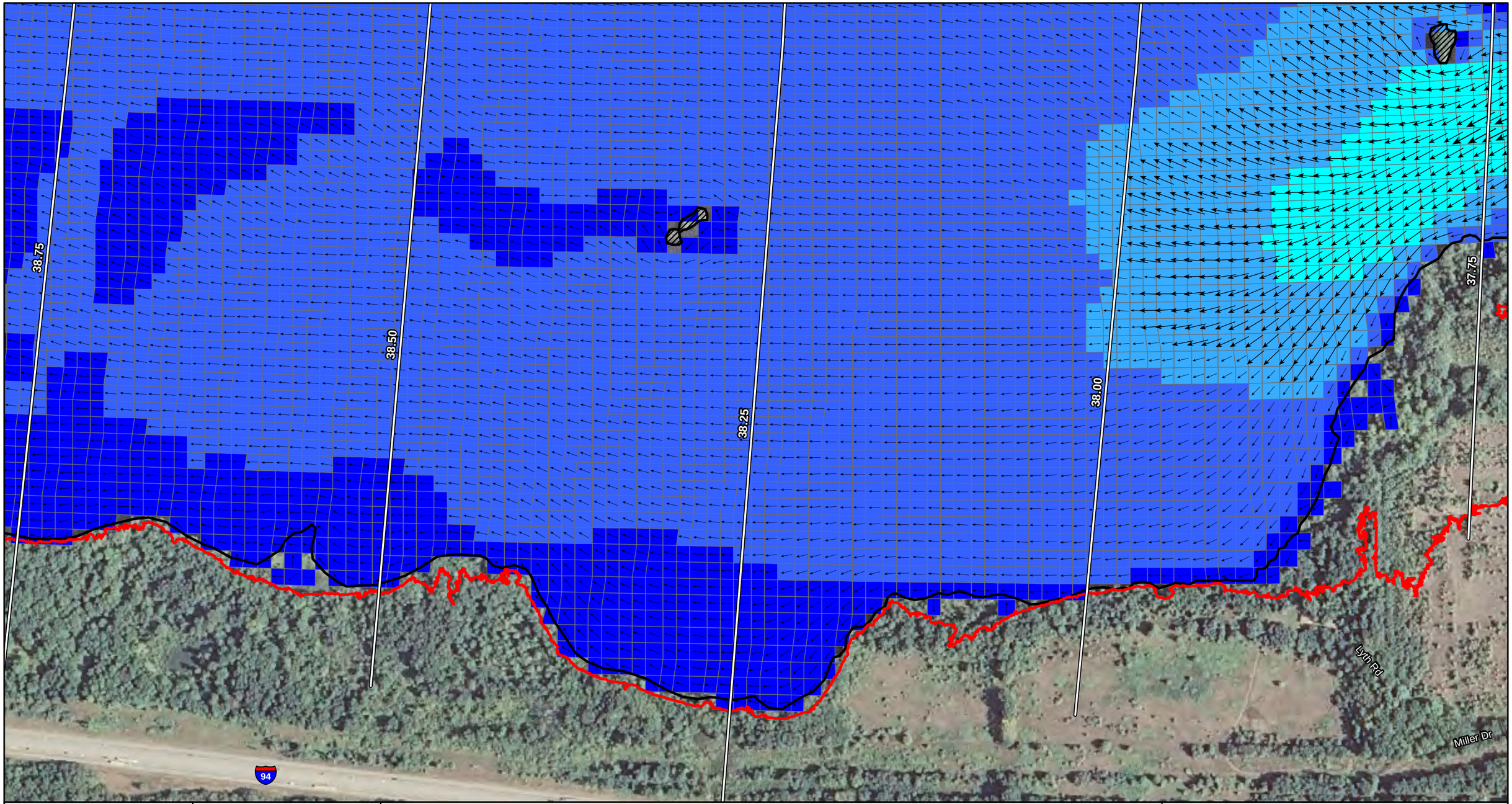
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

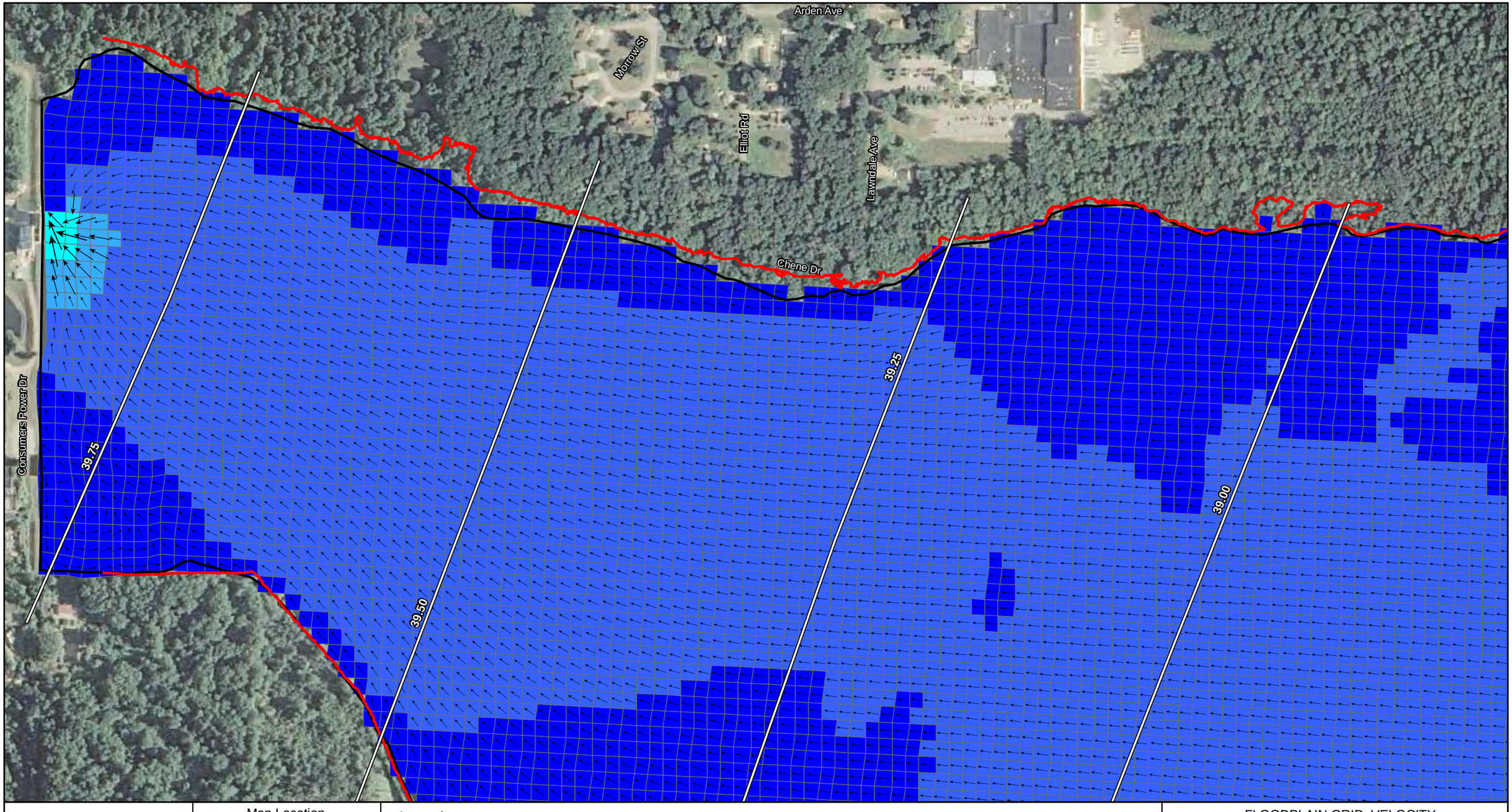
MP 37.75S - MP 38.80S

SHEET 43 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

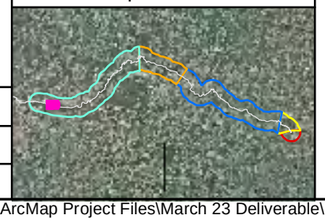
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

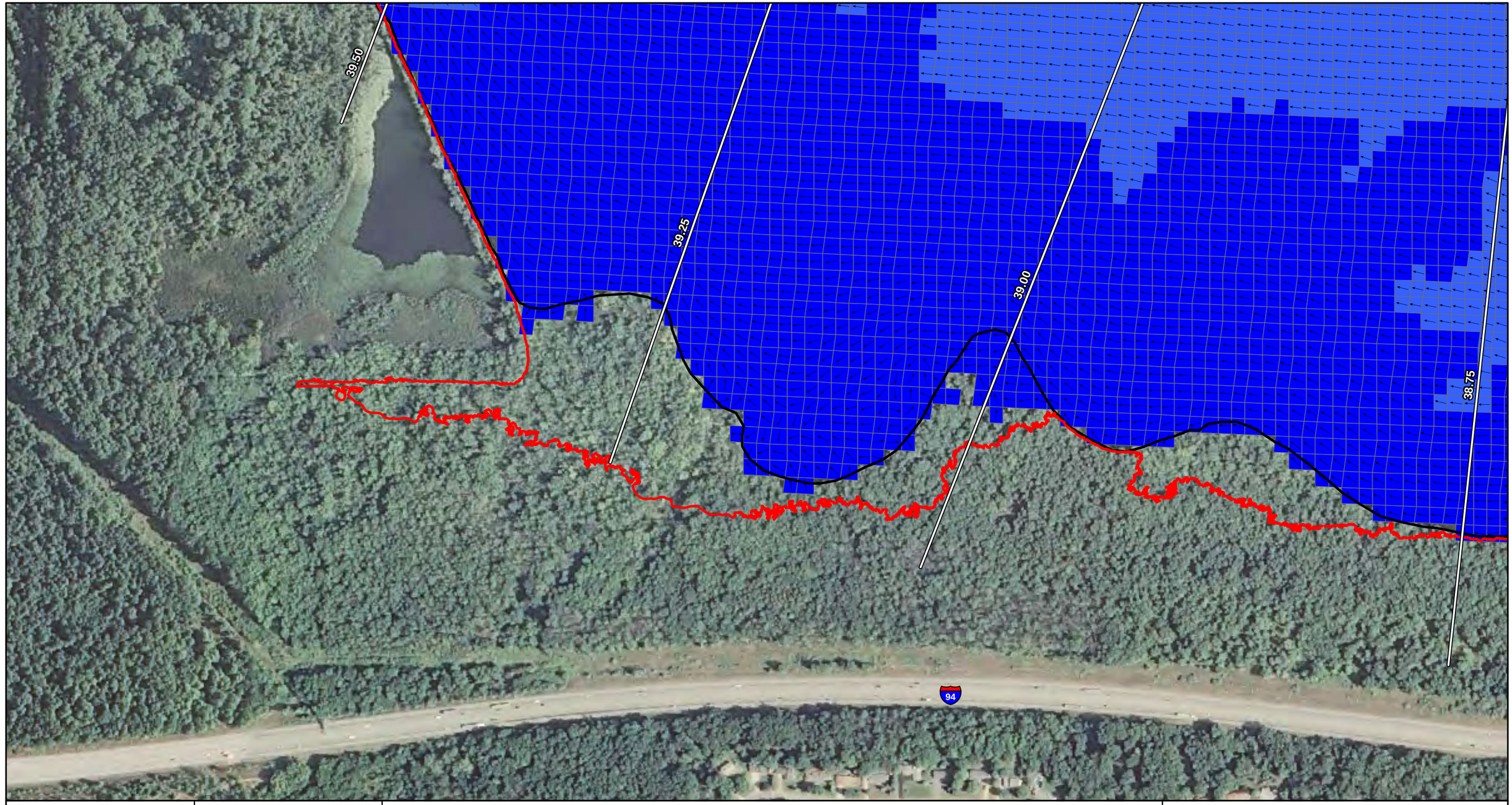
MP 38.80N - MP 39.95N

SHEET 44 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

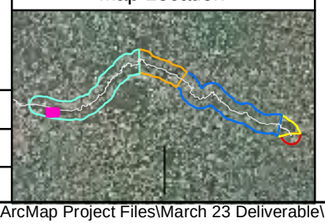
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 24, 2010

MP 38.80S - MP 39.95S

SHEET 45 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul24_2010.mxd

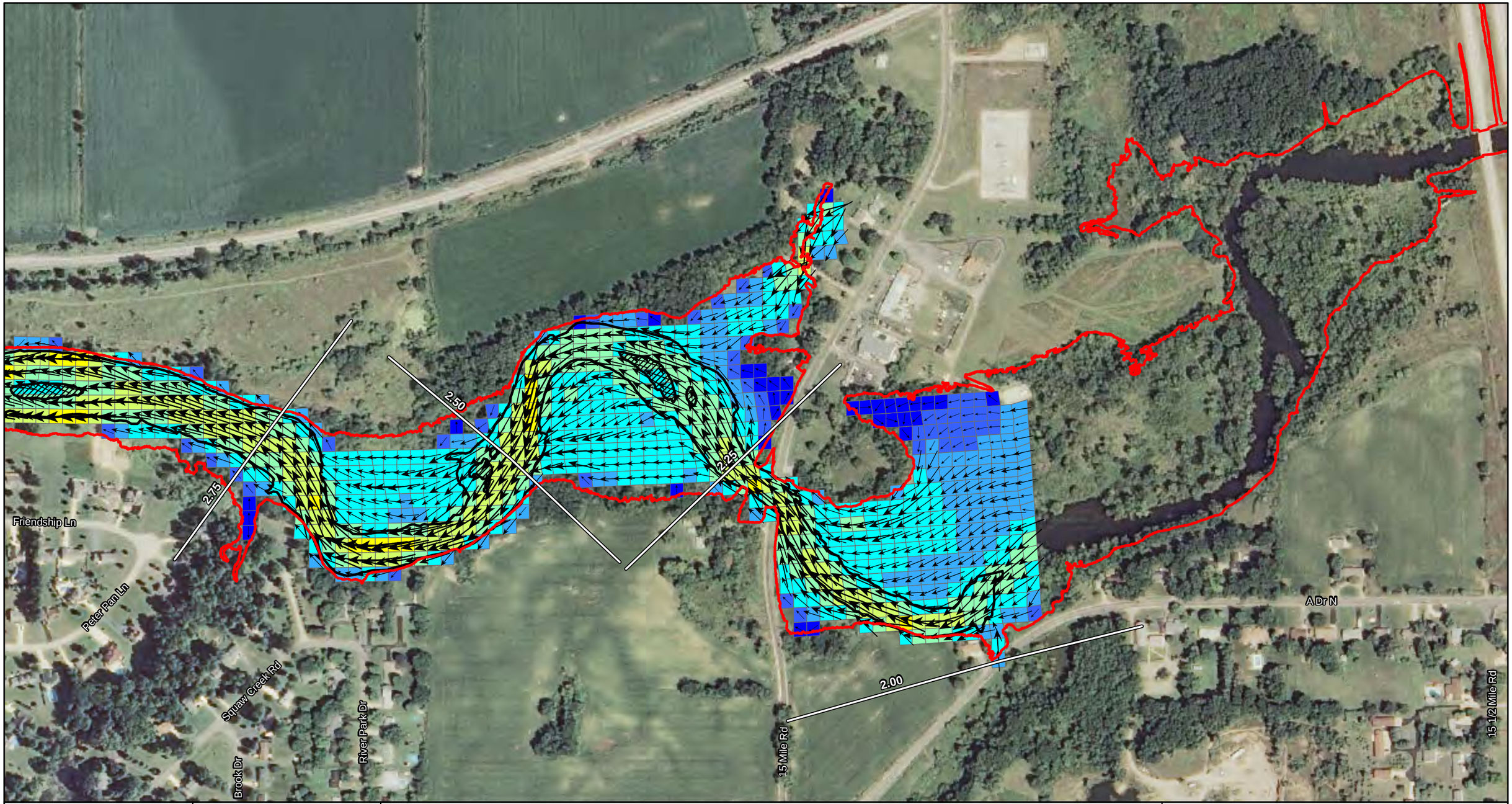
Aerial Photography Date: July & August 2009

Figure 4-22

Floodplain Grid: Velocity

July 26, 2010

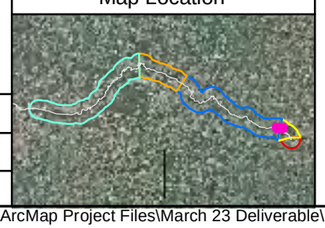
Sheets 1 through 45



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

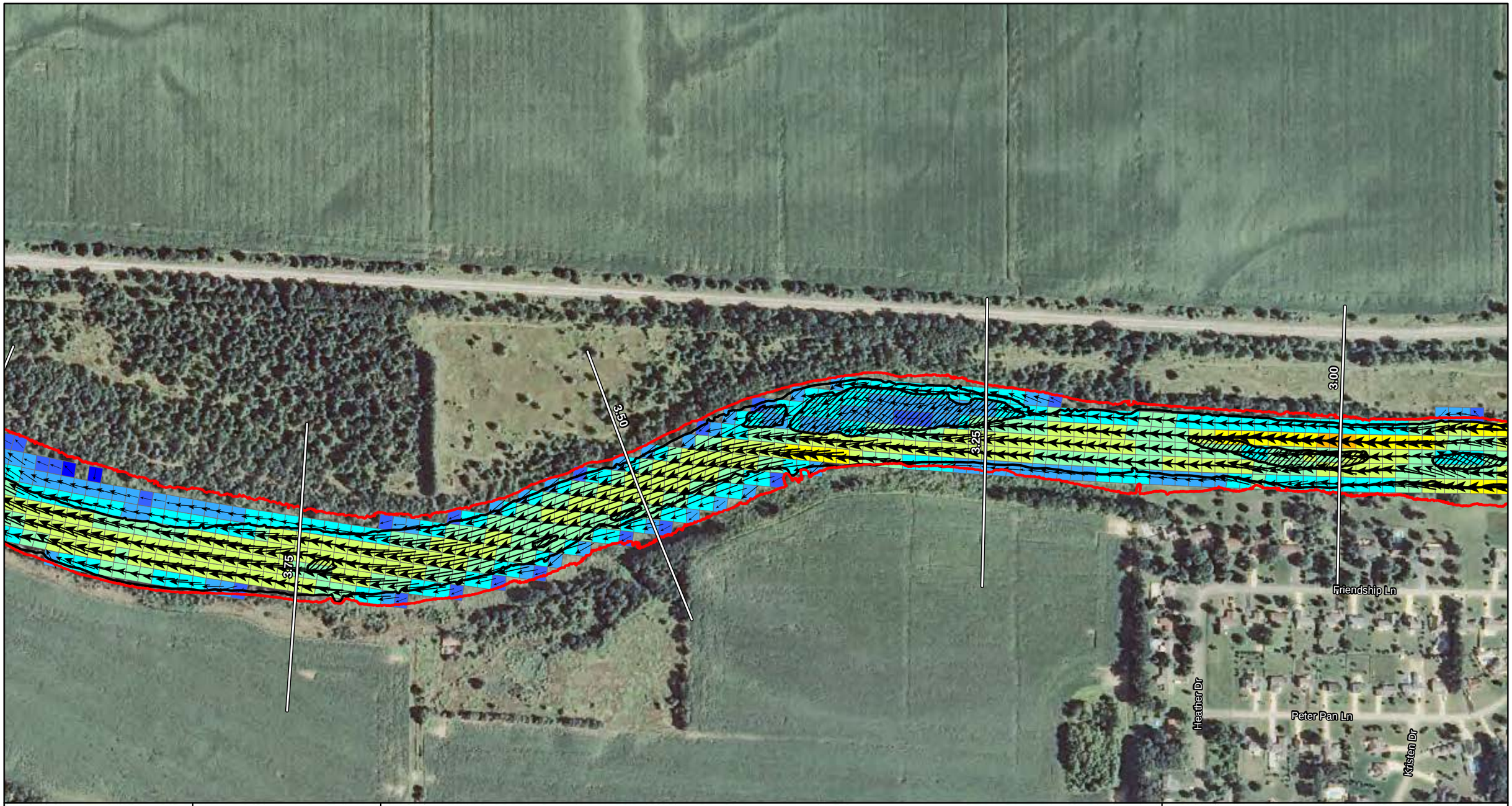
MP 01.88 - MP 02.91

SHEET 1 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

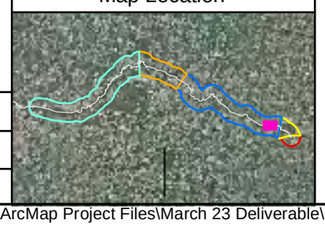
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 02.91 - MP 03.93

SHEET 2 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

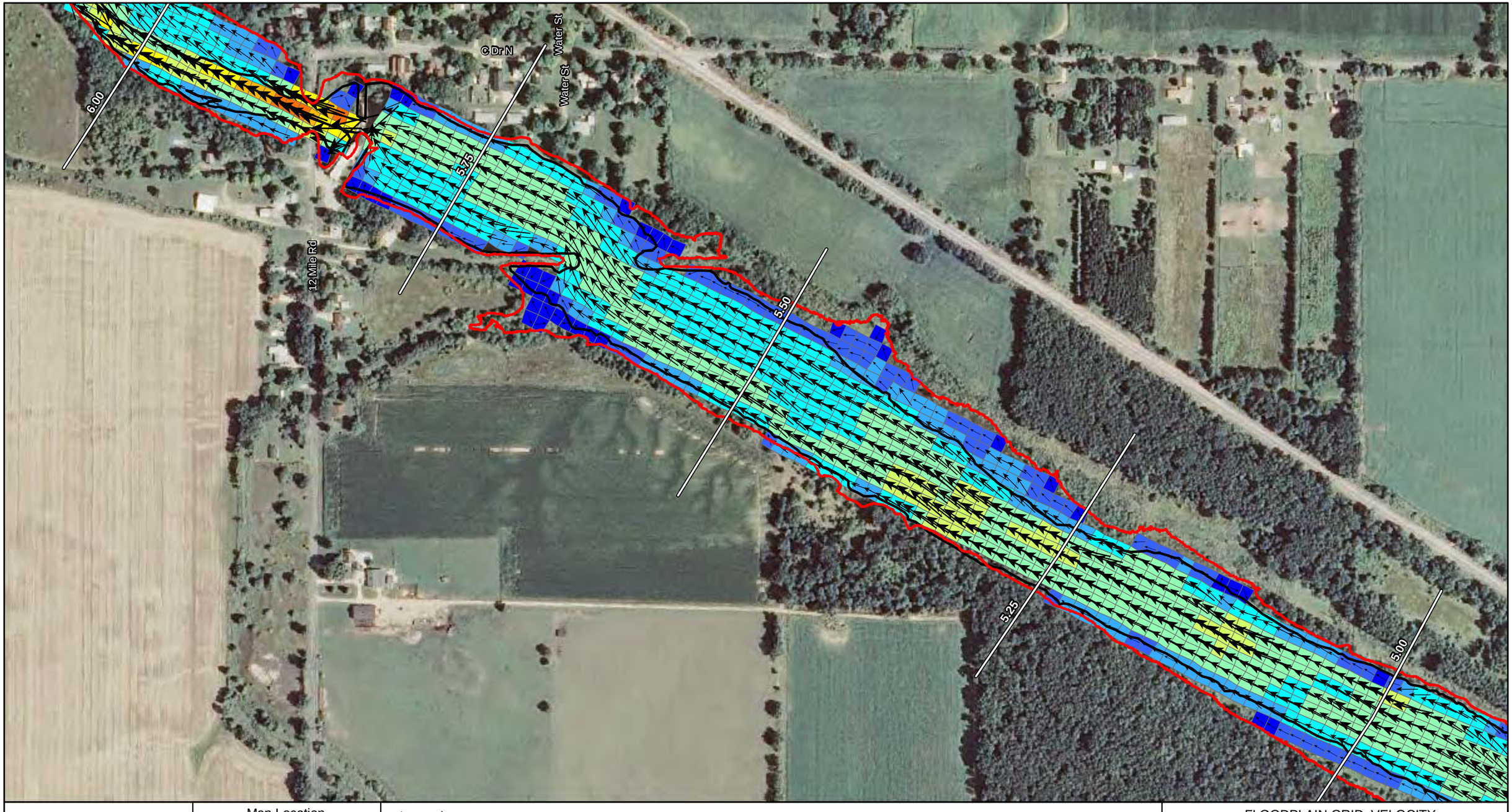
MP 03.93 - MP 04.98

SHEET 3 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

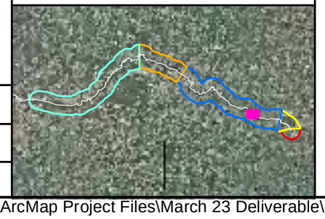
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

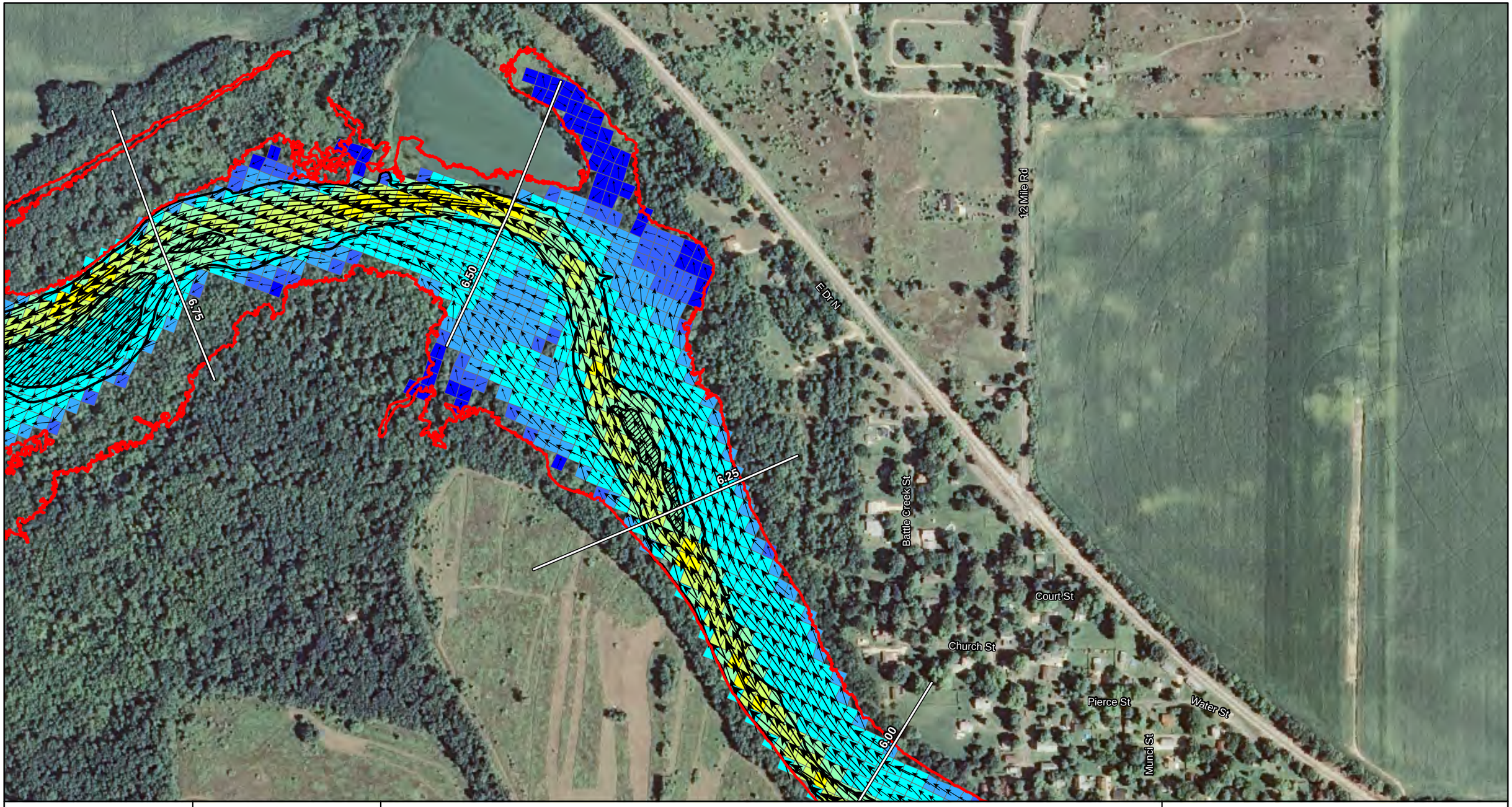
MP 04.98 - MP 06.03

SHEET 4 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

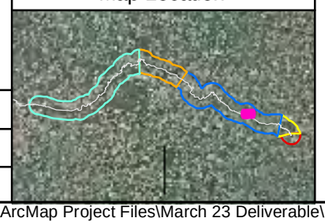
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

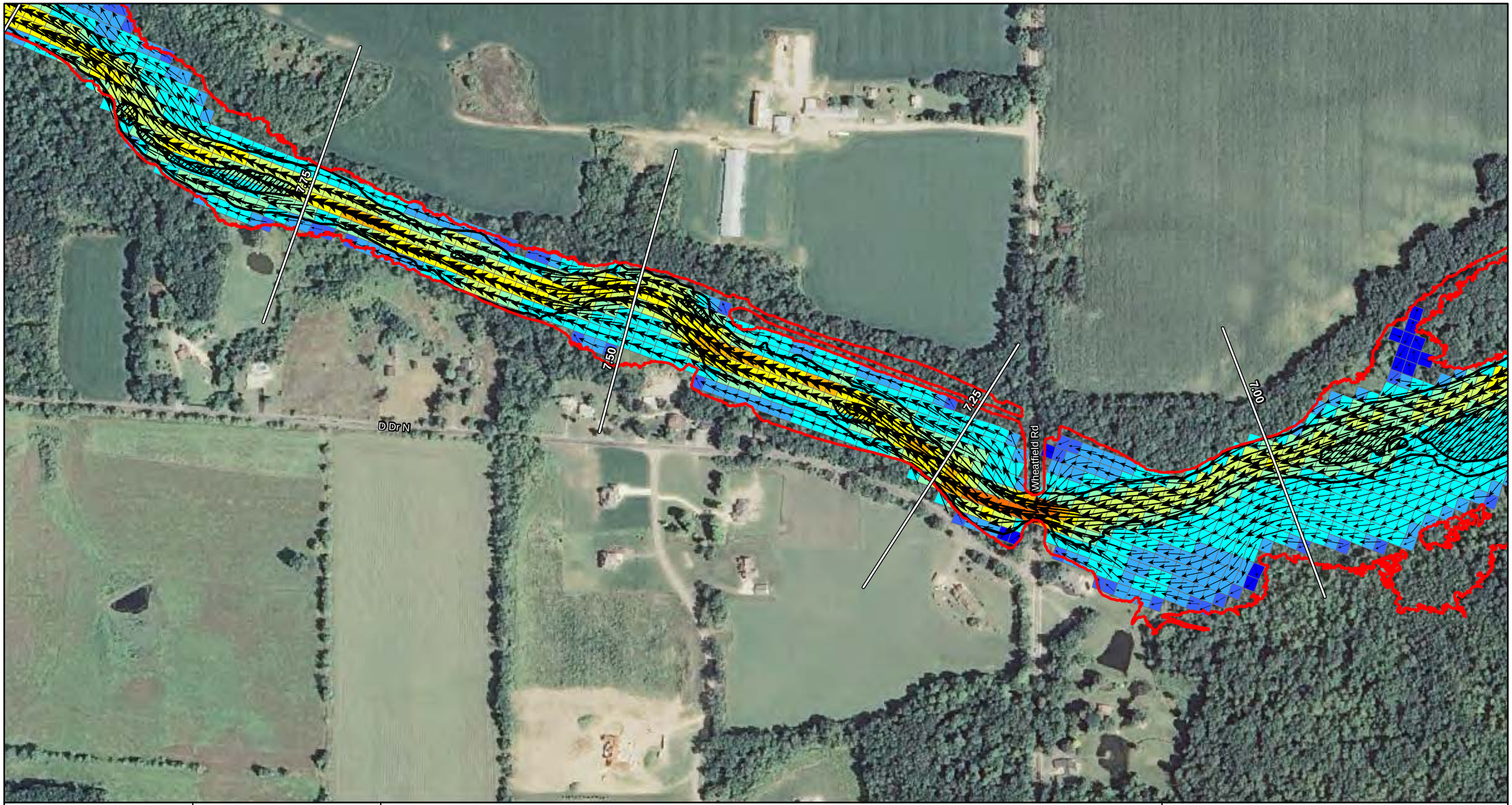
MP 06.03 - MP 06.85

SHEET 5 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
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- HEC-RAS 100-Year Floodplain
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ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 06.85 - MP 07.95

SHEET 6 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

9.00

8.75

8.50

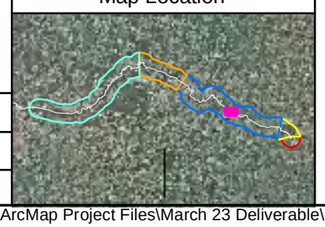
8.25

8.00

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
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- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

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N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 07.95 - MP 08.93

SHEET 7 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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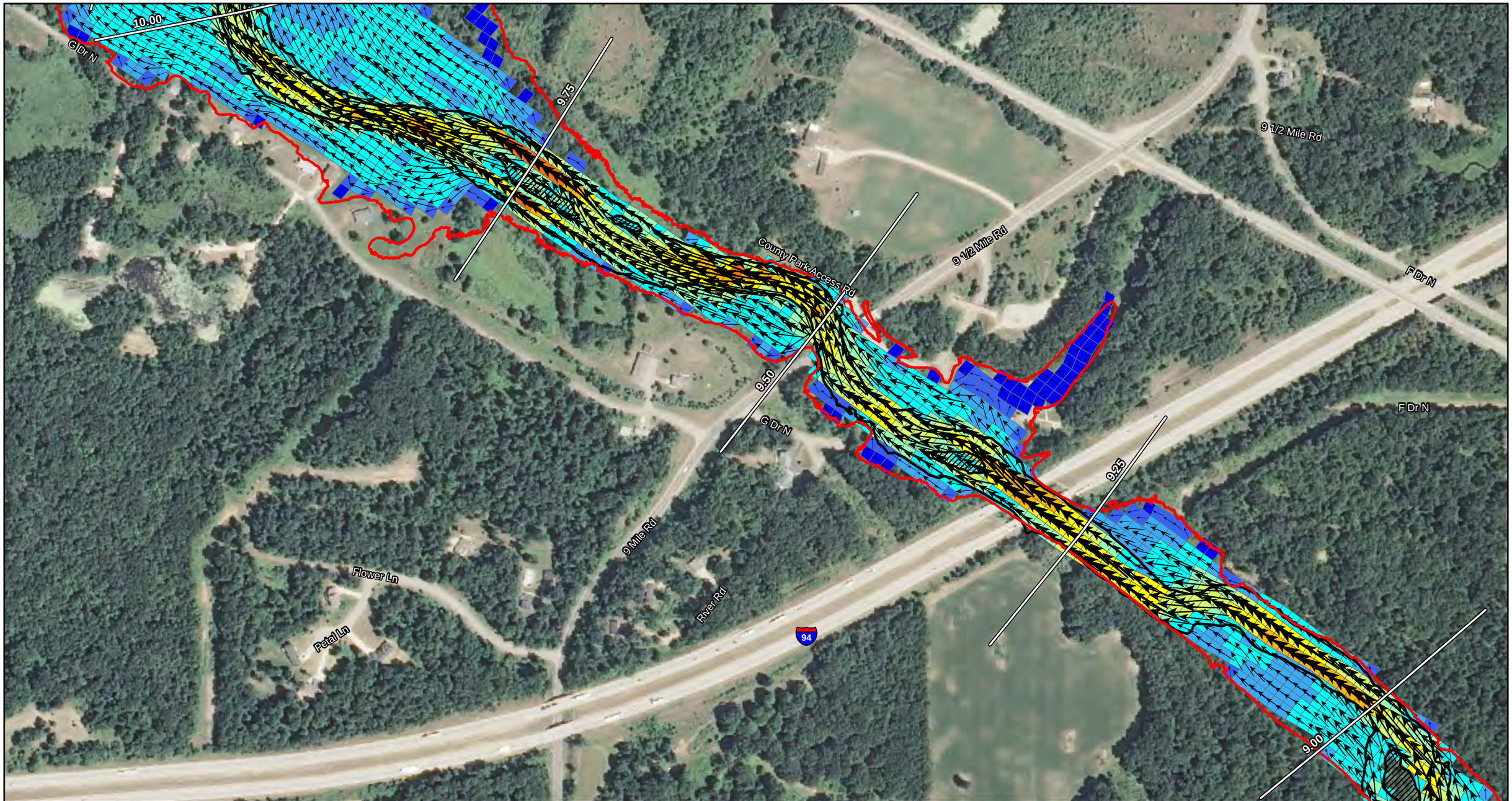
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 08.93 - MP 10.00

SHEET 8 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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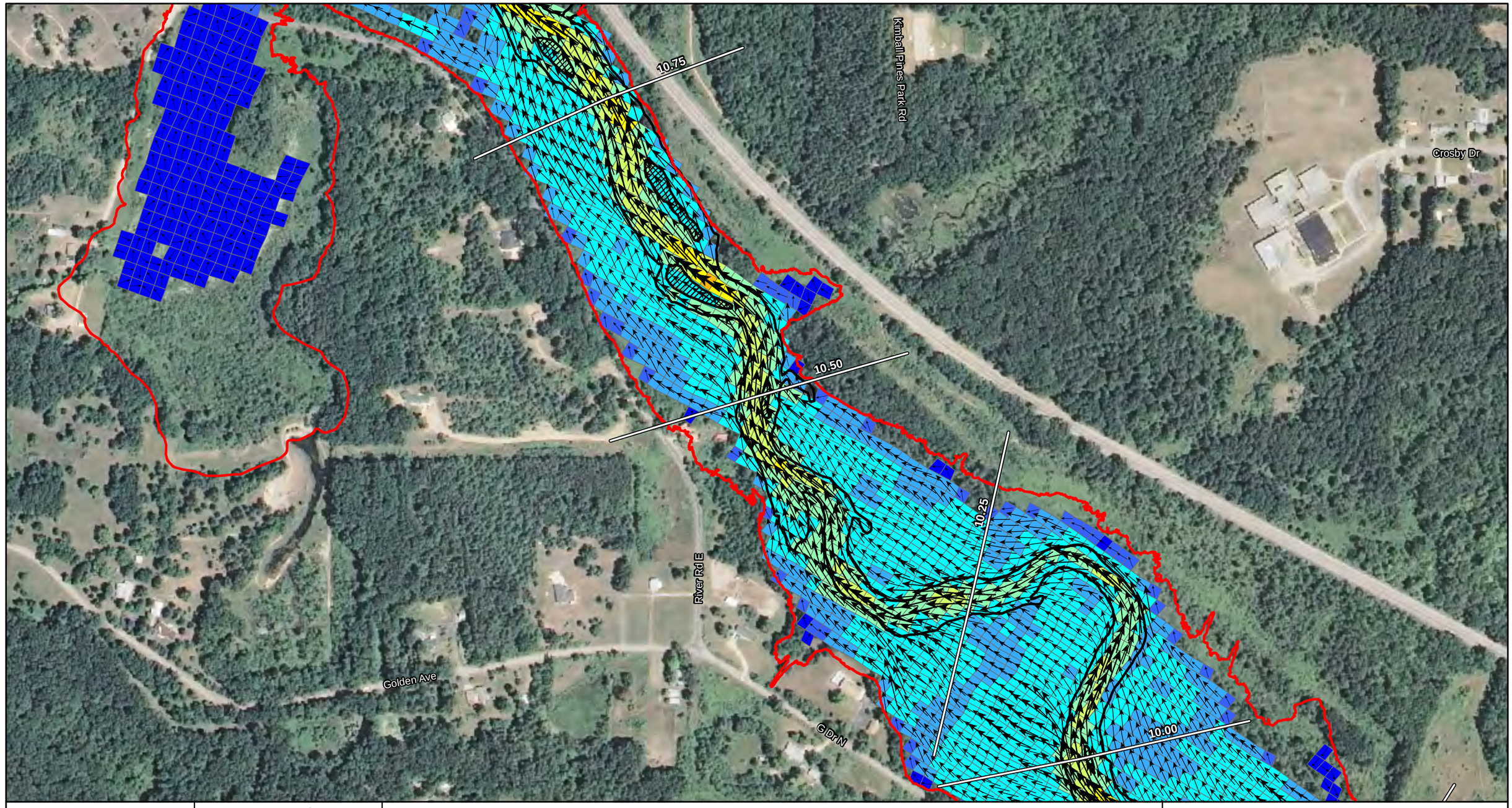
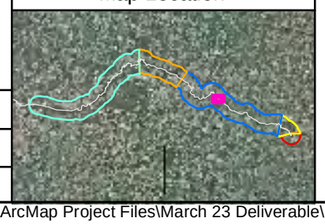
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
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- 2.5 - 3.0 ft/sec
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ft/sec = Feet Per Second
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Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

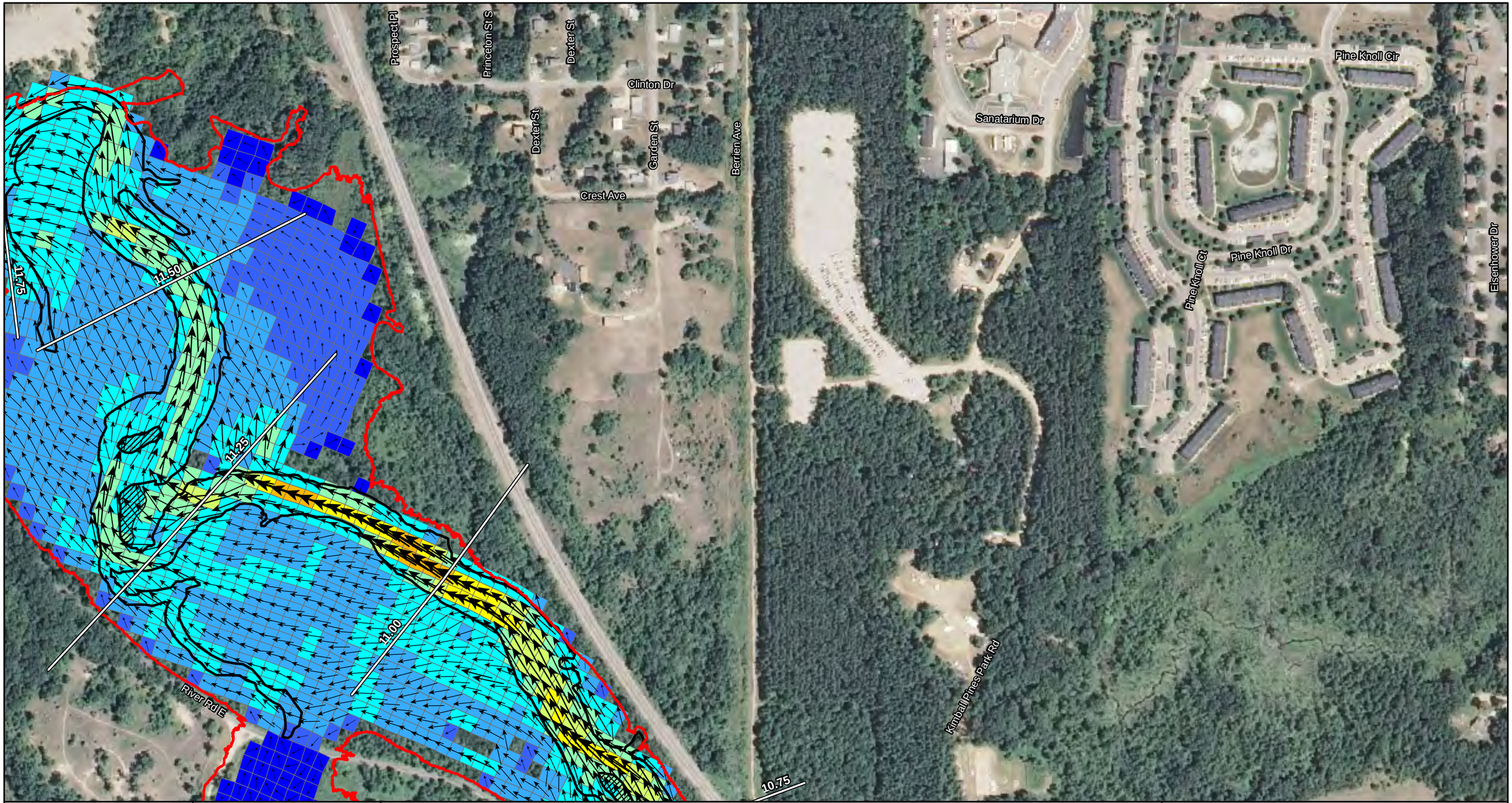
MP 10.00 - MP 10.80

SHEET 9 OF 45

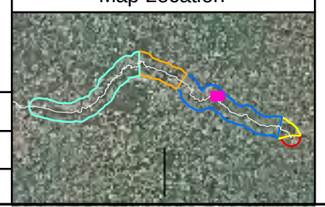
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
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Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

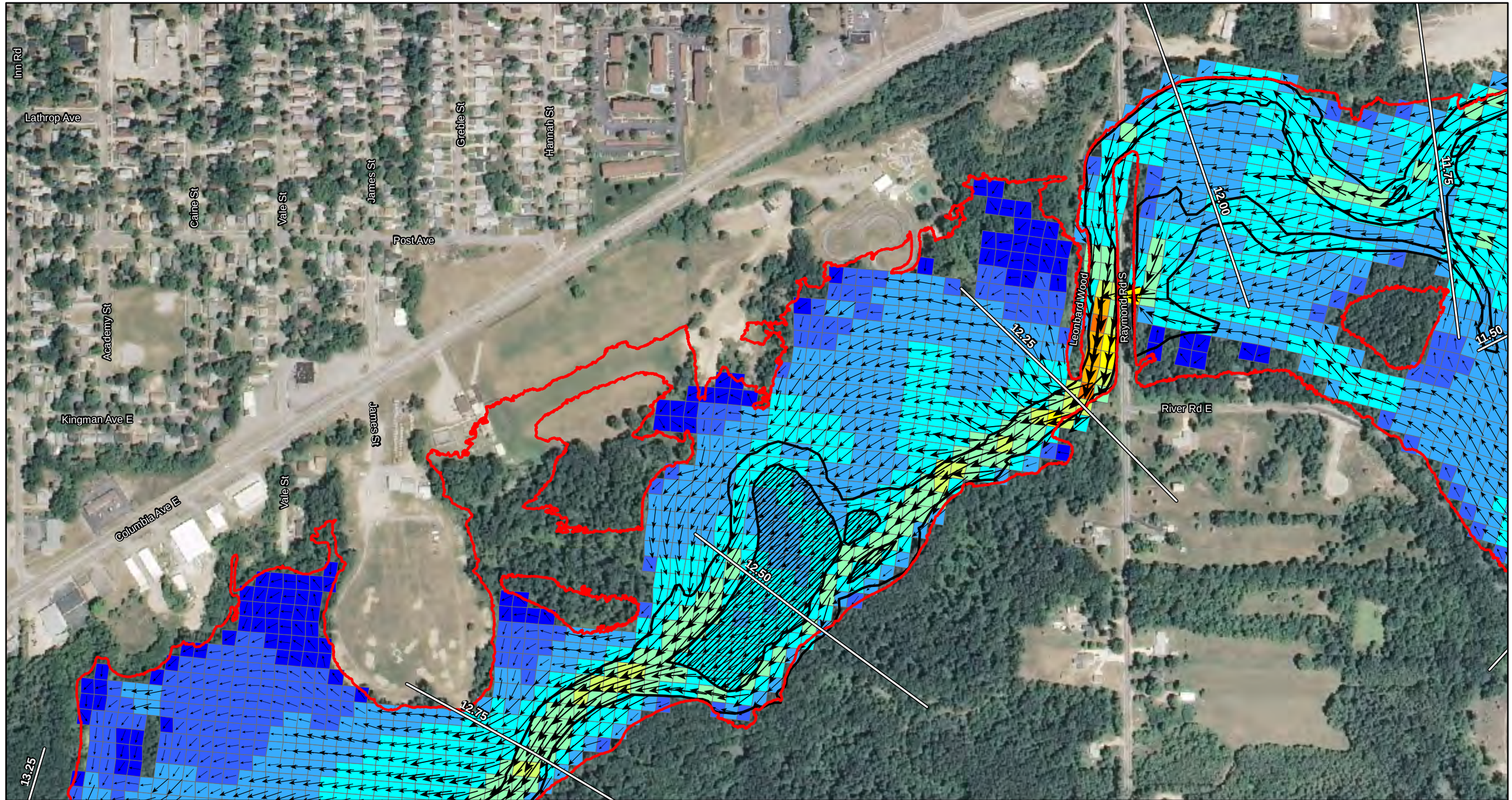
MP 10.80 - MP 11.70

SHEET 10 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
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- 2.5 - 3.0 ft/sec
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ft/sec = Feet Per Second
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Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

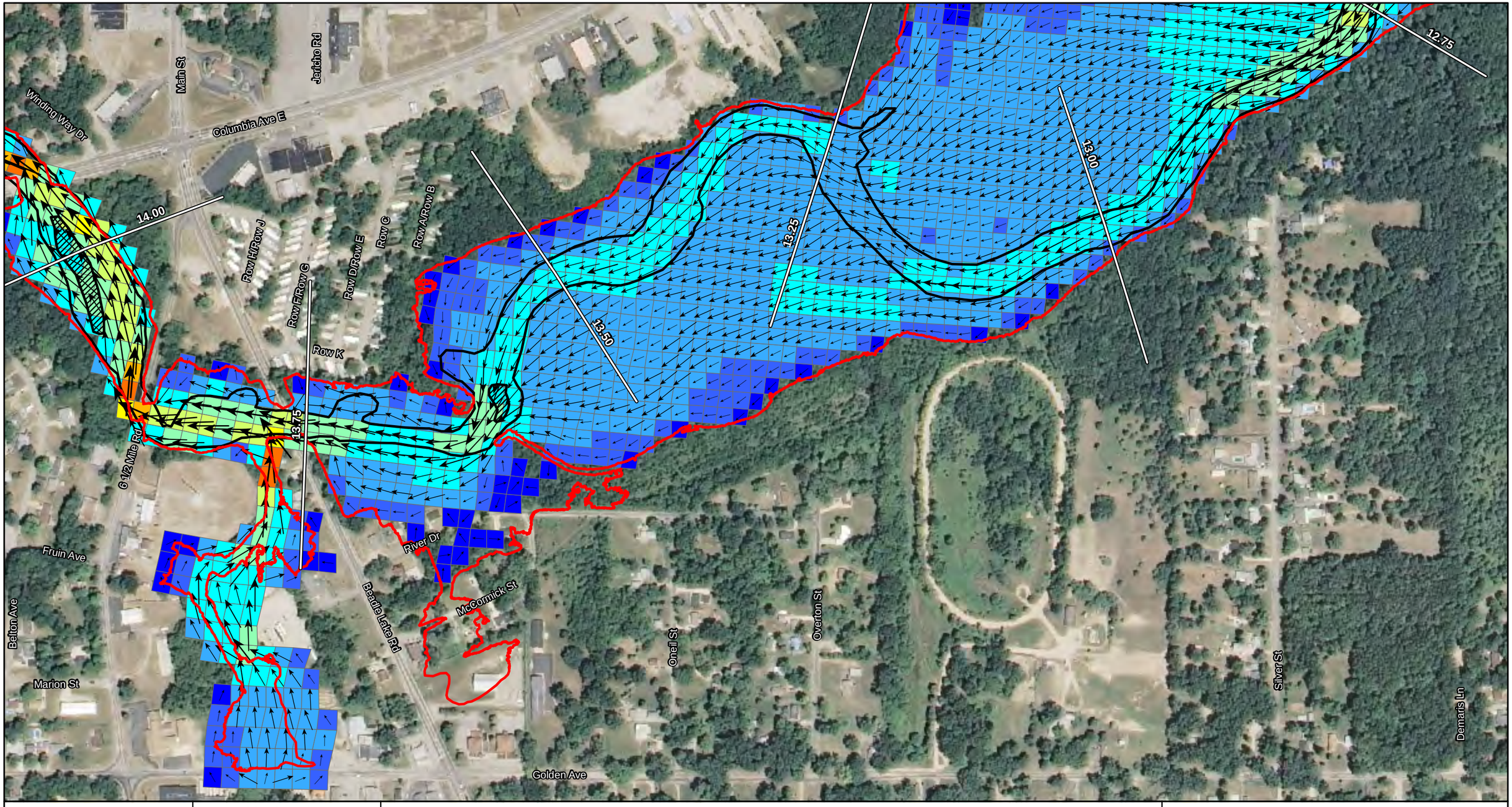
MP 11.70 - MP 12.77

SHEET 11 OF 45

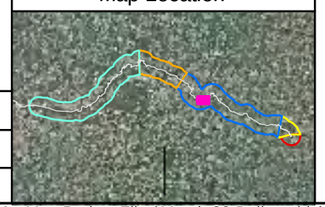
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



Map Location



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

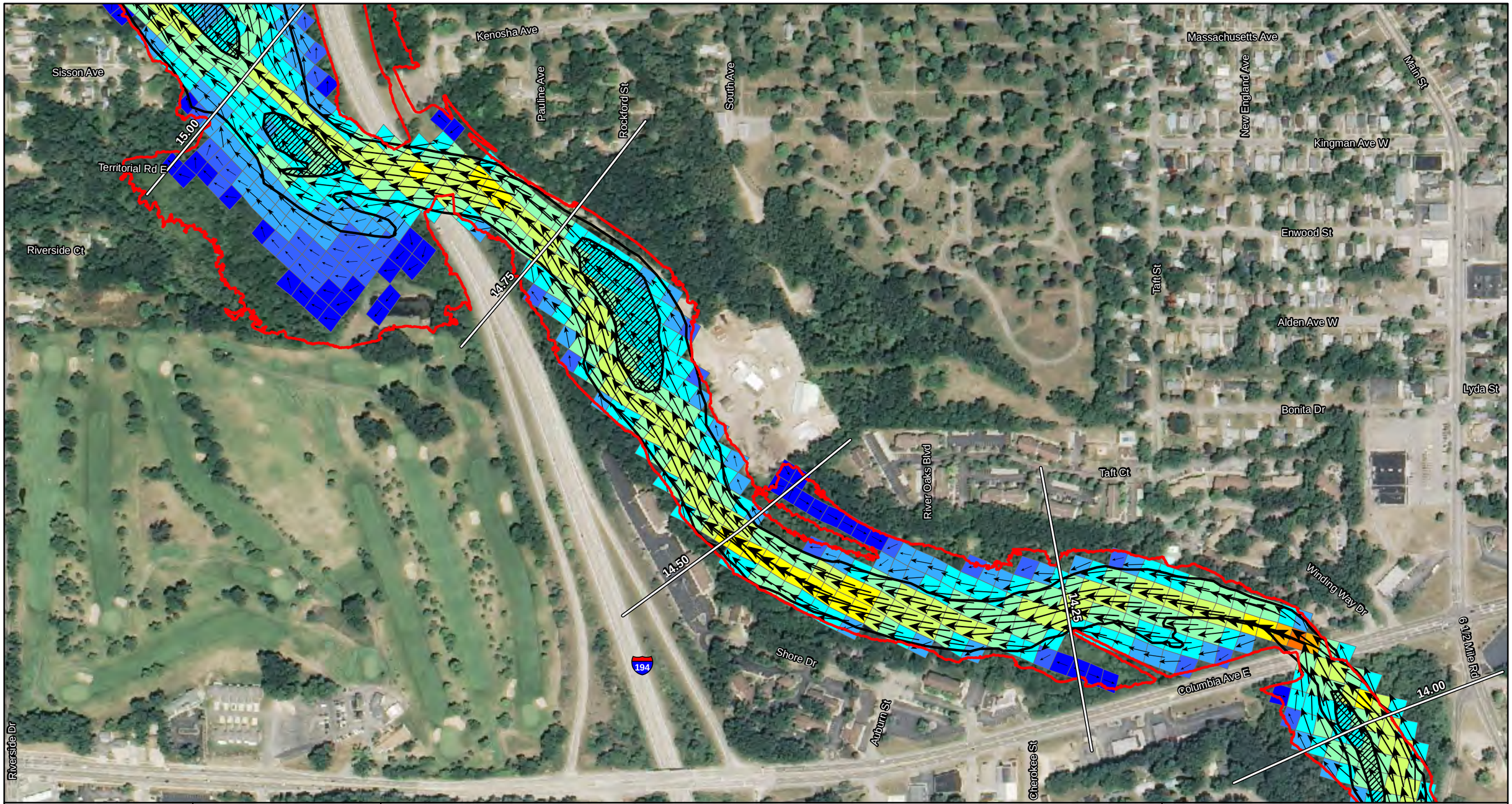
MP 12.77 - MP 14.00

SHEET 12 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

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ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 14.00 - MP 15.05

SHEET 13 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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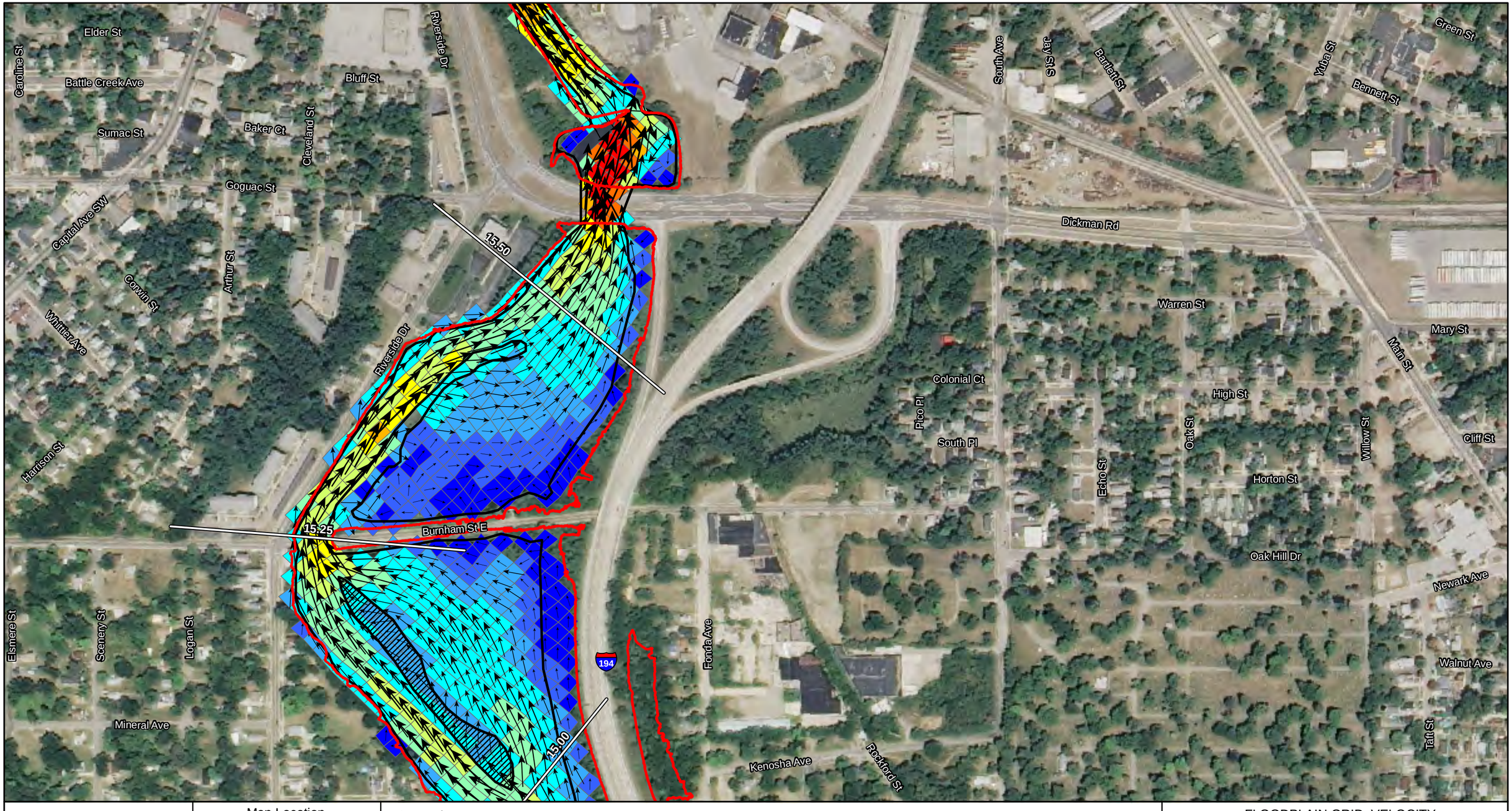
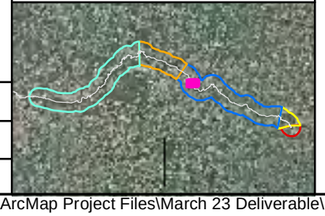
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
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- 2.0 - 2.5 ft/sec
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Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 15.05 - MP 15.71

SHEET 14 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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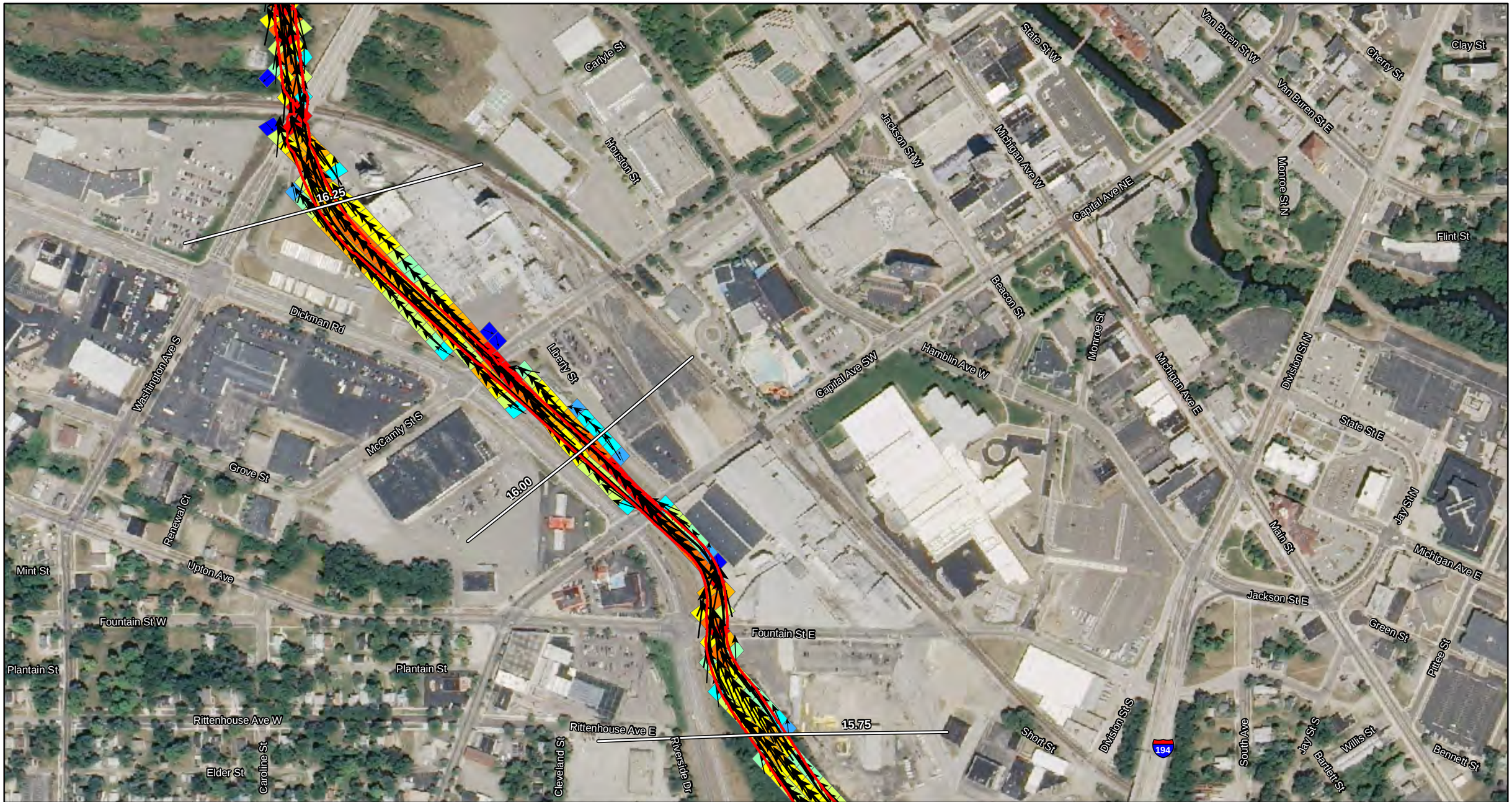
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
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- 2.0 - 2.5 ft/sec
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- > 4.0 ft/sec

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Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 15.71 - MP 16.38

SHEET 15 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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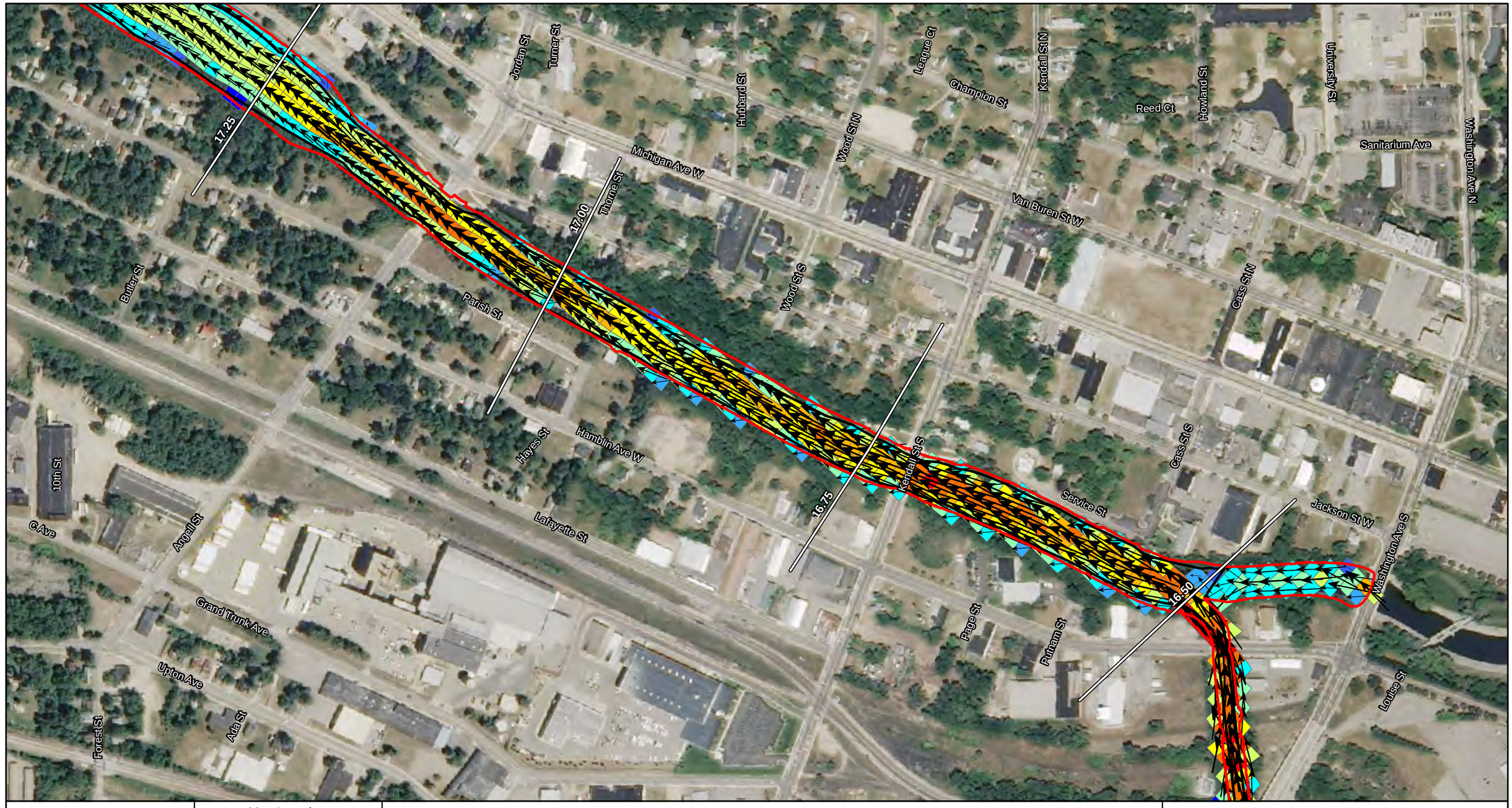
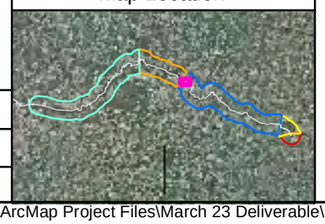
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
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ft/sec = Feet Per Second
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Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

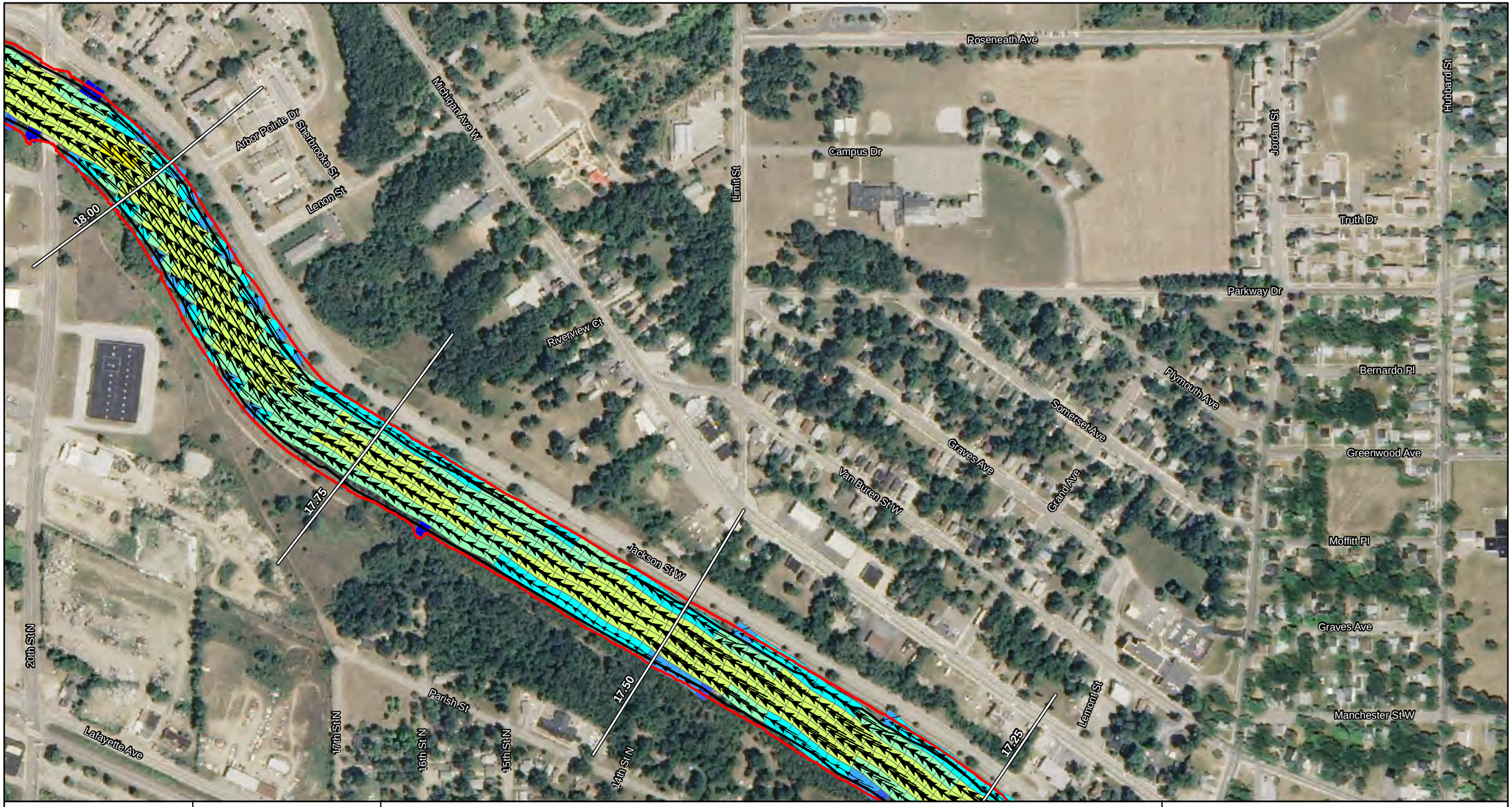
MP 16.38 - MP 17.30

SHEET 16 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

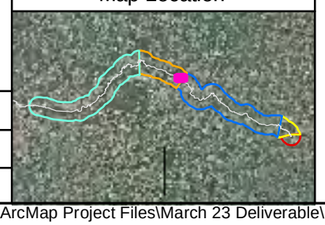
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

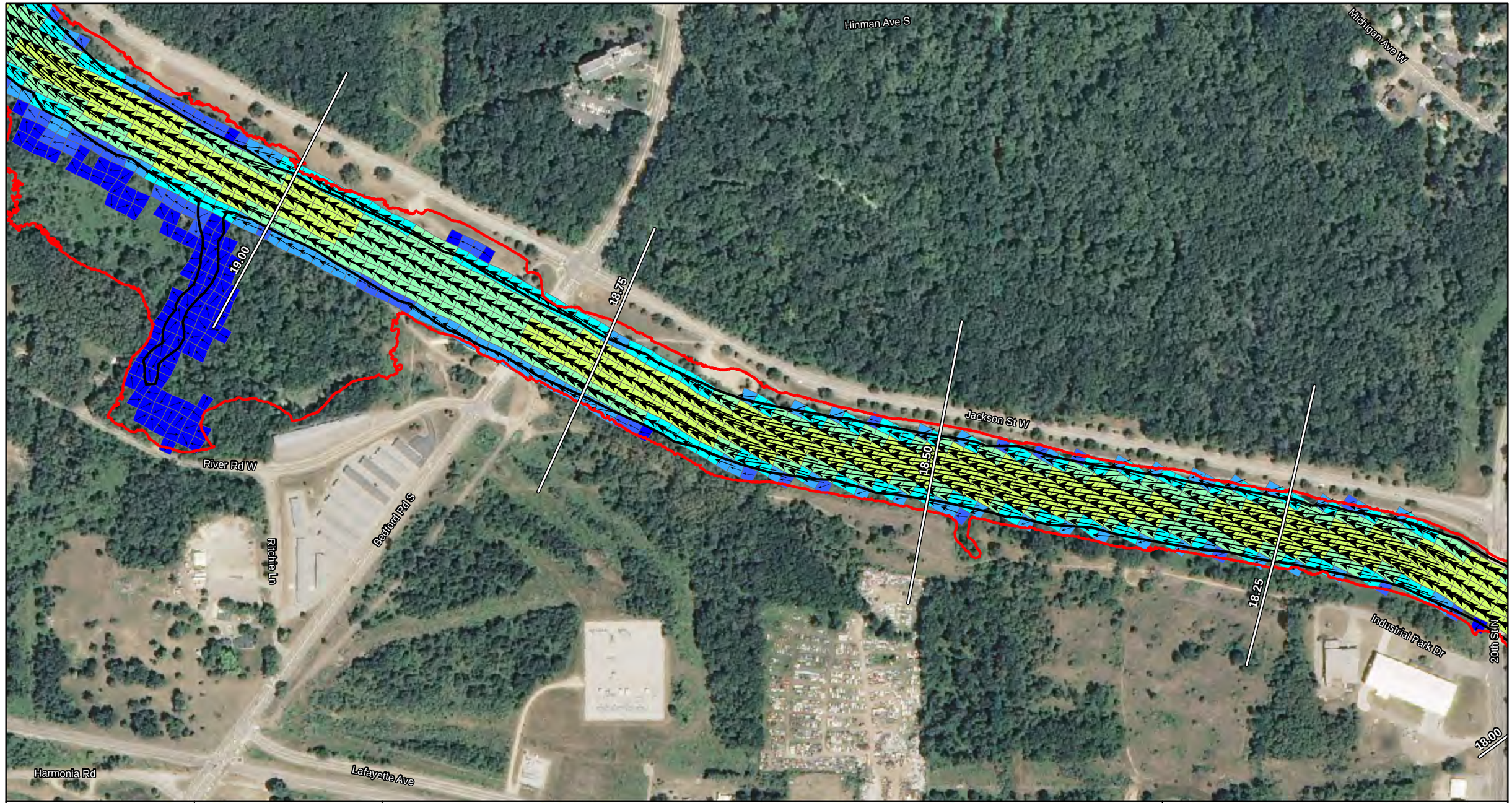
MP 17.30 - MP 18.11

SHEET 17 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 18.11 - MP 19.18

SHEET 18 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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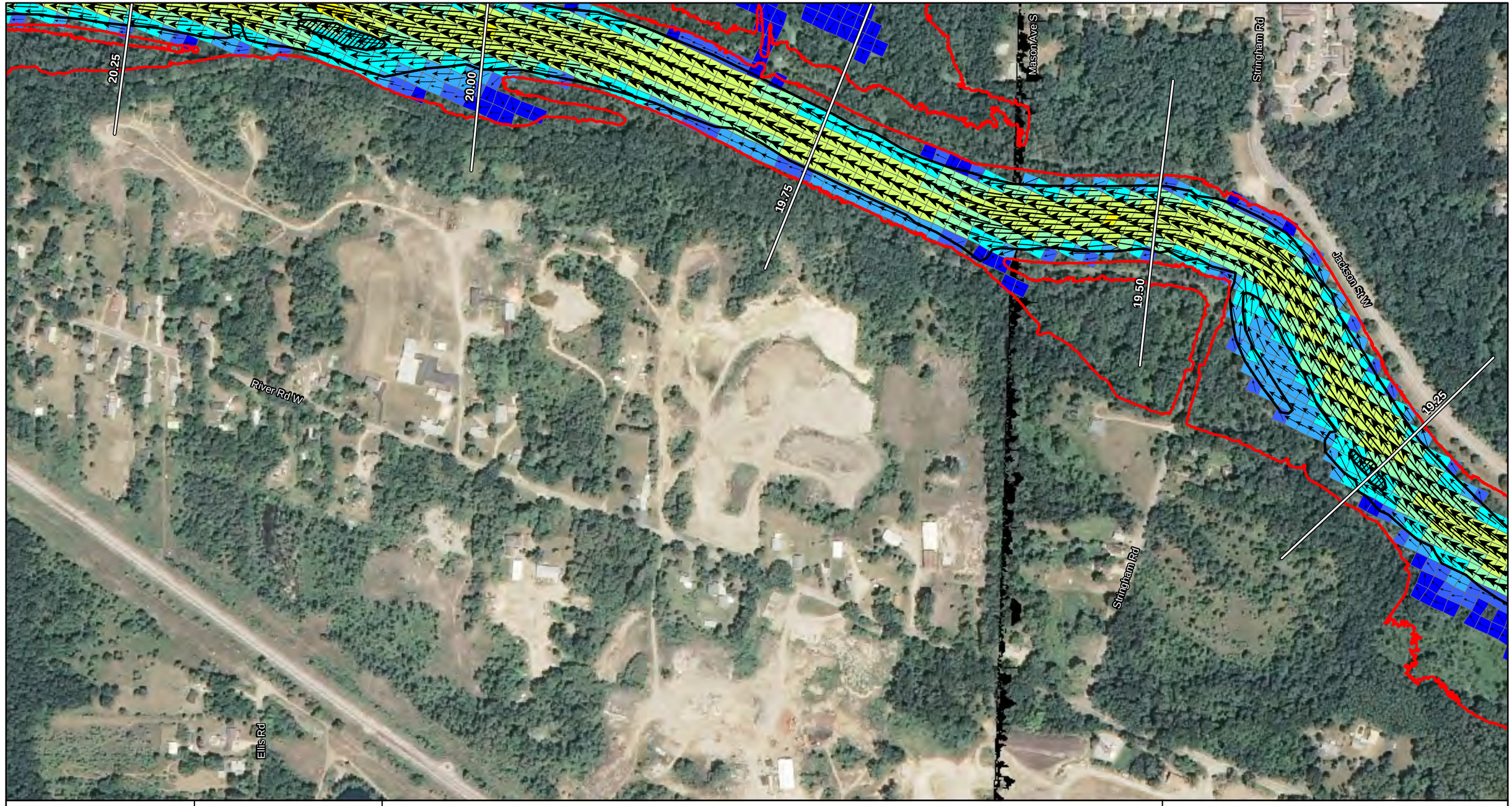
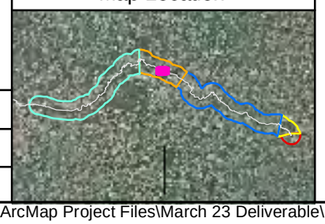
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 19.18 - MP 20.00

SHEET 19 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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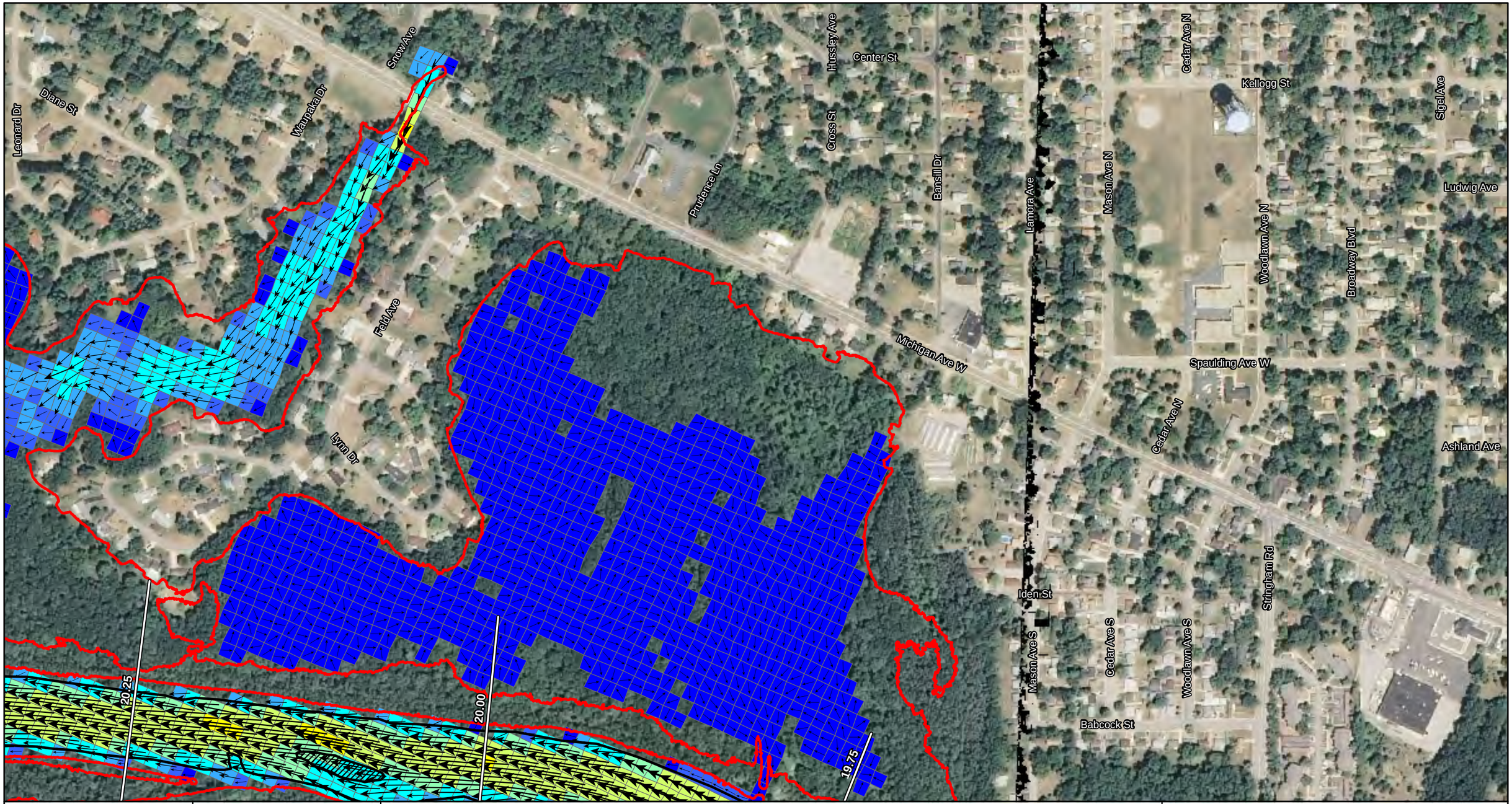
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 20.00 - MP 20.32

SHEET 20 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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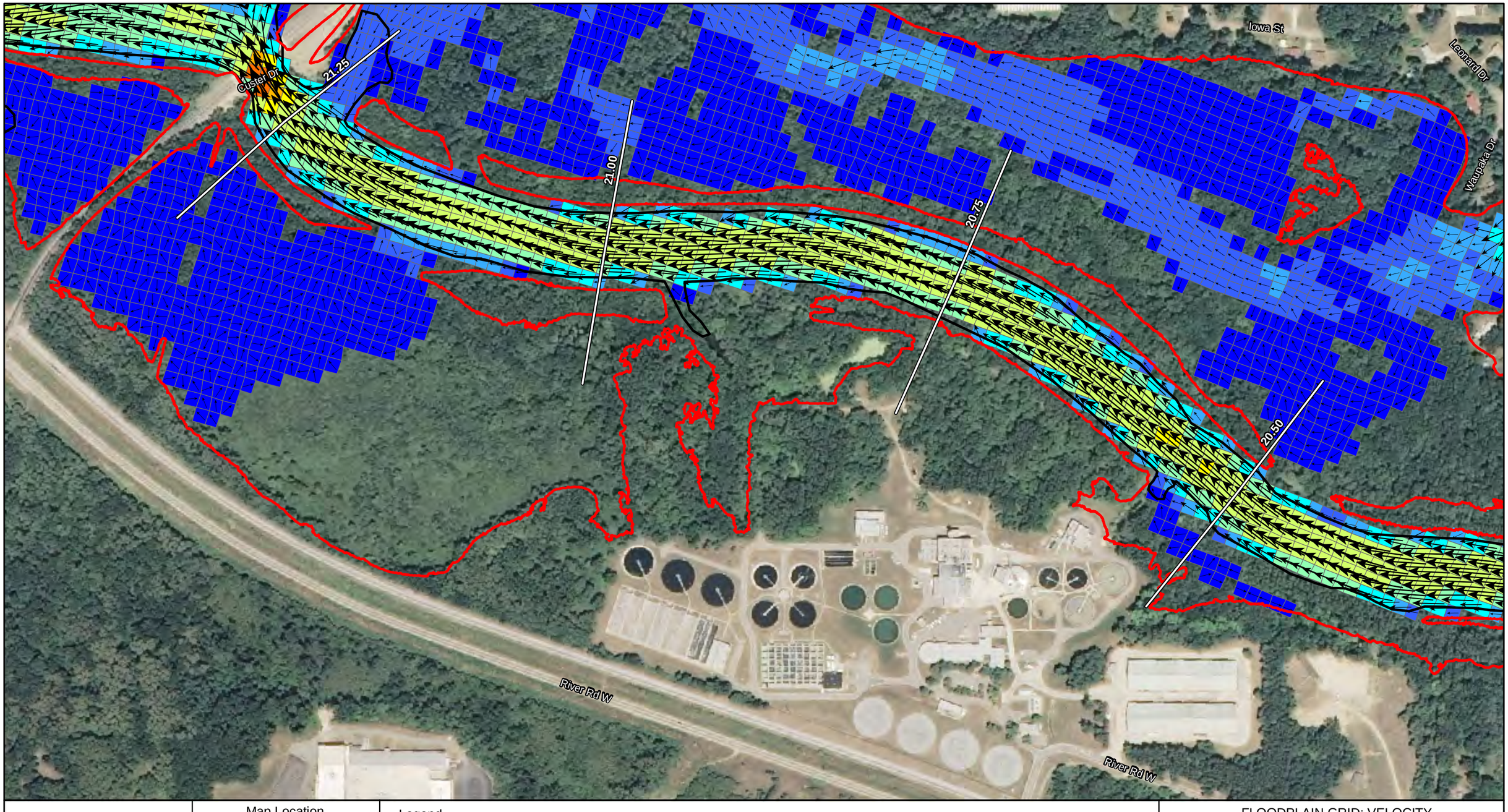
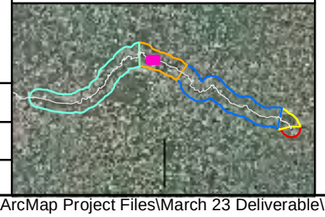
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 20.32 - MP 21.36

SHEET 21 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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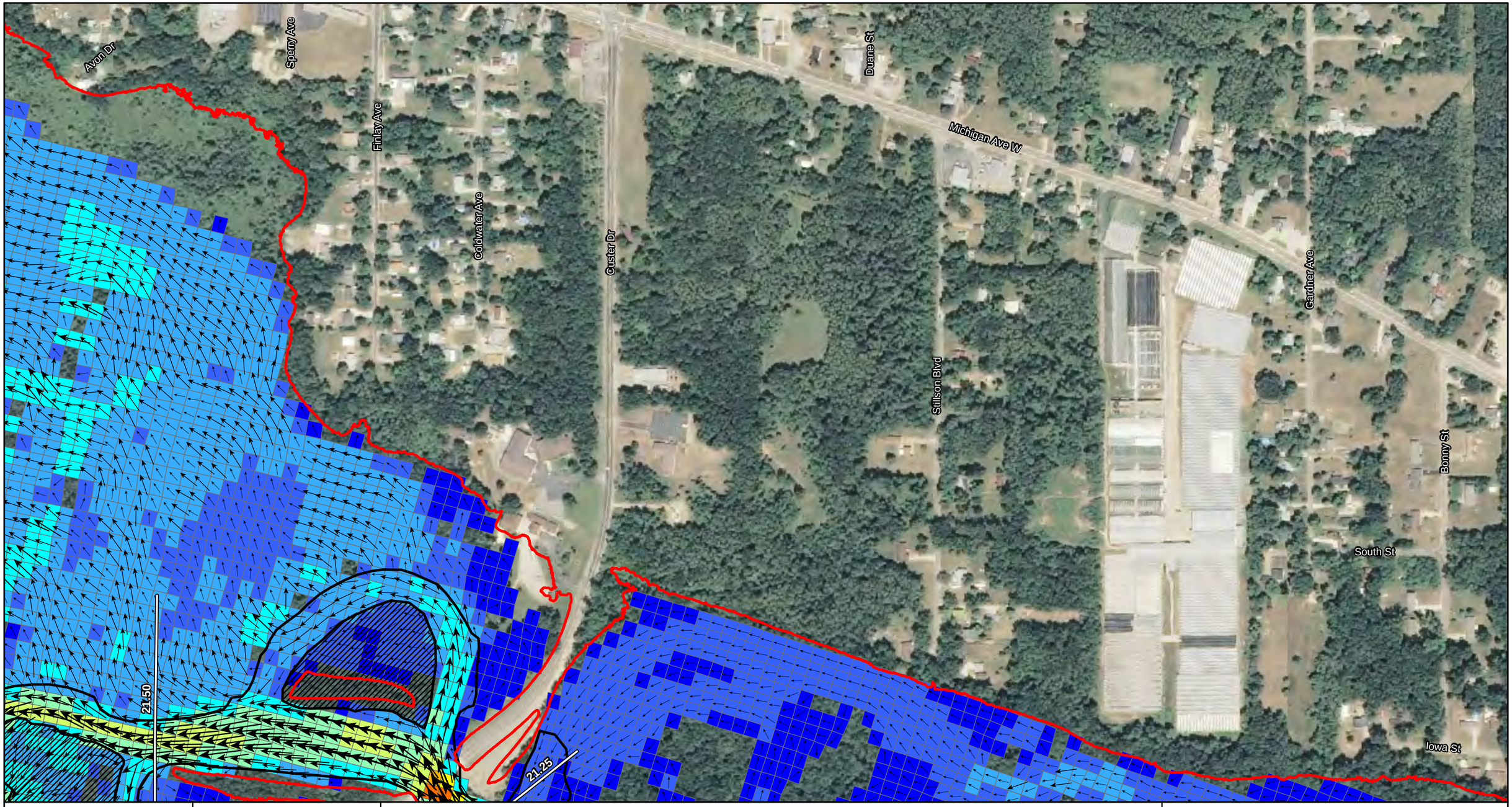
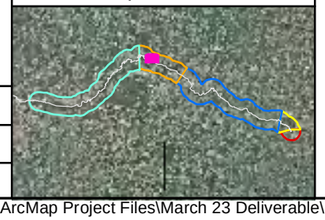
Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 21.36 - MP 21.59

SHEET 22 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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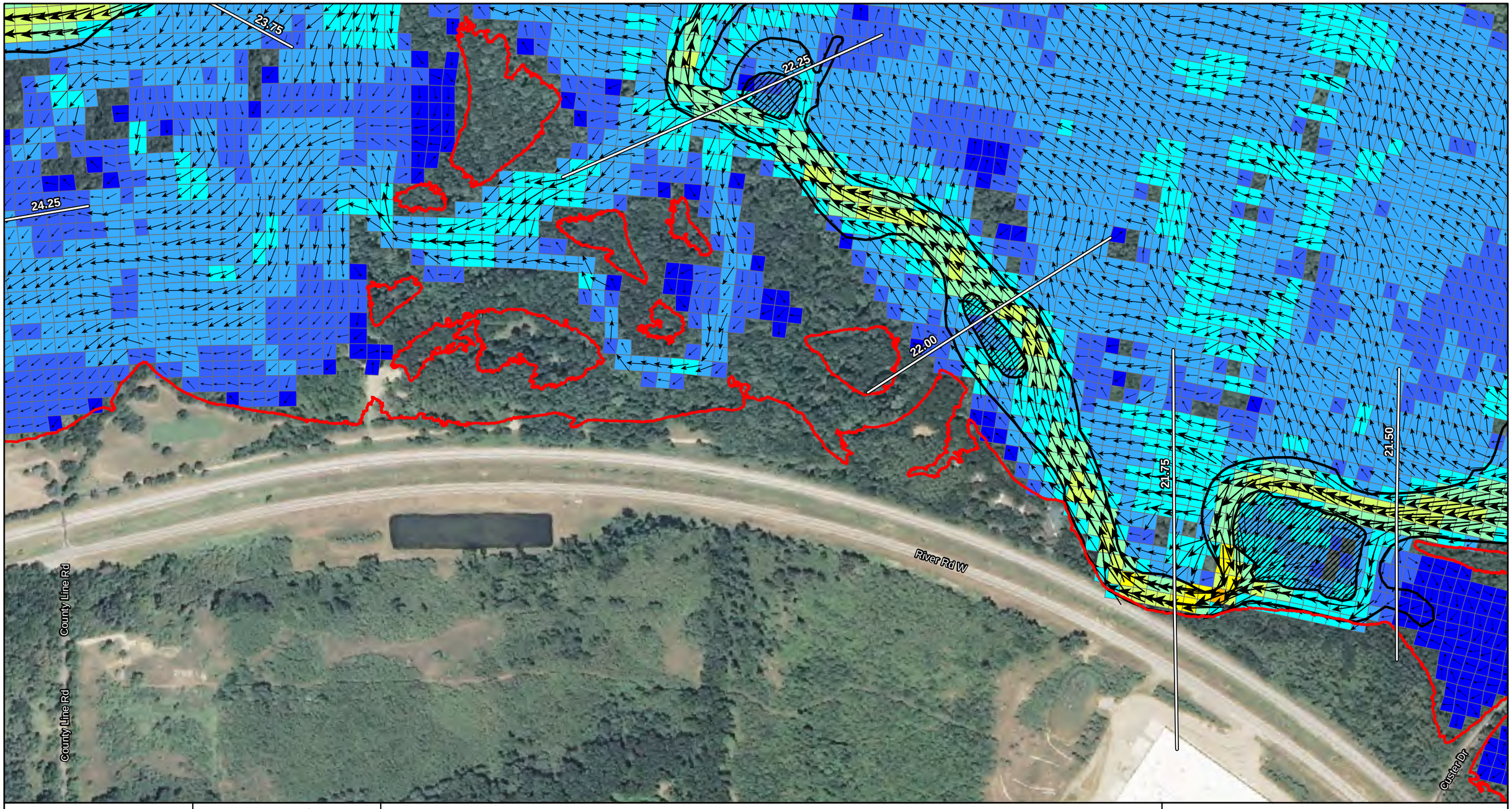
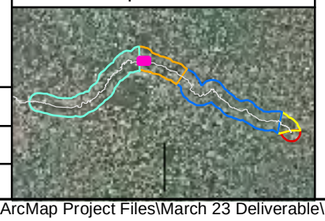
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

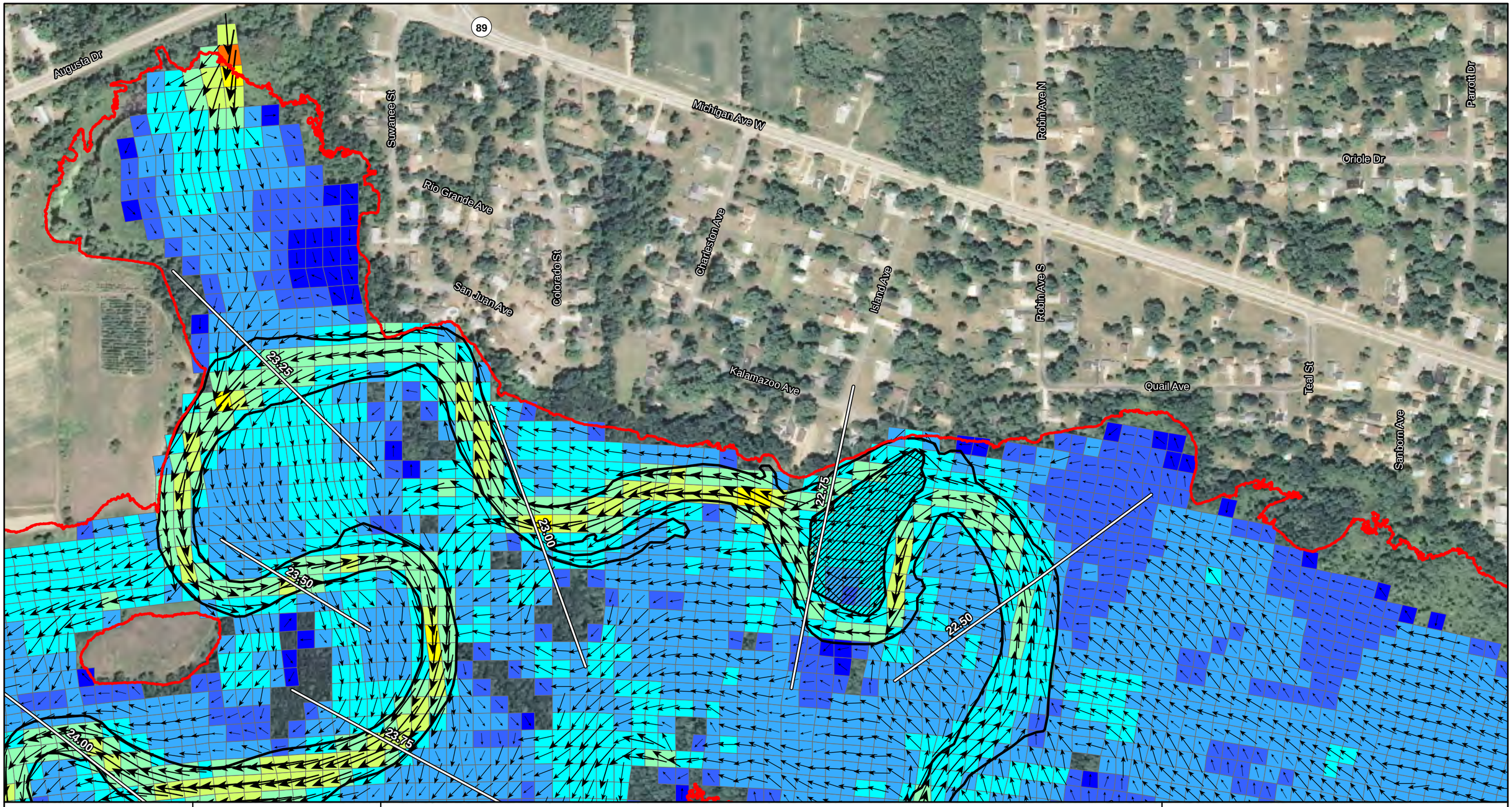
MP 21.59 - MP 22.33

SHEET 23 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

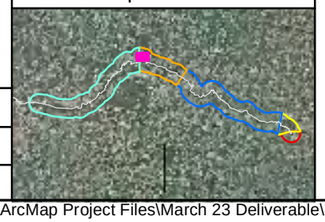
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

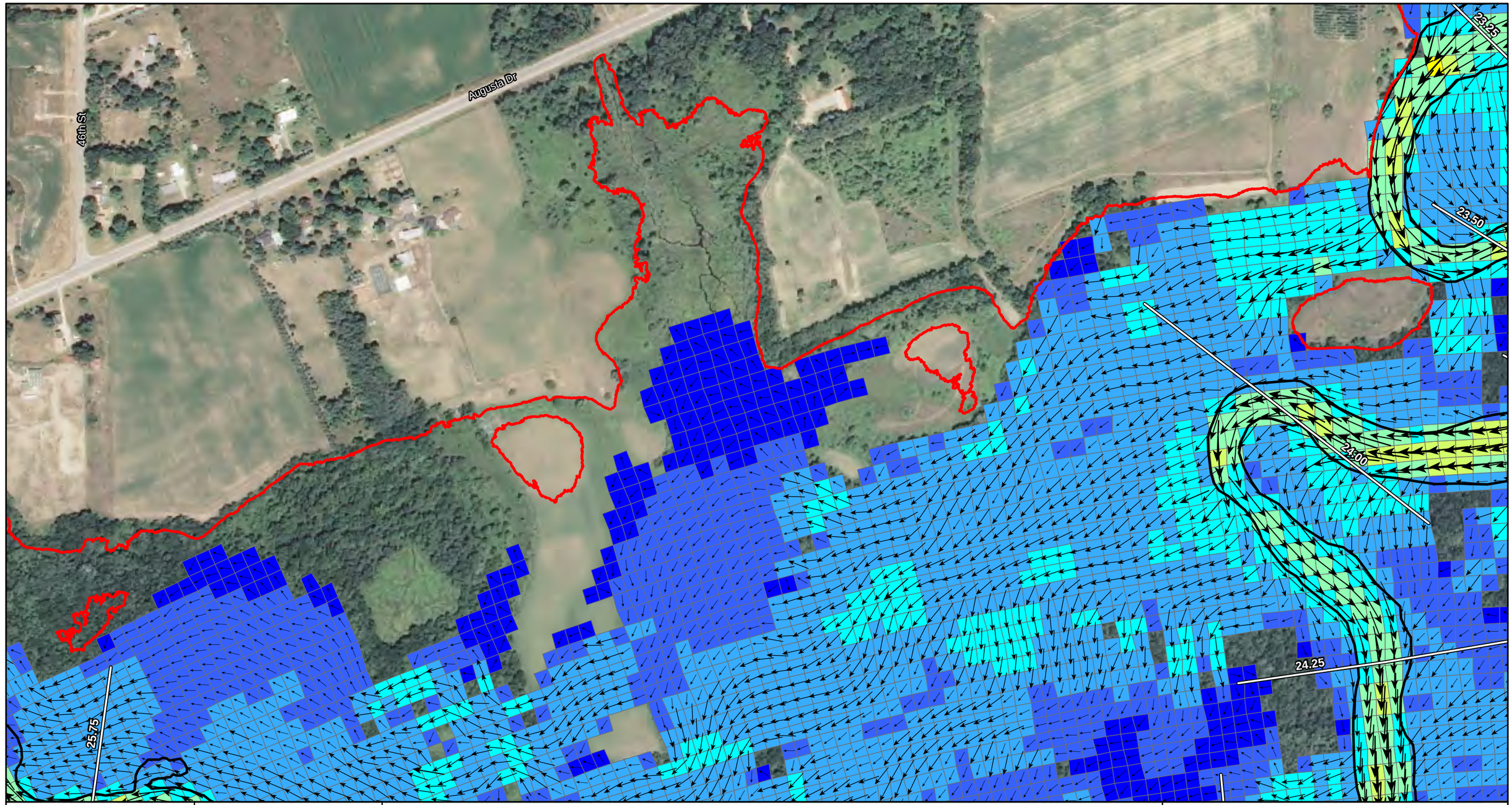
MP 22.33 - MP 24.01

SHEET 24 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

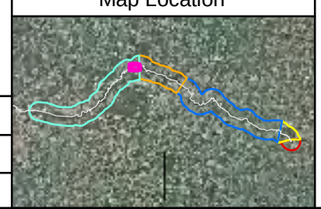
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 24.01 - MP 24.33

SHEET 25 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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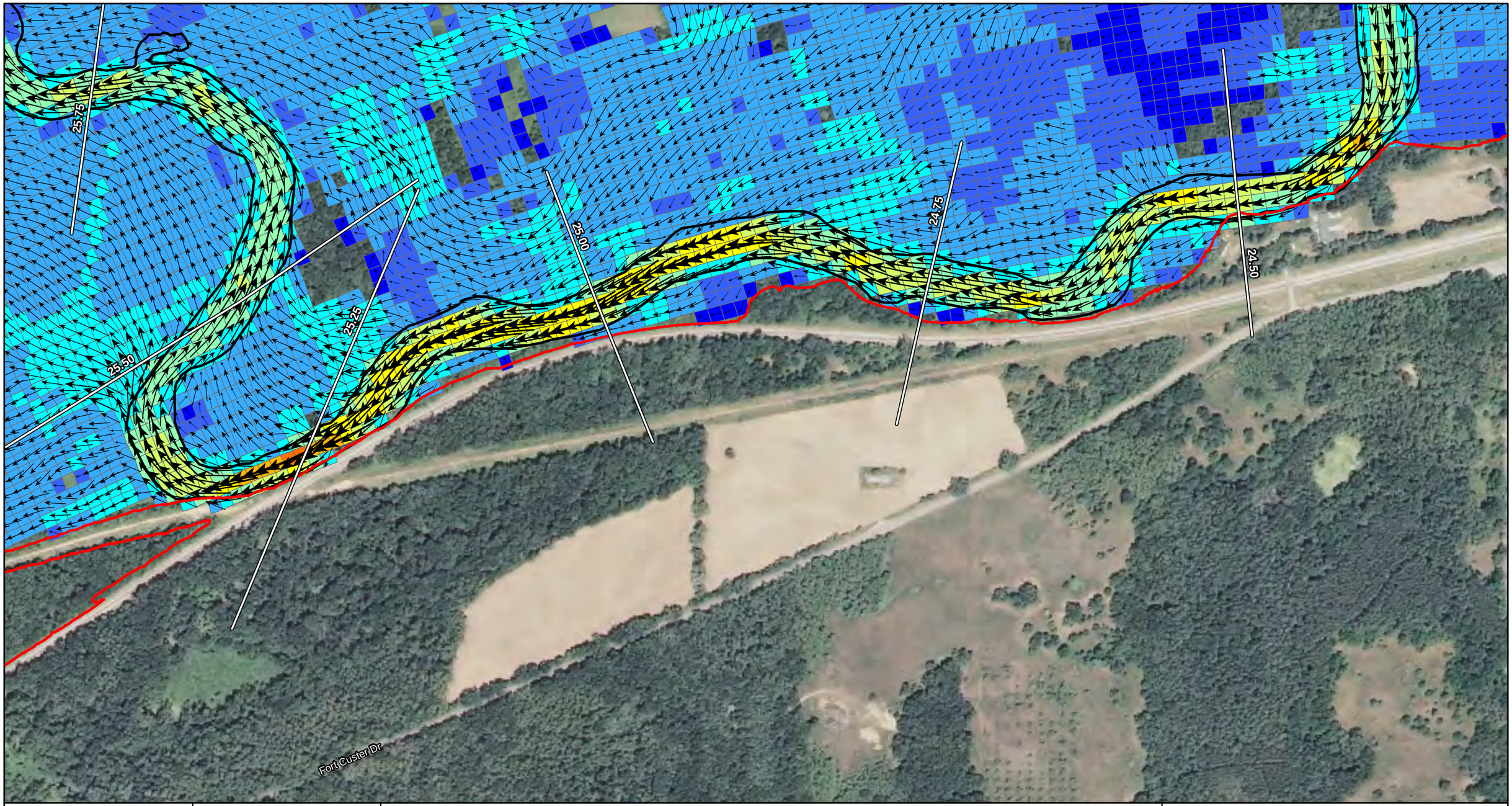
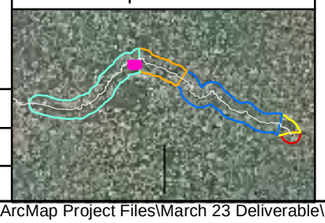
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 24.33 - MP 25.79

SHEET 26 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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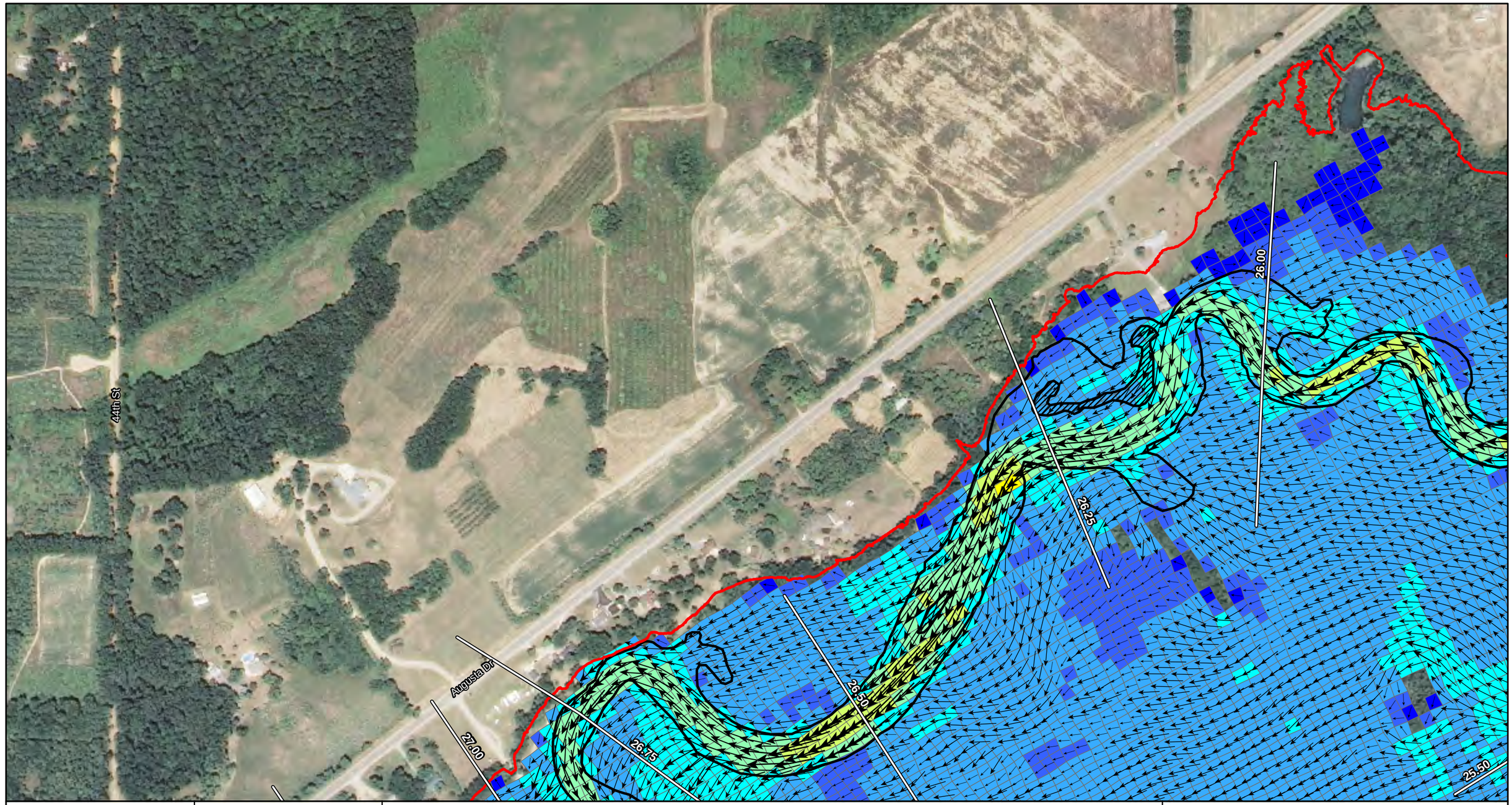
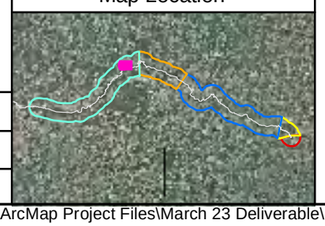
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 25.79 - MP 26.80

SHEET 27 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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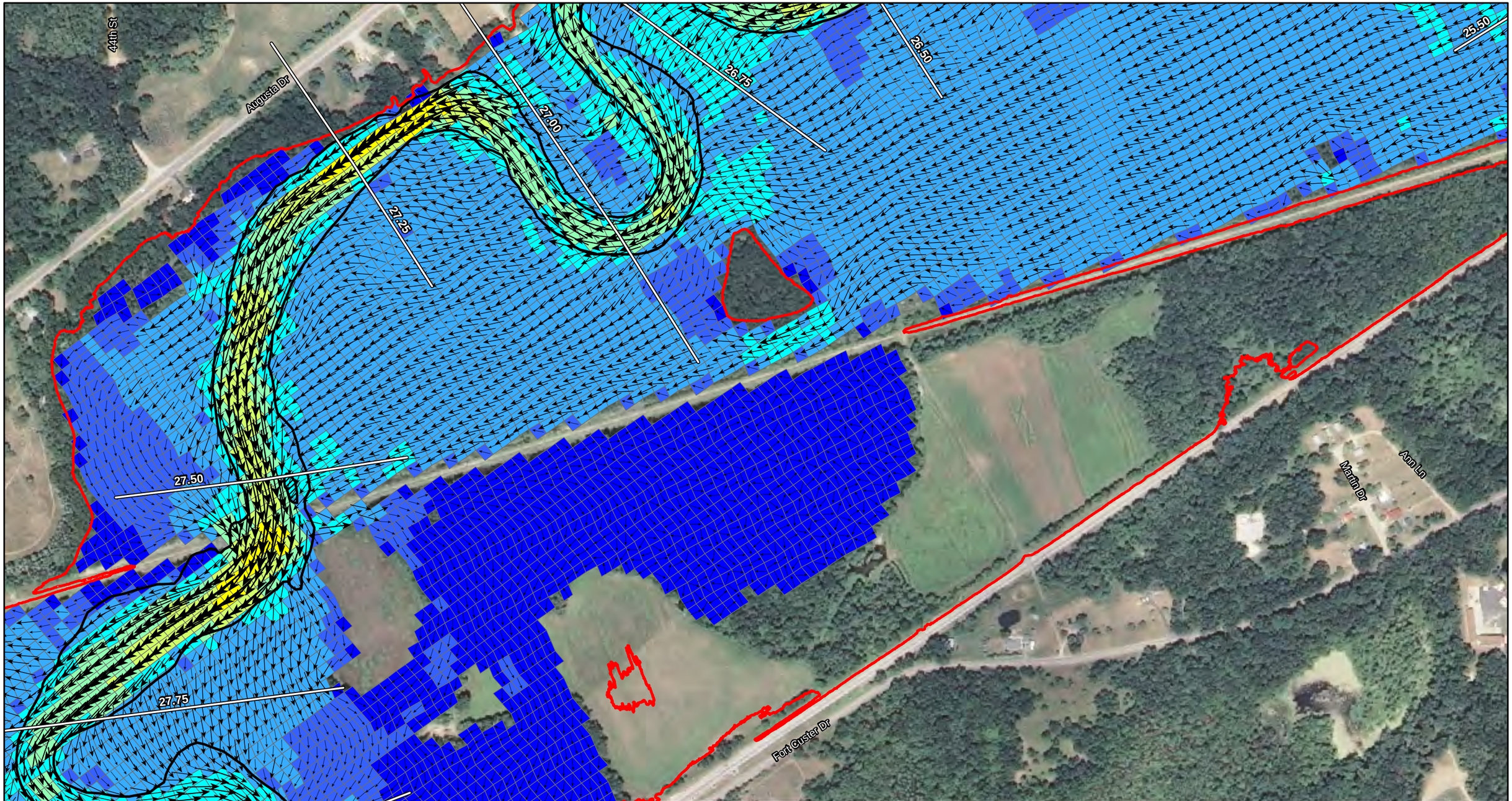
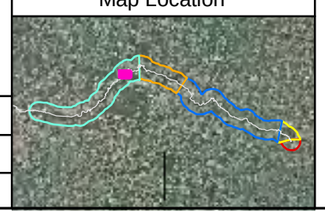
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

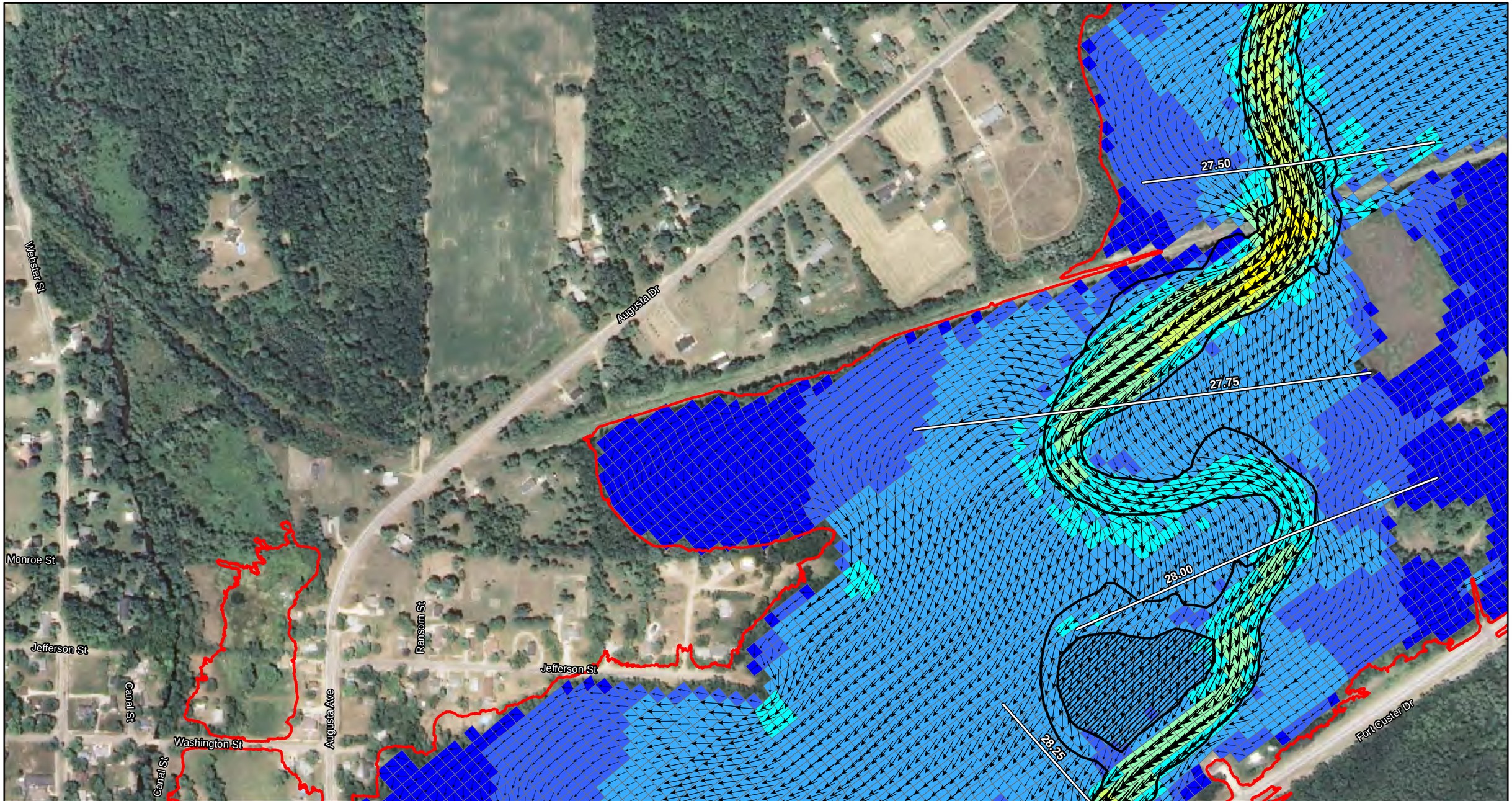
MP 26.80 - MP 27.80

SHEET 28 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

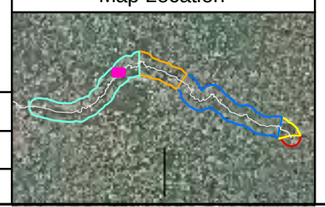
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 26.80 - MP 27.80

SHEET 29 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

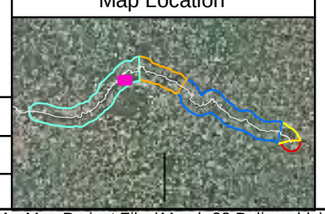
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

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- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 27.80SE - MP 28.22SE

SHEET 30 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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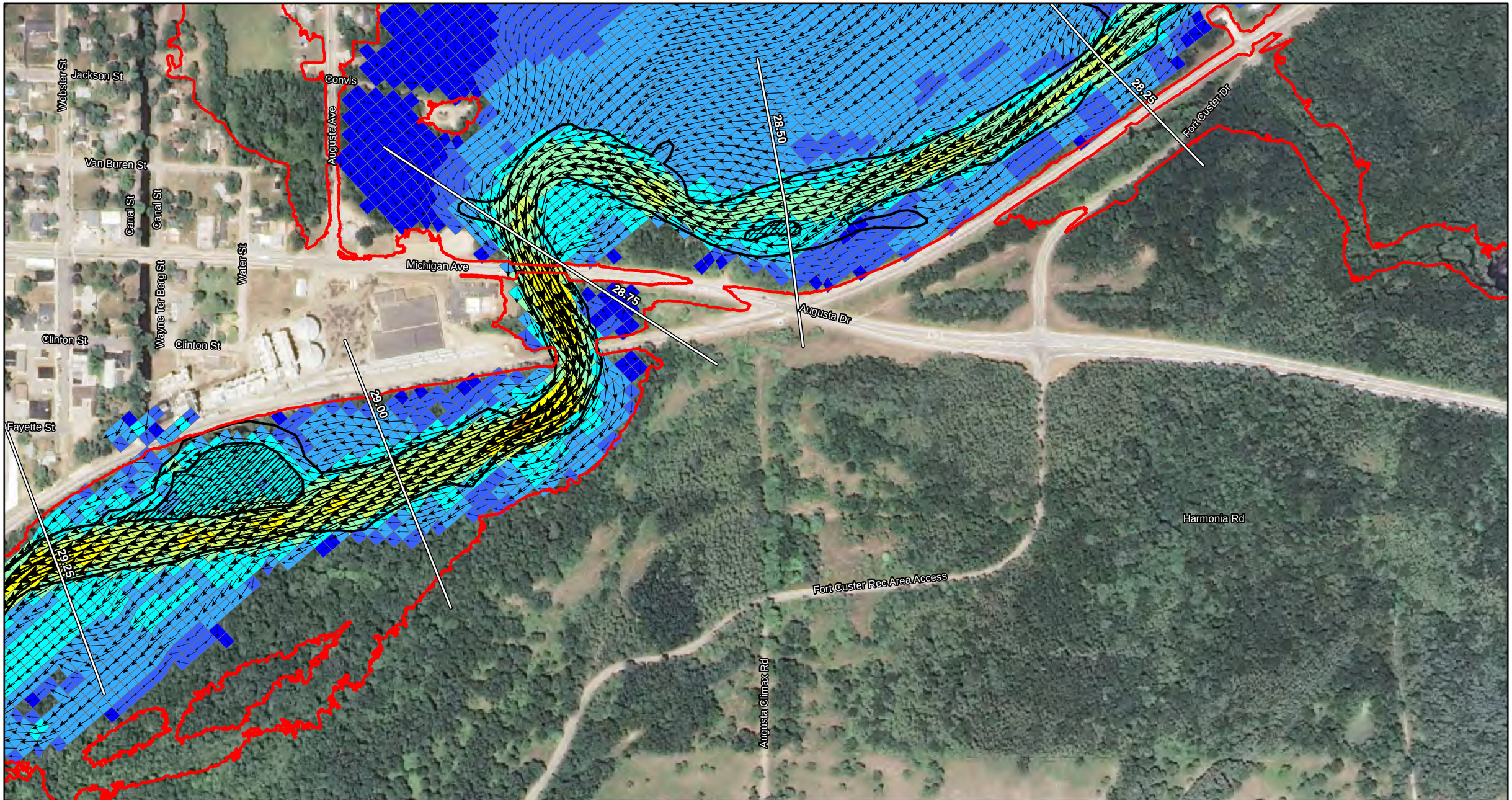
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

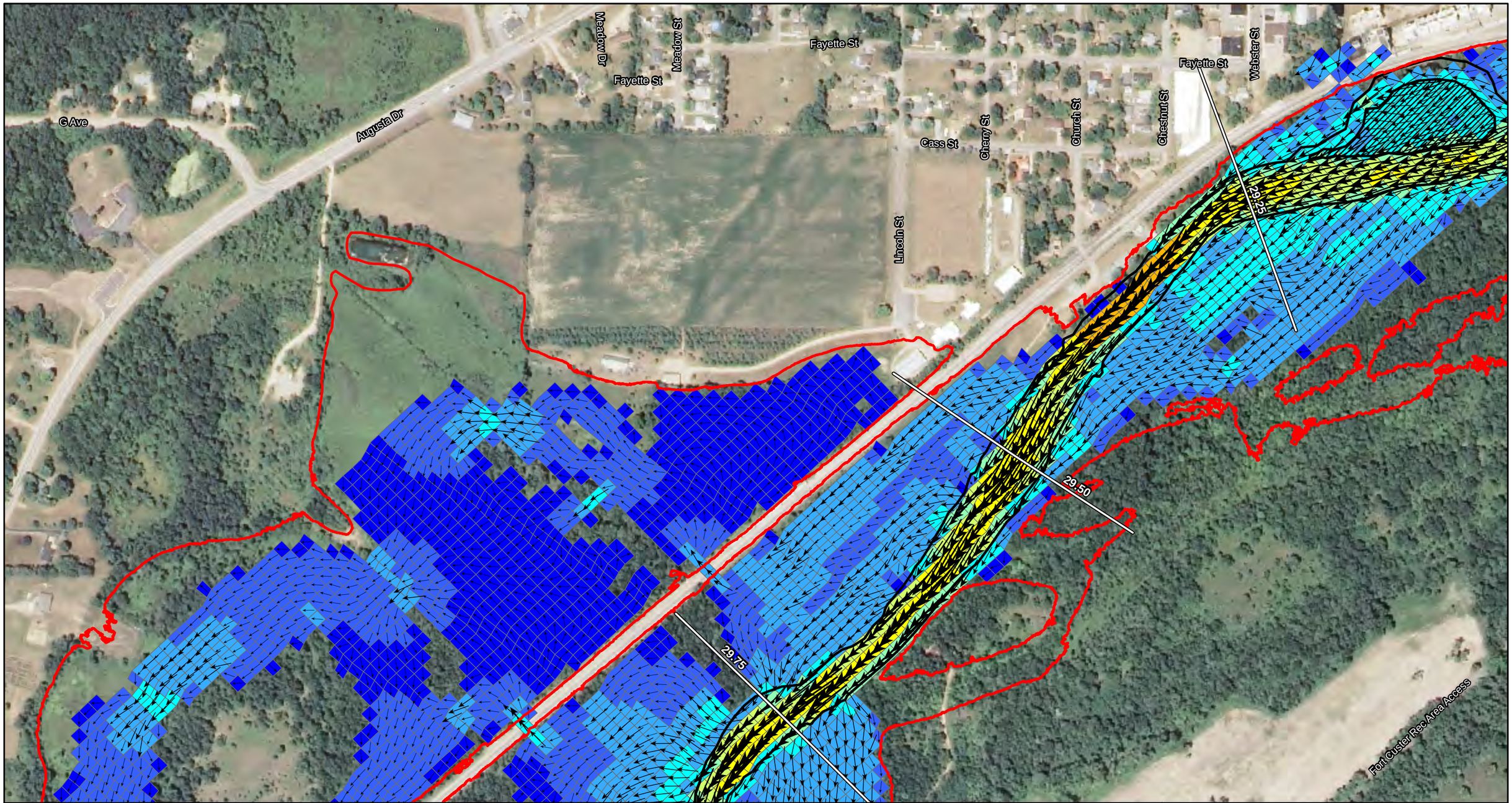
MP 28.22 - MP 29.20

SHEET 31 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 29.20 - MP 29.82

SHEET 32 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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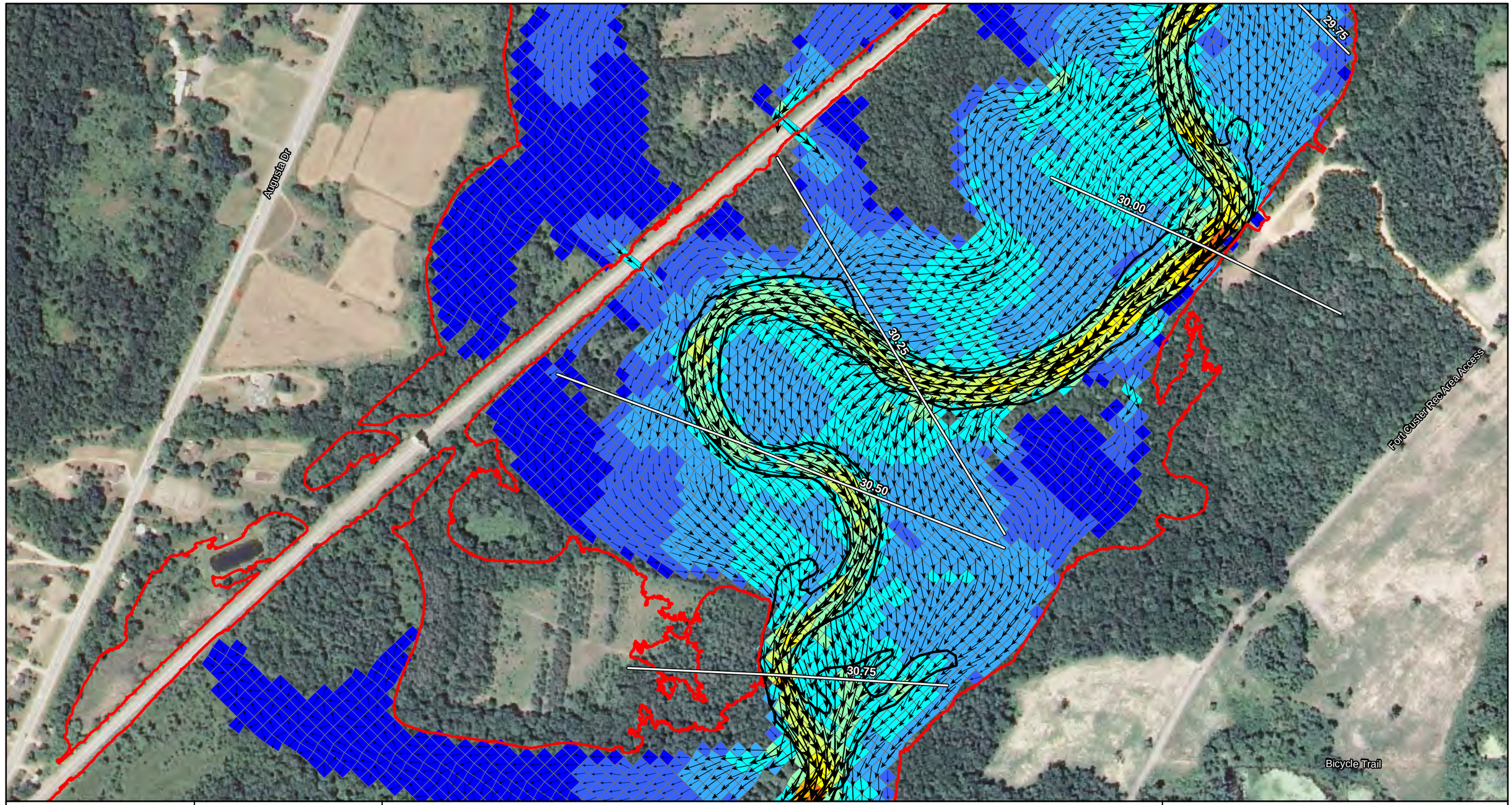
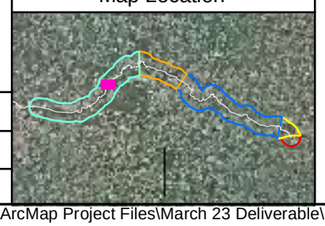
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 29.82 - MP 30.84

SHEET 33 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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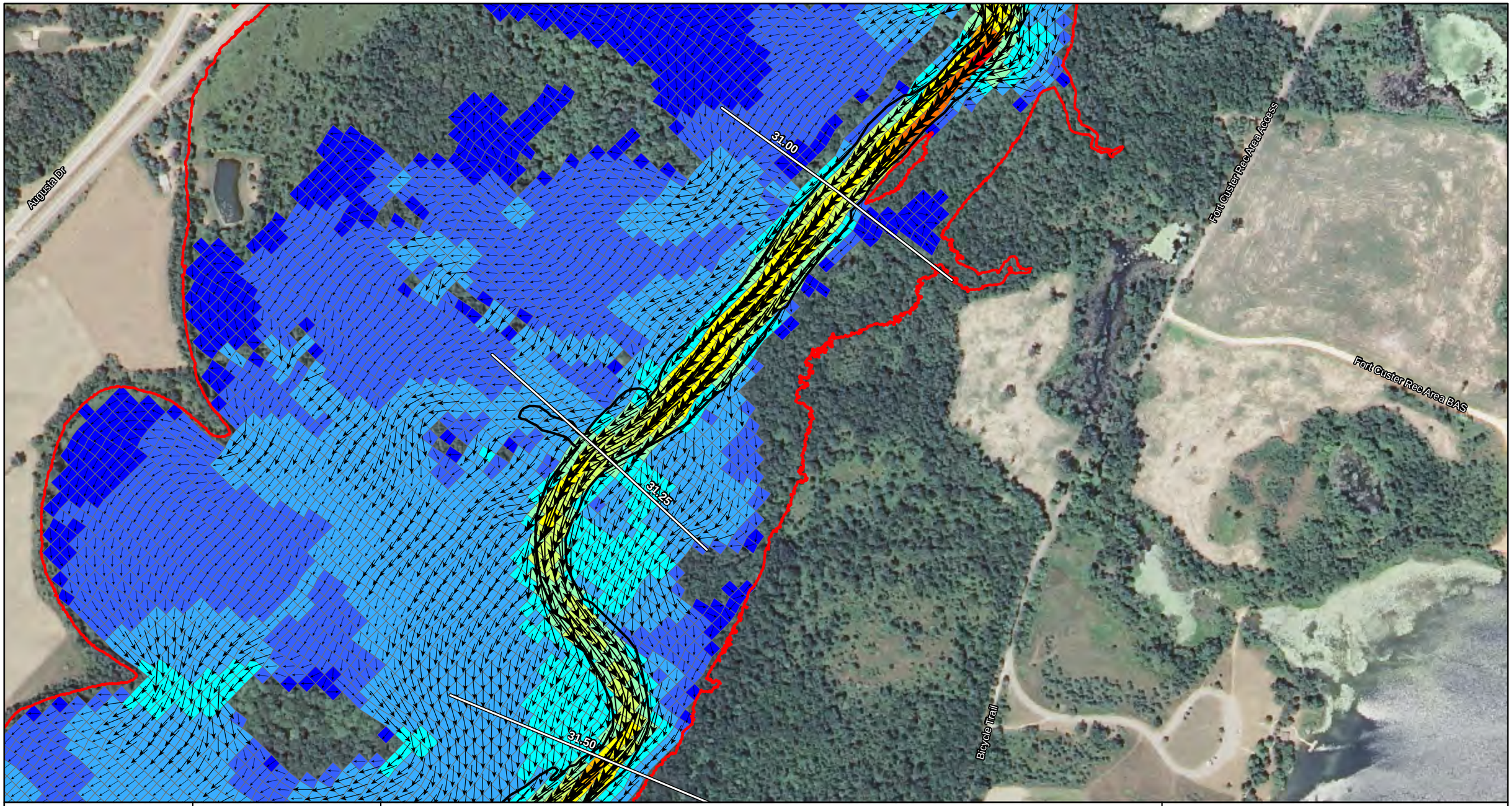
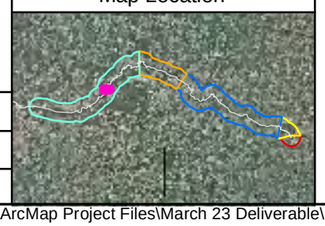
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 30.84 - MP 31.40

SHEET 34 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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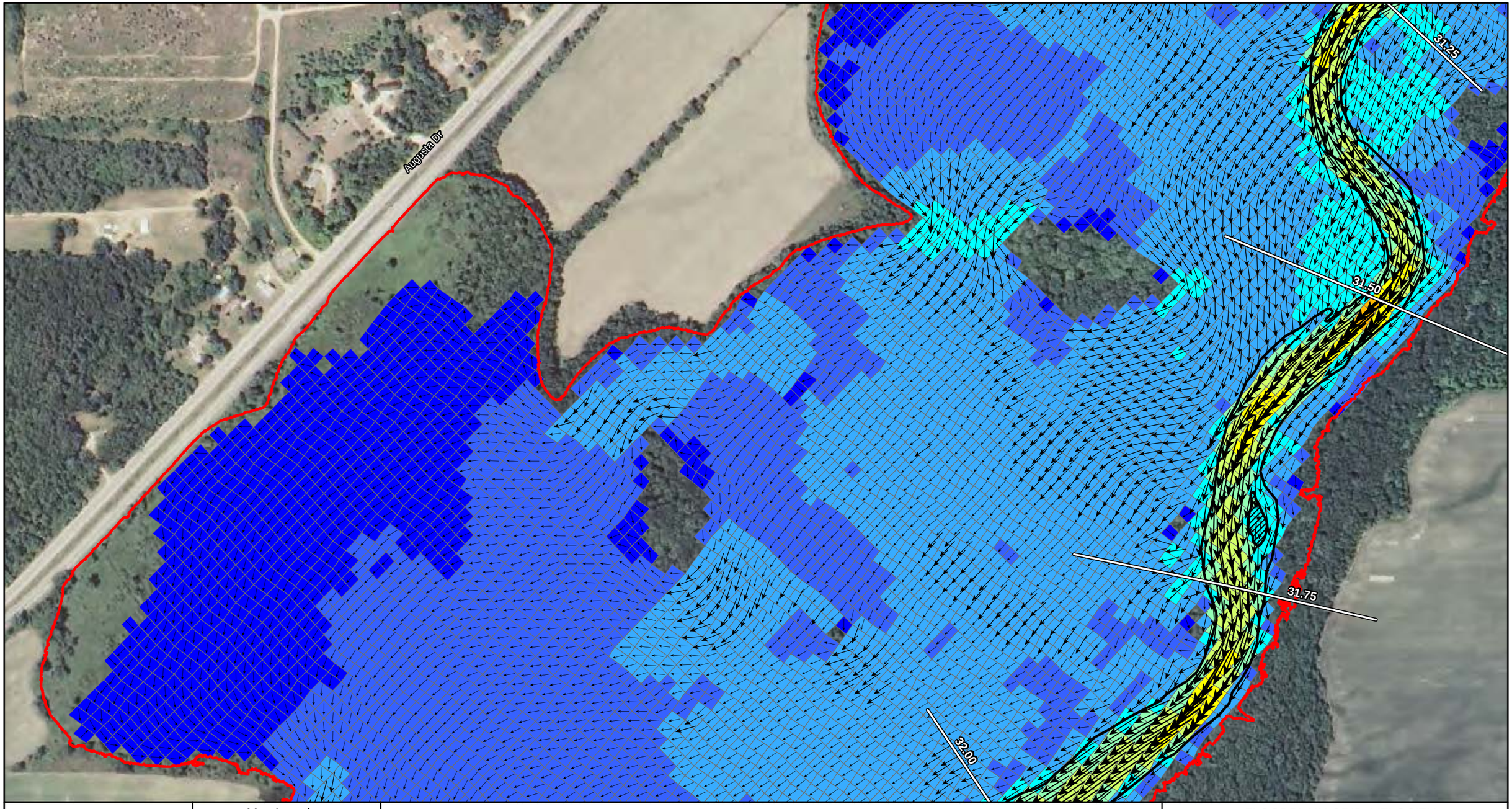
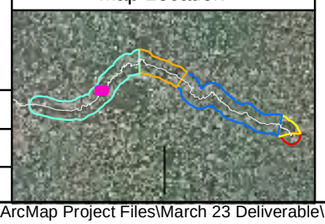
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 31.40 - MP 31.94

SHEET 35 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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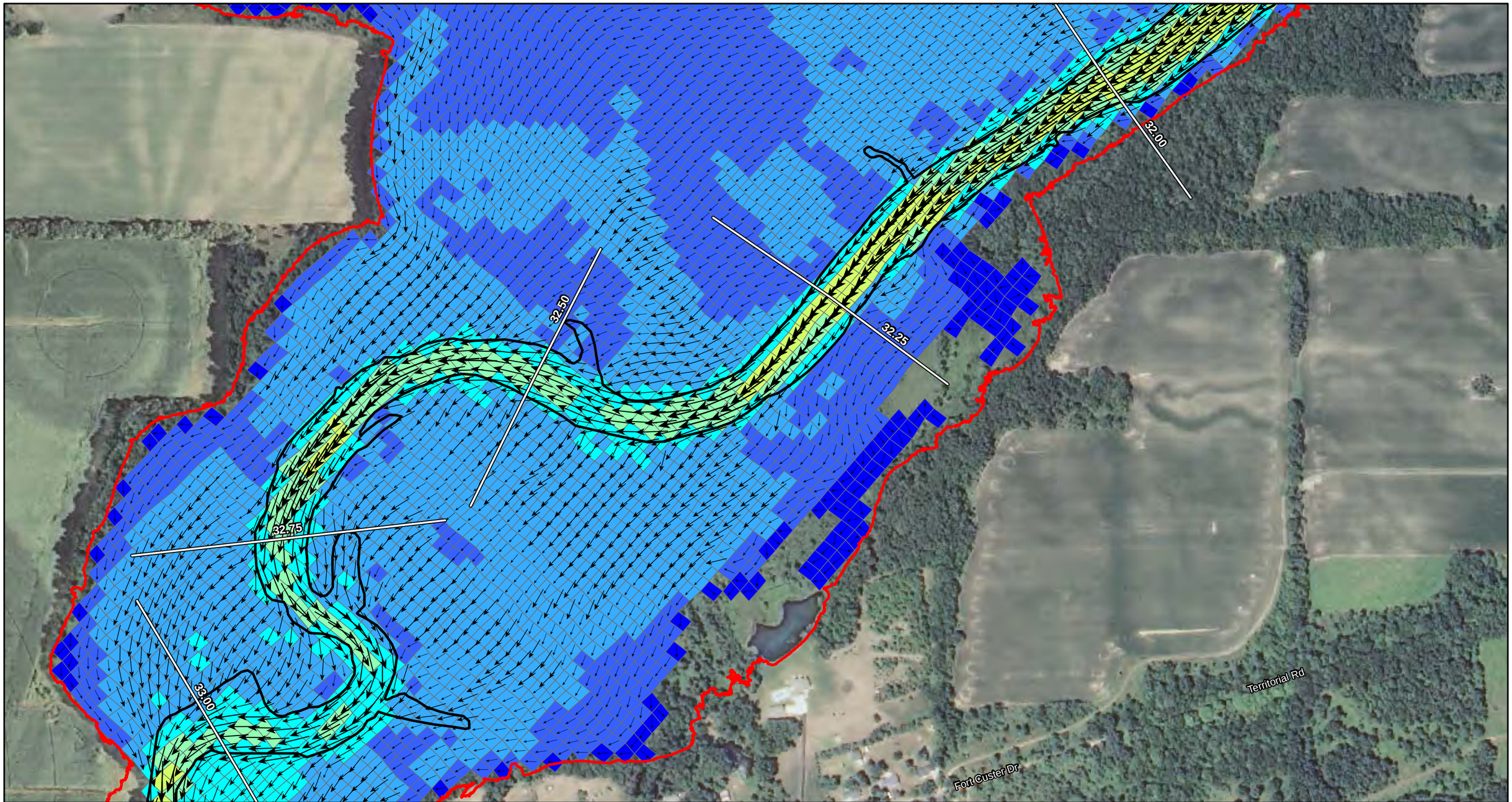
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
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- 2.5 - 3.0 ft/sec
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- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 31.94 - MP 33.00

SHEET 36 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009

Augusta Dr

32.75

33.00

33.25

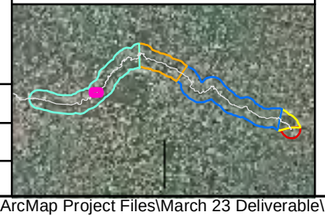
33.50

Fort Custer Dr

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
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- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 33.00 - MP 33.52

SHEET 37 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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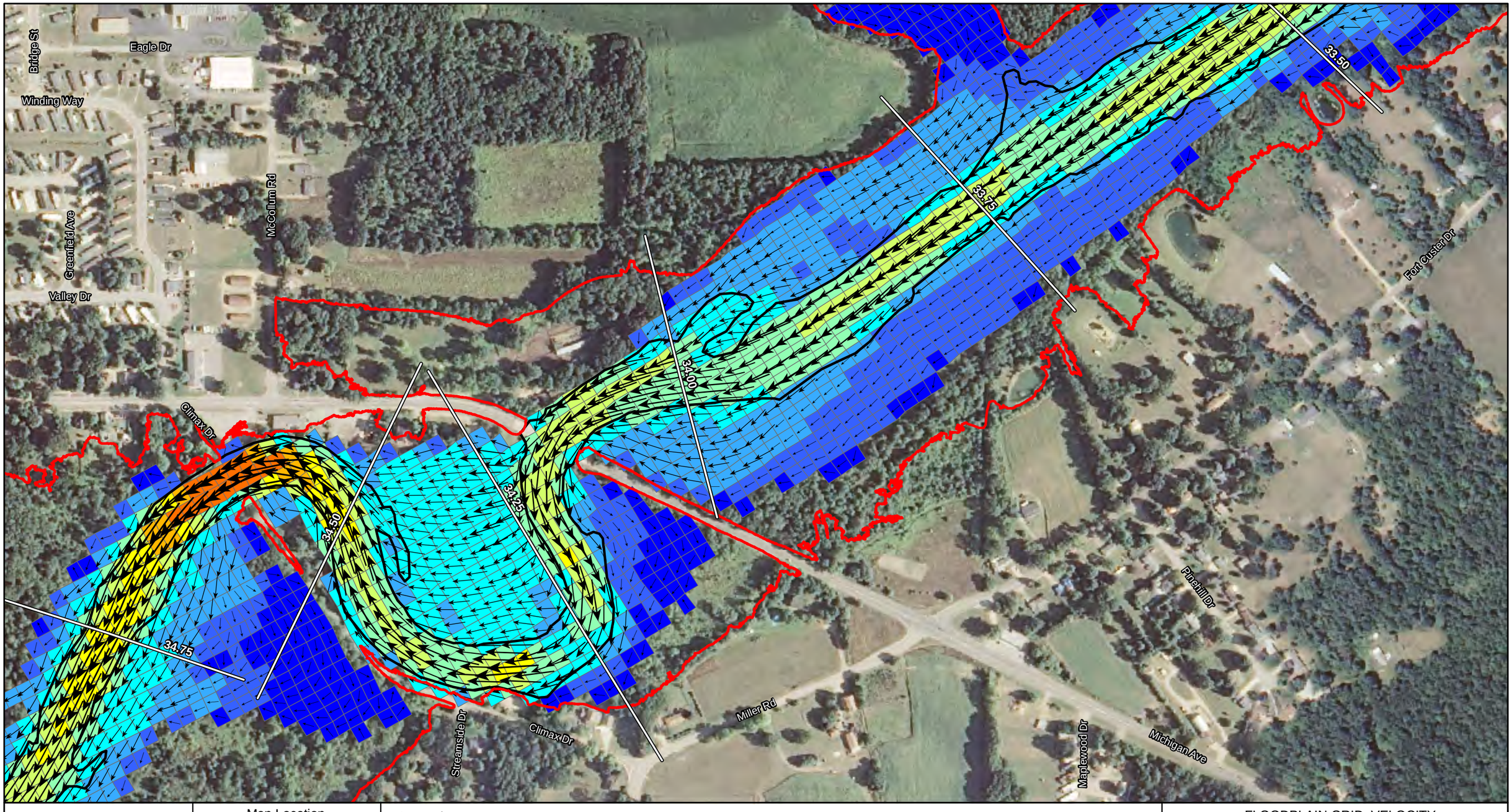
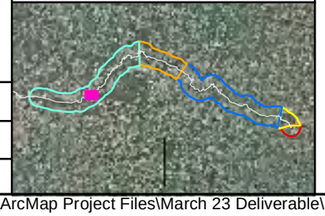
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
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- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 33.00 - MP 33.52

SHEET 38 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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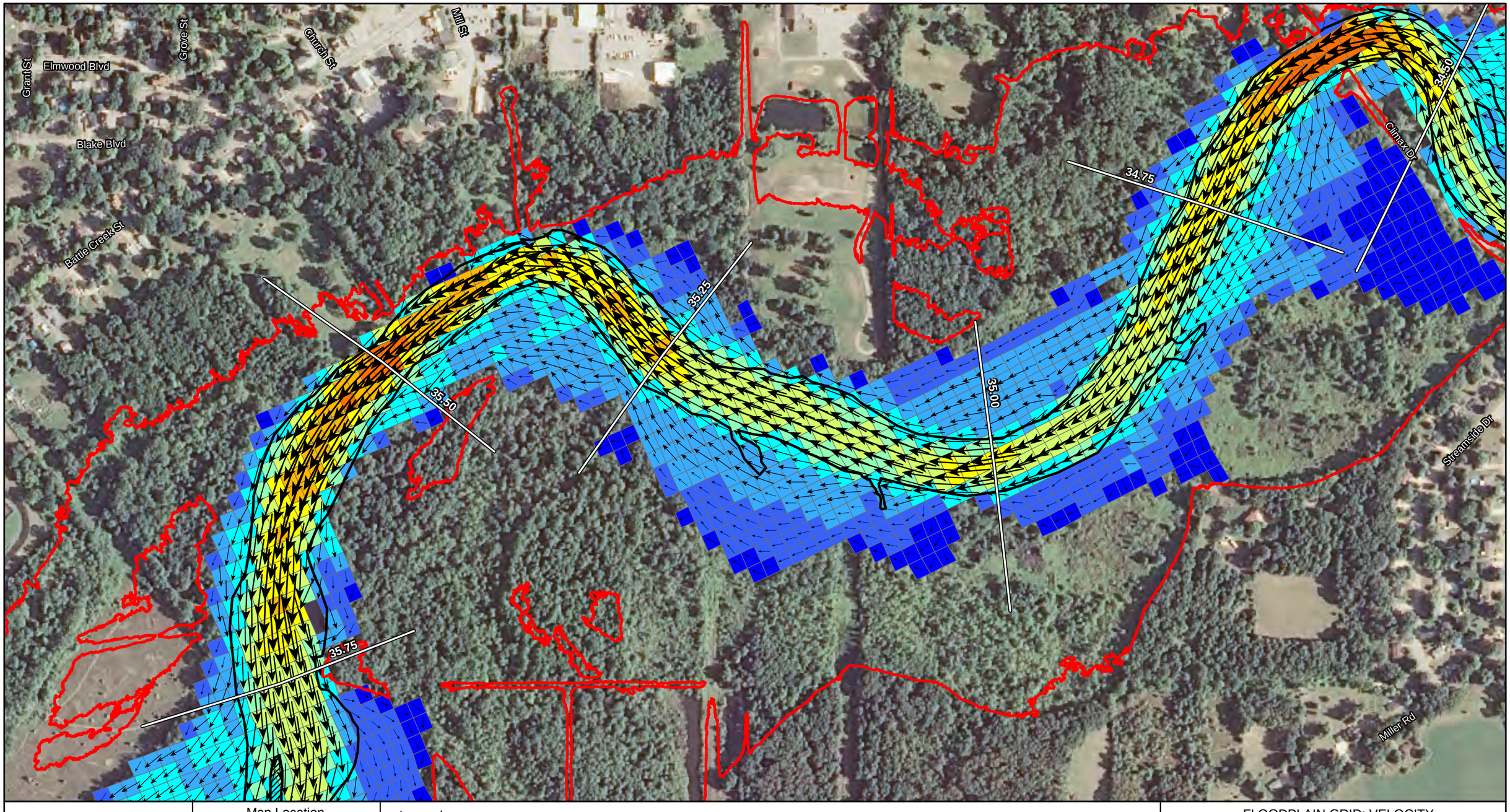
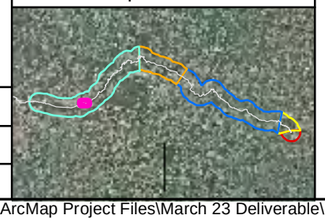
Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
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ft/sec = Feet Per Second
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Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 34.70 - MP 35.75

SHEET 39 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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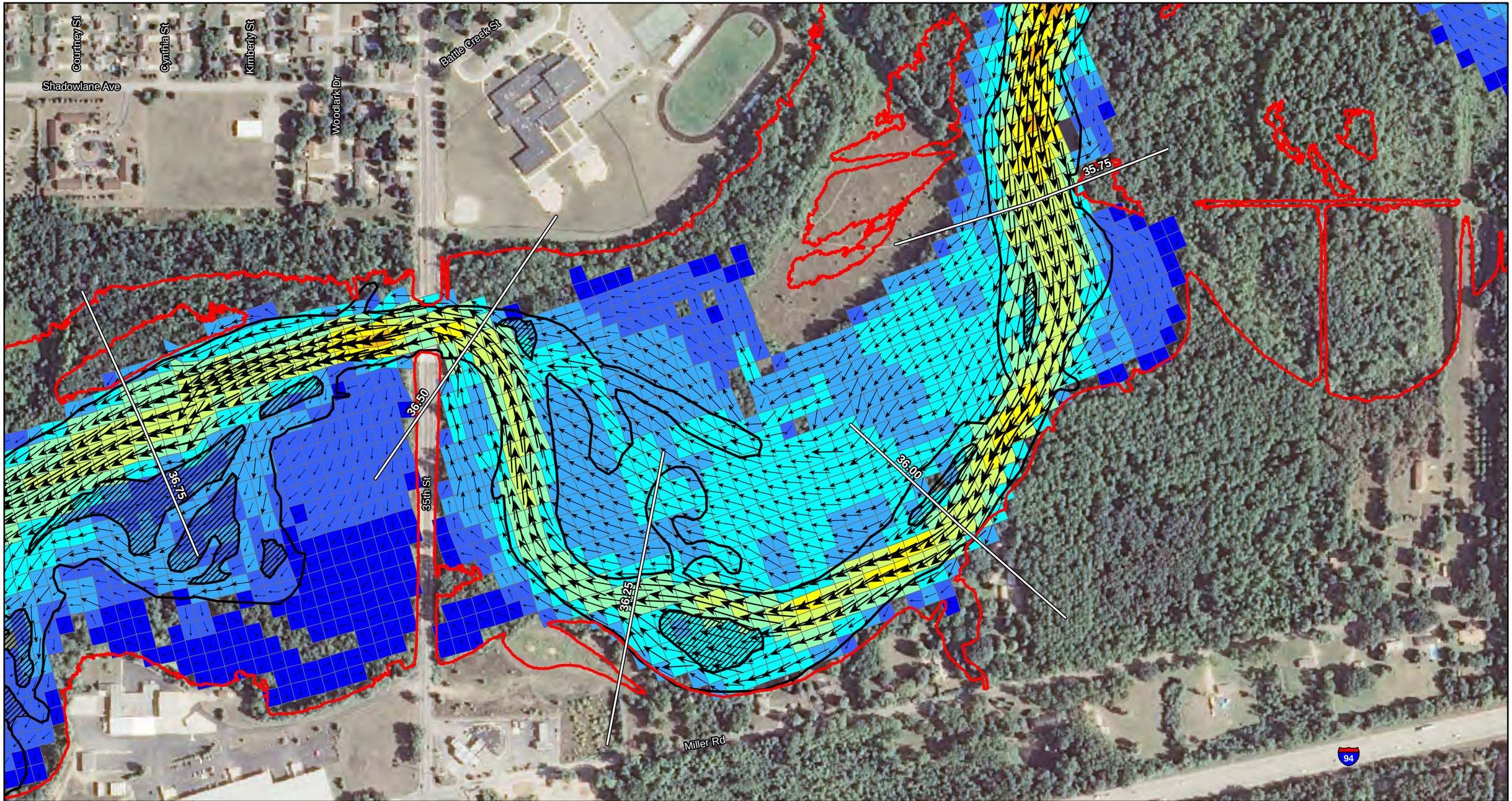
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
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N

0 175 350 700
Scale in Feet

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 35.75 - MP 36.75

SHEET 40 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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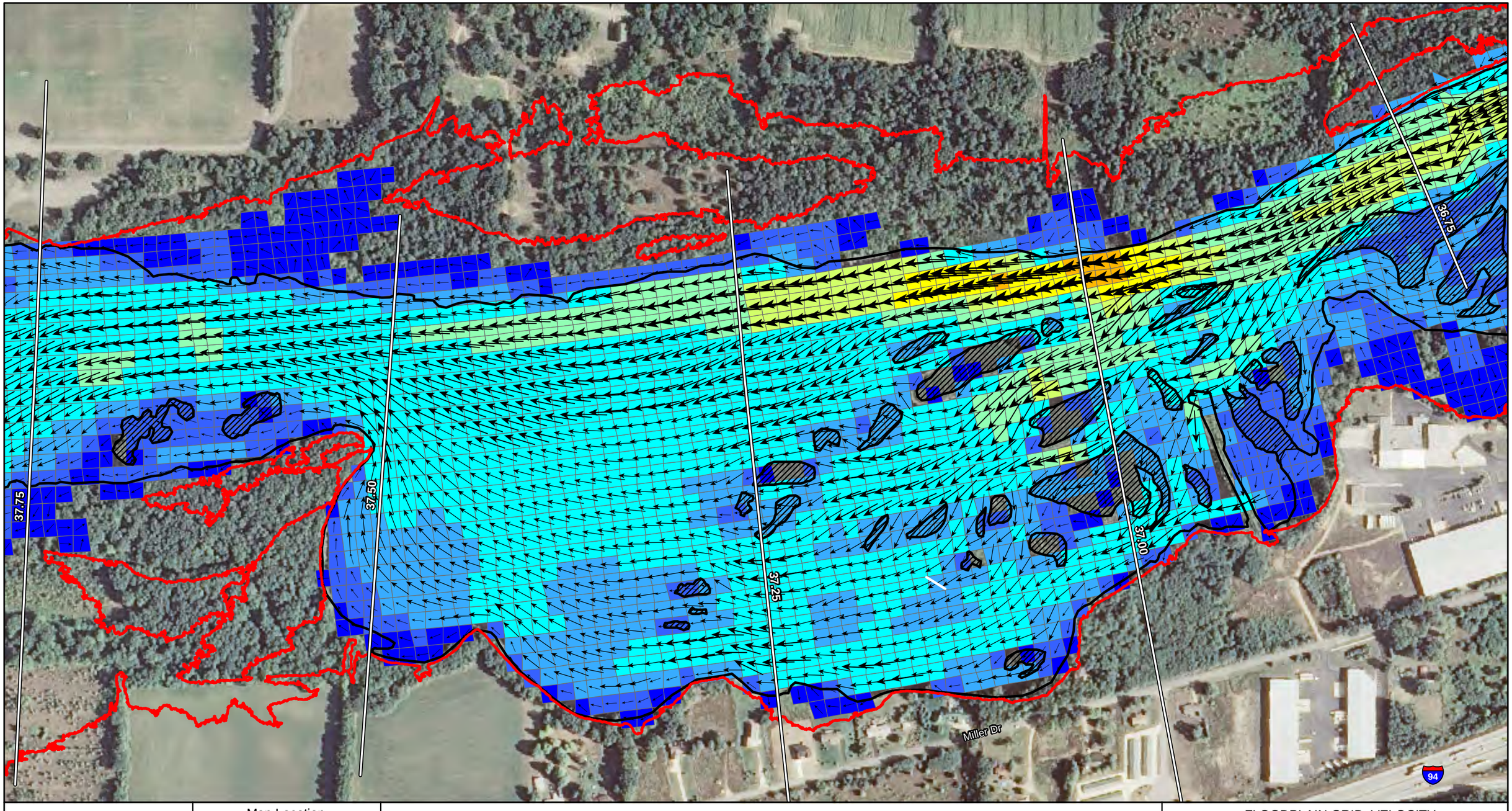
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
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- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
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Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 36.75 - MP 37.75

SHEET 41 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009

Krum Ave

Rosemont Dr

Plaza Pl

Morrow Lake BAS

38.50

38.75

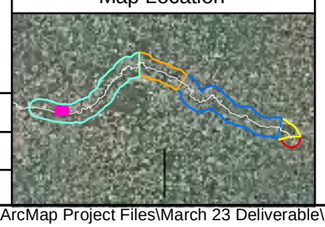
38.25

38.00

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 37.75N - MP 38.80N

SHEET 42 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

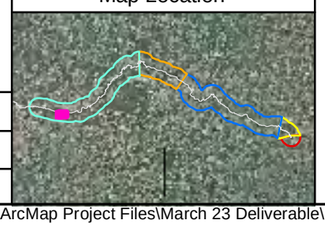
Aerial Photography Date: July & August 2009

38.75
38.50
38.25
38.00
37.75
94
Lyon Rd
Miller Dr

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

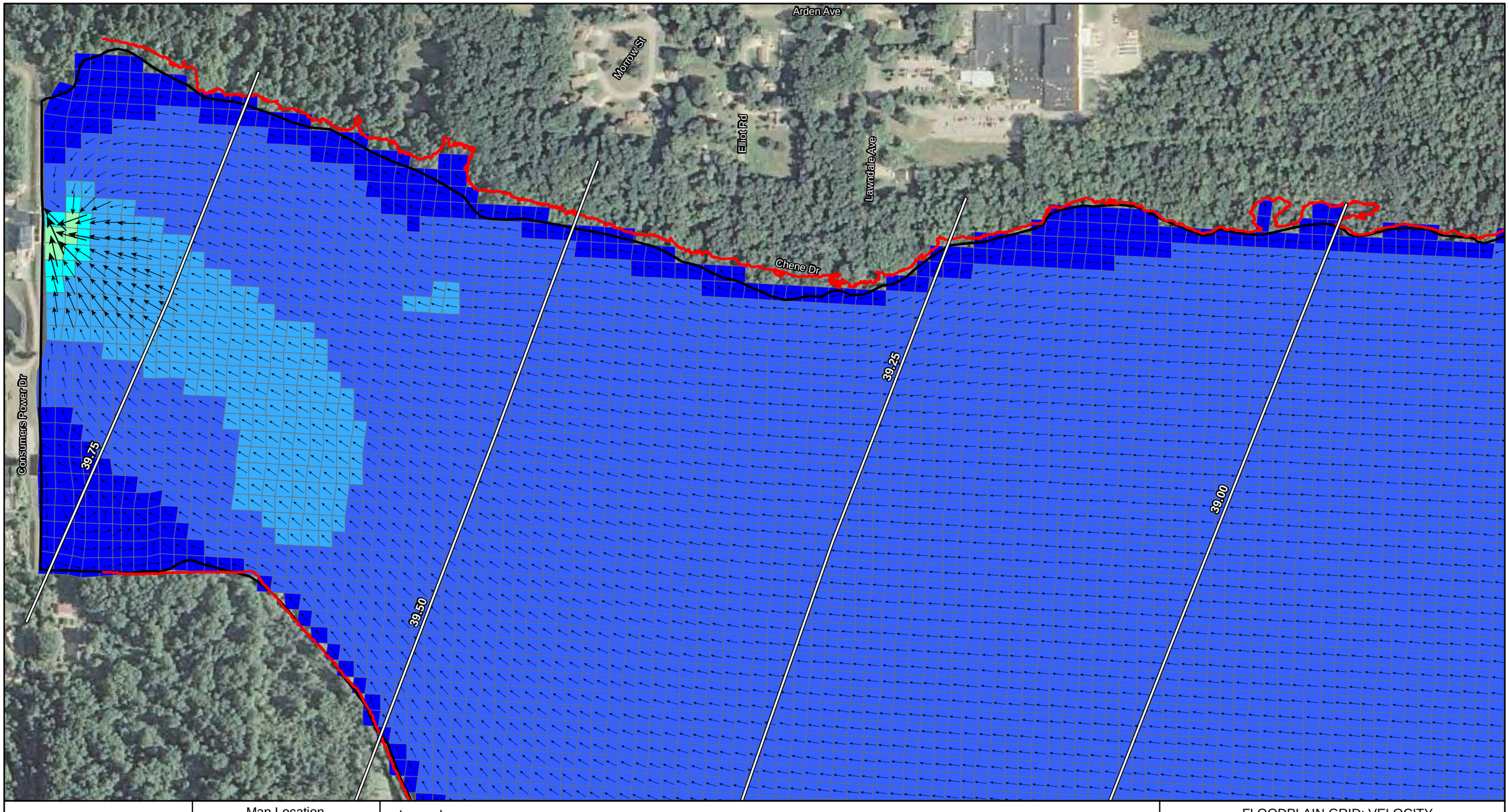
MP 37.75S - MP 38.80S

SHEET 43 OF 45

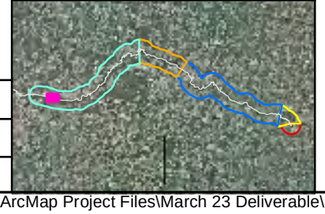
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

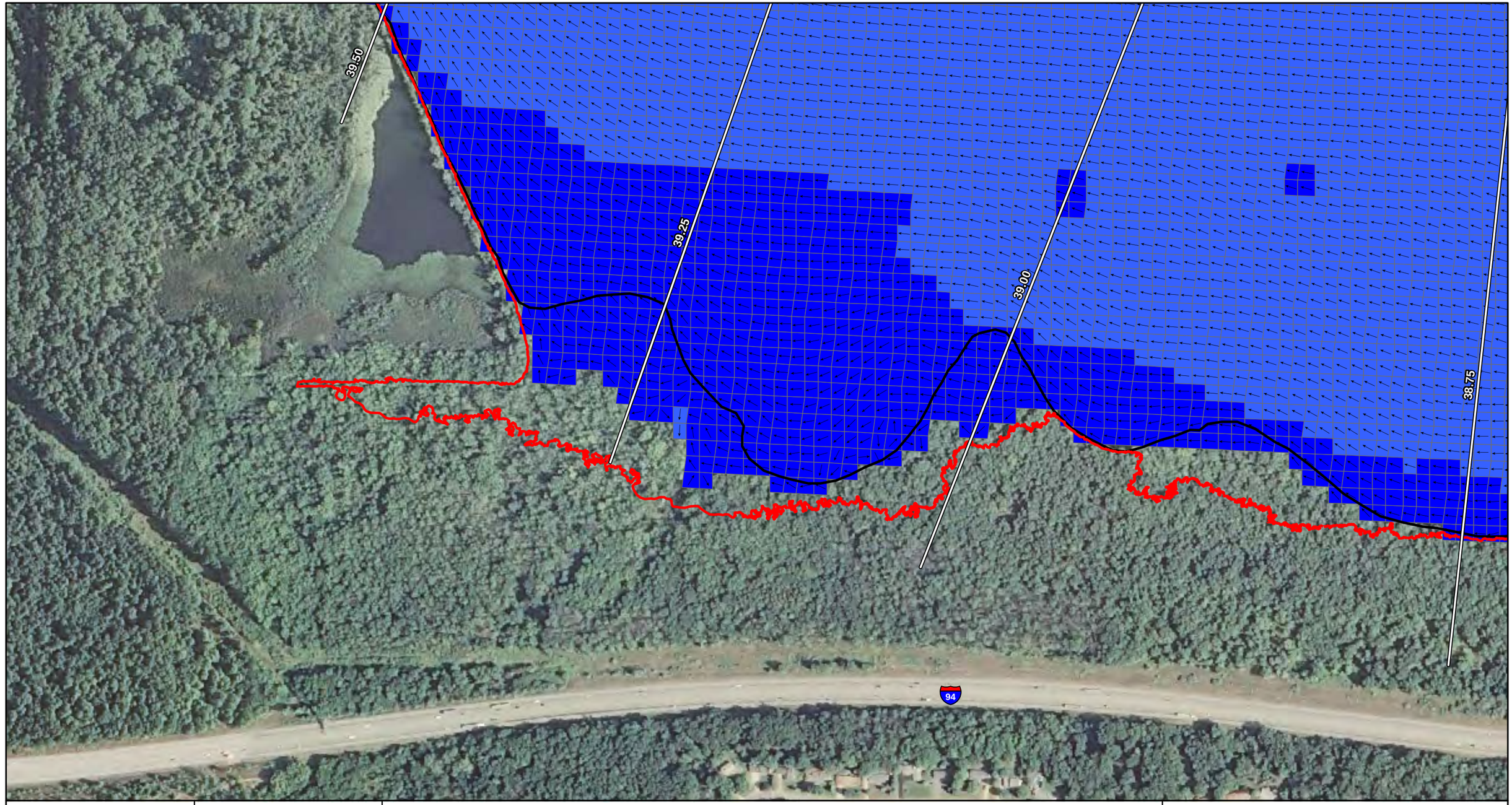
MP 38.80N - MP 39.95N

SHEET 44 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

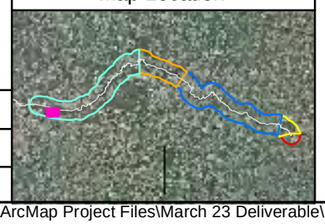
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 26, 2010

MP 38.80S - MP 39.95S

SHEET 45 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul26_2010.mxd

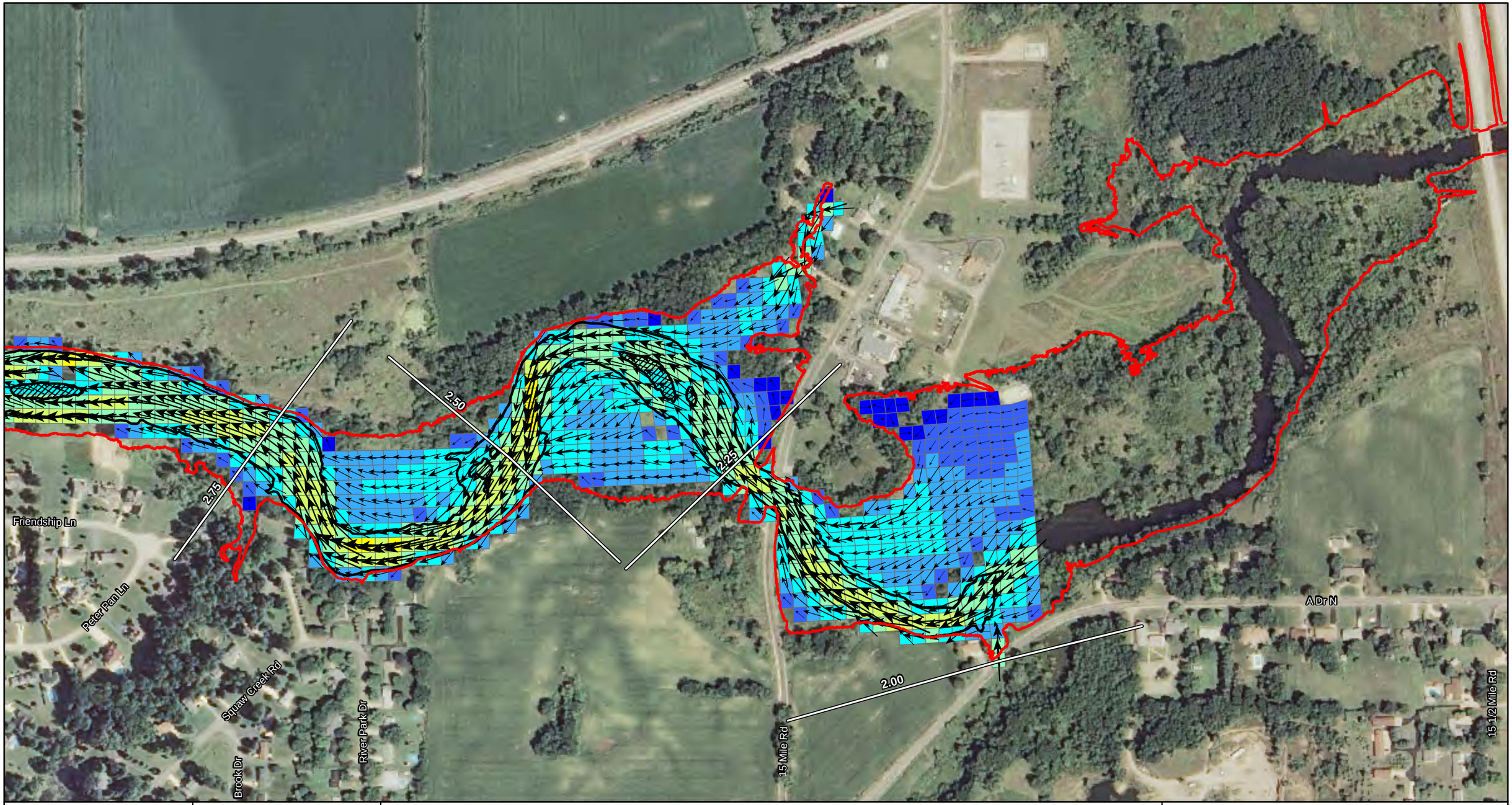
Aerial Photography Date: July & August 2009

Figure 4-23

Floodplain Grid: Velocity

July 28, 2010

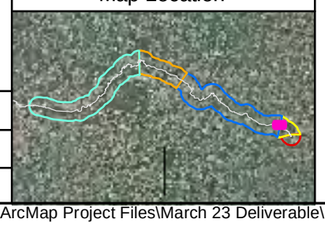
Sheets 1 through 45



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

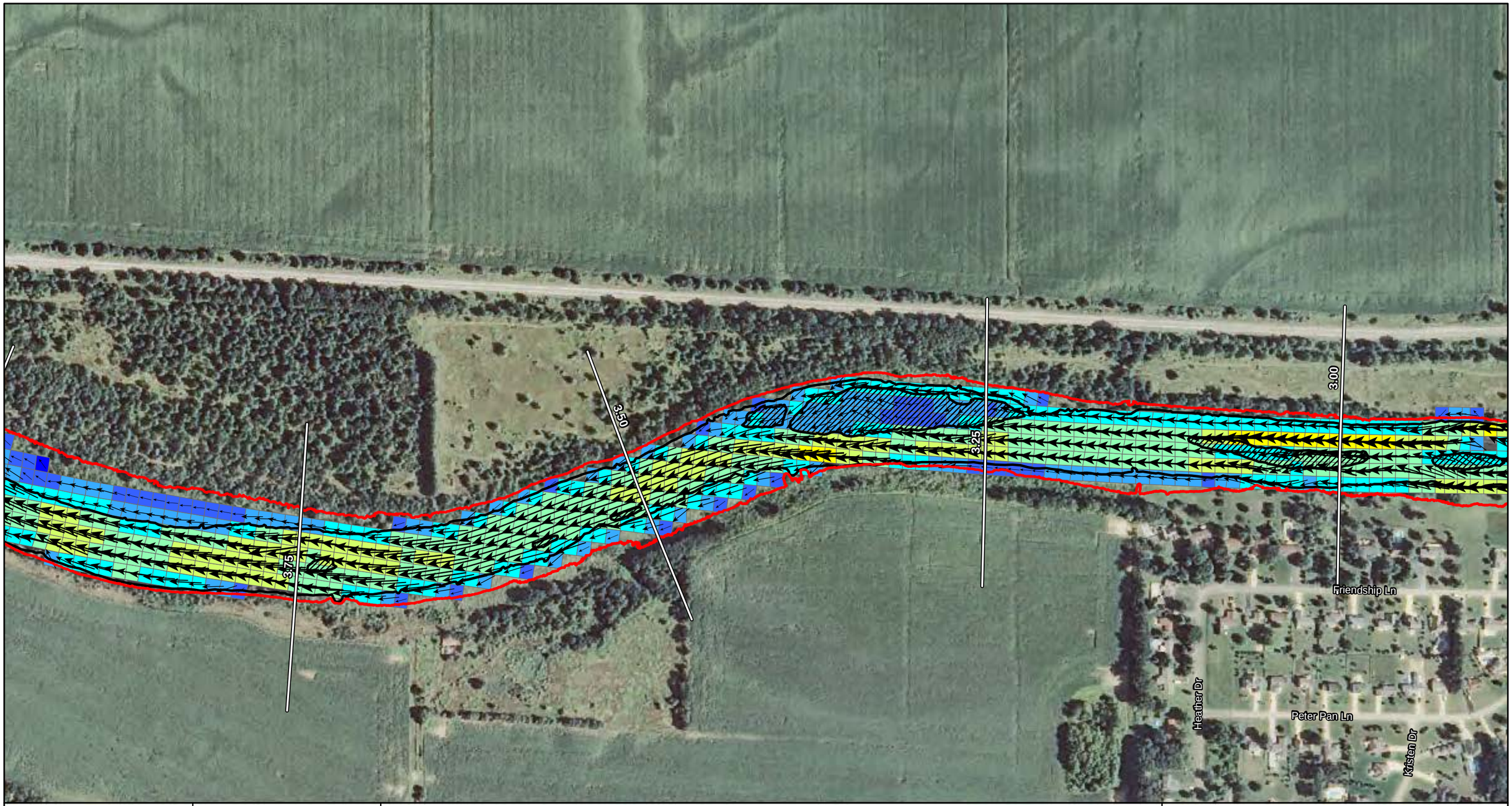
MP 01.88 - MP 02.91

SHEET 1 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

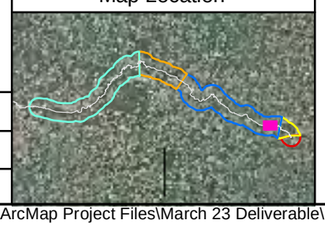
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

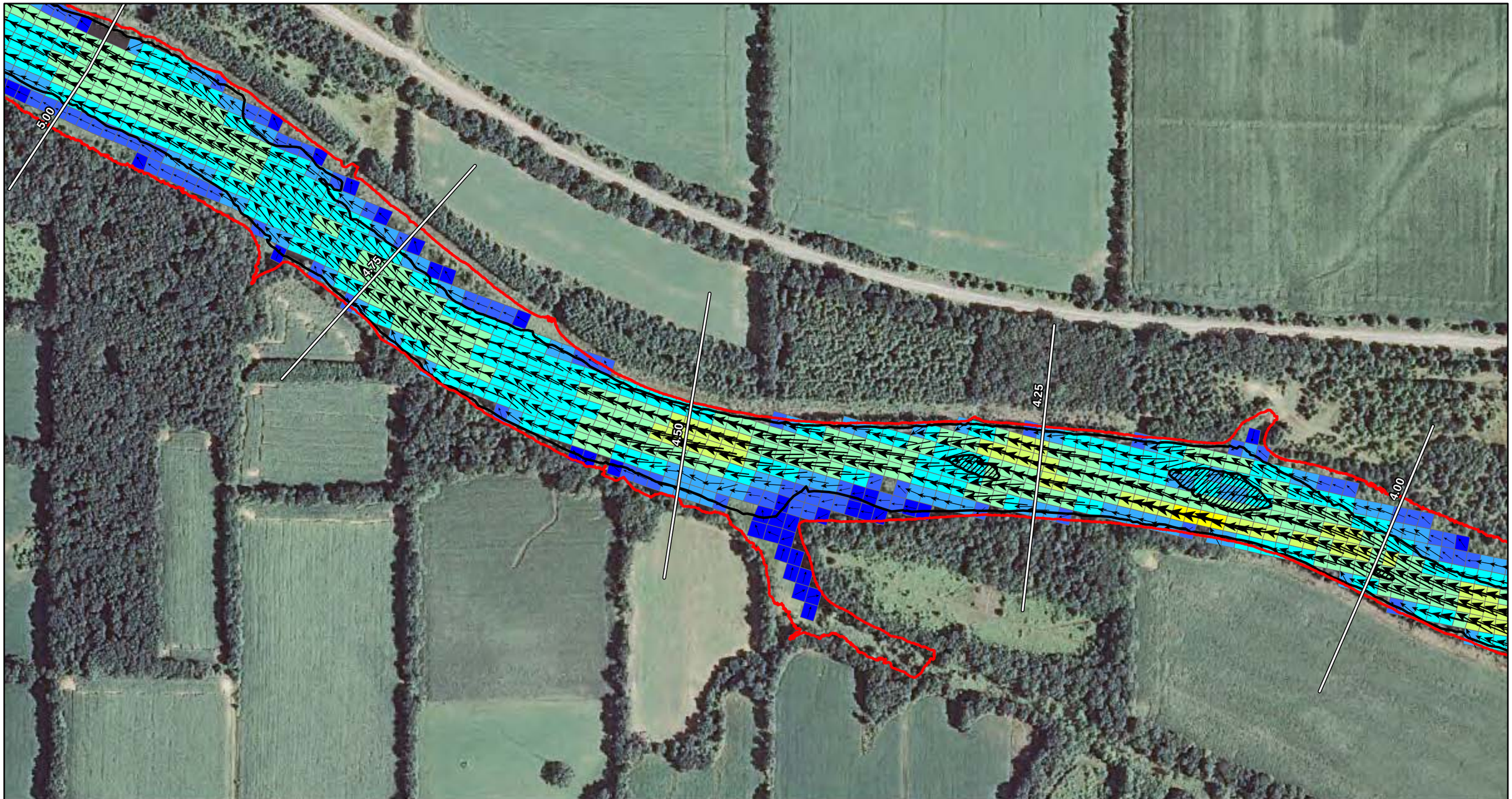
MP 02.91 - MP 03.93

SHEET 2 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

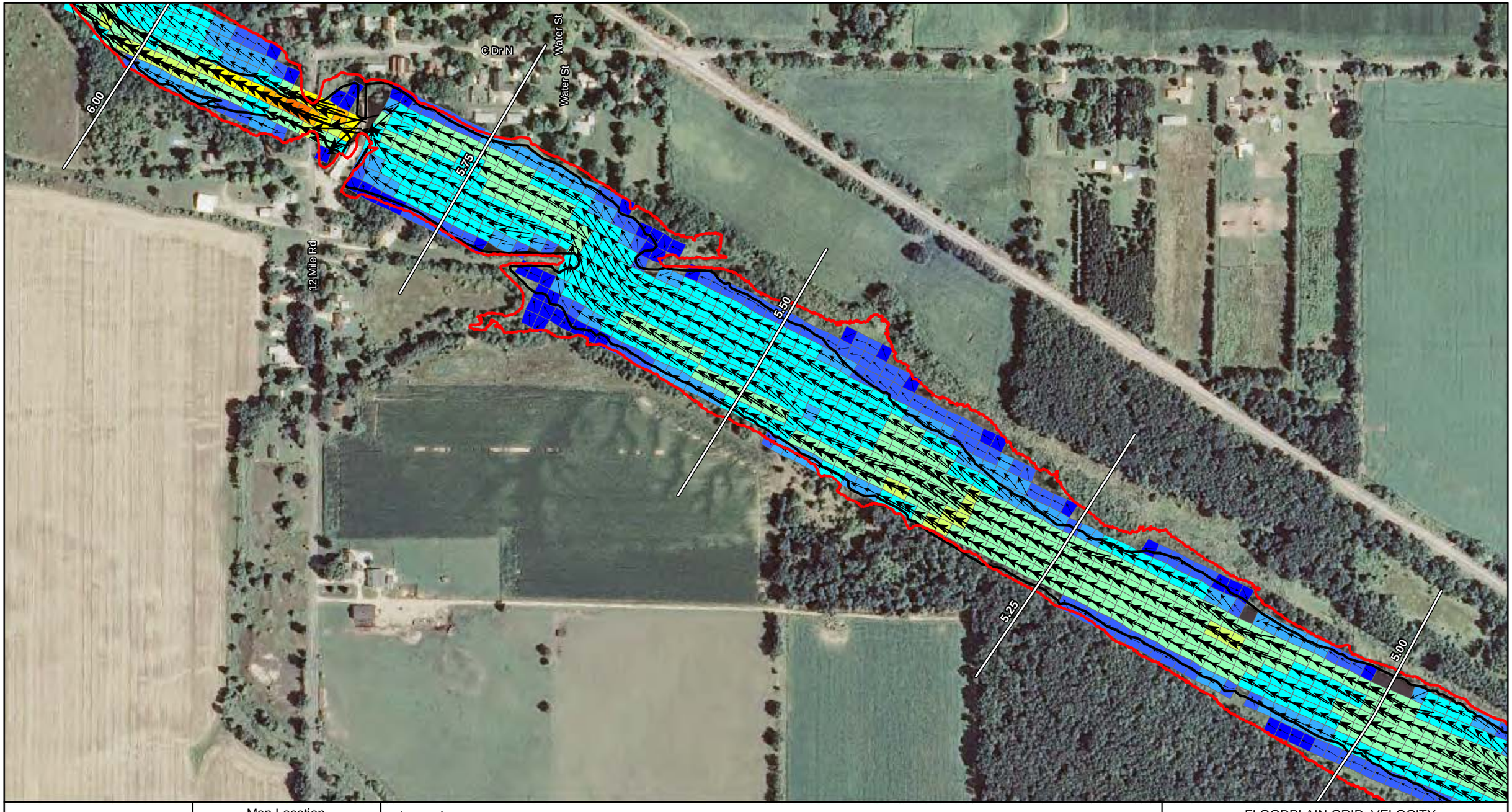
MP 03.93 - MP 04.98

SHEET 3 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

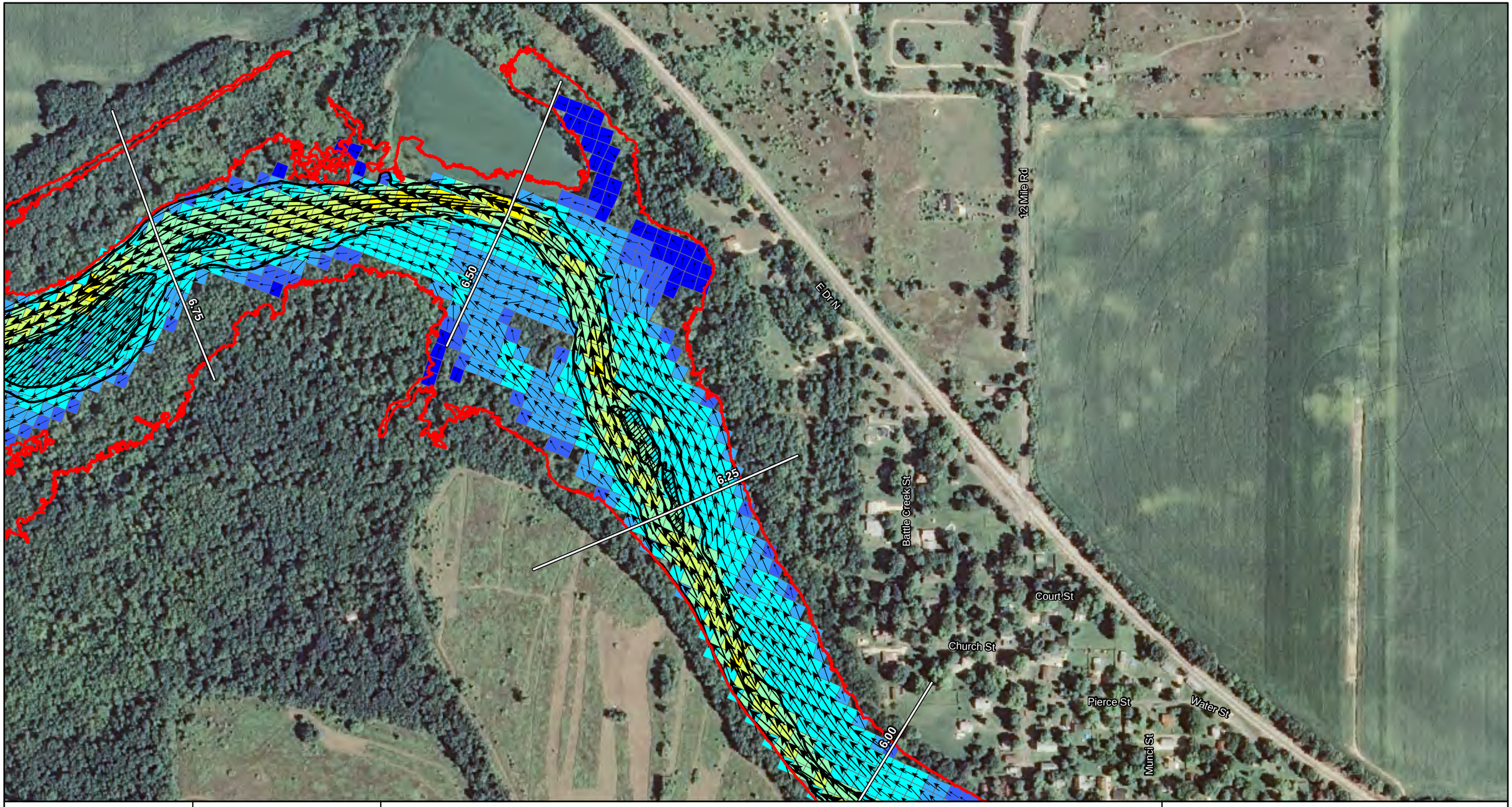
MP 04.98 - MP 06.03

SHEET 4 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

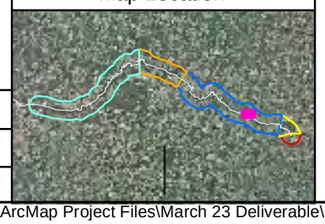
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

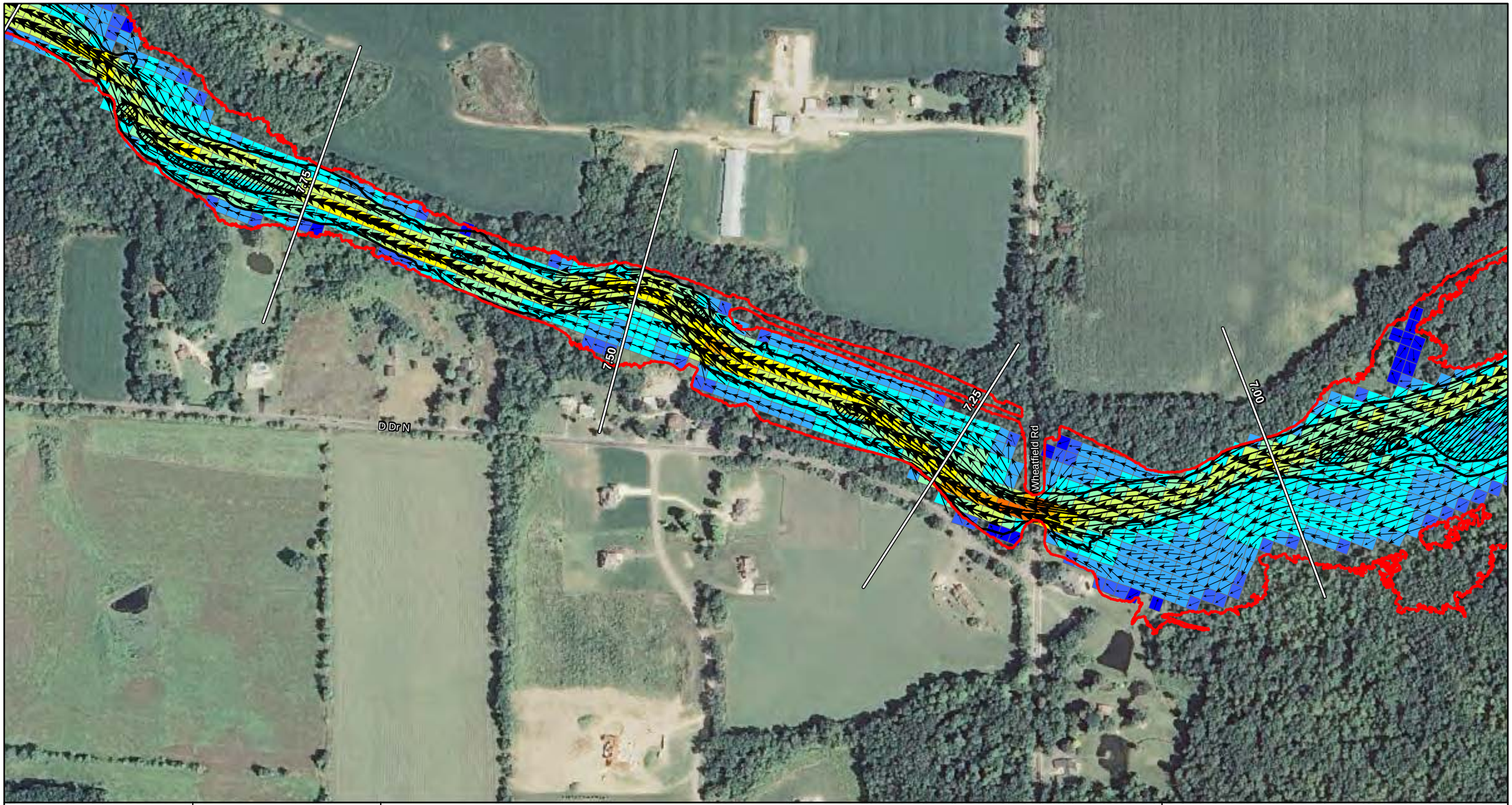
MP 06.03 - MP 06.85

SHEET 5 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
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- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 06.85 - MP 07.95

SHEET 6 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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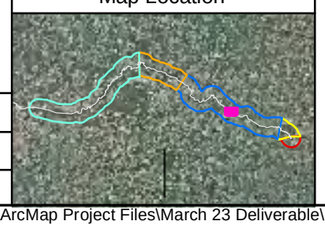
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
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- Flow Direction and Relative Magnitude
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Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

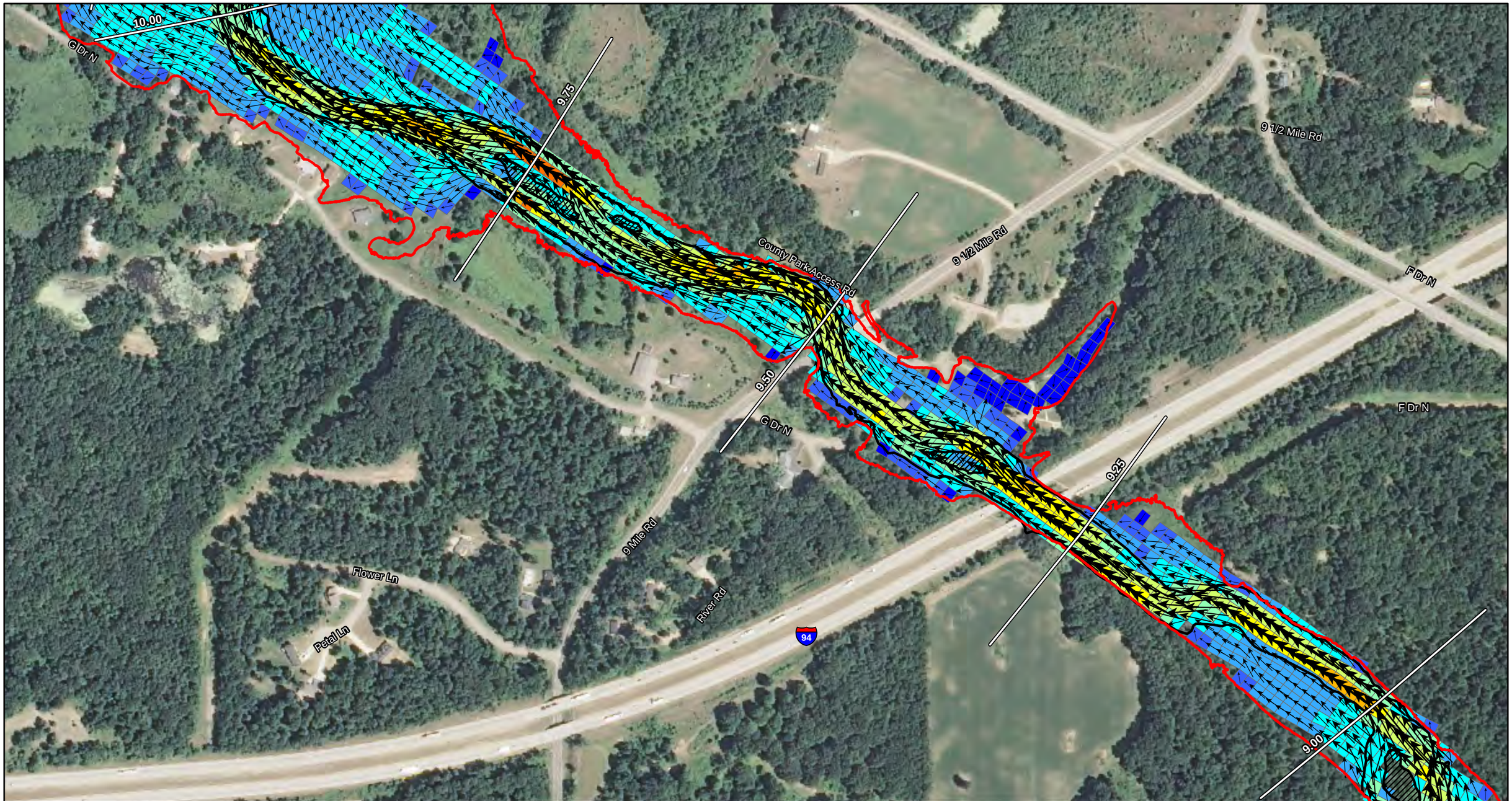
MP 07.95 - MP 08.93

SHEET 7 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

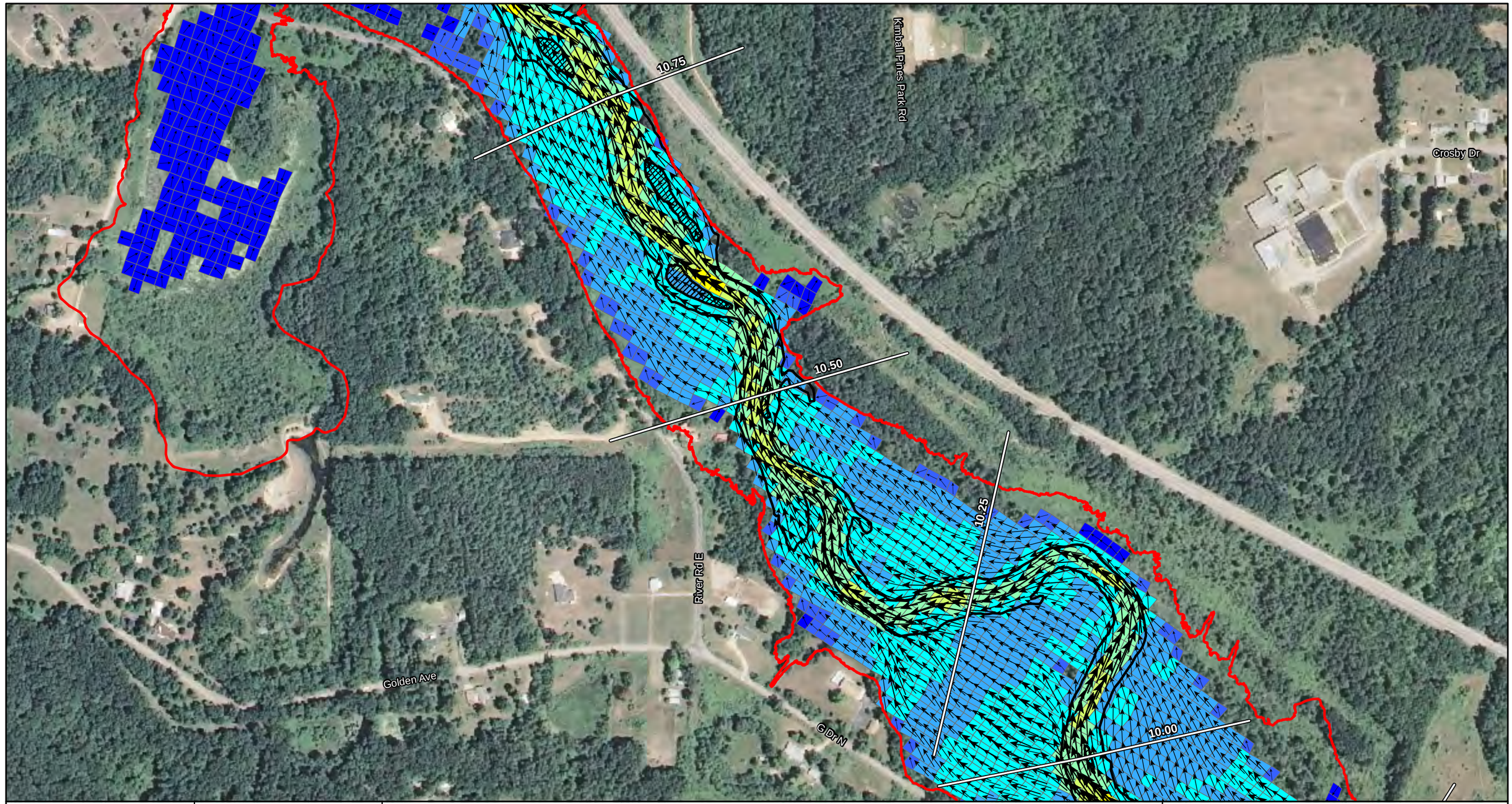
MP 08.93 - MP 10.00

SHEET 8 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

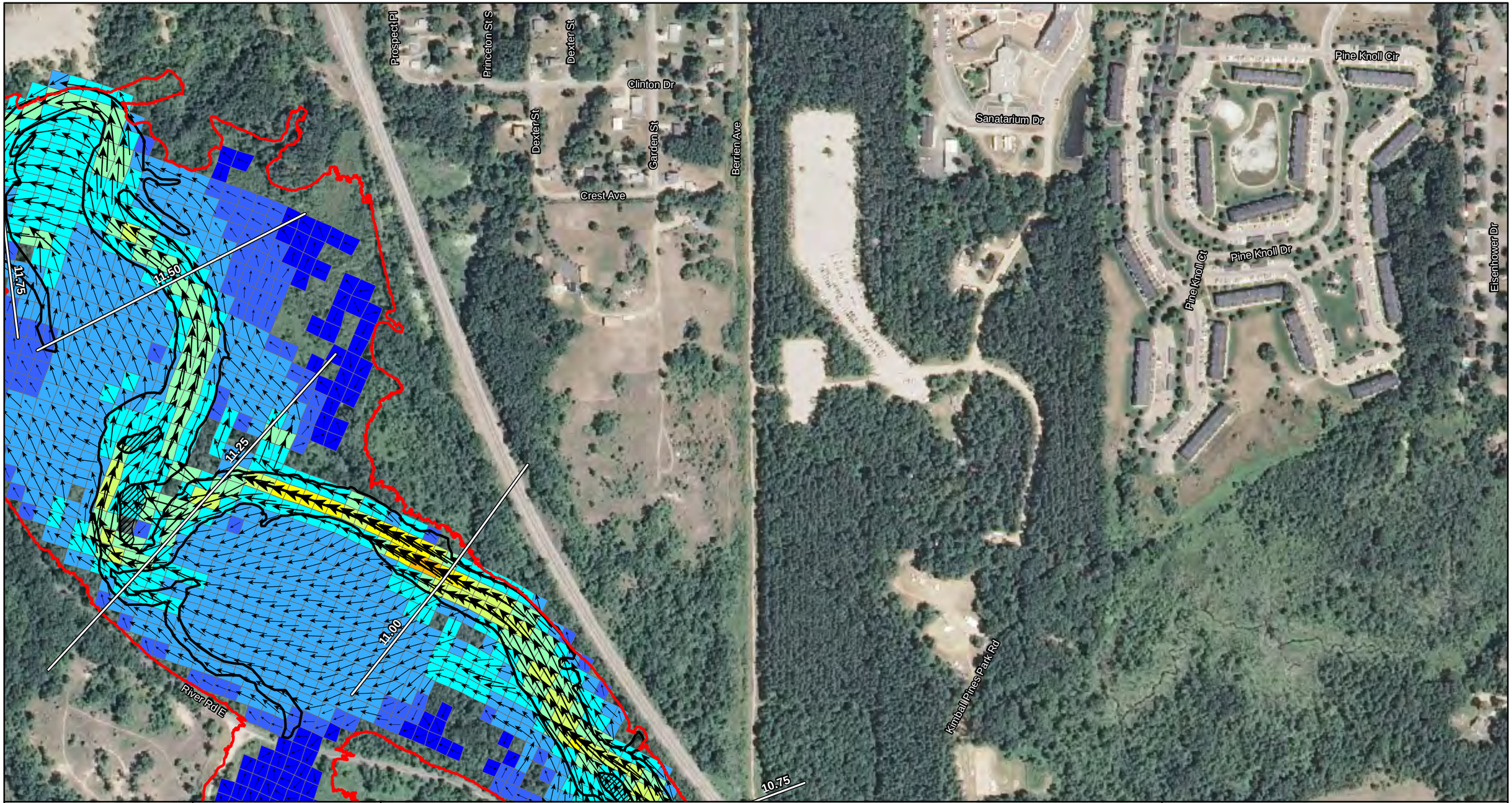
MP 10.00 - MP 10.80

SHEET 9 OF 45

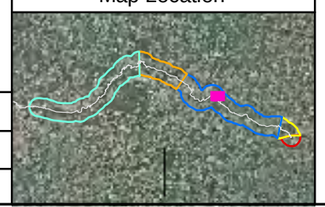
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

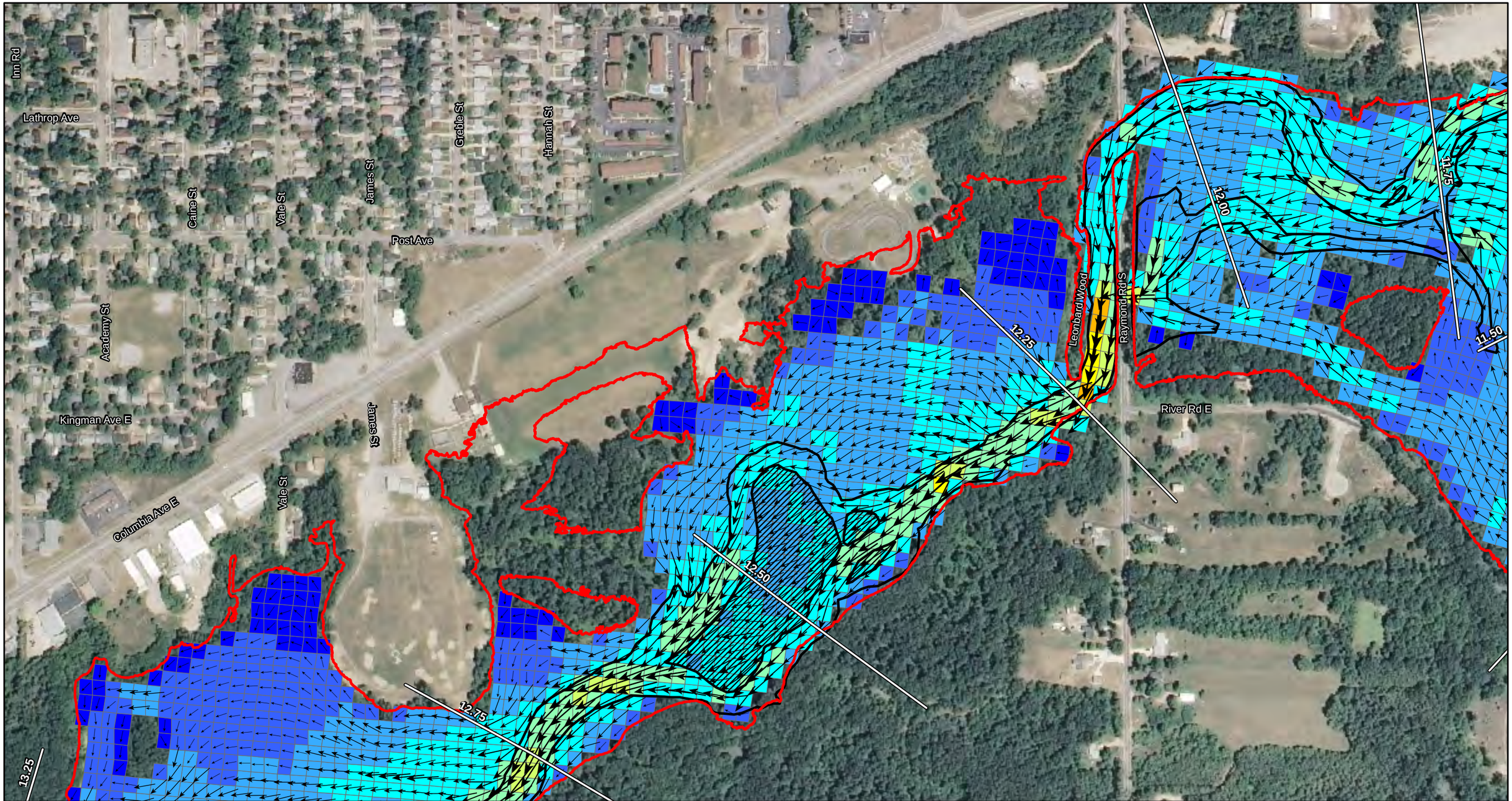
MP 10.80 - MP 11.70

SHEET 10 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

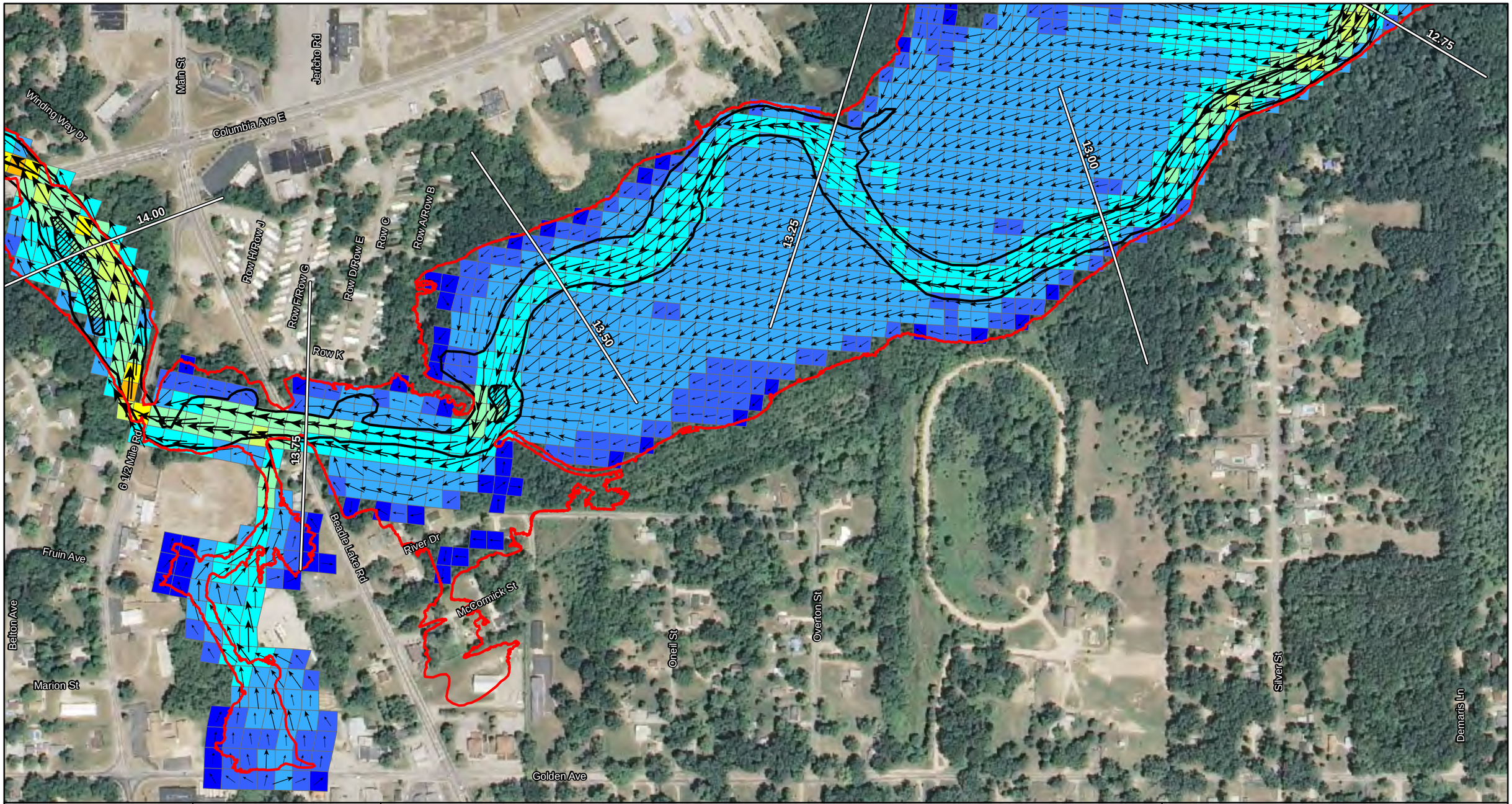
MP 11.70 - MP 12.77

SHEET 11 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

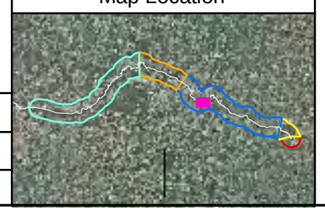
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

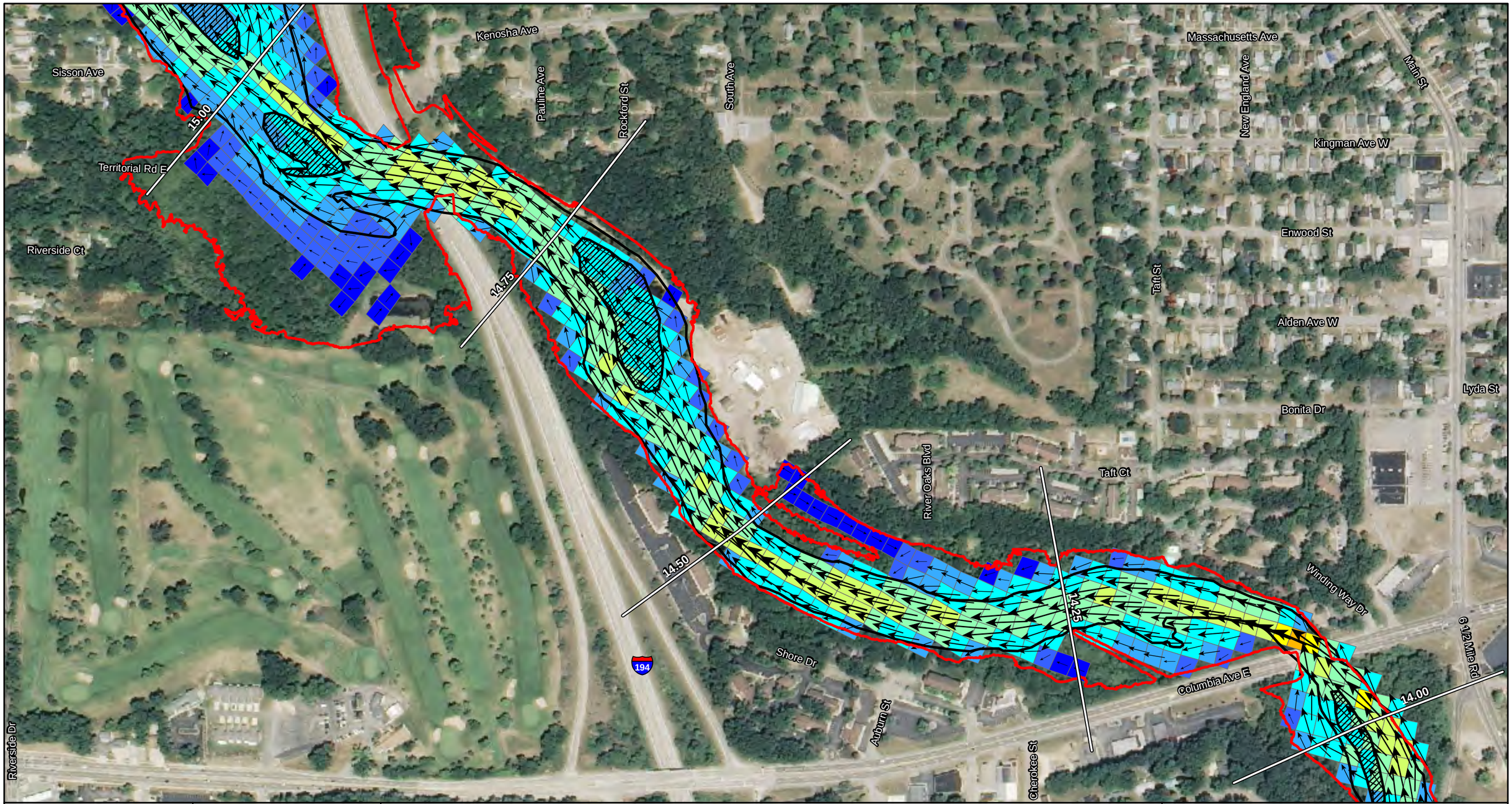
MP 12.77 - MP 14.00

SHEET 12 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

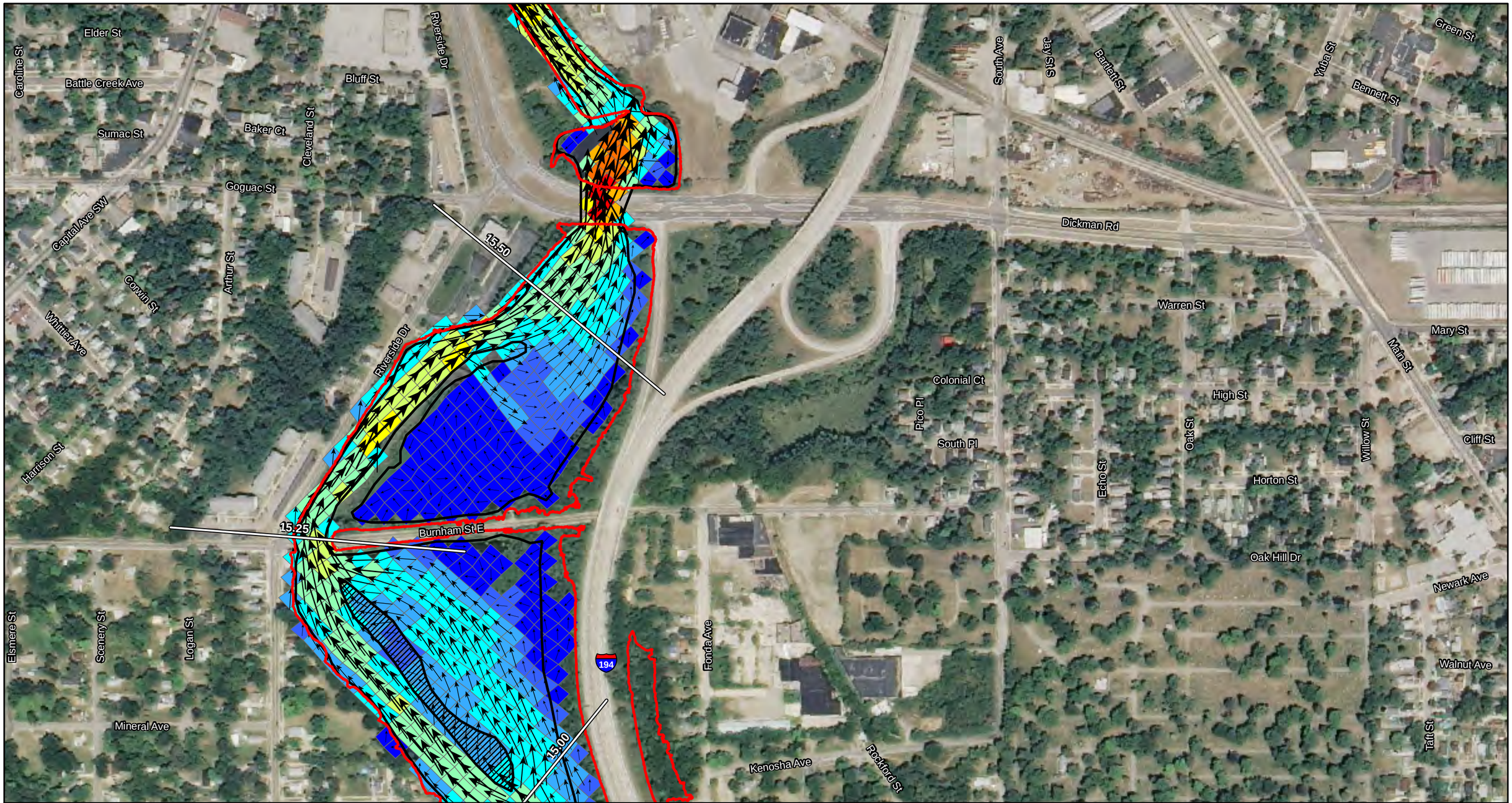
MP 14.00 - MP 15.05

SHEET 13 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 15.05 - MP 15.71

SHEET 14 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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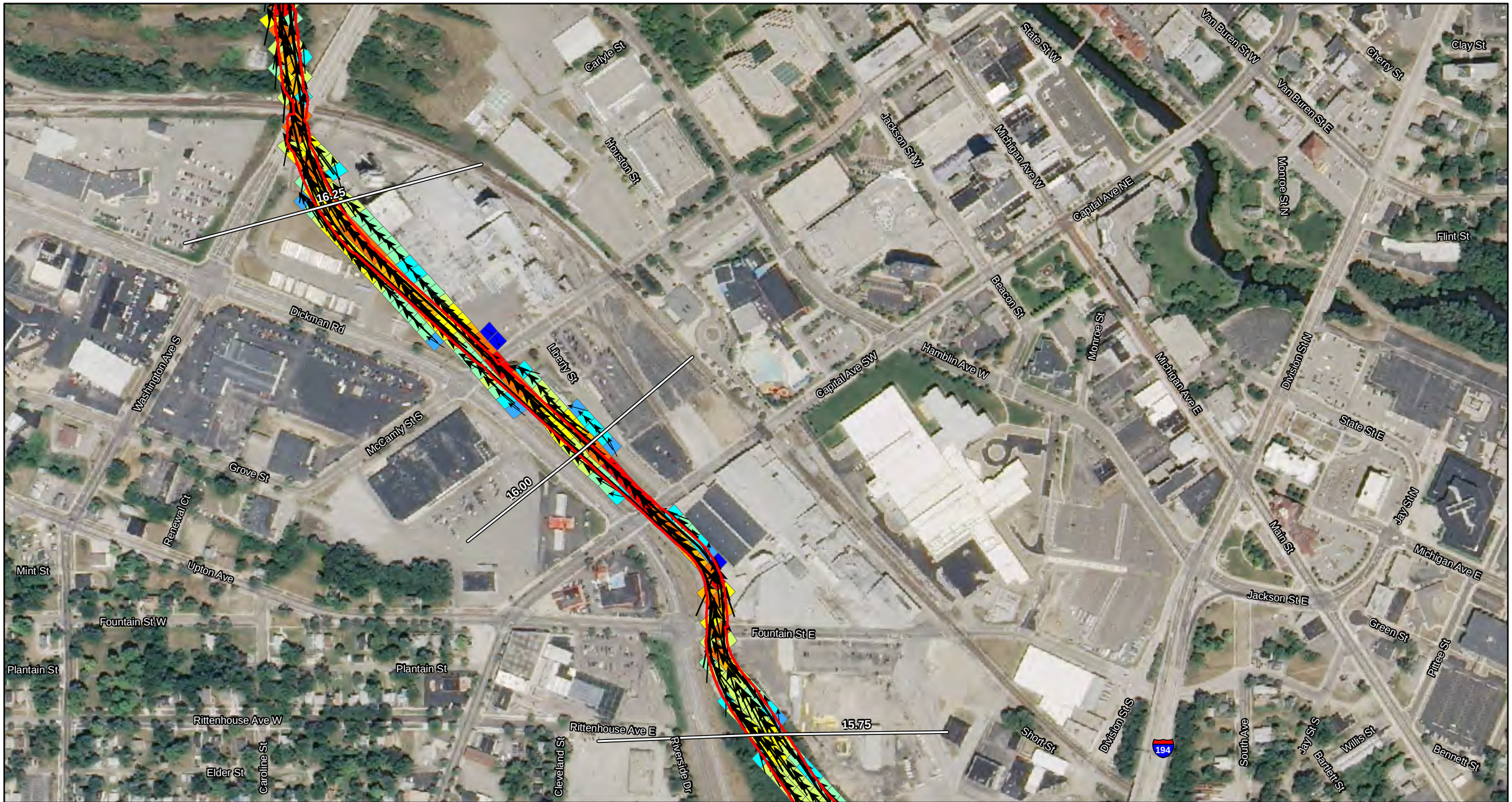
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 15.71 - MP 16.38

SHEET 15 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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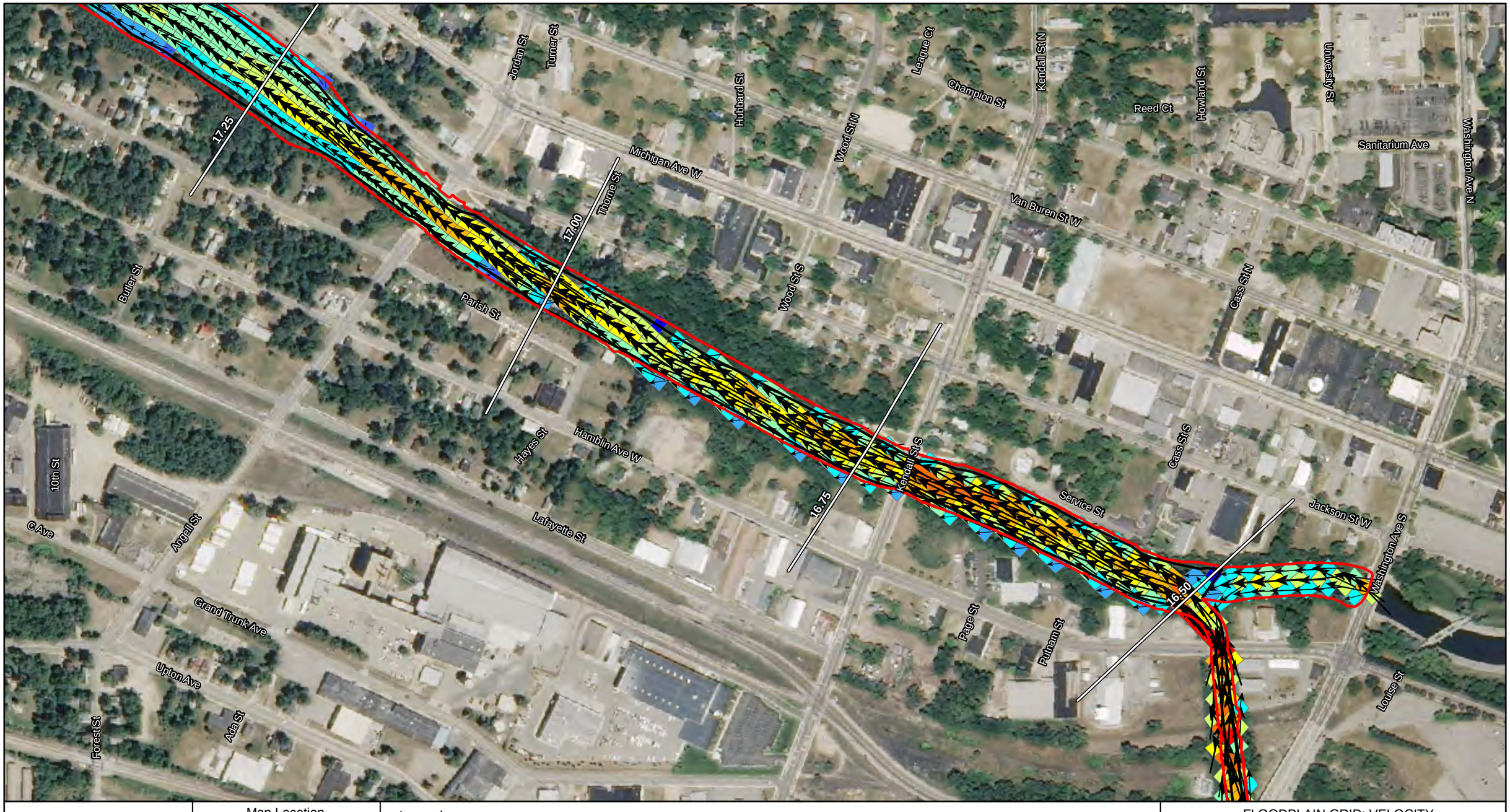
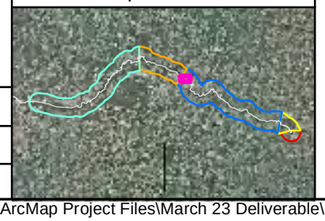
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 16.38 - MP 17.30

SHEET 16 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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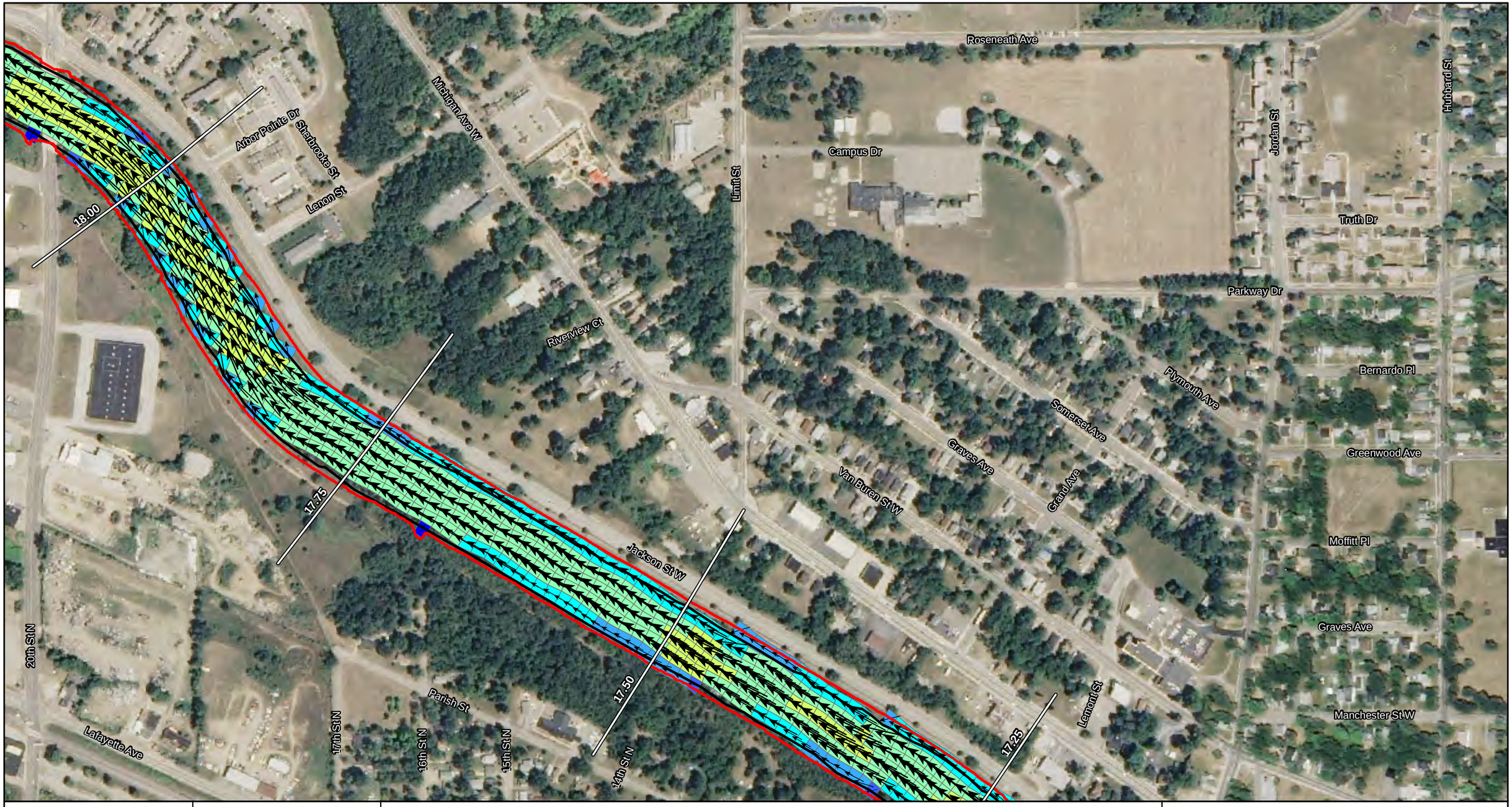
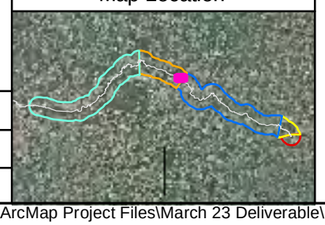
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

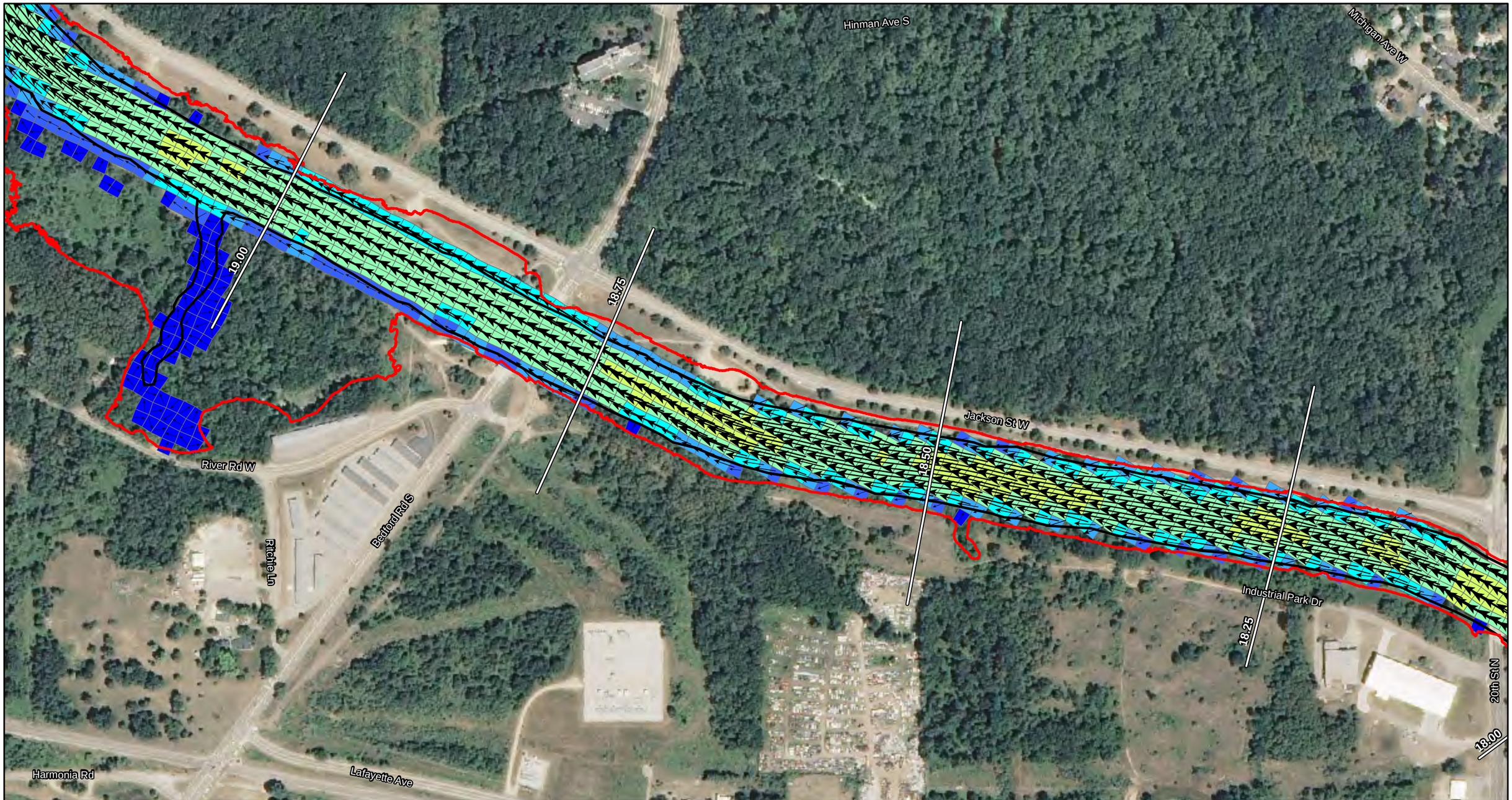
MP 17.30 - MP 18.11

SHEET 17 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 18.11 - MP 19.18

SHEET 18 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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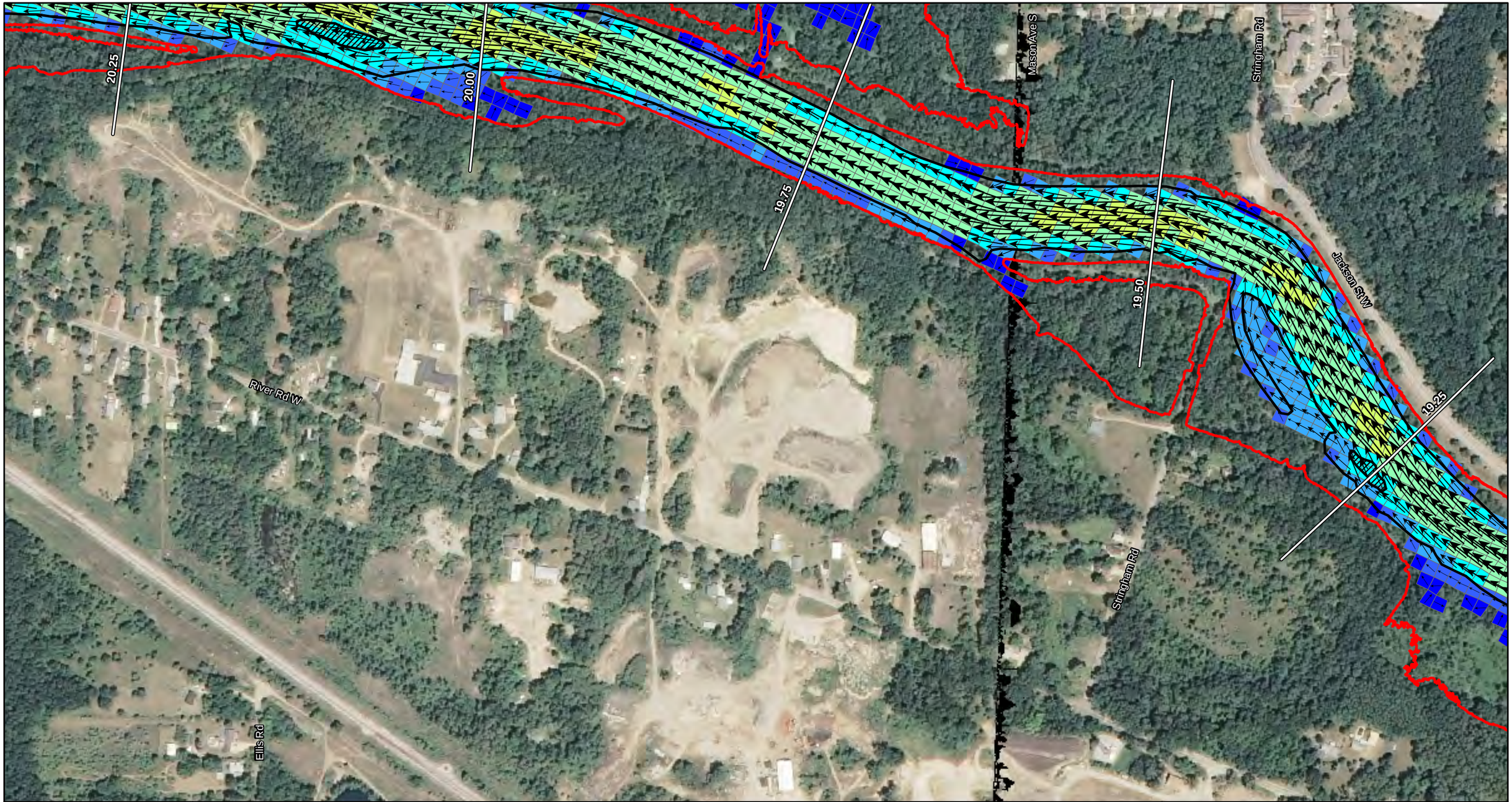
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 19.18 - MP 20.00

SHEET 19 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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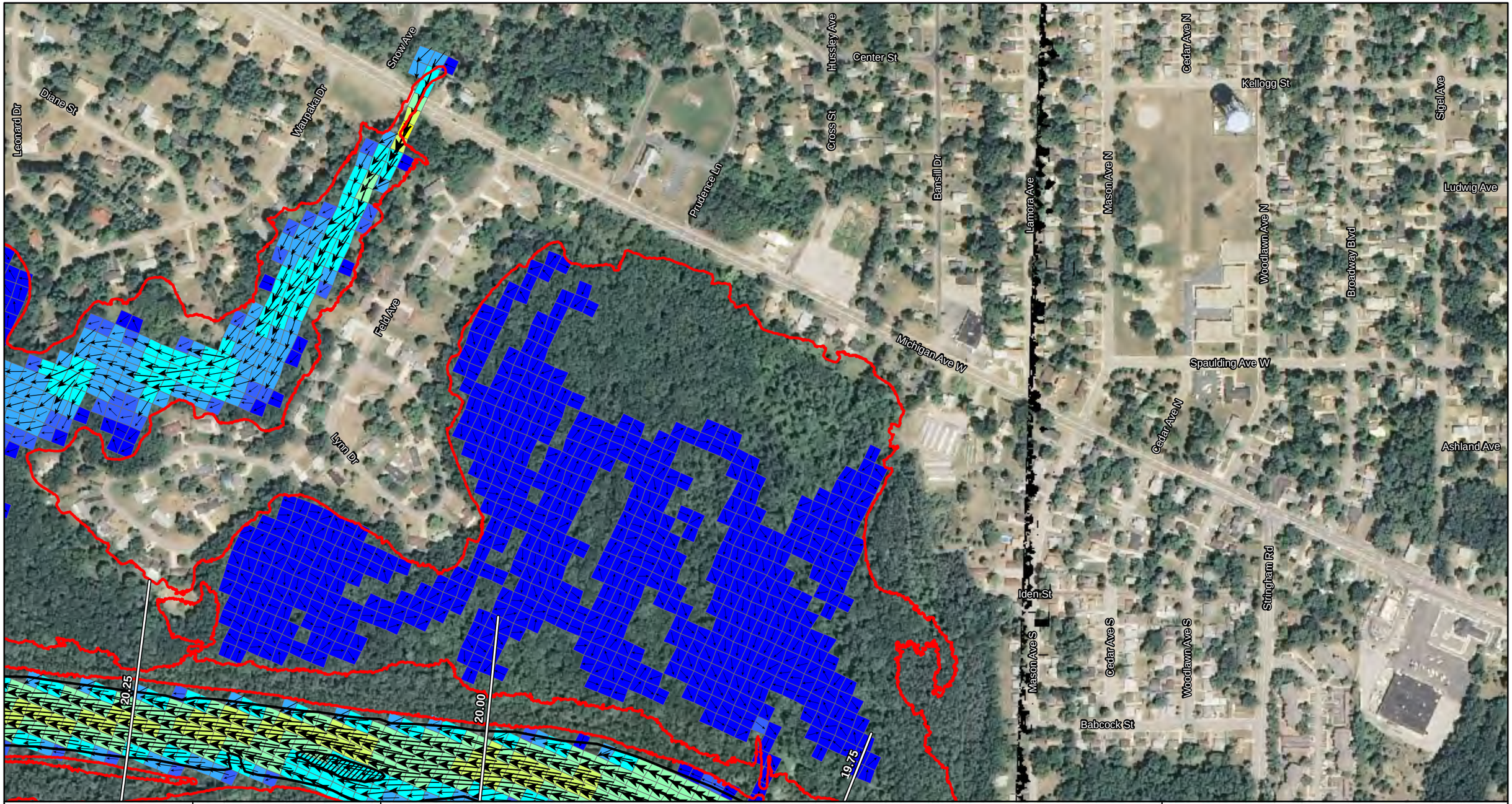
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

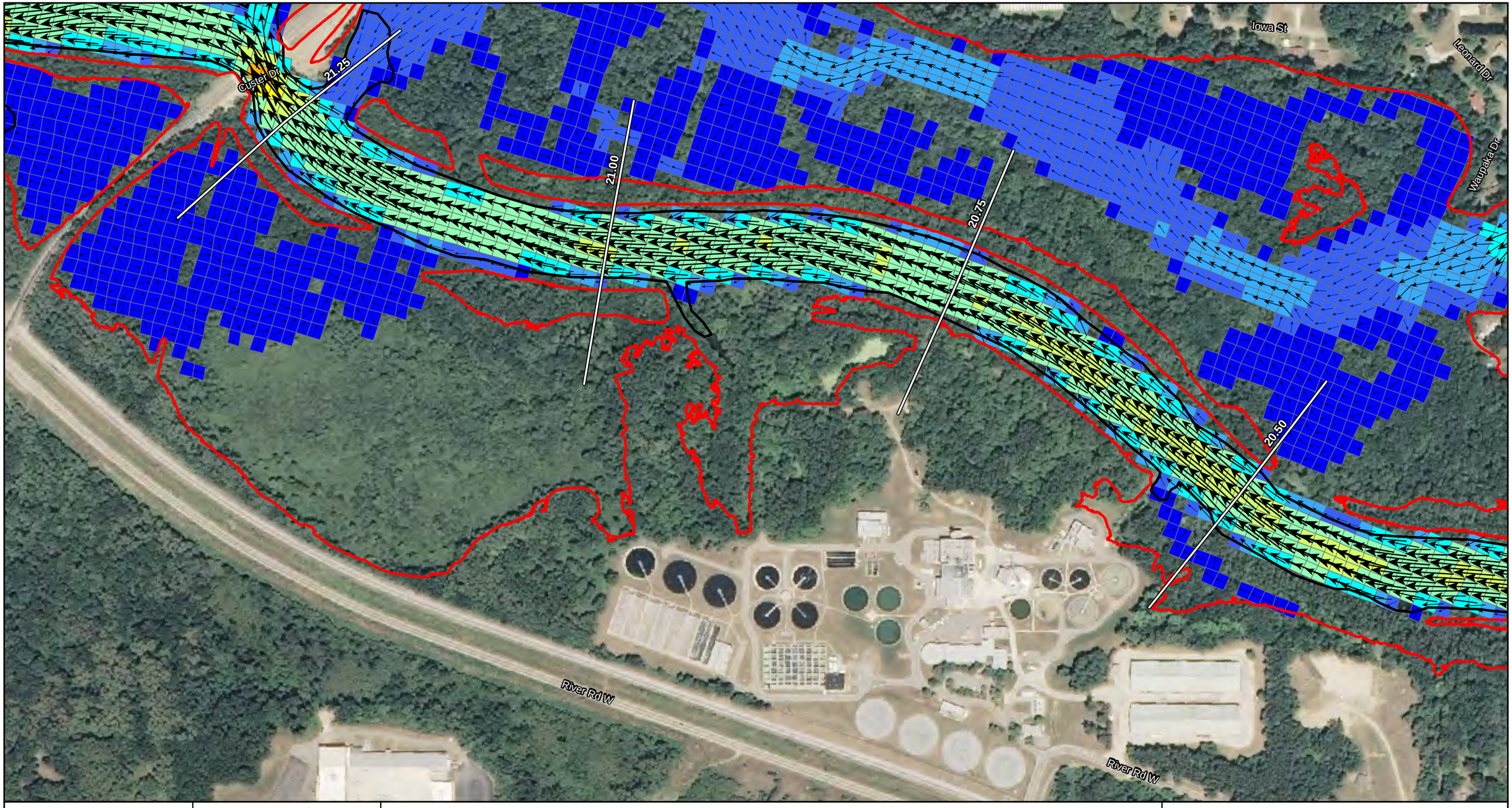
MP 20.00 - MP 20.32

SHEET 20 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

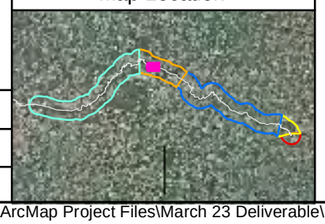
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 20.32 - MP 21.36

SHEET 21 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

Avon Dr
Sperry Ave
Finlay Ave
Coldwater Ave
Custer Dr
Duane St
Michigan Ave W
Stillson Blvd
Gardner Ave
Bonny St
South St
Iowa St
21.50
21.25

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

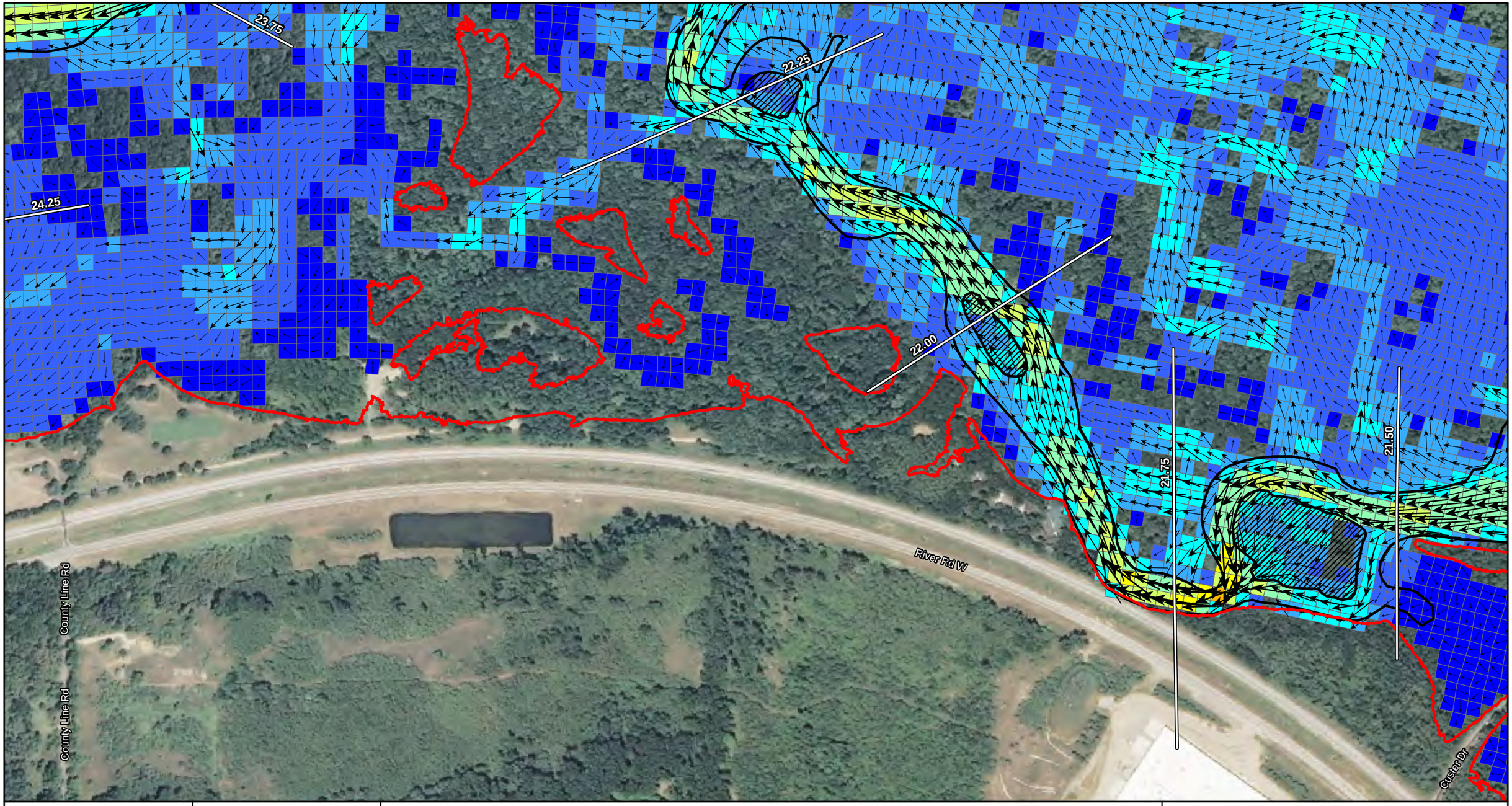
MP 21.36 - MP 21.59

SHEET 22 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

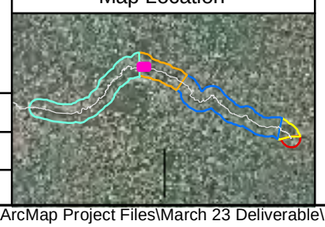
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

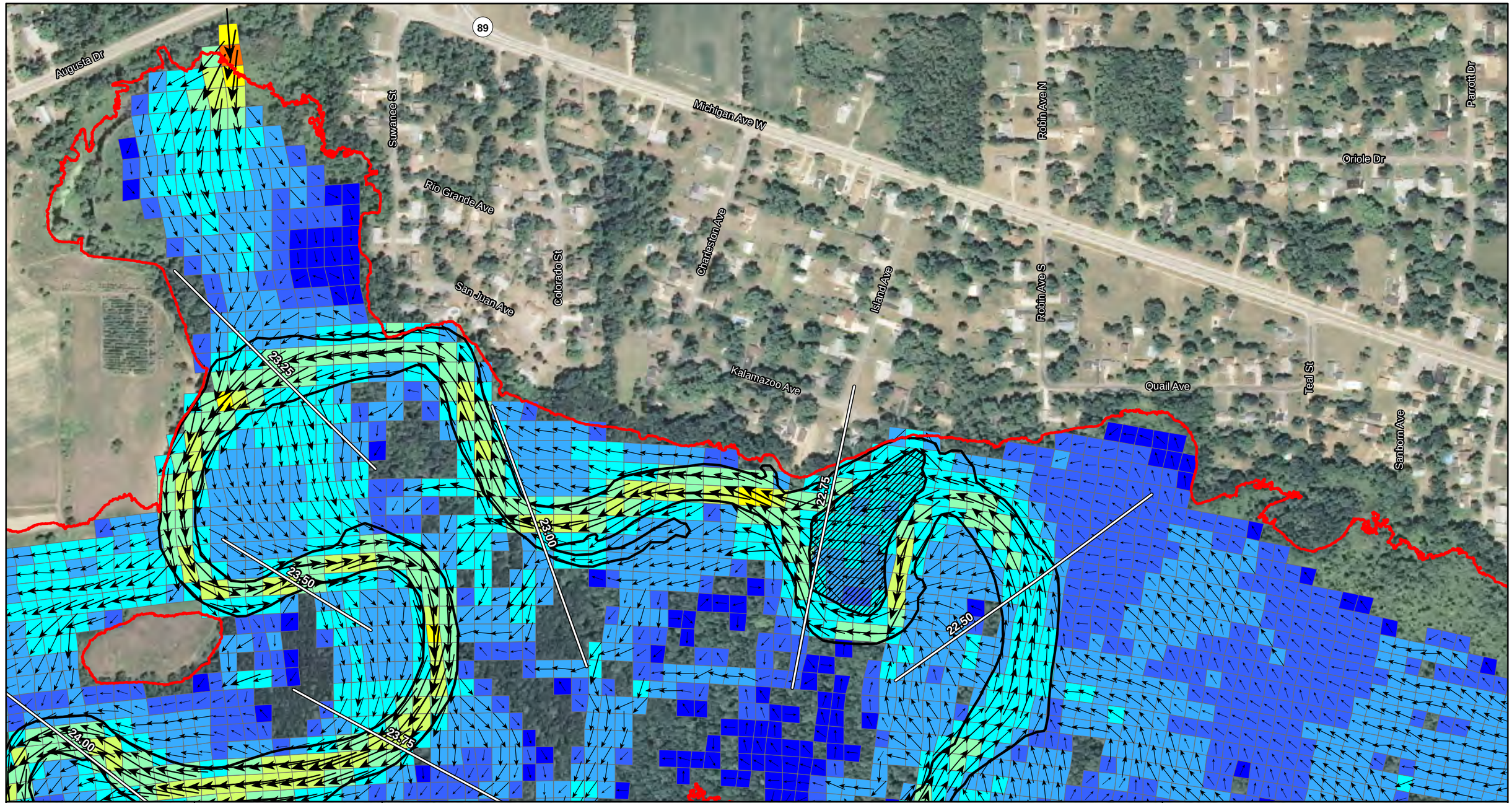
MP 21.59 - MP 22.33

SHEET 23 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

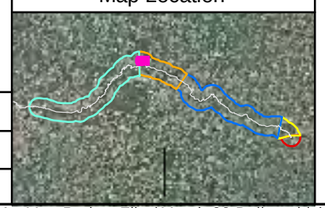
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

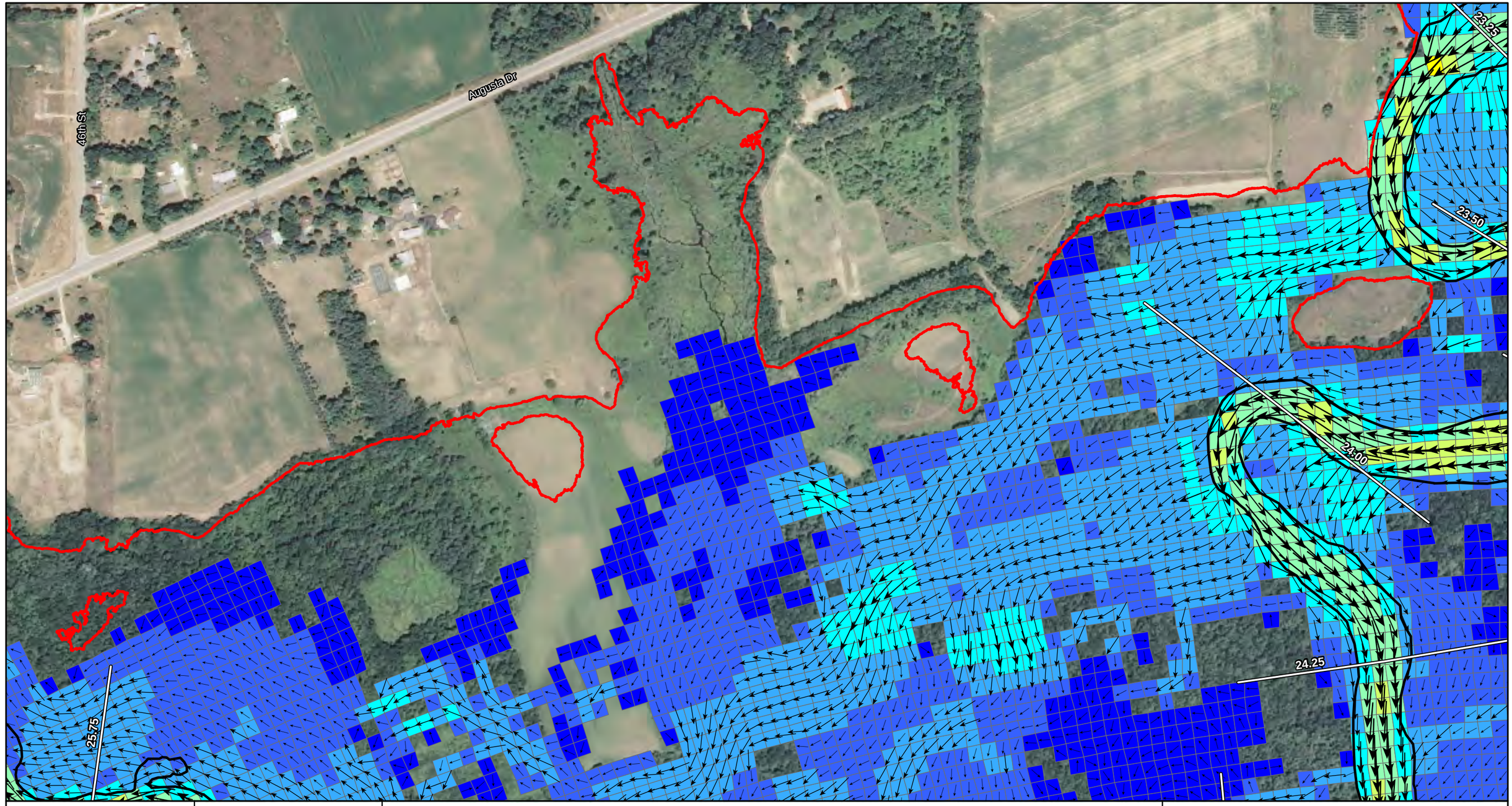
MP 22.33 - MP 24.01

SHEET 24 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

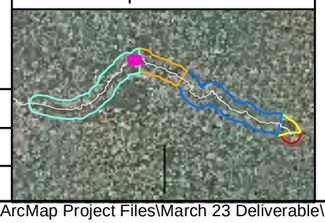
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

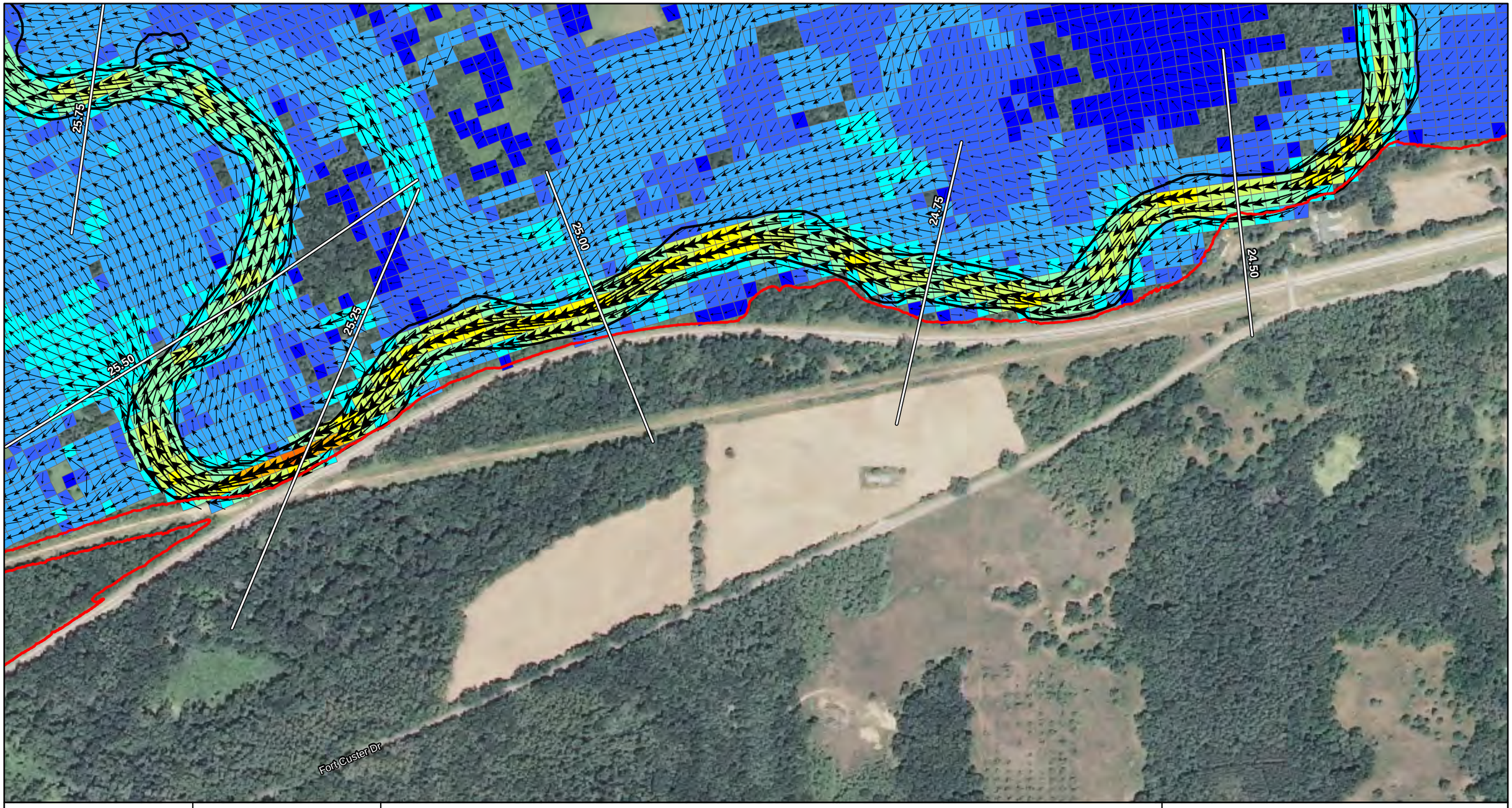
MP 24.01 - MP 24.33

SHEET 25 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

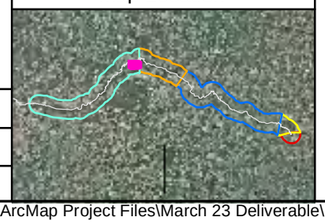
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 24.33 - MP 25.79

SHEET 26 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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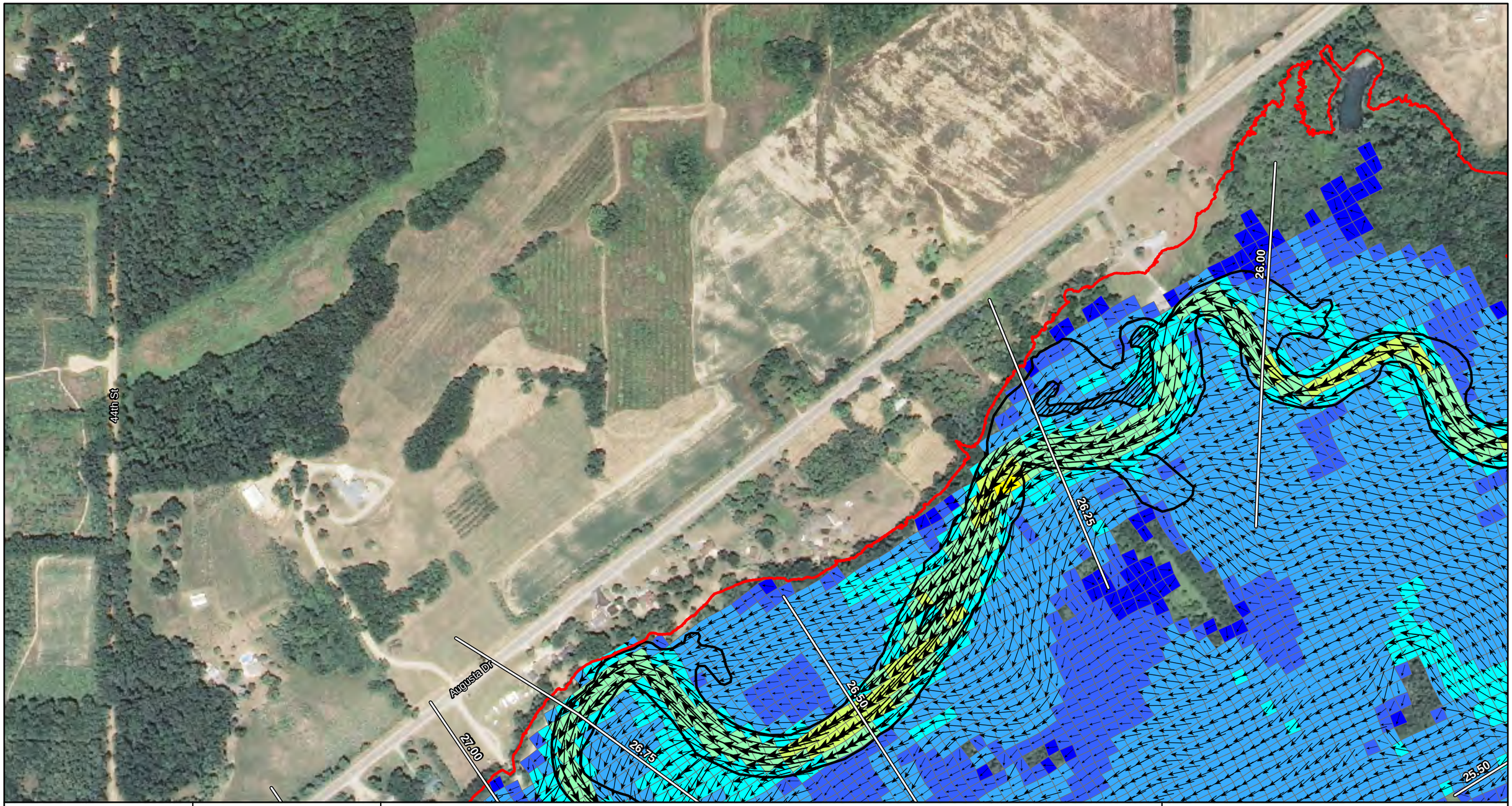
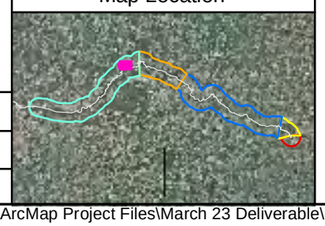
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

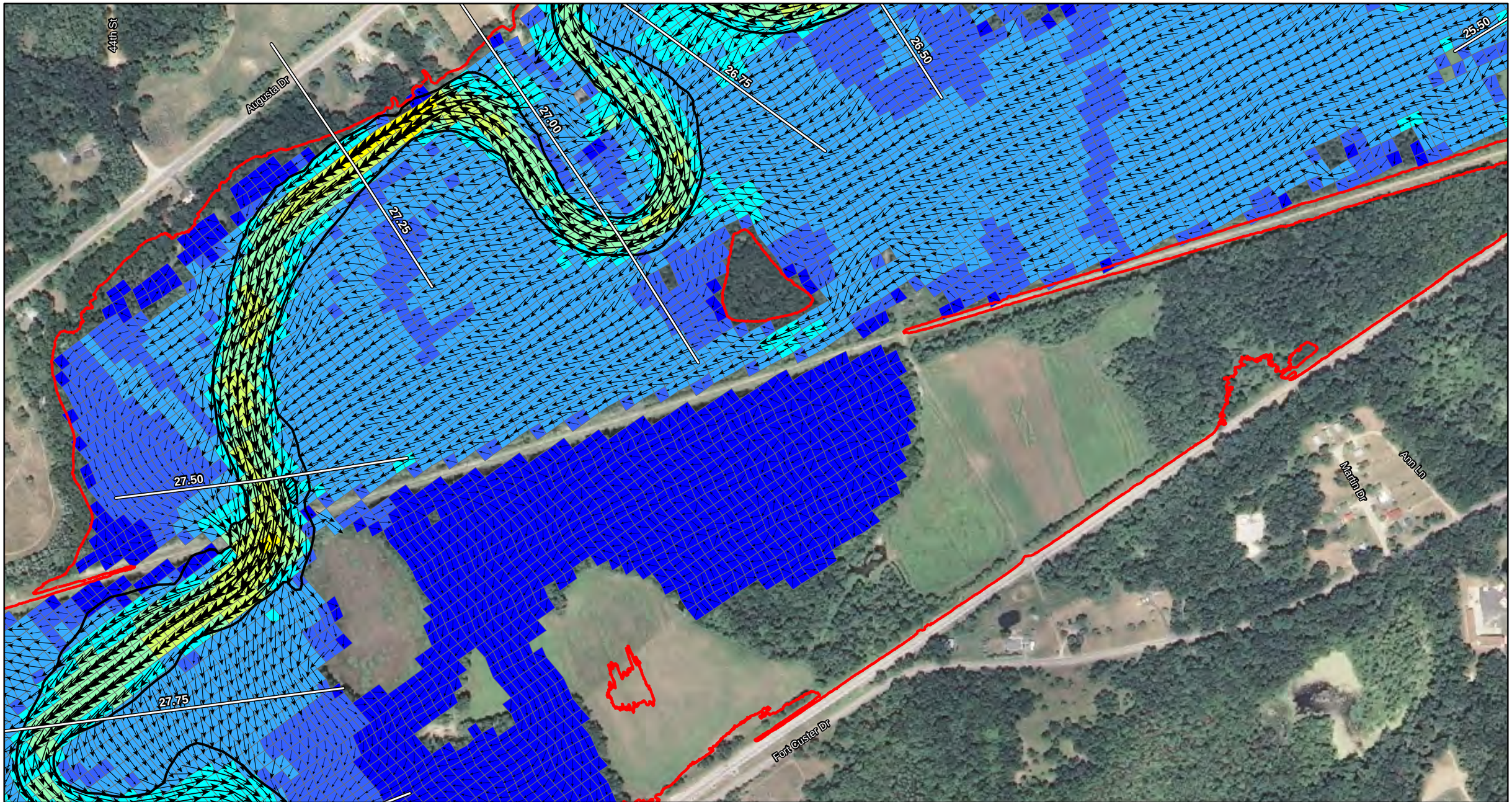
MP 25.79 - MP 26.80

SHEET 27 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

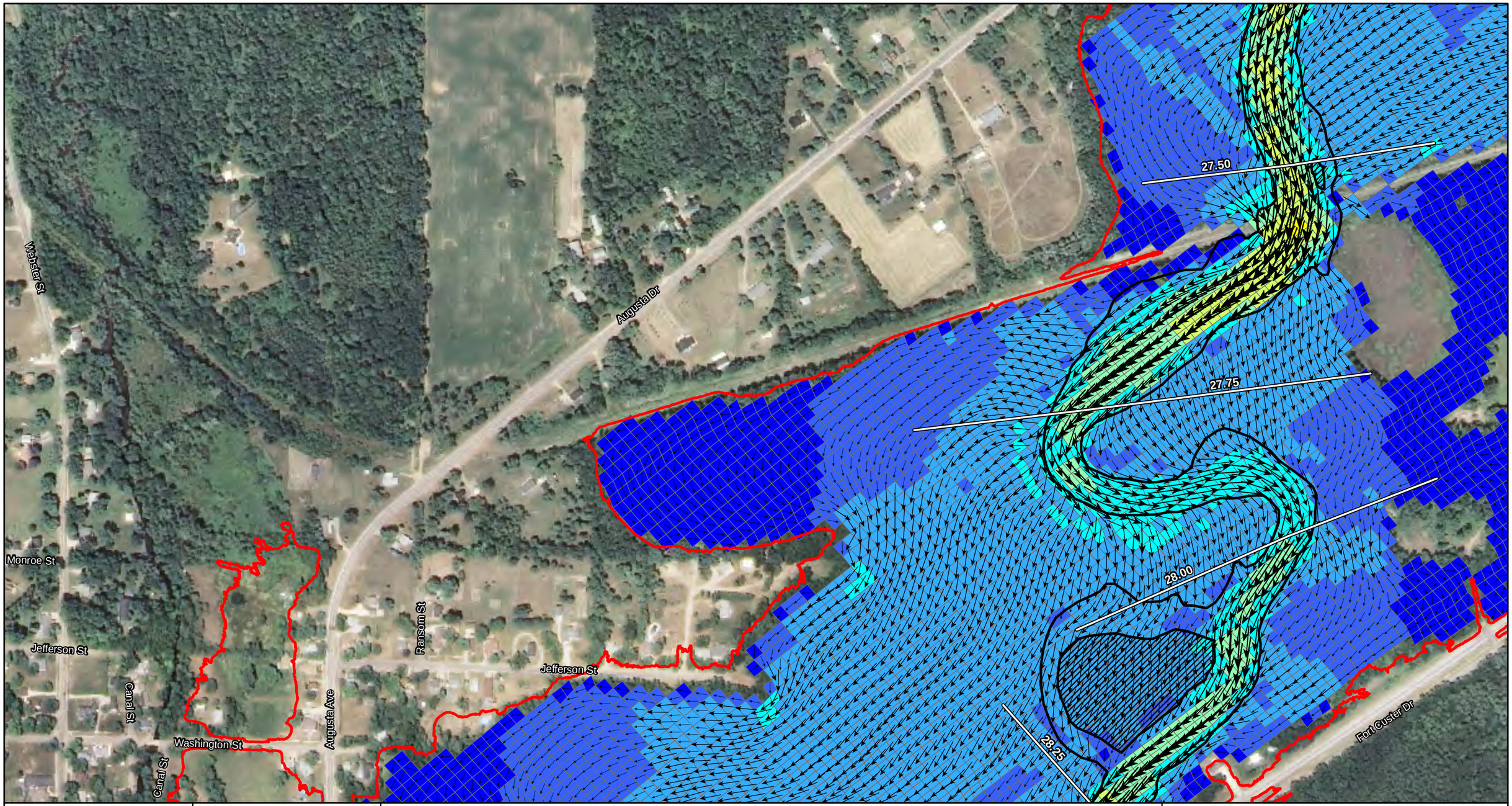
MP 26.80 - MP 27.80

SHEET 28 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

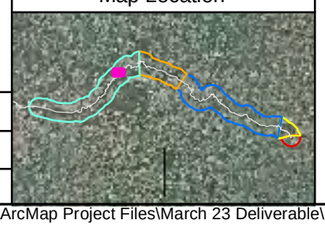
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 26.80 - MP 27.80

SHEET 29 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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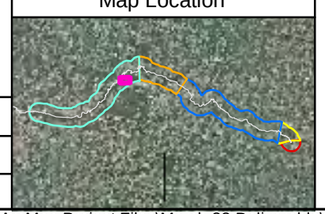
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 27.80SE - MP 28.22SE

SHEET 30 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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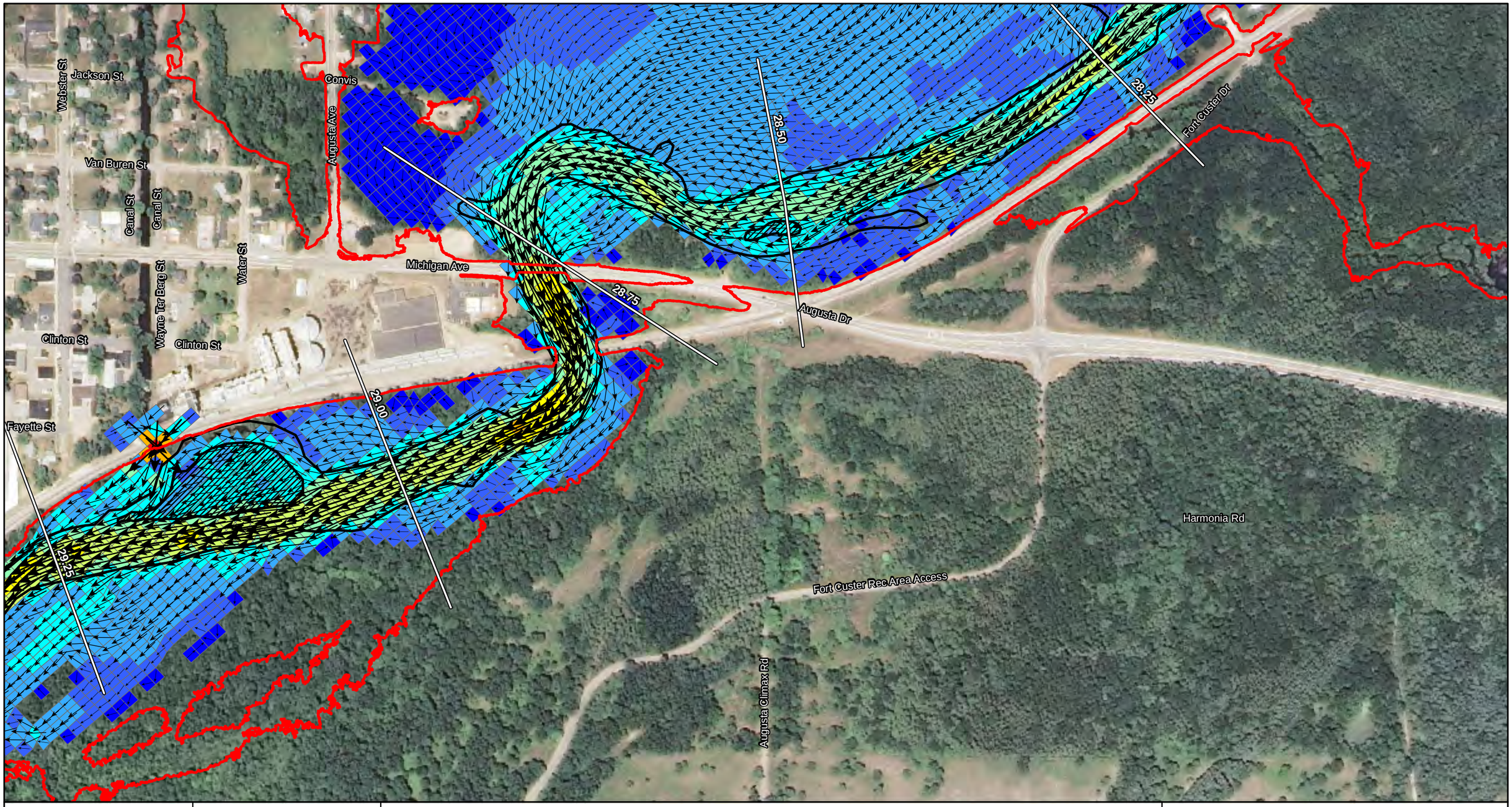
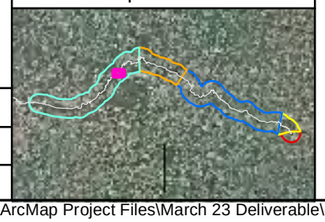
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 28.22 - MP 29.20

SHEET 31 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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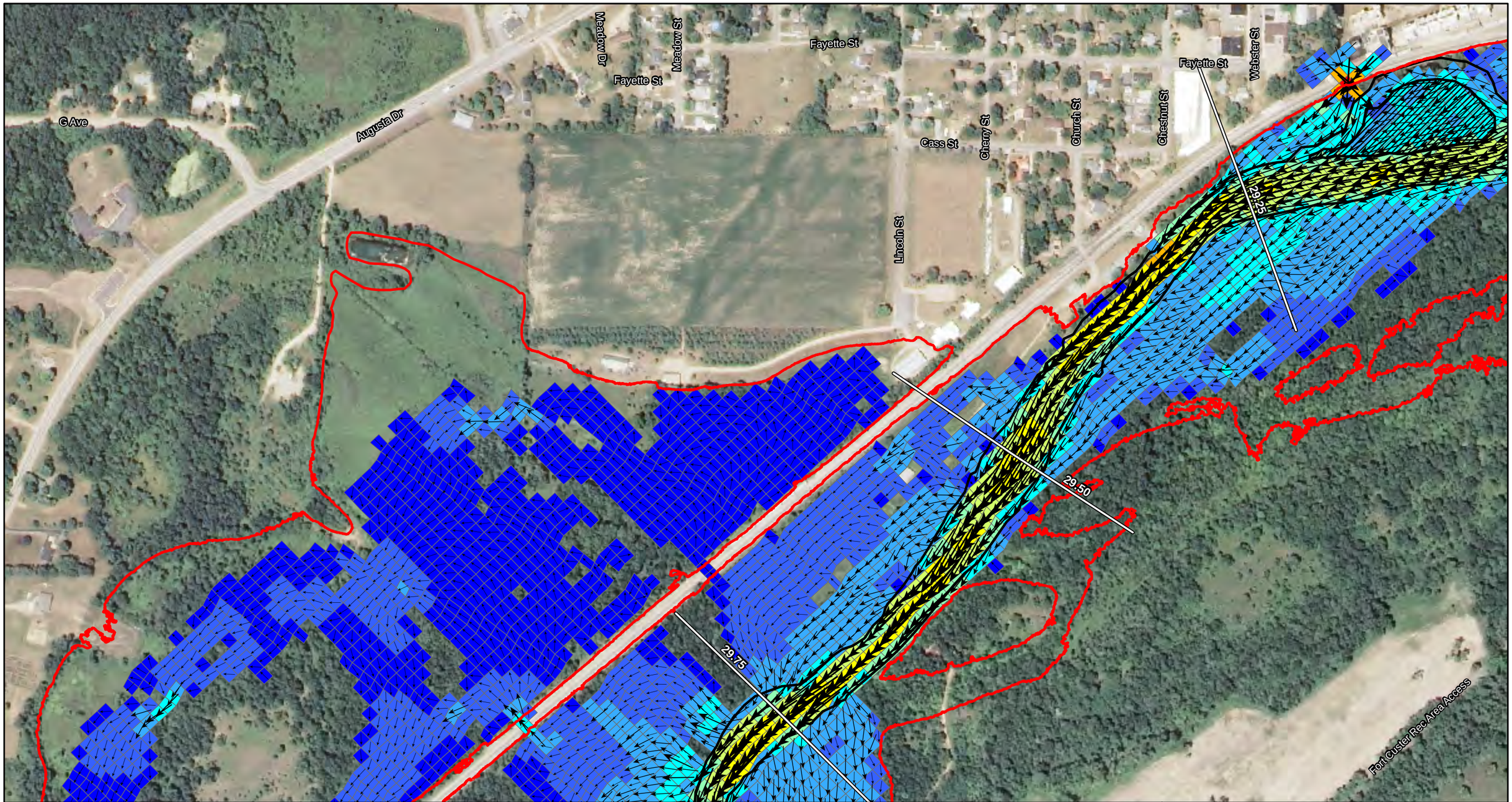
Aerial Photography Date: July & August 2009



Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 29.20 - MP 29.82

SHEET 32 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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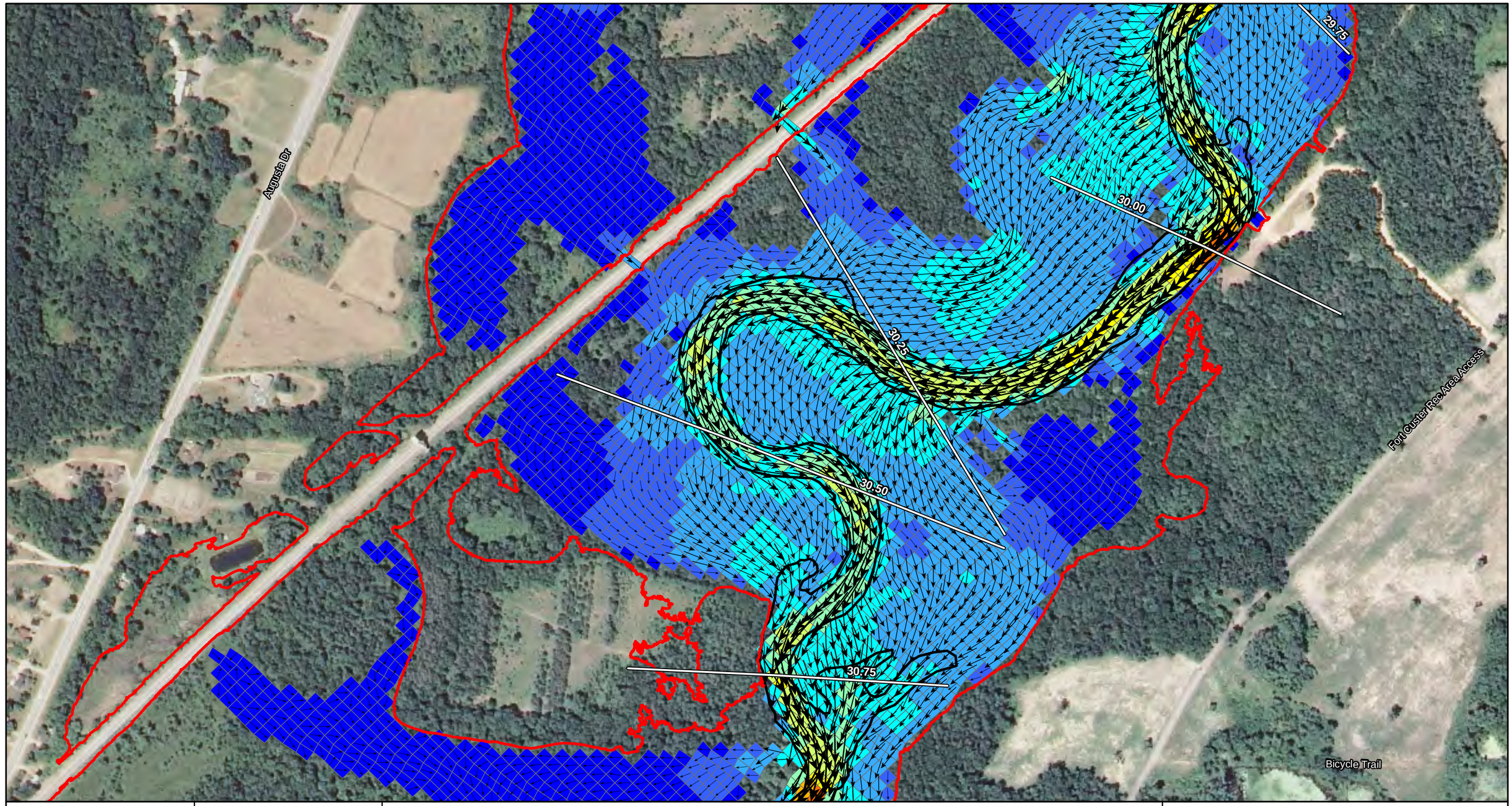
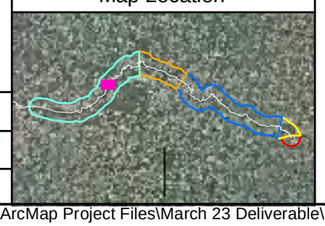
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 29.82 - MP 30.84

SHEET 33 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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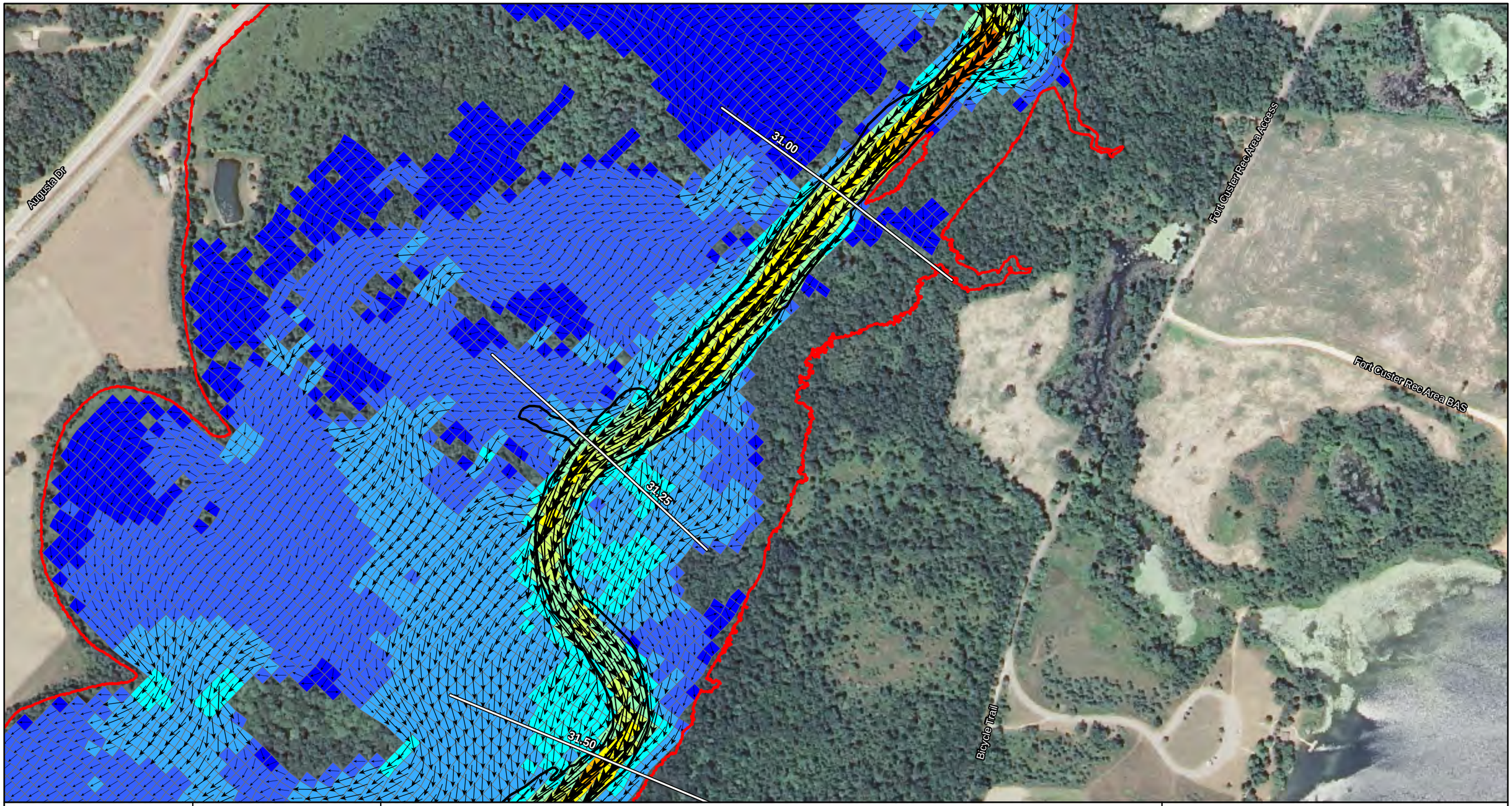
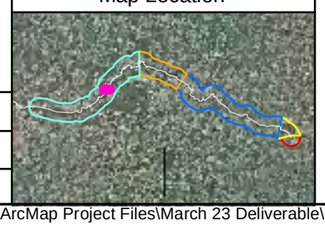
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 30.84 - MP 31.40

SHEET 34 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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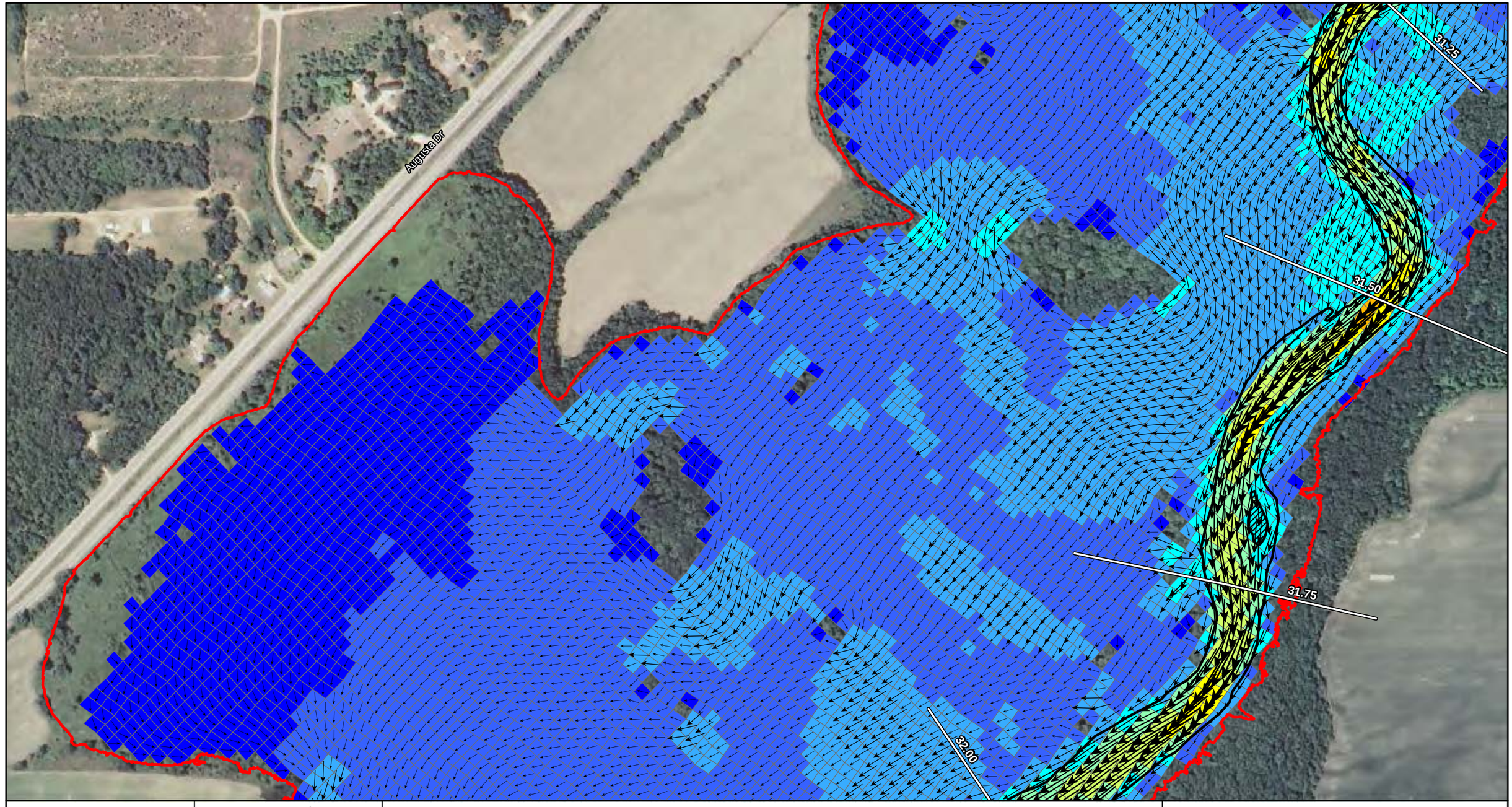
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

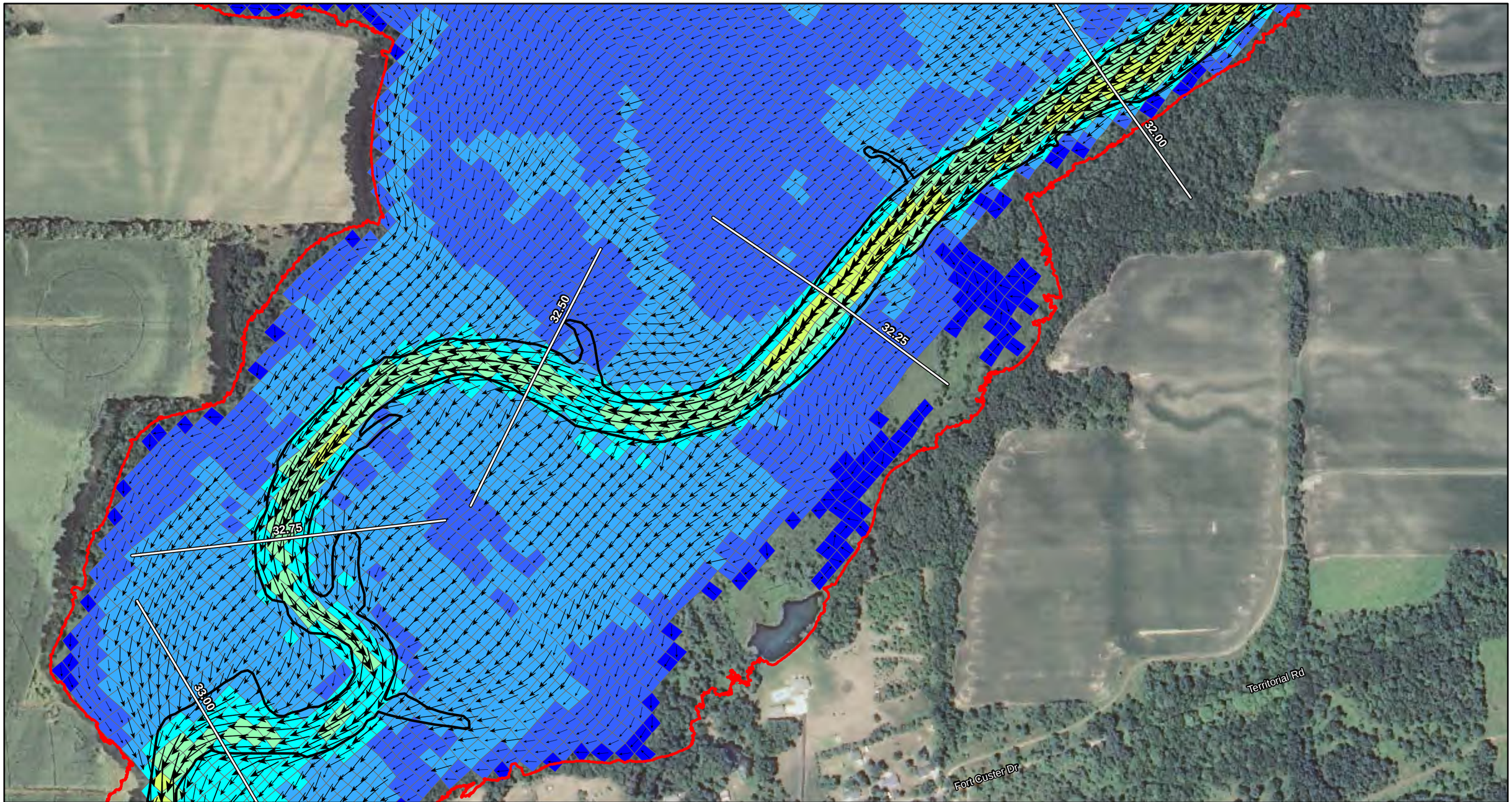
MP 31.40 - MP 31.94

SHEET 35 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

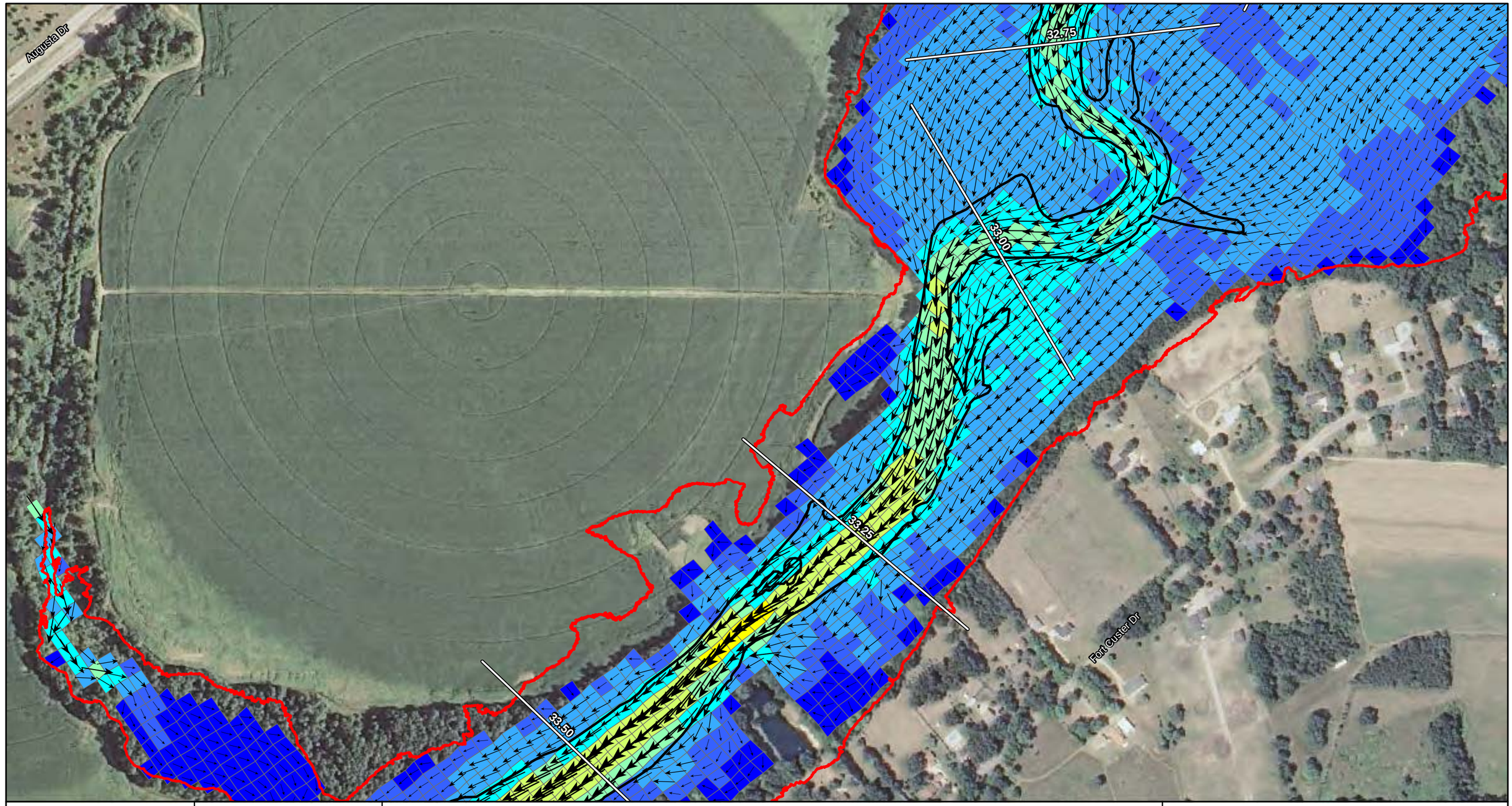
MP 31.94 - MP 33.00

SHEET 36 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

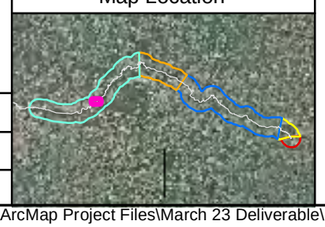
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

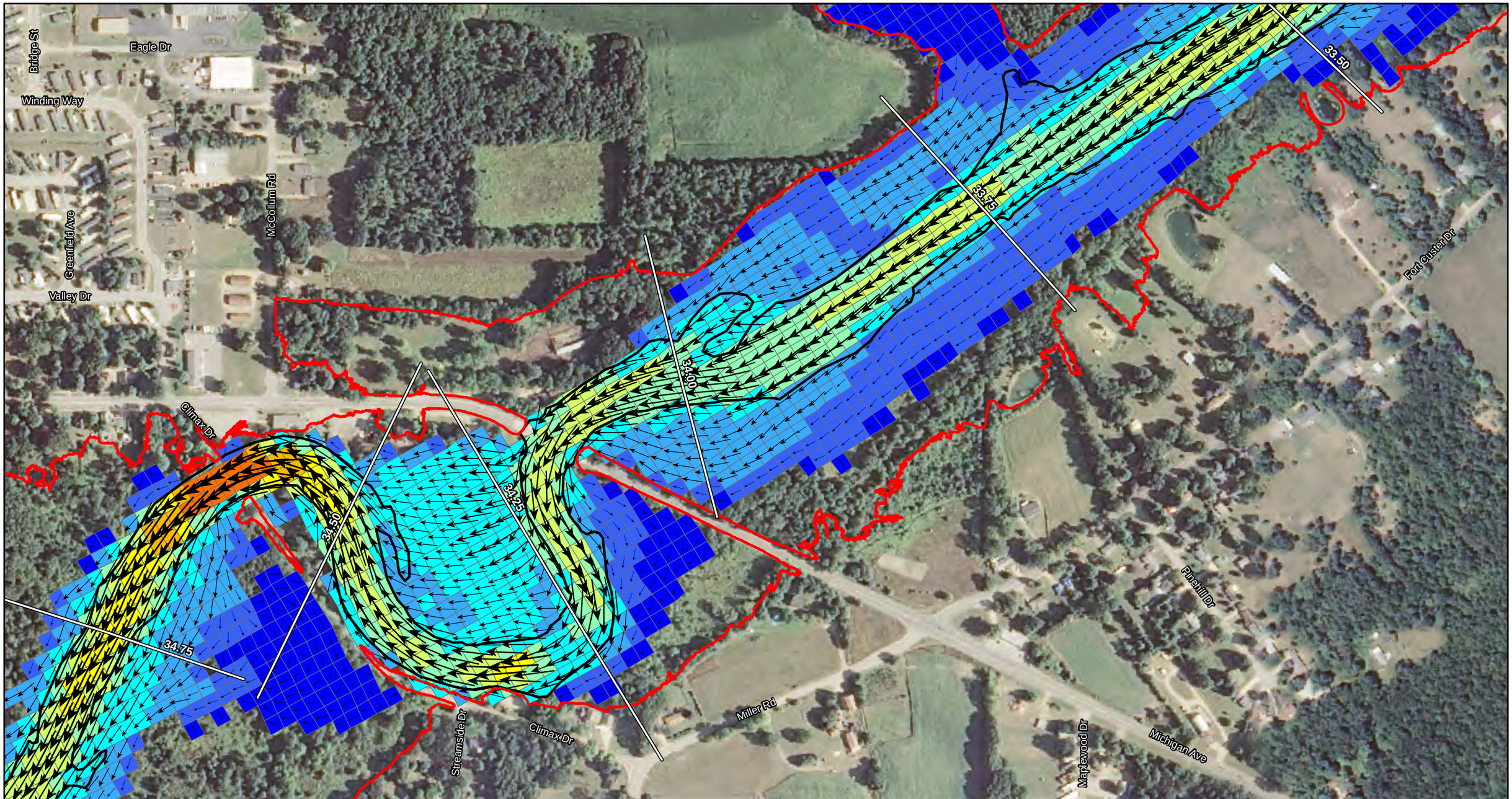
MP 33.00 - MP 33.52

SHEET 37 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

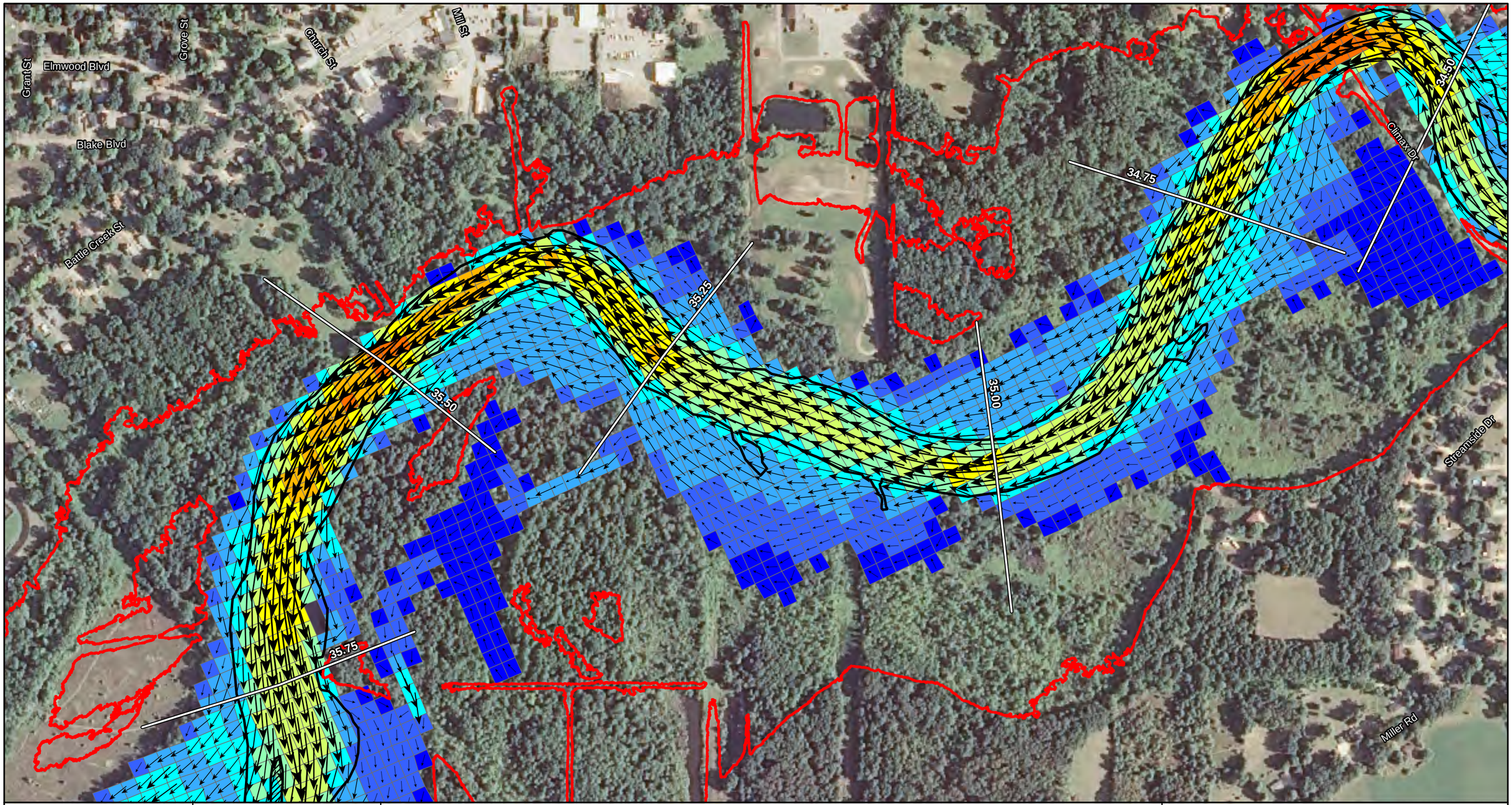
MP 33.52 - MP 34.70

SHEET 38 OF 45

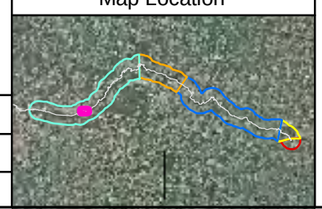
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

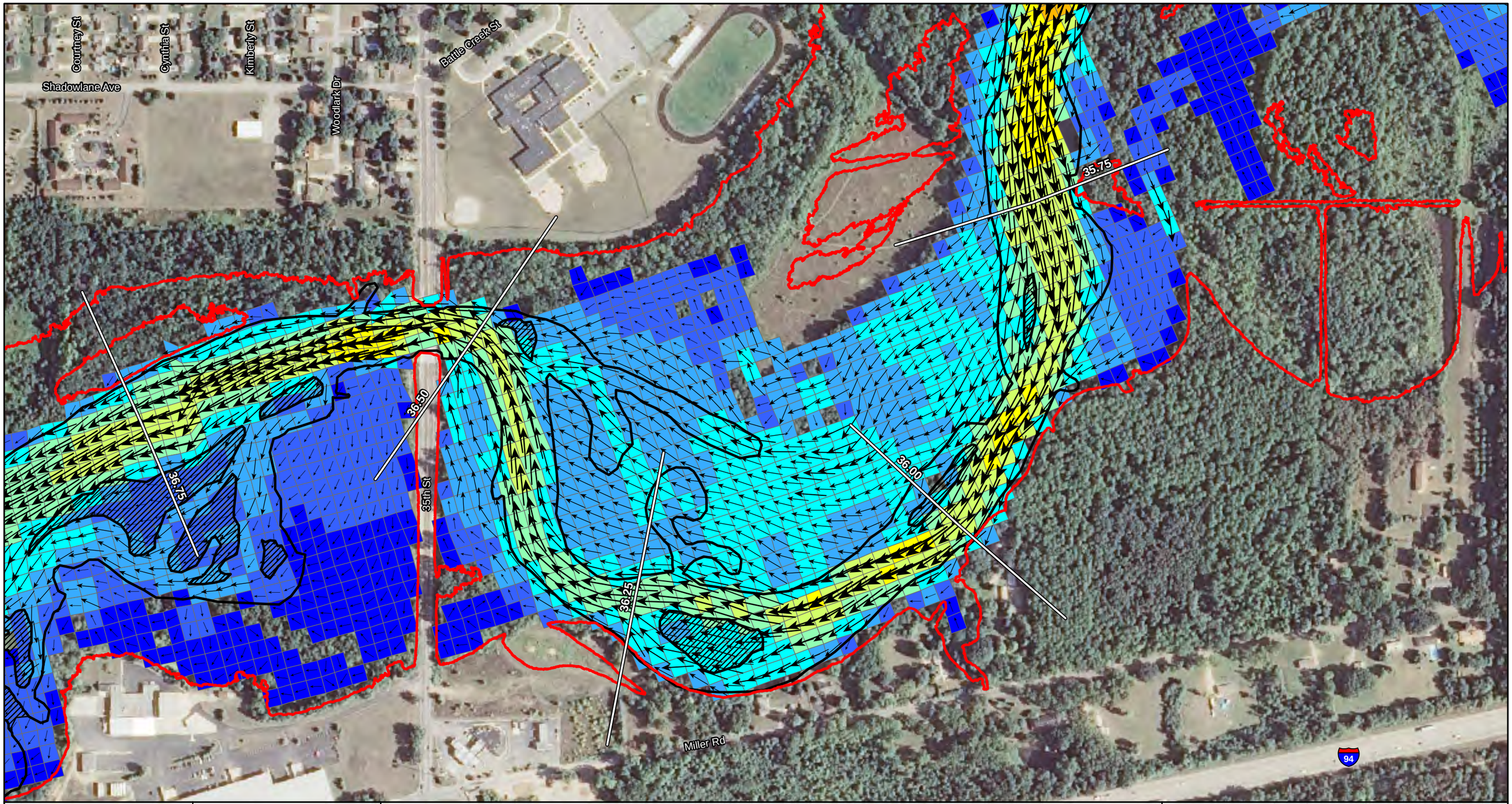
MP 34.70 - MP 35.75

SHEET 39 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

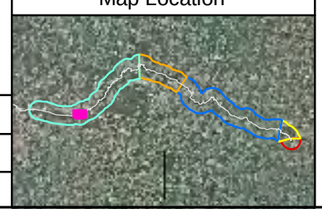
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

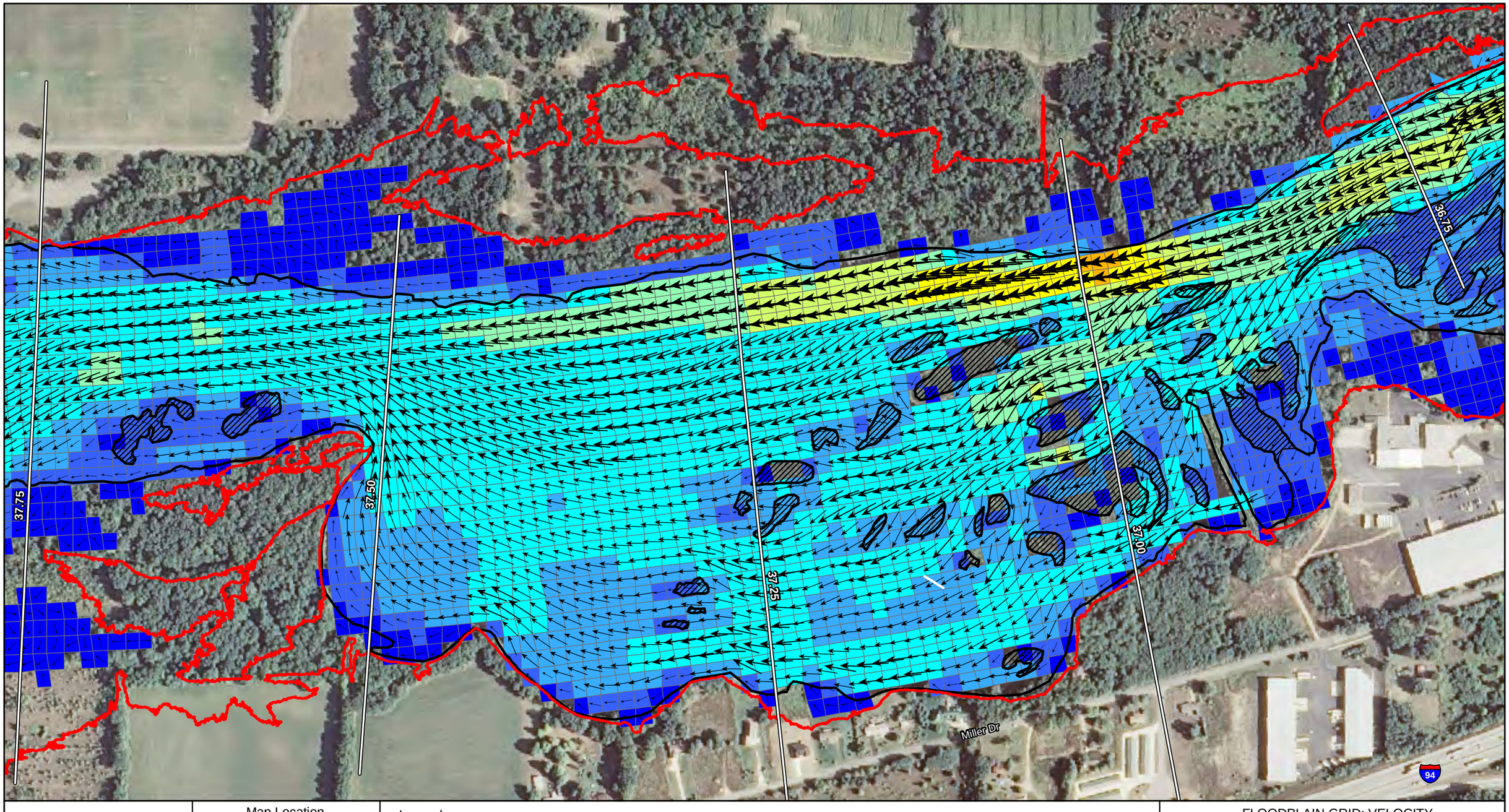
MP 35.75 - MP 36.75

SHEET 40 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 36.75 - MP 37.75

SHEET 41 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

Krum Ave

Rosemont Dr

Plaza Pl

Morrow Lake BAS

38.50

38.75

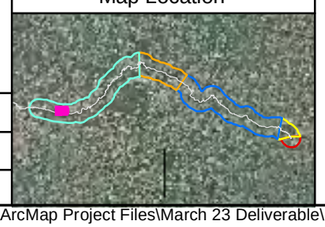
38.25

38.00

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 37.75N - MP 38.80N

SHEET 42 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

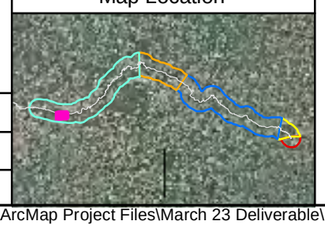
Aerial Photography Date: July & August 2009

38.75
38.50
38.25
38.00
37.75
94
Lyon Rd
Miller Dr

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

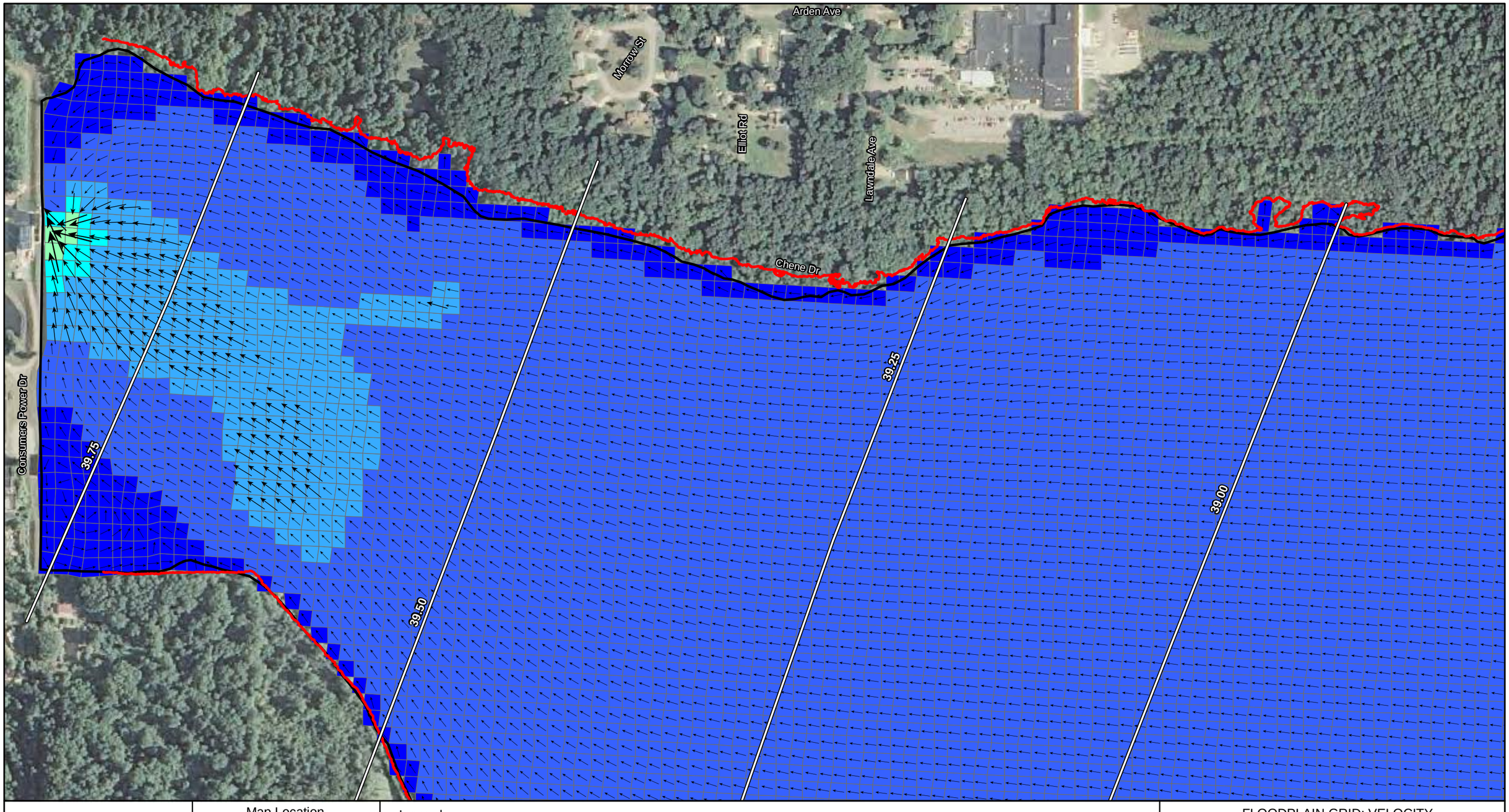
MP 37.75S - MP 38.80S

SHEET 43 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

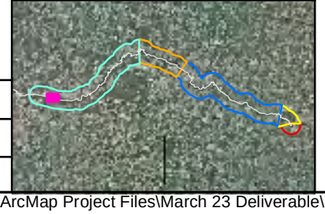
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)

- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

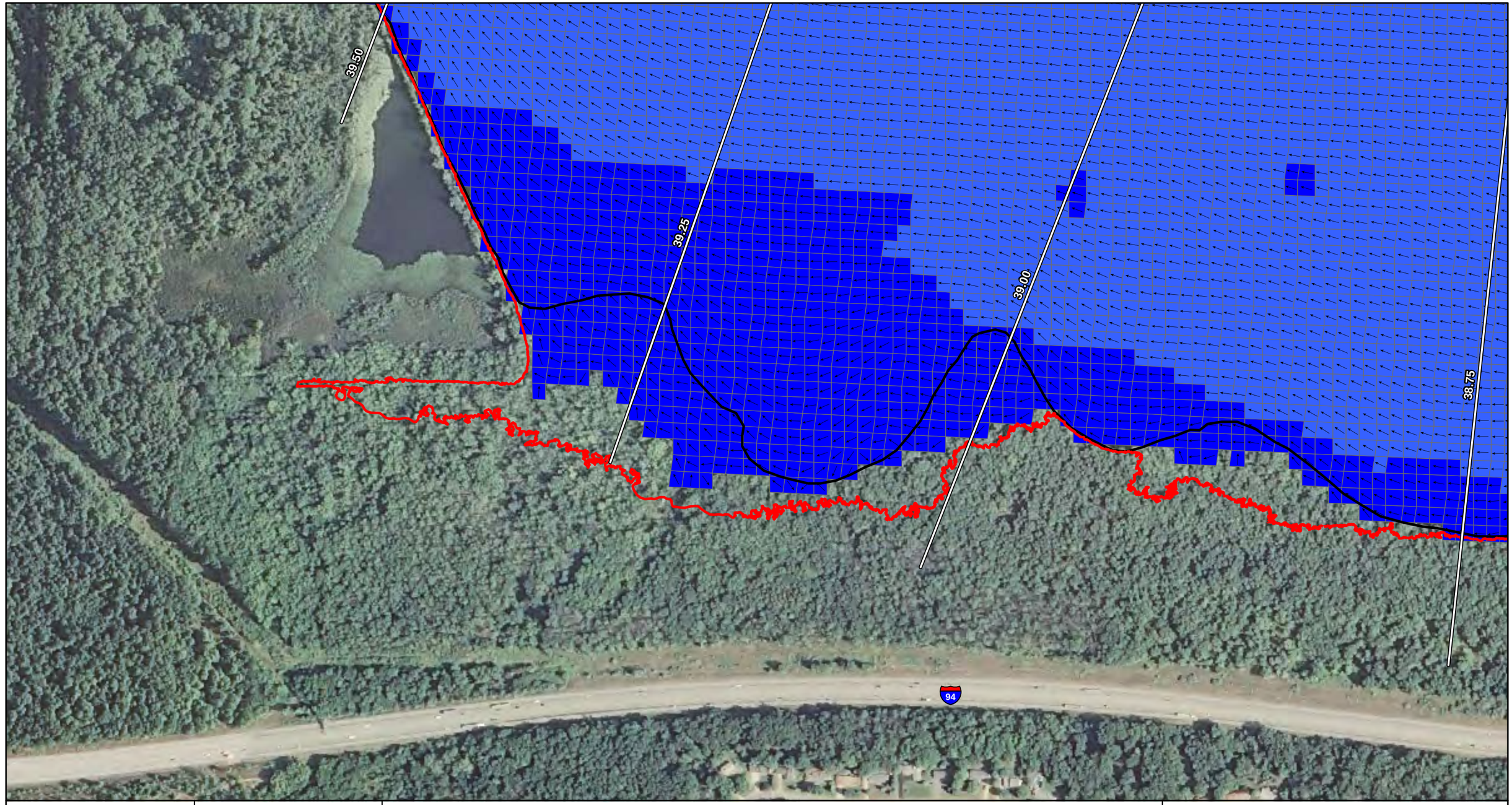
MP 38.80N - MP 39.95N

SHEET 44 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

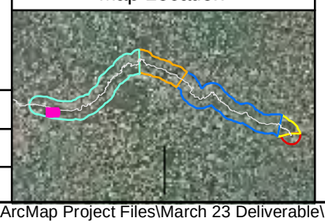
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Velocity (ft/sec)
- < 0.1 ft/sec
- 0.1 - 0.25 ft/sec
- 0.25 - 0.5 ft/sec
- 0.5 - 1.0 ft/sec
- 1.0 - 1.5 ft/sec
- 1.5 - 2.0 ft/sec
- 2.0 - 2.5 ft/sec
- 2.5 - 3.0 ft/sec
- 3.0 - 4.0 ft/sec
- > 4.0 ft/sec

- Flow Direction and Relative Magnitude
- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

ft/sec = Feet Per Second
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: VELOCITY
JULY 28, 2010

MP 38.80S - MP 39.95S

SHEET 45 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Velocity_Jul28_2010.mxd

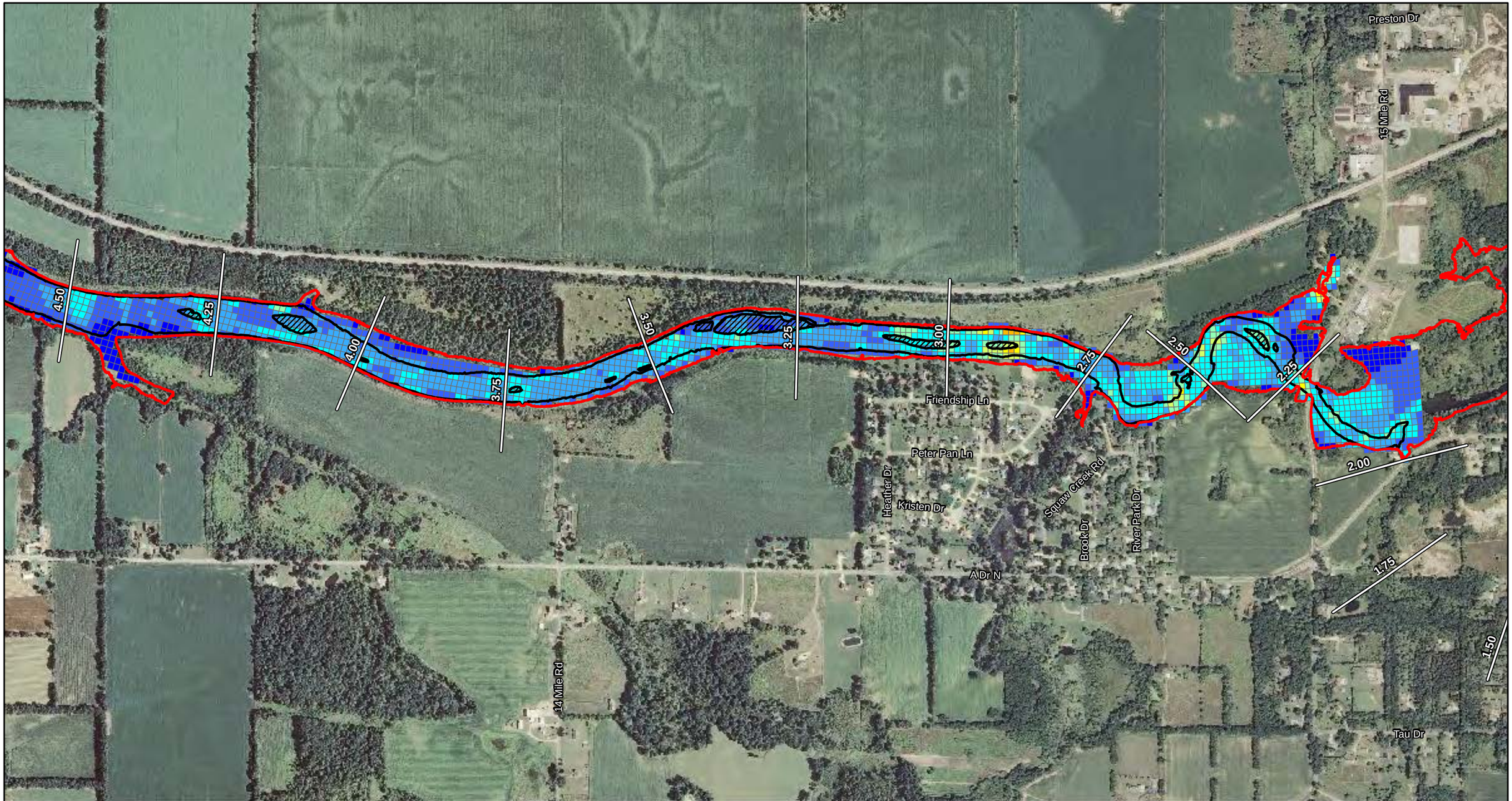
Aerial Photography Date: July & August 2009

Figure 4-24

Floodplain Grid: Bed Shear Stress

July 24, 2010

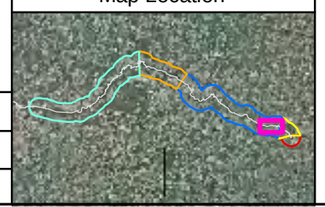
Sheets 1 through 16



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

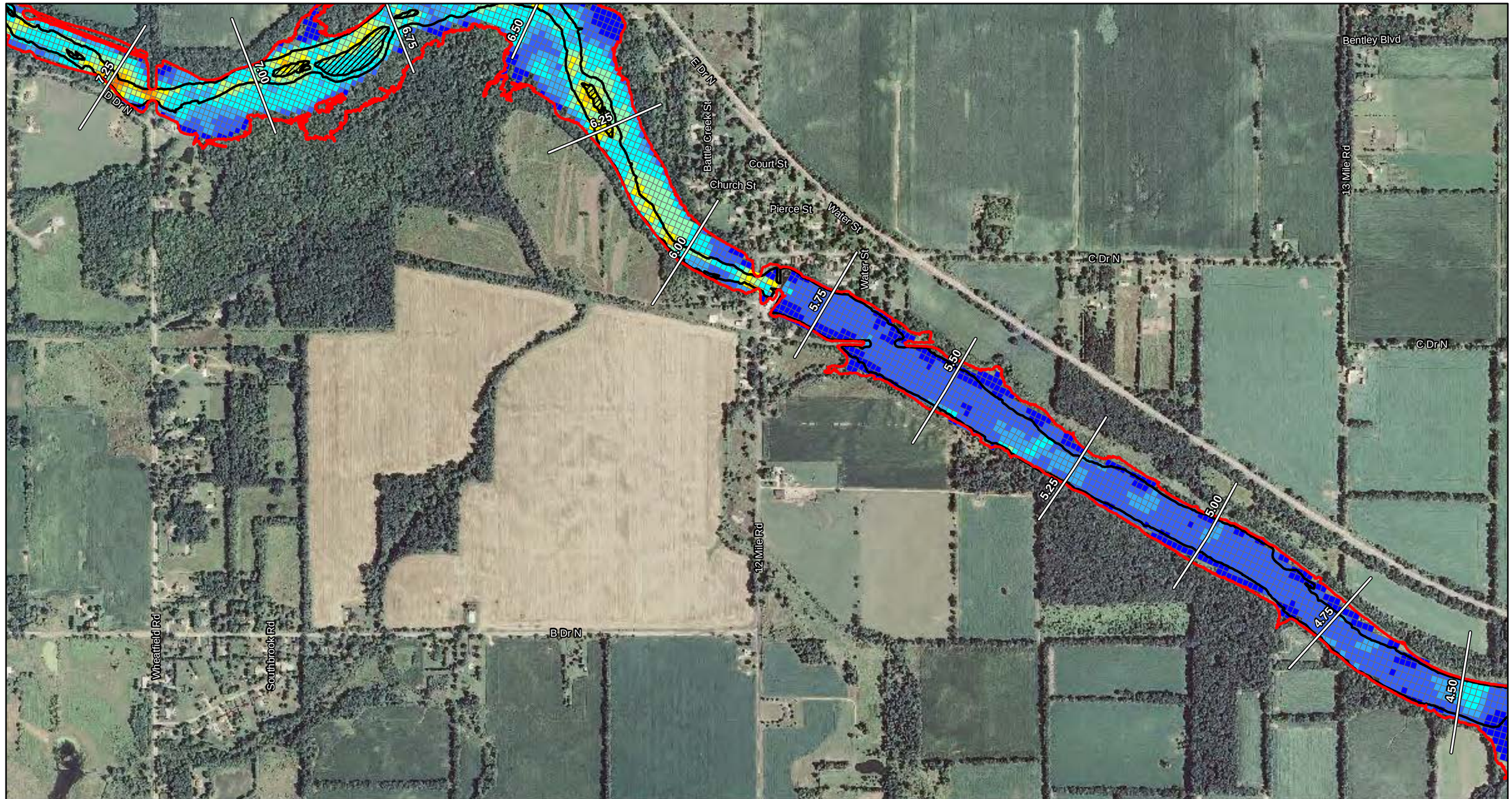
MP 1.50 - MP 4.50

SHEET 1 OF 16

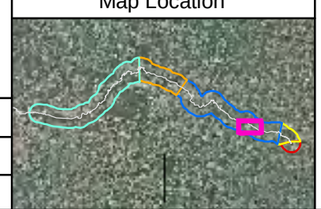
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

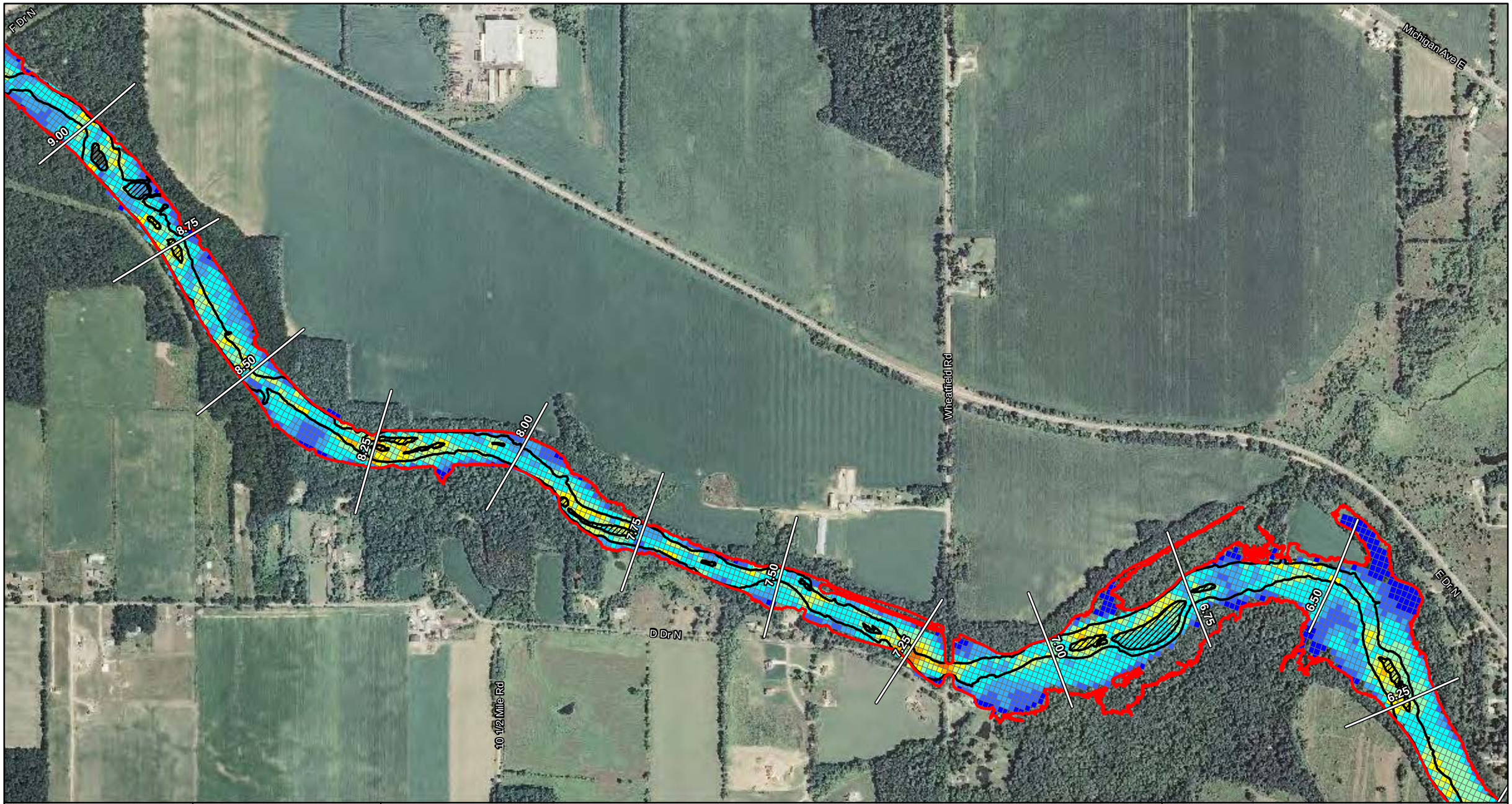
MP 4.50 - MP 6.25

SHEET 2 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

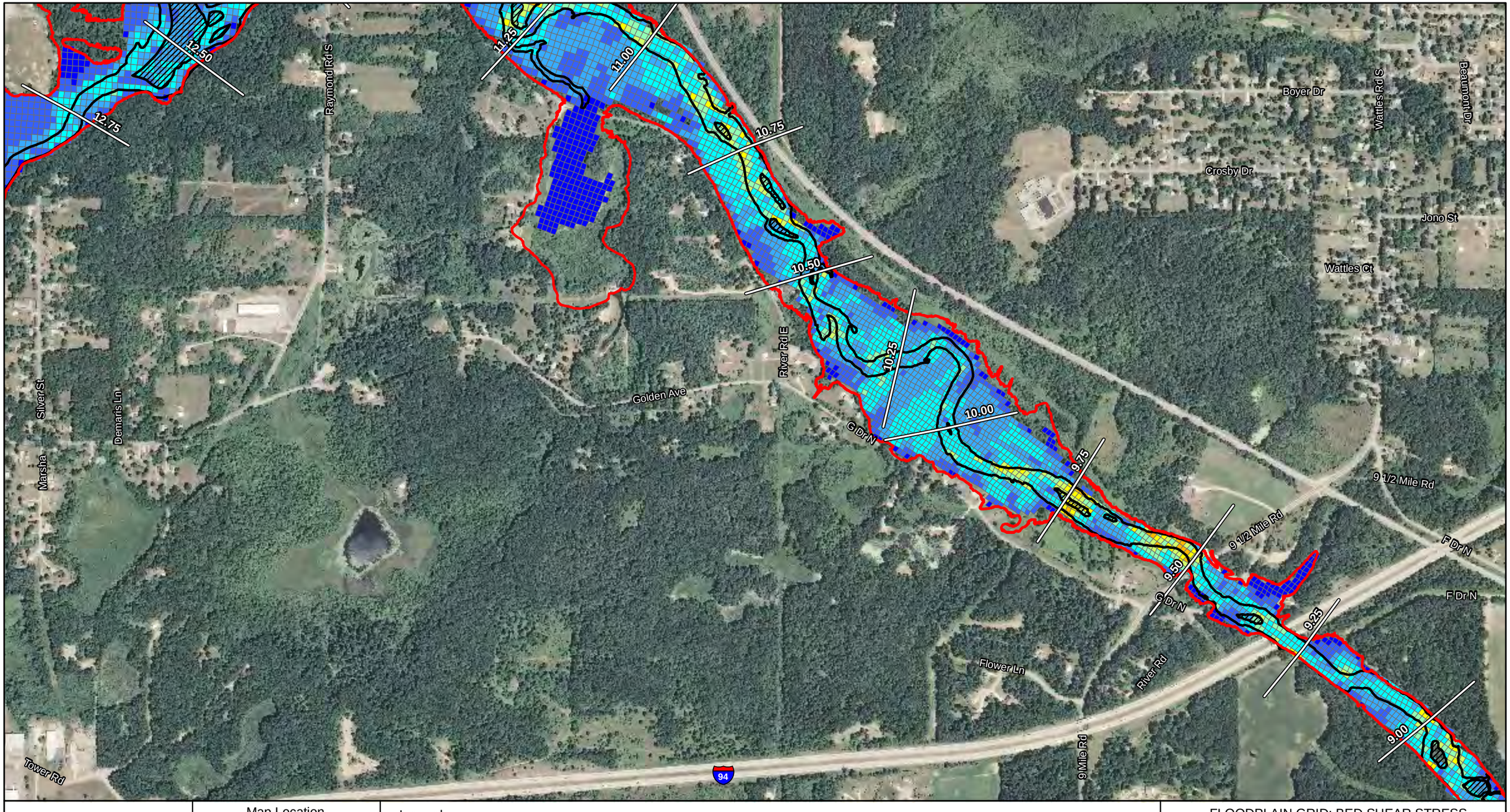
MP 6.25 - MP 9.00

SHEET 3 OF 16

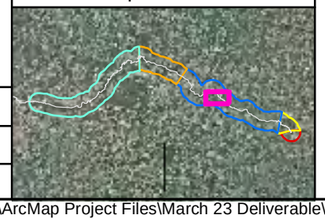
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

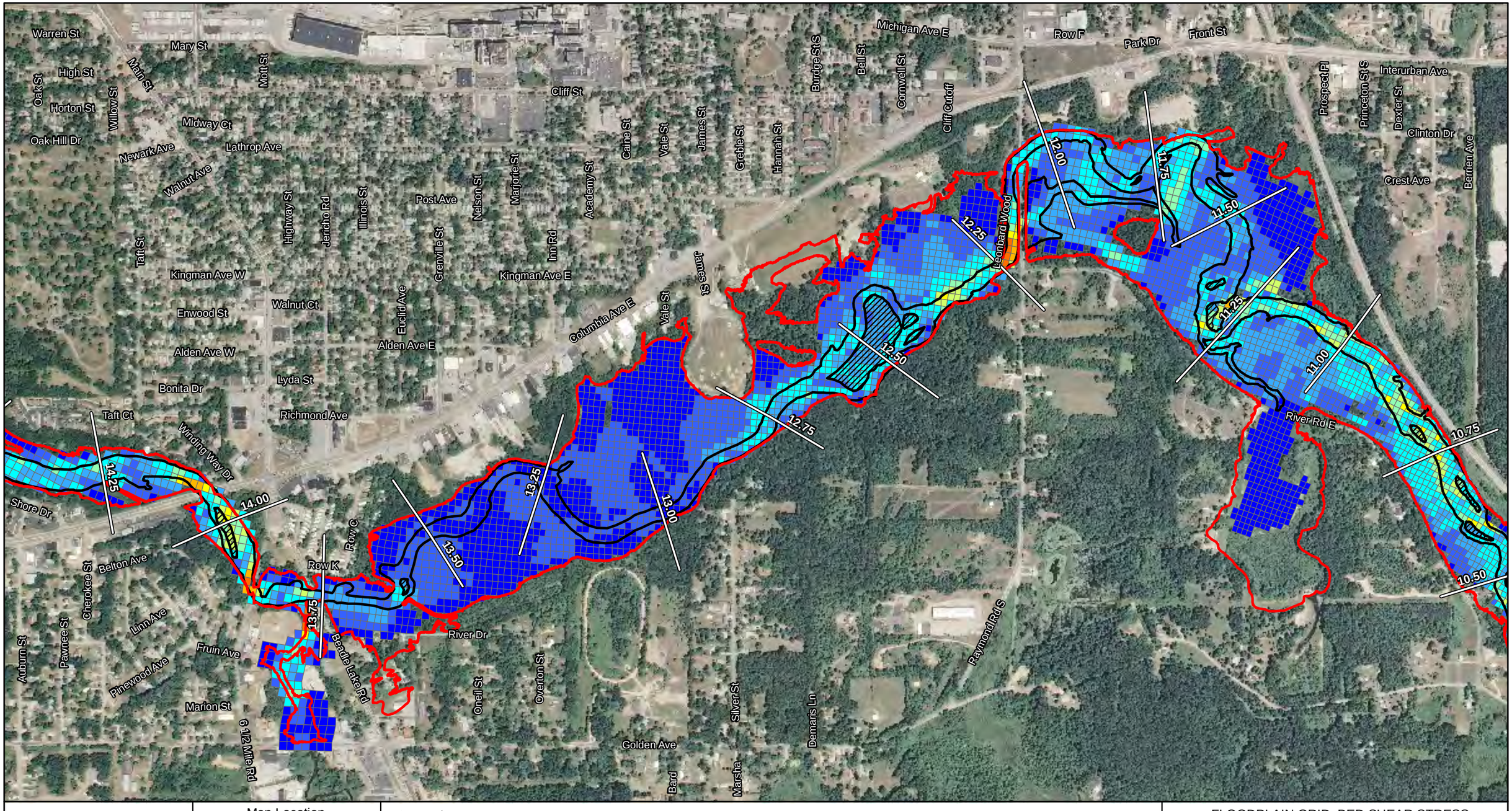
MP 9.00 - MP 10.50

SHEET 4 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

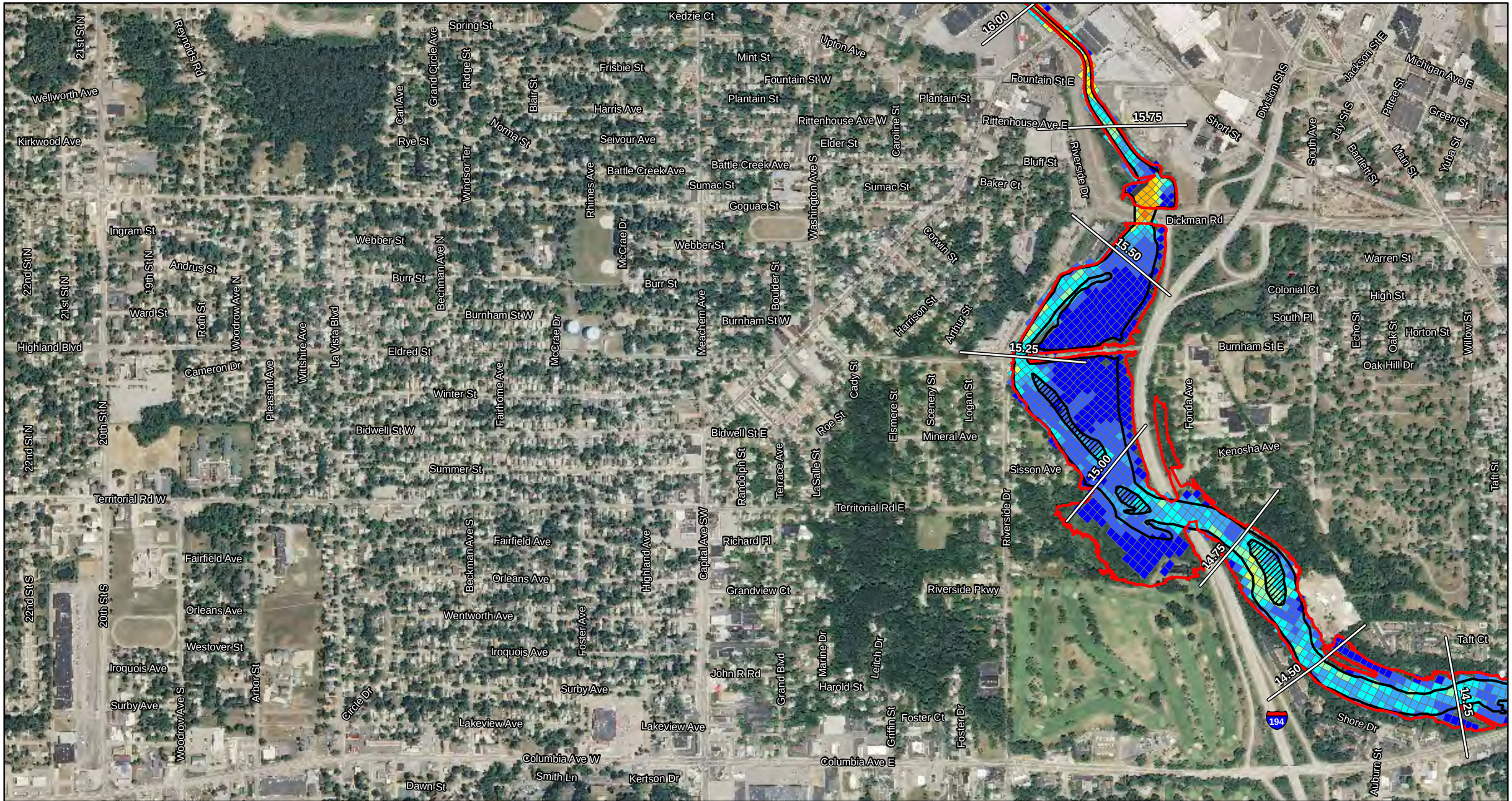
MP 10.50 - MP 14.25

SHEET 5 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

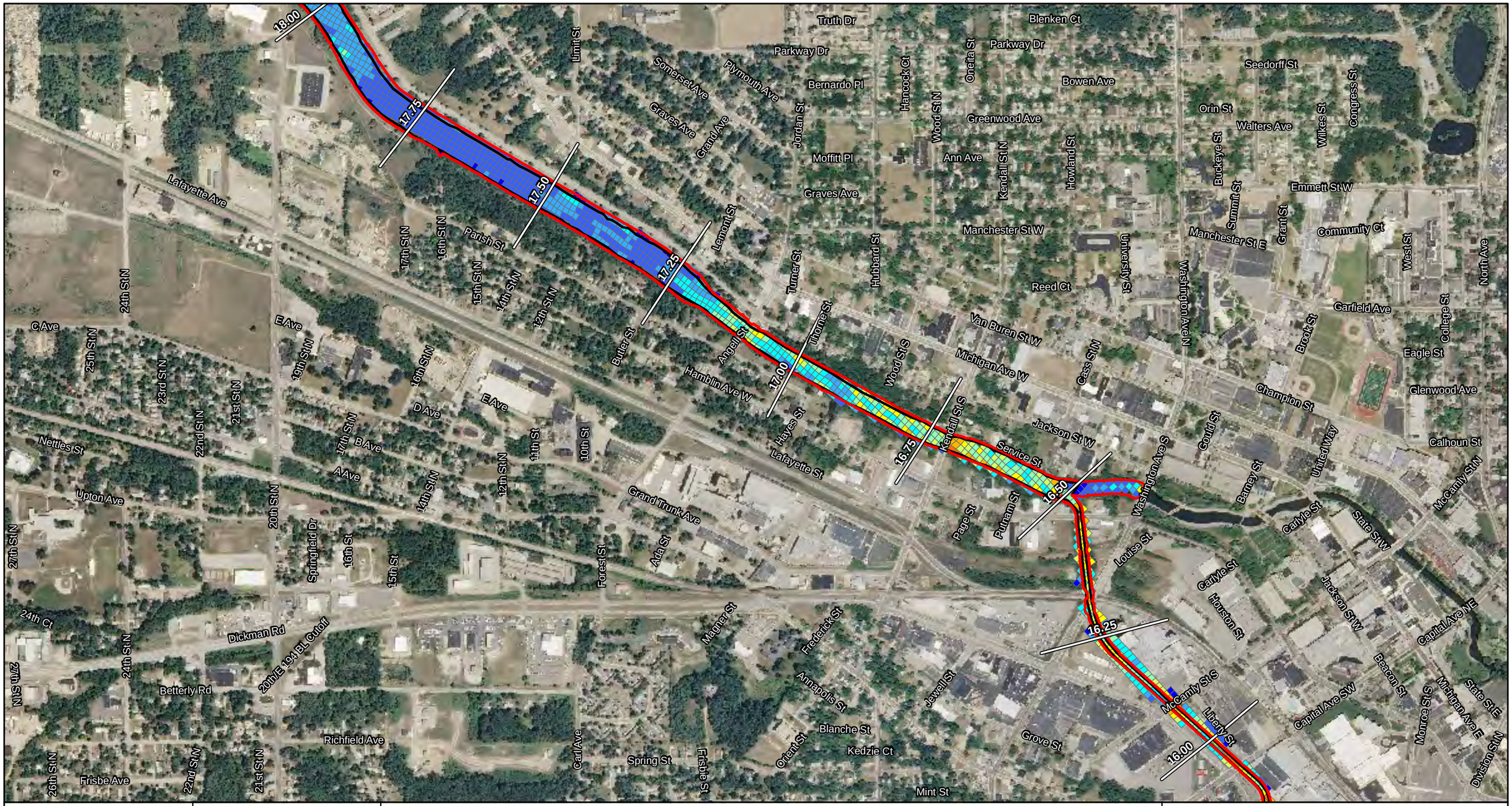
MP 14.25 - MP 16.00

SHEET 6 OF 16

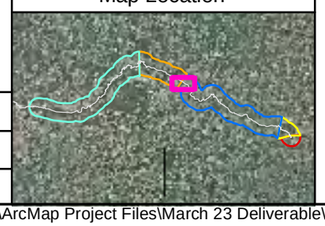
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

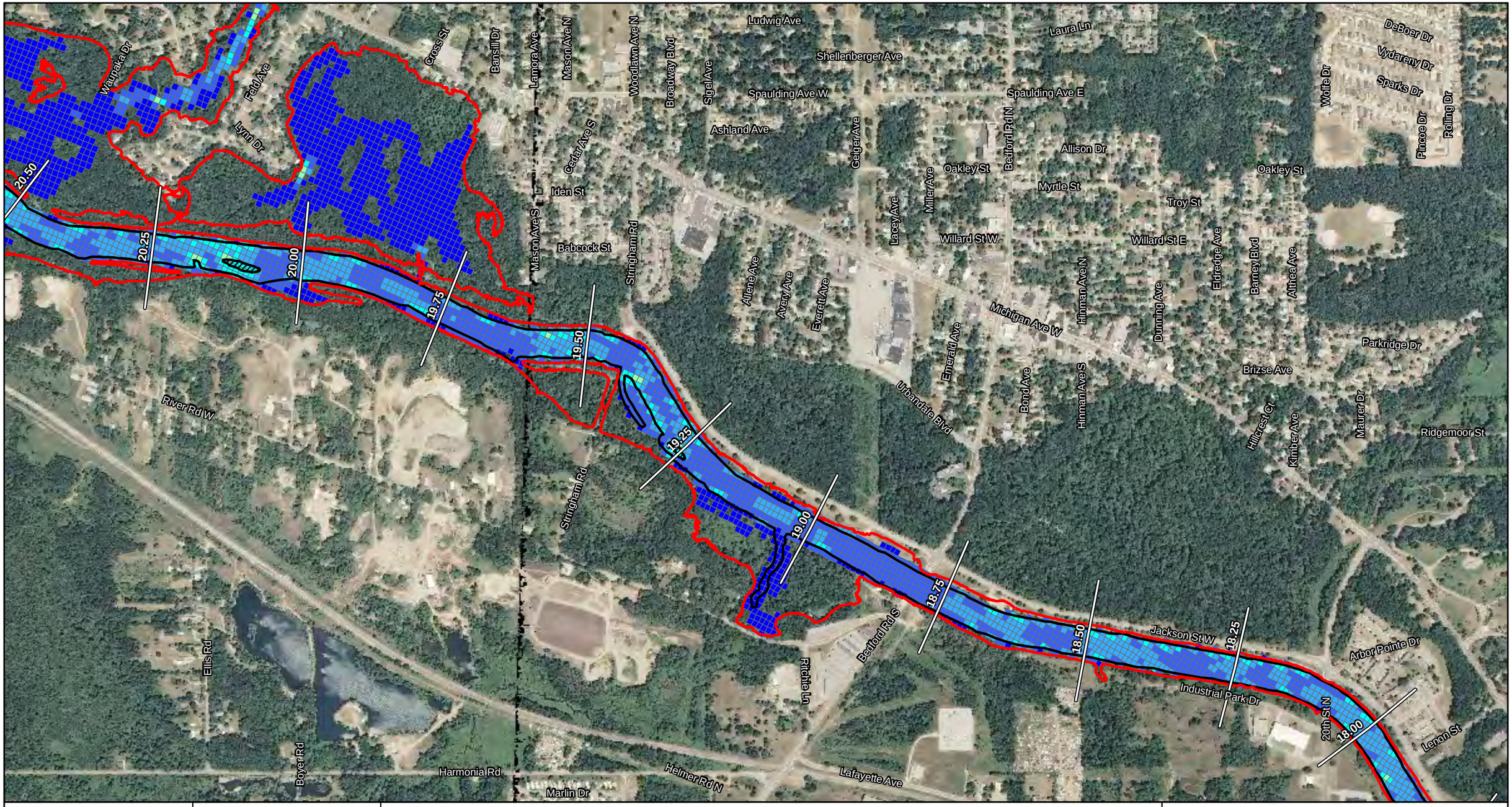
MP 16.00 - MP 18.00

SHEET 7 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

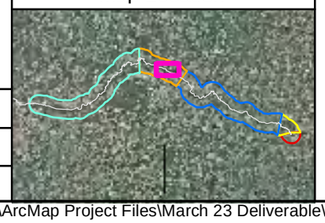
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

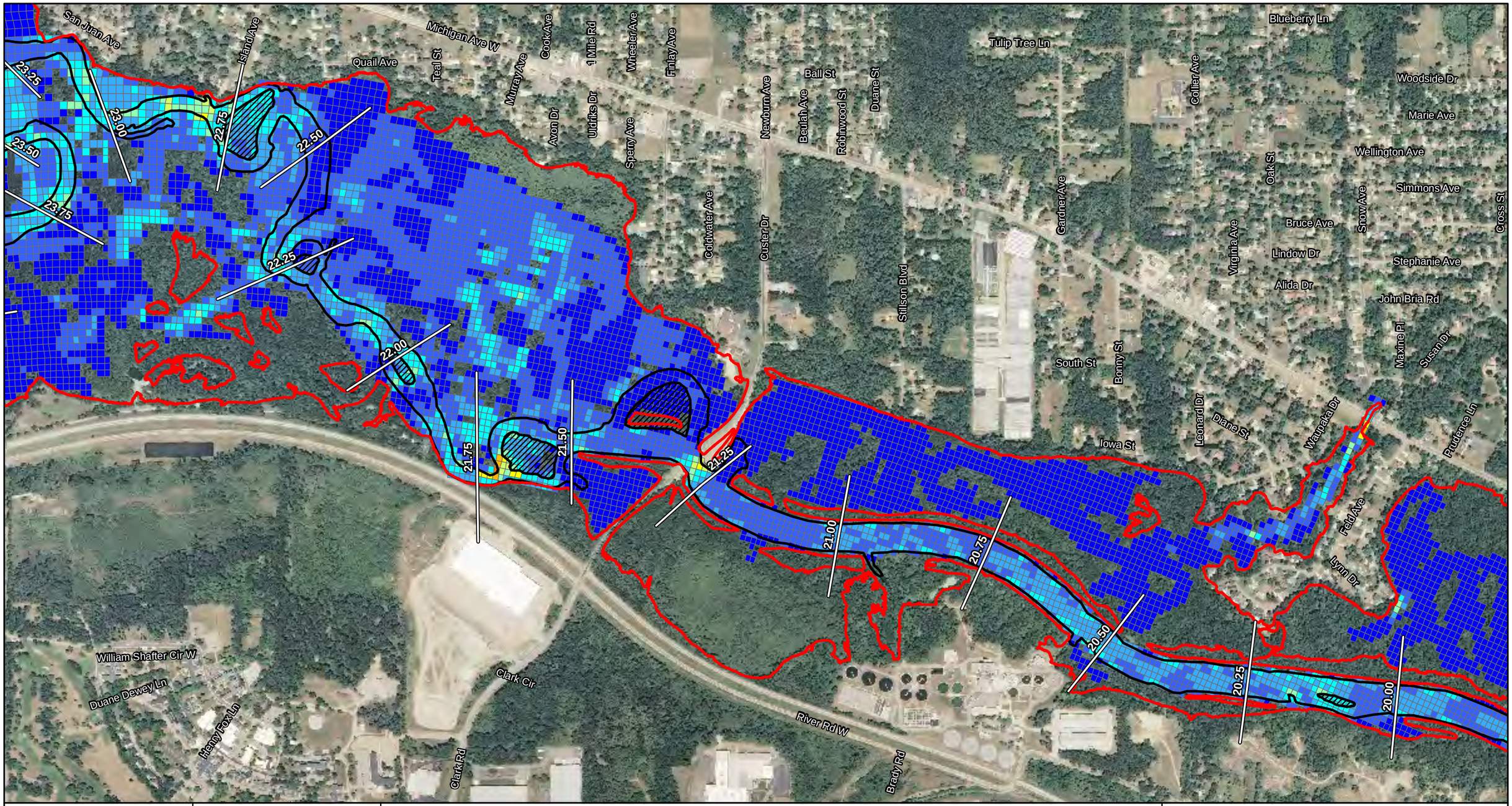
MP 18.00 - MP 20.00

SHEET 8 OF 16

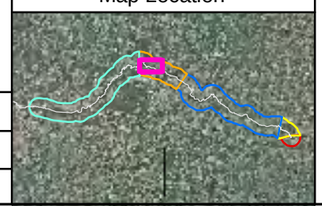
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

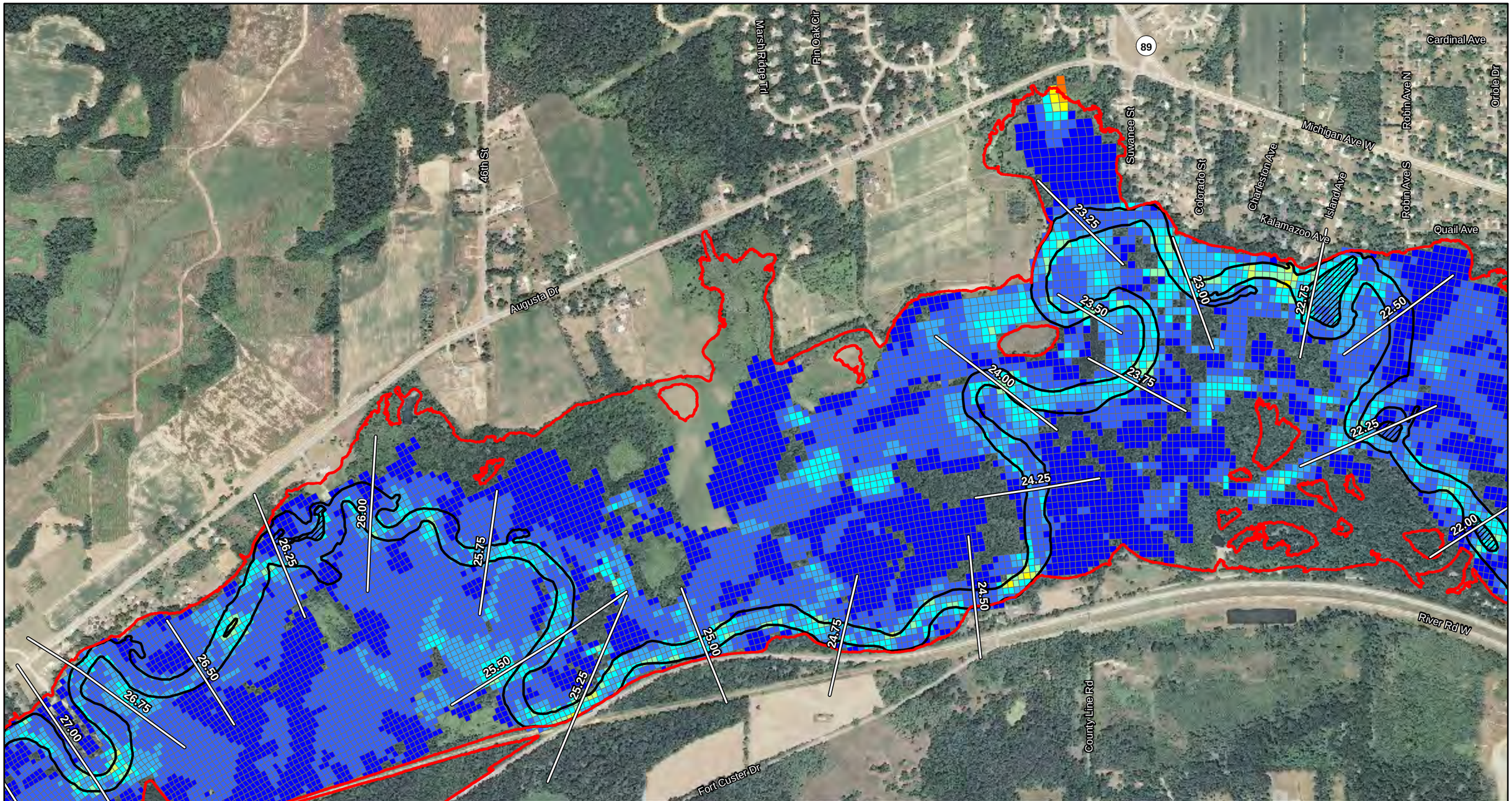
MP 20.00 - MP 22.50

SHEET 9 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

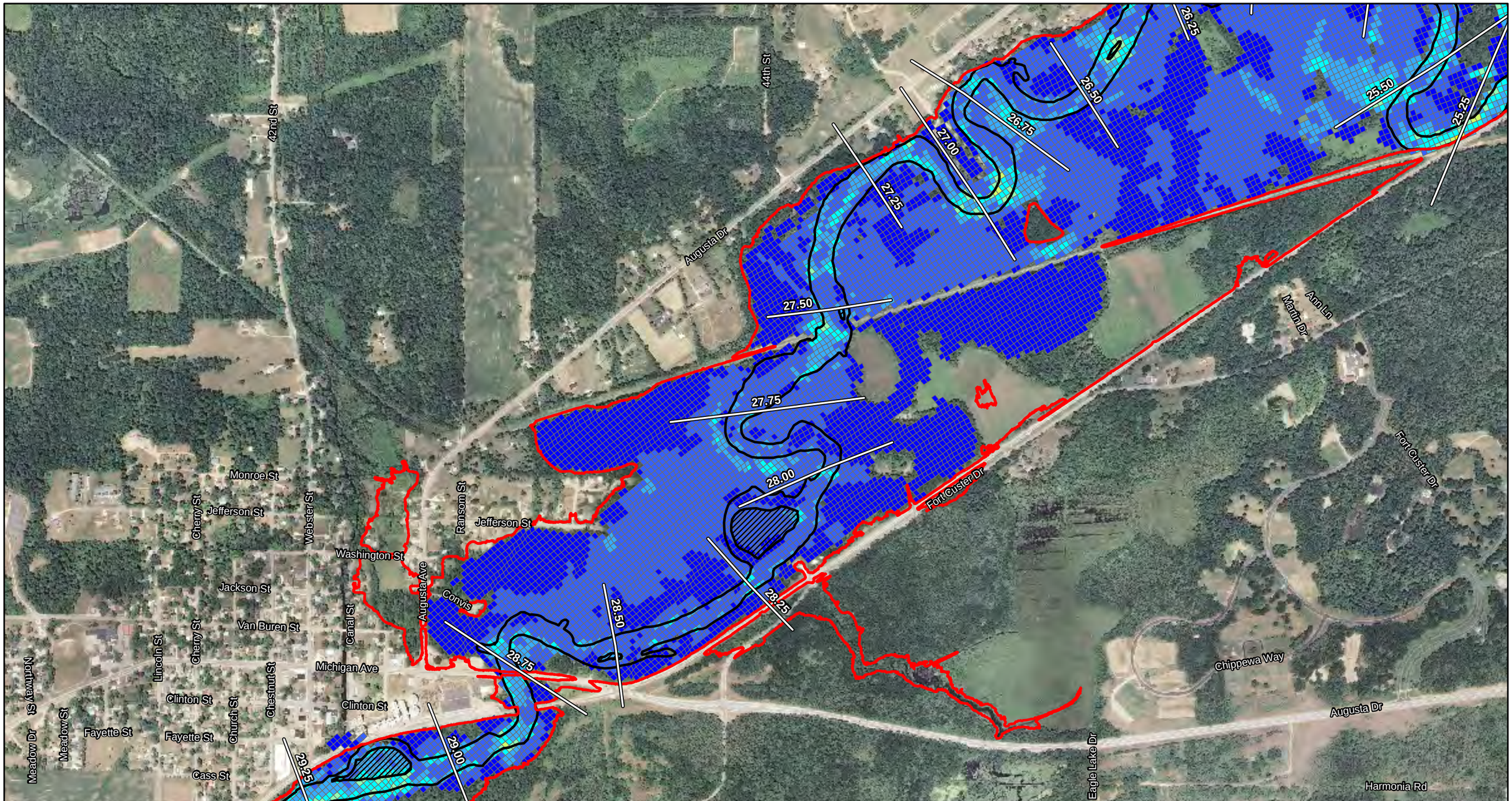
MP 22.50 - MP 27.00

SHEET 10 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

MP 27.00 - MP 28.75

SHEET 11 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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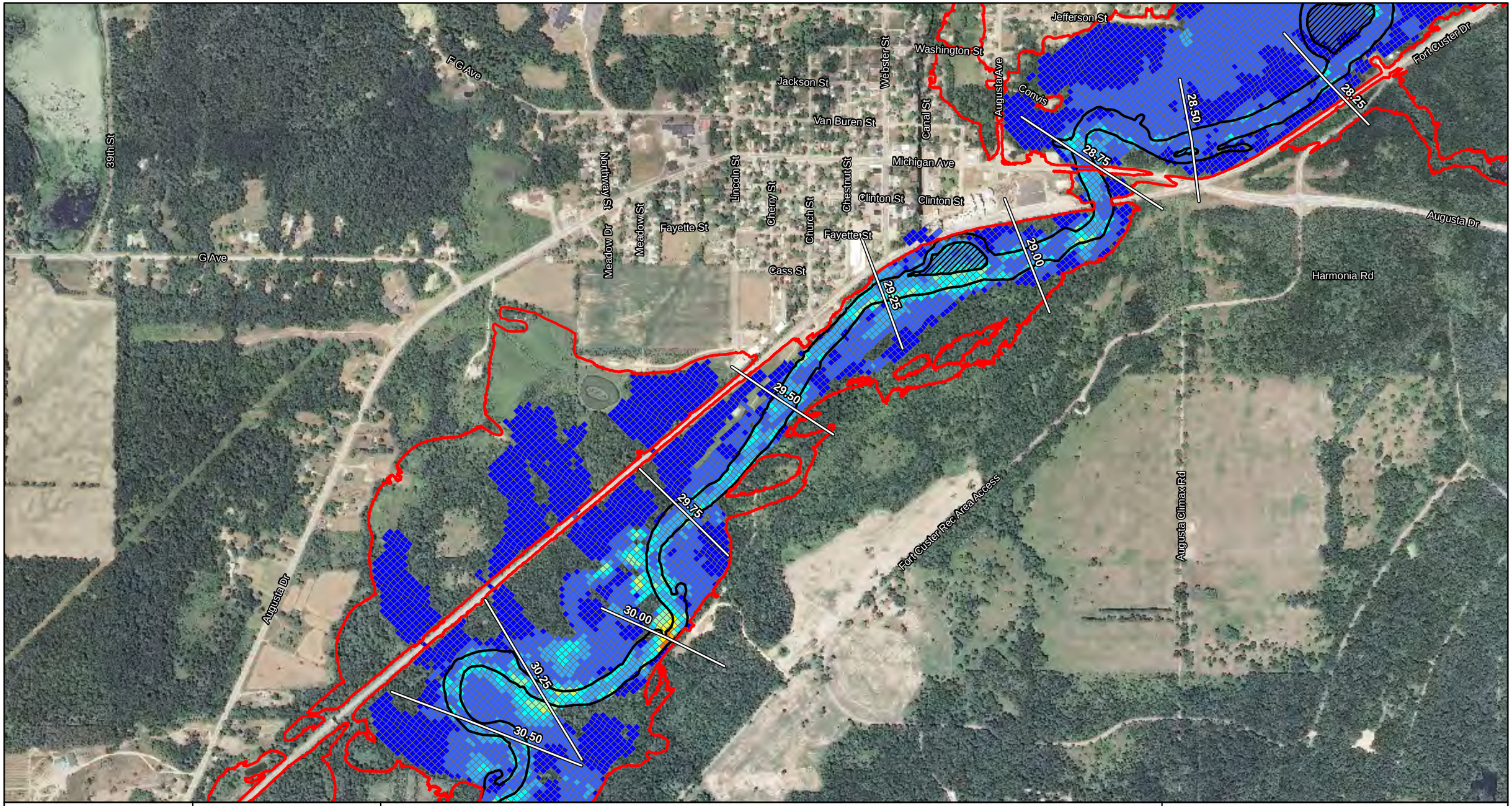
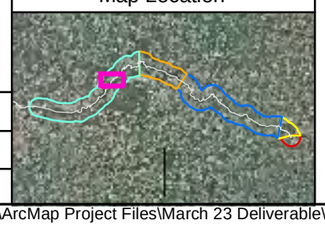
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

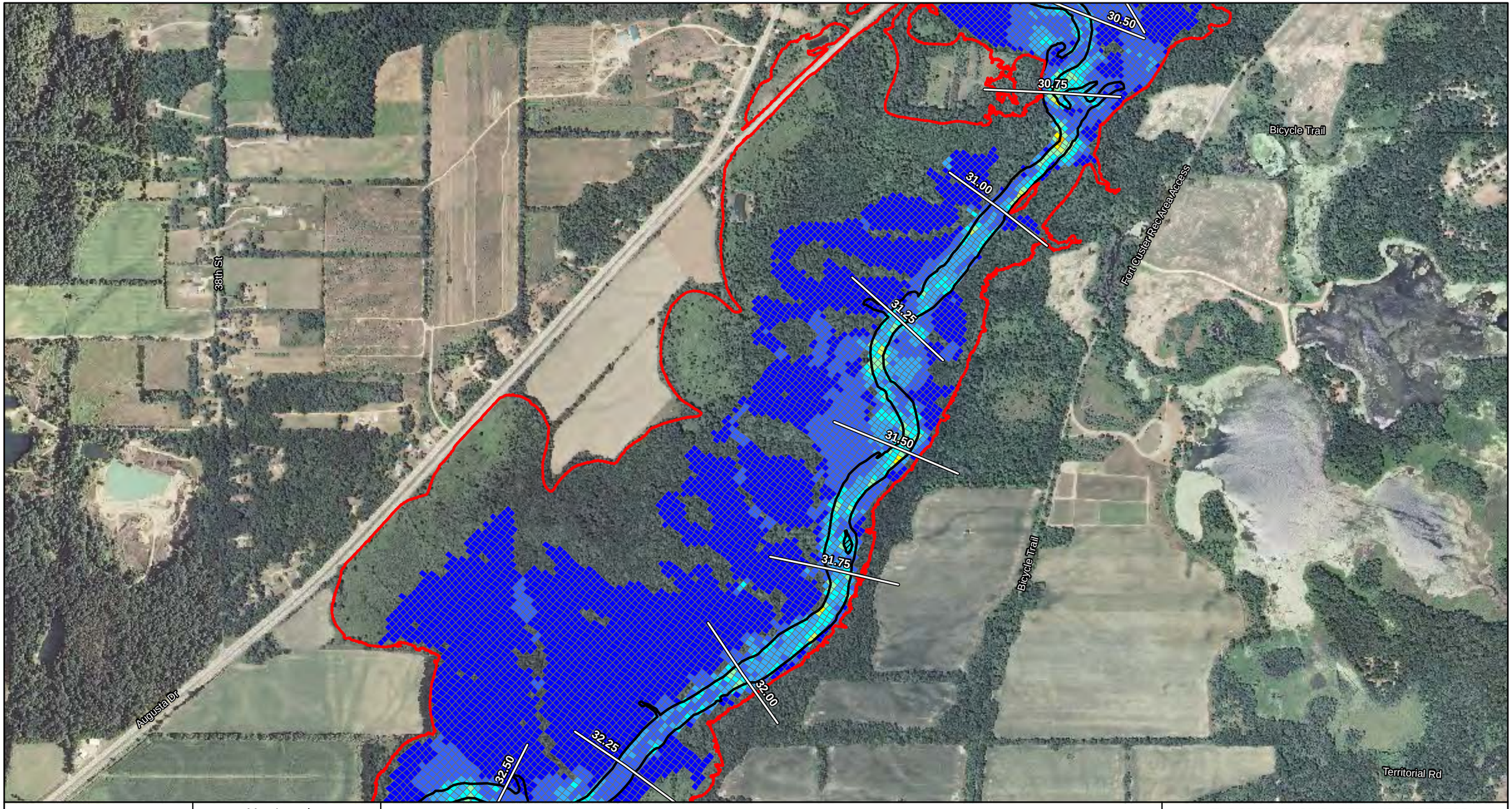
MP 28.75 - MP 30.50

SHEET 12 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

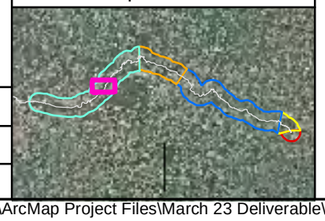
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

MP 30.50 - MP 32.25

SHEET 13 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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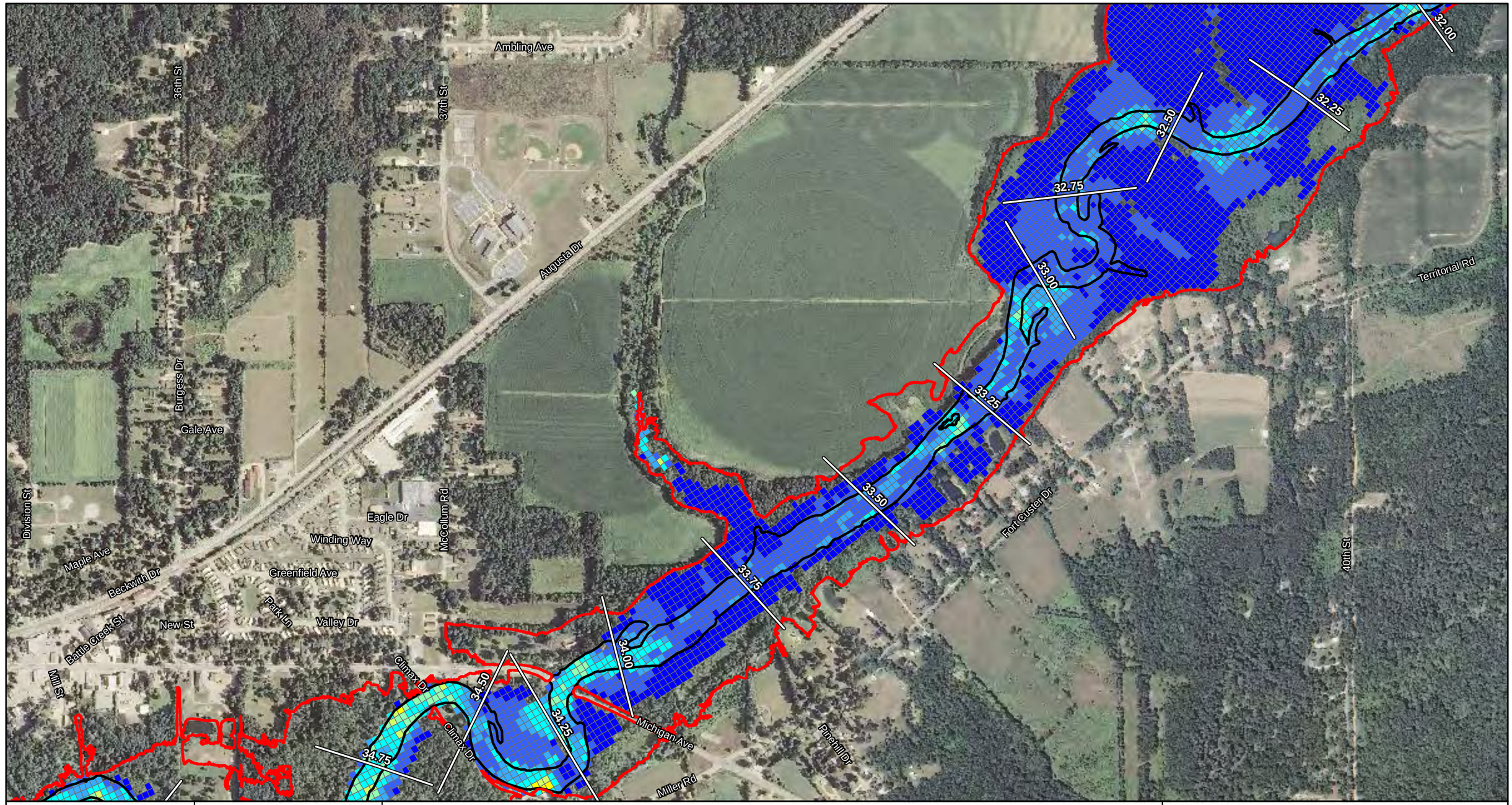
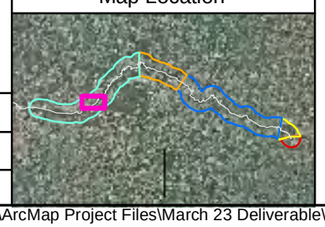
Aerial Photography Date: July & August 2009



Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

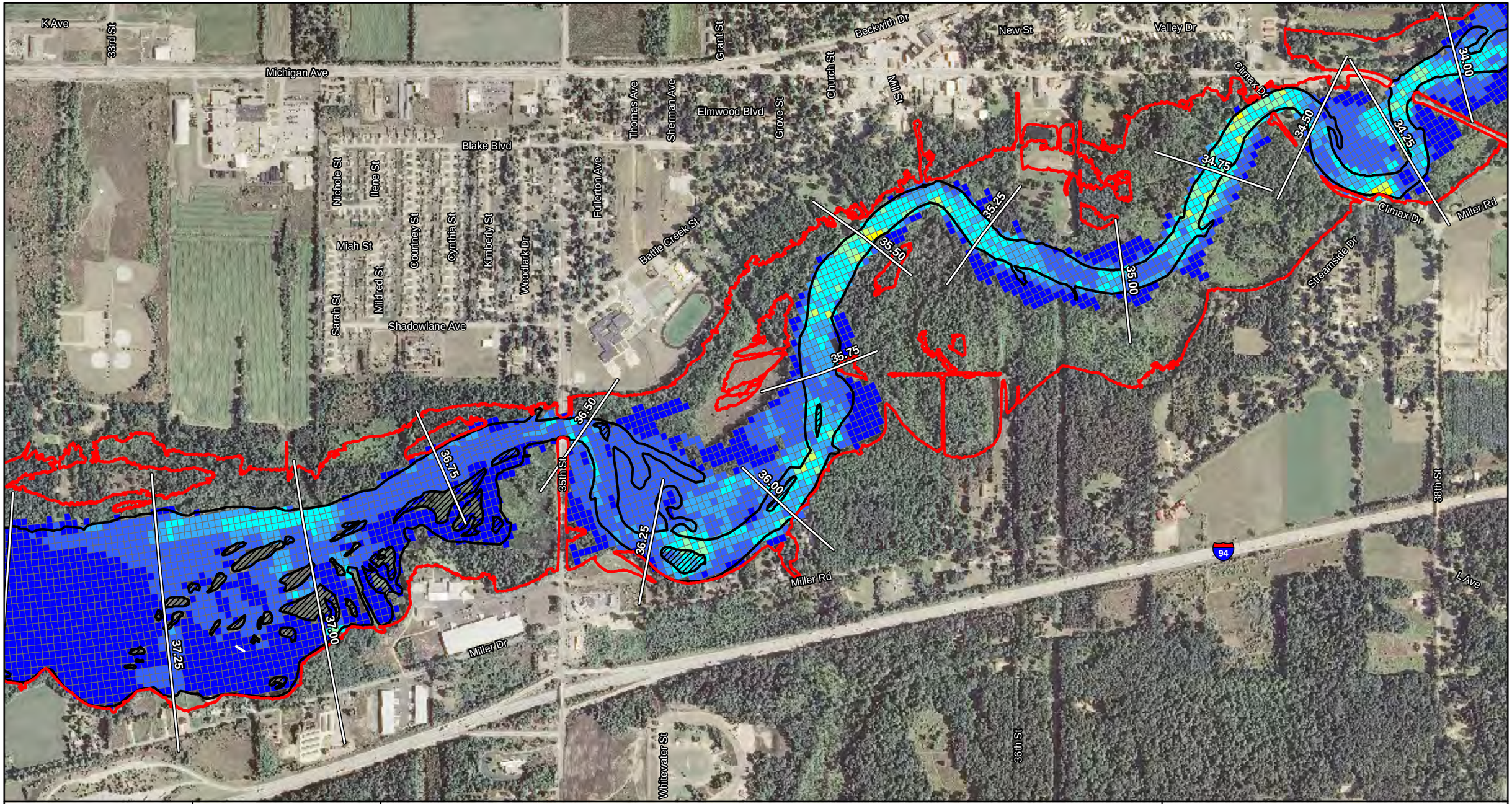
MP 32.25 - MP 34.75

SHEET 14 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

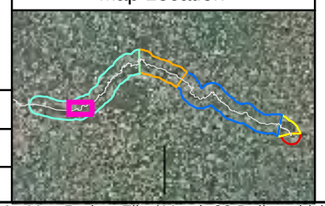
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

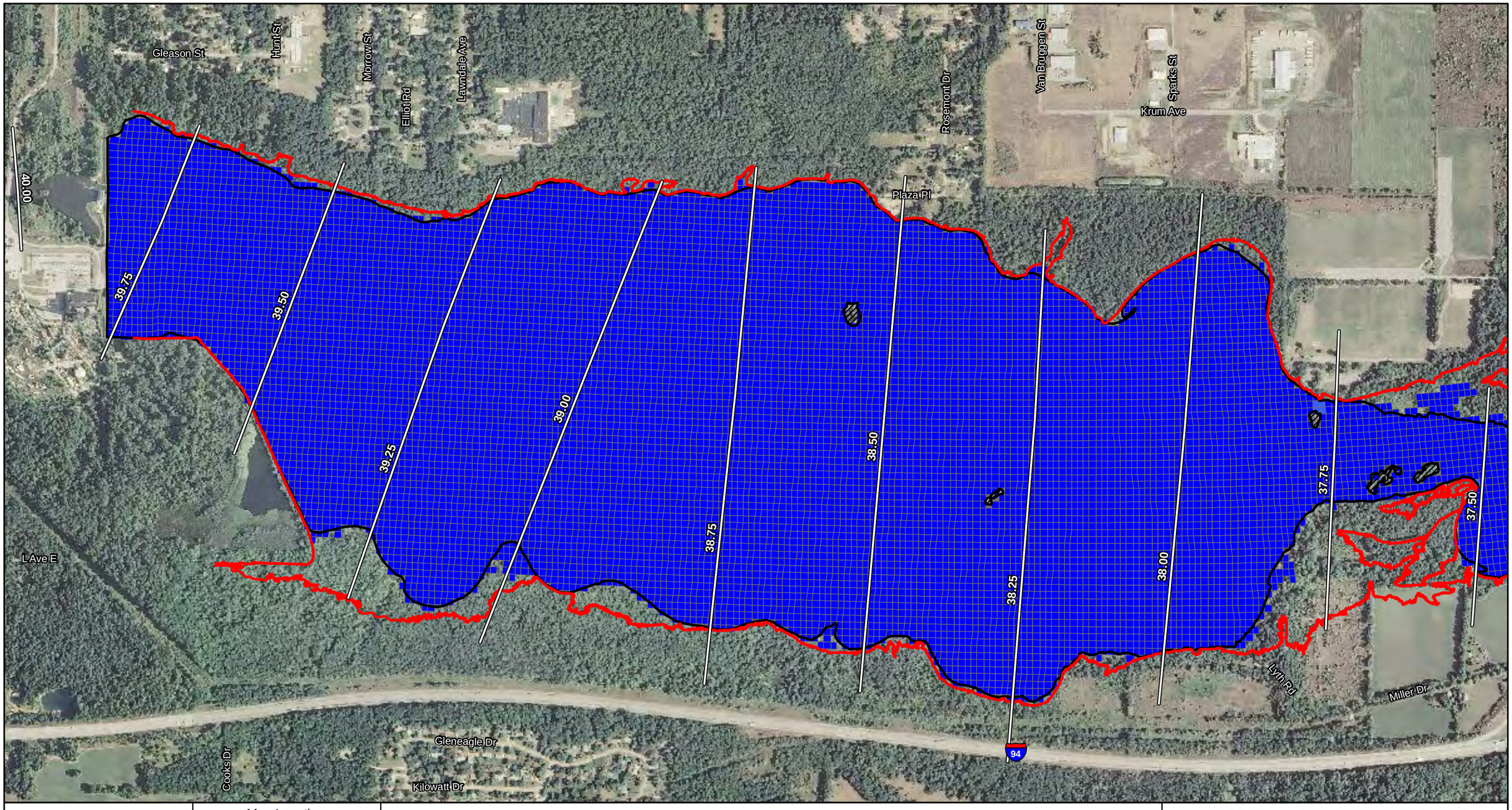
MP 34.25 - MP 37.50

SHEET 15 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

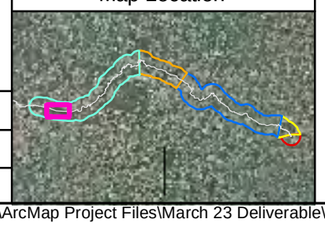
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 24, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,390 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 24, 2010

MP 37.50 - MP 40.00

SHEET 16 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul24_2010.mxd

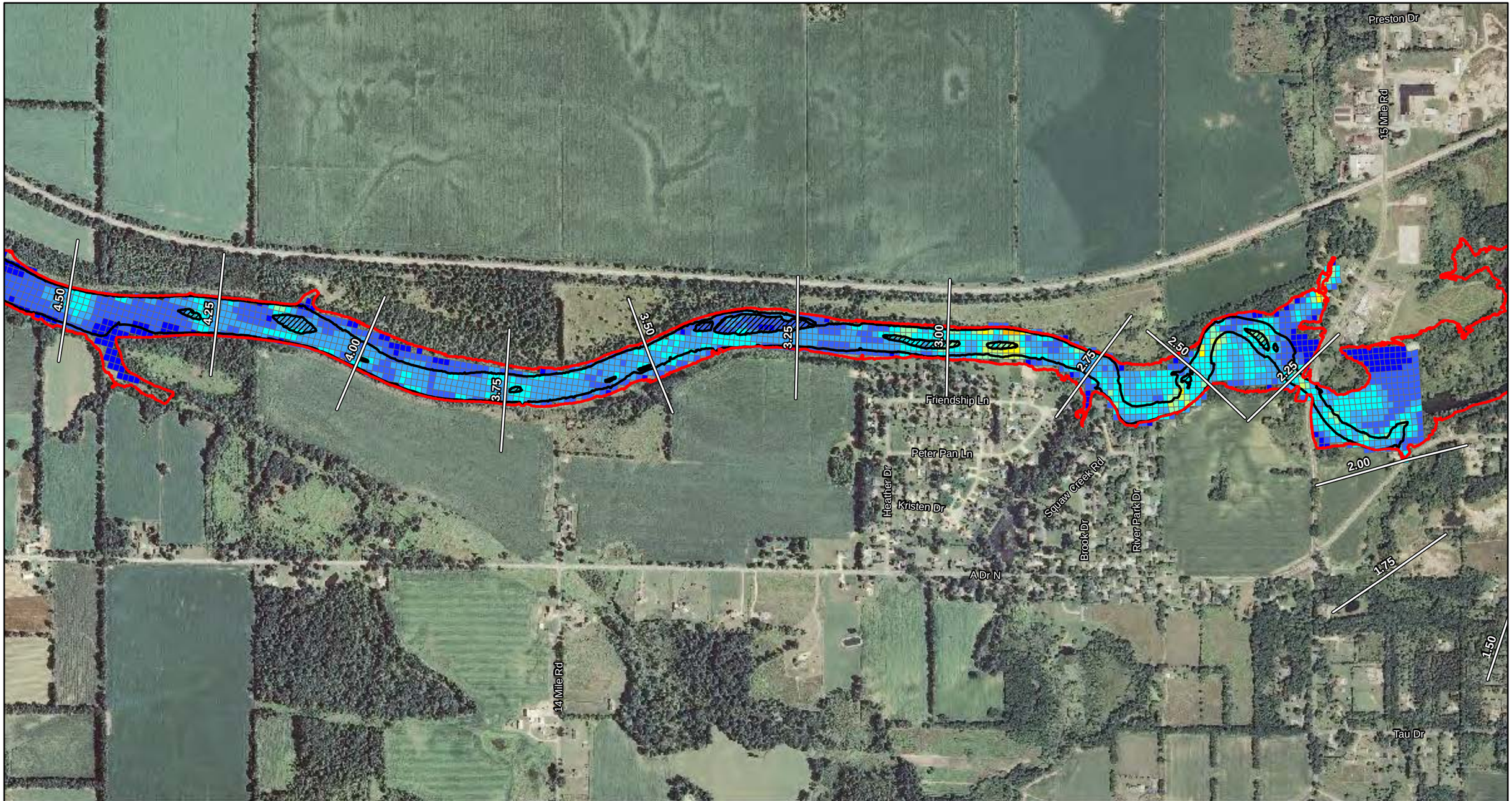
Aerial Photography Date: July & August 2009

Figure 4-25

Floodplain Grid: Bed Shear Stress

July 26, 2010

Sheets 1 through 16



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

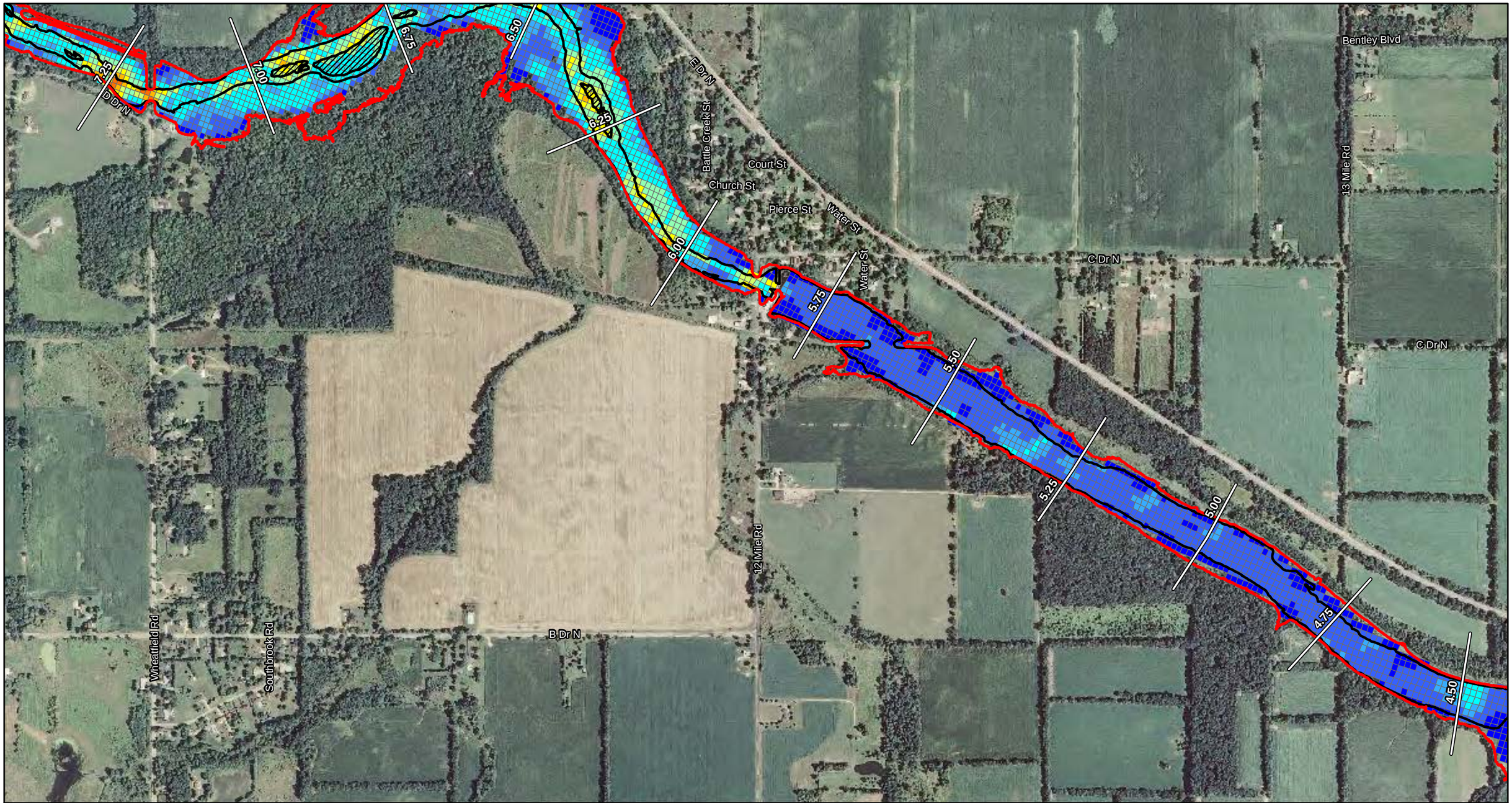
MP 1.50 - MP 4.50

SHEET 1 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

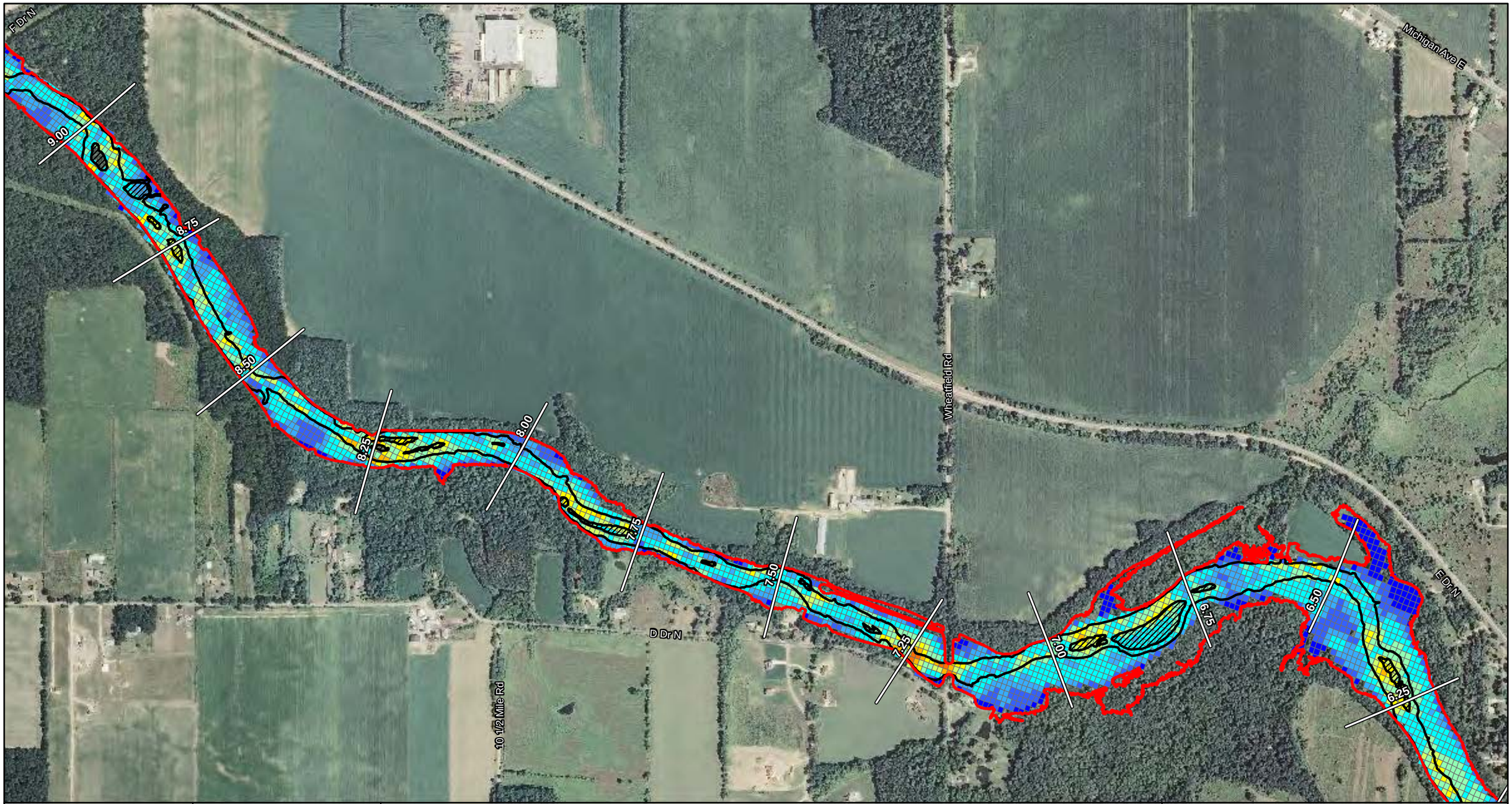
MP 4.50 - MP 6.25

SHEET 2 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

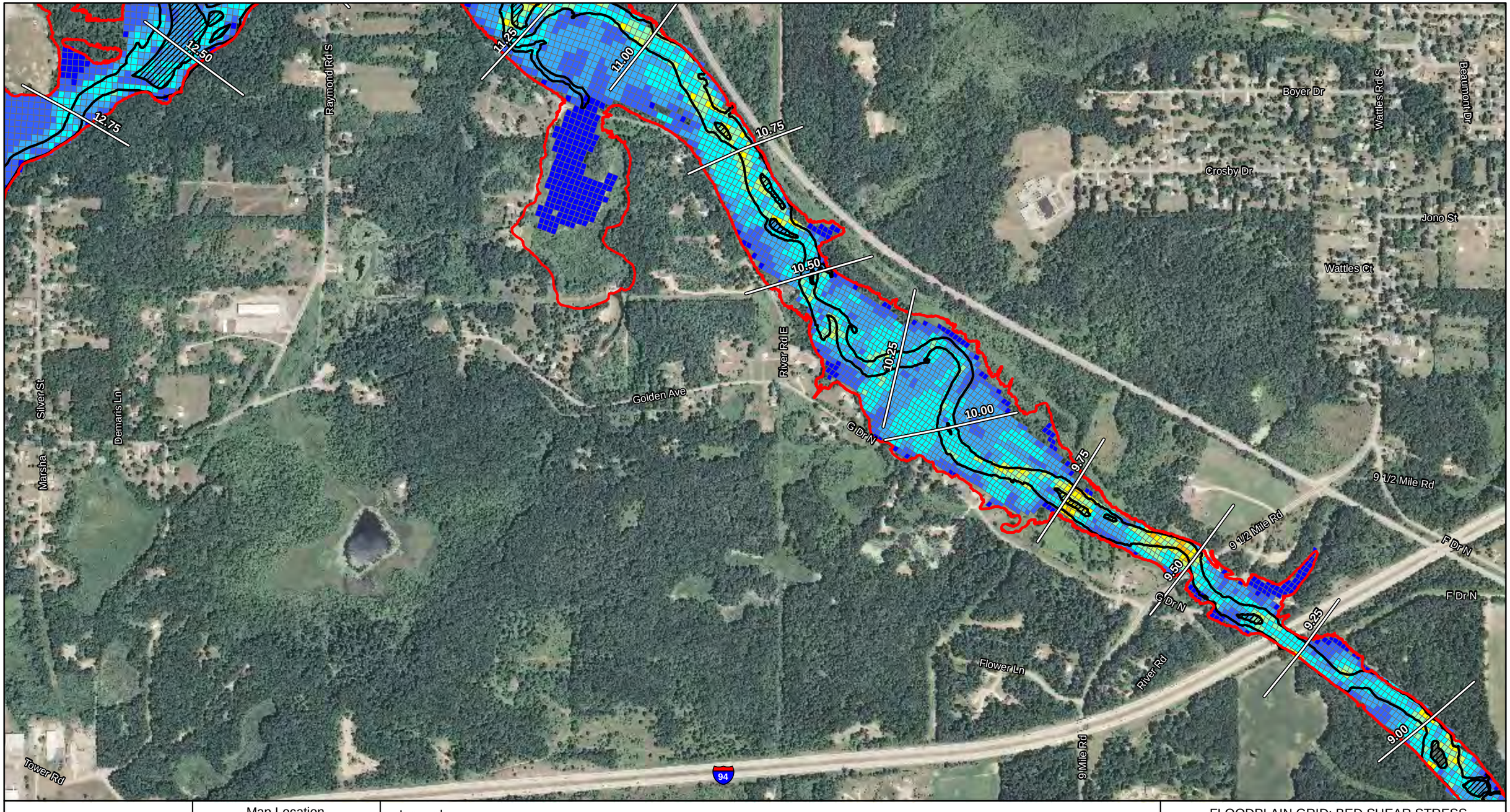
MP 6.25 - MP 9.00

SHEET 3 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

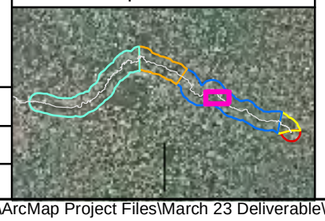
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

N

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

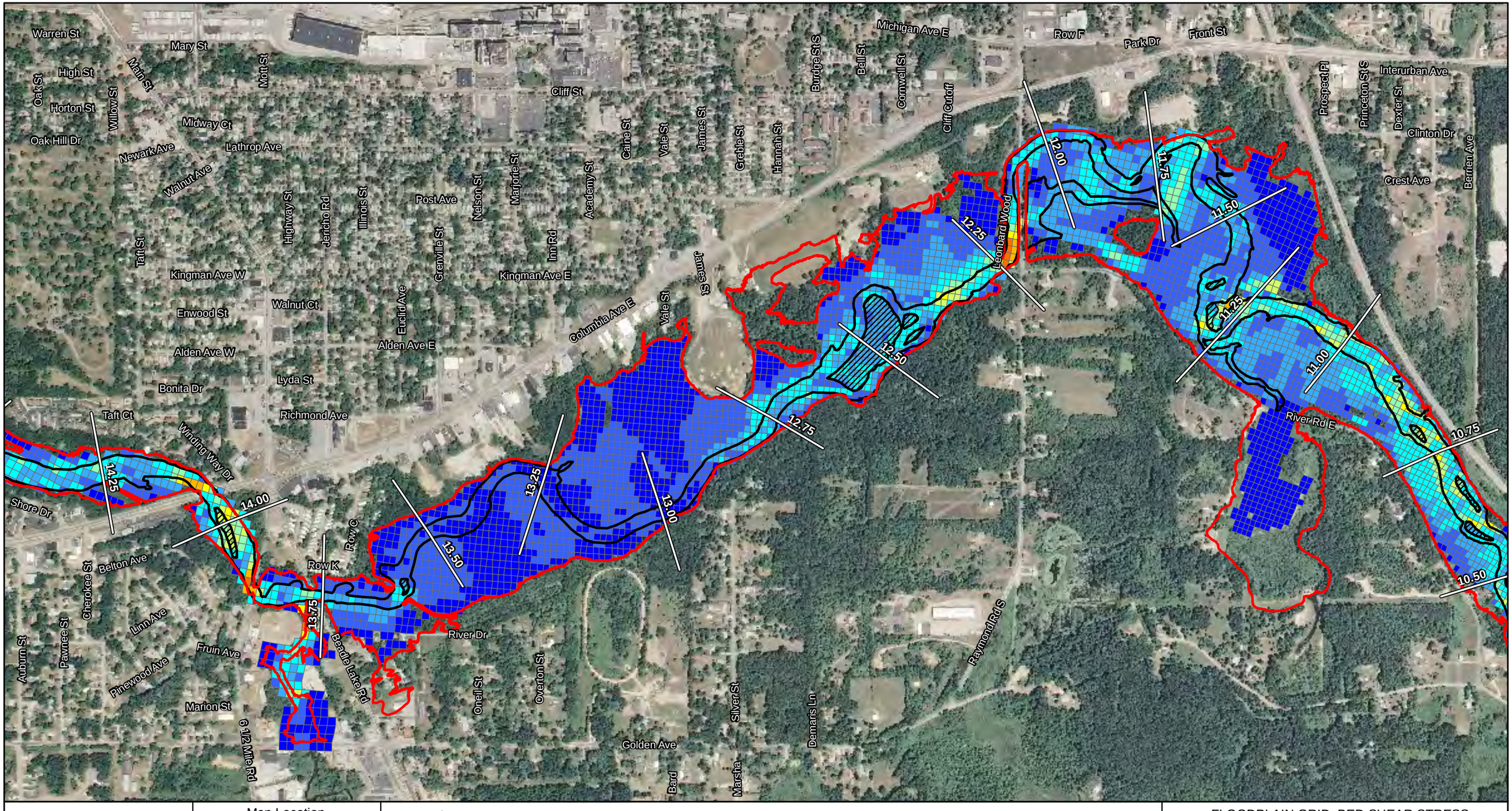
MP 9.00 - MP 10.50

SHEET 4 OF 16

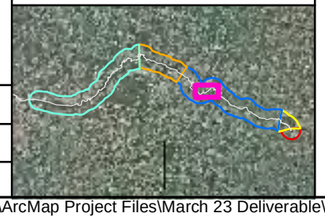
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



Map Location



Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

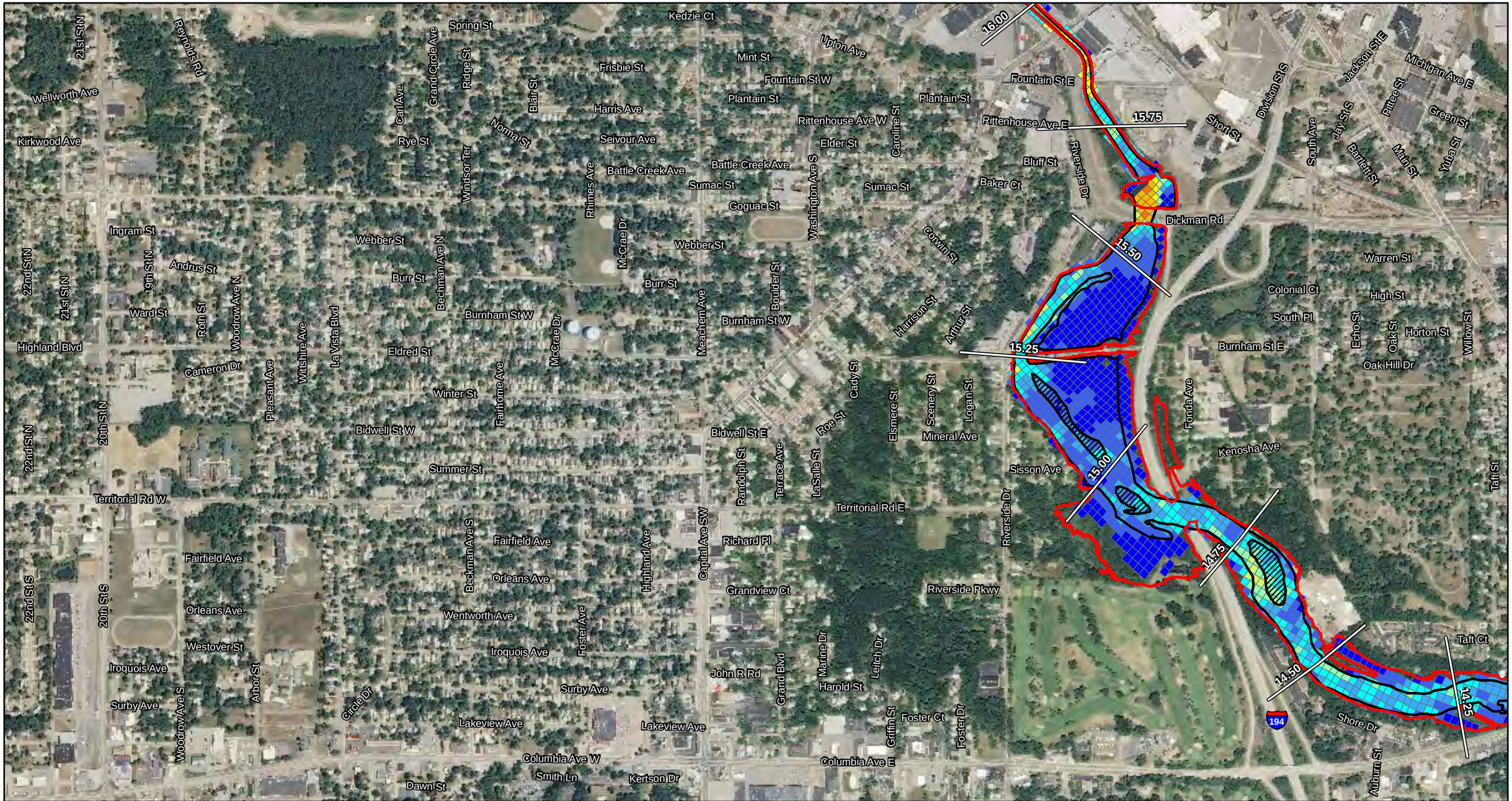
MP 10.50 - MP 14.25

SHEET 5 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

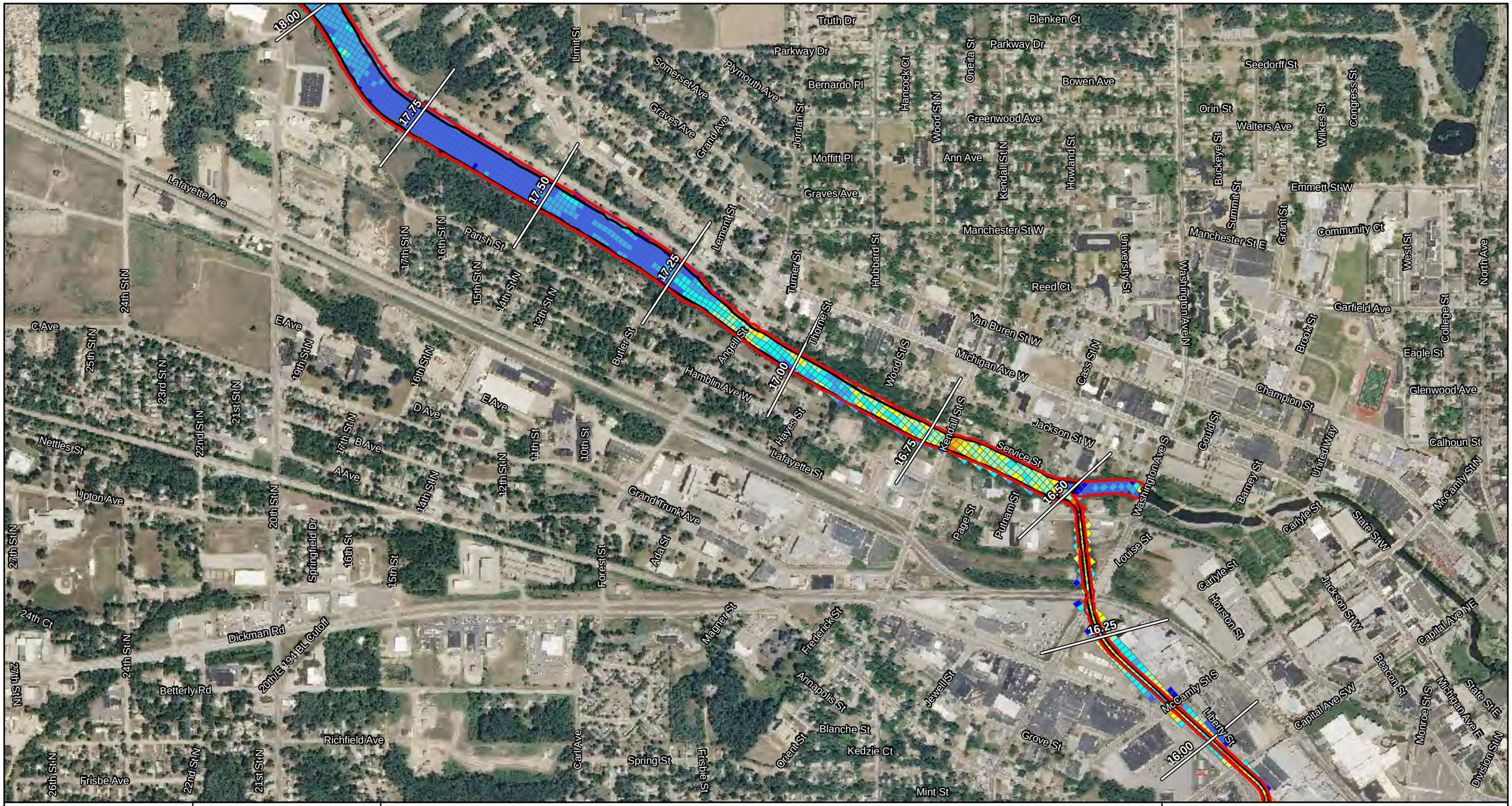
MP 14.25 - MP 16.00

SHEET 6 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

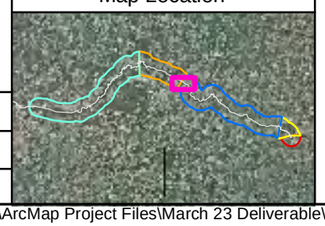
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE	
Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

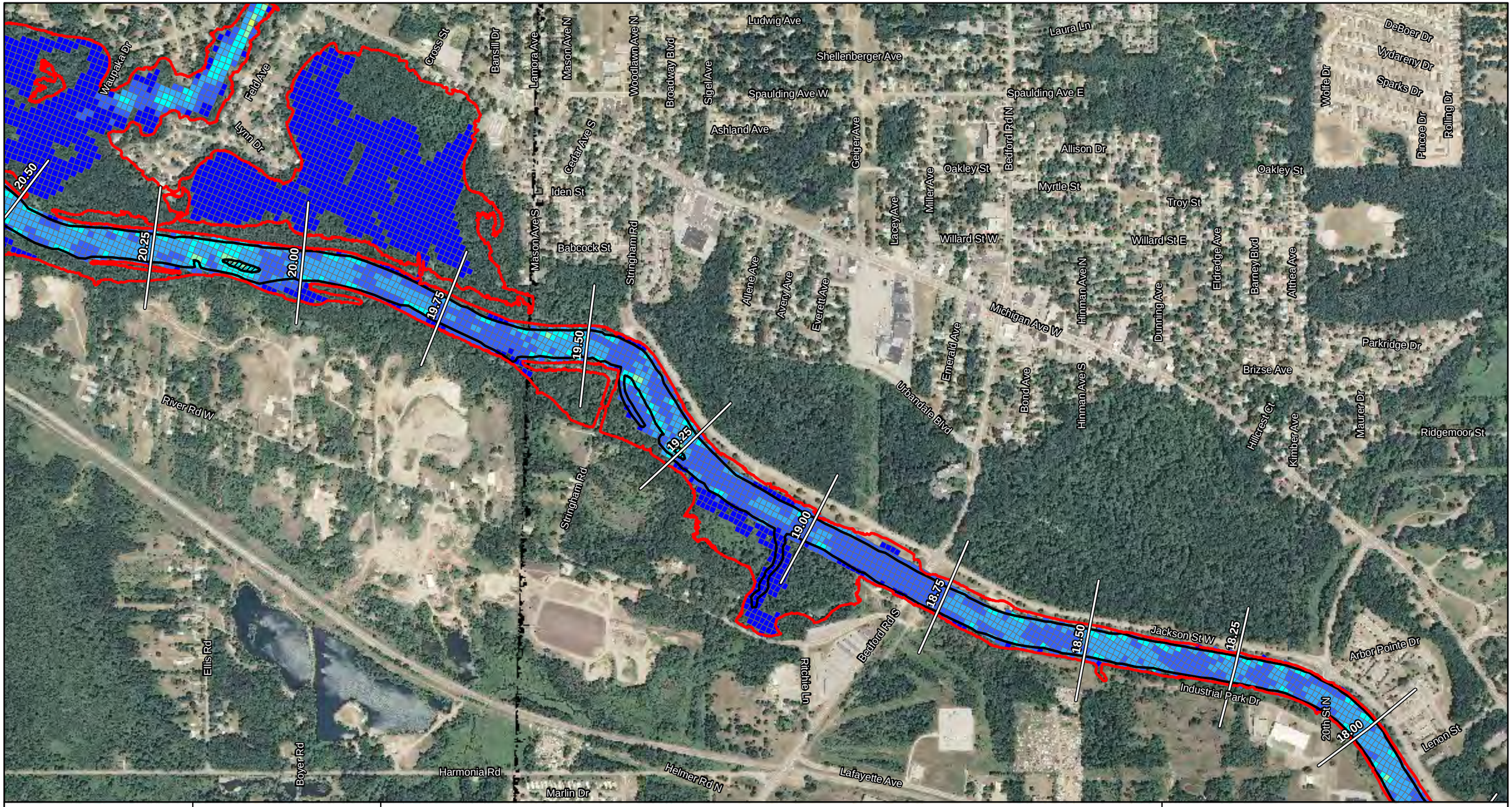
MP 16.00 - MP 18.00

SHEET 7 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

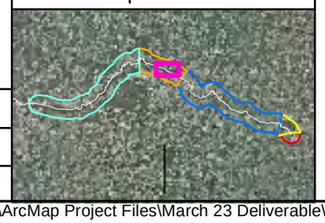
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

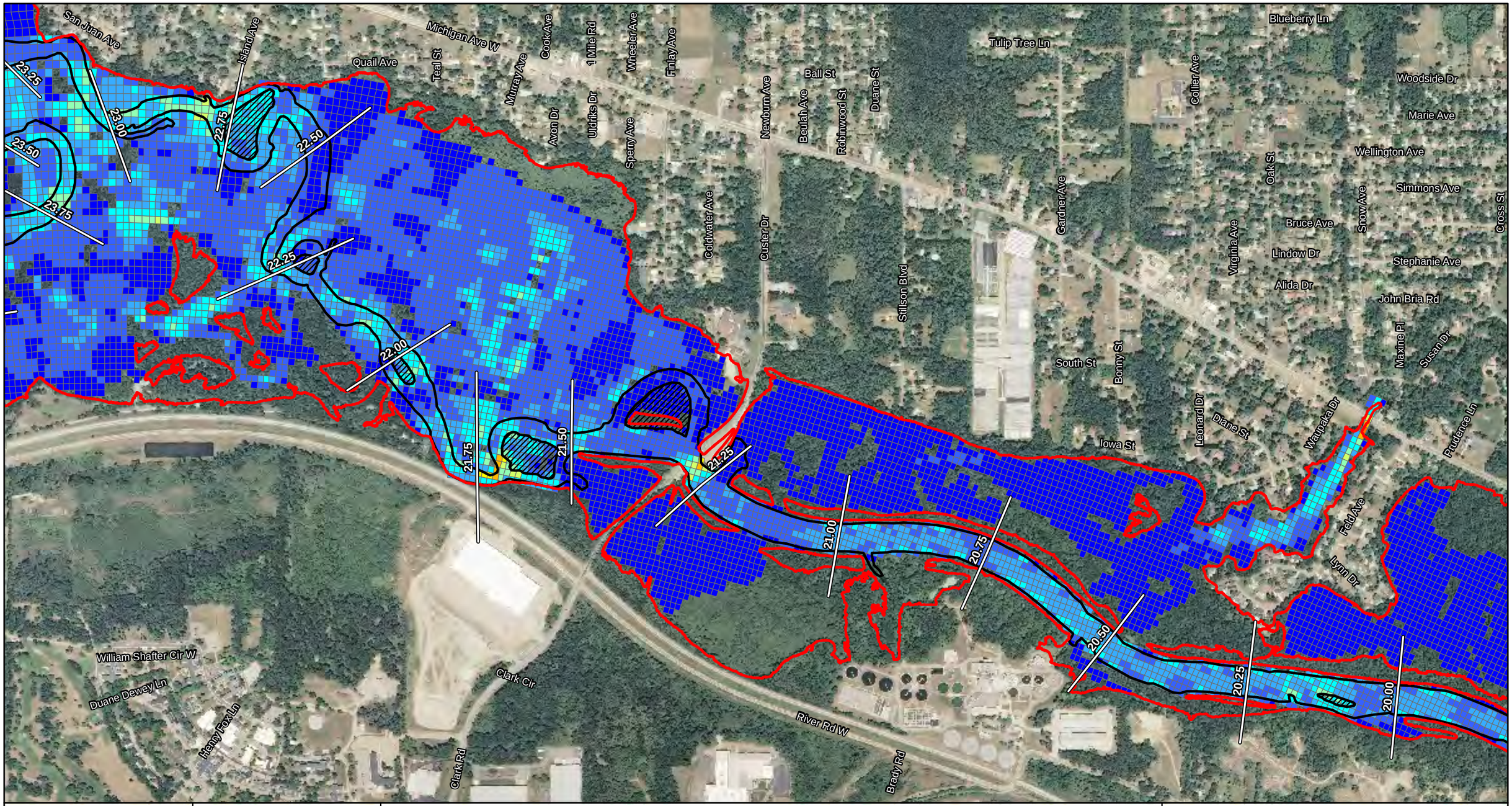
MP 18.00 - MP 20.00

SHEET 8 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

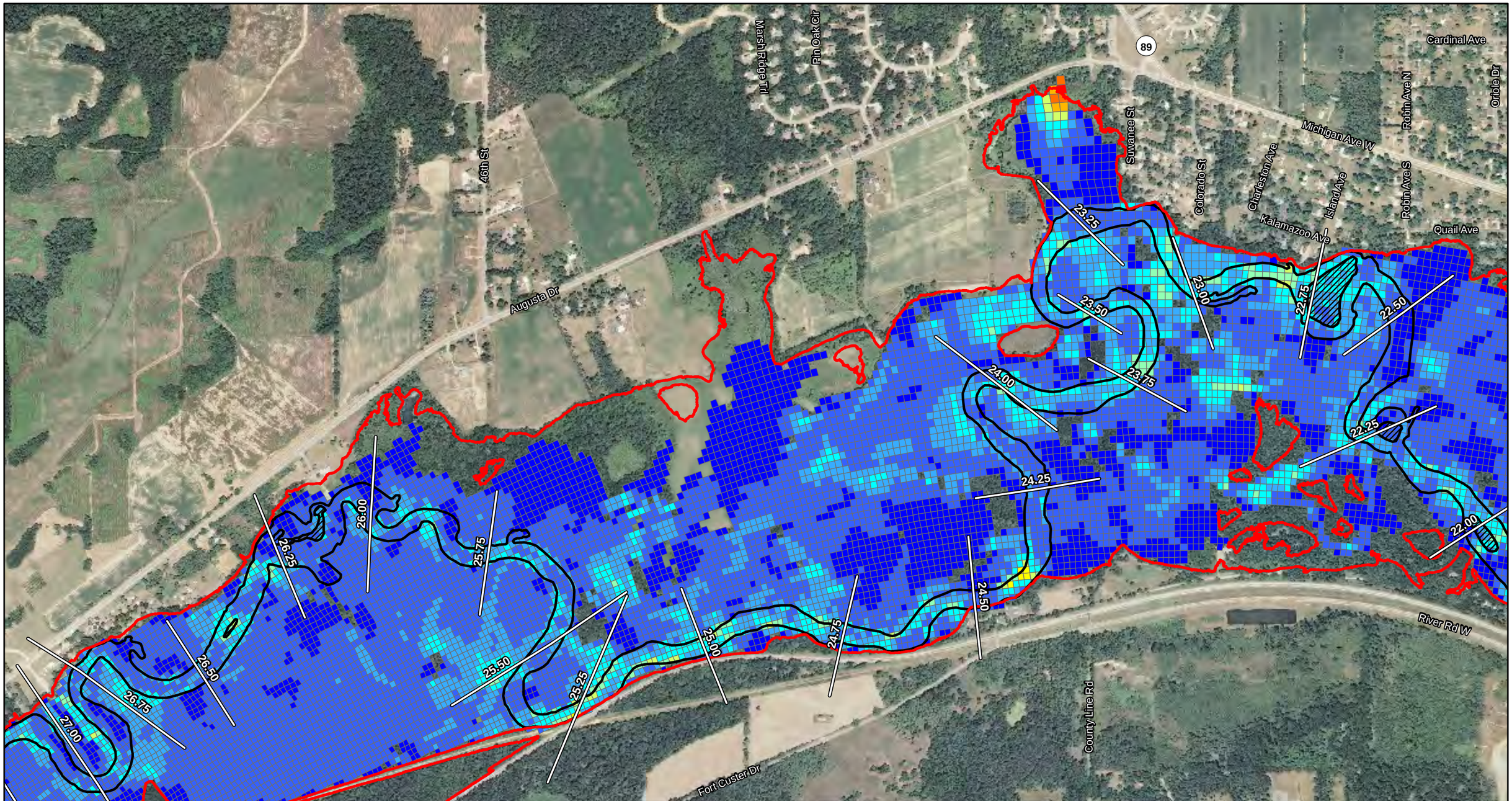
MP 20.00 - MP 22.50

SHEET 9 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

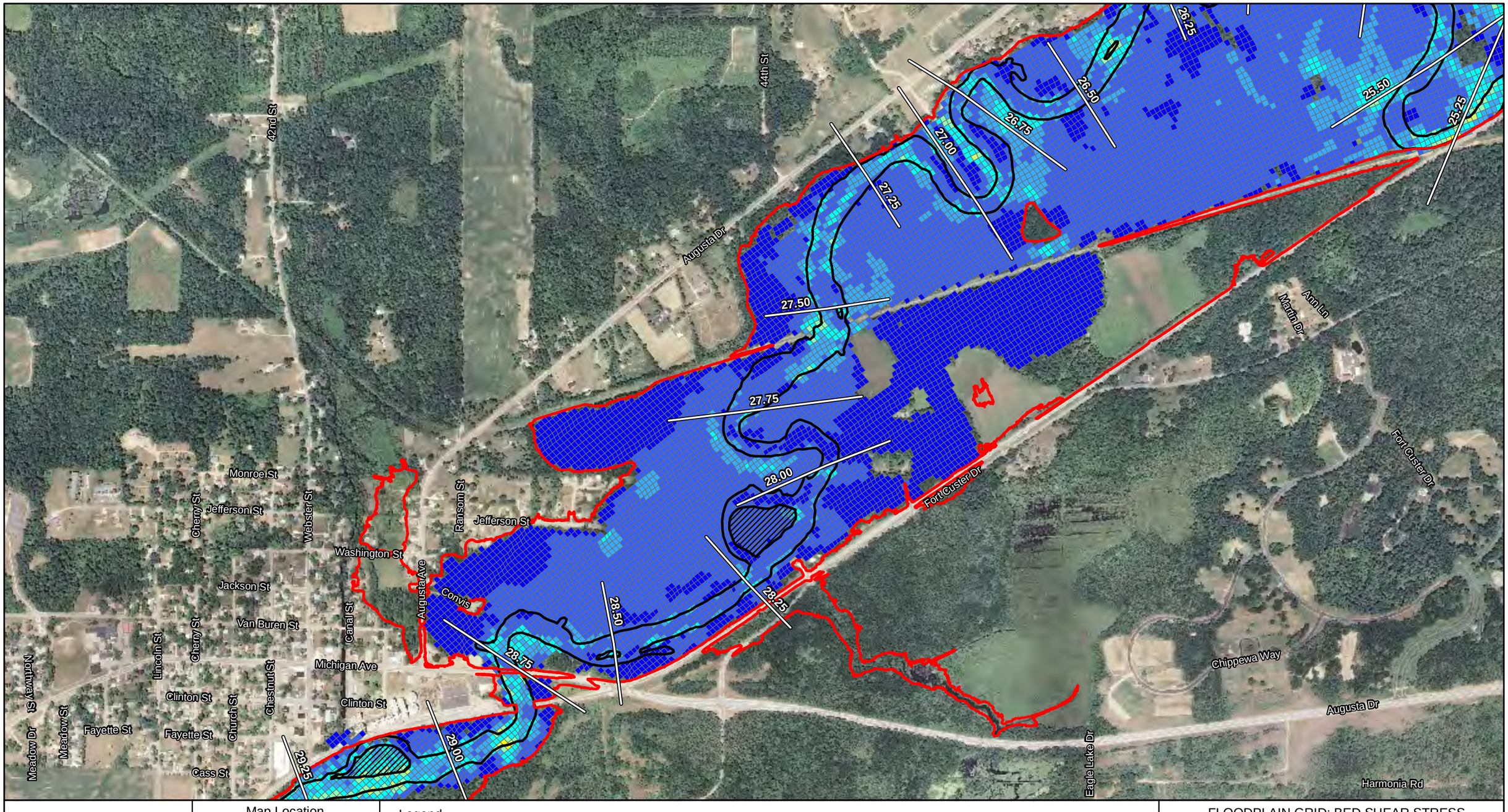
MP 22.50 - MP 27.00

SHEET 10 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

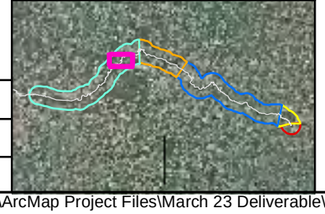
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

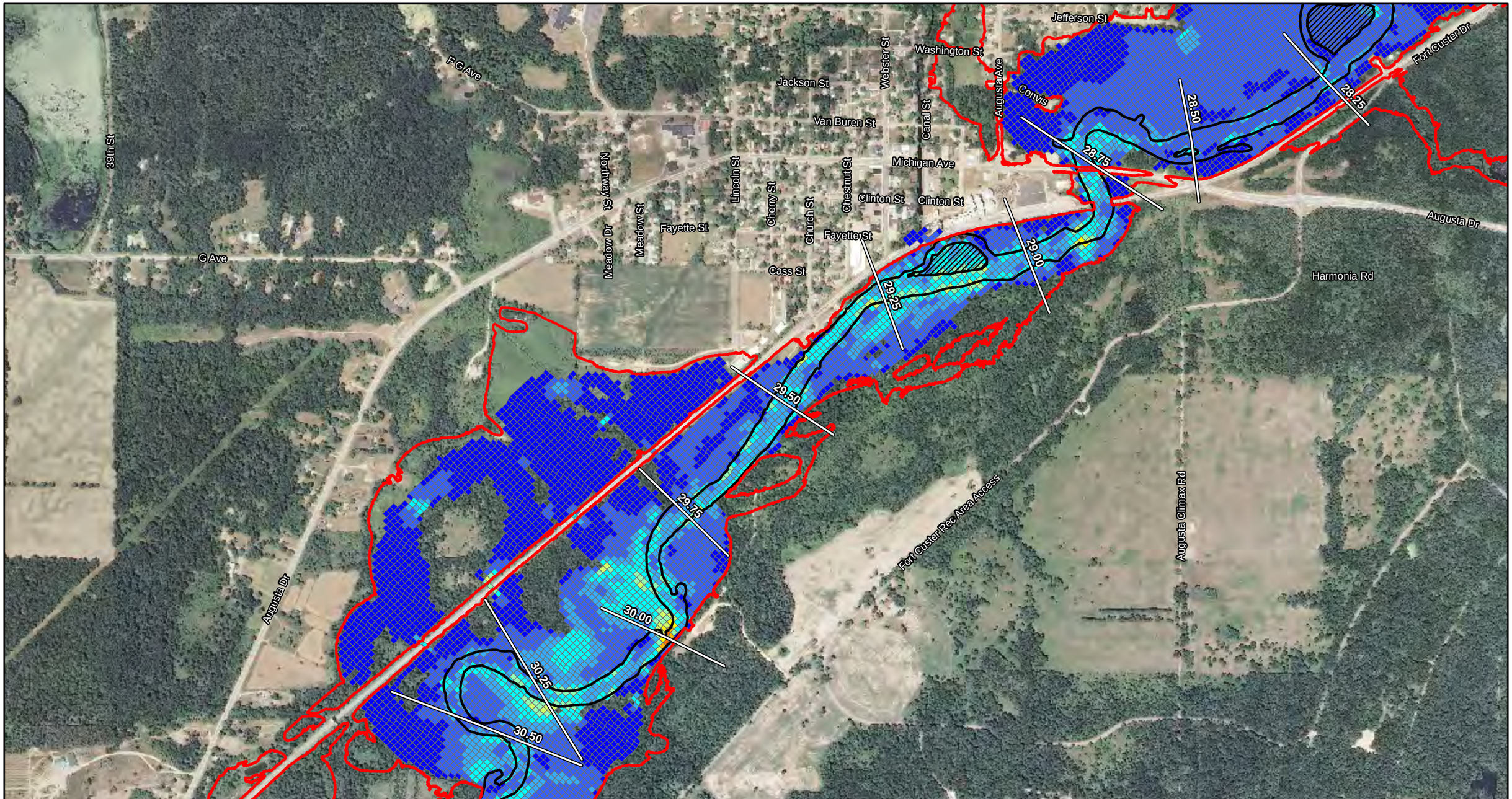
MP 27.00 - MP 28.75

SHEET 11 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location

Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
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- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

MP 28.75 - MP 30.50

SHEET 12 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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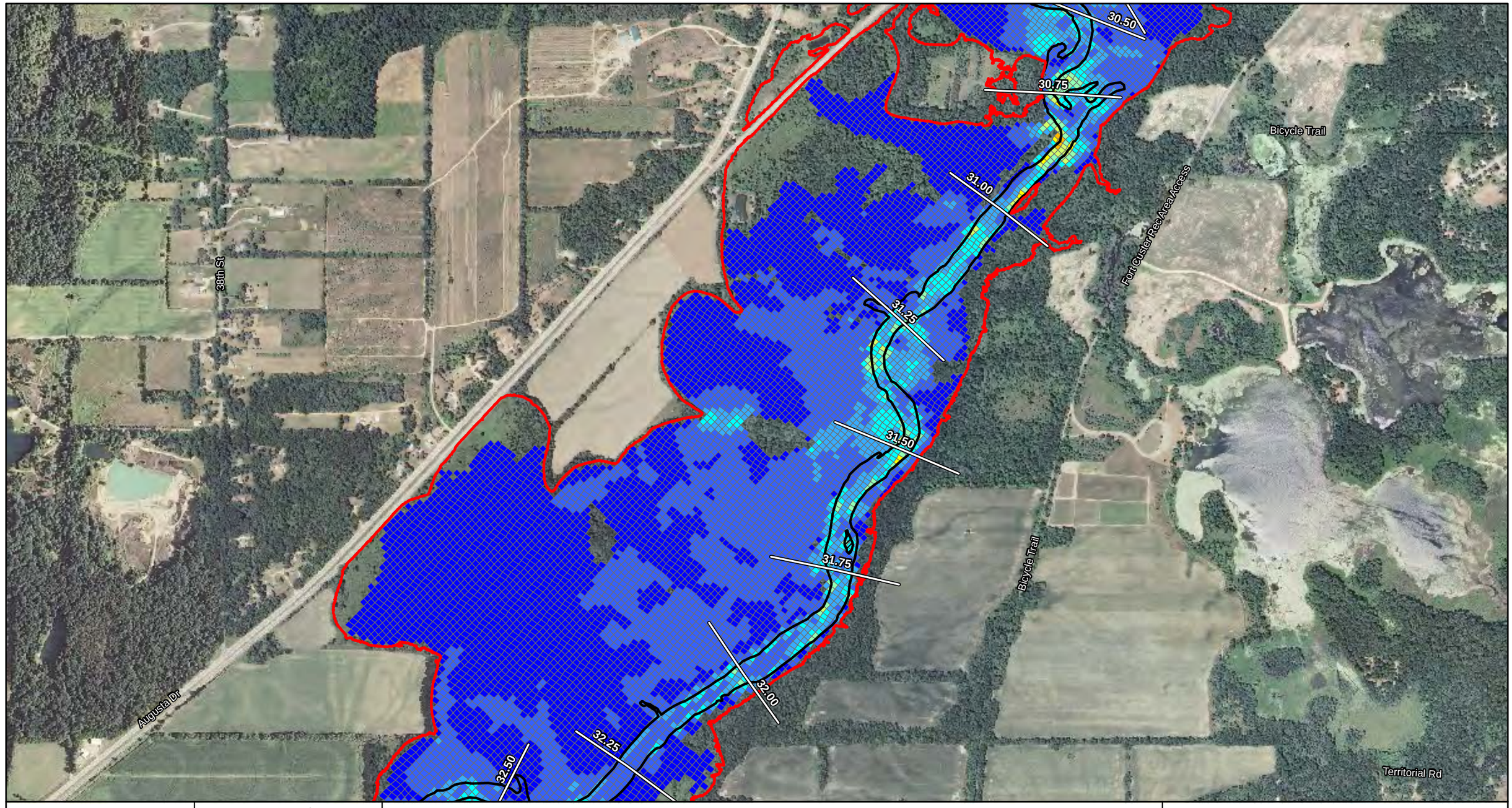
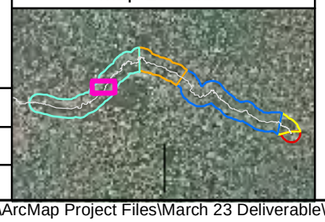
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
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- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

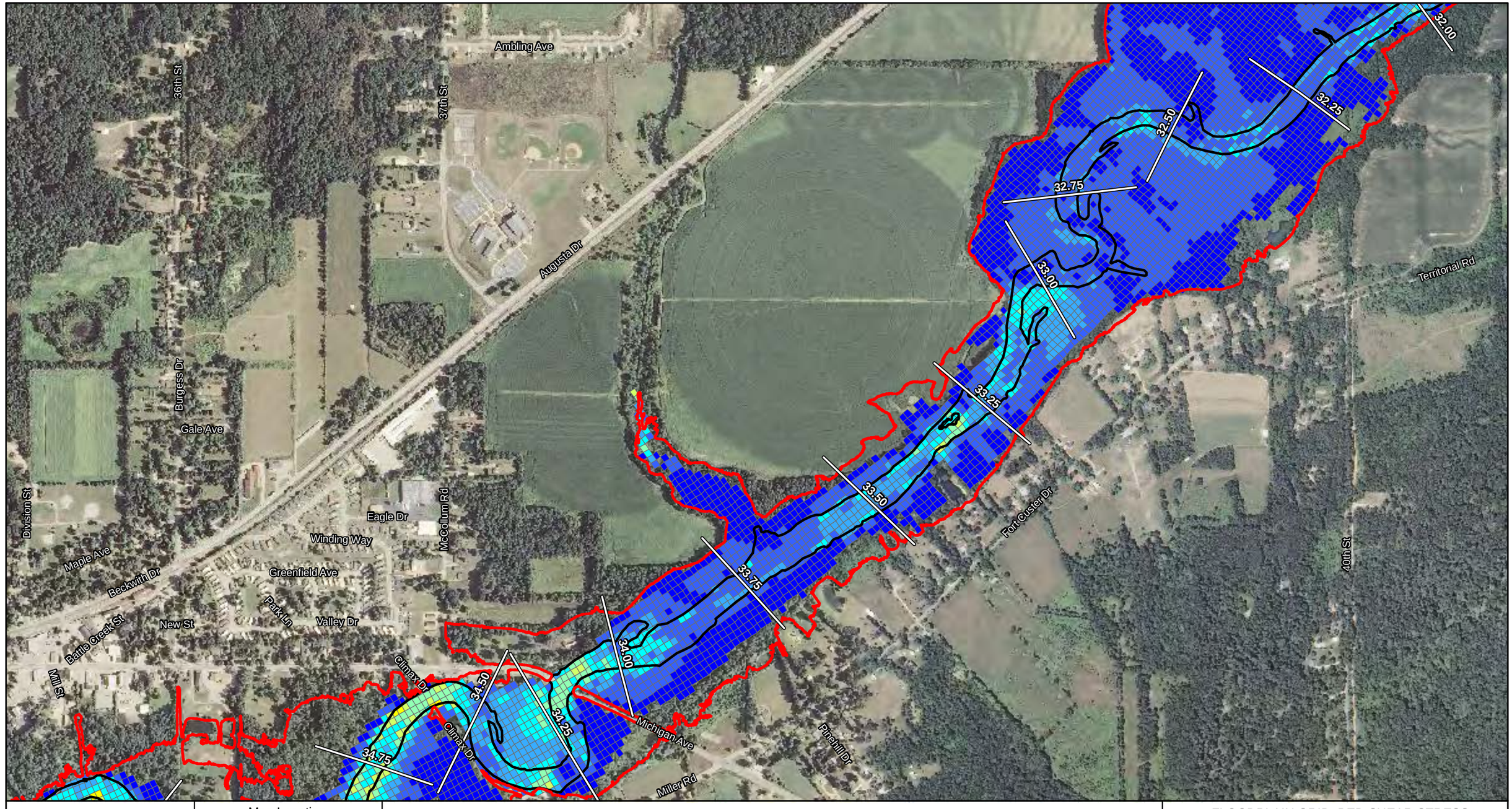
MP 30.50 - MP 32.25

SHEET 13 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

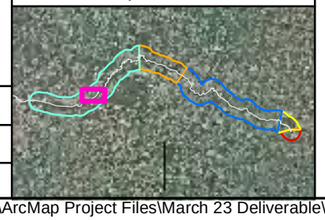
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

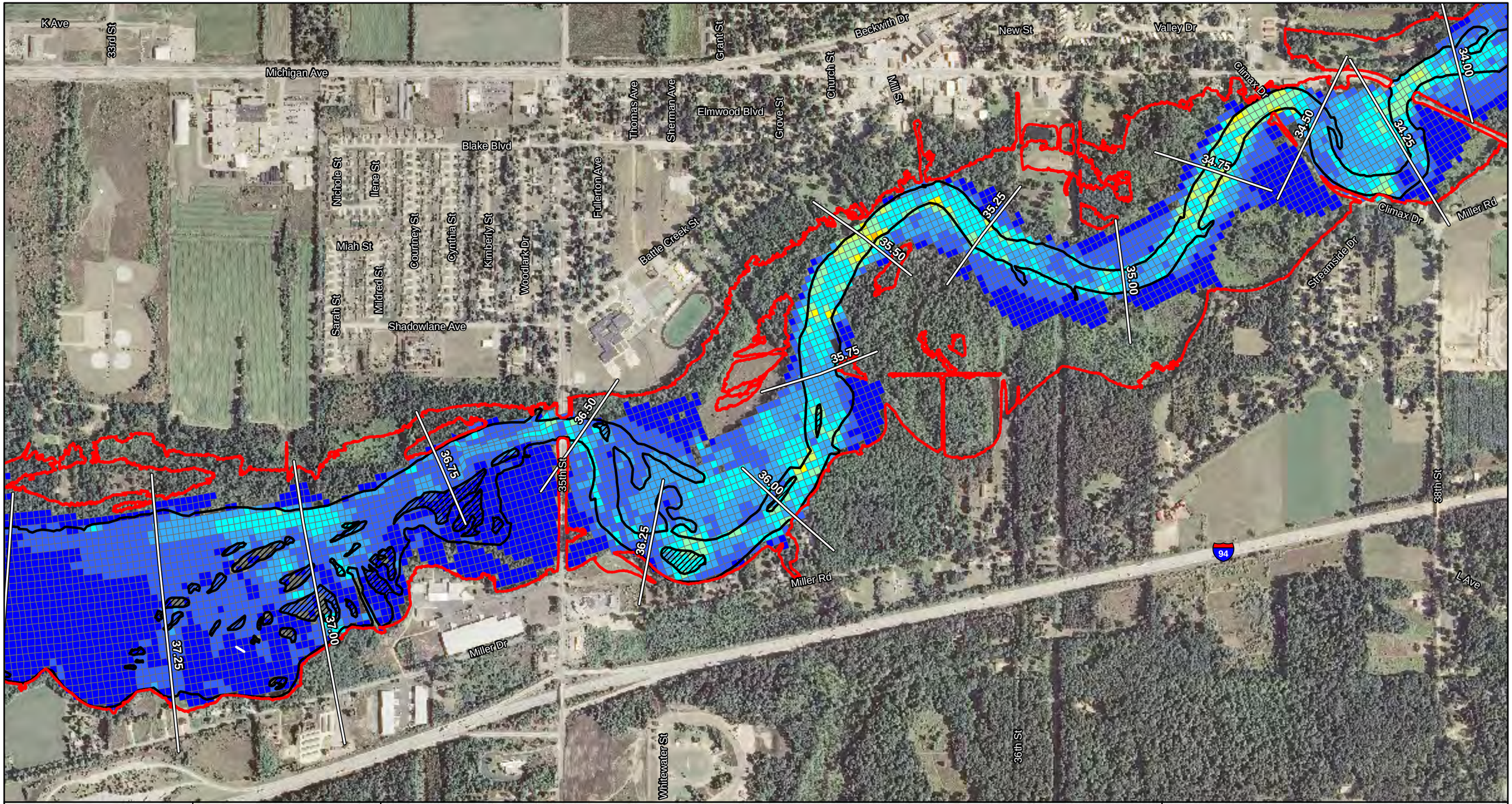
MP 32.25 - MP 34.75

SHEET 14 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

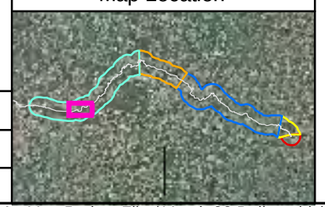
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

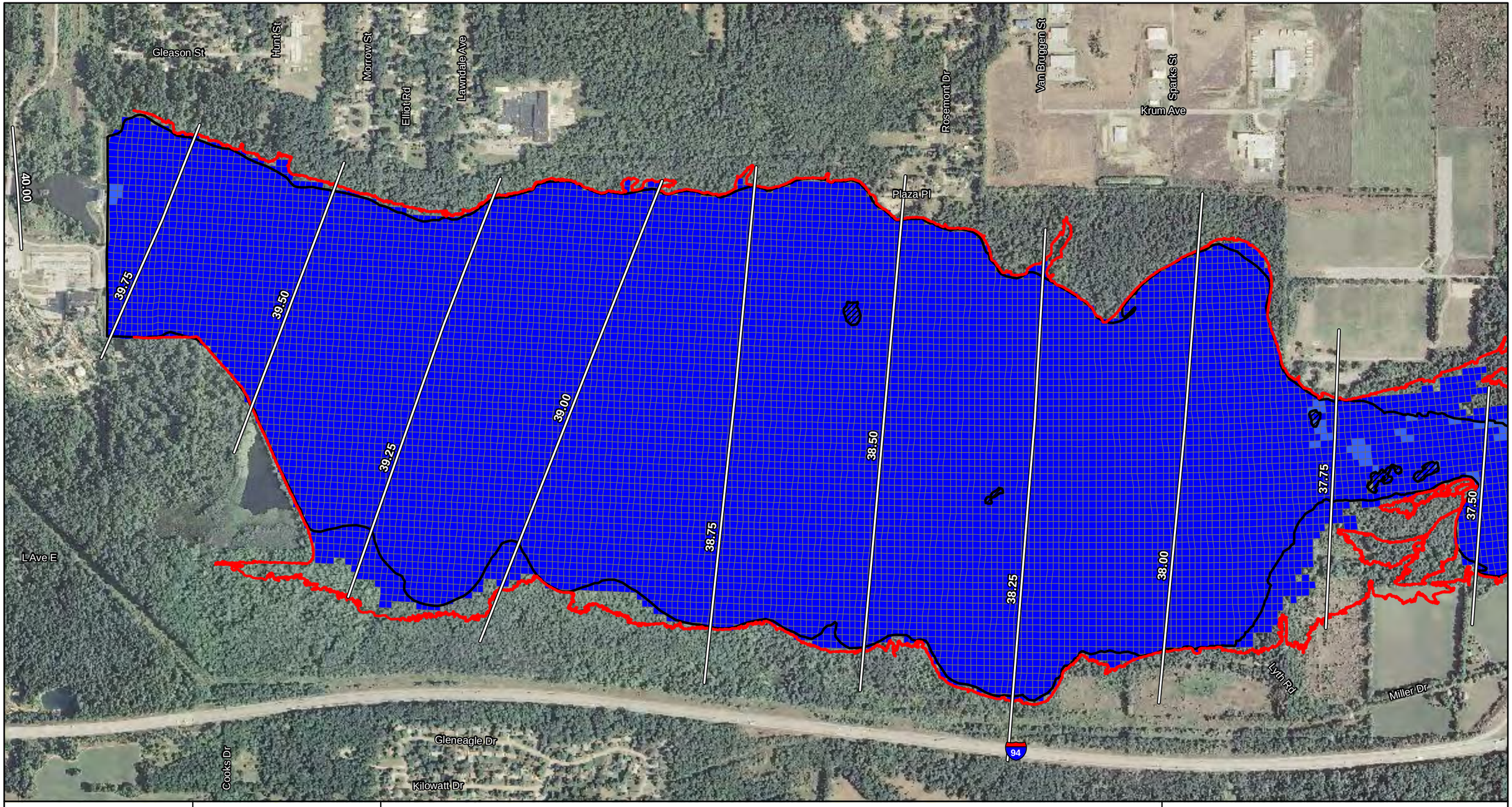
MP 34.25 - MP 37.50

SHEET 15 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

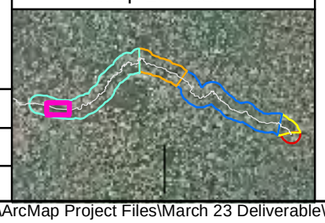
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 26, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

N

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,930 cfs

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 26, 2010

MP 37.50 - MP 40.00

SHEET 16 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul26_2010.mxd

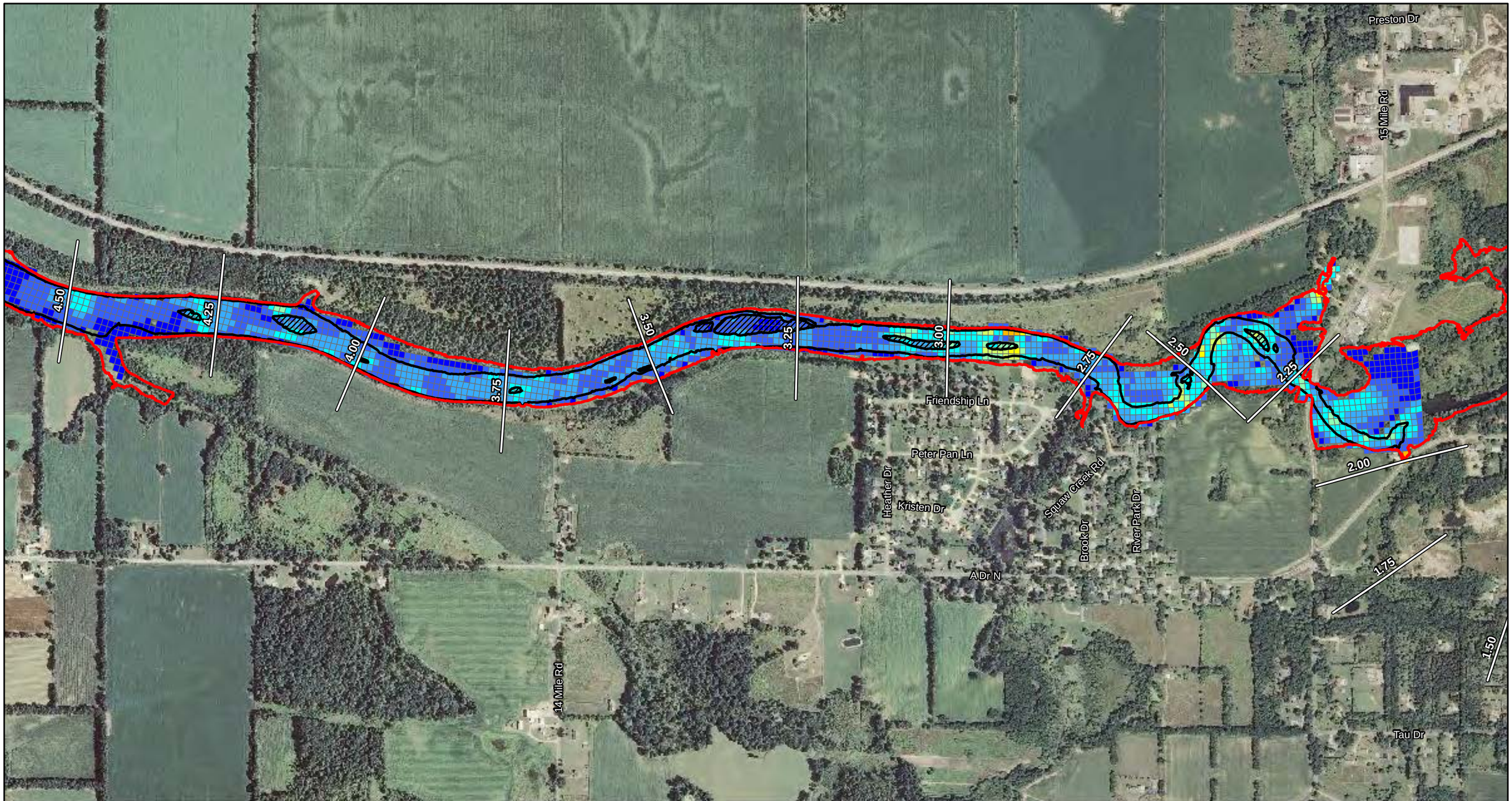
Aerial Photography Date: July & August 2009

Figure 4-26

Floodplain Grid: Bed Shear Stress

July 28, 2010

Sheets 1 through 16



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

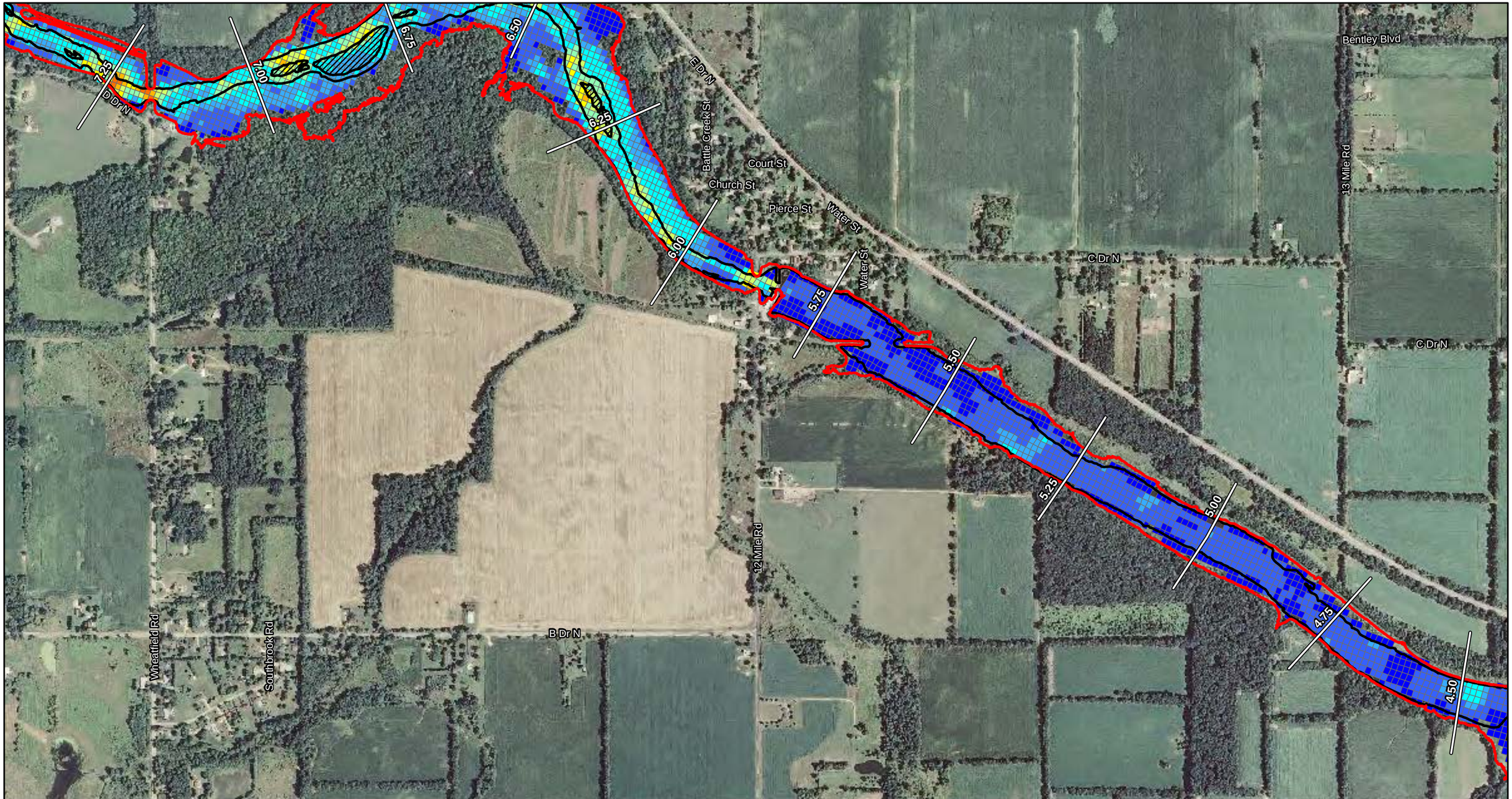
MP 1.50 - MP 4.50

SHEET 1 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

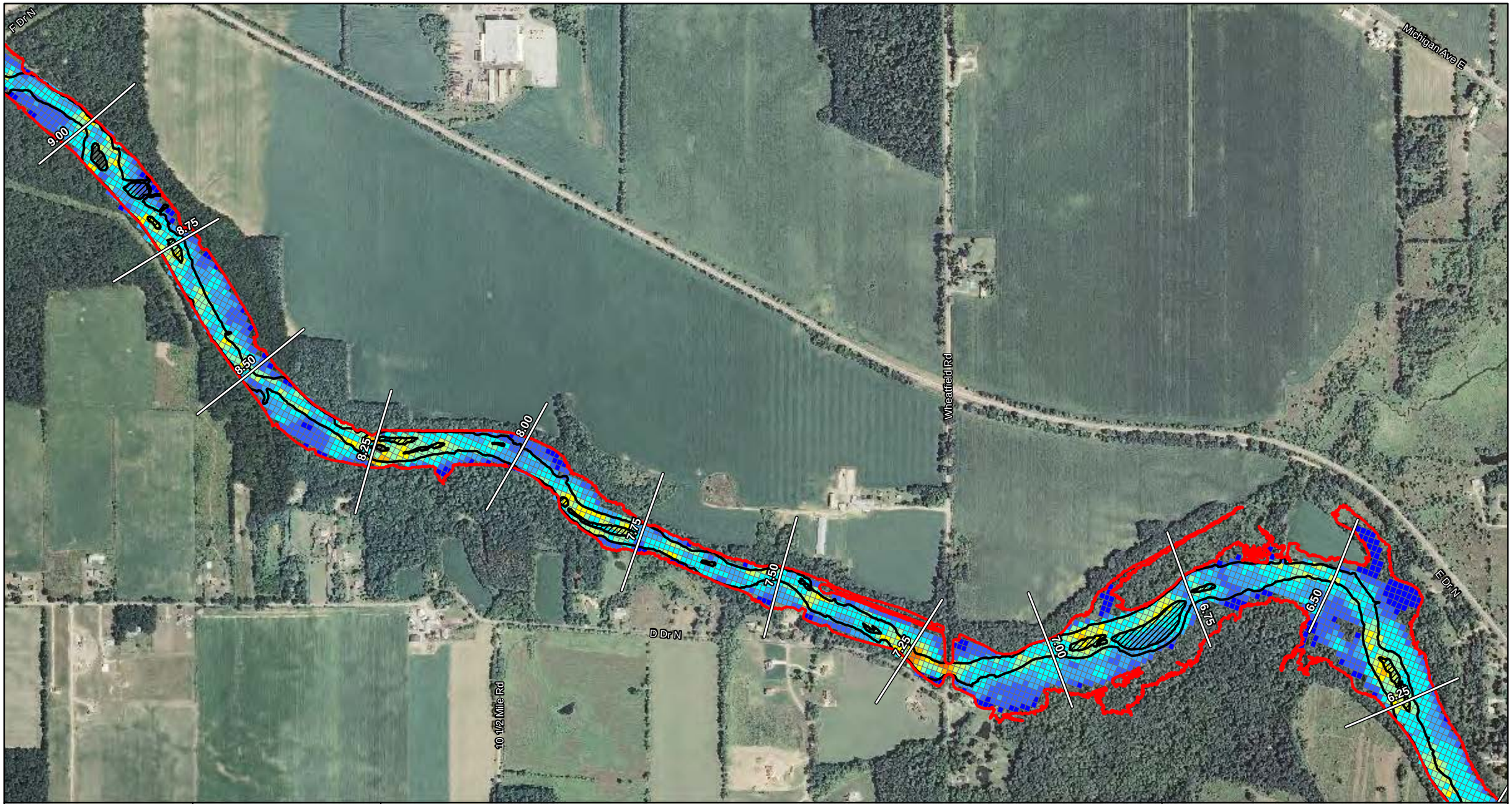
MP 4.50 - MP 6.25

SHEET 2 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

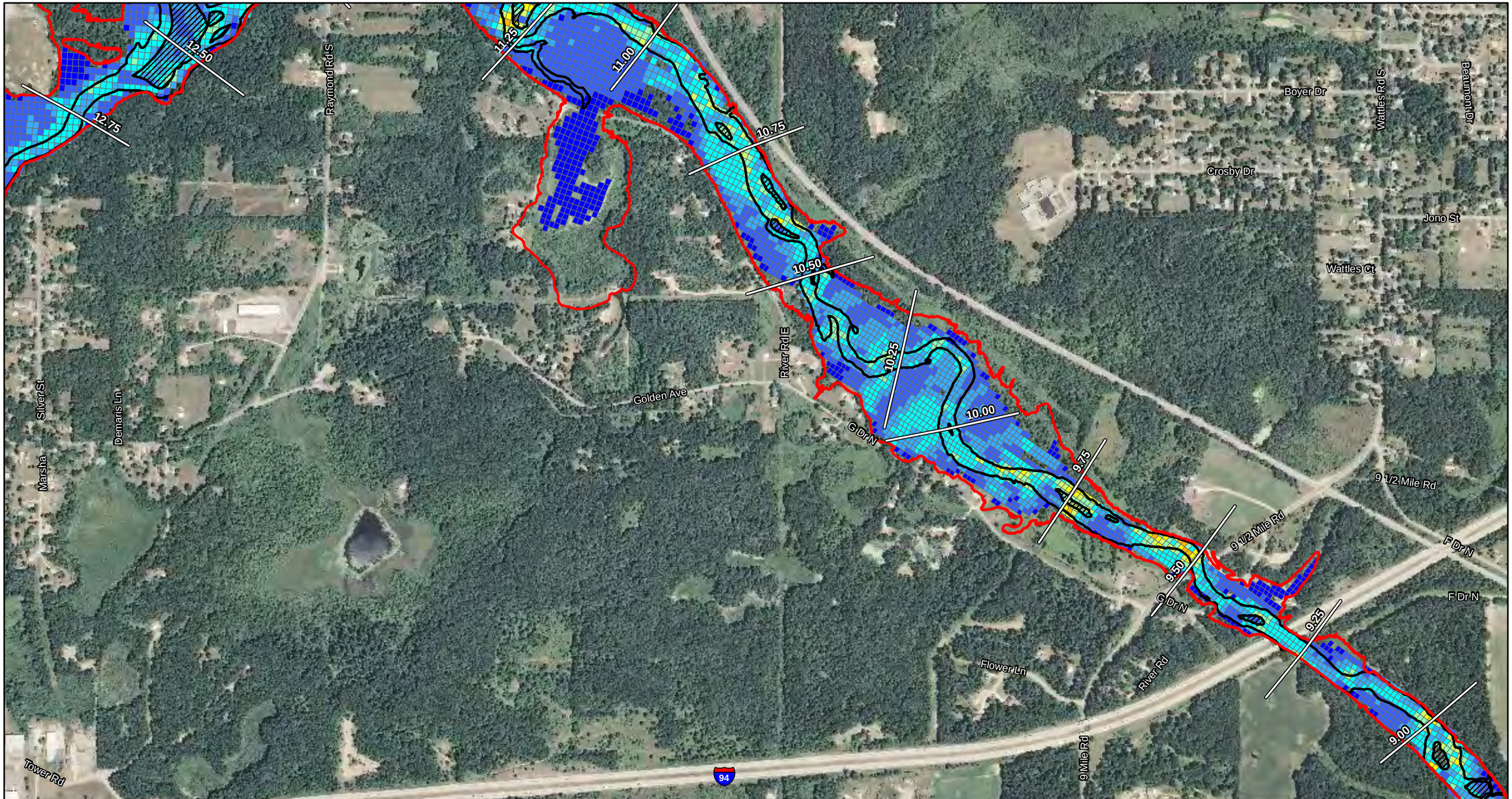
MP 6.25 - MP 9.00

SHEET 3 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

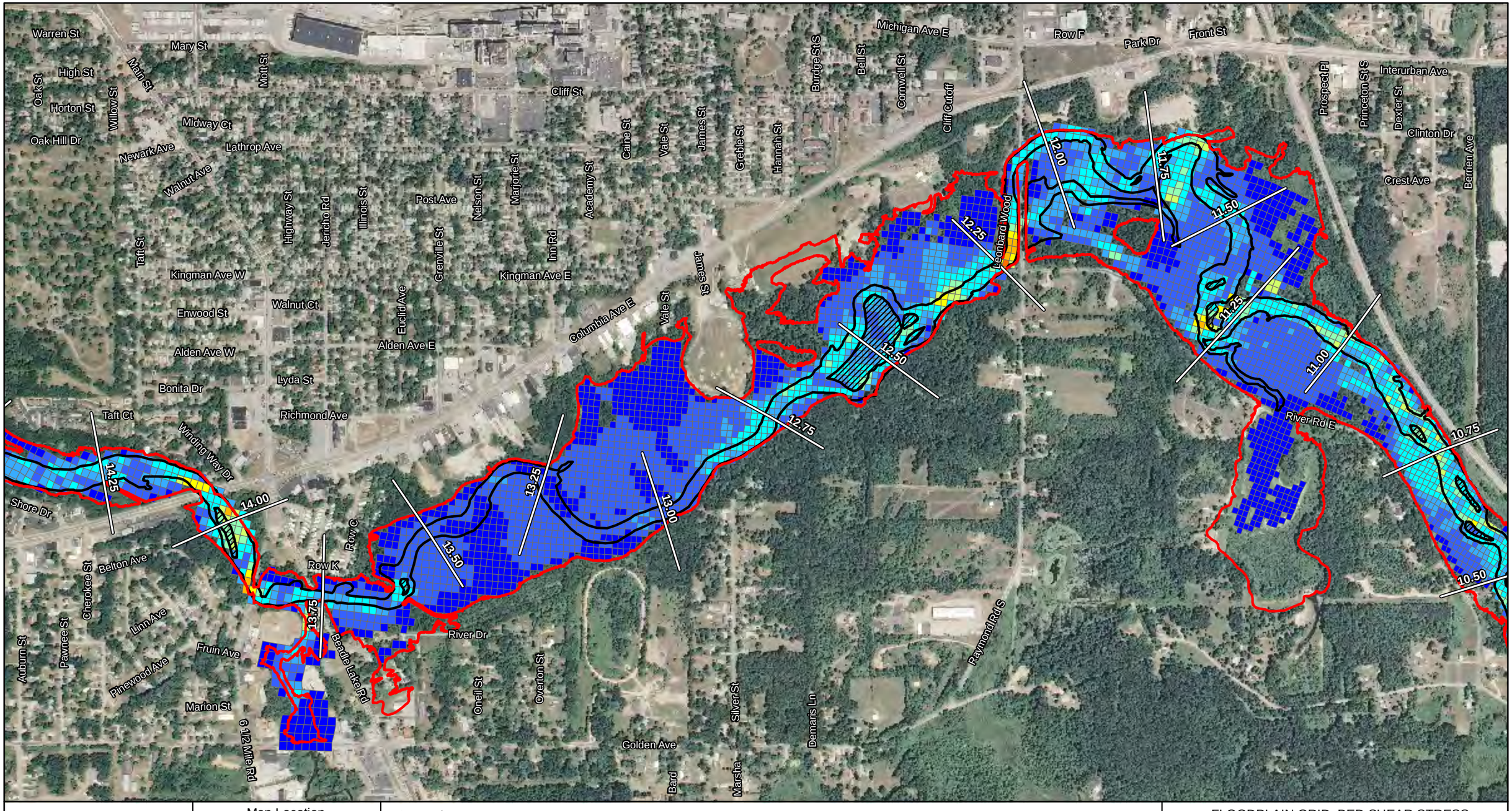
MP 9.00 - MP 10.50

SHEET 4 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

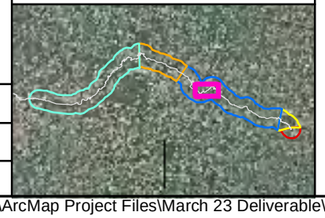
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

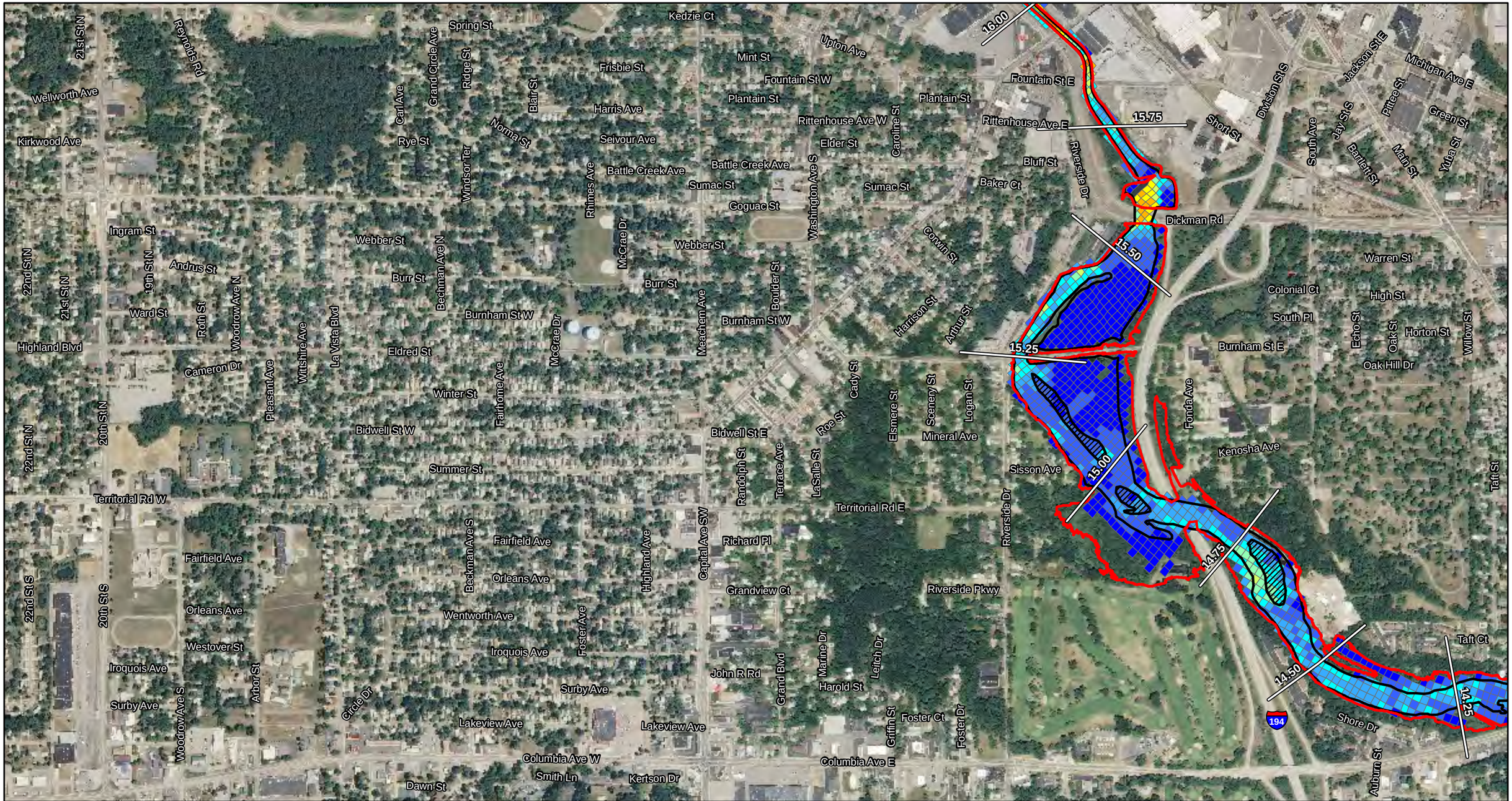
MP 10.50 - MP 14.25

SHEET 5 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

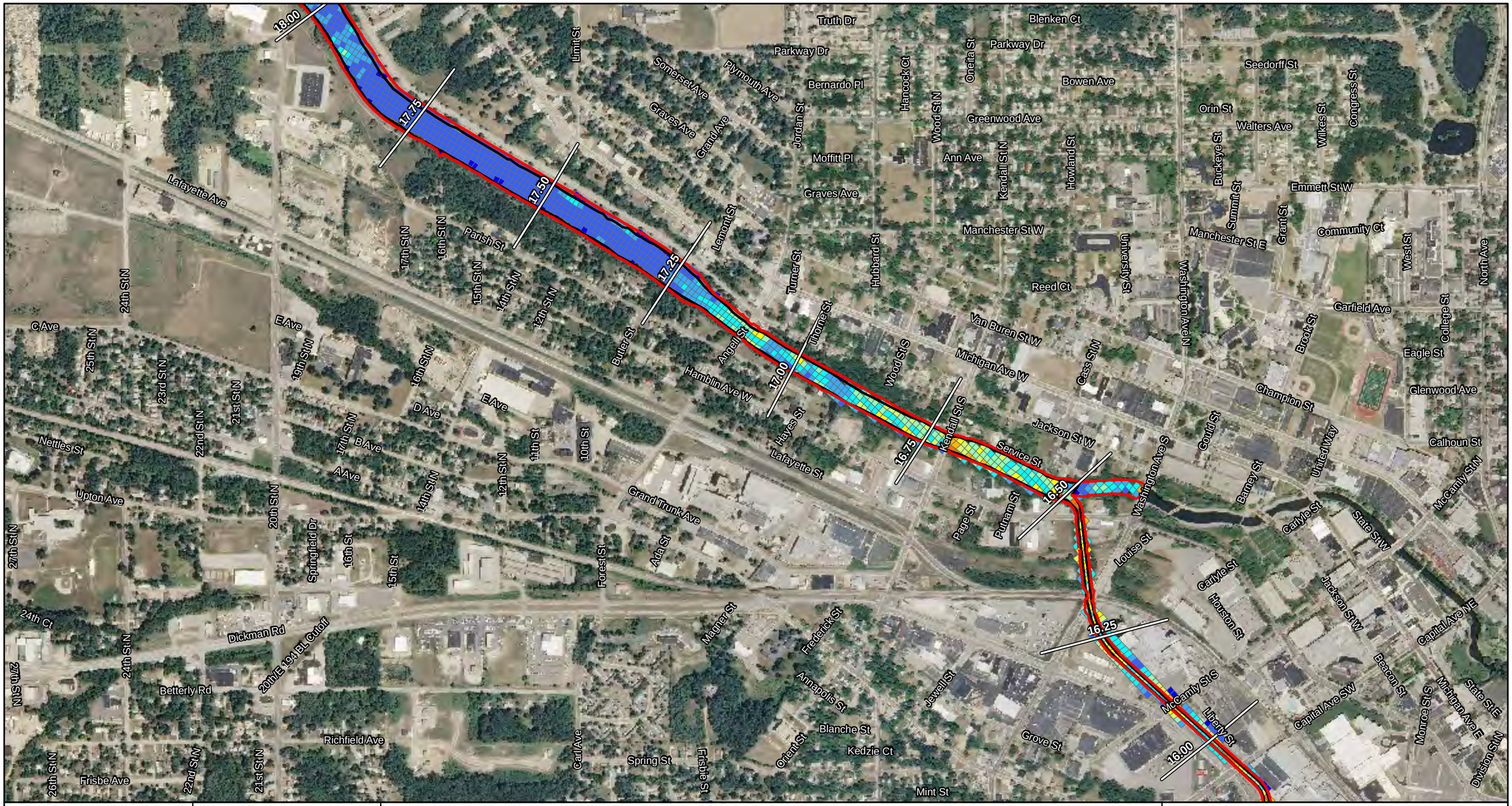
MP 14.25 - MP 16.00

SHEET 6 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

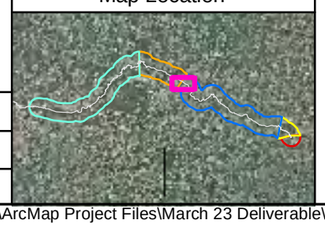
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

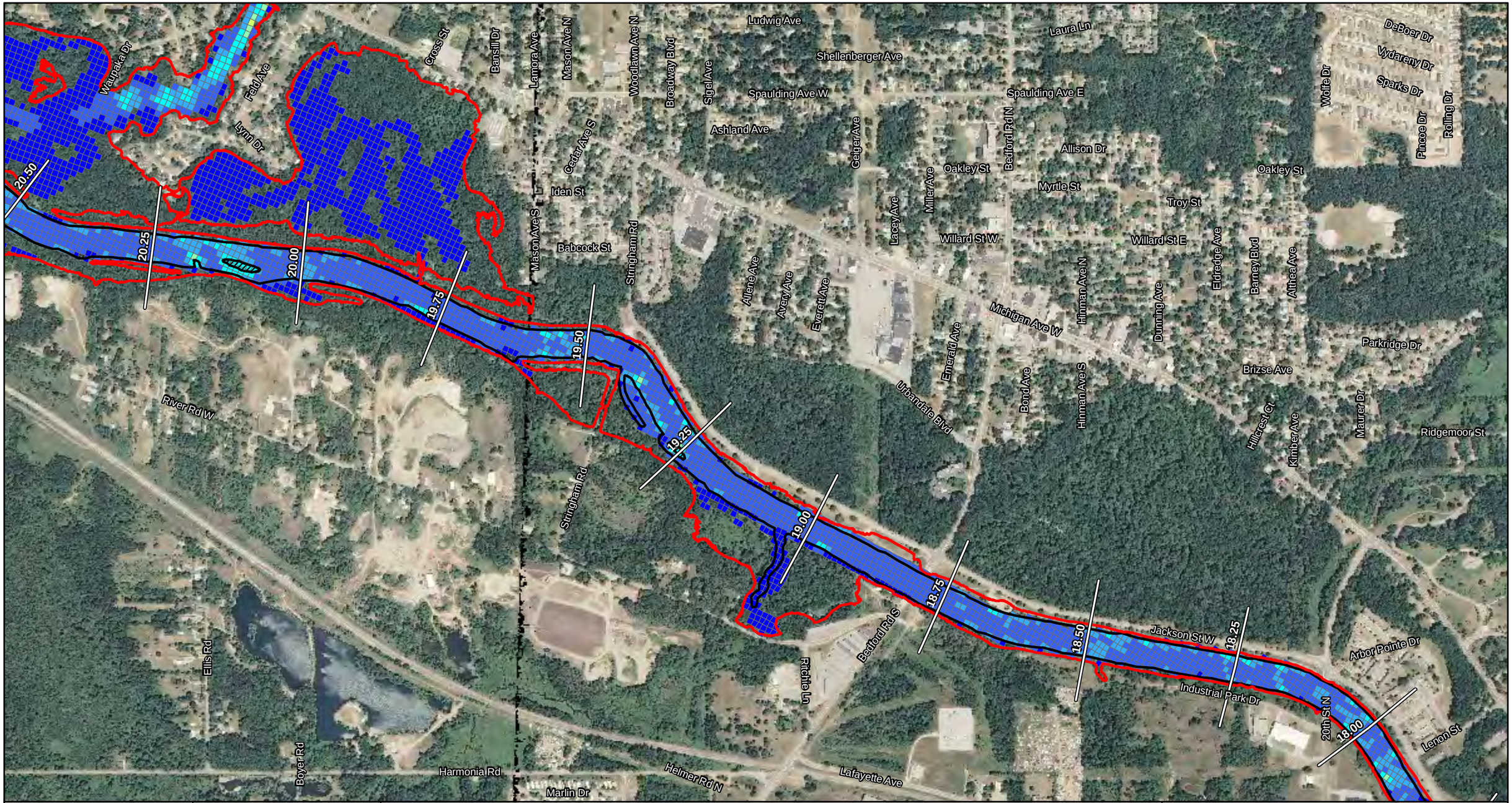
MP 16.00 - MP 18.00

SHEET 7 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

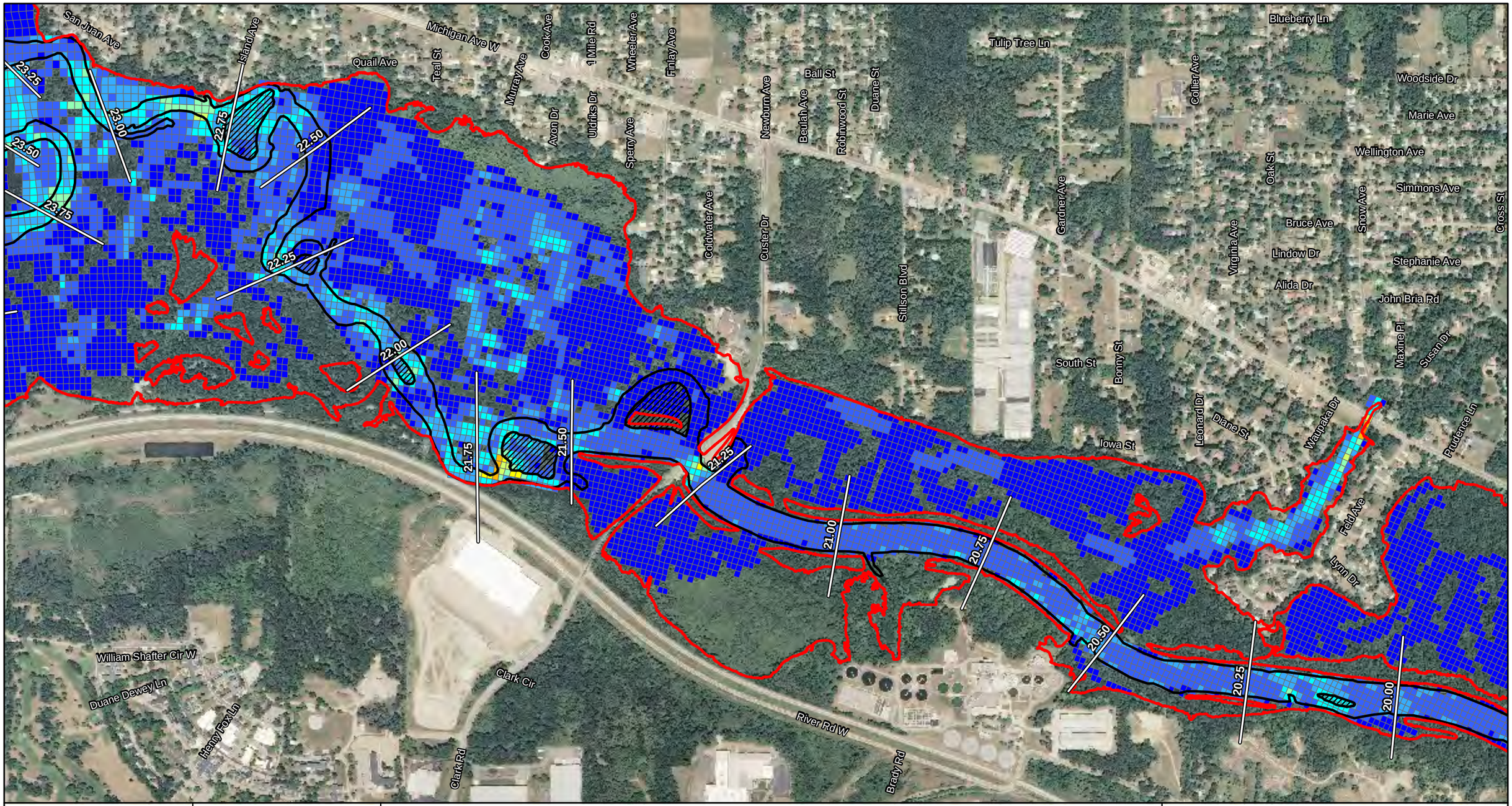
MP 18.00 - MP 20.00

SHEET 8 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

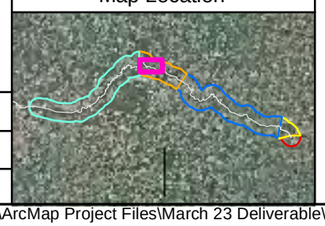
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

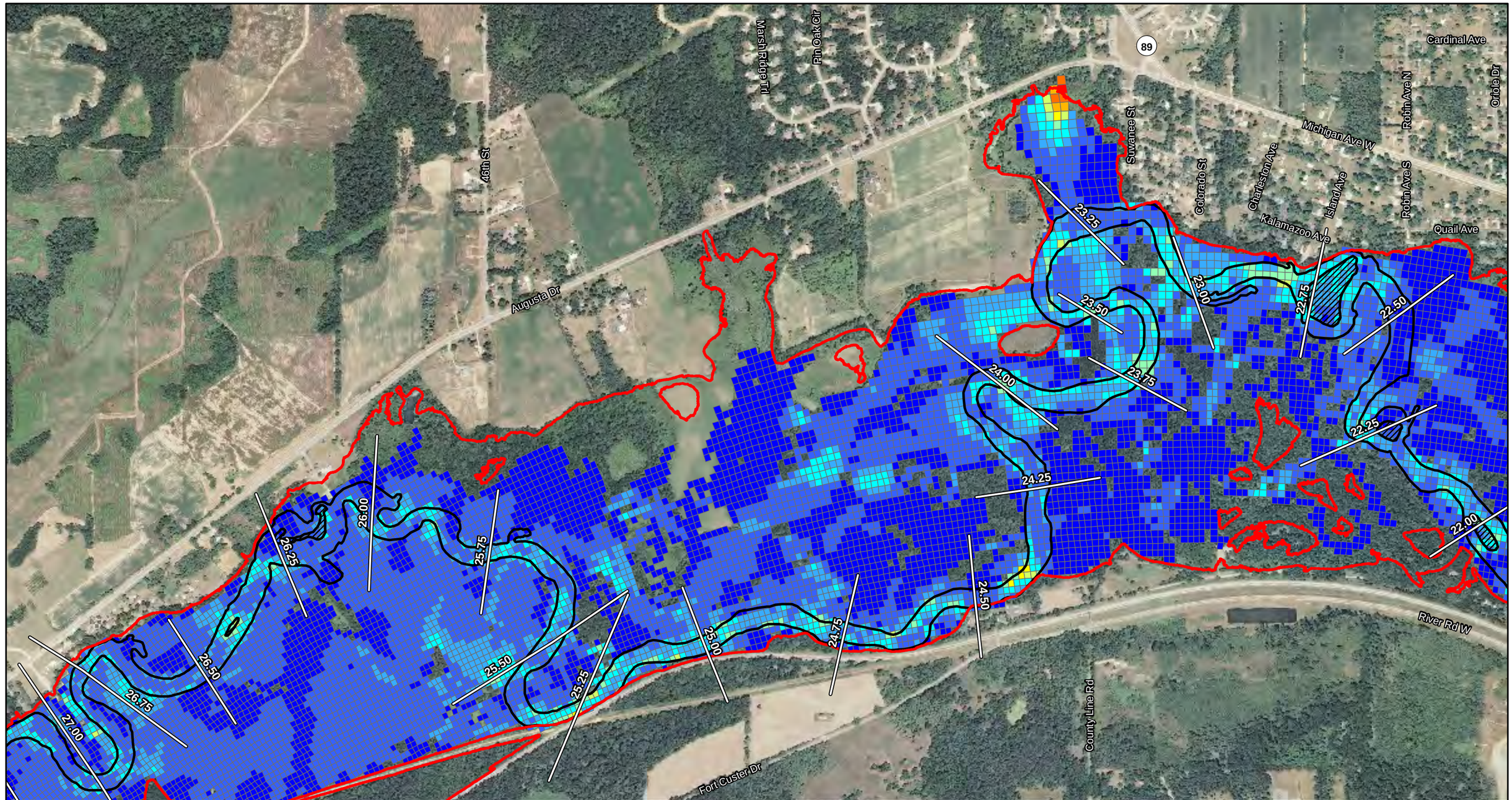
MP 20.00 - MP 22.50

SHEET 9 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

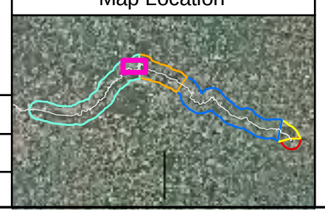
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

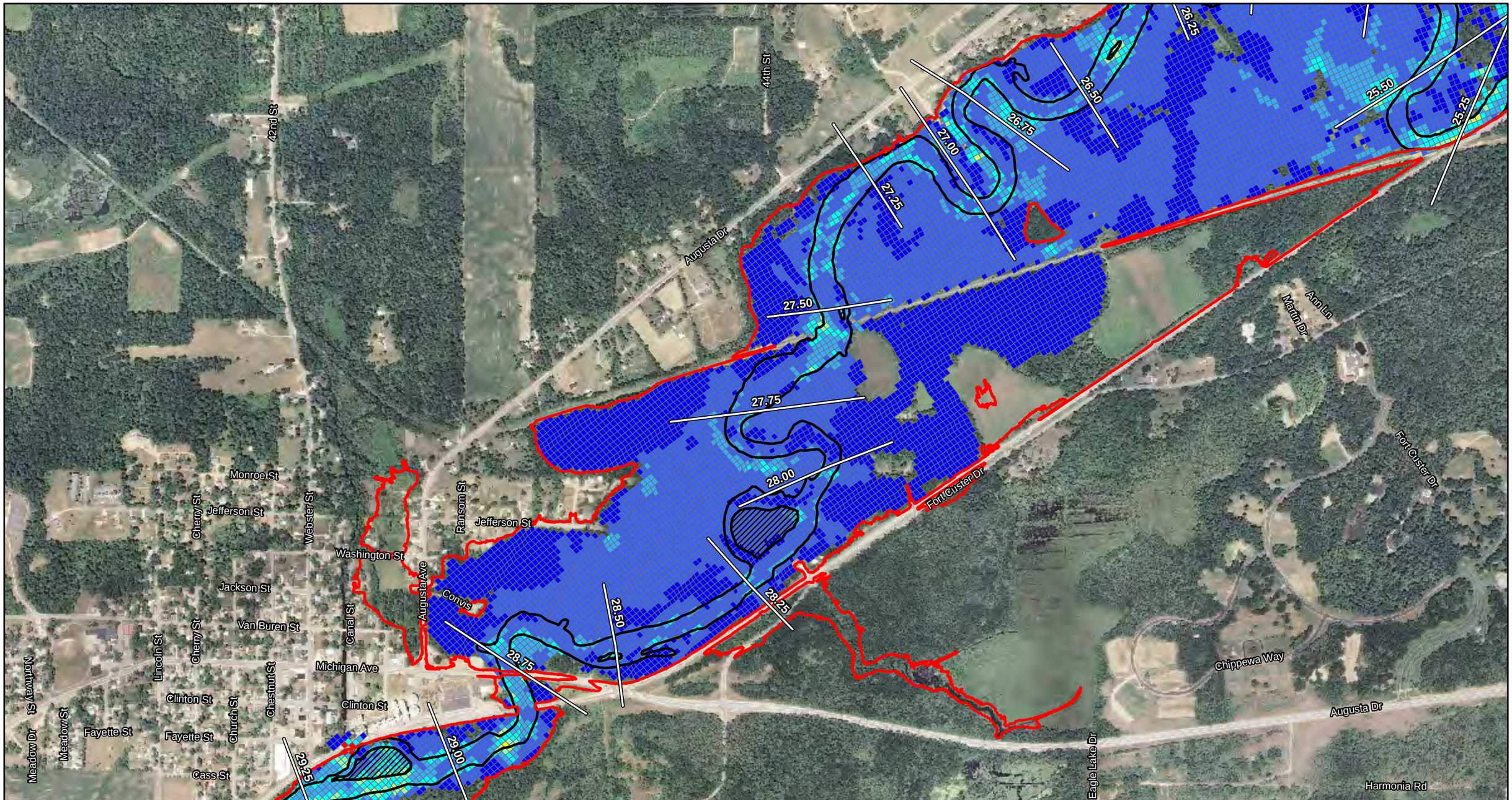
MP 22.50 - MP 27.00

SHEET 10 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

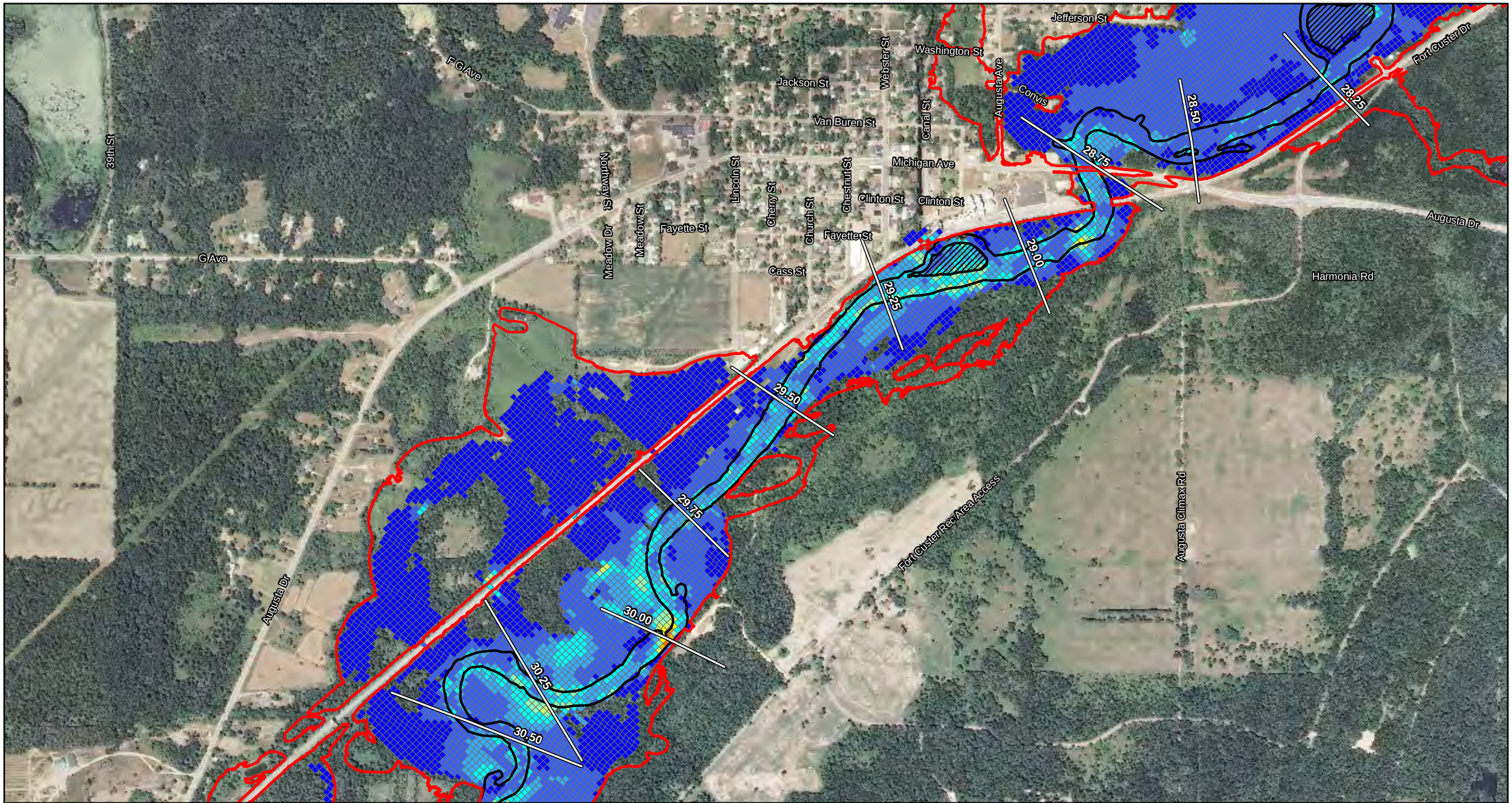
MP 27.00 - MP 28.75

SHEET 11 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location

Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

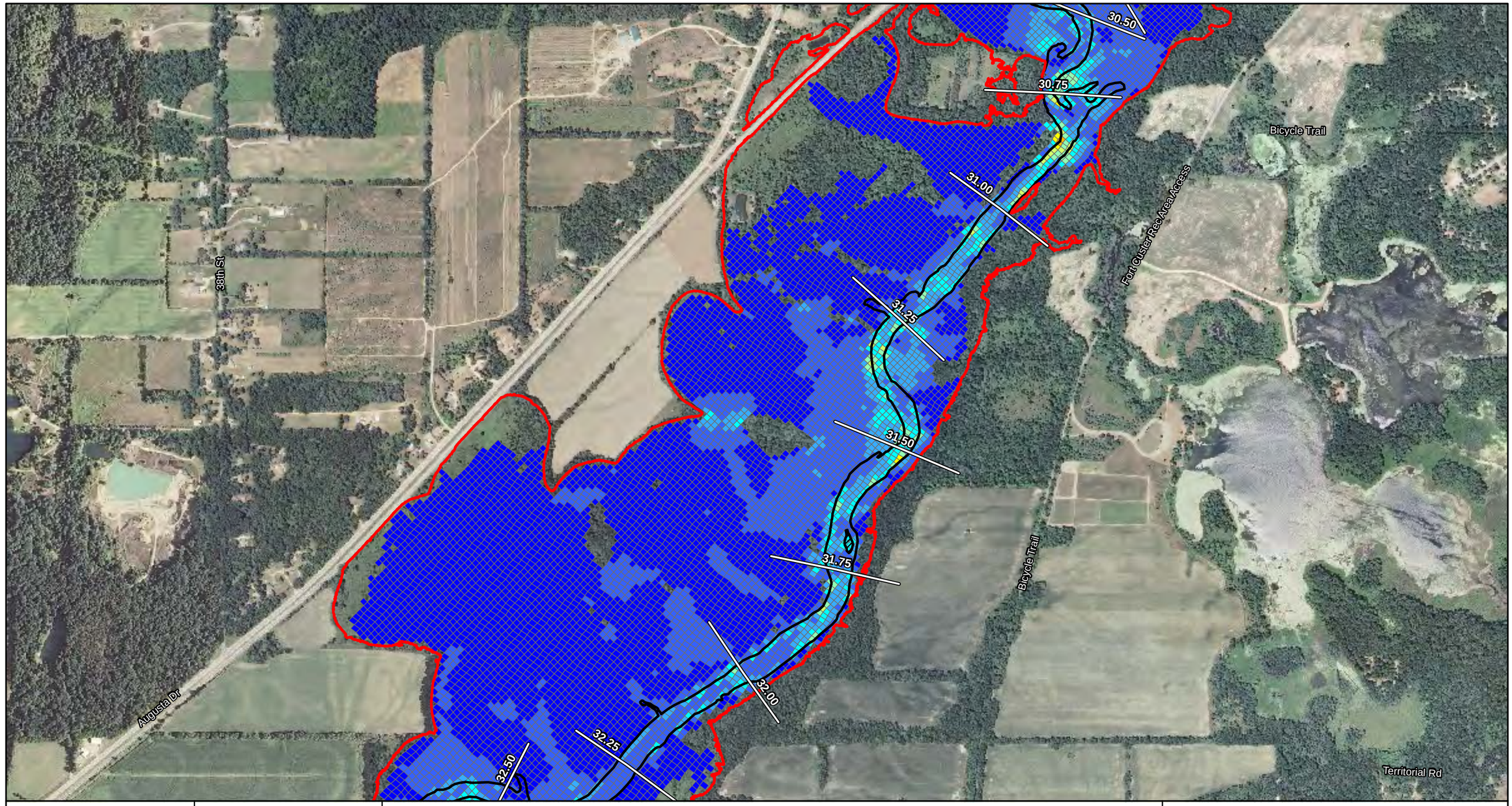
MP 28.75 - MP 30.50

SHEET 12 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

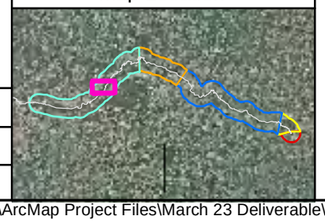
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

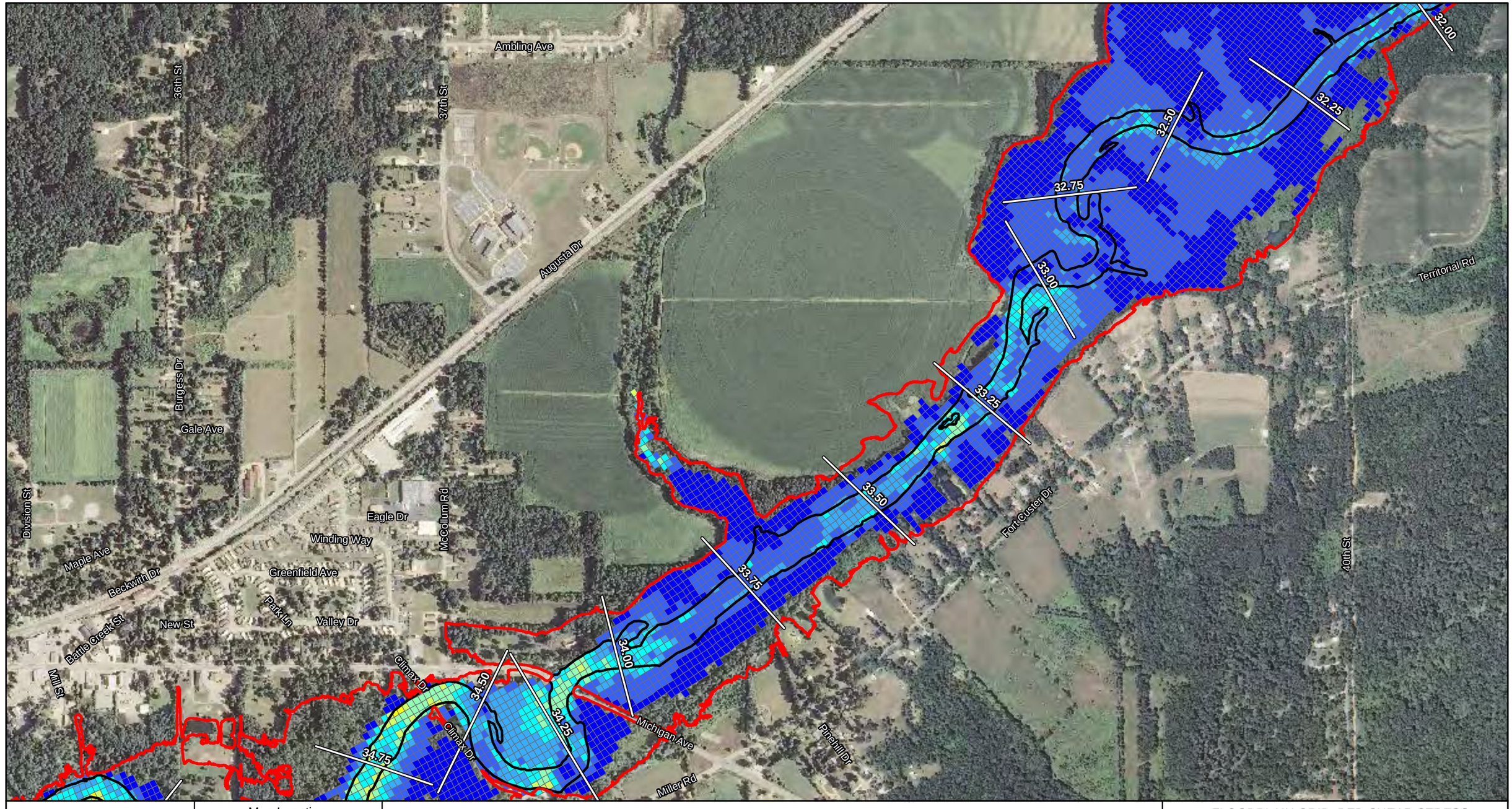
MP 30.50 - MP 32.25

SHEET 13 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

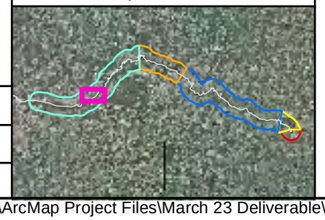
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

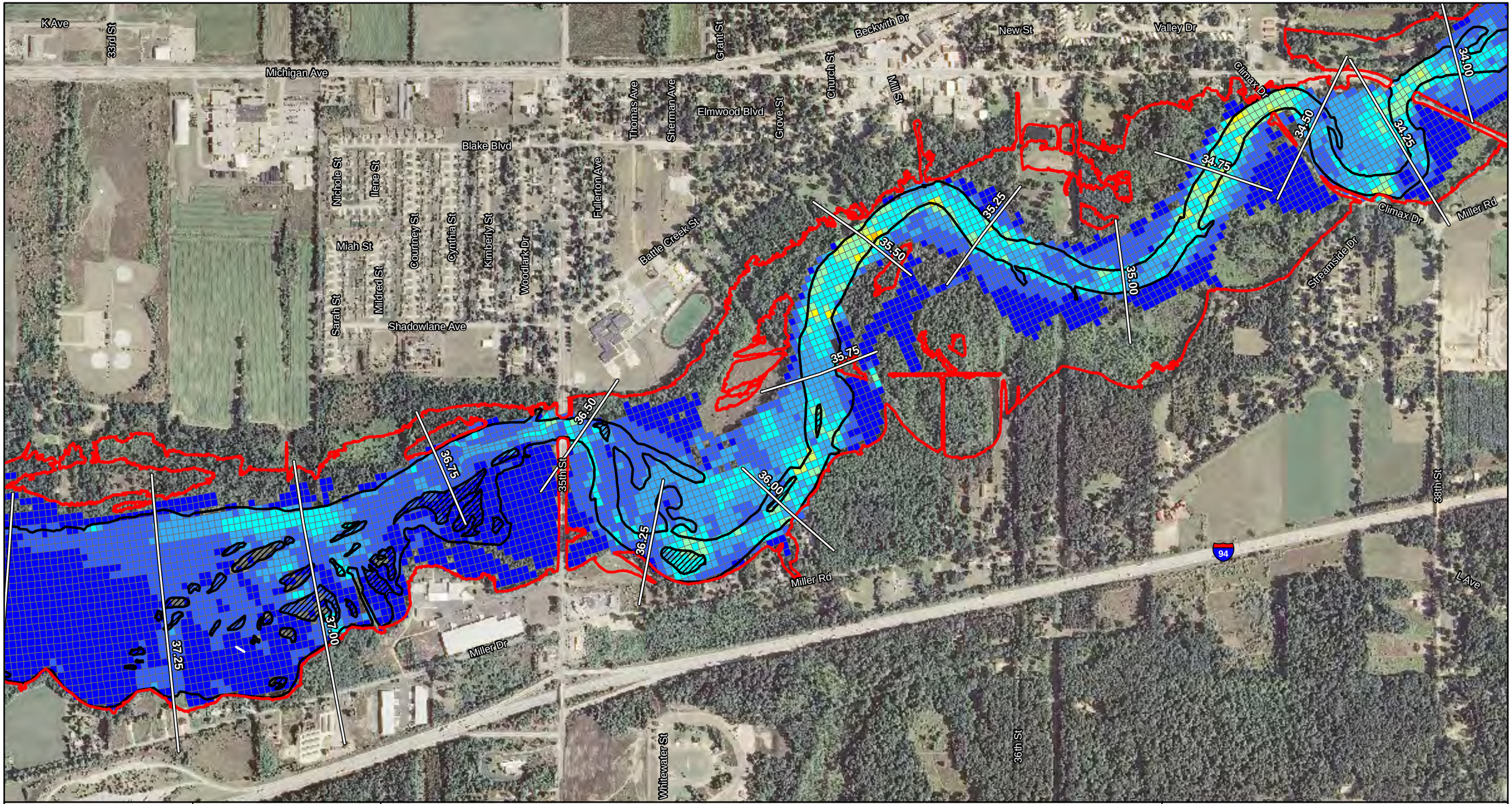
MP 32.25 - MP 34.75

SHEET 14 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

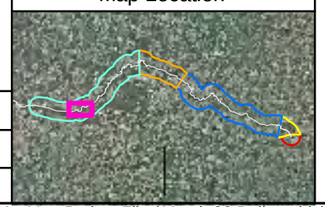
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/23/2012
Approved:	DBR	3/23/2012
Project #:	106-4186	

Map Location



Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

N

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

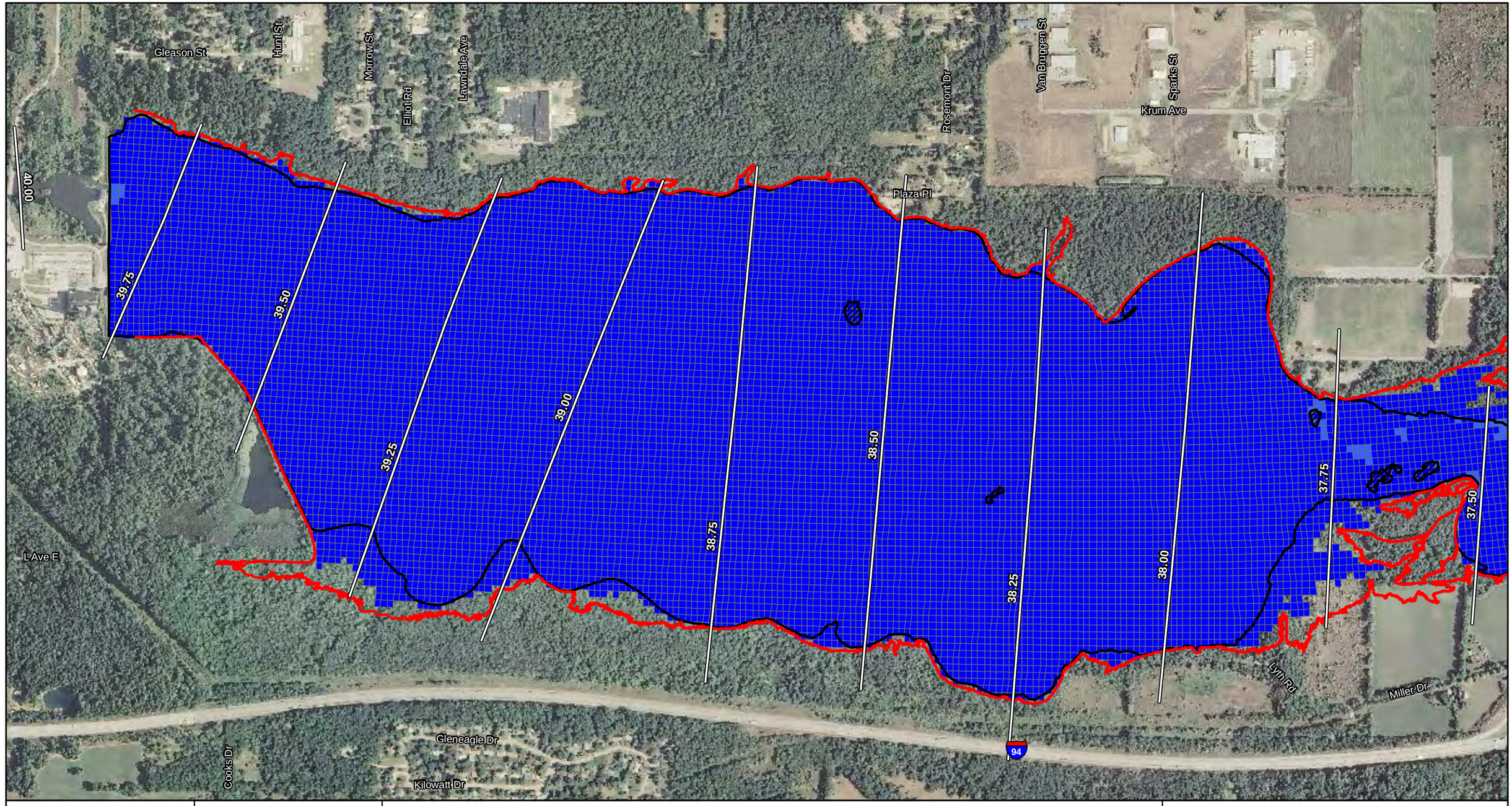
MP 34.25 - MP 37.50

SHEET 15 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

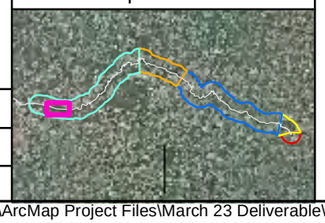
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/23/2012
Approved:	DBR 3/23/2012
Project #:	106-4186

Map Location



Legend

Bed Shear Stress (Pa), July 28, 2010

- < 1.000001
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 10.000000
- 10.000001 - 15.000000
- 15.000001 - 20.000000
- 20.000001 - 30.000000
- 30.000001 - 50.000000
- 50.000001 - 100.000000
- > 100.000000

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

Pa = Pascals
cfs = Cubic Feet Per Second

N

Kalamazoo River near Battle Creek USGS gage daily average discharge: 2,150 cfs

0 400 800 1,600
Scale in Feet

FLOODPLAIN GRID: BED SHEAR STRESS
JULY 28, 2010

MP 37.50 - MP 40.00

SHEET 16 OF 16

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Bed_Shear_Stress_Jul28_2010.mxd

Aerial Photography Date: July & August 2009

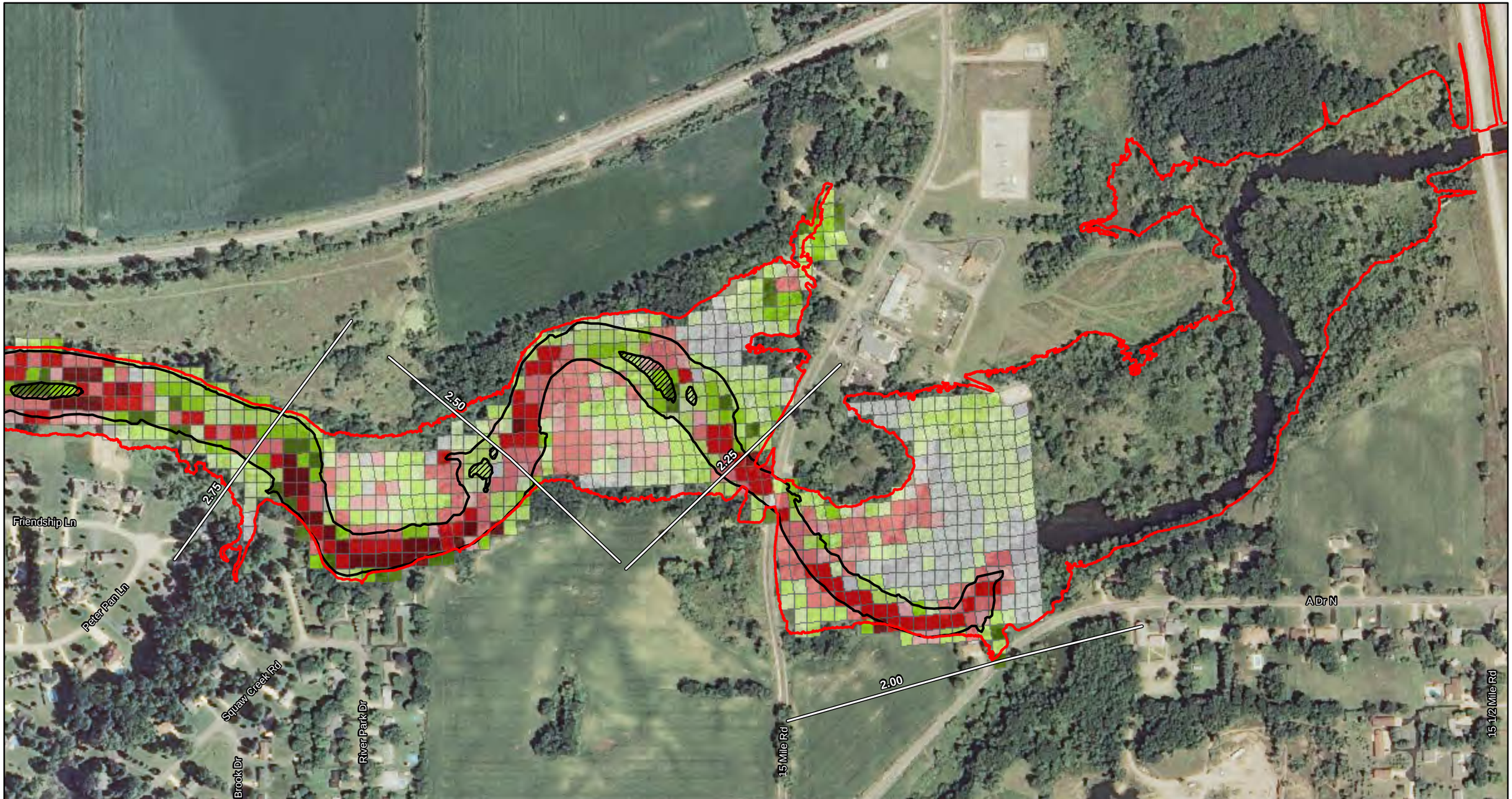
Figure 4-27

Floodplain Grid: Sedimentation Rate

All Grid Cells

July 24 – 31, 2010

Sheets 1 through 45



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

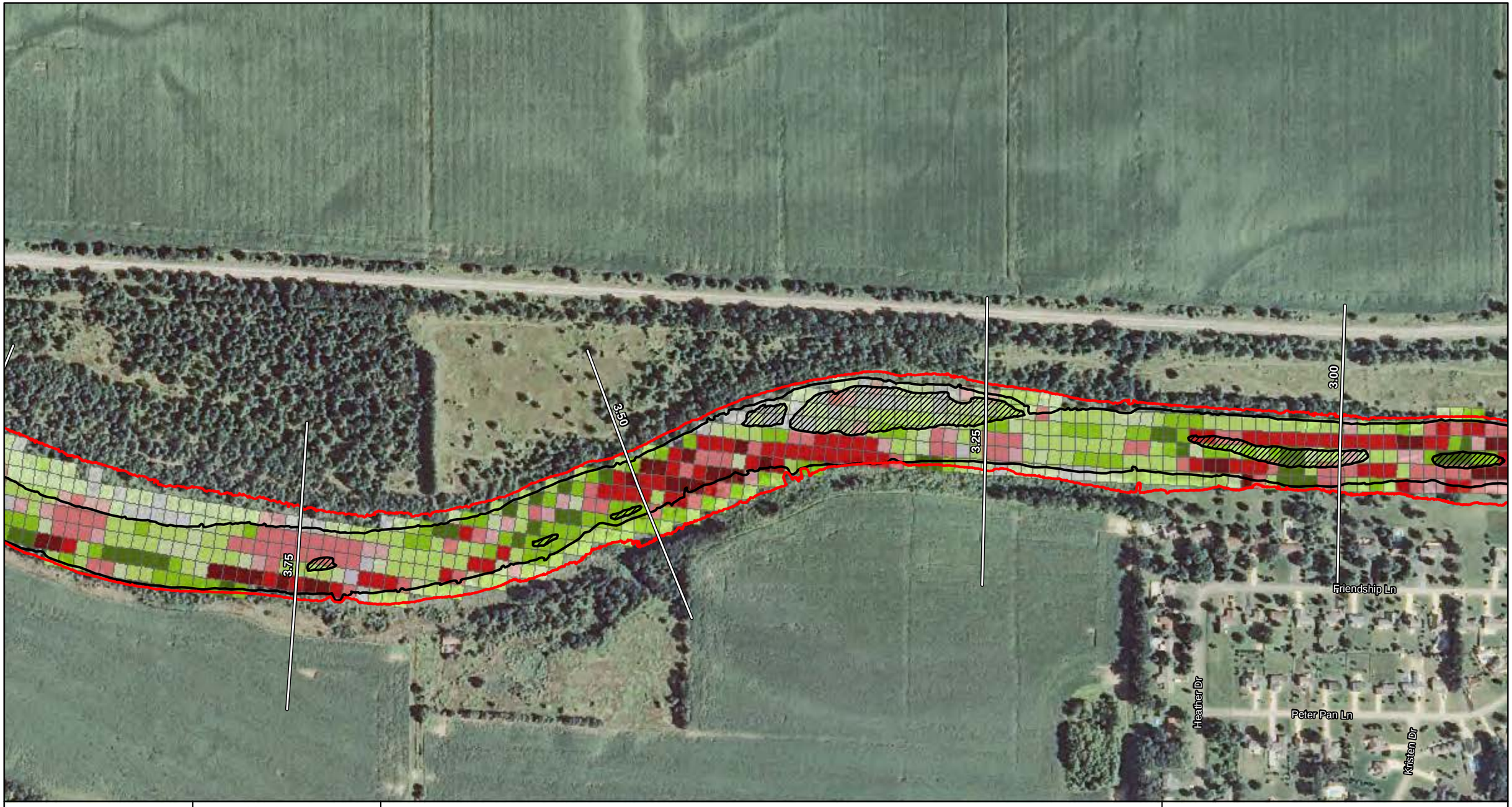
FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 01.88 - MP 02.91

SHEET 1 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Sedimentation_Rate_July_2010.mxd

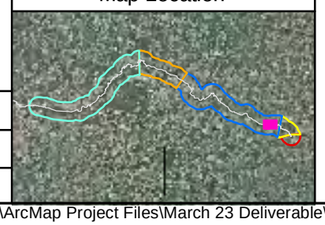
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 02.91 - MP 03.93

SHEET 2 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

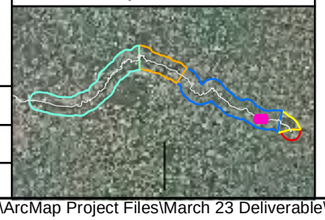
X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Sedimentation_Rate_July_2010.mxd

Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

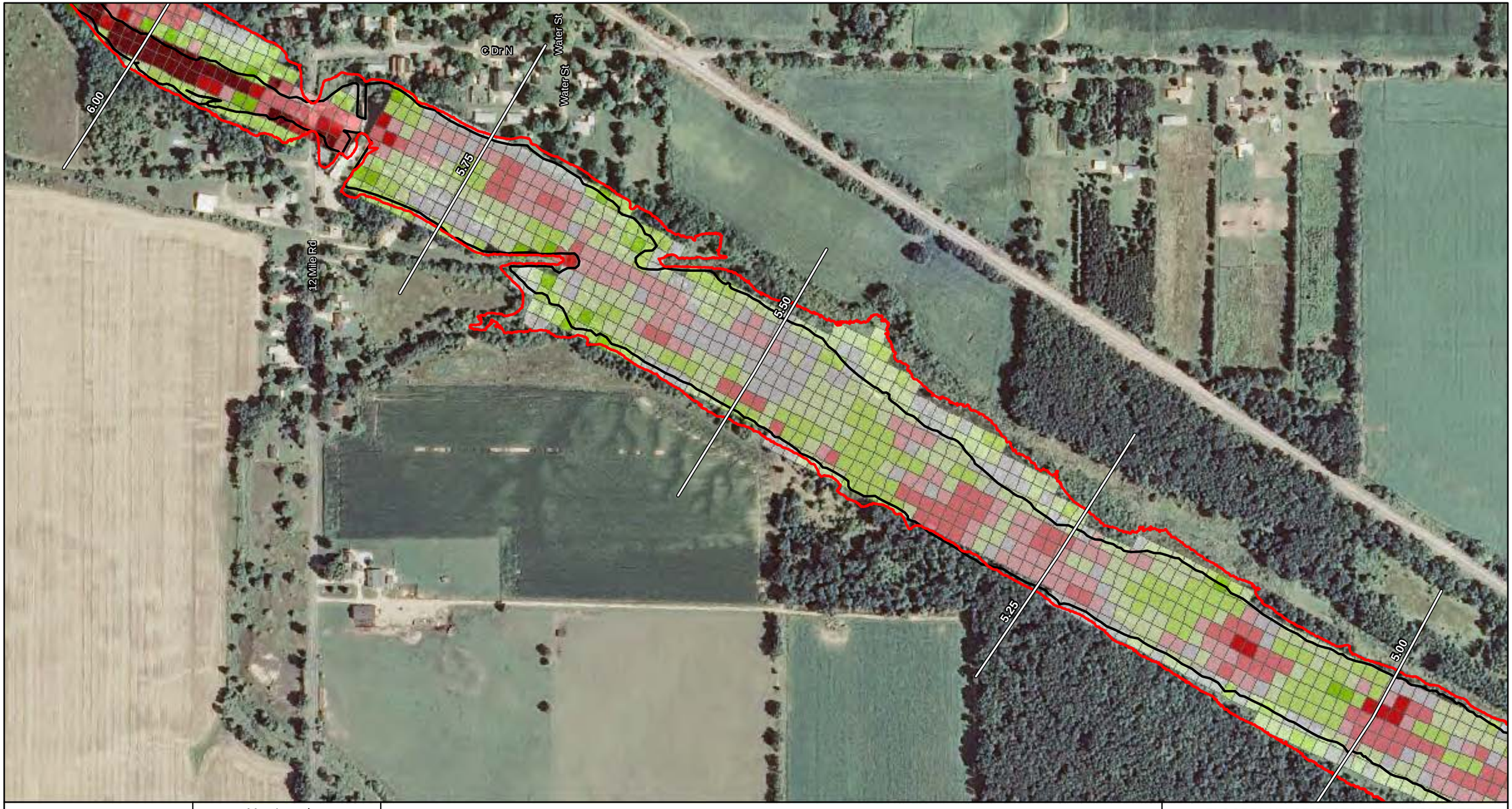
FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 03.93 - MP 04.98

SHEET 3 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Sedimentation_Rate_July_2010.mxd

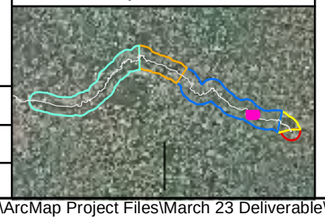
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 04.98 - MP 06.03

SHEET 4 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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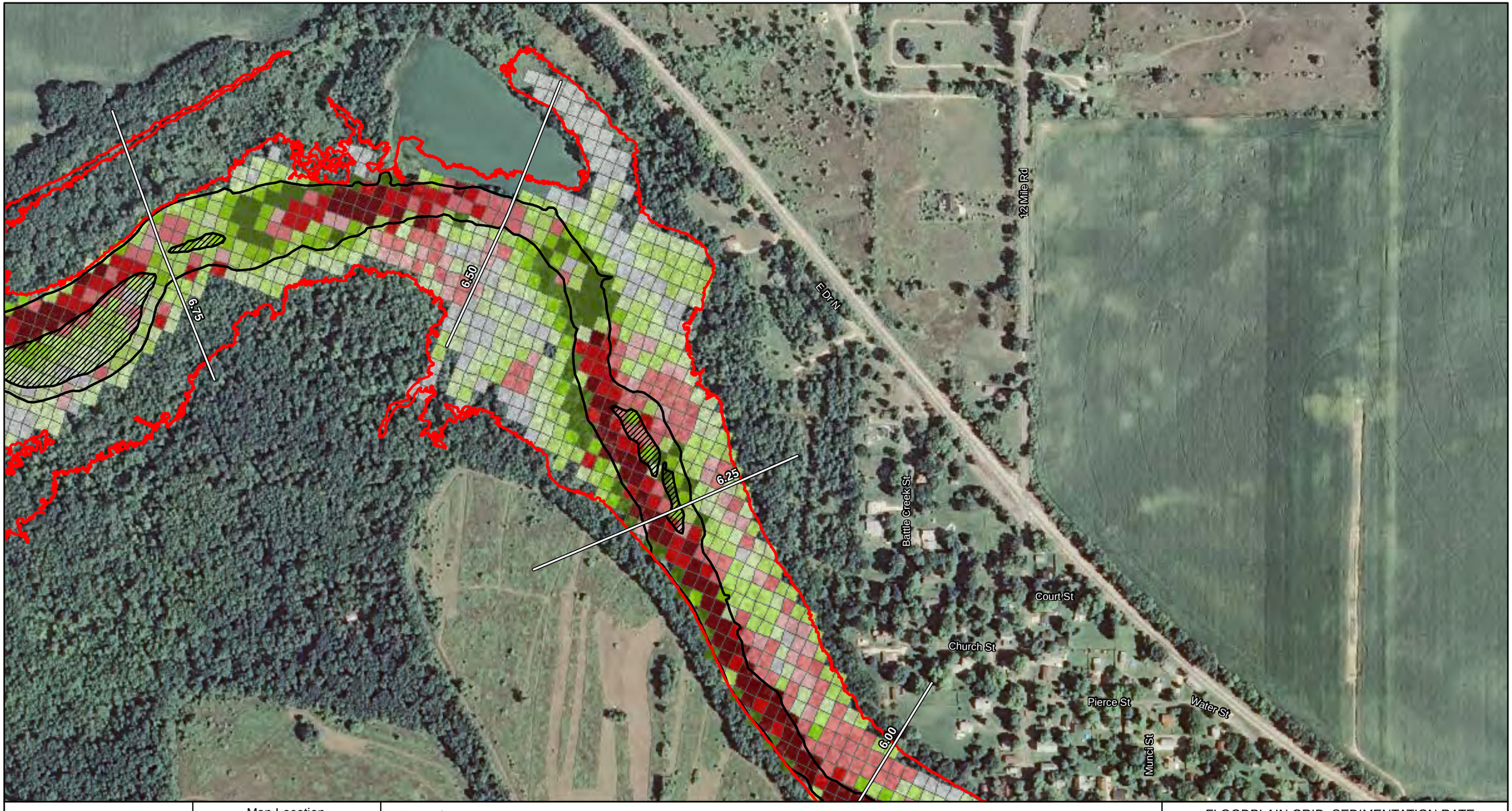
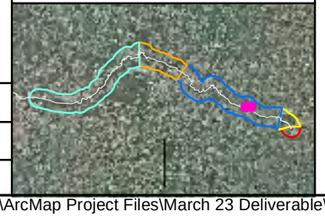
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 06.03 - MP 06.85

SHEET 5 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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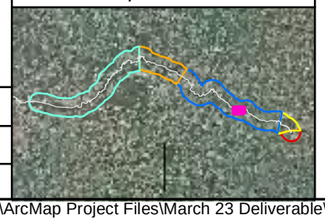
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 06.85 - MP 07.95

SHEET 6 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 07.95 - MP 08.93

SHEET 7 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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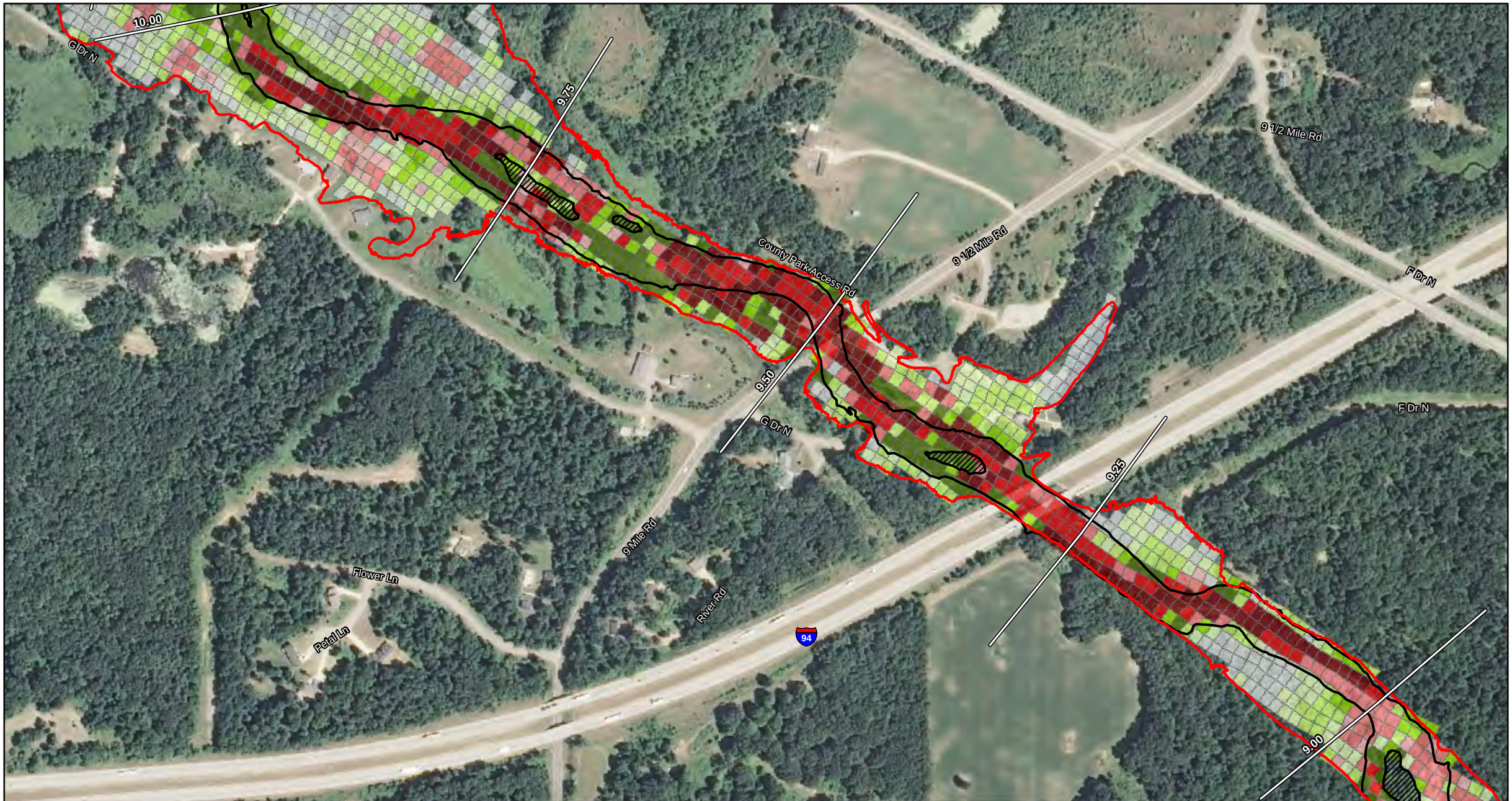
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

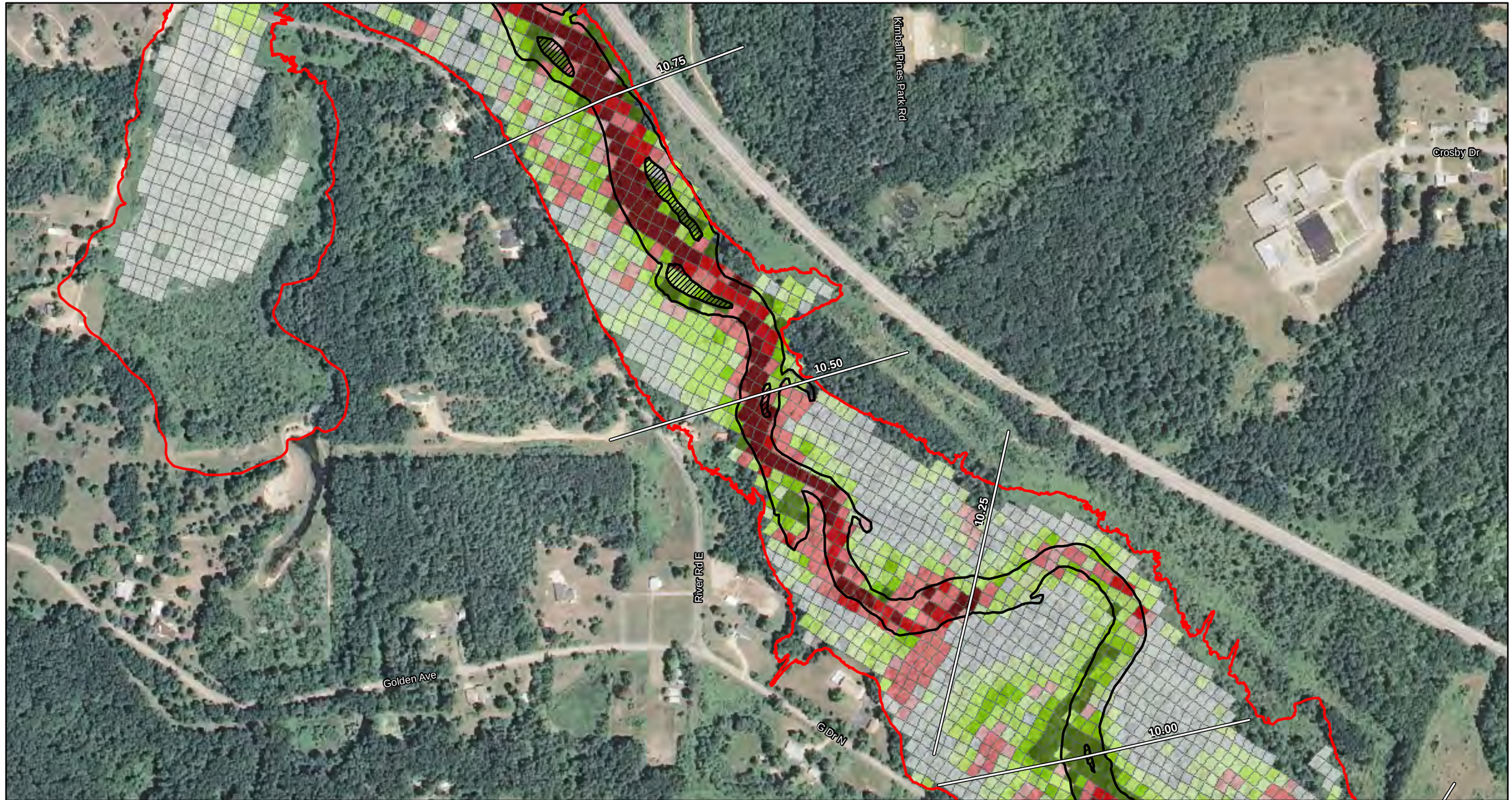
FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 08.93 - MP 10.00

SHEET 8 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Sedimentation_Rate_July_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 10.00 - MP 10.80

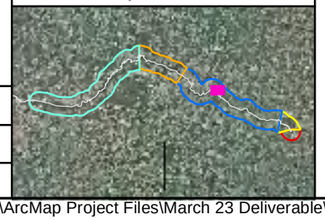
SHEET 9 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Sedimentation_Rate_July_2010.mxd

Aerial Photography Date: July & August 2009

Map Location



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

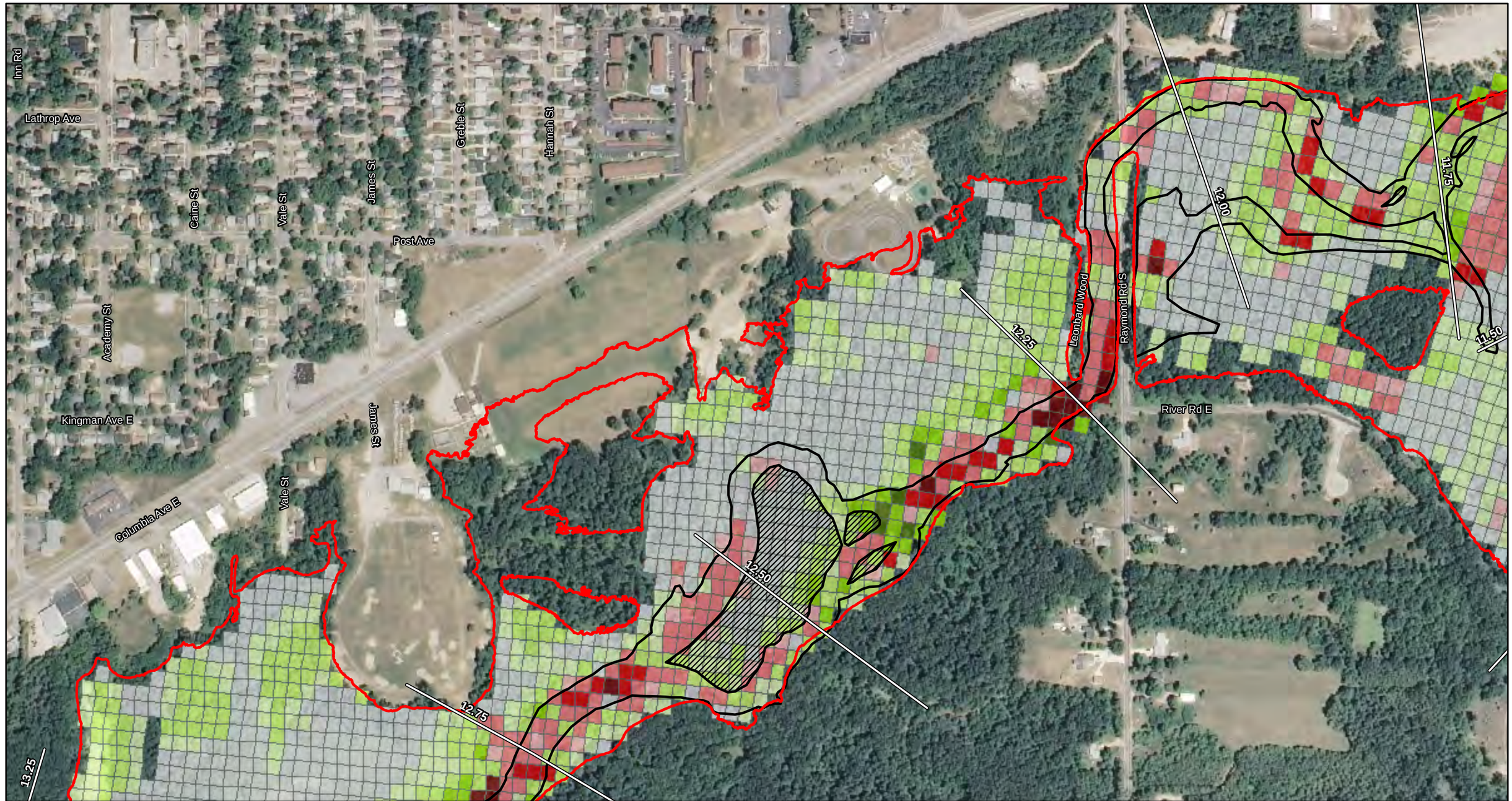
FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 10.80 - MP 11.70

SHEET 10 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Sedimentation_Rate_July_2010.mxd

Aerial Photography Date: July & August 2009



Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 11.70 - MP 12.77

SHEET 11 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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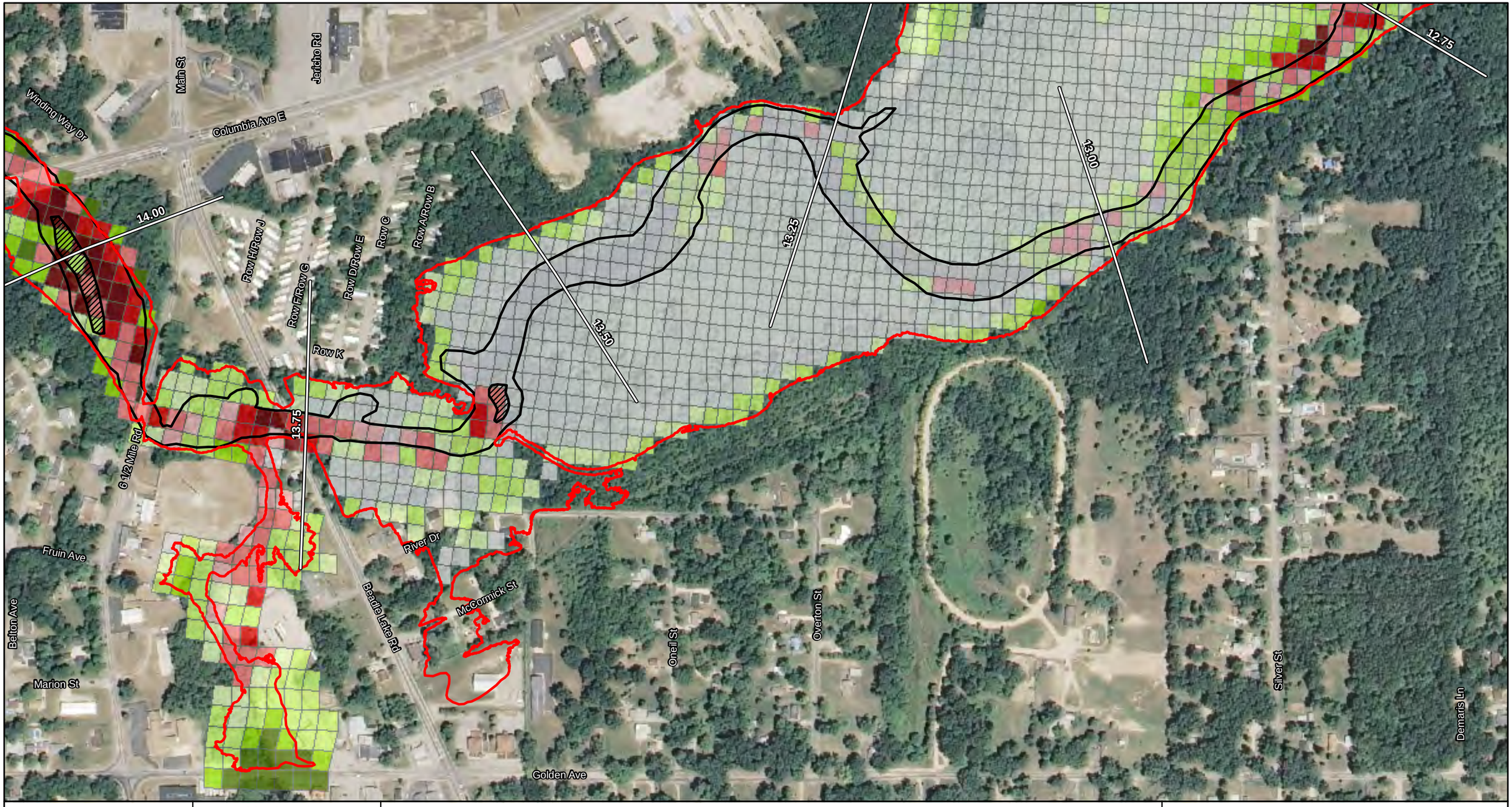
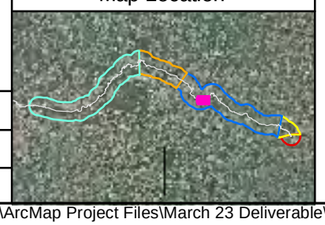
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 12.77 - MP 14.00

SHEET 12 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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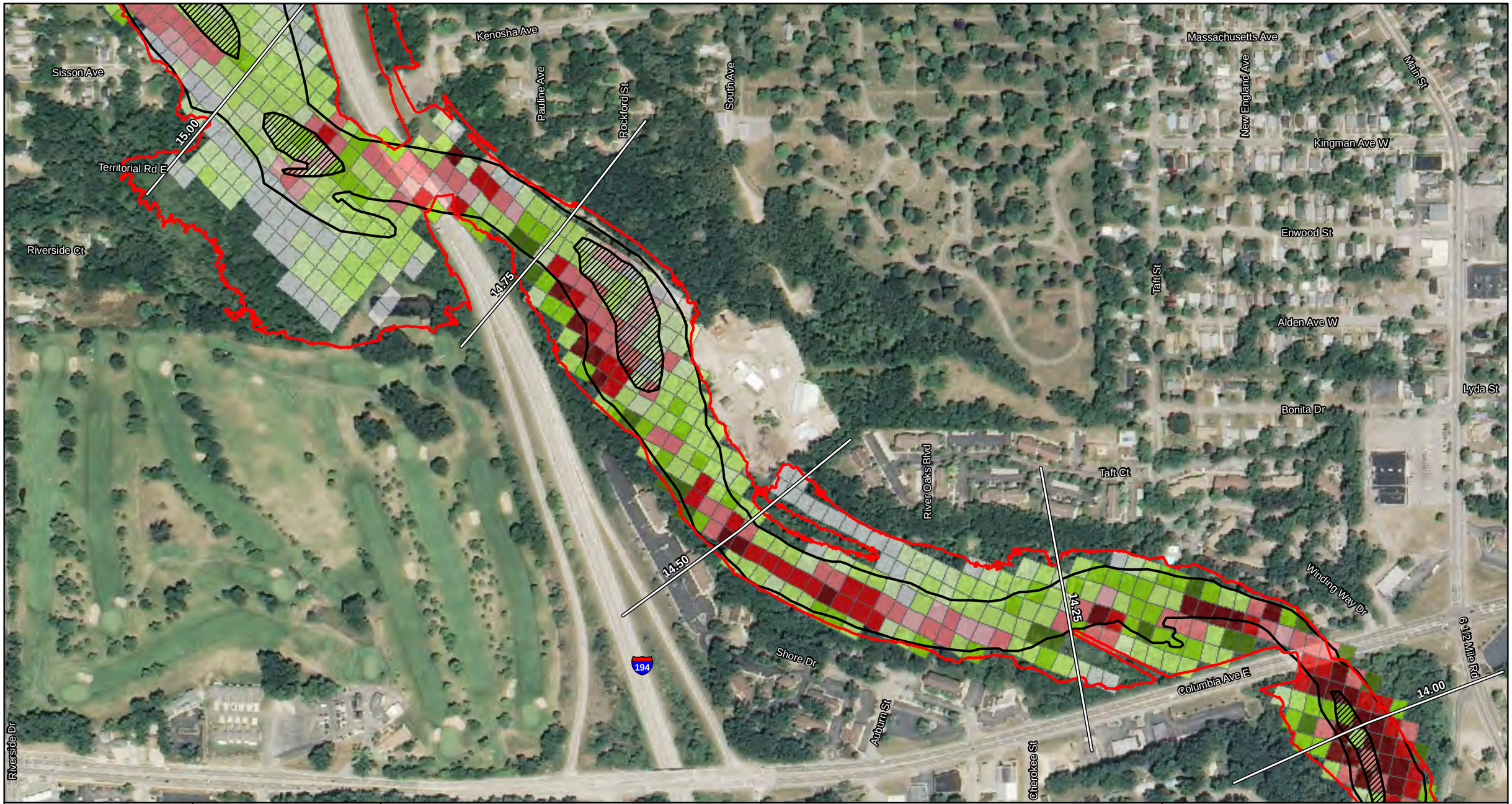
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 14.00 - MP 15.05

SHEET 13 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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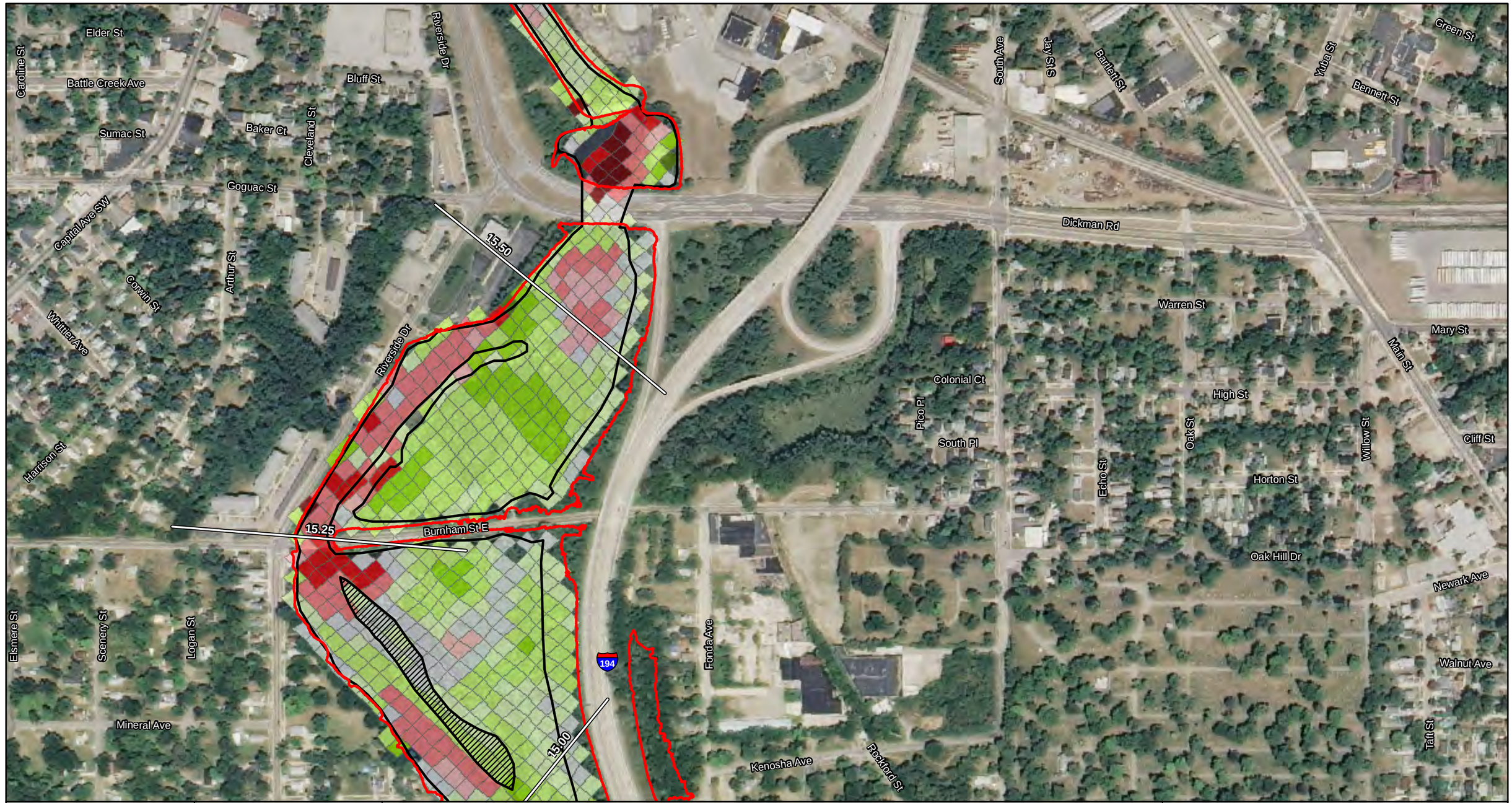
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 15.05 - MP 15.71

SHEET 14 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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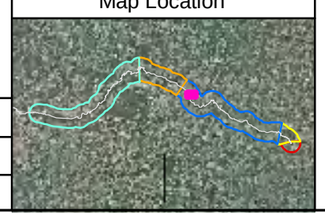
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 15.71 - MP 16.38

SHEET 15 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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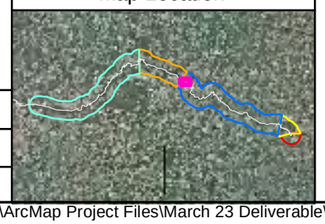
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 16.38 - MP 17.30

SHEET 16 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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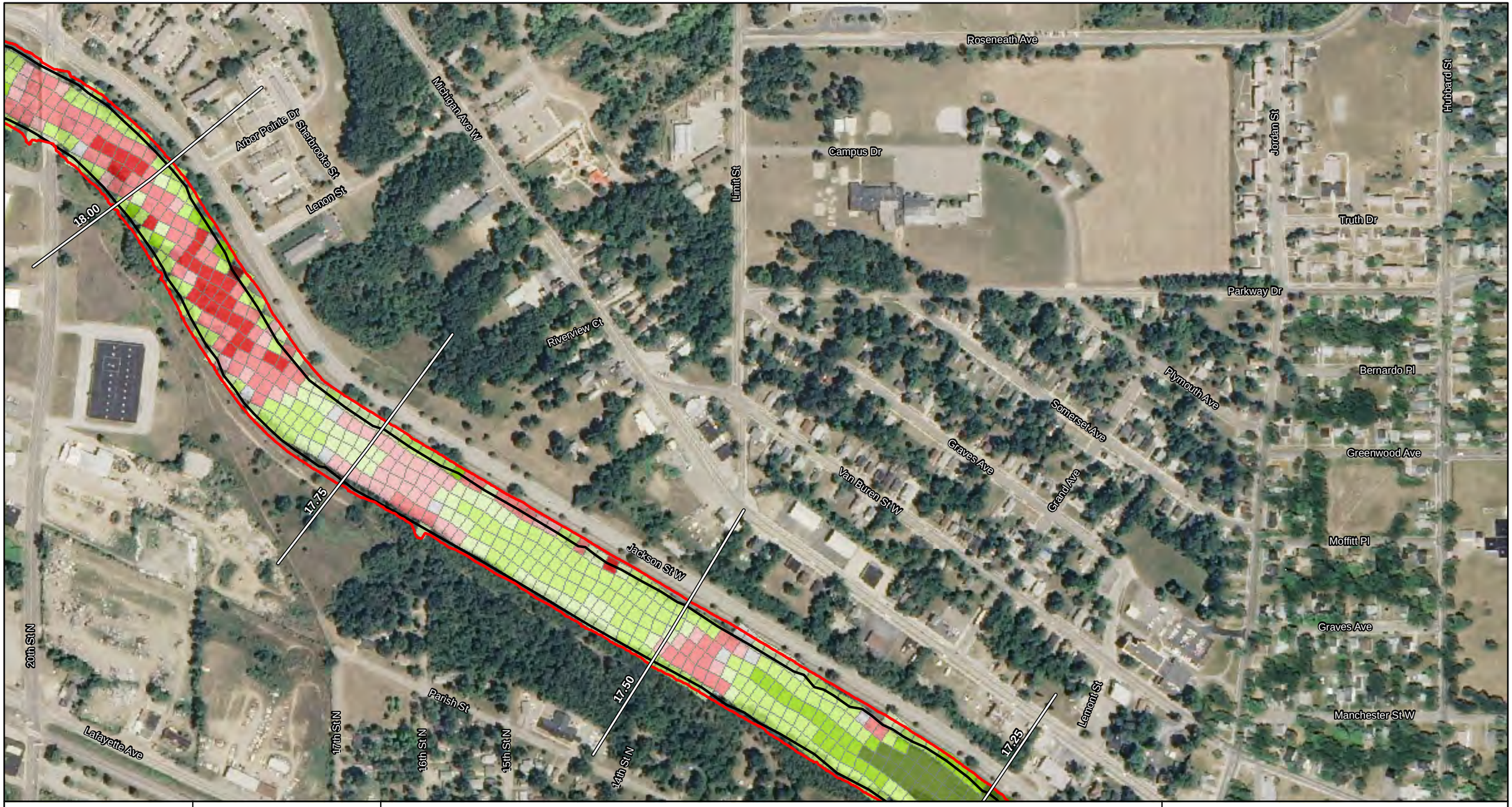
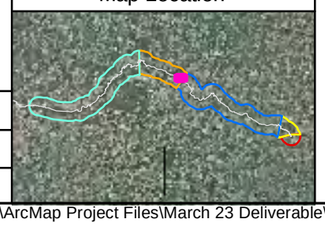
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 17.30 - MP 18.11

SHEET 17 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 18.11 - MP 19.18

SHEET 18 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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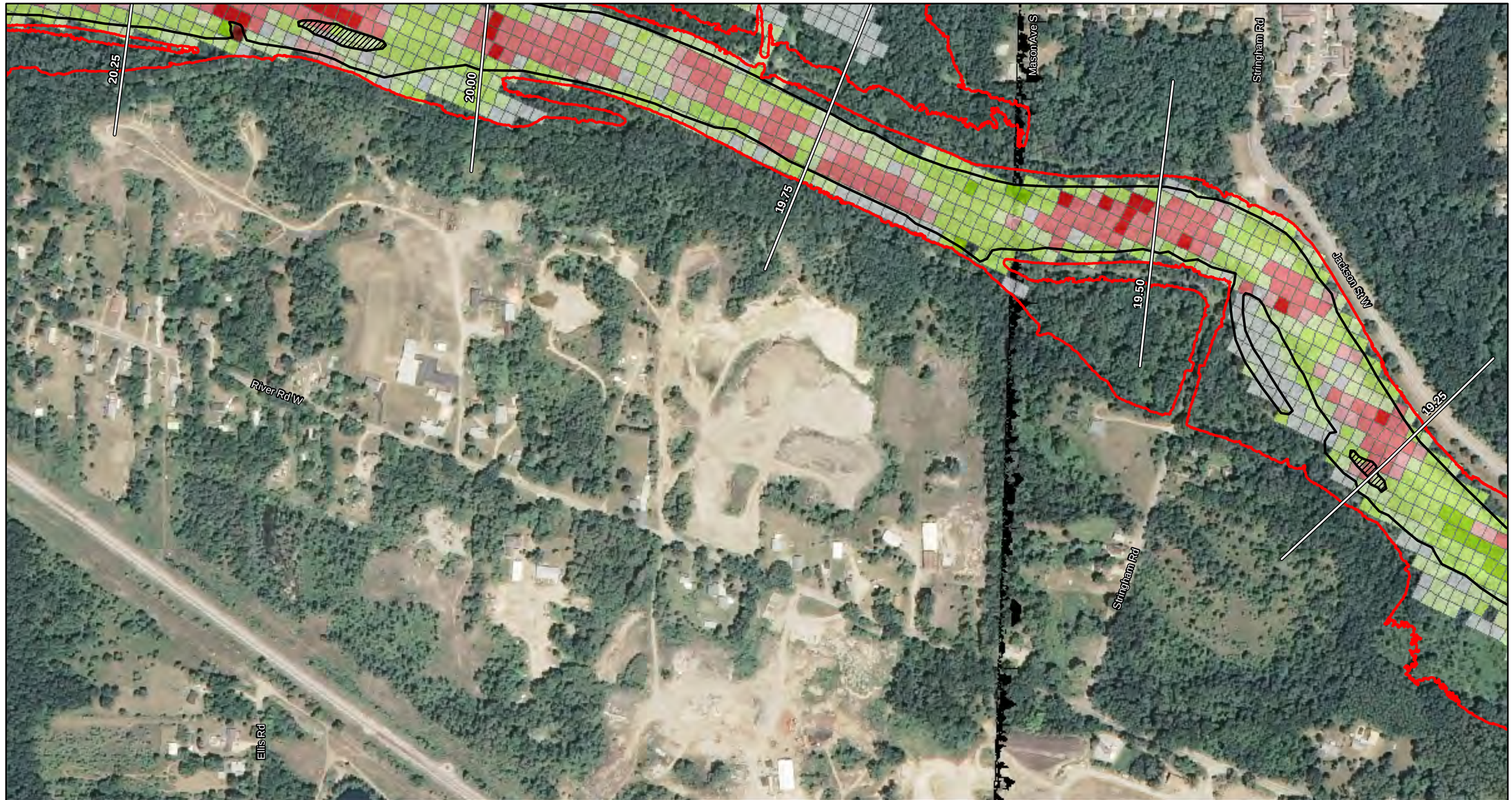
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 19.18 - MP 20.00

SHEET 19 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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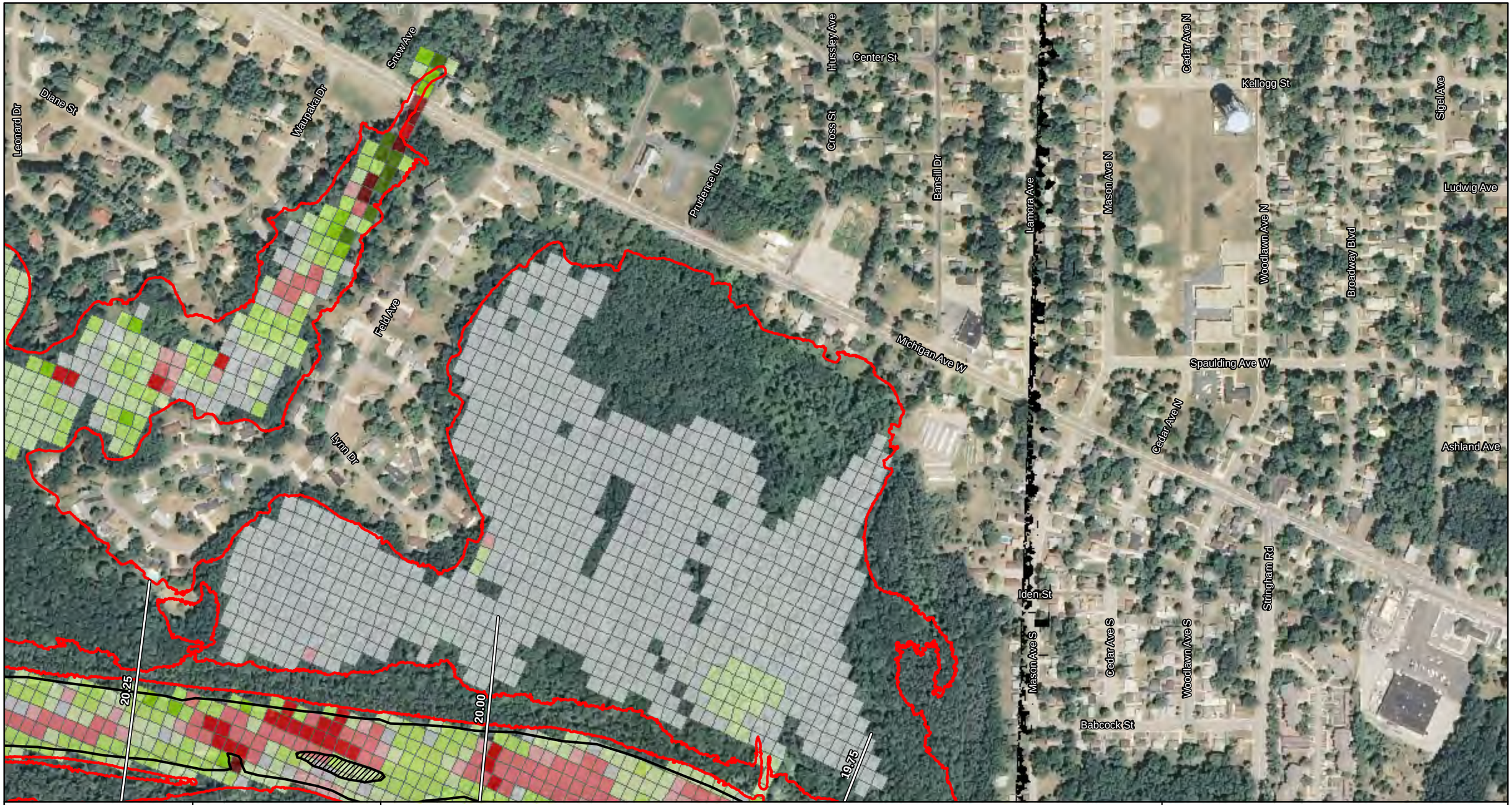
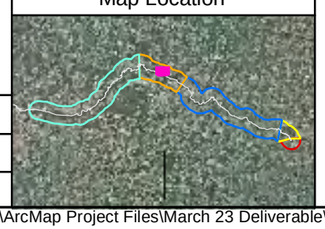
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 20.00 - MP 20.32

SHEET 20 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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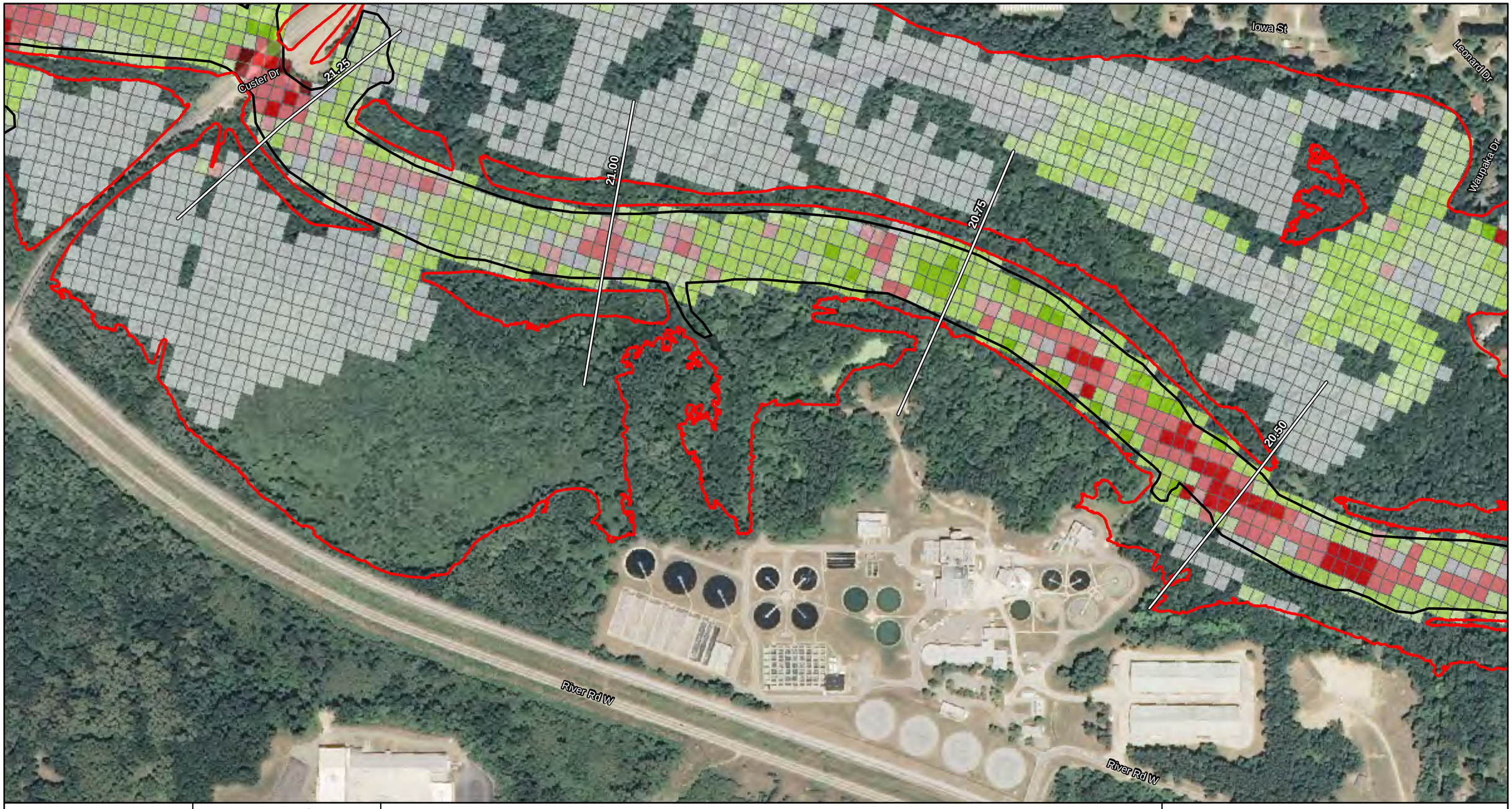
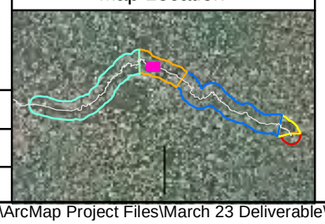
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 20.32 - MP 21.36

SHEET 21 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 21.36 - MP 21.59

SHEET 22 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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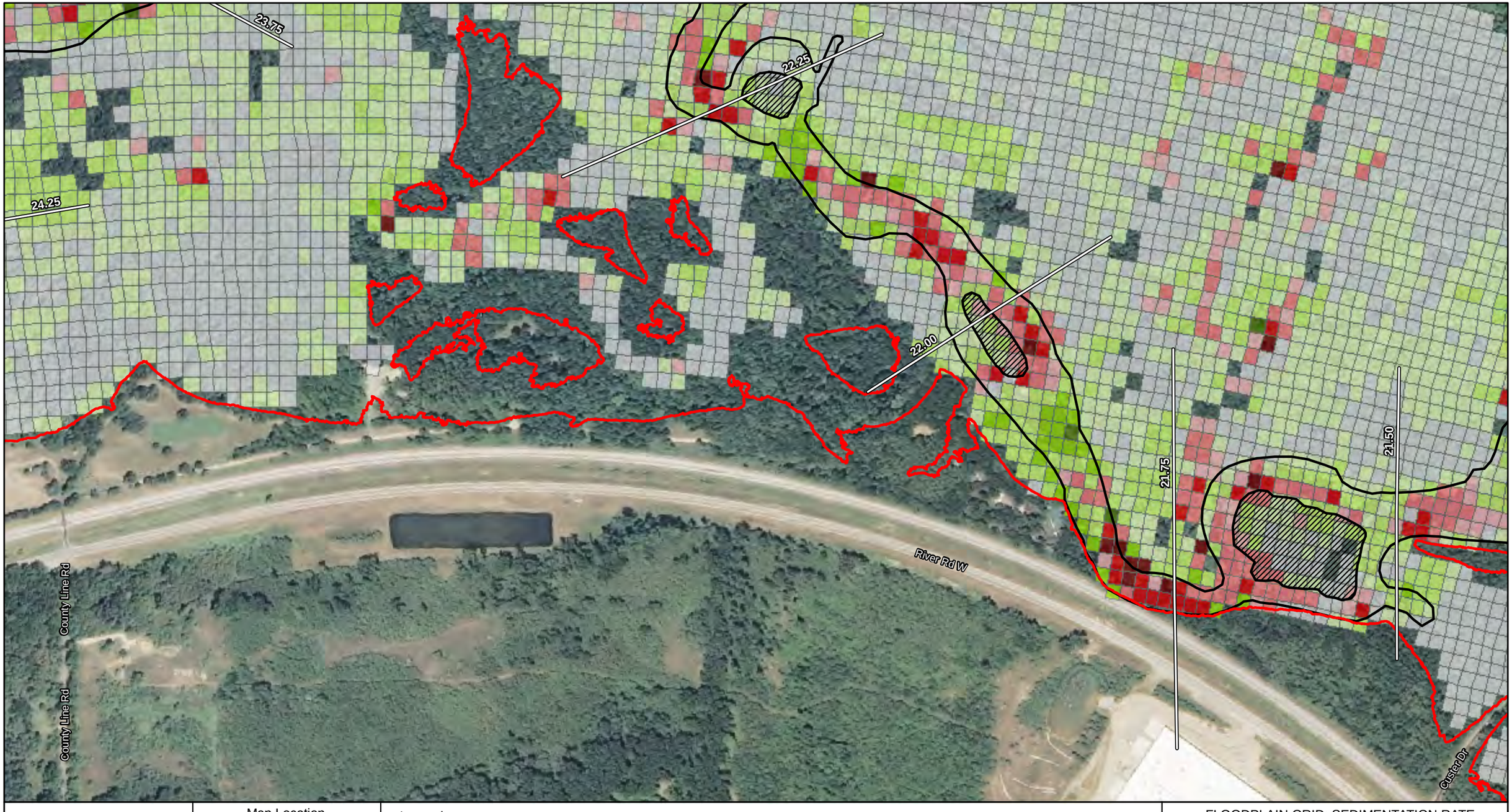
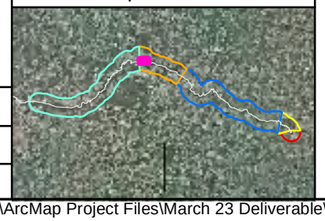
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 21.59 - MP 22.33

SHEET 23 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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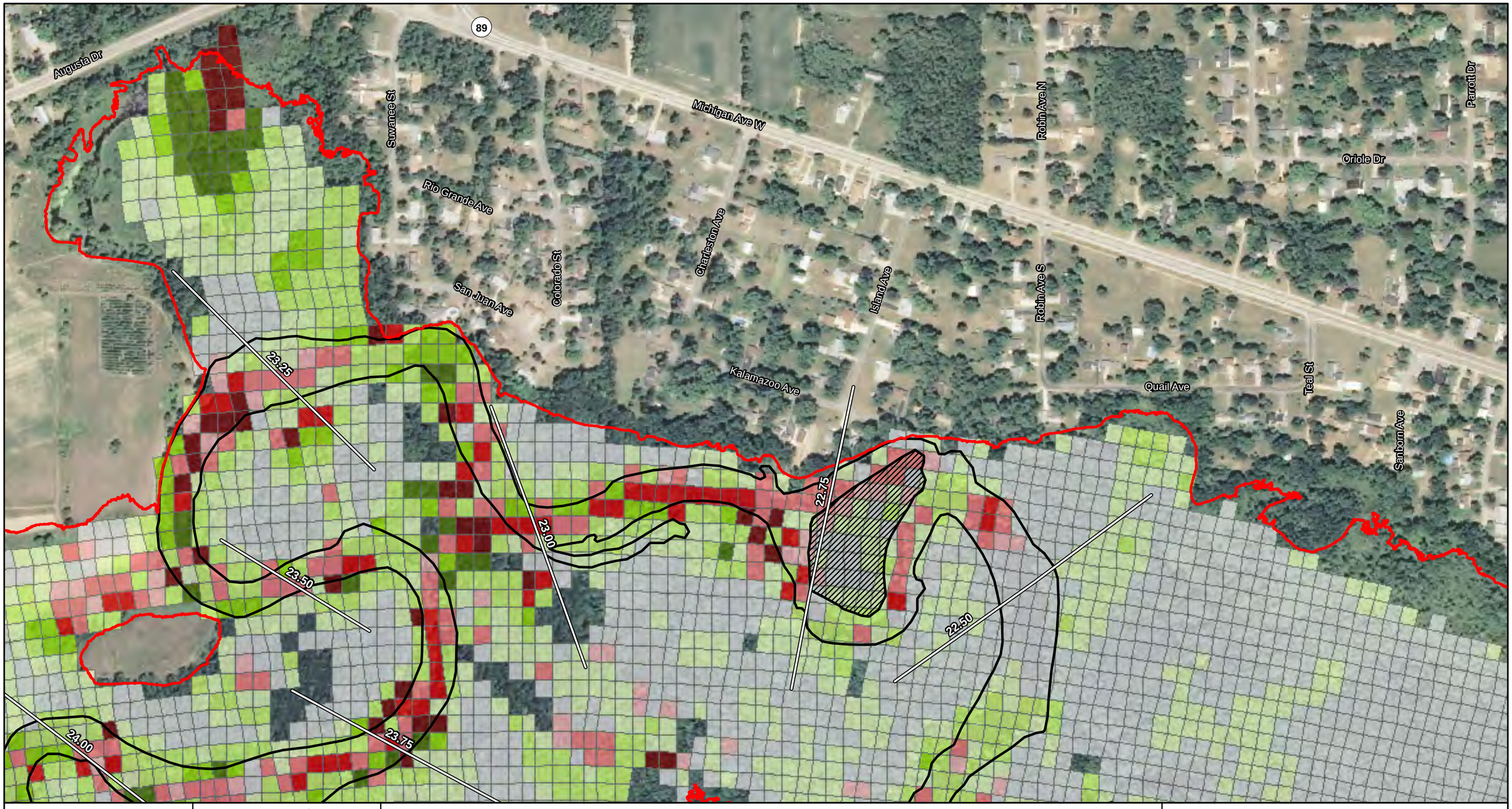
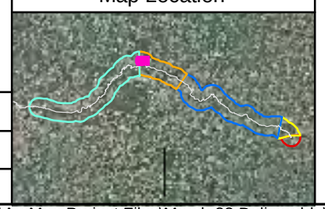
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

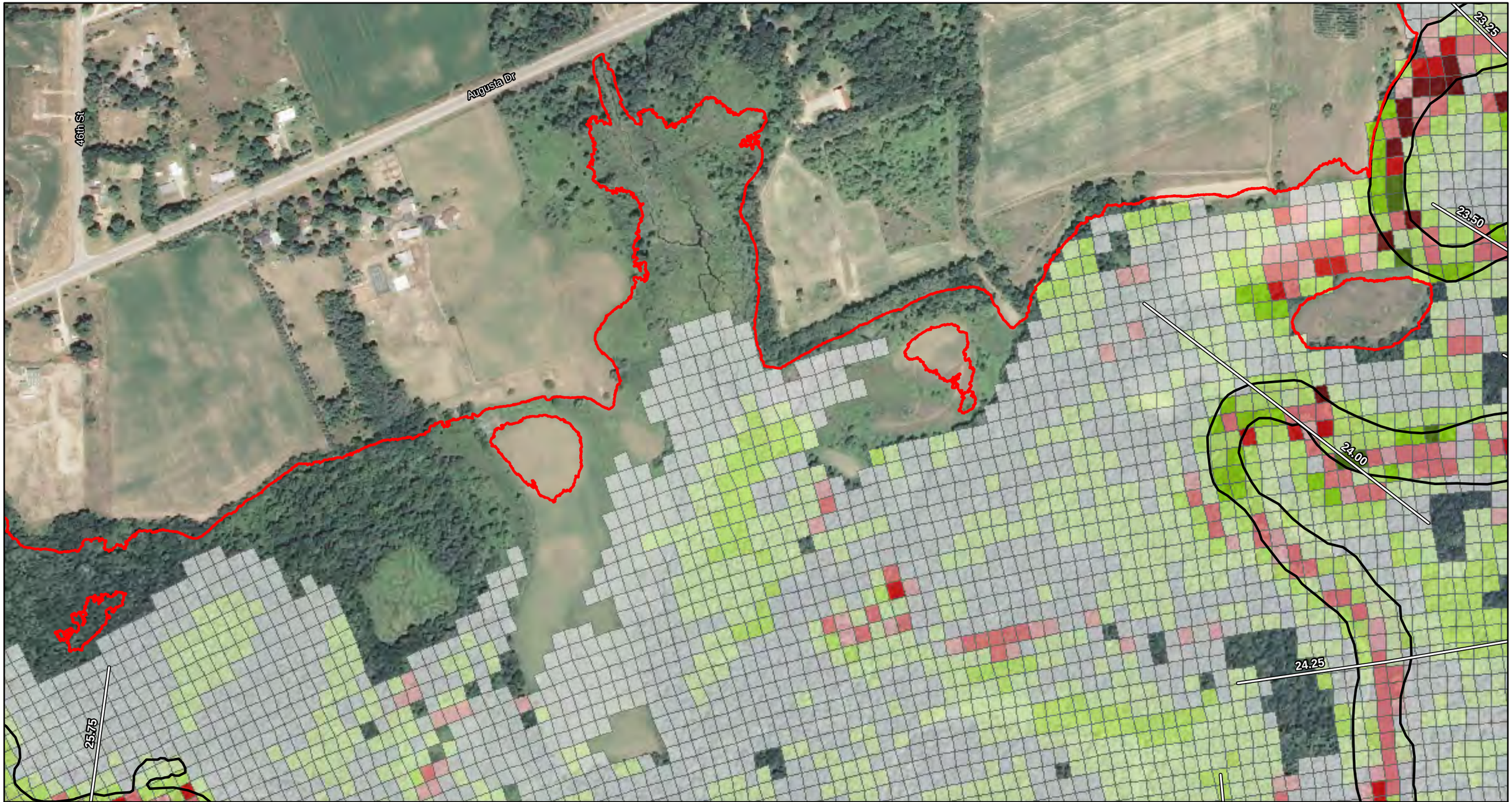
FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 22.33 - MP 24.01

SHEET 24 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Sedimentation_Rate_July_2010.mxd

Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

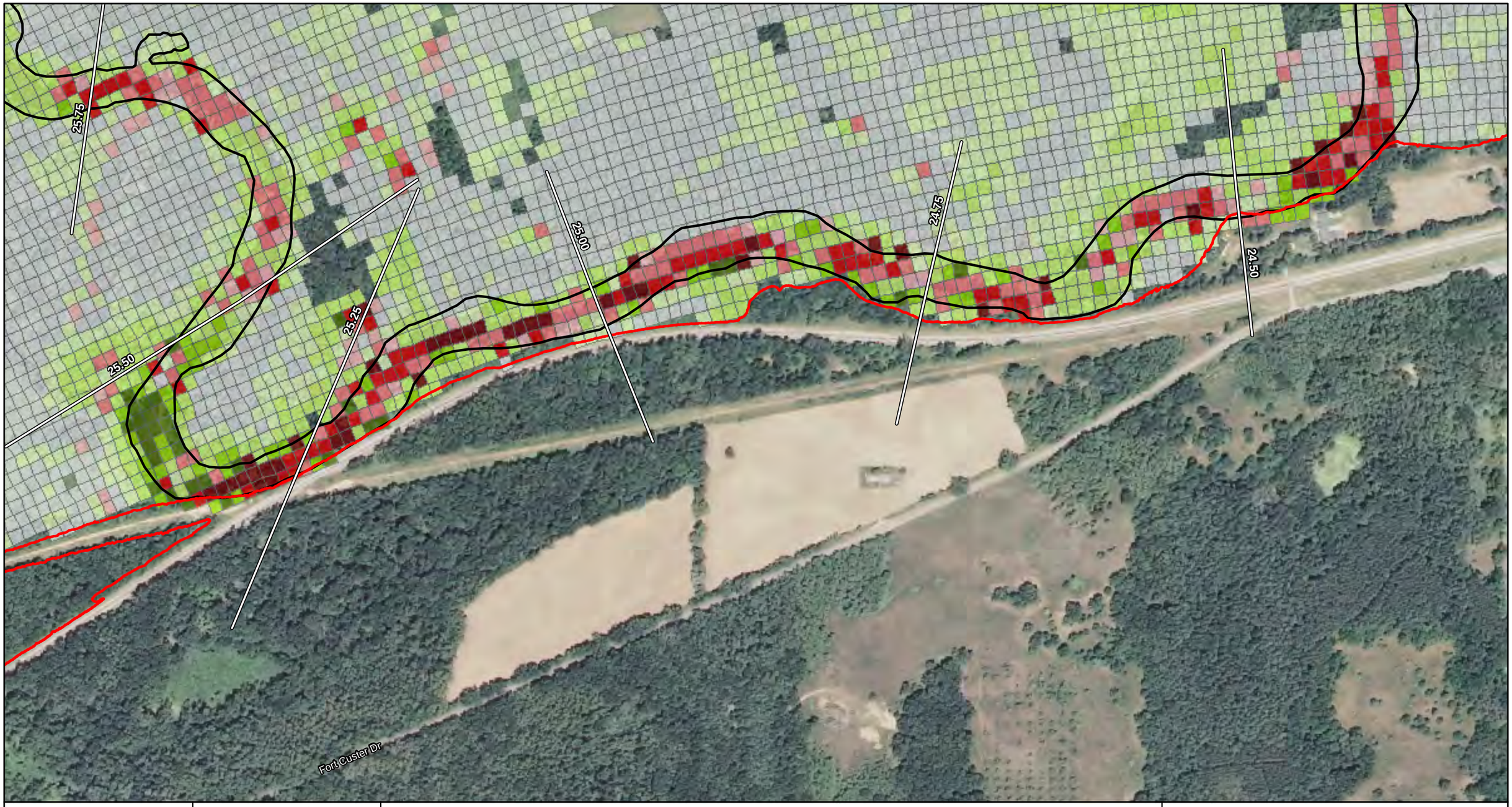
FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 24.01 - MP 24.33

SHEET 25 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Sedimentation_Rate_July_2010.mxd

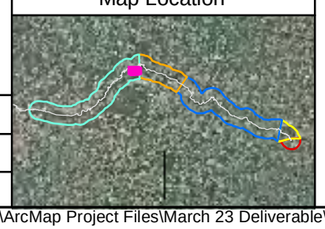
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 24.33 - MP 25.79

SHEET 26 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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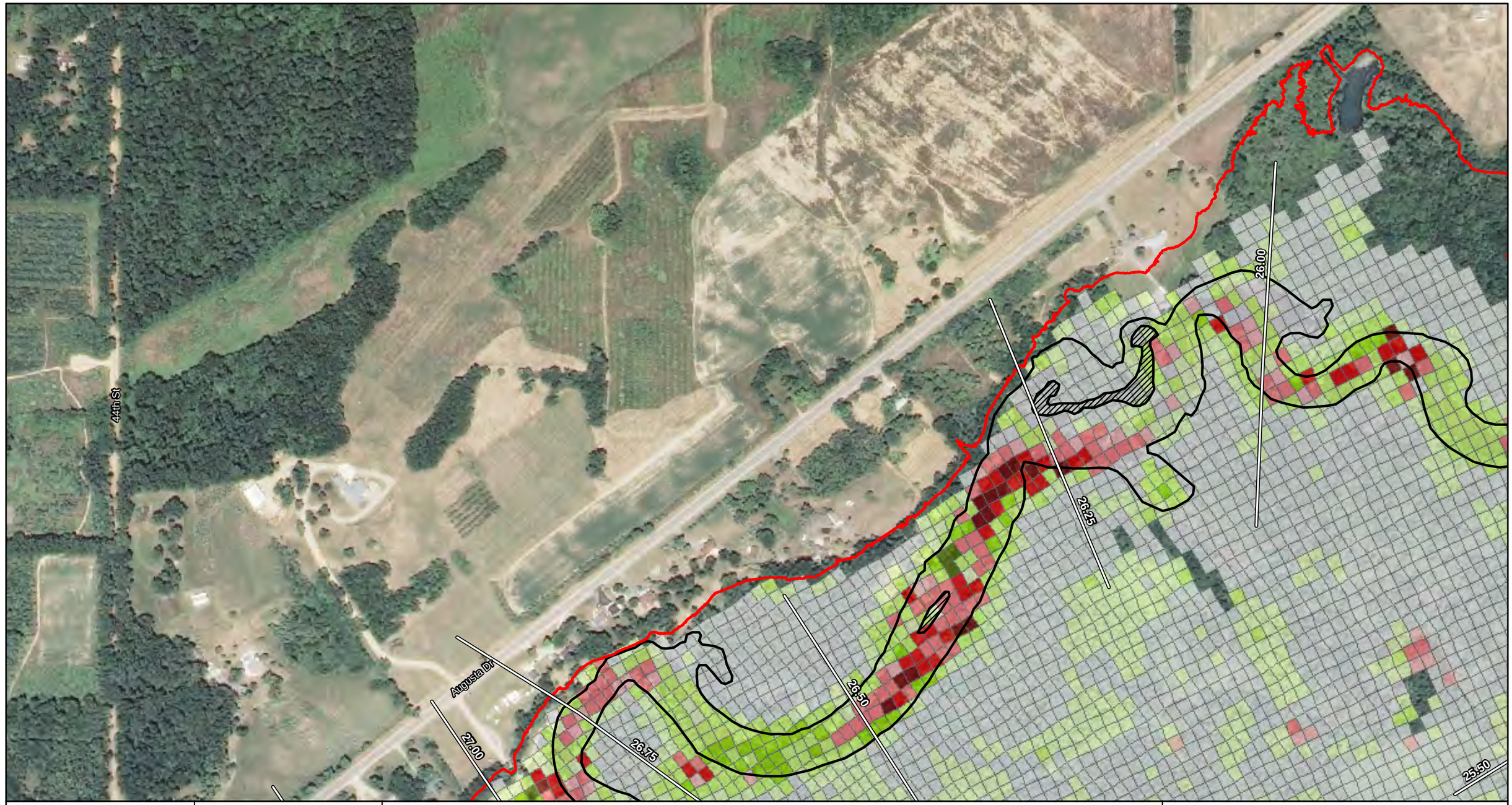
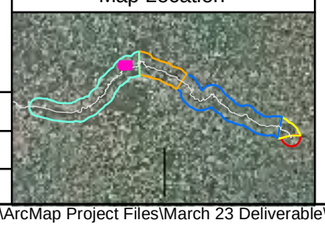
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 25.79 - MP 26.80

SHEET 27 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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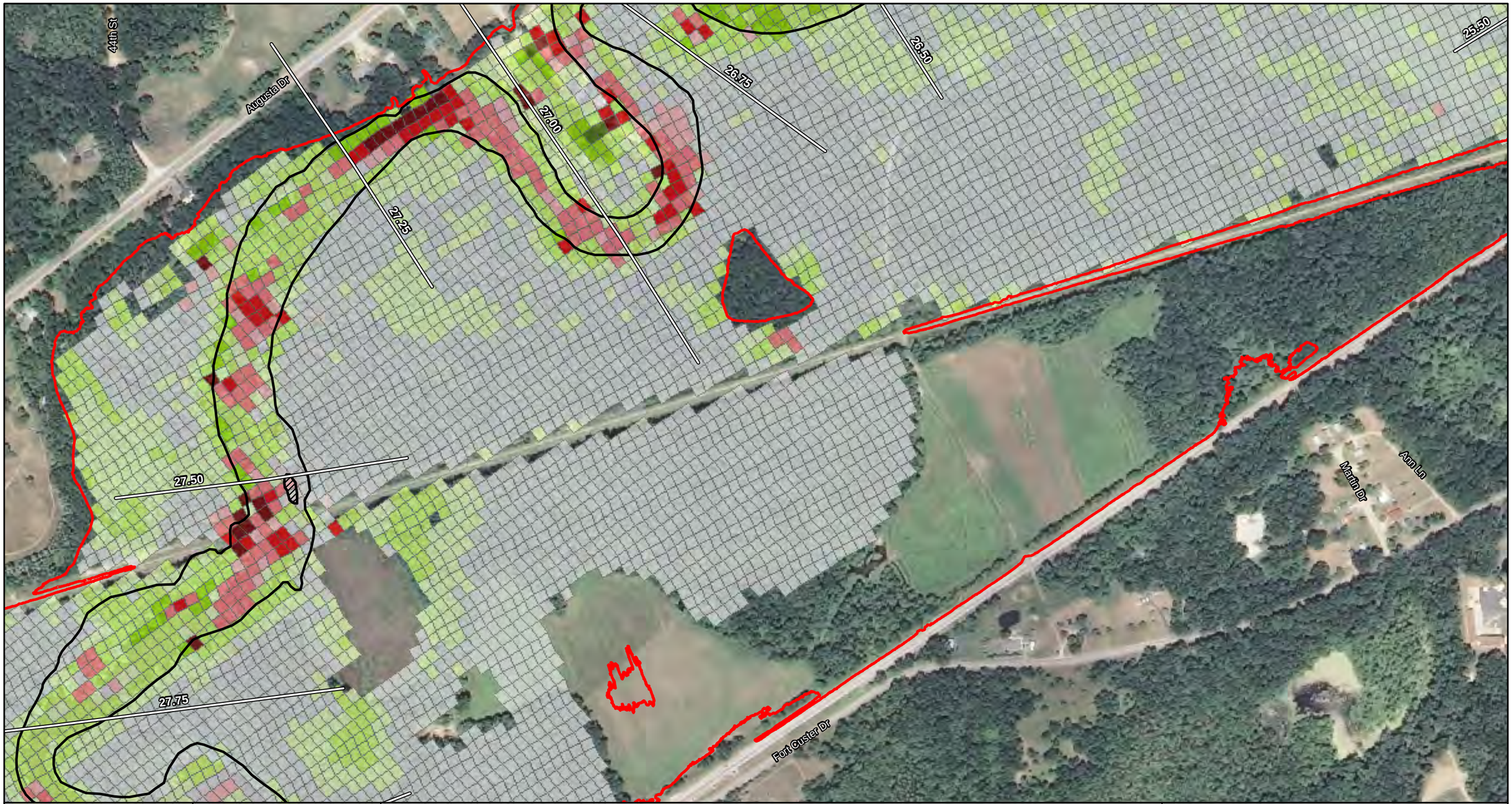
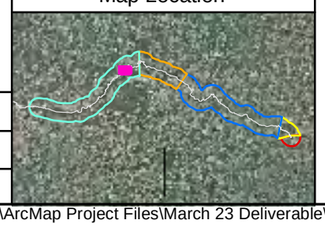
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 26.80 - MP 27.80

SHEET 28 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 27.80NW - MP 28.22NW

SHEET 29 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 27.80SE - MP 28.22SE

SHEET 30 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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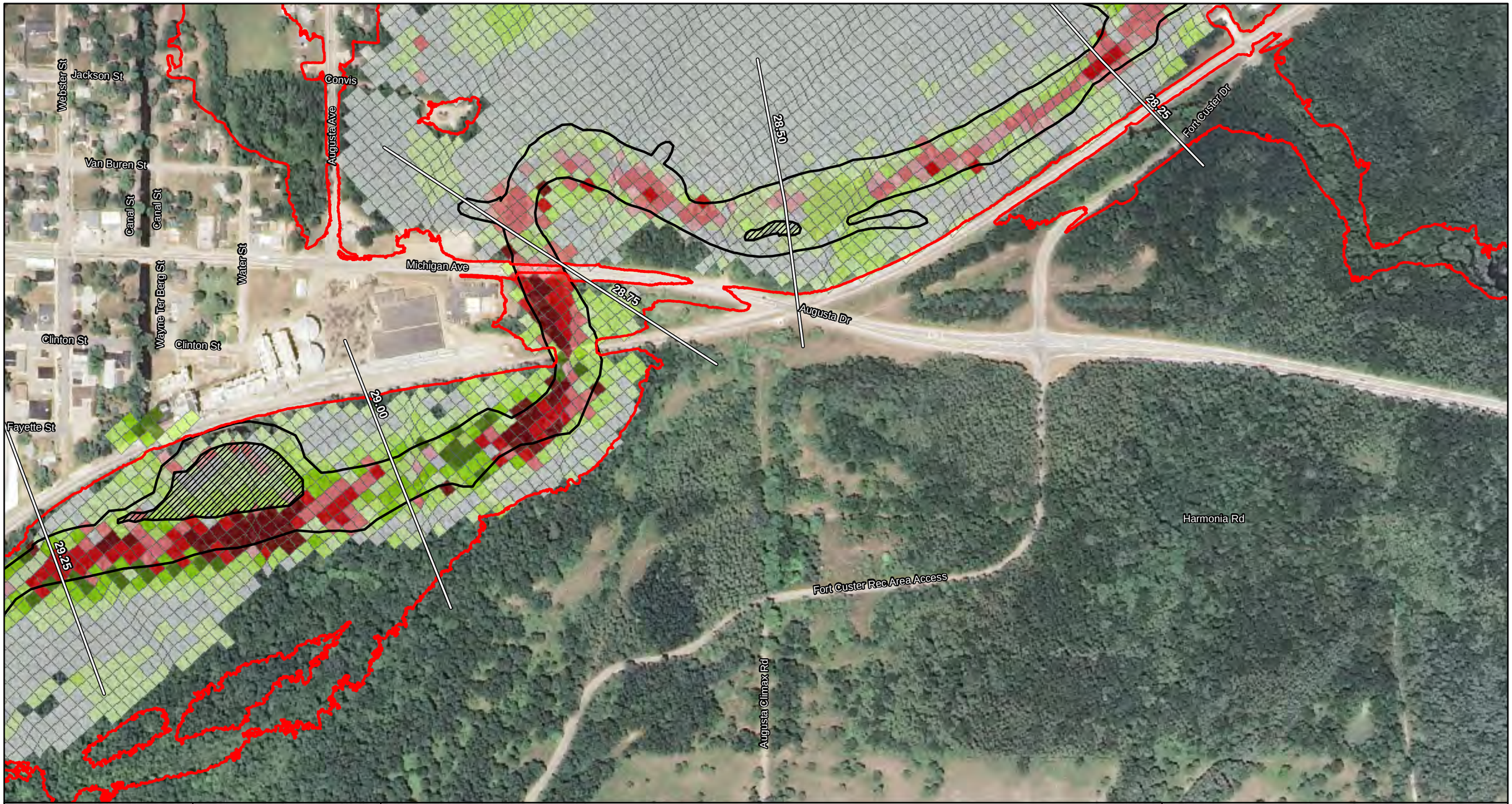
Aerial Photography Date: July & August 2009



Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 28.22 - MP 29.20

SHEET 31 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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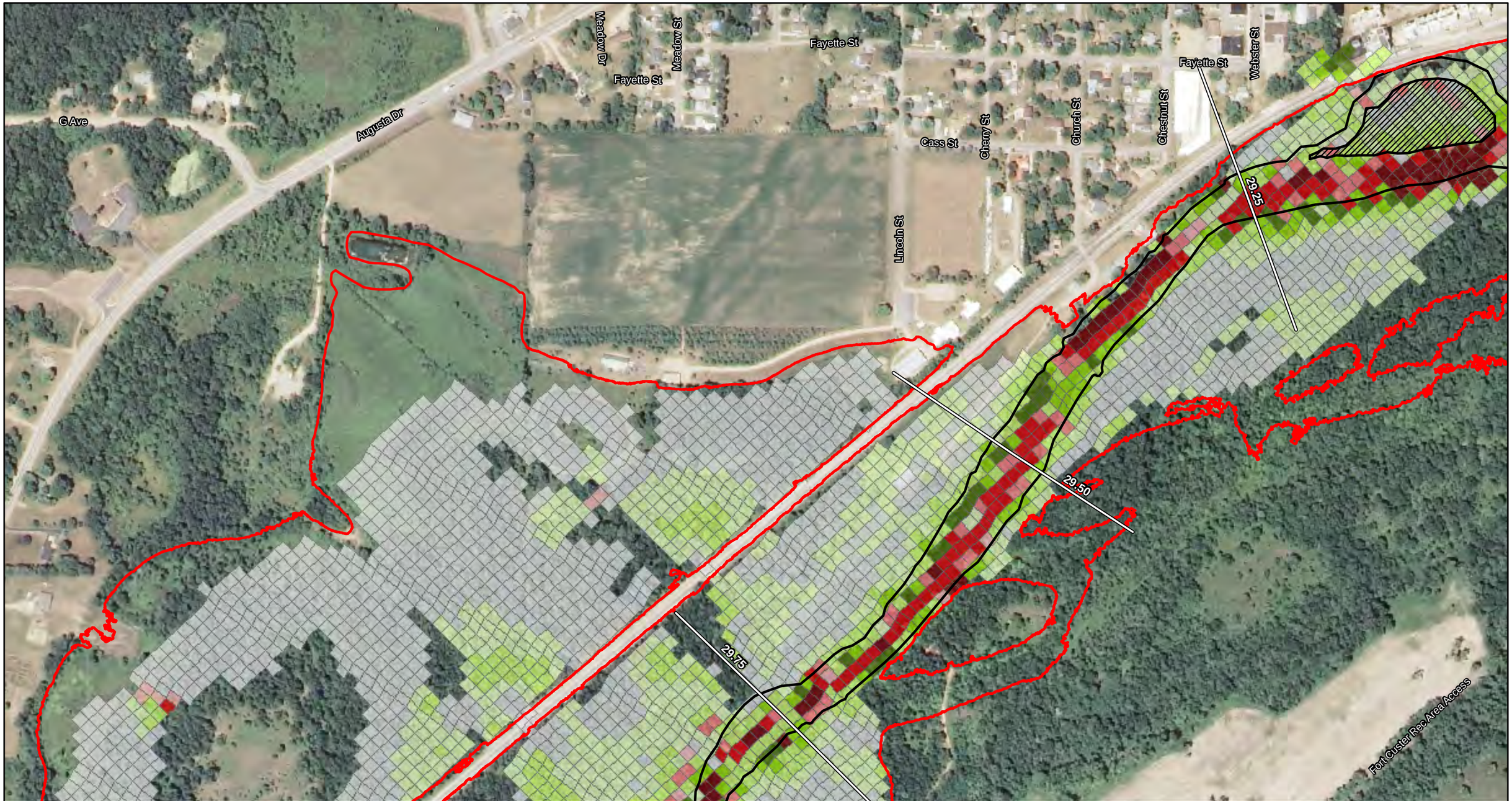
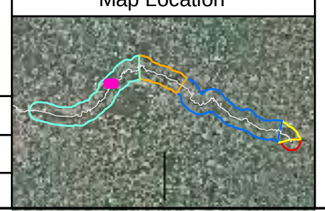
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 29.20 - MP 29.82

SHEET 32 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 29.82 - MP 30.84

SHEET 33 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 30.84 - MP 31.40

SHEET 34 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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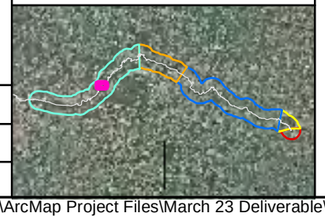
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 31.40 - MP 31.94

SHEET 35 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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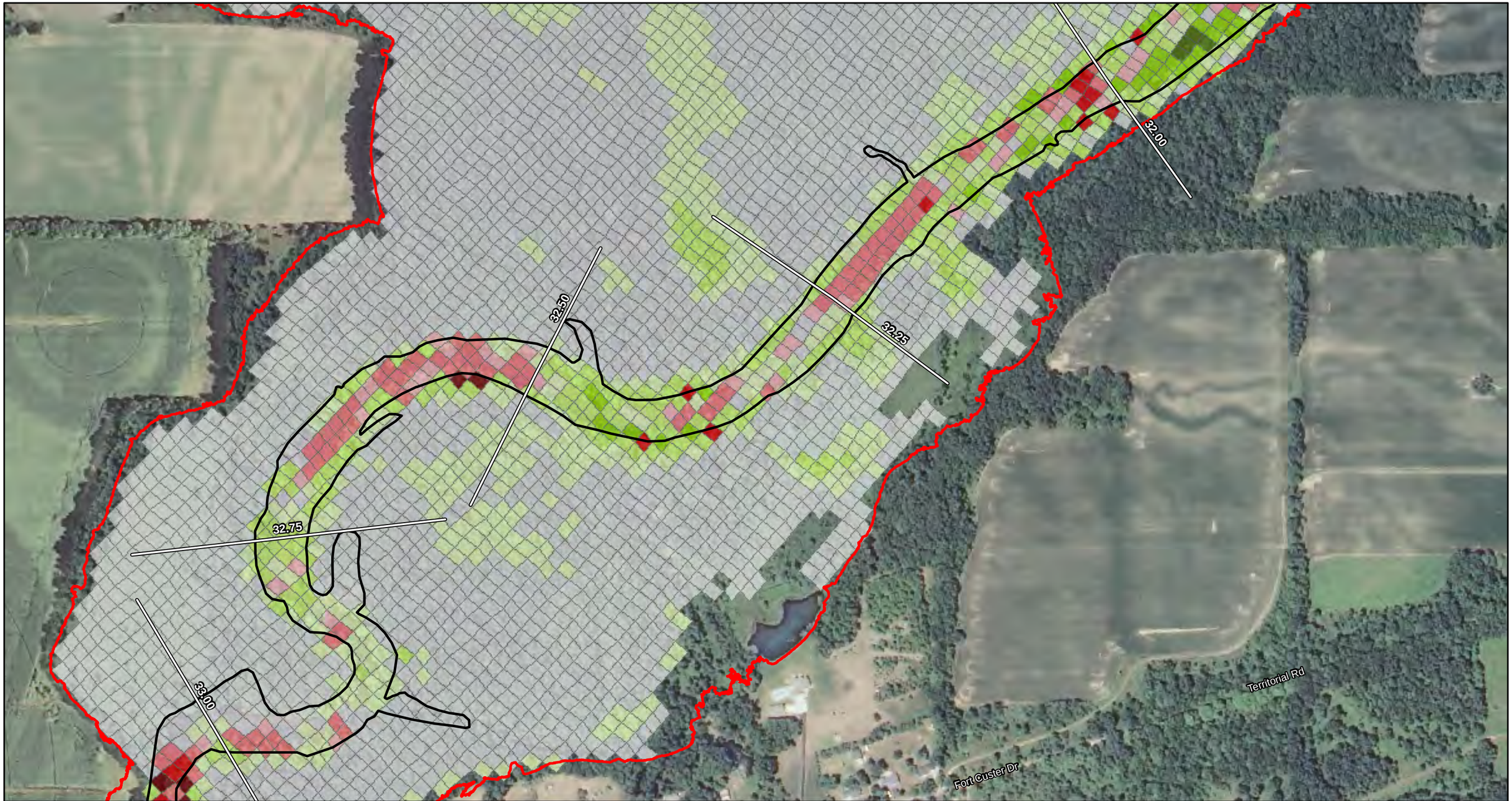
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 31.94 - MP 33.00

SHEET 36 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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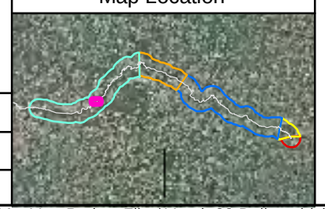
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 33.00 - MP 33.52

SHEET 37 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 33.52 - MP 34.70

SHEET 38 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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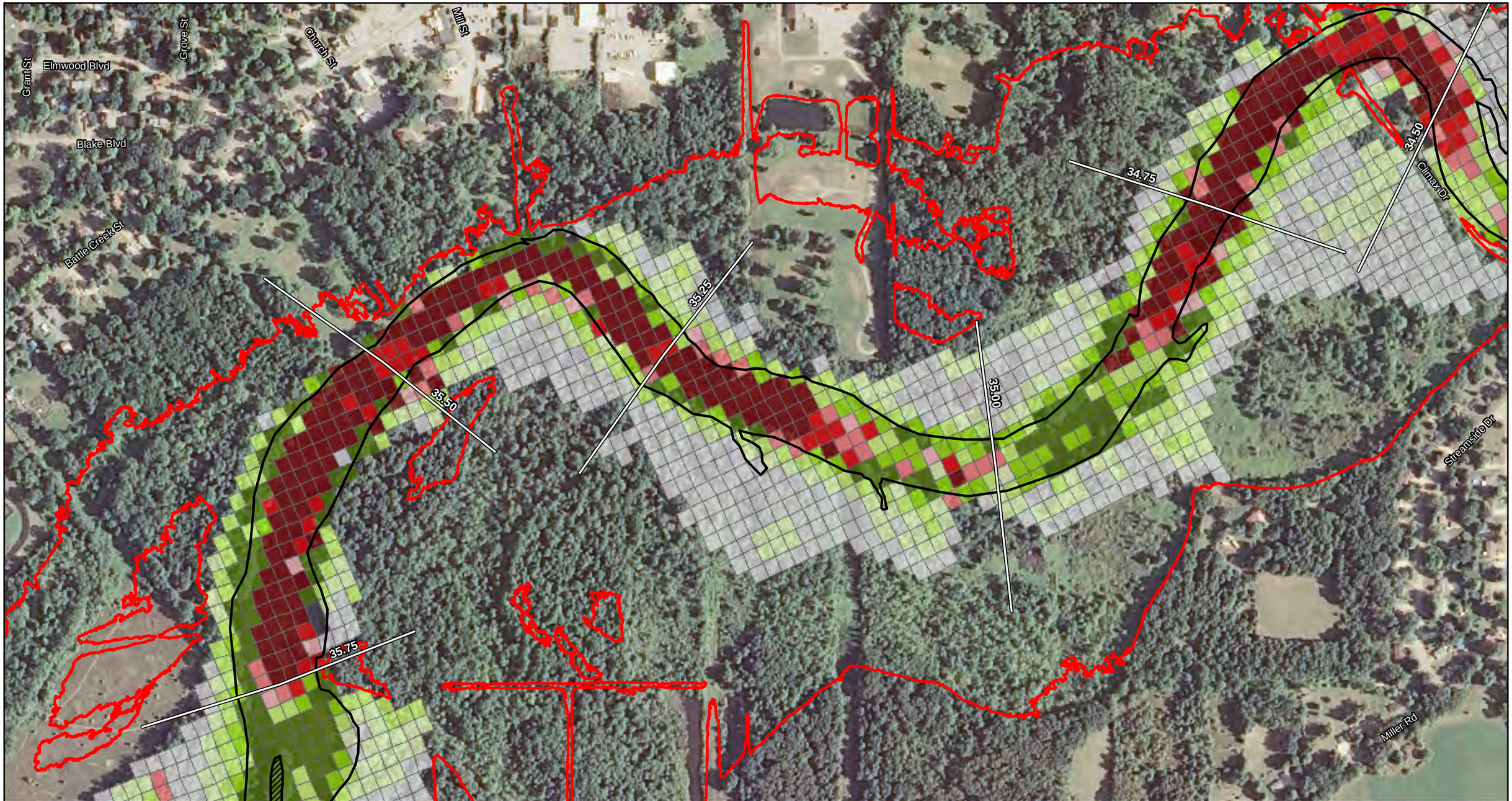
Aerial Photography Date: July & August 2009



Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 34.70 - MP 35.75

SHEET 39 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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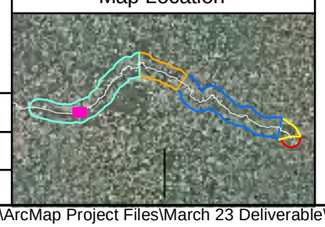
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

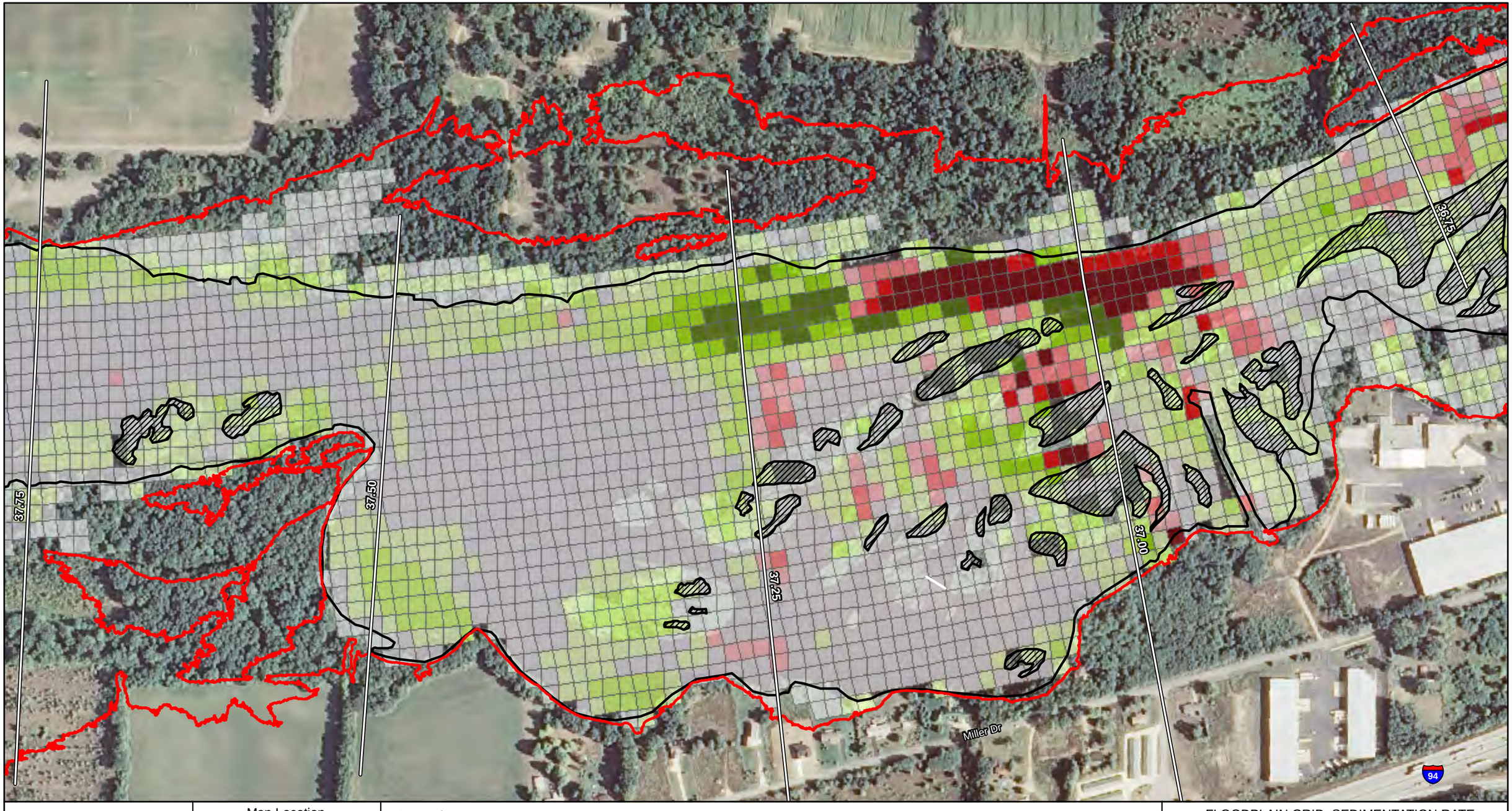
FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 35.75 - MP 36.75

SHEET 40 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Sedimentation_Rate_July_2010.mxd

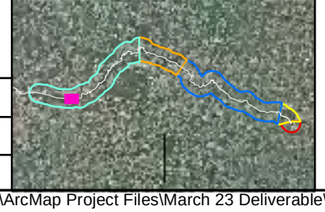
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 36.75 - MP 37.75

SHEET 41 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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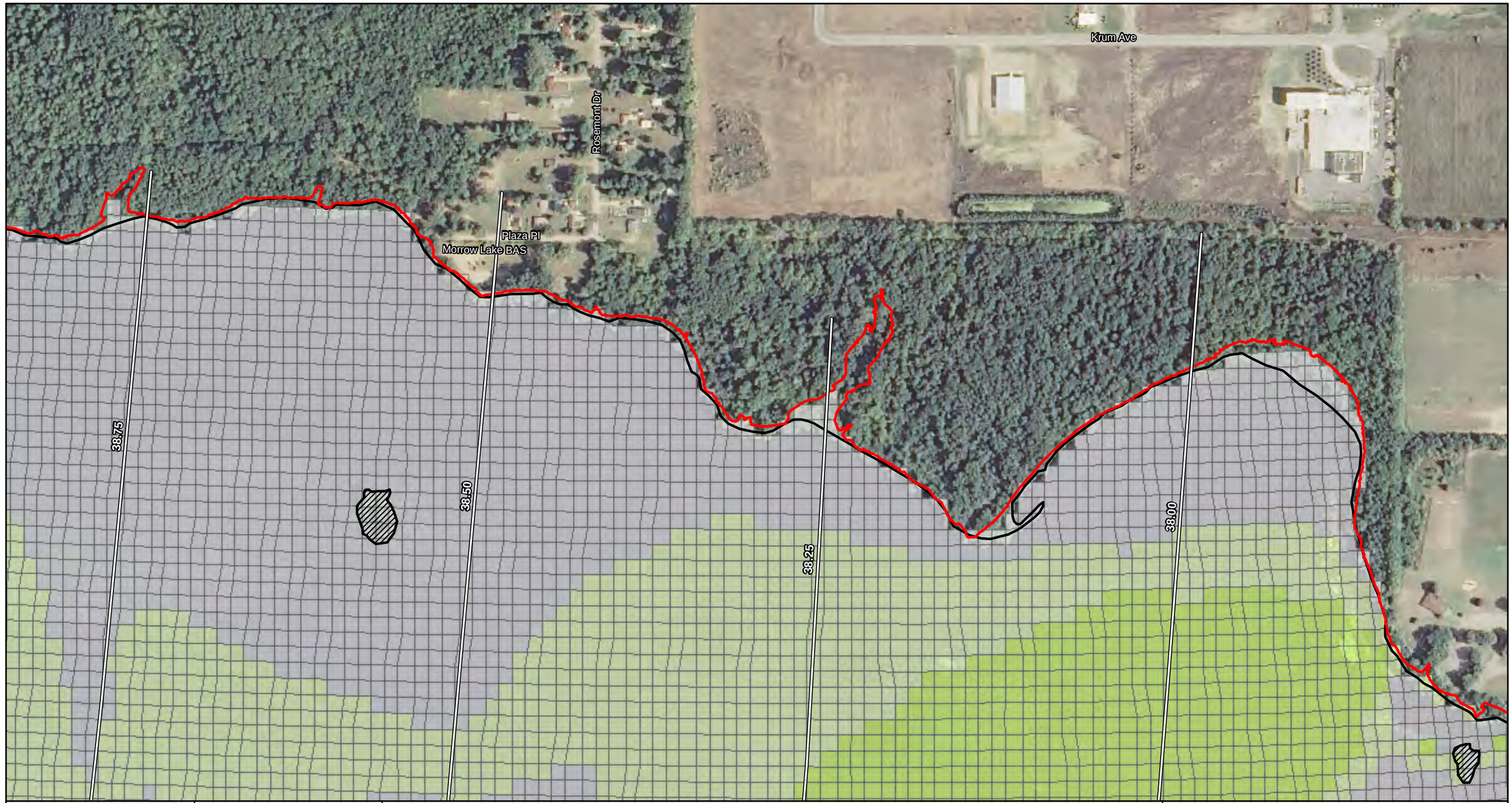
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 37.75N - MP 38.80N

SHEET 42 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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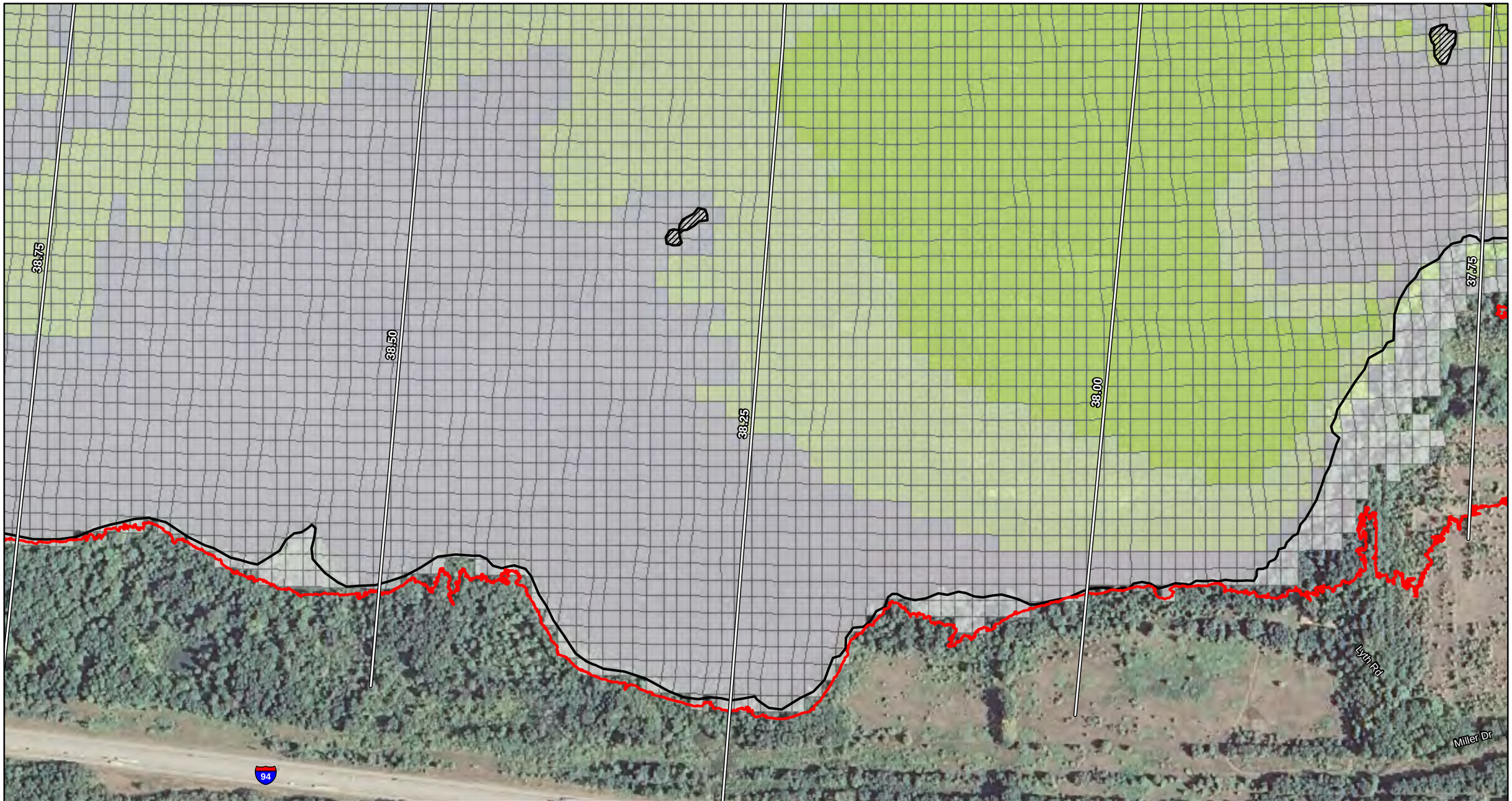
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

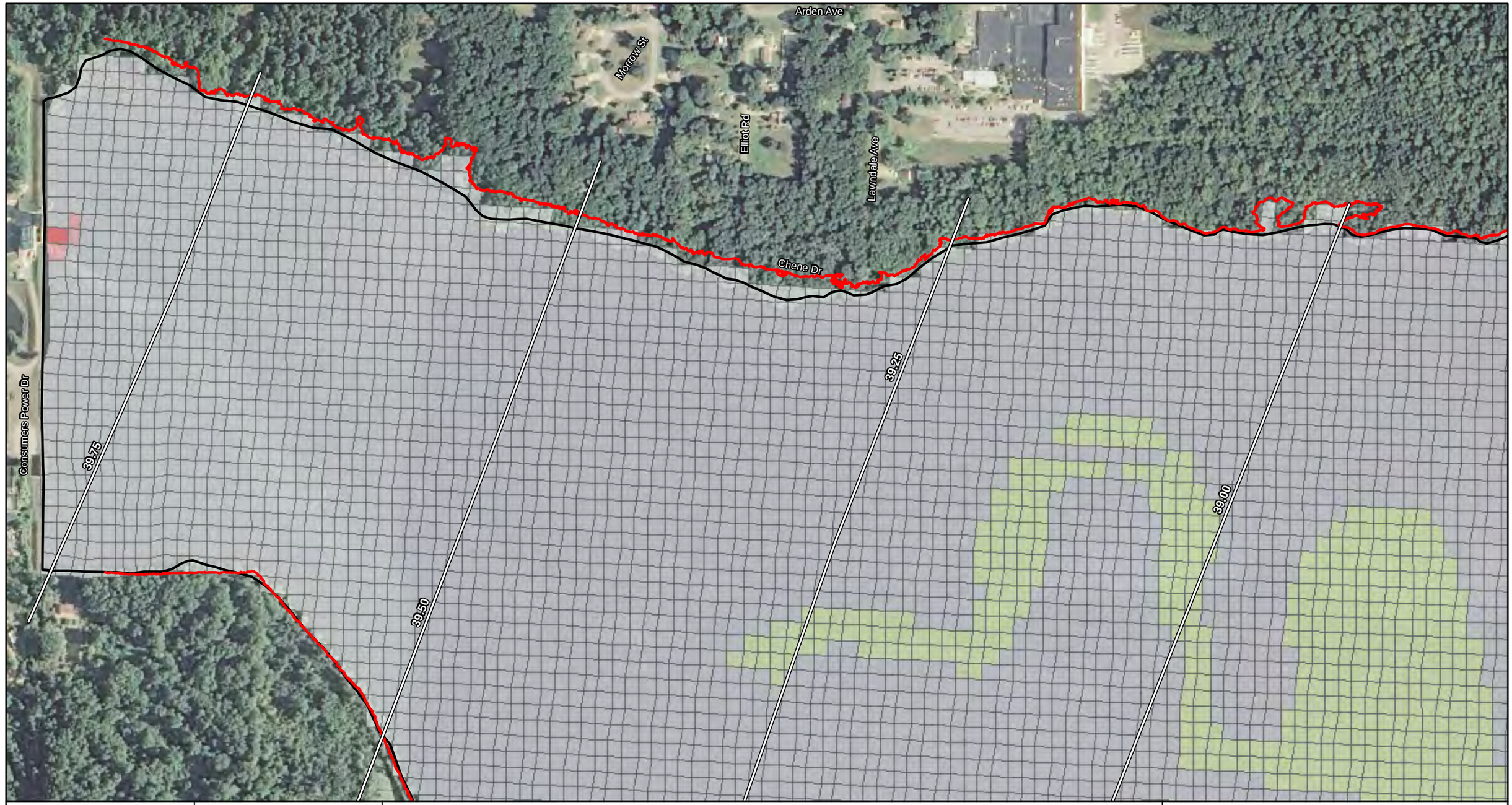
FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 37.75S - MP 38.80S

SHEET 43 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

X:\Hydrodynamic Model Data Transfer\ArcMap Project Files\March 23 Deliverable\Floodplain_Sedimentation_Rate_July_2010.mxd

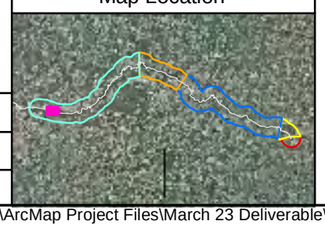
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 38.80N - MP 39.95N

SHEET 44 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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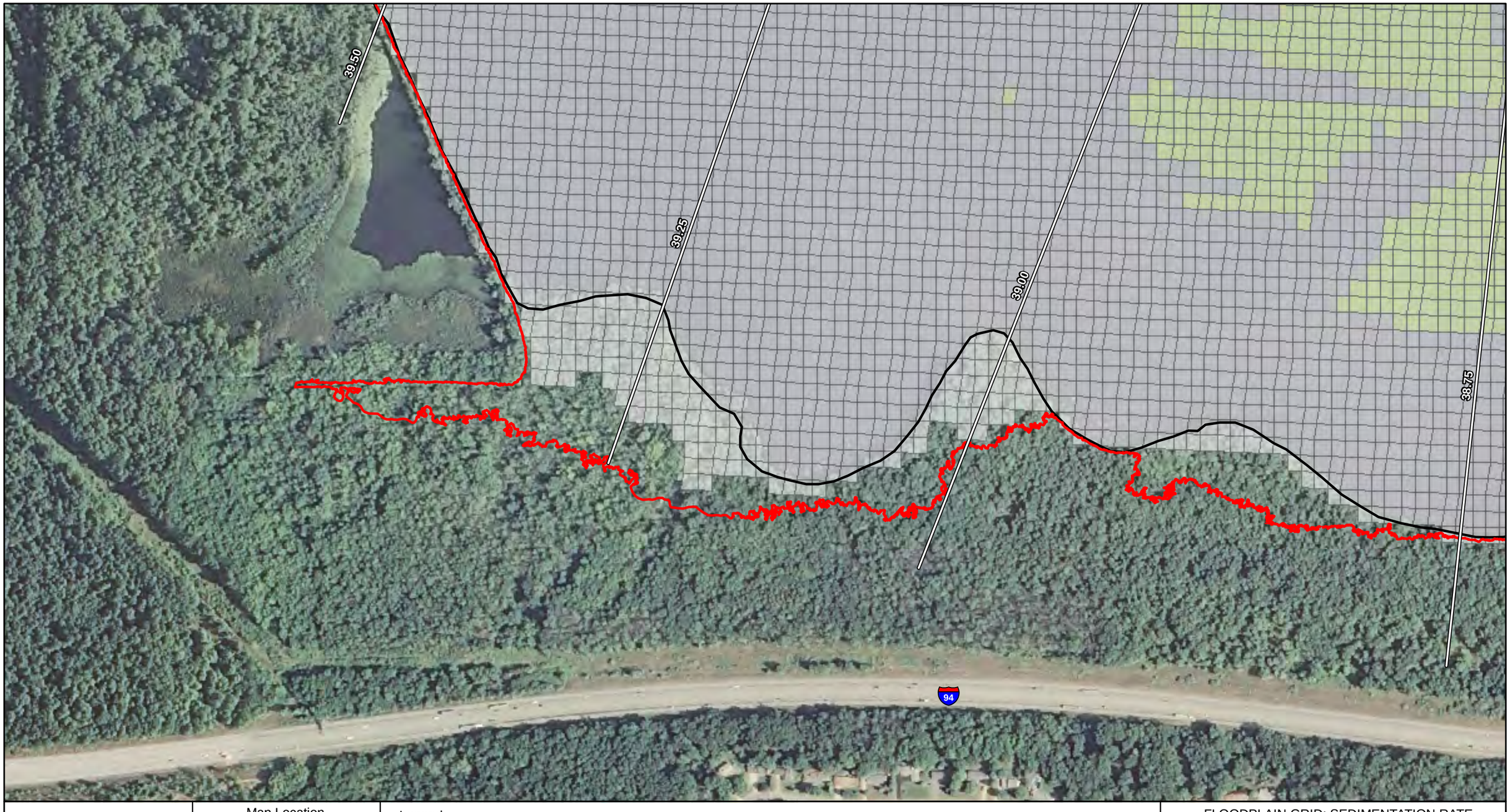
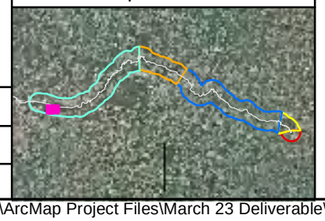
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

All Grid Cells

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
ALL GRID CELLS
JULY 24 - 31, 2010
MP 38.80S - MP 39.95S

SHEET 45 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

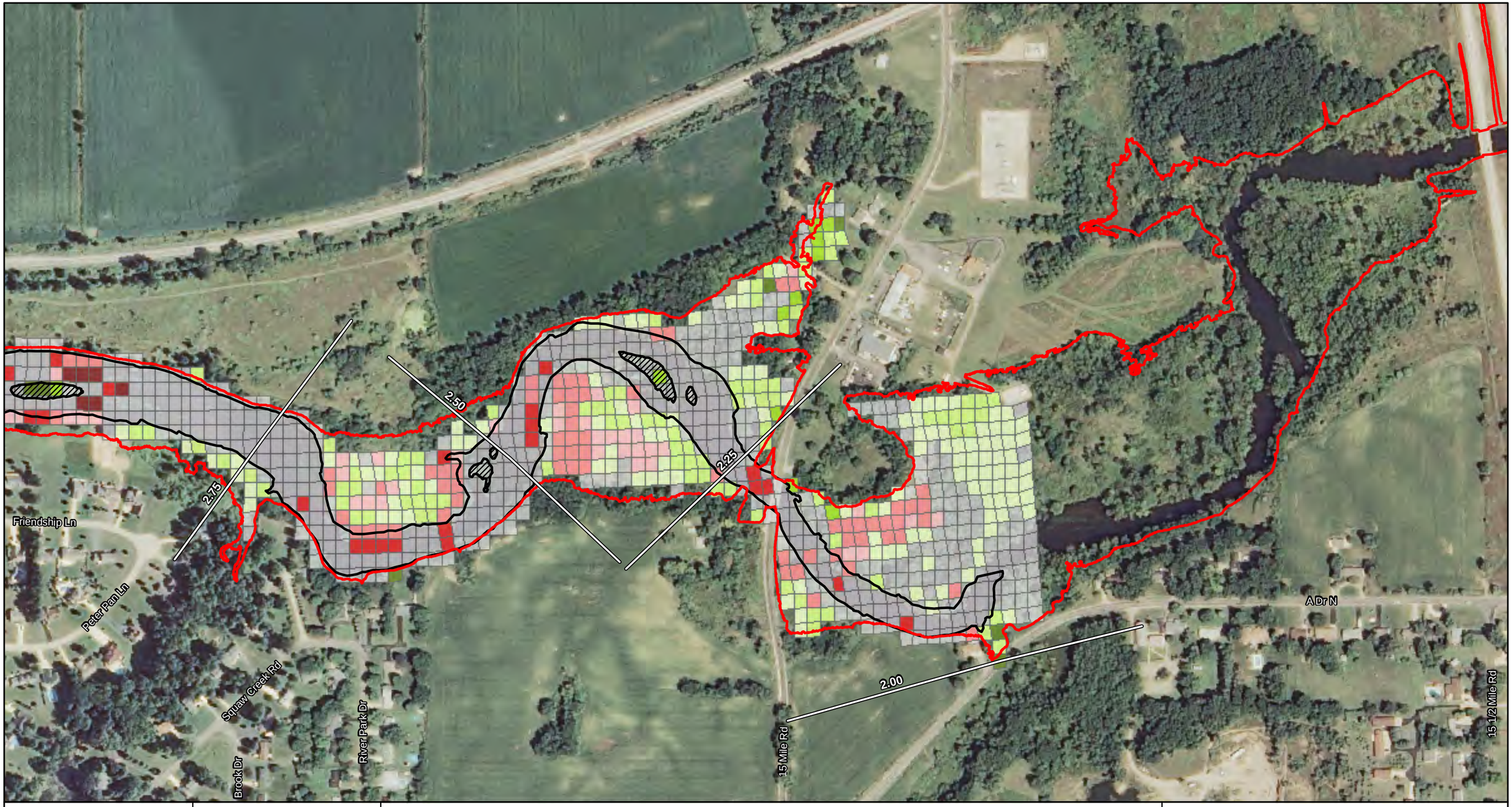
Figure 4-28

Floodplain Grid: Sedimentation Rate

Cells with Net Change in Silt or Clay Mass

July 24 – 31, 2010

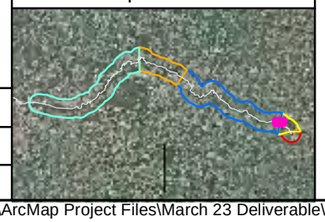
Sheets 1 through 45



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 01.88 - MP 02.91

SHEET 1 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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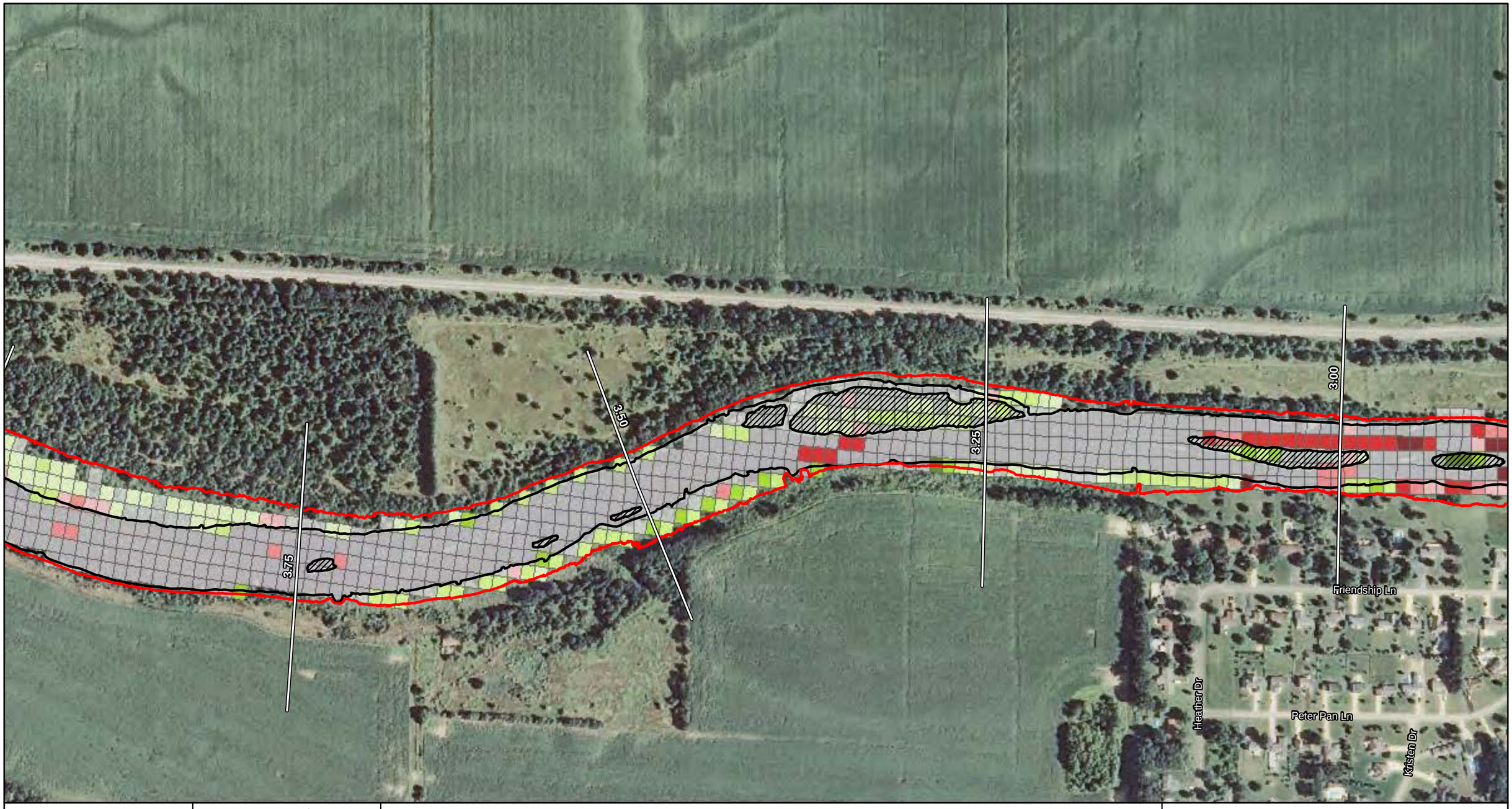
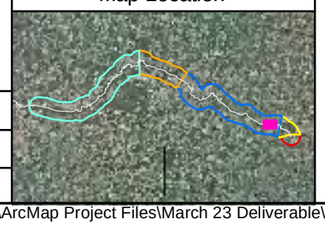
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 02.91 - MP 03.93

SHEET 2 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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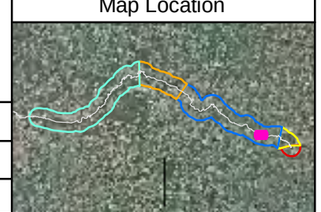
Aerial Photography Date: July & August 2009

5.00
4.75
4.50
4.25
4.00

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 03.93 - MP 04.98

SHEET 3 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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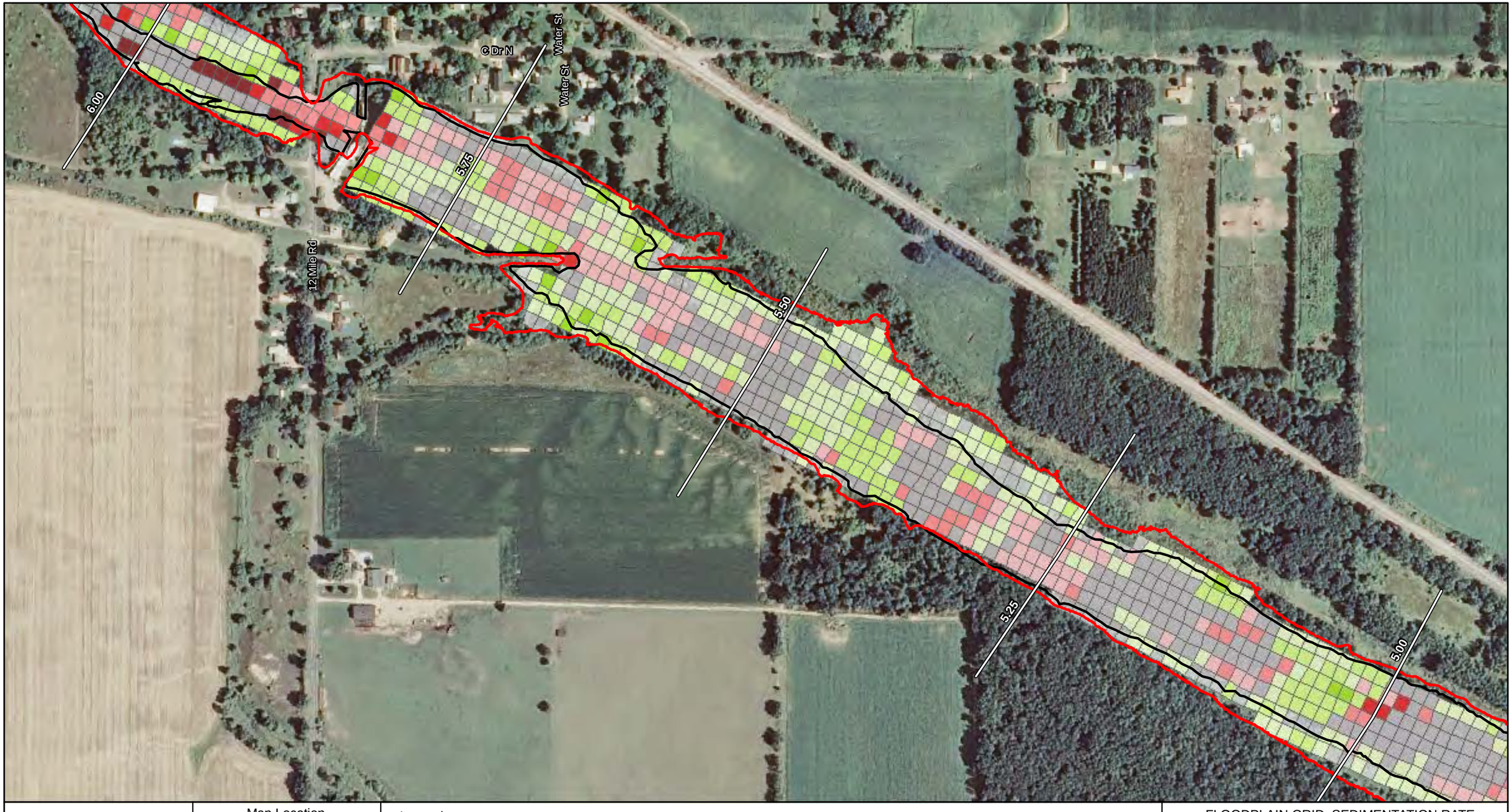
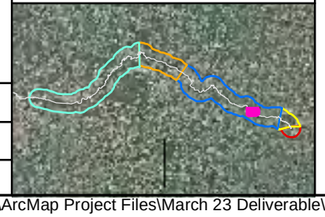
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 04.98 - MP 06.03

SHEET 4 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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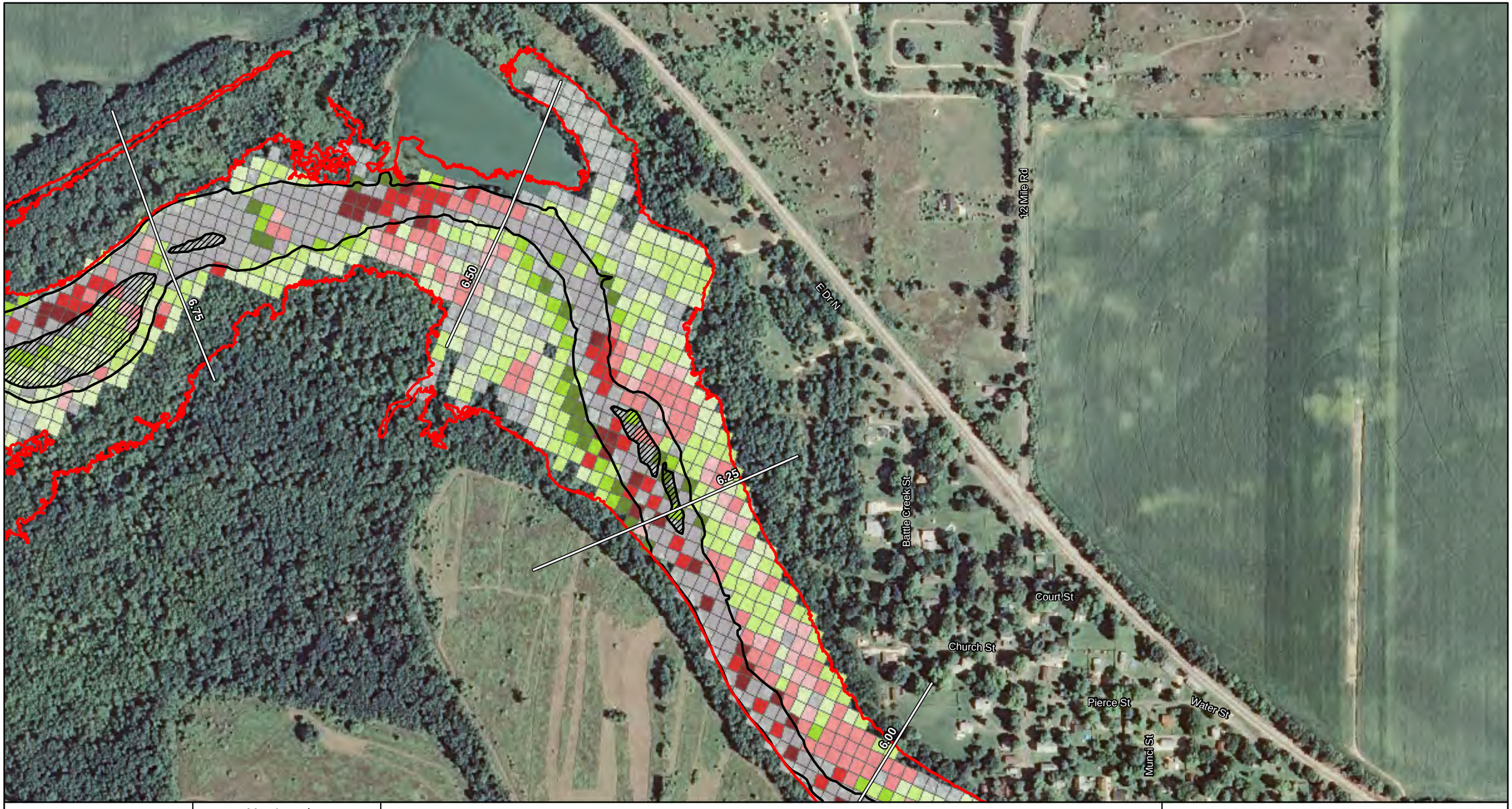
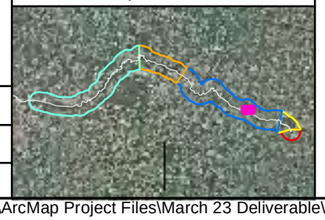
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 06.03 - MP 06.85

SHEET 5 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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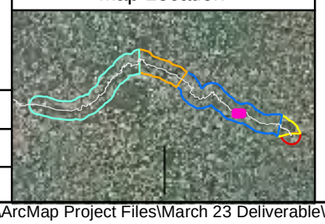
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 06.85 - MP 07.95

SHEET 6 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 07.95 - MP 08.93

SHEET 7 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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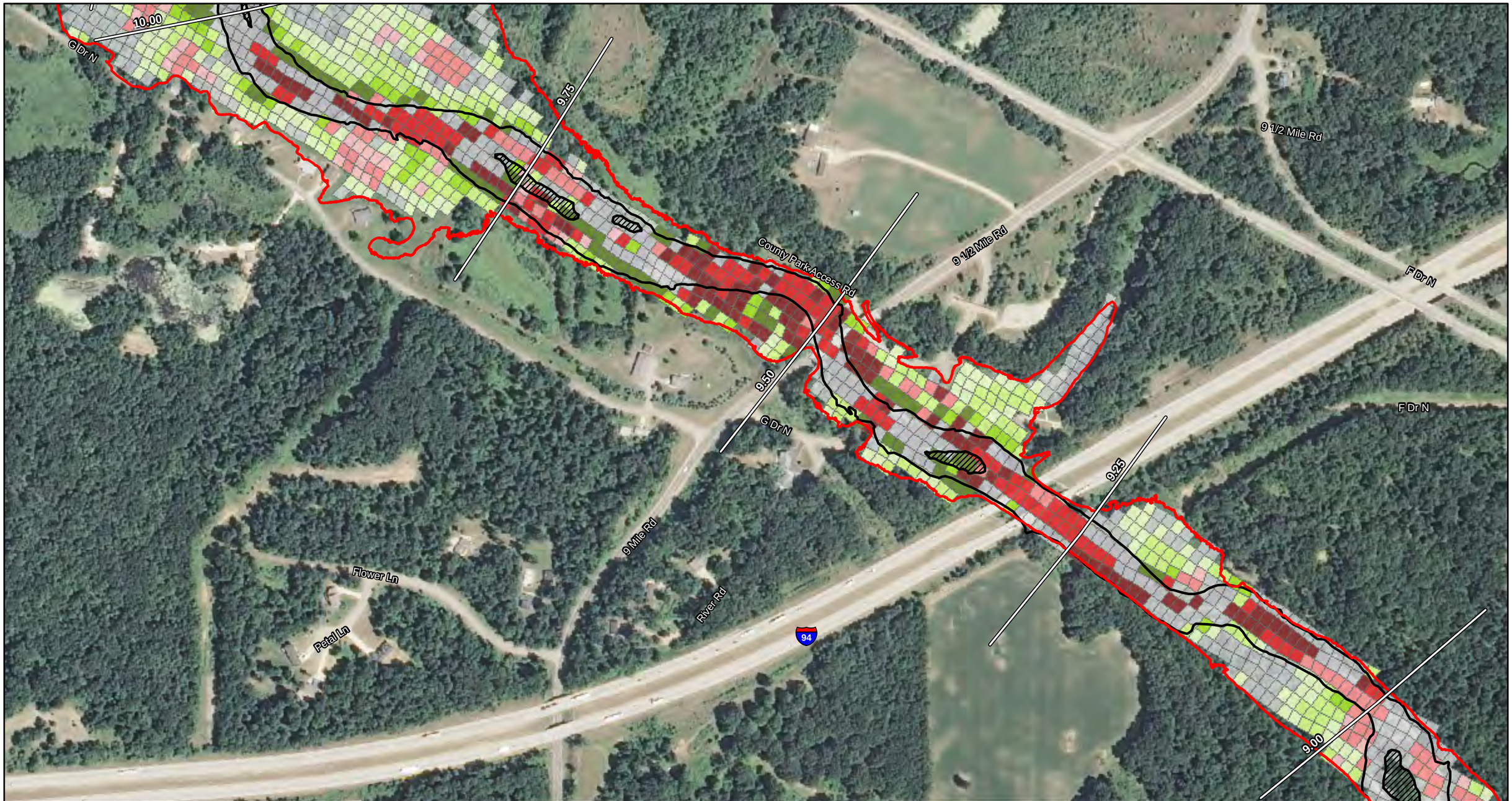
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 08.93 - MP 10.00

SHEET 8 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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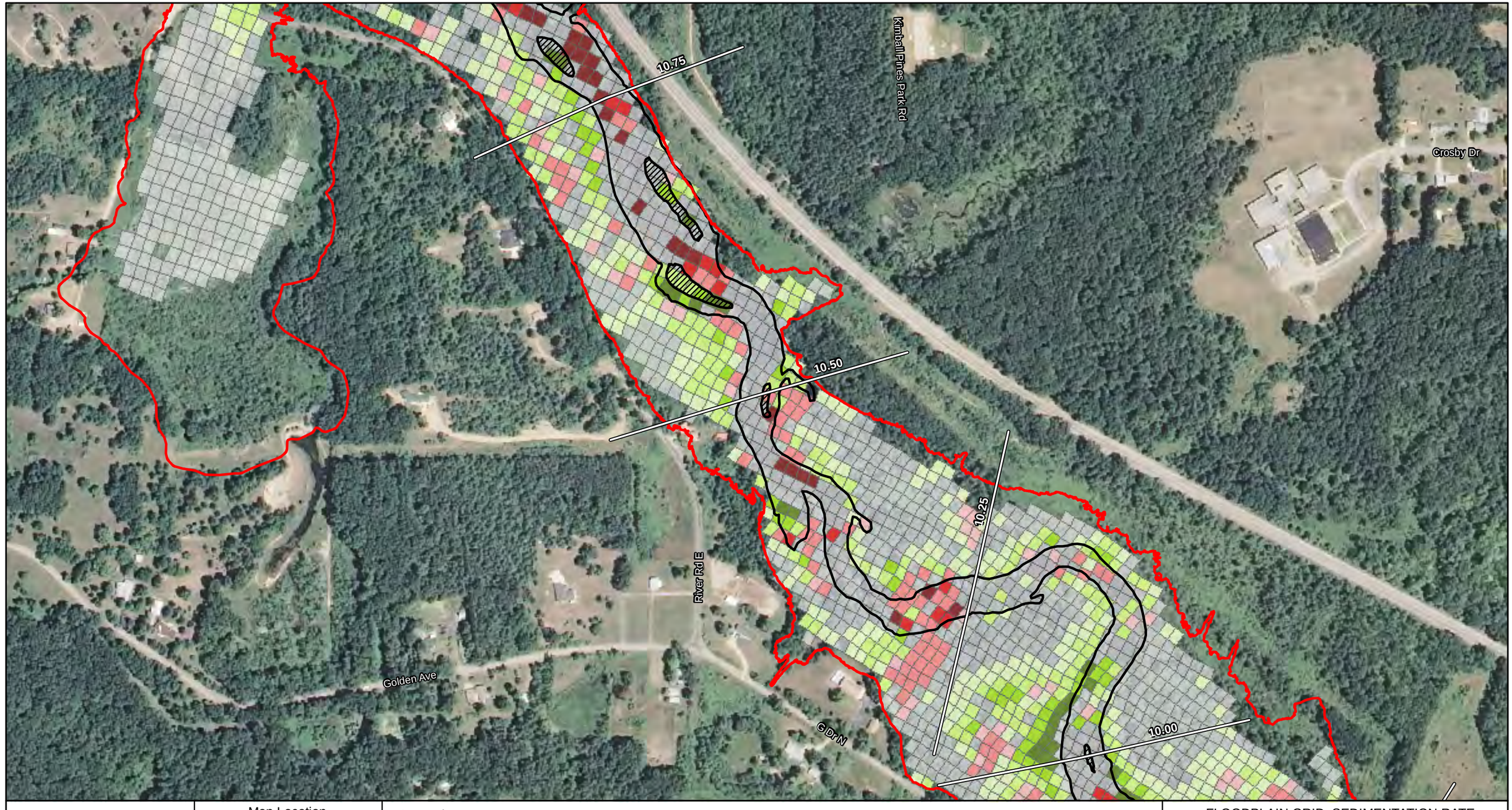
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 10.00 - MP 10.80

SHEET 9 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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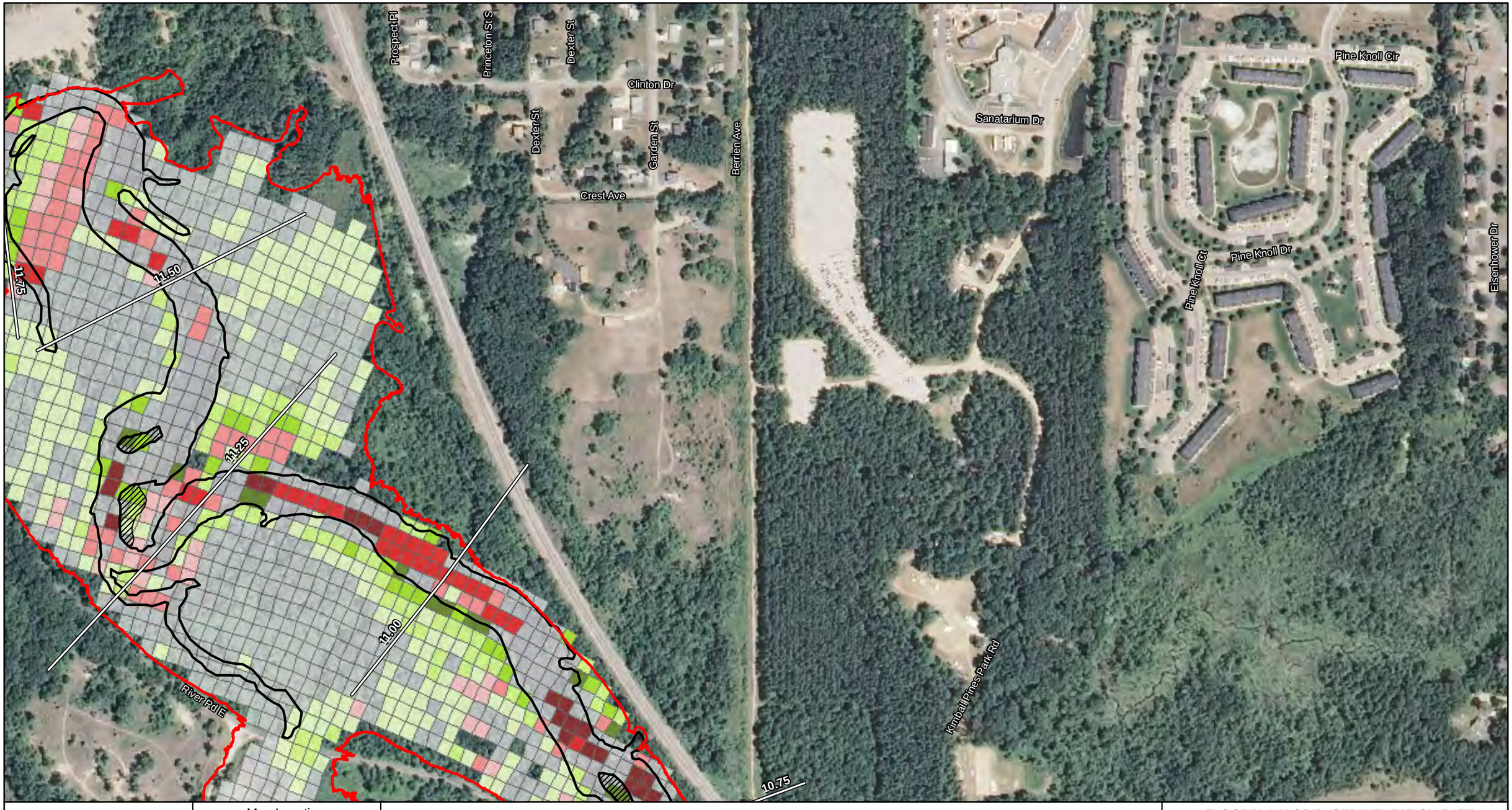
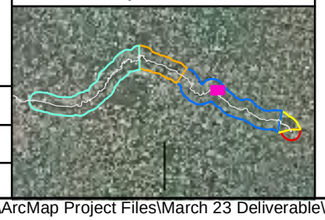
Aerial Photography Date: July & August 2009



Map Location



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 10.80 - MP 11.70

SHEET 10 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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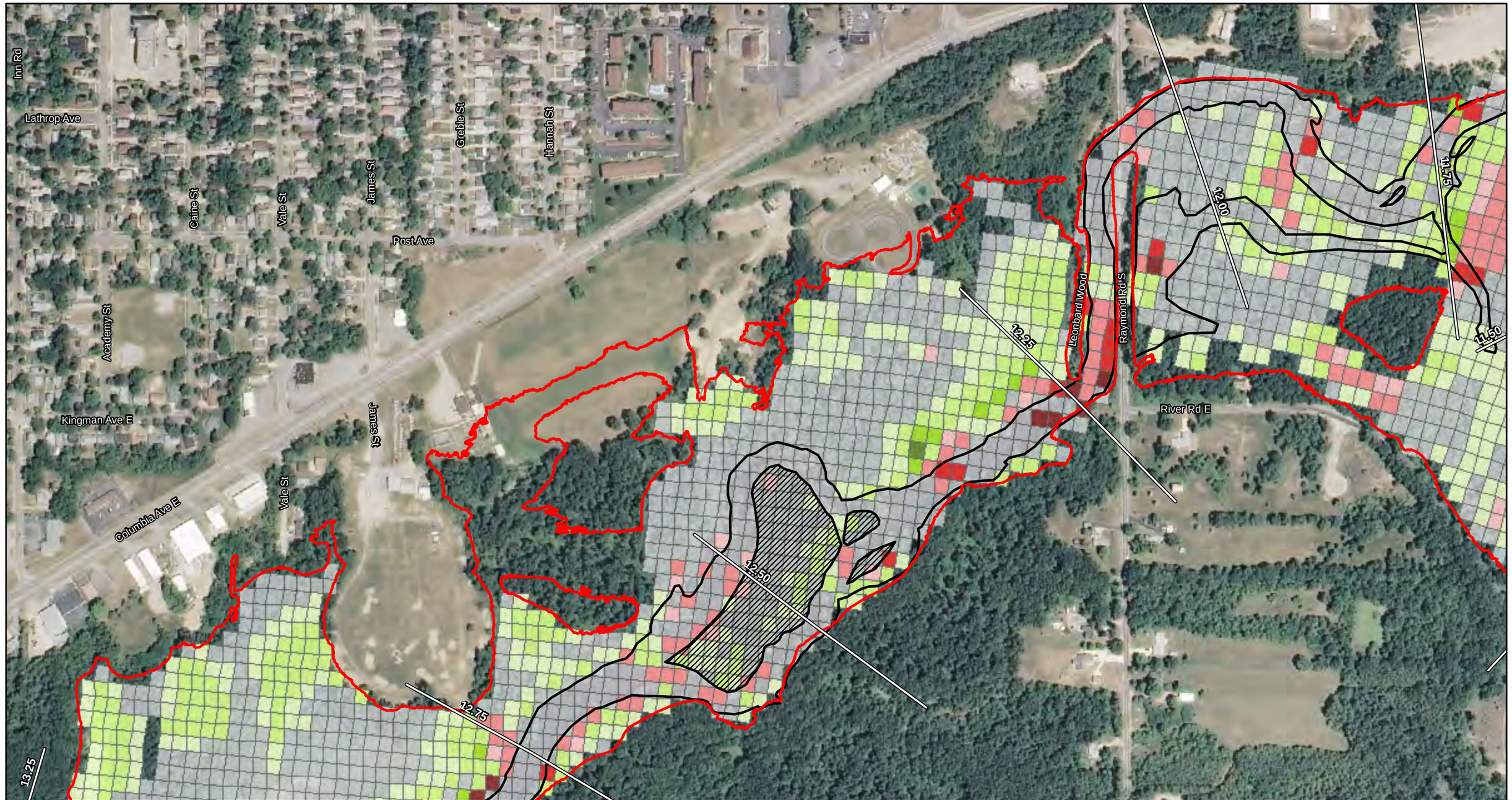
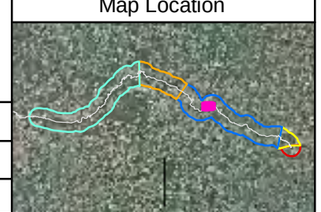
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 11.70 - MP 12.77

SHEET 11 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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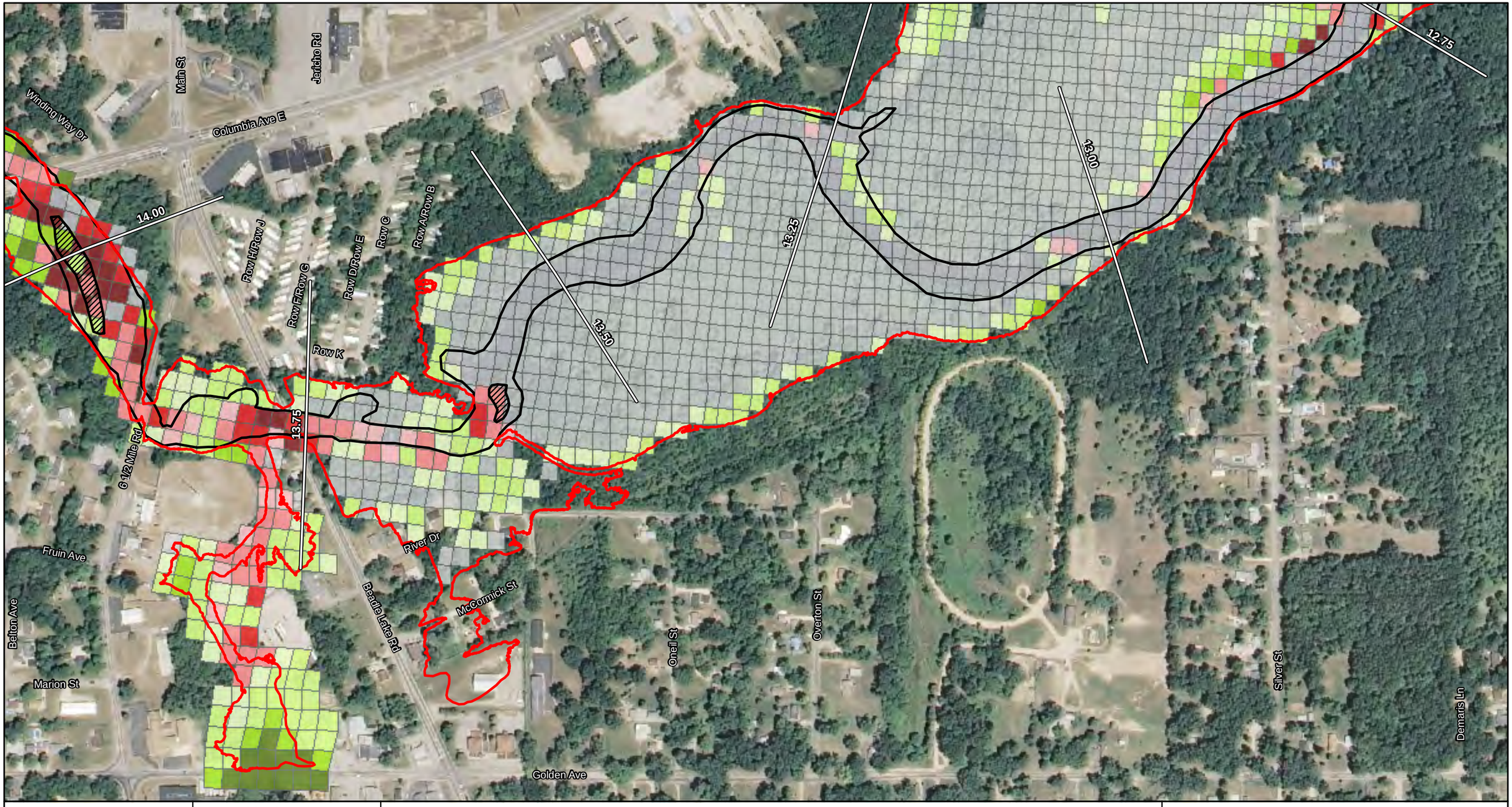
Aerial Photography Date: July & August 2009



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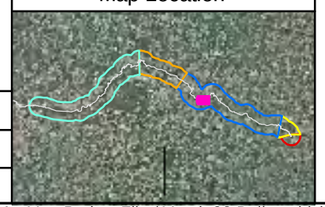

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 12.77 - MP 14.00

SHEET 12 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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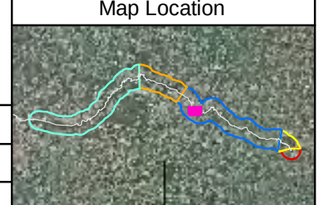
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 14.00 - MP 15.05

SHEET 13 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

Elder St
Caroline St
Battle Creek Ave
Bluff St
Riverside Dr
Sumac St
Baker Ct
Cleveland St
Goguac St
Capital Ave SW
Arthur St
Corwin St
Whittier Ave
Harrison St
15.50
15.25
15.00
Riverside Dr
Burnham St E
Elsmere St
Scenery St
Logan St
Mineral Ave
194
Fonda Ave
Kenosha Ave
Rockford St
Dickman Rd
South Ave
Jay St
Bartlett St
Yuba St
Green St
Bennett St
Warren St
Mary St
Main St
Colonial Ct
Pico Pl
South Pl
High St
Oak St
Willow St
Cliff St
Echo St
Horton St
Oak Hill Dr
Newark Ave
Walnut Ave
Taft St

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 15.05 - MP 15.71

SHEET 14 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 15.71 - MP 16.38

SHEET 15 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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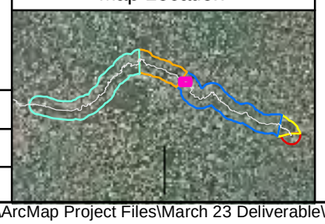
Aerial Photography Date: July & August 2009

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 16.38 - MP 17.30

SHEET 16 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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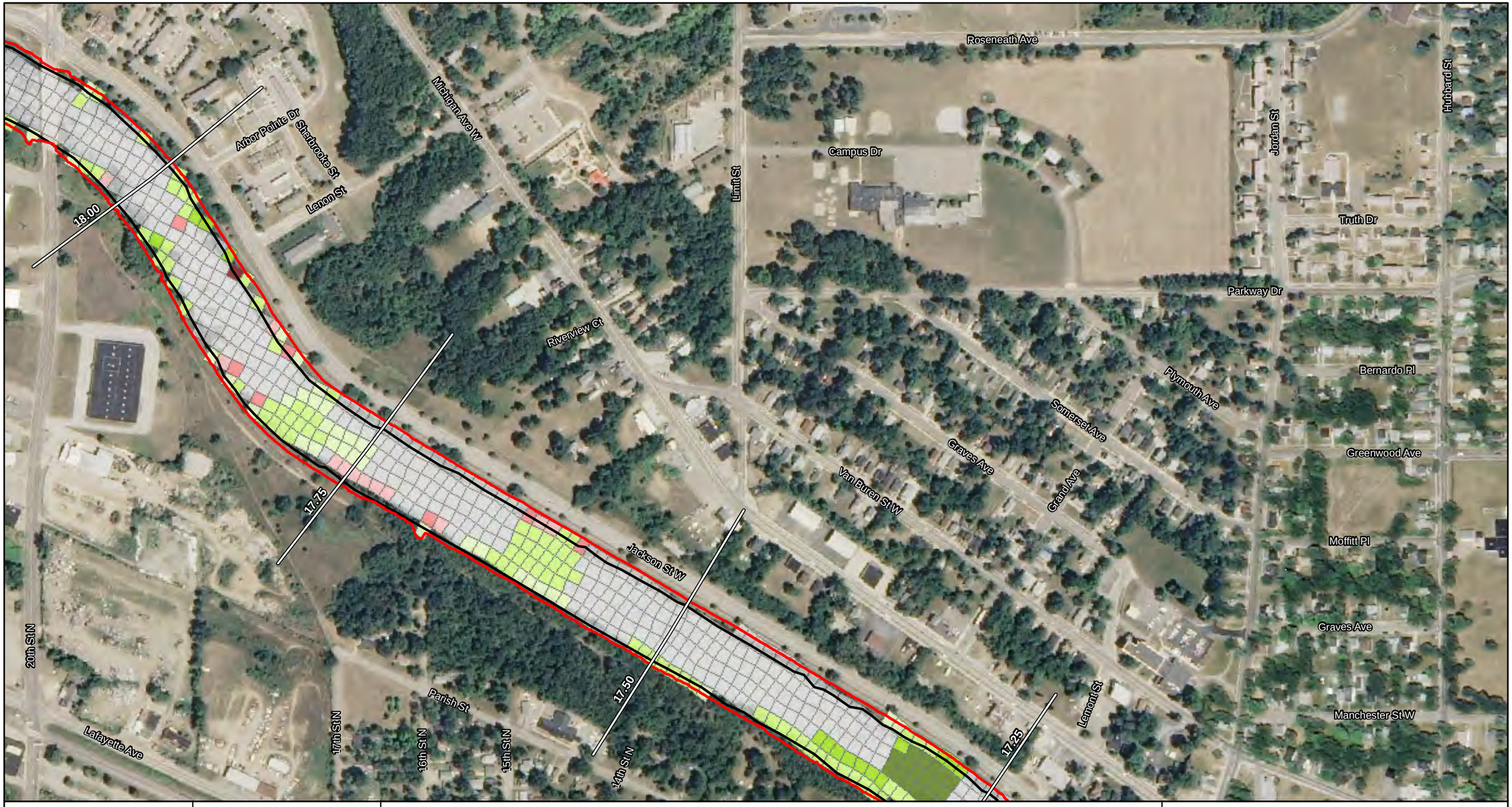
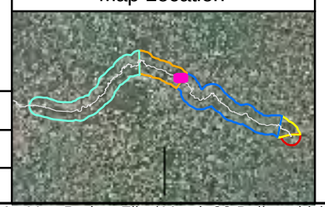
Aerial Photography Date: July & August 2009



Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 17.30 - MP 18.11

SHEET 17 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 18.11 - MP 19.18

SHEET 18 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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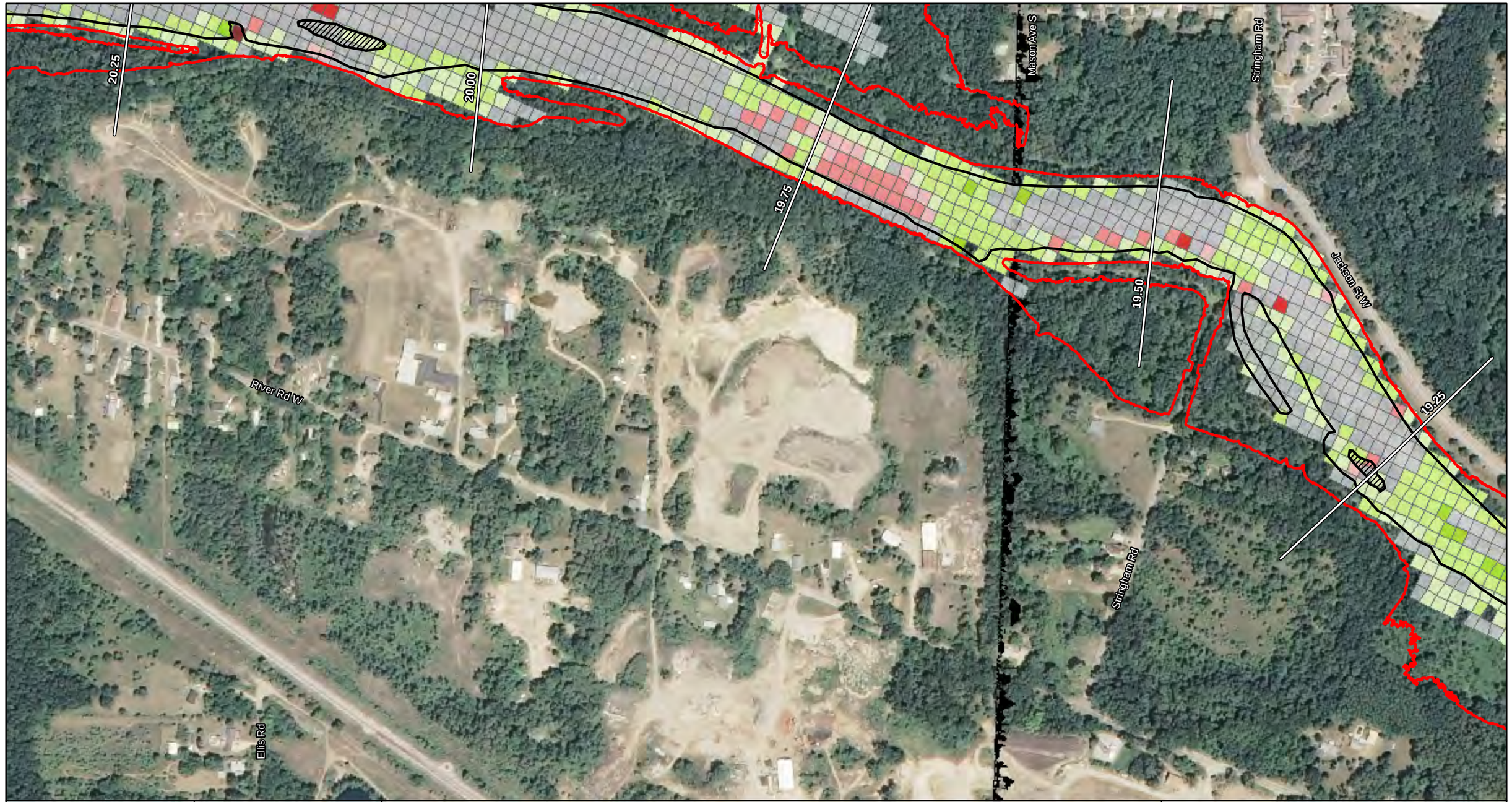
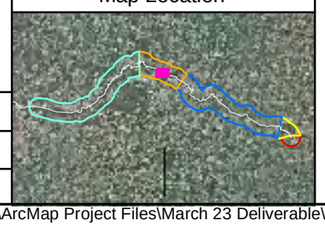
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 19.18 - MP 20.00

SHEET 19 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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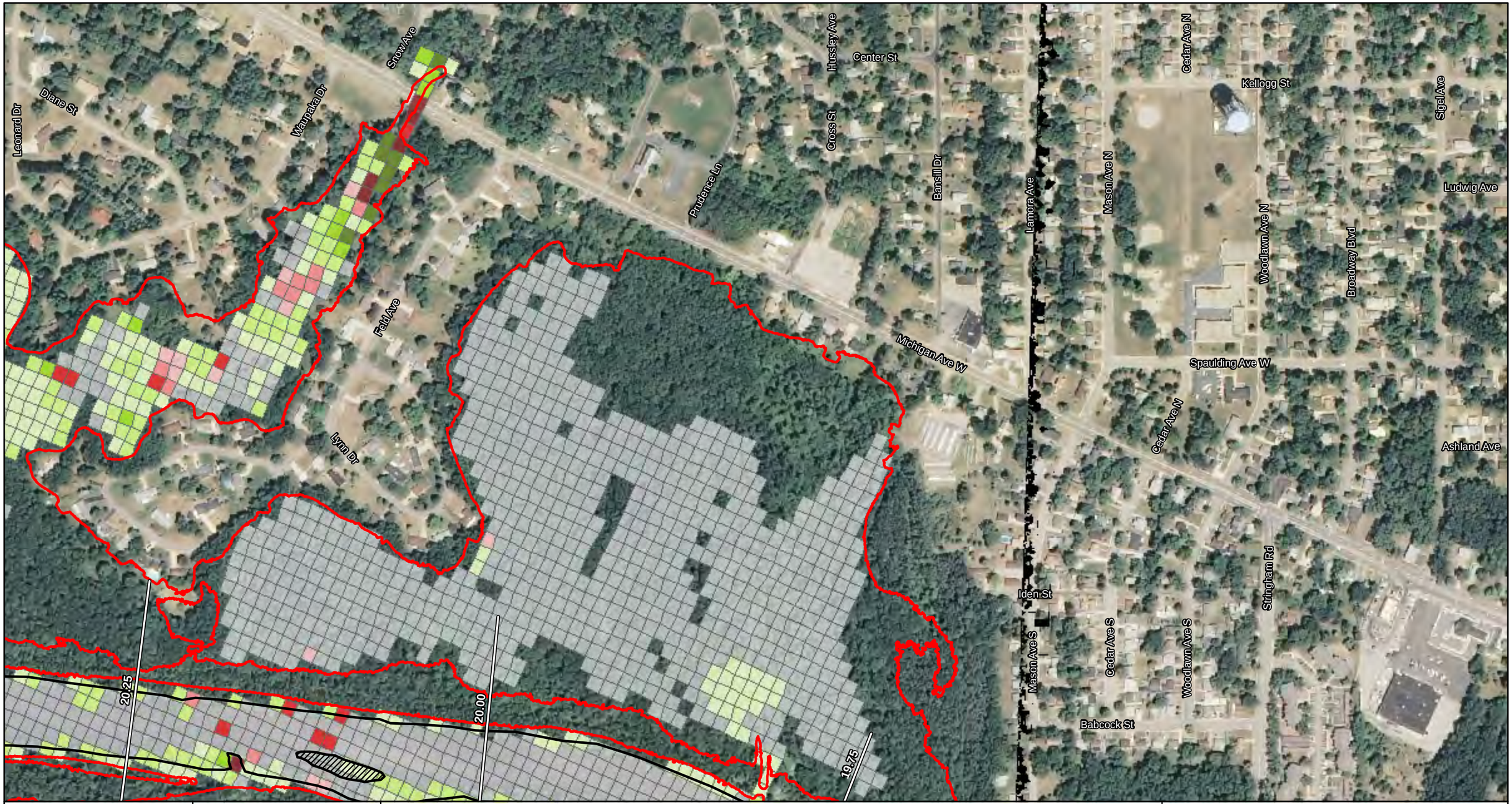
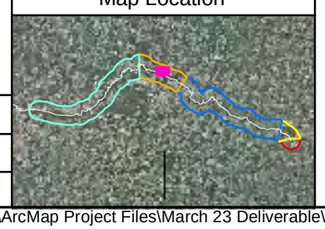
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 20.00 - MP 20.32

SHEET 20 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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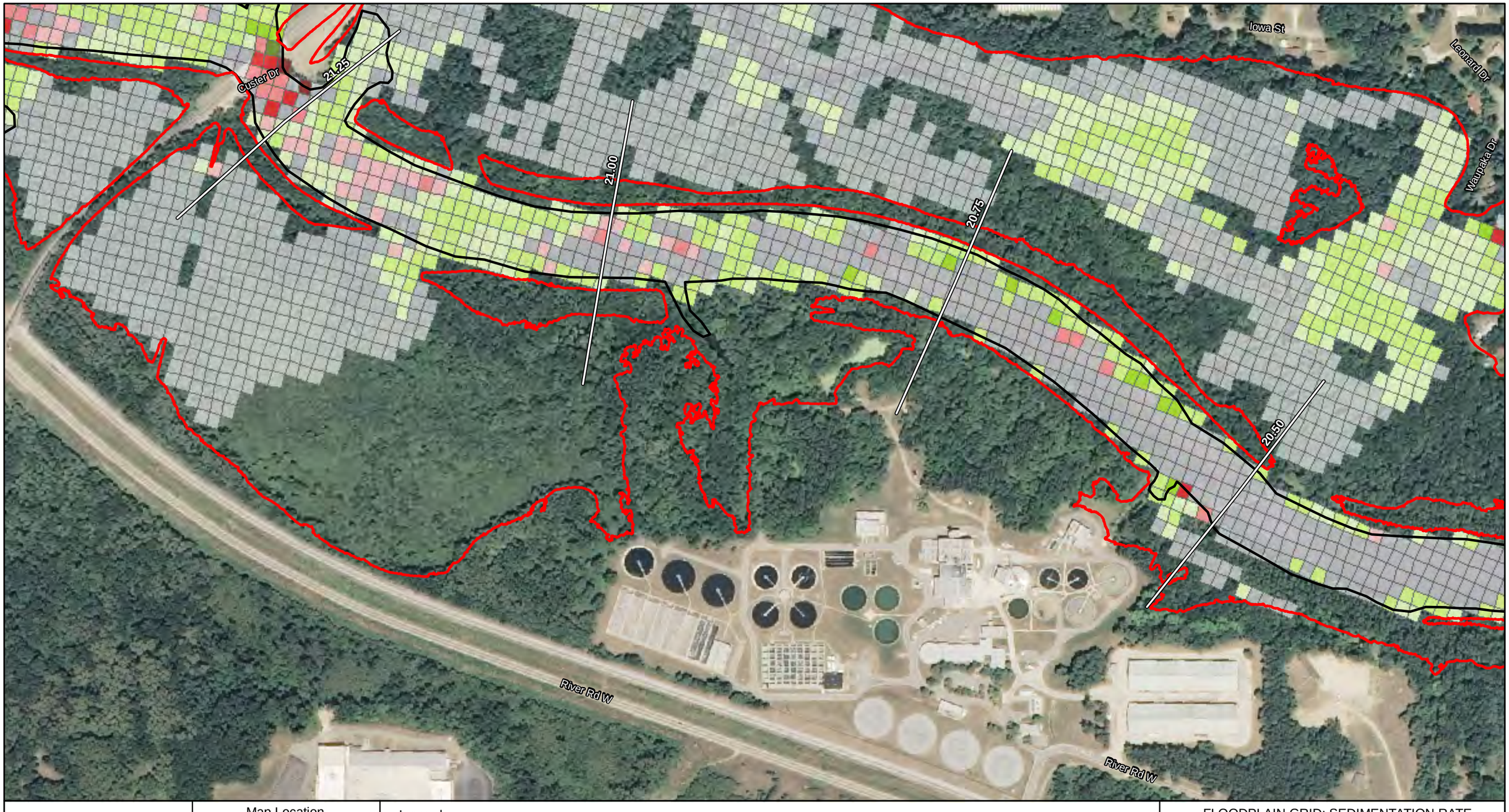
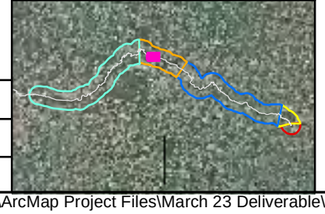
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 20.32 - MP 21.36

SHEET 21 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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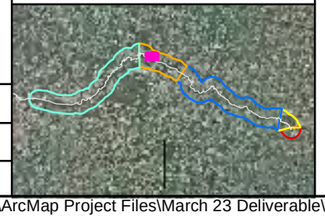
Aerial Photography Date: July & August 2009

Avon Dr
Sperry Ave
Finlay Ave
Coldwater Ave
Custer Dr
Duane St
Michigan Ave W
Stillson Blvd
Gardner Ave
Bonny St
South St
Iowa St
21.50
21.25

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 21.36 - MP 21.59

SHEET 22 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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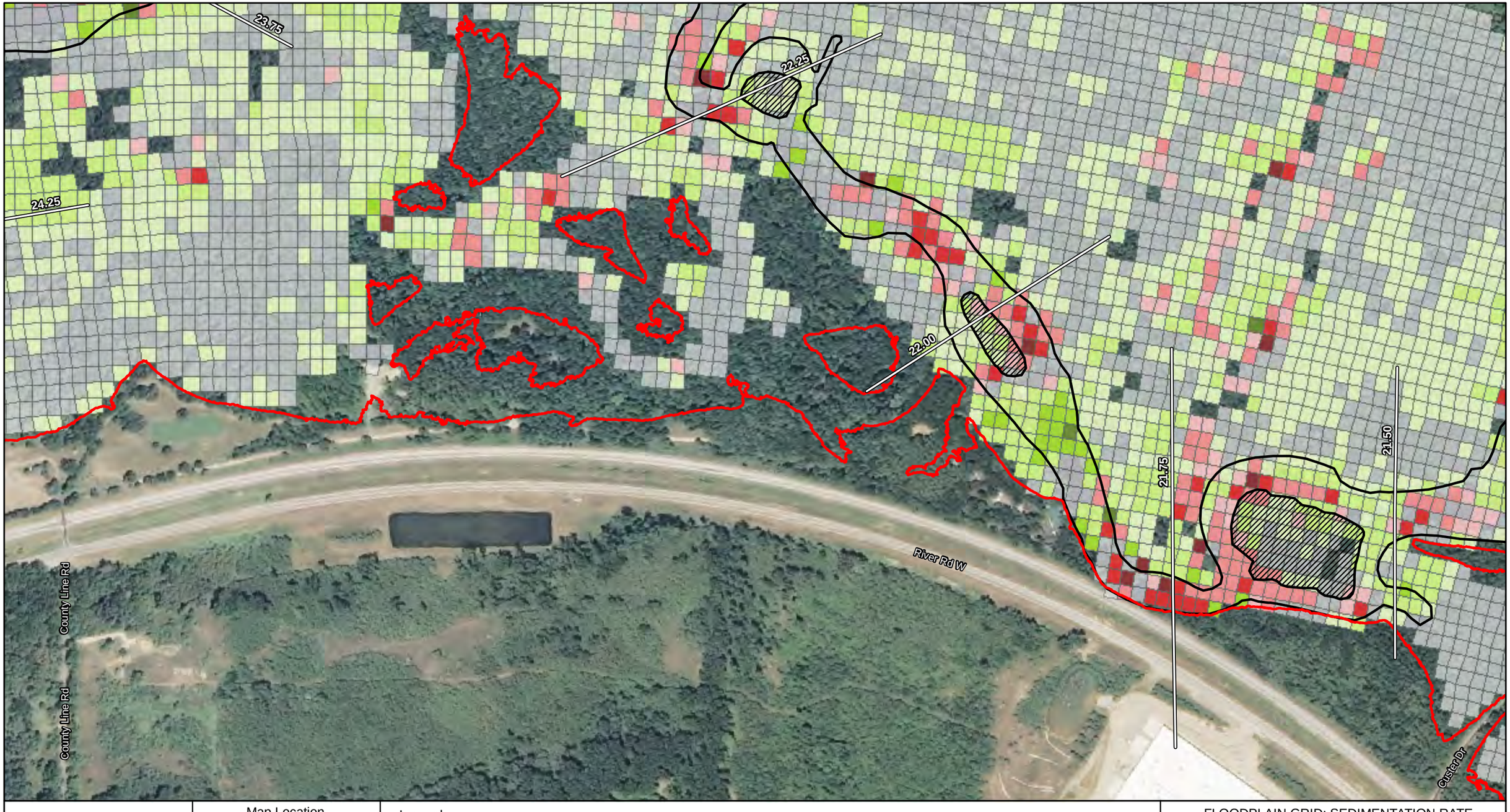
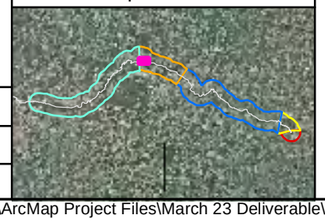
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 21.59 - MP 22.33

SHEET 23 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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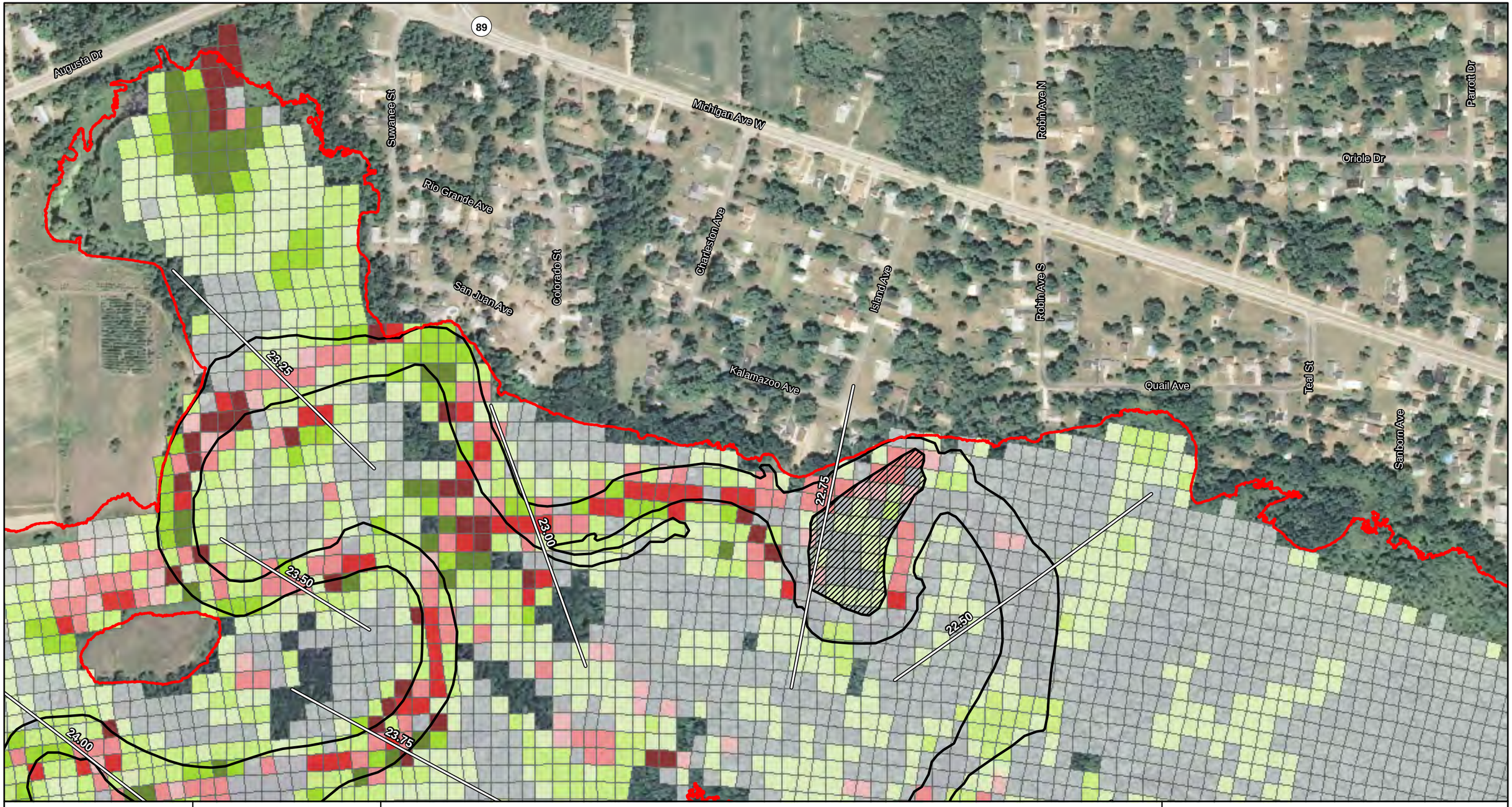
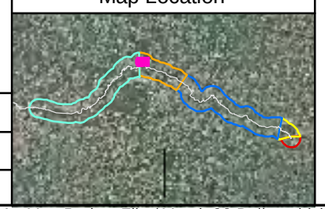
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 22.33 - MP 24.01

SHEET 24 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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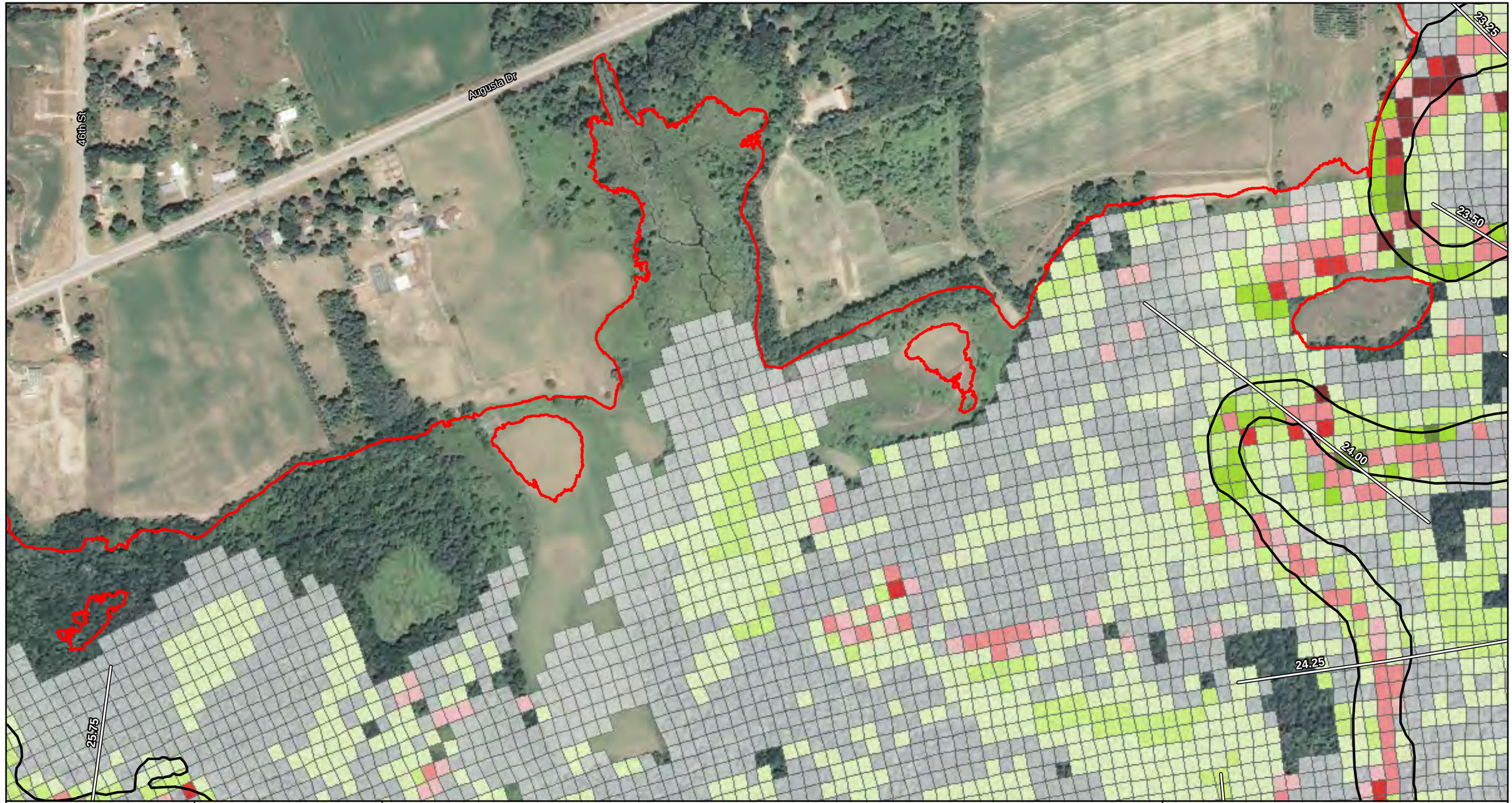
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 24.01 - MP 24.33

SHEET 25 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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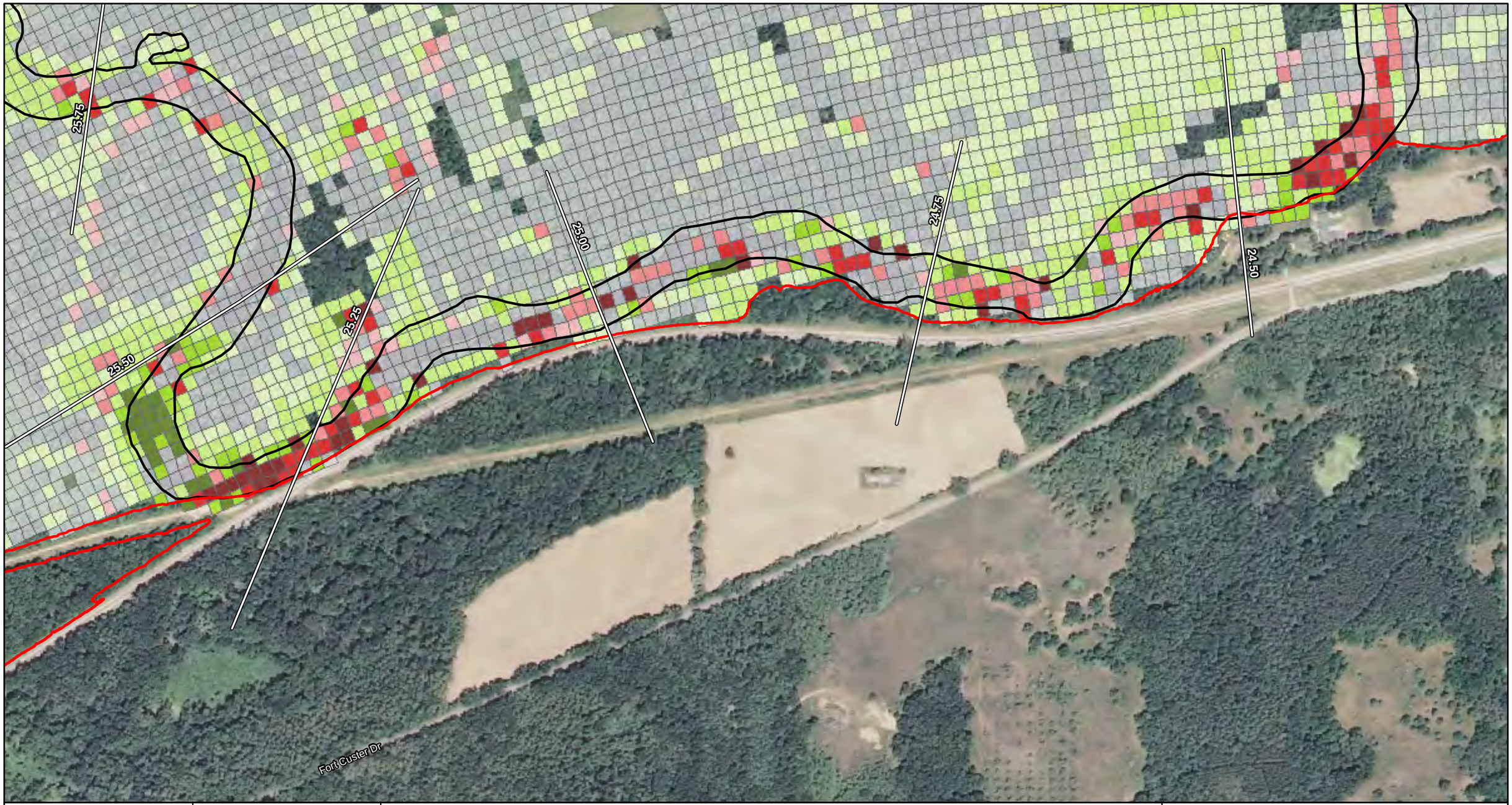
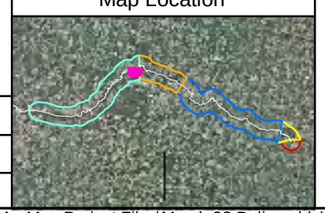
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 24.33 - MP 25.79

SHEET 26 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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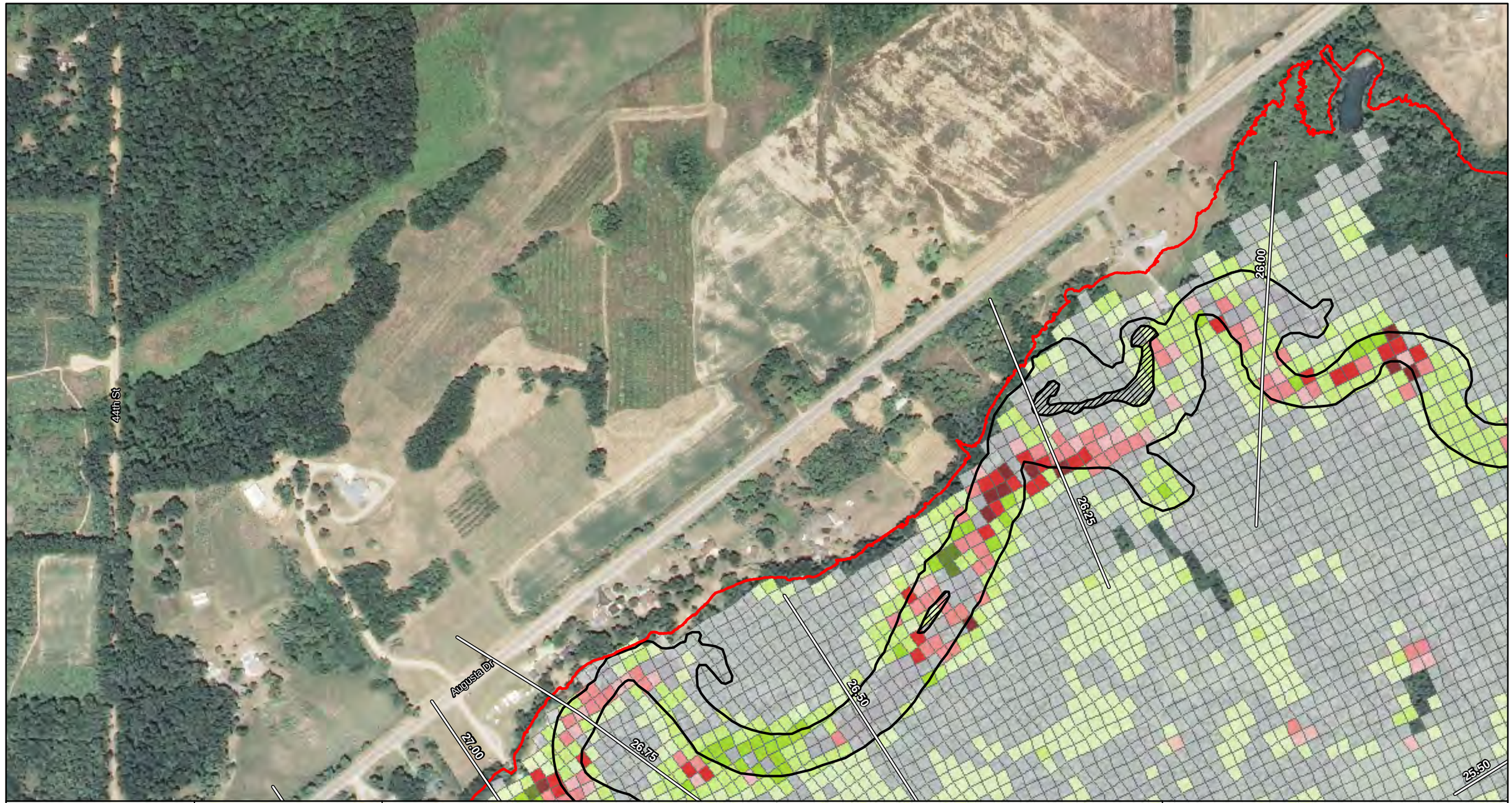
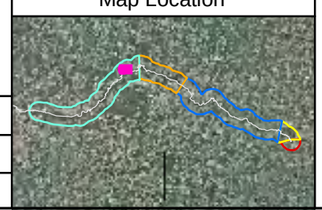
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 25.79 - MP 26.80

SHEET 27 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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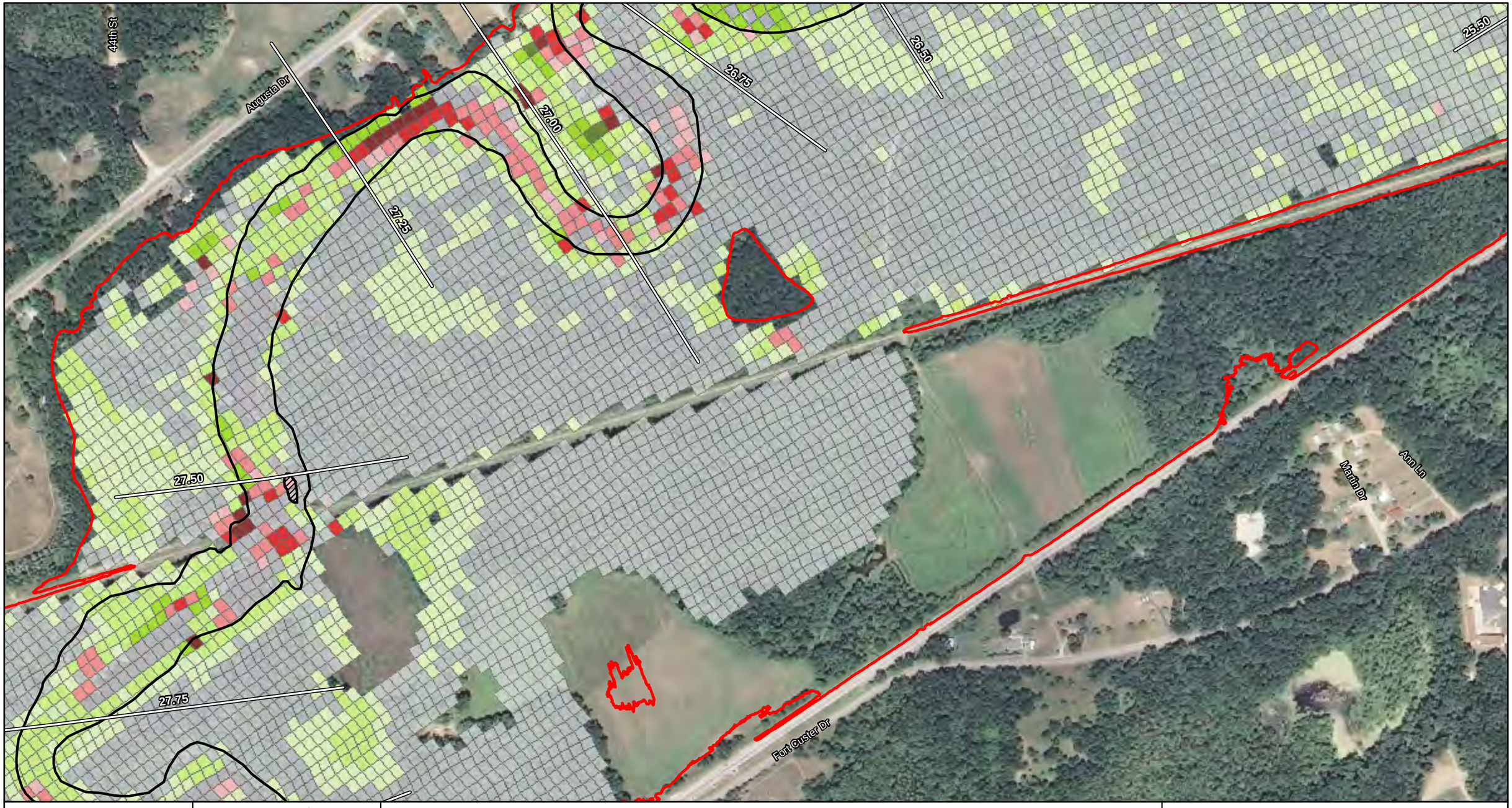
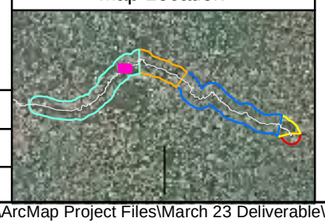
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 26.80 - MP 27.80

SHEET 28 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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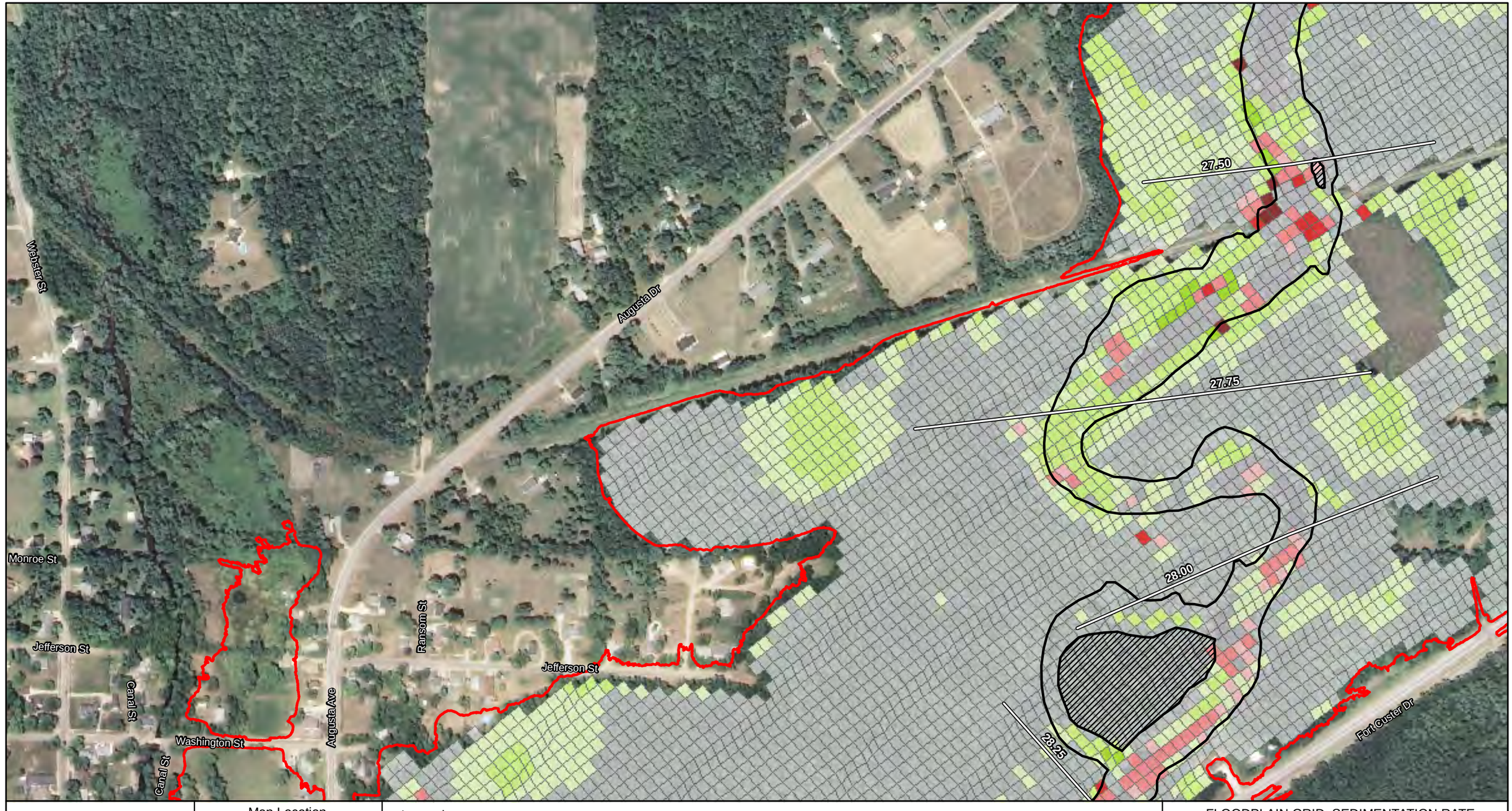
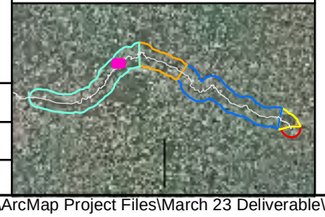
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 27.80NW - MP 28.22NW

SHEET 29 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 27.80SE - MP 28.22SE

SHEET 30 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

Webster St
Jackson St
Convis
Augusta Ave
Van Buren St
Canal St
Canal St
Water St
Michigan Ave
Wayne Ter Berg St
Clinton St
Clinton St
Fayette St
28.50
28.25
28.75
29.00
29.25
Fort Custer Dr
Augusta Dr
Harmonia Rd
Fort Custer Rec Area Access
Augusta Climax Rd

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700
Scale in Feet

ENBRIDGE

Drawn:	BRS	3/30/2012
Approved:	DBR	3/30/2012
Project #:	106-4186	

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 28.22 - MP 29.20

SHEET 31 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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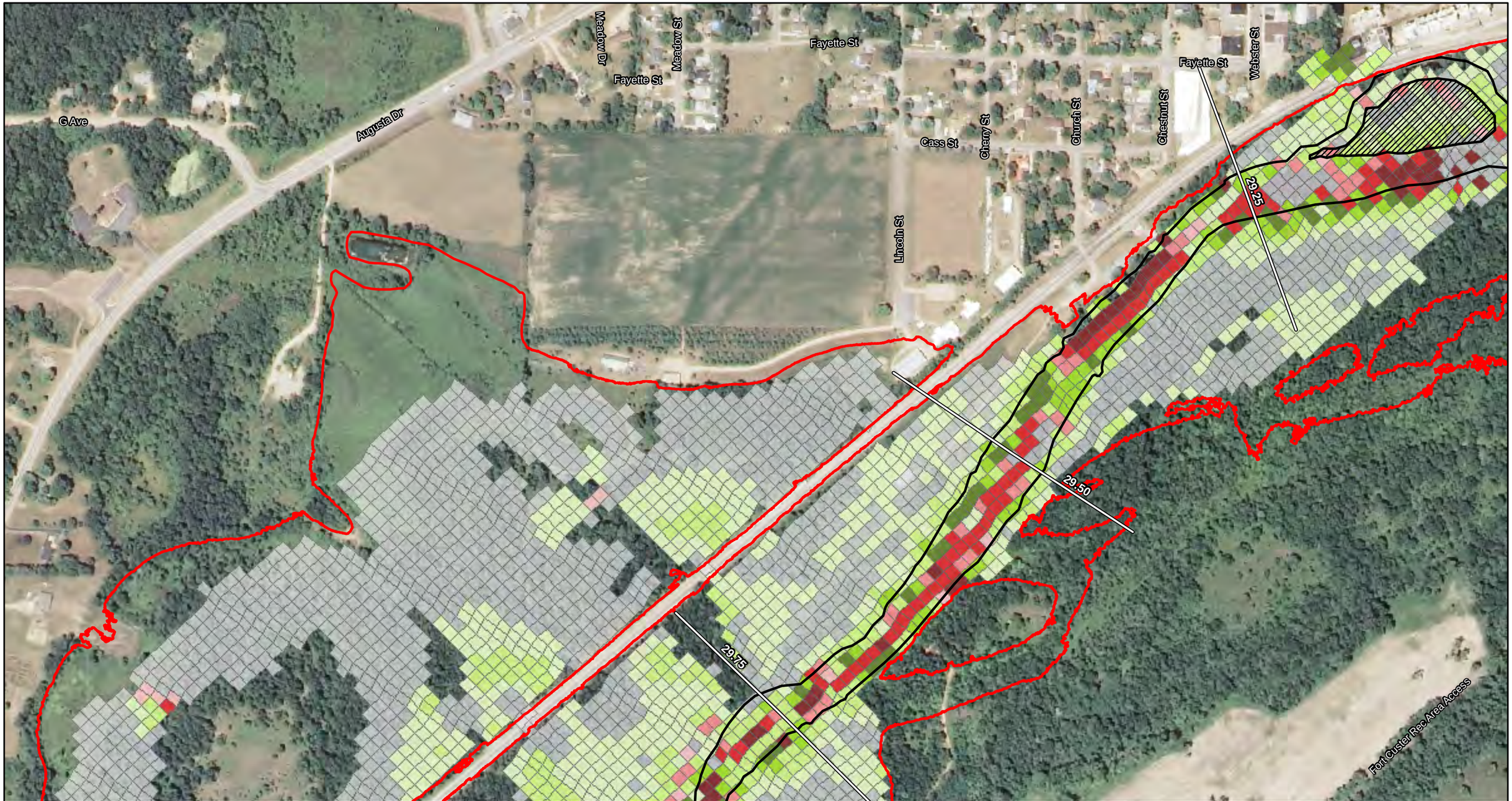
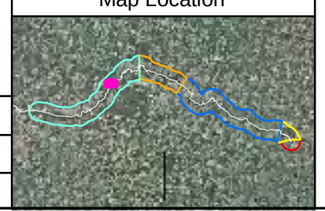
Aerial Photography Date: July & August 2009



Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 29.20 - MP 29.82

SHEET 32 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 29.82 - MP 30.84

SHEET 33 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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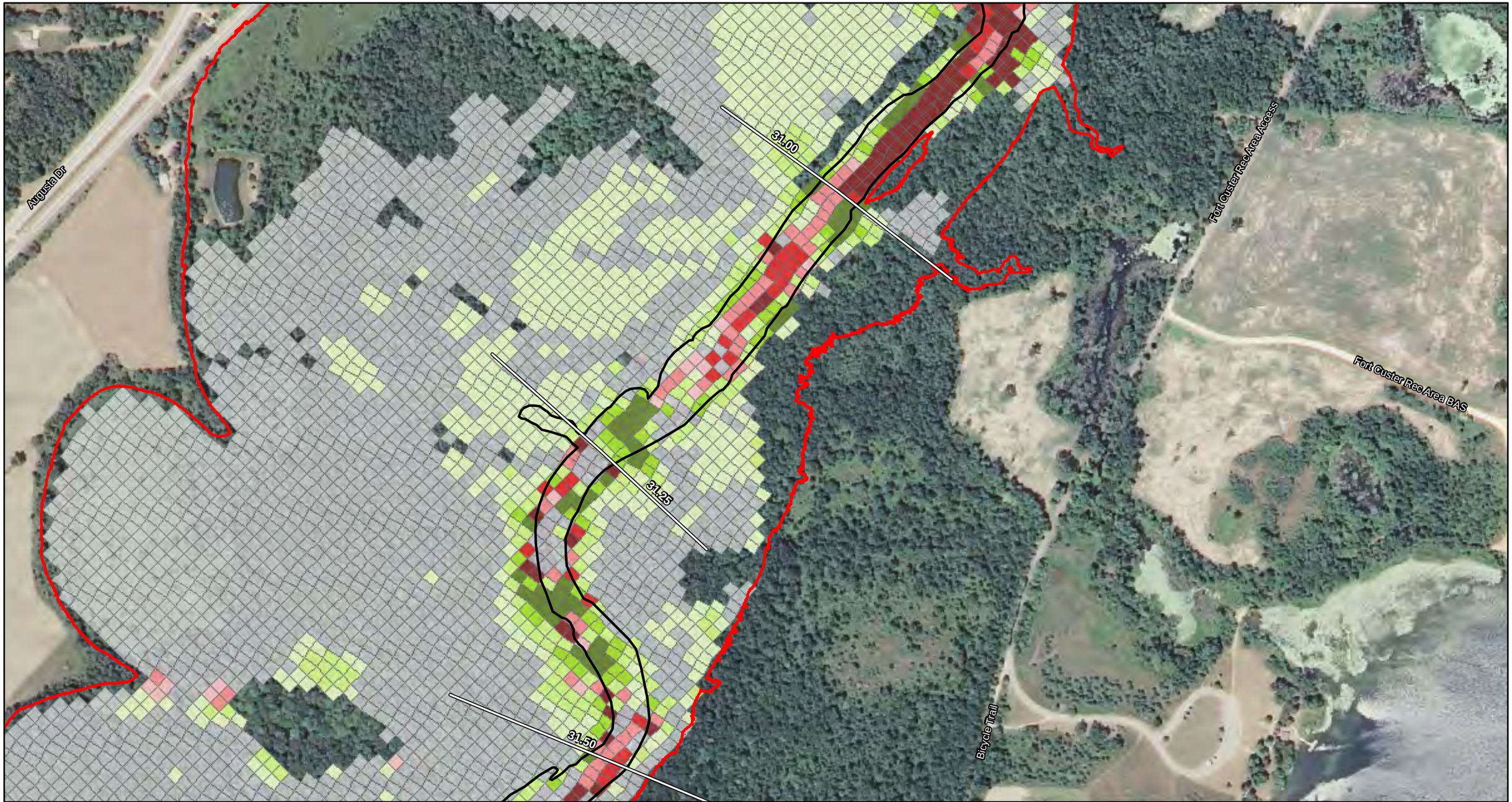
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 30.84 - MP 31.40

SHEET 34 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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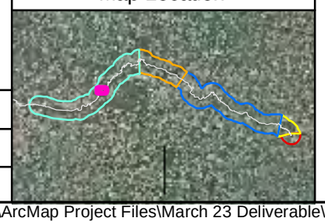
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 31.40 - MP 31.94

SHEET 35 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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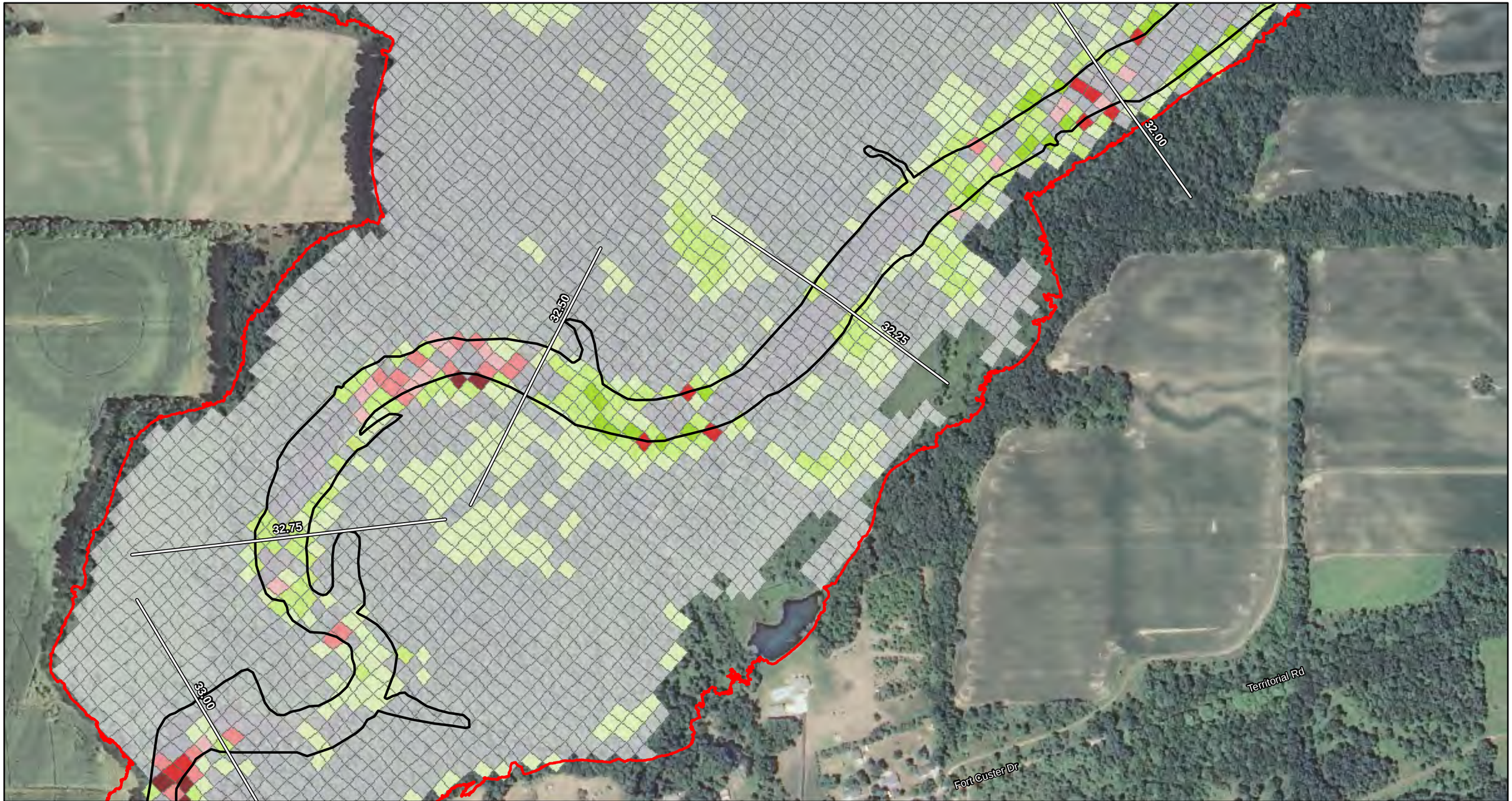
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 31.94 - MP 33.00

SHEET 36 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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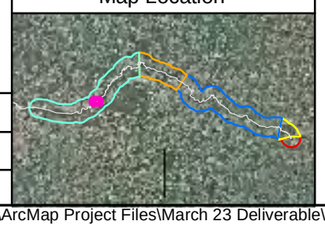
Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 33.00 - MP 33.52

SHEET 37 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: July & August 2009

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 33.52 - MP 34.70

SHEET 38 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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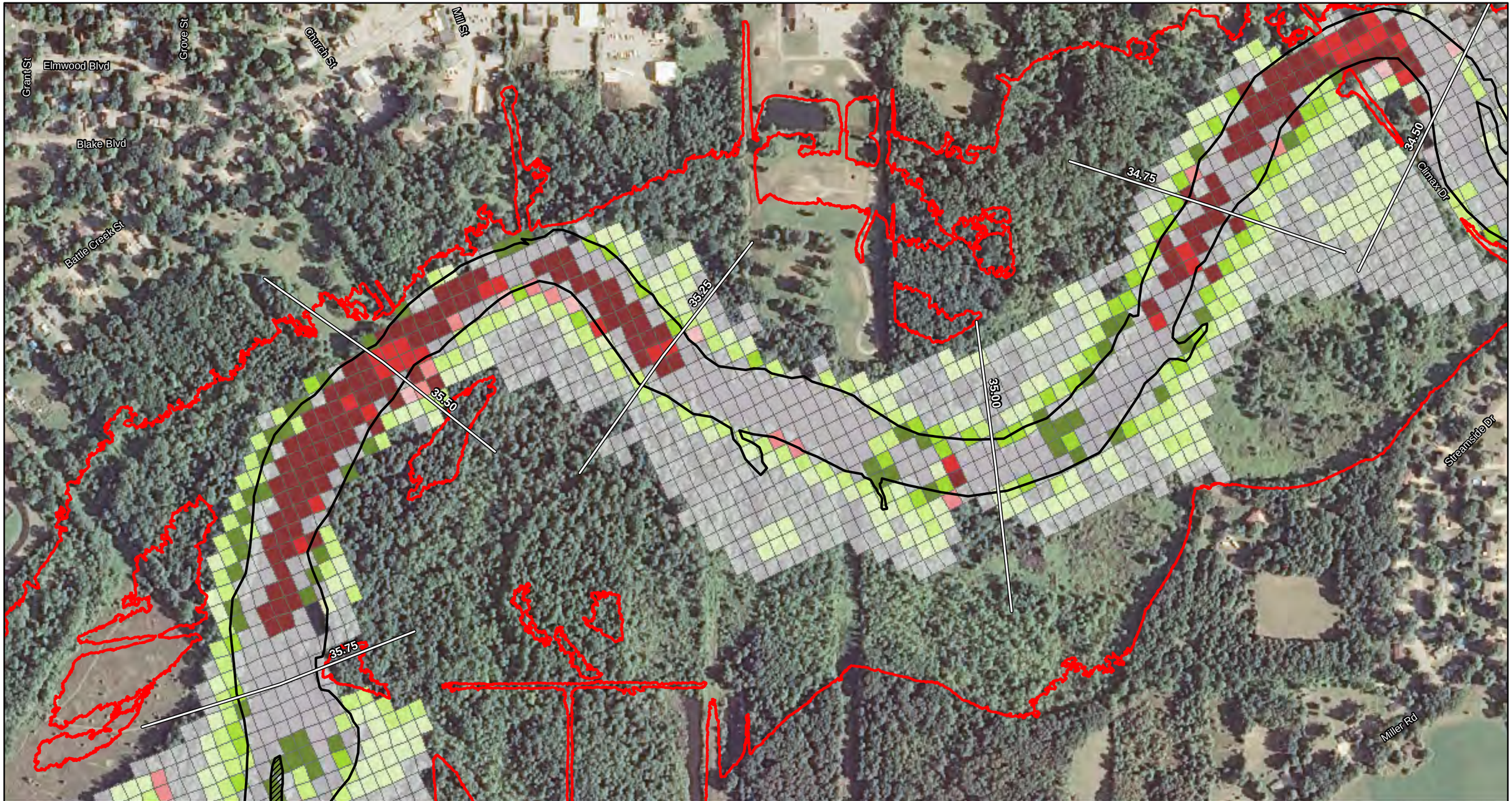
Aerial Photography Date: July & August 2009



Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 34.70 - MP 35.75

SHEET 39 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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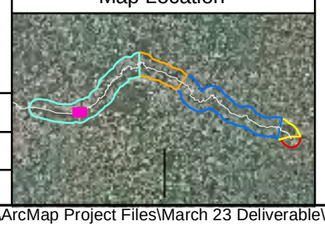
Aerial Photography Date: July & August 2009

Courtney St
Cynthia St
Kimberly St
Shadowlane Ave
Woodlark Dr
Battle Creek St
35.75
36.50
36.75
35th St
36.25
36.00
Miller Rd
94

ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700
Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 35.75 - MP 36.75

SHEET 40 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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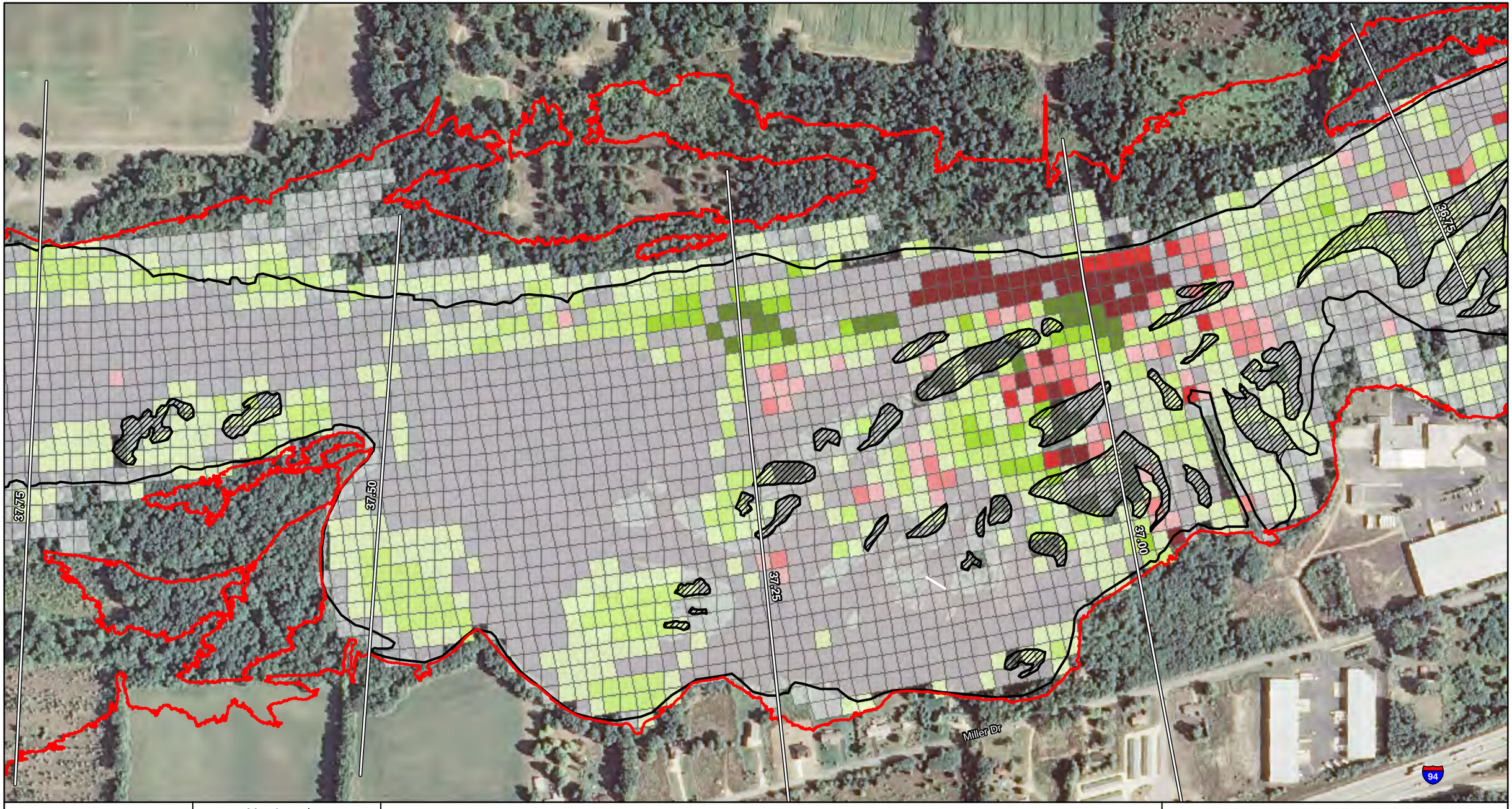
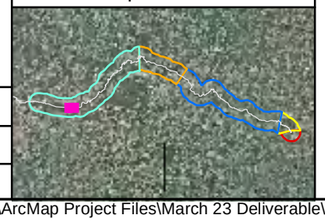
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 36.75 - MP 37.75

SHEET 41 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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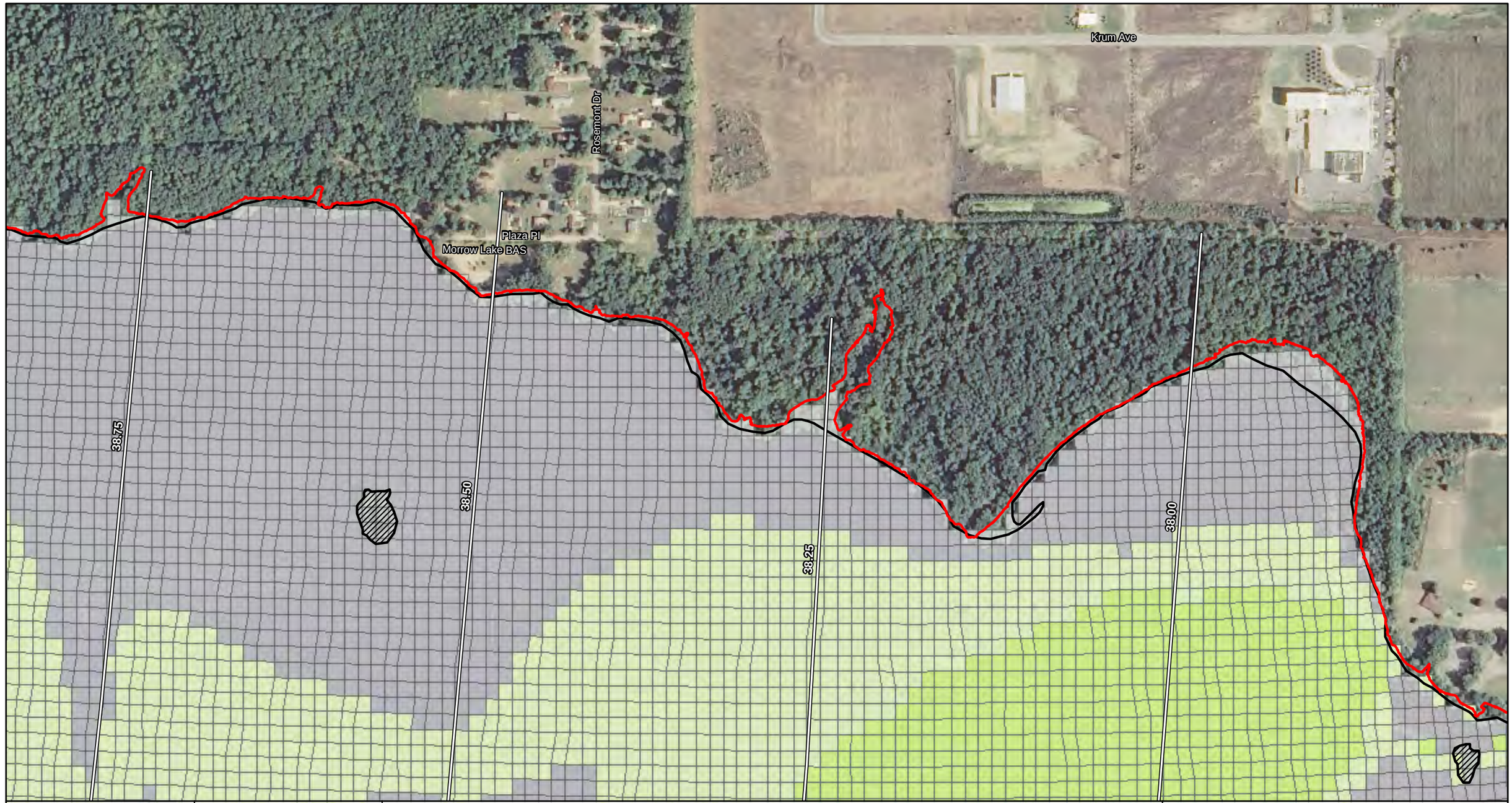
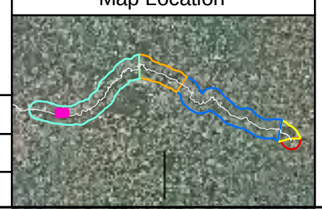
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 37.75N - MP 38.80N

SHEET 42 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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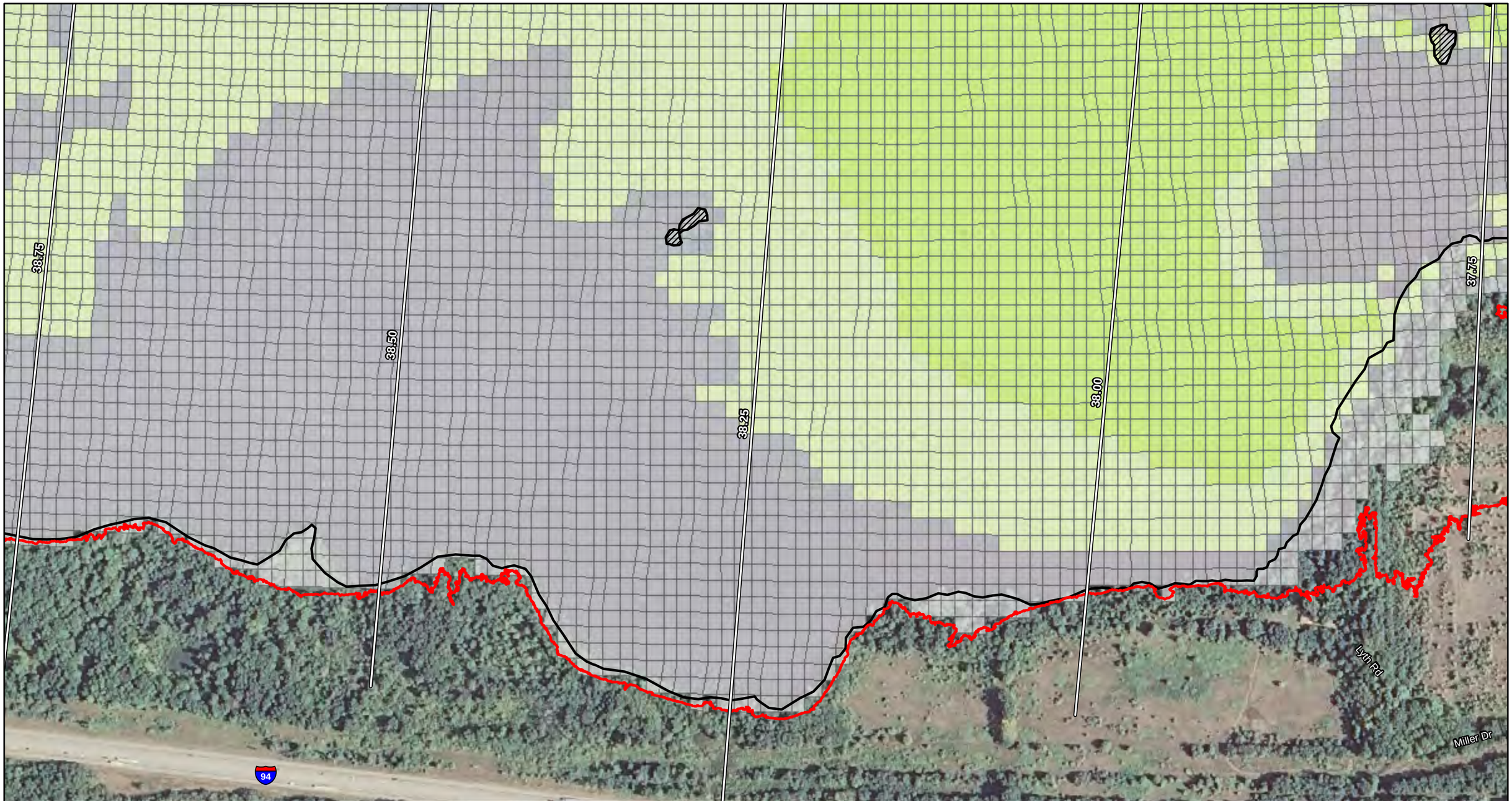
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location

Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 37.75S - MP 38.80S

SHEET 43 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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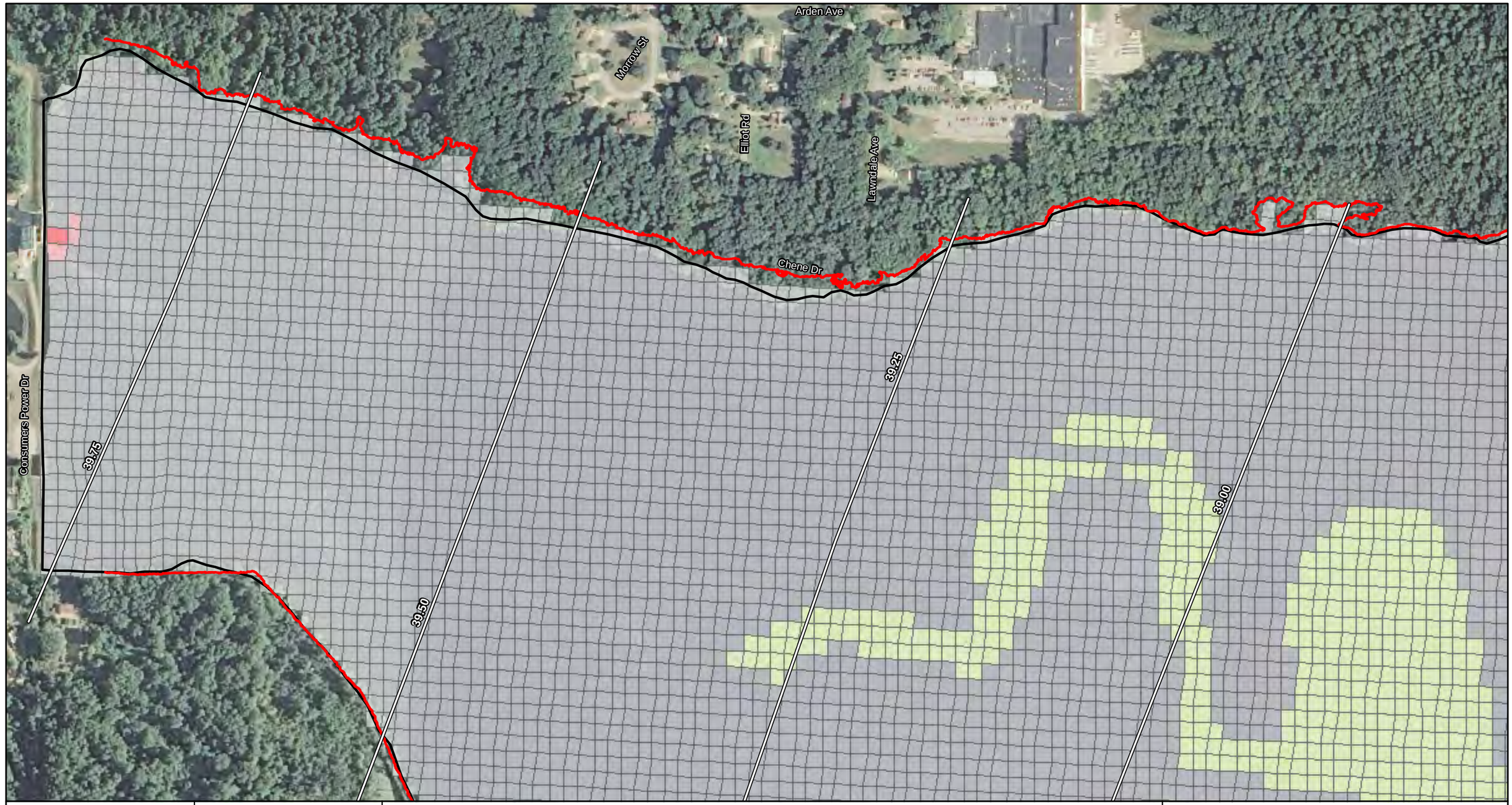
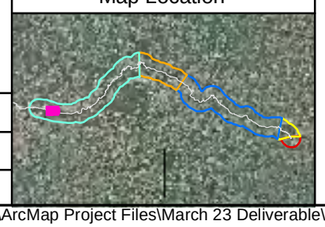
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 38.80N - MP 39.95N

SHEET 44 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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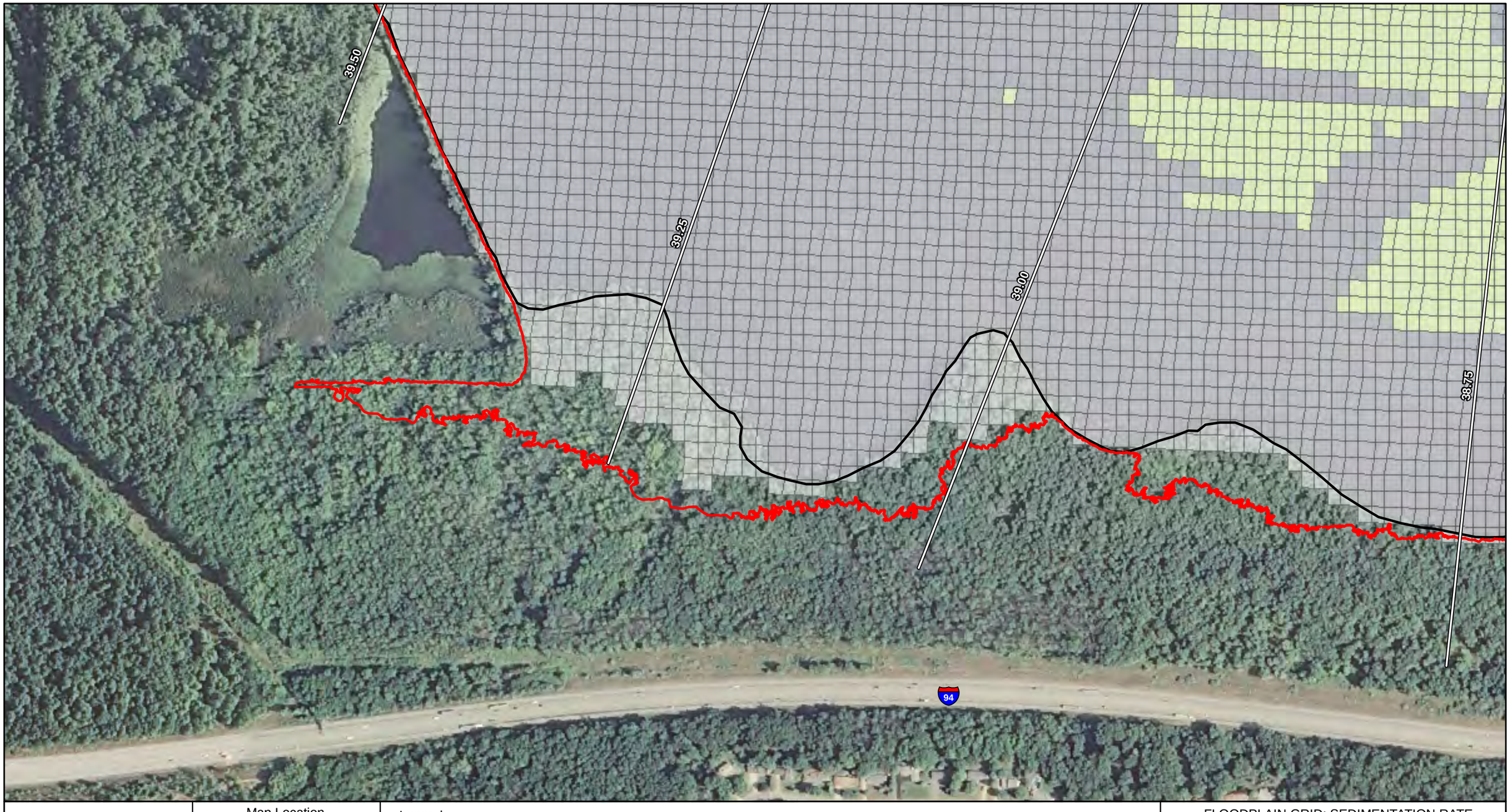
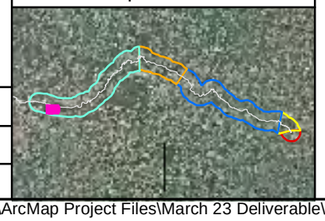
Aerial Photography Date: July & August 2009



ENBRIDGE

Drawn:	BRS 3/30/2012
Approved:	DBR 3/30/2012
Project #:	106-4186

Map Location



Legend

Sedimentation Rate (mm/week)

Cells with Net Change in Silt or Clay Mass

- >10.00 mm/week erosion
- 5.00 - 10.00 mm/week erosion
- 1.00 - 5.00 mm/week erosion
- 0.10 - 1.00 mm/week erosion
- No Change
- 0.10 - 1.00 mm/week deposition
- 1.00 - 5.00 mm/week deposition
- 5.00 - 10.00 mm/week deposition
- >10.00 mm/week deposition

mm/week = Millimeters Per Week

- Channel Bankline
- Island Bankline
- HEC-RAS 100-Year Floodplain
- Quarter Mile Grid Segment

N

0 175 350 700

Scale in Feet

FLOODPLAIN GRID: SEDIMENTATION RATE
CELLS WITH NET CHANGE IN SILT OR CLAY MASS
JULY 24 - 31, 2010
MP 38.80S - MP 39.95S

SHEET 45 OF 45

ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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Aerial Photography Date: July & August 2009