Approved

Enbridge Line 6B MP 608
Marshall, MI Pipeline Release

Sediment Trap Monitoring and Maintenance Plan

Prepared for United States Environmental Protection Agency

Enbridge Energy, Limited Partnership

Originally Submitted: January 27, 2012

Resubmitted: February 27, 2012

Resubmitted: April 25, 2012

Resubmitted: June 14, 2012

Approved: July 10, 2012

FIGURES

LIST OF ACRONYMS

ADCP	Acoustic Doppler Current Profiler
ADV	Acoustic Doppler Velocimeter
cfs	cubic feet per second
cm	centimeter
Consolidated Work Plan	*Addendum to the Response Plan for Downstream Impacted Areas, August 2, 2010 (Revised August 17, 2010 per U.S. EPA August 17, 2010 letter), Supplement to Source Area Response Plan, and Supplement to Response Plan for Downstream Impacted Areas, Referred to as Operations and Maintenance Work Plan Commonly referred to as "Consolidated Work Plan from Fall 2011 through Fall 2012"* approved by the U.S. EPA on December 21, 2011
CSD	Cylindrical Sampling Device
GPS – RTK	Global Positioning System – Real Time Kinematic
LDB	Left Descending Bank
MDEQ	Michigan Department of Environmental Quality
MP	Mile Post
RDB	Right Descending Bank
USGS	United States Geological Survey
U.S. EPA	United States Environmental Protection Agency

1.0 INTRODUCTION

A series of sediment traps located in natural and/or anthropogenic (i.e. Ceresco Dam, Mill Pond, Morrow Lake Delta, and Morrow Lake) depositional areas of the Kalamazoo River are proposed to enhance the natural accumulation of sediment and oiled sediments. These sediment traps will provide locations for the collection and removal of submerged oil and oiled sediments within the affected river system. This plan describes the methods by which designated sediment trap areas will be monitored and maintained, as well as the schedule for installation and eventual removal of sediment trap structures and monitoring devices. Installation, monitoring, maintenance, and removal of the sediment traps will be performed under the direction of the Containment Branch of the Unified Command Operations Section. Remediation activities will be performed by the Submerged Oil Branch as necessary. The organization and responsibilities of the Containment and Submerged Oil Branches are outlined in the *Addendum to the Response Plan for Downstream Impacted Areas, August 2, 2010 (Revised August 17, 2010 per U.S. EPA August 17, 2010 letter), Supplement to Source Area Response Plan, and Supplement to Response Plan for Downstream Impacted Areas, Referred to as Operations and Maintenance Work Plan Commonly referred to as "Consolidated Work Plan from Fall 2011 through Fall 2012"* (Enbridge, 2011) approved by the United States Environmental Protection Agency (U.S. EPA) on December 21, 2011 (Consolidated Work Plan).

2.0 SEDIMENT TRAP STRUCTURES

Sediment traps will consist of the placement of in-channel conifer tree structures to enhance the trapping and settling capabilities of existing depositional areas. Typical sediment trap structures are shown in *Figure 1*. In addition to the sediment trap structures, cylindrical sampling devices (CSDs) will be installed within the geomorphic feature. The CSDs are shown in *Figure 2.*

3.0 SEDIMENT TRAP LOCATIONS

Sediment trap structures will be installed in the Kalamazoo River between the confluence with Talmadge Creek and the Morrow Lake Dam. The proposed locations have been selected to represent a wide range of depositional areas within the Kalamazoo River

including: impounded areas, side channels, oxbows, areas of channel width increase, backwaters, and downstream of point bars. Strategic locations within the geomorphic features were selected for sediment trap structures to enhance sediment deposition and subsequent potential submerged oil accumulation based on the locations of 'heavy' and 'moderate' poling locations identified during 2011 poling activities. In addition, the locations were chosen based on site-specific criteria such as: flow characteristics within or around the geomorphic feature, the natural deposition of soft sediment, the depth of water within each feature, and 2011 poling results within the geomorphic features.

In consultation with the U.S. EPA and United States Geological Survey (USGS), 17 initial locations have been selected as possible sites for sediment trap structure placement. Final site selection among these 17 locations will be based upon the results of hydraulic calculations in addition to 2-dimensional hydrodynamic modeling of four representative flow scenarios. These proposed sites are shown in *Figure 3*. Other locations may be considered as possible sites for sediment trap structure placement based on on-going site assessment and hydrodynamic modeling results. Alternate locations for sediment trap structures within the geomorphic features may be considered depending on sedimentation rates determined by the hydrodynamic modeling results and site specific observations. Adjusting the location of previously permitted sediment structures within a geomorphic feature would require a new model run to determine the additional backwater effects of the proposed location and a minor revision to the existing MDEQ permit for the subject location. In the event a sediment structure is proposed for a geomorphic feature that has not been previously permitted by MDEQ, modeling to determine the backwater effects would be required, with the subsequent submittal of a new MDEQ permit application for the newly proposed locations. The following descriptions are provided for the 17 sites currently being evaluated for sediment trap structure placement.

3.1 MP 3.25 R1

Mile Post (MP) 3.25 R1 is a side channel located upstream of the impounded area upstream from Ceresco Dam that was excavated during Winter 2010-2011. This area did not accumulate heavy or moderate submerged oil in Spring or Fall 2011, although it remains a meaningful location for monitoring the potential for sediment and submerged oil deposition within side channel areas between Talmadge Creek and Ceresco Dam.

3.2 Ceresco

Ceresco is an impounded area located immediately upstream of Ceresco Dam that has been identified as a location of submerged oil accumulation. The Ceresco Dam area is an anthropogenic depositional area due to the decreased flow into the impounded area. Therefore, this area is subject to ongoing deposition, particularly in areas previously excavated during Fall 2010.

3.3 MP 10.40 N

MP 10.40 N is a backwater area located downstream of a point bar that indicated heavy submerged oil in both Spring and late Summer 2011. This area is located near a highly sinuous section of the river located approximately from MP 10.00 to MP 13.75.

3.4 MP 10.50 L2

MP 10.50 L2 is a backwater area that indicated heavy submerged oil in Fall 2010 and was subsequently excavated during Winter 2010-2011. This area accumulated new soft sediment including heavy submerged oil in Spring 2011. Additional sediment storage capacity is available at this location due to the previous excavation activities.

3.5 MP 10.75 LDB

MP 10.75 left descending bank (LDB) is a side channel at high water levels. During low water levels, it is open to the river at the downstream end (the upstream end being blocked by a sand bar deposit). This area has indicated heavy submerged oil accumulation since late Fall 2010 and was excavated during Winter 2010-2011. Poling in Spring and Fall 2011 indicated recent deposition.

3.6 MP 14.75 RDB

MP 14.75 right descending bank (RDB) is a side channel located within the impounded area upstream of the Mill Pond. The area is readily accessible and located outside the main channel; therefore, subject to ongoing deposition. This area indicated heavy submerged oil in Fall 2010, Spring 2011, and late Summer 2011.

3.7 MP 19.25 LDB

MP 19.25 LDB is a side channel that during periods of low water levels remains submerged; however, water does not flow through. This side channel indicated heavy submerged oil in Fall 2010, Spring 2011, and late Summer 2011. The area was excavated during Winter 2010-2011 and has since indicated the accumulation of soft sediment and submerged oil, particularly at the upstream and downstream ends.

3.8 MP 21.50 RDB

MP 21.50 RDB is an oxbow that has been an area of submerged oil accumulation located between the concrete channel in Battle Creek and the 35th Street Bridge, near Galesburg. The area was formerly the main channel of the Kalamazoo River, prior to the Kalamazoo River Diversion Project of 1960-1962 (Ashley, Martin & Thornton, Kurt, 2005). Excavation activities during Summer 2011 has increased its sediment storage capacity at this location. This oxbow is located immediately upstream of the transition from the low-gradient engineered channel to the higher-gradient naturally meandering river course. The initial sediment trap structure configuration considered for this location would be oriented parallel to overbank flood flows across the mouth of the oxbow at the downstream end where the oxbow reconnects to the main river channel.

3.9 MP 26.00 RDB

MP 26.00 RDB is a backwater area located at the downstream end of a point bar. This area contained submerged oil accumulation in Fall 2010 and in Spring 2011. The presence of extensive mudflats at low water levels indicates that this area accumulates soft sediment.

3.10 MP 28.25 RDB

MP 28.25 RDB is an oxbow that provides sediment storage. It has indicated heavy submerged oil in Fall 2010, Spring 2011, and late Summer 2011. Placement of a sediment trap structure would increase storage capacity and reduce sediment remobilization during high water flow events.

3.11 MP 30.80 LDB

MP 30.80 LDB is an extensive backwater area located at the downstream end of a point bar that was the site of submerged oil recovery work during 2011. Based upon the site history and geomorphic setting, this is an area of sediment deposition.

3.12 MP 33.00 A

MP 33.00 A is a complex area of channel widening located at the downstream end of a point bar. It includes backwater areas that may channel preferential flow during flood events. This area indicated heavy submerged oil accumulation during Fall 2010 and in Spring 2011. Due to the complex geomorphology of this area, hydraulic calculations to estimate the effectiveness of trapping and settling are not possible; therefore, selection of this area will be based upon 2-dimensional hydrodynamic modeling.

3.13 MP 33.00 B

MP 33.00 B is a backwater area located on the downstream side of a point bar where the channel widens. The area indicated heavy submerged oil accumulation in Fall 2010 and in Spring 2011 and is a known depositional area.

3.14 MP 36.10 NW

MP 36.10 NW is a side channel located at the upstream end of the Morrow Lake Dam impounded area. The area is considered a significant capture point for sediment and submerged oil deposition. There is a small channel at the upstream side that is connected to the river.

3.15 Delta A

Delta A is located furthest upstream of the delta's distributaries at the entrance to the Morrow Lake Delta. Delta A is a deposition area and was one of the original delta priority areas in Fall 2010. The area is considered important for monitoring sediment and/or submerged oil migration.

3.16 Delta Z

Delta Z was the most extensive surface area of heavy submerged oil in the Morrow Lake Delta in both 2010 and 2011. It is located at the downstream end of the delta's many distributary channels, where areas of confined flow between vegetated islands enter an area of more extensive open water.

3.17 MP 37.75 Islands

MP 37.75 Islands is the last depositional area prior to entering Morrow Lake. It is a shallow water area located south of the deeper main channel. The protection provided by the islands slows water velocities and encourages sediment deposition at this location.

4.0 INSTALLATION

The schedule and placement of sediment trap structures and the CSDs along with an initial site survey will be determined in coordination with U.S. EPA, Michigan Department of Environmental Quality (MDEQ), and USGS personnel.

4.1 Schedule

Installation of sediment trap structures and monitoring devices will occur in Spring 2012 following review of hydraulic calculations and 2-dimensional hydrodynamic modeling of proposed structure placements. The installation schedule will take place following approval of MDEQ permits. Additional considerations with regard to schedule include high water levels. If water levels rise prior to completion of the installation, work will be suspended until water levels recede to safe working conditions.

4.2 Site Survey

At each sediment trap structure location, initial monitoring measurements will be conducted prior to the installation of the sediment trap and a post installation survey will be conducted once the sediment trap structure has been installed. The initial monitoring survey will serve as a base line for future monitoring events. The initial monitoring survey and post installation survey will include detailed field mapping of three to five cross sections dependant on the size of the geomorphic features, which will consist of:

- Measuring channel width,
- Measuring channel length,
- Measuring depth of water,
- Measuring soft sediment thickness,
- Measuring depth to hard bottom,
- Classification of the geomorphic setting,
- GPS the location of the sediment trap structure,
- Measuring the length, width, and height of the structures and the depth below the water surface,
- Measuring and recording the number, size and species of trees installed, and
- Measuring flow velocities within the geomorphic setting pre- and post-installation.

The spatial extent for the three to five cross-sections will be determined by using the hydrodynamic model grid cells used to model sedimentation rates for each geomorphic feature. The locations of the cross-sections will be targeted towards grid cells that exhibited the greatest amount of sediment deposition. At each of the cross-sections, the bathymetry will be measured with a Geographic Positioning System – Real Time Kinematic (GPS-RTK) or equivalent unit to gather vertical (1 centimeter (cm) accuracy) and horizontal (2 cm accuracy) coordinates from bankfull to bankfull, with a minimum of 25 survey points, no greater than four feet apart, and identify slope breaks with 3 survey points per break within the geomorphic features. The data collected at each survey point will include the above mentioned criteria (depth of water, soft sediment thickness, and depth to hard bottom).

Flow velocity measurements will be conducted at five to eight locations along each of the cross-sections used for collecting bathymetry data. The flow velocity measurements will be conducted with an Acoustic Doppler Current Profiler (ADCP) or an Acoustic Doppler Velocimeter (ADV) as mentioned in the Consolidated Work Plan.

In coordination with U.S. EPA and USGS, the location of the sediment trap structure within the geomorphic feature will be determined based on the initial site survey, historic poling results, and hydrodynamic modeling results.

During the initial site survey and subsequent monitoring events, poling activities will occur when water and sediment temperatures reach or exceed the minimum approved temperature. Poling will be conducted at five to eight locations along the initial site survey

cross-sections by using a GPS-RTK unit to gather horizontal and vertical coordinates at the same poling locations within each feature during monitoring events. In an attempt to understand sedimentation rates, each geomorphic feature, depending on size, will have a minimum of five CSDs to collect sediment and oiled sediments as detailed in *Figure 2*. Larger geomorphic features will have 6 to 10 CSDs placed within their feature. The locations of the CSDs will be as follows, and is shown in *Figure 3*:

- One approximately 15 feet downstream of the structures within geomorphic features, which will be put in place one to two days after installation of the sediment trap structure,
- One approximately 15 feet upstream of the structures within geomorphic features, and
- The remaining samplers will be placed within the geomorphic feature targeting hydrodynamic model grid cells exhibiting the highest potential for sediment deposition.

5.0 MONITORING

Monitoring of the sediment trap sites will be performed on a regular schedule. The monitoring objectives are as follows:

- Determine the effectiveness of the sediment traps at each site,
- Document the performance of the sediment traps through quarterly bathymetry and flow velocity measurements,
- Check the site for submerged oil accumulation via poling or additional sample collection if temperatures are not at or above the minimum approved temperature of 60º Fahrenheit,
- Collect the sediment and oiled sediment from the CSDs and submit for analytical results when a sufficient volume is obtained,
- Analyze sediment samples according to *Section 4.2.5 Sediment Transport* of the Consolidated Work Plan. Additional analyses will be prioritized and conducted according to the "*Spring 2012 Analytical Chemistry Prioritization for Low Sample Volume Samples"* dated May 19, 2012 (U.S. EPA, 2012),
- Check the temperature of the water and sediment,
- Monitor the integrity of the sediment traps during routine site visits,

- Determine if maintenance is necessary to preserve oiled sediment trapping ability, and
- Determine if remediation is necessary to remove accumulated sediment and submerged oil.

Monitoring will be conducted once every two weeks for the first month and on a monthly basis thereafter. Each monitoring event will be documented and provided in the monthly report, which is submitted to U.S. EPA and MDEQ on the 27th of every month. Any and all geographic information system data can be provided upon request. Monitoring and maintenance of the sediment trap structures and/or sites will be performed under the direction of the Containment Branch.

5.1 Poling

Poling within the spatial extent of the sediment trap structure locations will be conducted to determine:

- The deposition of submerged oil,
- The thickness of soft sediment,
- The cross-sectional area of the sediment trap structure above the river bed, and
- The horizontal and vertical coordinates of the poling locations.

Poling will be conducted at five to eight locations along all of the initial site survey cross-sections from a shallow-draft water craft. During each monitoring event poling will be repeated at the five to eight poling locations within each geomorphic feature to characterize submerged oil.

5.2 Cylindrical Sampling Devices

There will be a minimum of five CSDs placed within the geomorphic features. Dependant on the size of the geomorphic features and the depositional rates determined by the grid cells of the hydrodynamic model, 6 to 10 additional CSDs placed within the sediment traps. During monitoring events, the CSDs will be sampled according to the following procedures:

- CSDs will be removed from the sediment trap from downstream to upstream to not disturb additional CSDs,

- Remove and make visual observations to determine if there is sufficient volume of sediment to sample,
- Photograph, measure, and record the volume of sediment within the sample jars,
- In the event that there is enough volume of sediment for analytical analysis, replace the jars with empty jars,
- Conduct poling activities at the above specified locations within the geomorphic feature, and
- Once all jars have been either collected and/or observed the CSDs will be repositioned in the sediment trap from upstream to downstream.

5.3 Repeat Bathymetry and Flow Velocity Measurements

The bathymetry and flow velocity measurements will be conducted within the geomorphic feature on a quarterly basis after the initial site survey. The purpose of the quarterly bathymetry and flow velocity measurements is to determine a sedimentation rate and identify spatial variation of sediment deposition within the geomorphic features. These measurements will be conducted at the same locations and follow the same procedures as the initial site survey.

5.4 Frequency

Monitoring frequency for observation and possible sampling of the CSDs will be every two weeks for the first month and then monthly thereafter. Poling activities will be conducted on a monthly basis following the initial site survey. Monitoring for all activities will also be performed following storm events when flows exceed 2,000 cubic feet per second (cfs), as measured at the USGS Battle Creek gage. A flow rate of 2,000 cfs was selected based upon a review of the historic flow rates of the past eight seasons provided by the USGS Battle Creek gage station. According to the gage station, a flow rate of 2,000 cfs is achieved approximately one to four times in any given season.

6.0 MAINTENANCE

Maintenance of the structures will be directed by the Containment Branch as needed following review of data collected during monitoring activities. Maintenance activities may include repair of structures, movement of structures, replacement of structures, or removal

of trapped sediment. Removal of trapped sediment, when applicable, will be considered when monitoring data suggests that the trap has reached its effective capacity. The effective capacity will be defined as a 50% reduction in the cross-sectional area of the sediment trap structure based on the initial site survey. Need for repair, movement, or replacement of structures will be based on routine site visits, the monitoring data collected during site monitoring checks, and following high flow events of 2,000 cfs or greater.

Prior to the initiation of site maintenance, siltation barriers will be installed downstream of each trap location to contain suspended sediment material mobilized through completion of the proposed maintenance activity. Siltation barriers will be designed to handle the sediment type, load, water depth, and flow conditions of each sediment trap location, and will be maintained in good working order throughout the duration of the maintenance effort.

7.0 REMOVAL OF SUBMERGED OIL

Removal of submerged oil from the sediment trap locations will be based on a review of data collected during monitoring events. Removal will be conducted under the direction of the Submerged Oil Branch using approved Operations and Maintenance 'toolbox' methods. Once a trigger has been identified within a geomorphic feature, a site specific plan will be developed at that time. All removal/recovery activities will be conducted in accordance with additional methods mentioned in the *Kalamazoo River – Subsurface Sediment Structures (14 Sites) – MEDQ Permit Application Submittal to Conduct Proposed Kalamazoo River Response Actions pursuant to Parts 31, 301, and 303 of NREPA,* (Enbridge, 2012).

7.1 Frequency/Triggers for Removal

Removal of submerged oil will be performed as necessary based on a review of the submerged oil poling data collected during monitoring. Removal activities will be conducted in consultation with U.S. EPA and USGS. The data review will incorporate both the extent and quantity of submerged oil, and the trend in the extent of submerged oil measured over time. Toolbox remediation will not occur in areas where 'none' or 'light' submerged oil is identified. Toolbox remediation will be initiated when poling results show 'moderate' and 'heavy' submerged oil has been identified over at least 50% of the sediment trap area as directed by U.S. EPA. Toolbox remediation will be initiated as necessaryto prevent the downstream migration of submerged oil.

Prior to the initiation of the removal of oiled sediments, siltation barriers will be installed downstream of each trap location to contain suspended sediment material mobilized through completion of the proposed maintenance activity. Siltation barriers will be designed to handle the sediment type, load, water depth, and flow conditions of each sediment trap location, and will be maintained in good working order throughout the duration of the maintenance effort.

7.2 Coordination with Maintenance Activities

Submerged oil remediation activities will be coordinated with sediment trap maintenance, if practical, to provide more efficient implementation of toolbox techniques and containment of submerged oil.

8.0 REMOVAL

Sediment trap structure and CSD removal will require prior approval from U.S. EPA, USGS, and MDEQ. Removal of the sediment trap structures and CSDs will occur prior to the river freezing unless it is determined that the structures can safely remain in place through the winter. The removal of the sediment trap structures and the CSDs will be coordinated with U.S. EPA, MDEQ, and USGS in accordance with the specifications mentioned in the *Kalamazoo River – Subsurface Sediment Structures (14 Sites) – MEDQ Permit Application Submittal to Conduct Proposed Kalamazoo River Response Actions pursuant to Parts 31, 301, and 303 of NREPA,* (Enbridge, 2012). All submerged oil assessment, removal, and/or recovery activities will be completed prior to the removal of the sediment trap structures and the CSDs in coordination with the U.S. EPA and MDEQ.

Prior to the initiation of the removal of any sediment trap structures and CSDs, siltation barriers will be installed downstream of each trap location to contain suspended sediment material mobilized through completion of the proposed maintenance activity. Siltation barriers will be designed to handle the sediment type, load, water depth, and flow conditions of each sediment trap location, and will be maintained in good working order throughout the duration of the maintenance effort.

9.0 REFERENCES

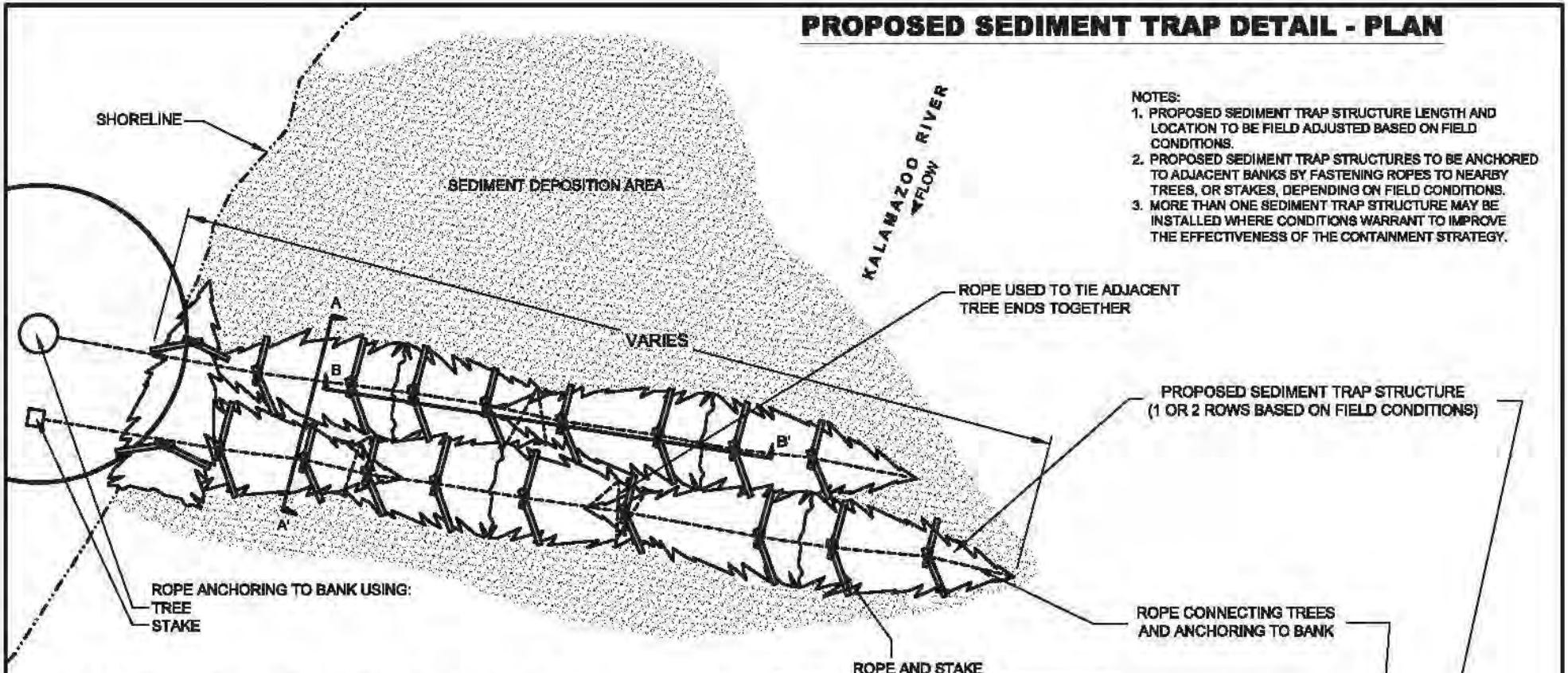
Ashley, Martin & Thornton, Kurt, 2005. *Then & Now: Battle Creek*. Charleston, South Carolina, Arcadia Publishing.

Enbridge, 2011. Enbridge Line 6B Pipeline Release, Marshall, Michigan; *Addendum to the Response Plan for Downstream Impacted Areas, August 2, 2010 (Revised August 17, 2010 per U.S. EPA August 17, 2010 letter), Supplement to Source Area Response Plan, and Supplement to Response Plan for Downstream Impacted Areas, Referred to as Operations and Maintenance Work Plan Commonly referred to as "Consolidated Work Plan from Fall 2011 through Fall 2012".* December 21, 2011.

Enbridge, 2012. "Enbridge Line 6B Pipeline Release, Marshall, Michigan: *Kalamazoo River – Subsurface Sediment Structures (14 Sites) – MEDQ Permit Application Submittal to Conduct Proposed Kalamazoo River Response Actions pursuant to Parts 31, 301, and 303 of NREPA."*

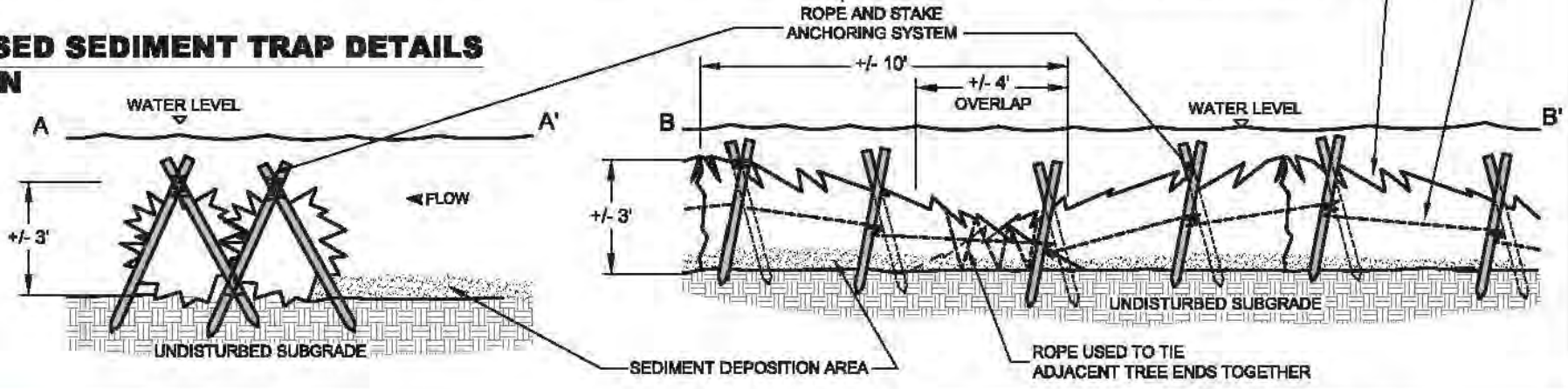
Figures

PROPOSED SEDIMENT TRAP DETAIL - PLAN



NOTES:
1. PROPOSED SEDIMENT TRAP STRUCTURE LENGTH AND LOCATION TO BE FIELD ADJUSTED BASED ON FIELD CONDITIONS.
2. PROPOSED SEDIMENT TRAP STRUCTURES TO BE ANCHORED TO ADJACENT BANKS BY FASTENING ROPES TO NEARBY TREES, OR STAKES, DEPENDING ON FIELD CONDITIONS.
3. MORE THAN ONE SEDIMENT TRAP STRUCTURE MAY BE INSTALLED WHERE CONDITIONS WARRANT TO IMPROVE THE EFFECTIVENESS OF THE CONTAINMENT STRATEGY.

PROPOSED SEDIMENT TRAP DETAILS SECTION



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Drawn: WL 04/23/2012
Approved: MZ 04/23/2012
Project #: 1006114.00

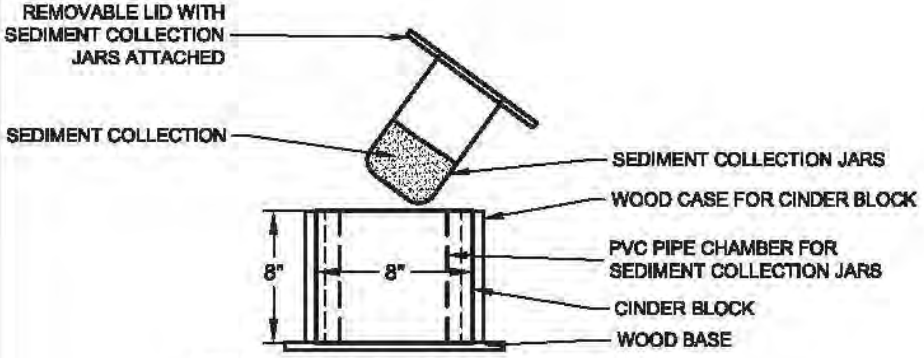
MAP LOCATION

LEGEND
SHORELINE
PROPOSED SEDIMENT DEPOSITION

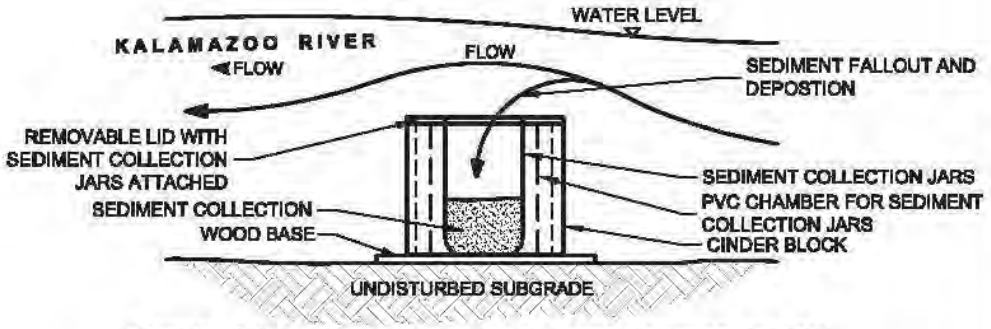
N
NOT TO SCALE

FIGURE 1
SEDIMENT TRAP DETAILS
PLAN AND SECTION - TYPICAL
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHI P

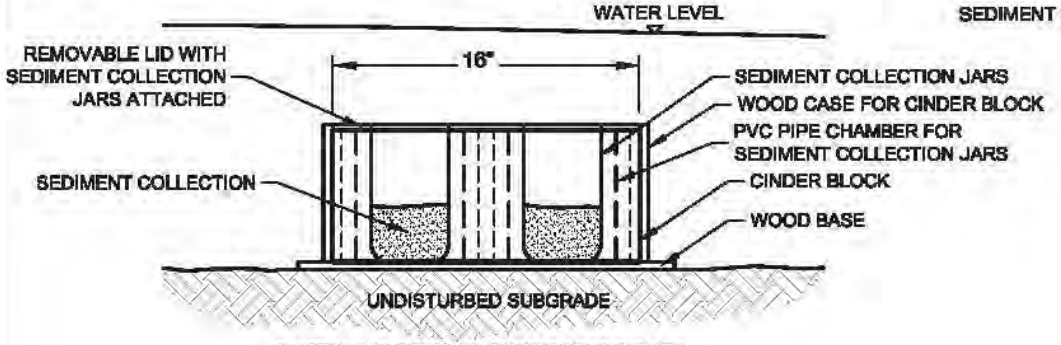
PROPOSED CYLINDRICAL SAMPLING DEVICE DETAIL



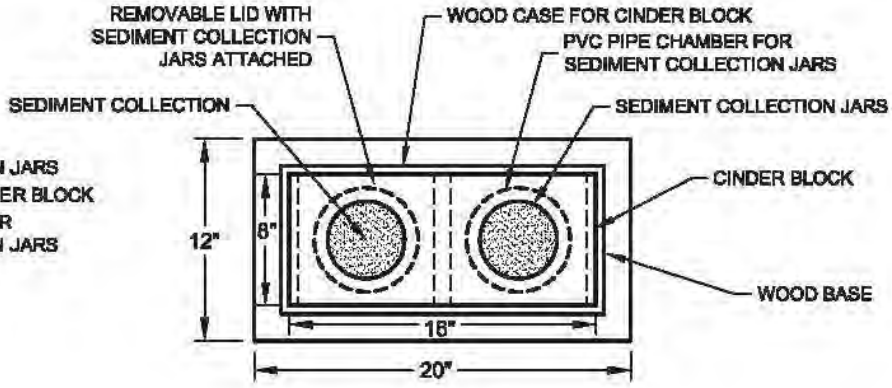
SEDIMENT MONITORING DETAIL



VIEW LOOKING PERPENDICULAR TO STREAM FLOW



VIEW LOOKING DOWNSTREAM



VIEW FROM ABOVE

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Drawn: WL 05/10/2012
Approved: MZ 05/10/2012
Project #: 1006114.00

MAP LOCATION

LEGEND

PROPOSED SEDIMENT COLLECTION

N

NOT TO SCALE

FIGURE 2
SEDIMENT MONITORING DETAILS
PROPOSED CYLINDRICAL SAMPLING DEVICE
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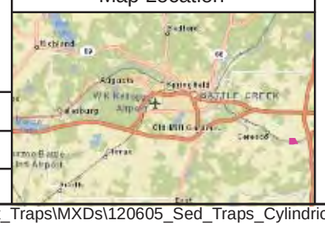
Approved:	EE	6/5/2012
Project #:	60246209	

Map Location



- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 40 80 160

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
3.25 R1
SHEET: 1 OF 17
ENBRIDGE LINE 6B MP 608
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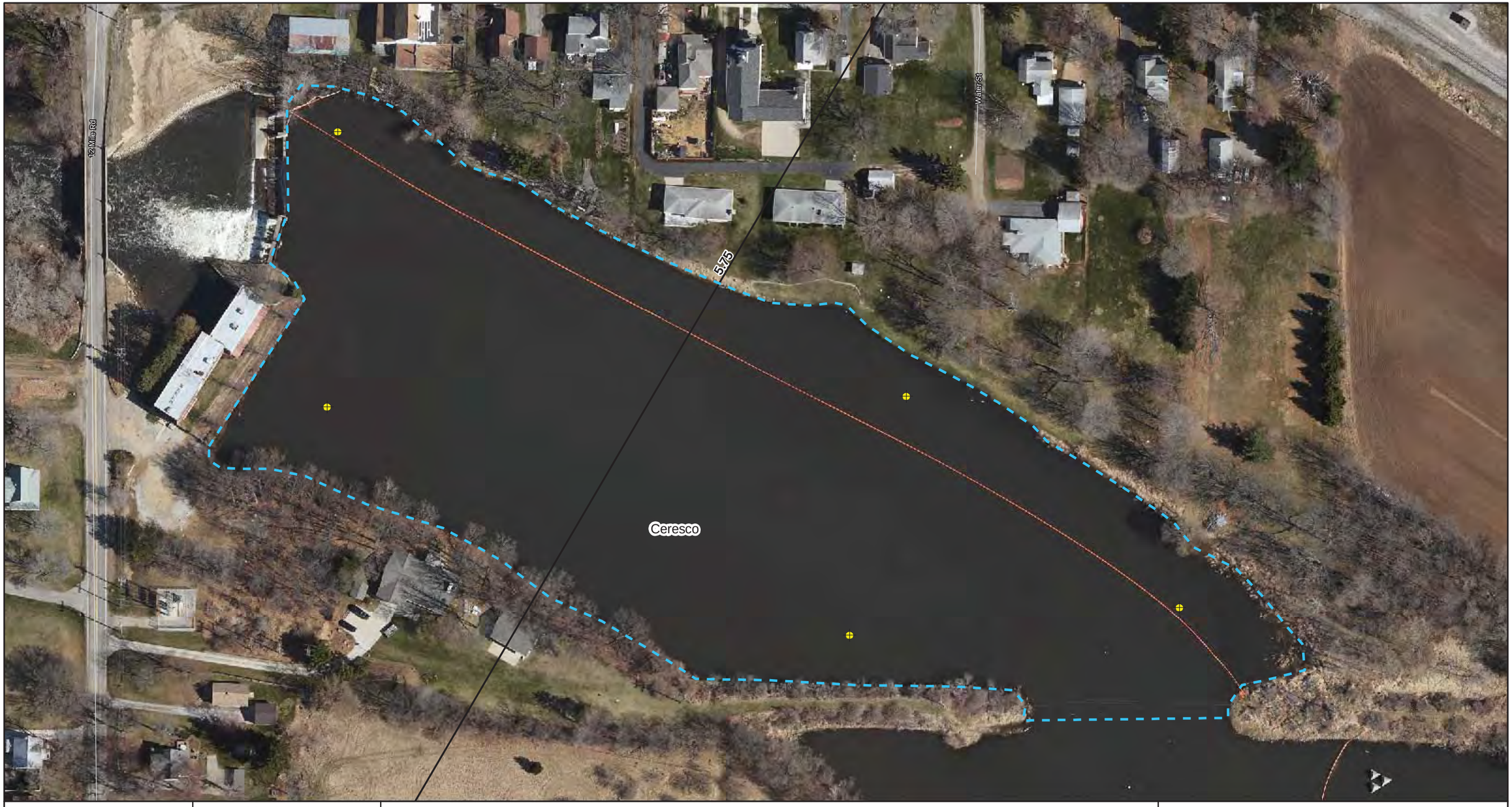
Z:\Work\GIS\Submerged_Oil\Sediment_Traps\MXDs\120605_Sed_Traps_Cylindrical.mxd

Aerial Photography Date: April 2011



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Approved:	EE	6/5/2012
Project #:	60246209	

Map Location

- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 50 100 200

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
CERESCO
SHEET: 2 OF 17
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MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: April 2011

ENBRIDGE

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Project #:	60246209	

Map Location

- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 25 50 100

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
10.40 N
SHEET: 3 OF 17
ENBRIDGE LINE 6B MP 608
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ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: April 2011

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Project #:	60246209	

Map Location

- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 25 50 100

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
10.50 L2
SHEET: 4 OF 17
ENBRIDGE LINE 6B MP 608
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Aerial Photography Date: April 2011

ENBRIDGE

Drawn:	GM	6/5/2012
Approved:	EE	6/5/2012
Project #:	60246209	

Map Location

- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 25 50 100

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
10.75 LDB
SHEET: 5 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Map Location

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- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 70 140 280

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
14.75 RDB
SHEET: 6 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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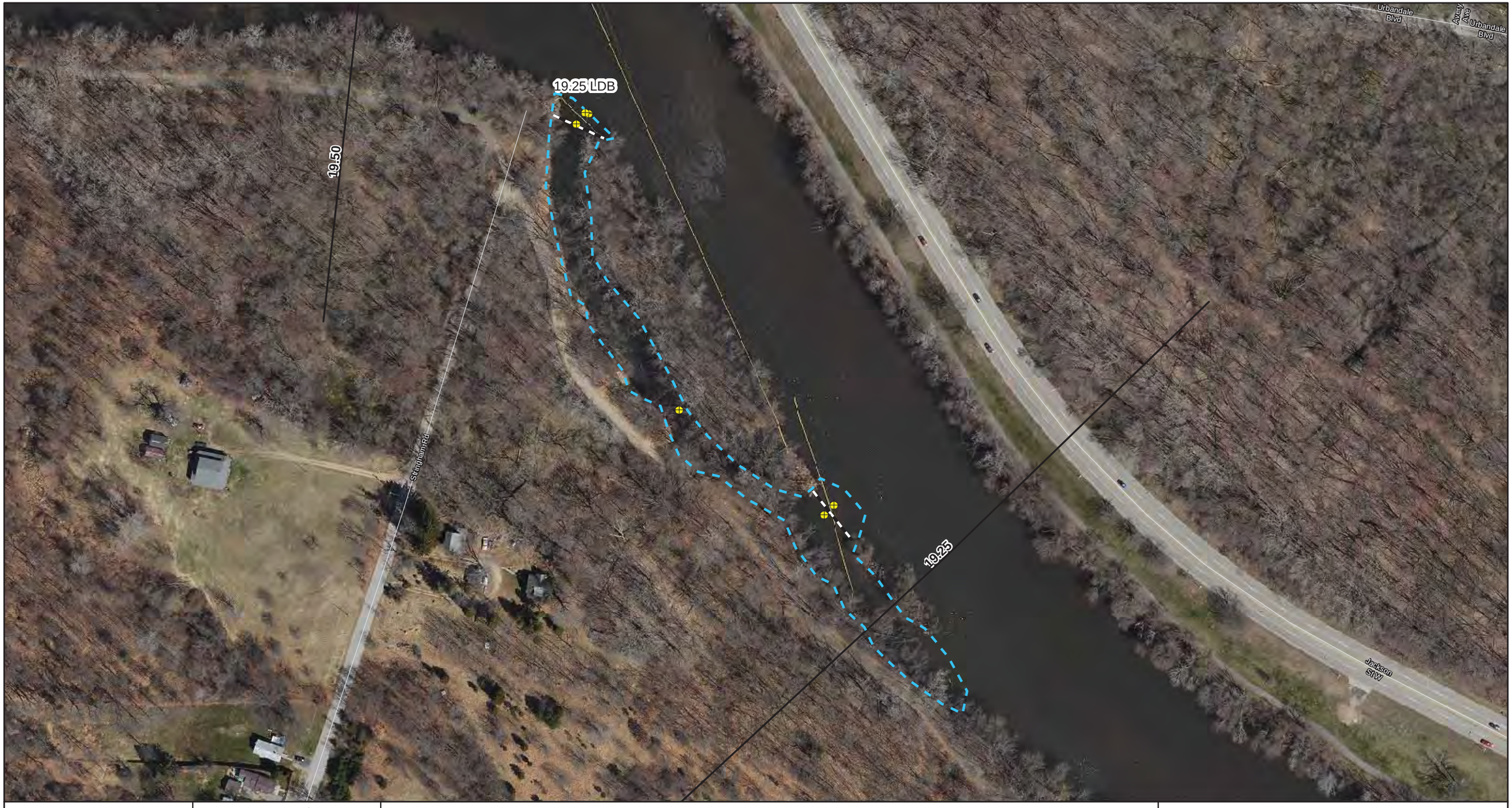
Aerial Photography Date: April 2011



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Map Location

- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 70 140 280

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
19.25 LDB
SHEET: 7 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Map Location

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- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 50 100 200

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
21.50 RDB
SHEET: 8 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Map Location

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- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 50 100 200

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
26.00 RDB
SHEET: 9 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Aerial Photography Date: April 2011

ENBRIDGE

Drawn:	GM	6/5/2012
Approved:	EE	6/5/2012
Project #:	60246209	

Map Location

- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 50 100 200

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
28.25 RDB
SHEET: 10 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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ENBRIDGE

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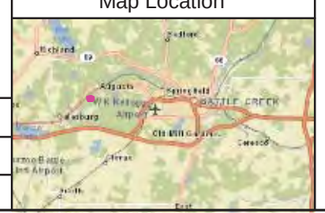
Map Location



- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 50 100 200

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
30.80 LDB
SHEET: 11 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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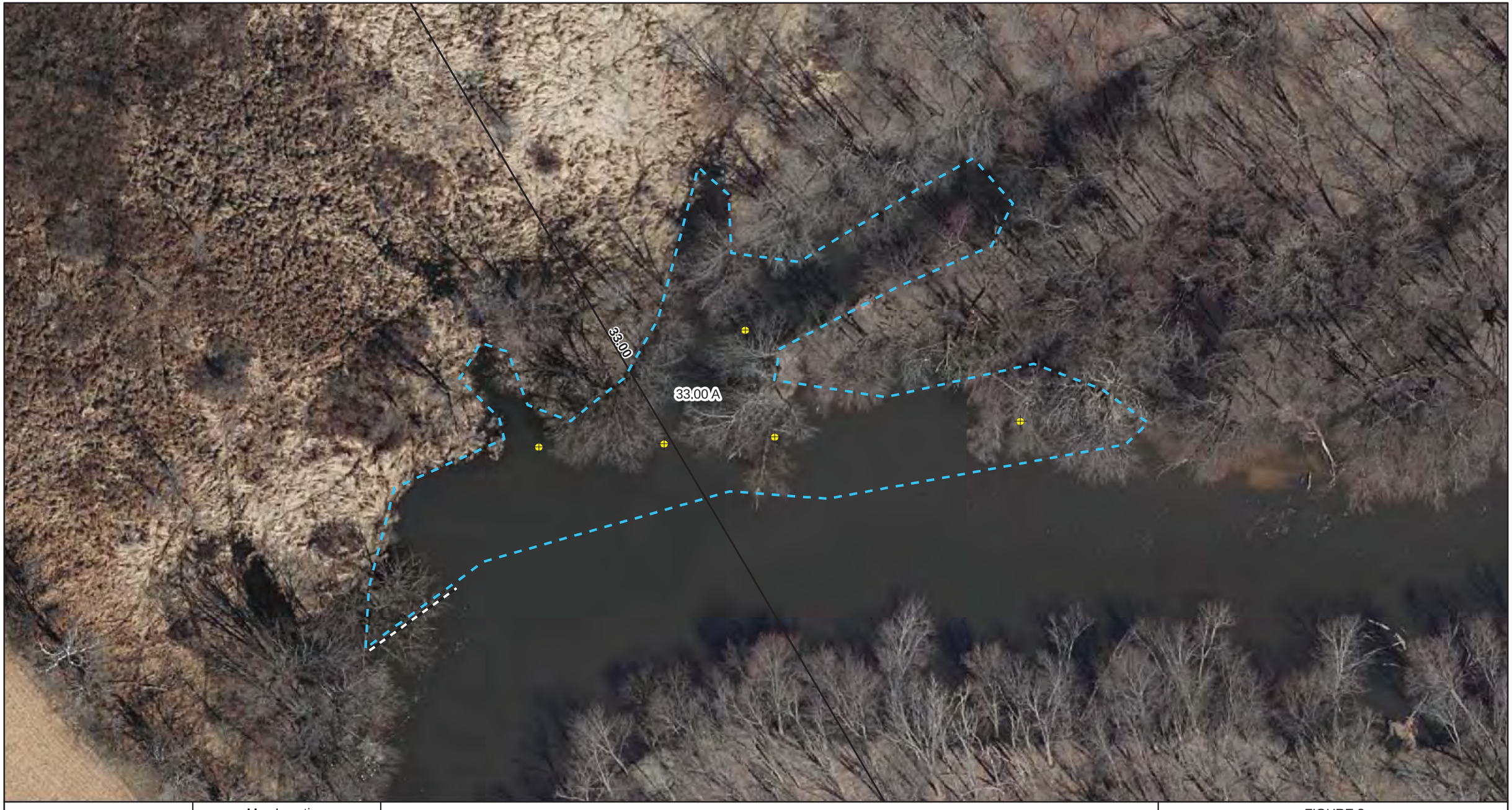
Aerial Photography Date: April 2011



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Map Location

- Proposed Cylindrical Sampling Device
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- Quarter Mile Grid Segments

N

0 25 50 100

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
33.00 A
SHEET: 12 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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ENBRIDGE

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Map Location

- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 40 80 160

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
33.00 B
SHEET: 13 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Map Location

- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 40 80 160

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
36.10 NW
SHEET: 14 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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ENBRIDGE

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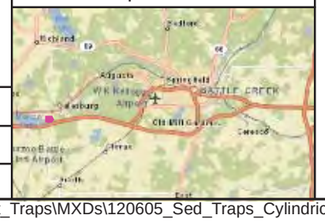
Map Location



- Proposed Cylindrical Sampling Device
- Sediment Trap Area
- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 50 100 200

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
DELTA A
SHEET: 15 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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Map Location

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- Potential Containment Structures
- Quarter Mile Grid Segments

N

0 70 140 280

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
DELTA Z
SHEET: 16 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

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N

0 40 80 160

Scale in Feet

FIGURE 3
POTENTIAL ACTIVE (STRUCTURE) SEDIMENT TRAP LOCATIONS AND PROPOSED CYLINDRICAL SAMPLING DEVICE LOCATIONS
37.75 ISLANDS
SHEET: 17 OF 17
ENBRIDGE LINE 6B MP 608
MARSHALL, MI PIPELINE RELEASE
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