Design Plan and Specifications Preliminary Basis of Design

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Acronyms and Abbreviations

3D	three-dimensional
AOC	Administrative Order on Consent
BMP	best management practice
CFR	Code of Federal Regulations
CSM	conceptual site model
CWA	Clean Water Act
ESRP	Enhanced Sediment Removal Plan
EVS	Environmental Visualization System
facility	Tyco Fire Products LP manufacturing facility in Marinette, Wisconsin
GLAOC	Great Lakes Area of Concern
GLWQA	Great Lakes Water Quality Agreement
gpd	gallons per day
gpm	gallons per minute
GPS	global positioning system
GWCT	groundwater collection and treatment
IMI	interim measures investigation
JPA	Joint Permit Application
K&K	K&K Integrated Logistics
MF	microfiltration
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MMC	Marinette Marine Corporation
MNR	monitored natural recovery
PBOD	Preliminary Basis of Design
PM_{10}	particulate matter finer than 10 micrometers in diameter and smaller
RCRA	Resource Conservation and Recovery Act
RFI	Resource Conservation and Recovery Act facility investigation

RO	reverse osmosis
SCM	semi-consolidated material
site	Tyco Fire Products LP manufacturing facility in Marinette, Wisconsin
SRWP	Sediment Removal Work Plan
TCLP	toxicity characteristic leaching procedure
TSS	total suspended solids
Tyco	Tyco Fire Products LP
URS	URS Corporation
USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VBW	vertical barrier wall
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollutant Discharge Elimination System
WSHS	Wisconsin State Historical Society
yd^3	cubic yards

SECTION 1

Introduction

This Design Plan and Specifications, Preliminary Basis of Design (PBOD) document summarizes the results of pre-design investigations, and describes remedial approaches and technologies that will be applied to address impacted sediment present at the Tyco Fire Products LP (Tyco) manufacturing facility in Marinette, Wisconsin (hereafter referred to as the "site" or "facility"). This PBOD document also responds to direction provided by the U.S. Environmental Protection Agency (USEPA) in a letter to Tyco dated August 29, 2011, and presents activities that will be undertaken to accomplish sediment cleanup work as set forth in the Sediment Removal Work Plan (SRWP) submitted to USEPA on December 1, 2010 (CH2M HILL 2010) and formally approved by the agency with conditions in a letter dated June 1, 2011 (USEPA 2011). Tyco submitted the SRWP and an Alternative Menominee River Sediment Removal Plan to USEPA on December 1, 2010, in accordance with the requirements set forth in the Administrative Order on Consent (AOC) between Tyco and USEPA, dated February 26, 2009.

As discussed with USEPA, the sediment removal activities described in this PBOD document will conform to the SRWP and additional conditions outlined in the June 1, 2011, approval letter, with one exception. The exception is that rather than reinforcing or replacing the existing sheet pile wall along the former 8th Street Slip to allow removal of semi-consolidated material (SCM) along that portion of the sheet pile wall, a chemical isolation layer will be placed over the area as appropriate, as more fully described in this PBOD document.

While this PBOD document describes remedial approaches and technologies that conform to the SRWP as approved by USEPA, Tyco continues to seek approval of an optimized risk management approach that is equally or more protective than the SRWP, and appropriately balances implementability and incremental risk reduction with the cost of the remedy, while minimizing the potential short-term impacts of remedy implementation, consistent with USEPA's (2005) sediment remediation guidance. This optimized remedy is more fully described in the proposed Enhanced Sediment Removal Plan (ESRP), which was submitted to USEPA on September 9, 2011 (CH2M HILL 2011), with proposed modifications to the ESRP as discussed with USEPA on October 4, 2011, and further documented in correspondence dated October 6, 2011. Where the proposed ESRP activities differ from those described in this PBOD document, the reader is referred to additional information included in Appendix A.

In subsequent levels of design, dredging plans described herein may also be modified to appropriately address the activities necessary to achieve the remedial goals of the project.

1.1 Site Description and History

The site is an active manufacturing facility in the city of Marinette in northeastern Wisconsin, adjacent to the southern shore of the Menominee River (Figure 1). The property is bordered by the Menominee River to the north; the 6th Street Slip and City of Marinette property to the east; Water Street, City of Marinette property, Marinette School District property, and residential properties to the south; and Stanton Street and Marinette Marine Corporation to the west.

The facility consists of approximately 63 acres, including a manufacturing area on the western part of the property and an undeveloped area to the east, referred to as the "wetlands area." A fence surrounds both parts of the facility, and access is restricted. The facility began operations in 1915, and manufacturing entities acquired by Tyco in the 1990s produced cattle feed, refrigerants, and specialty chemicals. Arsenic-based agricultural herbicides were manufactured at the facility between 1957 and 1977. A byproduct of the manufacturing of these herbicides was a salt that contained approximately 2 percent arsenic by weight and was stockpiled at several locations on the property. Some of this arsenic subsequently entered site soil and groundwater. By 1978, the facility ceased production of arsenic-based herbicides, and since 1983 has produced only fire extinguishers and fire suppression systems.

1.2 Previous Facility Investigations and Corrective Actions

1.2.1 Investigation Activities

Investigations of environmental conditions at the facility began in 1974. Subsequently, five detailed investigations have been performed to characterize arsenic in sediment of the Menominee River adjacent to the facility. The first was a sediment site assessment conducted in October 1996 (Dames & Moore 1996). The purpose of the assessment was to evaluate potential impacted sediment in the 8th Street Slip, the 6th Street Slip, the Turning Basin, and adjacent areas of the Menominee River. Elevated arsenic levels were detected in the sampled areas, with sediment containing arsenic concentrations up to 22,300 milligrams per kilogram (mg/kg) in the 8th Street Slip. Based on the results of this investigation, and following discussions with USEPA, Tyco subsequently removed sediment within the 8th Street Slip that contained the highest arsenic concentrations.

The second sediment investigation was performed in 2000 as part of an interim measures investigation (IMI) and is summarized in the final IMI report appended to the *Summary of Findings Report* (URS Corporation [URS] 2001). The IMI included the following:

- Performing a hydrographic survey and sub-bottom profile survey of sediment in the Menominee River.
- Advancing and logging 20 borings to bedrock within the Menominee River to assess total arsenic concentrations in soft sediment, SCM, and glacial till units. The borings were continuously sampled, with samples for laboratory analysis of arsenic collected from each 2-foot interval.
- Collecting soft sediment samples at 24 locations within the Menominee River, the Turning Basin, and the South Channel to assess total arsenic concentrations. These samples were collected at 0- to 0.5-foot intervals, with additional samples collected to the bottom of the soft sediment over 2-foot intervals. Soft sediment was defined operationally as sediment that could be sampled using vibracoring equipment.

- Collecting surface water samples at the 24 soft sediment sampling locations to assess arsenic concentrations in the water column, with samples collected at the surface, mid-depth, and bottom of the water column.
- Collecting sediment pore water samples to assess total arsenic concentrations at the 24 soft sediment sampling locations.
- Performing arsenic speciation analyses on the soft sediment and pore water samples from the SCM.
- Collecting geotechnical and geochemical data to evaluate how site conditions affect the movement of arsenic throughout the Menominee River.

A third investigation was performed in late 2001 to fill data gaps for the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI; URS 2002). RFI activities related to the Menominee River included the following:

- Collecting and analyzing eight soft sediment samples from two locations adjacent to the 6th Street Slip to determine whether a former channel was present adjacent to the slip. Samples were collected from the 0- to 0.5-foot depth interval and then over 2-foot intervals to the base of the soft sediment.
- Collecting and analyzing 13 soft sediment samples from five locations within the Turning Basin to further characterize sediment for a Wisconsin Department of Natural Resources (WDNR) dredging permit. Samples were collected from the 0- to 0.5-foot depth interval and then over 2-foot intervals to the base of the soft sediment.
- Collecting groundwater samples from 16 locations in the Menominee River. Groundwater samples were collected at 5-foot intervals, beginning at a depth of 5 feet below the sediment/water interface and continuing to the top of bedrock at each location.

A fourth investigation was performed in June 2004 to further evaluate groundwater conditions below the Menominee River (URS 2004). Sixty groundwater samples were collected from 10 locations within the river, with sampling depth intervals ranging from 5 to 40 feet below the sediment surface. Groundwater samples were analyzed for total and dissolved arsenic.

The fifth investigation was conducted in May and June 2010—the results of which are reported in this PBOD document. Soft sediment, SCM, and groundwater samples were collected to complete this pre-design investigation, filling in data gaps remaining after the June 2004 investigation. A total of 722 samples were collected and submitted for analysis of total arsenic. Sample locations are shown on Figure 2. Subsets of these samples also were submitted for arsenic speciation, the State of Wisconsin NR374 parameters (to support a dredge permit application), geotechnical analyses, and moisture content. Appendix B includes results for all samples collected and analyzed. The conceptual site model (CSM) describing the nature and extent of arsenic and the basis for remedial actions at the site (provided in Section 2) was developed based on data collected from the 2010 pre-design investigation.

1.2.2 Corrective Measures in the Resource Conservation and Recovery Act Program

Tyco has implemented a number of corrective measures through the Resource Conservation and Recovery Act (RCRA) program. Between 1999 and 2000, interim site corrective actions were completed including constructing a slurry wall and sheet pile sections around the Salt Vault and 8th Street Slip (Figure 1), respectively, to contain groundwater with elevated arsenic concentrations. (These site features are now enclosed/contained and no longer used for their original purposes; therefore, they are referred to as the former Salt Vault and the former 8th Street Slip.) An interim corrective action was conducted in the former 8th Street Slip, the slip was filled and covered with asphalt, and a groundwater monitoring program was initiated. Based on the results of the monitoring program, USEPA agreed to cease monitoring within these contained areas because the long-term effectiveness of the barriers had been well established.

Investigations conducted since 2006 have provided the information necessary to design corrective actions for the rest of the manufacturing area and the wetlands area at the site. The culmination of these investigations has been the identification of additional corrective and remedial measures that have been implemented at the facility property as required by the AOC, including installing a vertical barrier wall (VBW) system to surround the facility (Figure 1), a groundwater collection and treatment (GWCT) system to prevent flooding within the VBW, and a network of phyto-pumping tree plantings to remove additional water.

1.3 Menominee River Great Lakes Area of Concern

In 1987, the federal governments of the United States and Canada adopted amendments to the Great Lakes Water Quality Agreement (GLWQA). One of these amendments, called "Annex 2 of the 1987 Protocol," directed the two countries to identify areas of concern that did not meet the objectives of the GLWQA. The Lower Menominee River was identified as being one of the 43 Great Lakes Areas of Concern (GLAOCs).

Long-term goals for the Menominee River GLAOC include (USEPA 2010):

- Protect the aquatic ecosystem of the Menominee River and Harbor from the effects of toxic and conventional pollutants
- Maintain a balanced aquatic and terrestrial community to ensure long-term health of the ecosystem
- Maintain and enhance recreational and commercial uses of the Menominee River and Harbor, consistent with the long-term maintenance of the natural resource base and a healthy economy

This PBOD and the optimized risk management approach described in the proposed ESRP (CH2M HILL 2011) were developed in consideration of these long-term goals.

SECTION 2

Conceptual Site Model

This section briefly describes key components of the CSM, including the nature and extent of arsenic concentrations in soft sediment, SCM, and glacial till units beneath the Menominee River, along with a summary of contaminant transport mechanisms and the basis for remedial action at the site. For organizational purposes, the river adjacent to the facility is divided into seven subareas as indicated on Figure 1. The designated subareas include:

- Main Channel
- Turning Basin
- South Channel
- Transition Area 1
- Transition Area 2
- Transition Area 3
- 6th Street Slip

2.1 Generalized Stratigraphy and Groundwater Flow Direction

In general, four material types (or layers) are present in the upland portion of the site (Figure 3). The upper soil layer is generally comprised of fill (sand and gravel with cinders, wood chips, brick, and glass). Beneath the fill is a layer of loose to medium dense alluvial deposits of fine- to coarse-grained sand and gravel with varying amounts of silt (alluvium). Underlying the sand is a layer of dense to extremely dense silty sand to sandy silt (compacted glacial "till" deposit). Below the dense silty sand/sandy silt is dolomitic bedrock.

In the Menominee River, typical water depths range between a few feet in the South Channel and 26 feet in the Main Channel. Soft sediment thickness ranges between less than 1 foot in the Main Channel and 8 feet in the Turning Basin (with the greatest soft sediment thicknesses occurring outside the federally authorized navigation channel), Transition Area 1, and the 6th Street Slip (Figure 4). SCM (as evidenced by its higher blow count) underlies the soft sediment, and the thickness of this layer ranges from 2 feet in the Turning Basin to 27 feet in Transition Area 3 (Figure 5). The glacial till layer beneath the SCM ranges between 0.5 and 7 feet thick (Figure 6). The northern portion of the river (along the shoreline outside of the Main Channel) was dredged in 2002 down to bedrock, so SCM and glacial till are not present in this area. The elevations of the top of bedrock range from a low of 539.1 feet (North American Vertical Datum of 1988) at SD556 within the Main Channel northeast of the Turning Basin to a high of 562.6 feet at SD501 in the western portion of the Turning Basin, directly adjacent to the southern shoreline of the Menominee River. The bedrock surface slopes east-northeast downward toward the Main Channel.

Portions of the Main Channel and Turning Basin fall within the federally authorized navigation channel. The authorized dredging depth in the federally authorized navigation channel is 21 feet below the Lake Michigan low water datum of 577.5 feet above mean sea level referenced to the International Great Lakes Datum of 1985. While the entire federally authorized navigation channel has not been dredged for decades to the full authorized depth, historical dredging by the U.S. Army Corps of Engineers (USACE) in the Turning Basin and Main Channel appears to have removed some of the SCM layer, and soft sediment subsequently has deposited through natural accretion directly on the surface of the till and, in areas where it remains, on top of the SCM. The outline of the approximate limits of the federally authorized navigation channel is shown on Figure 1.

Regional groundwater flow beneath the facility is generally northeast toward the Menominee River. The VBW, which was completed in fall 2010, influences the direction of groundwater flow in the vicinity of the facility. Regional groundwater flow outside the facility boundaries likely will remain generally toward the river but will be diverted around the VBW directly south of the facility.

2.2 Historical Sources of Arsenic

Arsenic concentrations in groundwater at the facility are highest in the vicinity of the former 8th Street Slip and former Salt Vault areas because of historical storage of the salts in these areas. Three primary historical transport mechanisms may have released arsenic from the former salt piles that were situated near the river. These transport mechanisms include:

- Overland transport via surface water and stormwater runoff into the Menominee River.
- Windblown transport of salt into the river and surrounding environment.
- Dissolution and infiltration into groundwater beneath the site with subsequent subsurface transport to the river. Arsenic accumulations within the SCM primarily are attributable to this historical subsurface transport mechanism, which has since been controlled through RCRA corrective measures (see Section 1.2.2).

Figure 7 shows a conceptual depiction of these transport mechanisms.

2.3 Sediment Characterization

Several figures were prepared to depict features within the individual sediment investigation study areas. The top of soft sediment elevation contour map is shown on Figure 8 and is based on bathymetry data collected in April and May 2010. The thickness of this soft sediment is shown on Figure 4. The soft sediment in the lower velocity areas of the river consists of highly organic silt and detritus. Soft sediment in the portions of the river with higher flow velocity also includes loosely consolidated sand and gravel. The underlying SCM unit is comprised of fine- to medium-grained sand. The elevation contour map for the top of SCM beneath the soft sediment (Figure 9) shows that the SCM unit is highest in elevation near the southern shoreline of the Turning Basin and the Transition Areas, and gradually decreases in elevation toward the northern portion of the Main Channel of the Menominee River. The thickness of the SCM is shown on Figure 5.

The glacial till situated beneath the SCM is described as dry to moist, hard silt with small to medium pebbles; firm to hard sandy silt with some gravel; and fine-grained, hard silty sand with trace gravel. The elevation of the top of the glacial till is shown on Figure 10—with a shallower elevation near the southern shoreline of the Turning Basin and becoming deeper toward the northern shore of the Menominee River, sloping in a north-northeast direction. The glacial till thickness is shown on Figure 6.

Sediment characteristics specific to individual study areas are included in the subsections that follow. Figures 11A through 11P are horizontal slice maps at elevations 746 feet through 776 feet (in 2-foot intervals) and depict stratigraphy at the respective elevation in the project area.

2.3.1 Main Channel

The soft sediment in the northern portion of the Main Channel of the Menominee River is comprised of loosely consolidated sands and gravel. Soft sediment in the southern portion of the Main Channel is comprised of soft, moist clay/silt with a trace to minor fine-grained sand component and a medium-grained, dark brown to dark gray sand with a minor fines component. Soft sediment deposits within the Main Channel are relatively thin, ranging from 0.3 to 5 feet thick.

The SCM thickness ranges from 2.5 to 16 feet in borings advanced in the Main Channel, with glacial till thickness ranging from 0.5 to 7 feet (Figure 5).

2.3.2 Turning Basin

Since this area has a relatively slow river water velocity, soft sediment within the Turning Basin is comprised of clay/silt with a trace to minor fine-grained sand component and a medium-grained, dark brown to dark gray sand with a minor fines component. Soft sediment thickness in the Turning Basin ranges from 0.5 foot to approximately 8 feet, with most locations in the central area of the Turning Basin approximately 4 to 5 feet thick (Figure 4).

The SCM thickness ranges from 2 to 25.3 feet in borings within the Turning Basin (Figure 5). The thickest sequences of the SCM within the Turning Basin are in the eastern portion, outside the federally authorized navigation channel. The glacial till thickness within the Turning Basin ranges from 1 to 6.2 feet (Figure 6).

2.3.3 Transition Areas

The Transition Areas also are a slower-velocity environment, with soft sediment being comprised of soft, moist clay/silt with a trace to minor fine-grained sand component and a medium-grained, dark brown to dark gray sand with a minor fines component. Sediment thickness in the Transition Areas appears to be relatively uniform, with most locations exhibiting approximately 5 feet of soft sediment (Figure 4).

The SCM thickness ranges from 8 to 26.8 feet in borings within the Transition Areas, with the majority of the borings indicating a thickness of 25 to 26.8 feet (Figure 5). The observed glacial till thickness in the Transition Areas ranges from 0.5 to 2.5 feet (Figure 6).

2.3.4 6th Street Slip

Soft sediment in the 6th Street Slip is comprised of soft, moist clay/silt with a trace to minor fine-grained sand component and a medium-grained, dark brown to dark gray sand with a minor fines component. Sediment thicknesses in the 6th Street Slip range from 4 to 8 feet.

2.3.5 South Channel

Another slow-velocity environment, soft sediment in the South Channel exhibits similar characteristics as soft sediment in the 6th Street Slip and Transition Areas. The river bottom in the South Channel is largely covered with wood, wood chips, bark, and other debris from the former lumber operations in the area. The soft sediment thickness within the South Channel ranges from 0.3 to 5 feet, with the thickest deposits occurring at the western end of the channel (Figure 4).

2.4 Sediment Arsenic Concentrations

The 2010 sediment investigation analytical data were used to define the lateral and vertical extents of the elevated arsenic concentrations. While a more detailed geostatistical analysis of these data was used to develop the dredge plans (see Section 3.3.4), preliminary figures were compiled to depict maximum arsenic concentrations in each zone—soft sediment, SCM, and glacial till (Figures 12, 13, and 14, respectively). The maximum arsenic concentrations within each zone at individual sampling locations were used to provide a conservative (that is, upper-bound concentration) depiction of the maximum extent of arsenic at the site for the CSM. Figures 12 ,13, and 14 use the following maximum concentration range categories: less than 20 mg/kg, 20 to 50 mg/kg, 50 mg/kg to 500 mg/kg, and greater than 500 mg/kg..

Appendix B, Table B1 summarizes sediment total arsenic concentrations measured in samples collected by CH2M HILL in April 2010 (CH2M HILL 2010). The summary statistics of the arsenic concentration by area and zone (soft sediment, SCM, glacial till, and weathered bedrock) are provided in Table 1, including the number of samples collected in each area and within each zone. Discussions for each layer and observations for concentrations between layers are presented below. Figures 15A through 15P are horizontal slice maps at elevations 746 feet through 776 feet (in 2-foot intervals) that depict arsenic concentrations at respective elevations in the project area. Figures 16 and 17A through 17F depict vertical cross sections in the project area and show stratigraphy as well as arsenic concentrations.

2.4.1 Soft Sediment

Within the central and western part of the Turning Basin, maximum arsenic concentrations within the soft sediment unit were greater than 500 mg/kg. However, locations in the eastern portion of the Turning Basin, adjacent to Transition Areas 1 and 2 (that is, mostly outside the federally authorized navigation channel), do not exhibit arsenic concentrations above 20 mg/kg. The highest concentrations in the Turning Basin are detected within the center of the Turning Basin and adjacent to the shoreline. Soft sediment collected from the Main Channel has concentrations exceeding 500 mg/kg adjacent to the Turning Basin. However, concentrations in soft sediment collected from the Main Channel decrease to the east and west of the Turning Basin (Figure 12).

Maximum concentrations of arsenic in soft sediment exceed 50 mg/kg near the southern shoreline, within the 6th Street Slip, and South Channel. The 50 mg/kg concentration also is in exceedance at sample locations SD533 and SD534 in Transition Area 2, and SD554 in the Main Channel. Arsenic concentrations exceed 500 mg/kg in the southern portion of the site adjacent to Transition Area 3 and the former 8th Street Slip.

The soft sediment samples collected in the 6th Street Slip contained maximum arsenic concentrations above 50 mg/kg.

2.4.2 Semi-Consolidated Material

Maximum arsenic concentrations in the SCM within the Turning Basin follow a similar pattern as those found in the soft sediment. The highest concentrations (greater than 500 mg/kg) in this layer are adjacent to the southern shoreline and extend outward into the Turning Basin and the western portions of Transition Areas 2 and 3 (Figure 13). Along the southern shoreline of the Turning Basin, the highest arsenic concentrations are in the top intervals of the SCM and concentrations generally appear to decrease with depth (Appendix B).

The zone where maximum arsenic concentrations exceed 50 mg/kg extends beyond the greater than 500 mg/kg zone, just a bit farther into the Menominee River (Figure 13).

2.4.3 Glacial Till

Figure 14 shows areas of maximum arsenic concentrations for the sample locations where one or more glacial till samples were collected. Similar to the access issues encountered when attempting to sample the SCM, glacial till samples were either not collected or not encountered in the 6th Street Slip and the South Channel during the 2010 investigation. Additionally, only one location in Transition Area 1 was accessible to the drilling rig.

Maximum arsenic concentrations within the glacial till layer do not exceed 50 mg/kg in most areas (Figure 14).

2.4.4 Comparisons Across Layers

When viewing concentration results for total arsenic in the various layers, several areas exist where the arsenic concentrations are relatively low in the shallower sediment deposits, but increase at relatively deeply buried depths within the sediment column. This information is summarized in Table 2, which contains a subset of the information provided in Appendix B. The region summarized in Table 2 includes sample locations SD515, SD519, SD562, and SD574. Each of these locations is situated at least 100 feet from the southern shoreline of the Menominee River (see Figure 13 for the SCM). These data suggest arsenic in this area of the semi-consolidated zone has been transported by groundwater from the site rather than originating from soft sediment at the surface.

SECTION 3

Menominee River Sediment Removal Plan

3.1 Project Objectives

Consistent with the SRWP (CH2M HILL 2010), soft sediment and SCM containing total arsenic concentrations greater than or equal to 50 mg/kg will be removed from the Menominee River adjacent to the facility, and monitored natural recovery (MNR) will be used to address sediment with total arsenic concentrations between 20 and 50 mg/kg. As noted above, Tyco continues to seek USEPA approval of an optimized risk management approach that is equally or more protective than the SRWP. This optimized remedy is more fully described in the proposed ESRP (CH2M HILL 2011). Where the proposed ESRP activities differ from those described in this PBOD document, the reader is referred to additional information presented in Appendix A.

3.2 SRWP Corrective Action Plan

Data from the 2010 pre-design investigation, as well as previous investigations, were used to develop this PBOD. This section describes the SRWP approach for removal, stabilization, and disposal of the targeted sediment. Following USEPA review, final design plans and specifications will be developed and submitted to USEPA for review 60 days before commencing construction in accordance with the AOC. After USEPA reviews the final design documents, Tyco will implement corrective activities as appropriate.

Dredging, stabilization, and disposal corrective actions will be implemented in phases. During the corrective action activities, some phases may be performed simultaneously with others. The sediment remediation preliminary design drawings in Appendix C provide additional details regarding the corrective activities. Phases also are depicted on Figures 18A and 18B. The proposed construction phases include:

1. **Phase I (Mechanical Dredging of Contaminated Soft Sediment in the Turning Basin)**: Soft sediment containing total arsenic concentrations greater than or equal to 50 mg/kg that is located within the Turning Basin and small portions of the Main Channel and Transition Area 2 will be mechanically dredged using an environmental clamshell bucket and stabilized onsite. The stabilization process will reduce the concentration of leachable arsenic in the sediment such that it passes the toxicity characteristic leaching procedure (TCLP) test with less than 5 milligrams per liter (mg/L) of total arsenic. The stabilized soft sediment then will be transported for disposal at an offsite RCRA Subtitle D (nonhazardous) landfill.

2. **Phase II (Mechanical Dredging of Contaminated SCM in the Turning Basin):** The SCM that underlies the soft sediment dredged in Phase I containing total arsenic concentrations greater than or equal to 50 mg/kg will be mechanically dredged using a standard clamshell bucket and, if necessary, stabilized onsite. The stabilized SCM then will be transported for disposal at an offsite RCRA Subtitle D landfill. Some mechanical dredging of SCM also will be performed in the Main Channel. The lateral extent of

Phase II will be limited in the southeastern portion of the Turning Basin (outside the authorized navigational channel) so that existing SCM is left in place to support temporary sheet piling to be installed as part of Phase III.

3. **Phase III (Dry Excavation of Contaminated Soft Sediment):** Sheet piling will be installed along the northern side of Transition Area 2 to enclose most of Transition Area 2, Transition Area 3, the 6th Street Slip, and the South Channel. Water inside the temporary enclosure will be pumped out. Depending upon water levels in the Menominee River, the eastern end of the South Channel may need to be blocked temporarily to prevent backflow into the dry excavation area. Conventional excavation equipment (backhoes and articulated haulers) will be used to stabilize the soft sediment in situ, excavate it, and transport it back to the facility for further stabilization. The stabilized material will be transported for disposal at an offsite RCRA Subtitle D landfill. As presented in the ESRP (CH2M HILL 2011), dry excavation is appropriately limited to only the South Channel area. Details of the ESRP approach for this area are presented in Appendix A.

4. **Phase IV (Dry Excavation of SCM):** Following dry excavation of soft sediment within the areas enclosed by sheet piling, underlying SCM containing arsenic concentrations greater than or equal to 50 mg/kg will be excavated from within the dry excavation area using conventional excavation equipment and, if necessary, will be stabilized onsite. The stabilized SCM will be transported for disposal at an offsite RCRA Subtitle D landfill. Some SCM containing arsenic concentrations greater than 50 mg/kg will be permanently left in place near the existing sheet pile wall along the former 8th Street Slip to avoid compromising the wall's stability. The underlying SCM would not be removed, but instead would be covered with an engineered chemical isolation layer on these materials to provide equal or greater protection. Additionally, some SCM will be temporarily left in place along the temporary sheet piling in the northwestern portion of the dry excavation area to maintain support for that sheet piling. This SCM will be removed in Phase V. Details of the ESRP approach for this area are presented in Appendix A.

5. **Phase V (Mechanical Dredging of SCM Near Temporary Sheet Piling):** After Phase IV has been completed, the temporary sheet pile wall forming the dry excavation cell will be extracted. The SCM containing total arsenic concentrations greater than or equal to 50 mg/kg that was left in place to provide support for the temporary sheet pile wall used to isolate the dry excavation area described in Phase IV will be mechanically dredged using a standard clamshell bucket and, if necessary, stabilized onsite. The stabilized SCM then will be transported for disposal at an offsite RCRA Subtitle D landfill.

6. **Phase VI (Placement of Chemical Isolation Layer):** A chemical isolation layer consisting of clean sediment, sand, and gravel will be placed over SCM containing total arsenic concentrations greater than or equal to 50 mg/kg that will be left in place to support the existing sheet pile wall along the former 8th Street Slip. As presented in the ESRP (CH2M HILL 2011), a chemical isolation layer placed over SCM outside the federally authorized navigation channel will provide permanent protection under an optimized risk management approach, consistent with USEPA's (2005) sediment remediation guidance. Details of this approach are further described in Appendix A.

7. **Phase VII (Monitoring Natural Recovery):** Sediment containing arsenic concentrations between 20 and 50 mg/kg will be left in place. These and other sediment areas at the site will be monitored to verify anticipated natural recovery. Monitoring activities will be described under a separate plan. It is anticipated that sufficient MNR data will be collected within 10 years following implementation of Phases I through VII to permit a review of the remedy's effectiveness.

The corrective activities consist of the following key components.

3.2.1 Pre-Dredging Activities

- Mobilizing equipment and personnel
- Completing minor improvements to the existing asphalt surface in the former Salt Vault area for use as a staging pad
- Demarcating roads on the existing asphalt surface for trucks to travel
- Constructing a temporary mooring structure along the shoreline of the facility
- Installing a temporary water treatment system and other temporary infrastructure on the facility
- Installing turbidity monitoring equipment in the river
- Start developing relationship between turbidity and total suspended solids (TSS)
- Performing a bathymetric survey to document the pre-dredge sediment elevations
- Installing turbidity control devices (such as silt curtains) in the river

3.2.2 Phase I Activities (Mechanical Dredging of Contaminated Soft Sediment in the Turning Basin)

- Mechanical dredging of approximately 41,000 cubic yards (yd^3) of soft sediment in the Turning Basin that contains arsenic equal to or greater than 50 mg/kg using an environmental bucket[1], following best management practices (BMPs), and loading the sediment into watertight scows.
- Transporting loaded scows to the mooring area adjacent to the facility.
- Pumping free water off the dredged material to the temporary water treatment system.
- Offloading dredged material from the scows to a temporary stockpile or, depending on available stabilization capacity, directly to the stabilization process. (Free water that drains from the offloaded, dredged material that is stockpiled before stabilization will be pumped to the temporary water treatment facility. Active dewatering of the dredged material is not planned.)
- Stabilizing the dredged material with suitable reagents to reduce leachable arsenic, eliminate free water, and provide moderate strength gain.

[1] Environmental bucket and best management practices are defined in Sections 5.3.1 and 5.8.1, respectively.

- Allowing sufficient time for reagents added to sediment to react sufficiently to meet landfill acceptance criteria.
- Placing the stabilized sediment into trucks.
- Covering the truck bed and decontaminating the exterior of the trucks.
- Transporting the sediment to an offsite RCRA Subtitle D landfill.
- Collecting and treating wastewater through the temporary water treatment system.
- Performing ongoing monitoring activities consisting of monitoring dredge-generated turbidity in the river, arsenic concentrations in the water treatment system effluent, and stabilized sediment disposal parameters (that is, TCLP, paint filter, and laboratory soil strength testing).
- In areas where no SCM will be excavated below the soft sediment, performing confirmation sampling to document that materials with arsenic concentrations exceeding 50 mg/kg have been removed.
- If necessary, removing additional soft sediment based on the initial confirmation sampling, followed by additional confirmation sampling.
- Performing a bathymetric survey to document the post-Phase I subsurface elevations.

3.2.3 Phase II Activities (Mechanical Dredging of Contaminated SCM in the Turning Basin)

- Mechanical dredging of approximately 56,000 yd^3 of SCM in the Turning Basin that contains arsenic concentration greater than or equal to 50 mg/kg using a standard clamshell bucket, and loading the material into watertight scows.
- Transporting loaded scows to the mooring area adjacent to the facility.
- Pumping free water off the dredged material to the temporary water treatment system.
- Offloading dredged material from the scows to a temporary stockpile or directly to the stabilization process depending on available capacity. (Free water that drains from offloaded, dredged material that is stockpiled before stabilization will be pumped to the temporary water treatment facility. Active dewatering of the dredged material is not planned.)
- Stabilizing, as necessary, the dredged material with suitable reagents to reduce leachable arsenic, eliminate free water, and provide moderate strength gain.
- Allowing sufficient time for reagents added to the material to react sufficiently to meet landfill acceptance criteria.
- Placing the stabilized material into trucks.
- Covering the truck bed and decontaminating the exterior of the trucks.
- Transporting the stabilized material to an offsite RCRA Subtitle D landfill.

- Collecting and treating wastewater through the temporary water treatment system.
- Performing ongoing monitoring activities consisting of monitoring dredge-generated turbidity in the river, arsenic concentrations in the water treatment system effluent, and stabilized sediment disposal parameters (that is, TCLP, paint filter, and laboratory soil strength testing).
- Performing confirmation sampling to document that SCM with arsenic concentrations exceeding 50 mg/kg has been removed, or that glacial till has been reached.
- If necessary, removing additional SCM based on the initial confirmation sampling, followed by additional confirmation sampling.
- Performing a bathymetric survey to document the post-Phase II subsurface conditions.

3.2.4 Phase III Activities (Dry Excavation of Contaminated Soft Sediment)

- Mobilizing equipment necessary specifically for Phase III activities.
- Installing sheet piling along the northern (and southern, if necessary) boundary of Transition Area 2 to facilitate dry excavation.
- Installing a temporary pumping system to bypass 6th Street stormwater around the dry excavation area.
- Pumping free water on top of the sediment to the river until TSS in the discharge reaches 80 mg/L.
- Pumping remaining free water within the dry excavation area to the onsite temporary water treatment system.
- Installing well points or constructing sump areas to facilitate additional dewatering below the top of sediment and pumping this water to the onsite temporary water treatment system.
- Constructing an earthen ramp to enable equipment to access the dry excavation area from the site.
- Preparations (as necessary) will be made to allow for excavation equipment and haul trucks to work safely within the dry excavation area. These preparations may include building temporary haul roads utilizing crane mats or other surface preparation techniques.
- Removing approximately 49,000 yd3 of soft sediment in the dry excavation area that contains arsenic greater than or equal to 50 mg/kg in situ using an excavator and loading the sediment into articulated trucks to transport the material back to a temporary stockpile in the stabilization area on the facility (a cementitious stabilization agent may need to be added to the soft sediment in situ to facilitate its removal and transport by haul truck to the facility).
- Stabilizing the dredged material following removal from the dry excavation area with suitable reagents to reduce leachable arsenic, eliminate free water, and provide moderate additional strength gain, as required by the landfill.

- Allowing sufficient time for reagents added to sediment to react sufficiently to meet landfill acceptance criteria.
- Placing the stabilized sediment into trucks.
- Covering the truck bed and decontaminating the exterior of the trucks.
- Transporting the stabilized sediment to an offsite RCRA Subtitle D landfill.
- Collecting and treating wastewater through the temporary water treatment system.
- Performing ongoing monitoring activities consisting of monitoring arsenic concentrations in the water treatment system effluent, stabilized sediment disposal parameters (that is, TCLP, paint filter, and laboratory soil strength testing), and fugitive dust emissions from the in situ stabilization activities.
- In areas where no SCM will be excavated below the soft sediment, performing confirmation sampling to document that materials with arsenic concentrations exceeding 50 mg/kg have been removed.

3.2.5 Phase IV Activities (Dry Excavation of SCM)

- Pumping water collecting in the dry excavation cell well points to the onsite temporary water treatment system.
- Removing approximately 56,000 yd^3 of SCM in the dry excavation area that contains arsenic greater than or equal to 50 mg/kg in situ using an excavator and loading the material into articulated trucks to transport the material back to a temporary stockpile in the stabilization area on the facility. Between 10,000 and 12,000 yd^3 of SCM potentially contaminated with arsenic exceeding 50 mg/kg will remain in place to provide support to the sheet pile wall at the former 8th Street Slip. Fifty percent of this material is inside the dry excavation area alongside the sheet pile wall, and the remaining 50 percent is outside the dry excavation area alongside the sheet pile wall.
- Stabilizing, as necessary, the dredged material with suitable reagents to reduce leachable arsenic, eliminate free water, and provide moderate strength gain.
- Allowing sufficient time for reagents added to sediment to react sufficiently to meet landfill acceptance criteria.
- Placing the stabilized material into trucks.
- Covering the truck bed and decontaminating the exterior of the trucks.
- Transporting the stabilized material to an offsite RCRA Subtitle D landfill.
- Collecting and treating wastewater through the temporary water treatment system.
- Performing ongoing monitoring activities consisting of monitoring arsenic concentrations in the water treatment system effluent and stabilized material disposal parameters (that is, TCLP, paint filter, and laboratory soil strength testing).

- Performing confirmation sampling to document that materials with arsenic concentrations exceeding 50 mg/kg have been removed or that glacial till has been reached.
- Performing a survey to document the post-Phase IV subsurface conditions.
- Removing the earthen access ramp used to provide access from the site to the dry excavation area, disposing of the top 12 inches of material from the ramp at an offsite RCRA Subtitle D landfill, and testing the remaining material to verify it can be transported offsite for reuse. The material in the bottom layer of the ramp, in direct contact with the impacted material, also will be disposed of at an offsite RCRA Subtitle D landfill.
- Actively filling the dry excavation area with river water.
- Removing temporary sheet piling along the northern (and southern, if applicable) side of Transition Area 2.

3.2.6 Phase V Activities (Mechanical Dredging of SCM Near Temporary Sheet Piling)

- Mechanical dredging approximately 25,000 yd^3 of SCM that supported the temporary sheet piling used to isolate the dry excavation area and that contains arsenic concentrations greater than or equal to 50 mg/kg using a standard clamshell bucket, and loading the material into watertight scows.
- Transporting loaded scows to the mooring area adjacent to the facility.
- Pumping free water off the dredged material to the temporary water treatment system.
- Offloading dredged material from the scows to a temporary stockpile or directly to the stabilization process depending on available capacity. (Free water that drains from offloaded, dredged material that is stockpiled before stabilization will be pumped to the temporary water treatment facility. Active dewatering of the dredged material is not planned.)
- Stabilizing, as necessary, the dredged material with suitable reagents to reduce leachable arsenic, eliminate free water, and provide moderate strength gain.
- Allowing sufficient time for reagents added to the material to react sufficiently to meet landfill acceptance criteria.
- Placing the stabilized material into trucks.
- Covering the truck bed and decontaminating the exterior of the trucks.
- Transporting the stabilized material to an offsite RCRA Subtitle D landfill.
- Collecting and treating wastewater through the temporary water treatment system.
- Performing ongoing monitoring activities consisting of monitoring dredge-generated turbidity in the river, arsenic concentrations in the water treatment system effluent, and

stabilized material disposal parameters (that is, TCLP, paint filter, and laboratory soil strength testing).

- Performing confirmation sampling to document that SCM with arsenic concentrations exceeding 50 mg/kg has been removed, or that glacial till has been reached.
- If necessary, removing additional contaminated SCM based on the initial confirmation sampling, followed by additional confirmation sampling.
- Performing a bathymetric survey to document the post-Phase V subsurface conditions.

3.2.7 Phase VI Activities (Placement of Chemical Isolation Layer)

- Mobilizing equipment necessary specifically for placement of the chemical isolation layer materials.
- Placing imported soft sediment, sand, and gravel to provide chemical isolation of SCM left in place at the toe of the sheet pile wall at the former 8th Street Slip. This layer is further discussed in Section 5.5.
- Performing ongoing monitoring activities consisting of monitoring turbidity in the river.
- Performing bathymetric surveys and core sampling to document the post-Phase VI subsurface conditions.

The approximate dredge cut lines and chemical isolation layer placement are shown on cross-sections on Figures 17A through 17F.

3.2.8 Post-Dredging Activities

- Teardown, removing, and offsite disposal of temporary infrastructure built on the Tyco property.
- Restoring the Tyco property to pre-corrective action conditions, to the extent practical. The South Channel restoration activities are presented in Section 5.10.
- Demobilizing equipment and personnel.

3.2.9 Phase VII Activities (Monitoring Natural Recovery)

Soft sediment and SCM containing arsenic at concentrations between 20 and 50 mg/kg will be left in place, and MNR will be implemented for approximately 10 years following dredging activities. An MNR plan will be submitted separately in accordance with the AOC.[2]

3.3 Design Components

This section describes the major components of the PBOD approach design.

[2] "Respondent shall submit the monitoring plans for the monitored natural recovery and barrier wall monitoring 90 days before completion of construction of these components [90 days prior to completion of sediment removal]" per Attachment 2, Section IV.A, 2nd paragraph, of the AOC.

3.3.1 Bathymetric and Sediment Thickness Surveys

A bathymetric survey of the 2010 sediment investigation area within the Menominee River, including the Main Channel, Turning Basin, Transition Areas, 6th Street Slip, and the South Channel areas, was completed in April 2010 (CH2M HILL 2010). Additionally, water depth and sediment thickness data were collected during the May-June 2010 sediment sampling events. These data were combined to create figures showing the estimated soft sediment surface elevation (Figure 8) and soft sediment thickness (Figure 4).

Before performing in-water work, the dredging contractor will be required to perform a pre-dredge bathymetric survey that covers areas to be dredged. A post-dredge bathymetric survey will be performed at the conclusion of each phase of mechanical dredging activities (Phases I, II, and V) to document final conditions and establish payment quantities. A terrestrial-based survey will be performed within the dry excavation area after excavation in Phases III and IV is completed to document final conditions and establish payment quantities. For the Phase VI chemical isolation layers, a combination of hydrographic surveys and/or other widely accepted methods (for example, coring and buckets) for monitoring placement of the sorptive, filtering, and armoring layers will be used to verify the post-placement thicknesses.

3.3.2 Bulkhead/Shoreline Stability

The VBW installed along the shoreline adjacent to the facility consists of steel sheet piling, most of which was installed in 2010. Some of the sheet piling is supported with tieback anchors, and other segments are entirely cantilever-supported (Figure 19). Figures 20A and 20B show cross-sections through the sheet piling and materials present in the Menominee River based on nearby borings (cross-section locations on Figure 19). For cross-sections A-A’ and B-B’, this sheet piling was installed in the late 1990s.

As presented in the SRWP (CH2M HILL 2010) and discussed in the USEPA June 1, 2011, approval document (USEPA 2011), removing impacted SCM adjacent to the sheet pile wall was determined to be technically impractical, because removing the material to the depth required to achieve removal of all material with concentrations greater than or equal to 50 mg/kg would result in failure of the sheet pile wall.

As shown on Figure 18B (Phase VI), the area of concern related to structural failure is adjacent to the 8th Street Slip cofferdam, not the recently installed sheet pile wall. The 8th Street Slip cofferdam was installed in the late 1990s as a part of the interim action completed in the former 8th Street Slip. At the time, USEPA required that Tyco stop the migration of surface water and soft sediments into the Menominee River from the 8th Street Slip. The cofferdam was installed solely for containing surface water and soft sediment in the slip until such time that groundwater could be contained in the area and soft sediments removed. Therefore, the cofferdam sheet pile was only installed to a depth necessary for stability to contain surface water, not installed to bedrock as has been conducted at the remainder of the site.

A secondary sheet pile wall was installed inside the cofferdam to the depth of bedrock, again, solely for containing groundwater in the area. The focus of subsequent remedial action in this area was soft sediment; SCM was not considered for removal at that time. As such, the sheet pile installed in this area does not have tiebacks or other structures that would stabilize the wall to allow for SCM removal immediately adjacent to it to the depths required. To implement the SRWP in this area, the construction of an expensive structure to replace the existing sheet pile wall before dredging adjacent to the former 8th Street Slip area would be required. The cost of this new sheet pile wall is estimated at $1.4 million.

To maintain stability of the sheet pile wall, SCM in the area will be excavated at a 4:1 (horizontal to vertical) slope. As such, approximately 10,000 to 12,000 yd^3 of SCM will not be removed. The remaining potentially arsenic-contaminated SCM would be covered with a chemical isolation layer. This layer is discussed in Section 5.5. Figure 18B shows the location of the SCM area of concern adjacent to the sheet pile wall (indicated as the Phase VI chemical isolation layer).

It is important to note that impacted SCM is present between the inner sheet pile wall and the cofferdam. Currently, the asphalt cap covers these materials over the former 8th Street Slip area; however, under the SRWP, the impacted materials would be exposed in the subsurface following removal of SCM adjacent to the cofferdam (CH2M HILL 2010). Consequently, these materials will be addressed by leaving the cofferdam in place.

3.3.3 Utilities

Thew Associates performed a utility survey in April 2010 prior to CH2M HILL conducting subsurface investigation activities. A buried high-density polyethylene waterline crossing the South Channel was identified at two spots during the April-May 2010 work, as well as an electrical line associated with the bridge at Ogden Street. It is unlikely that soft sediment removal in the South Channel will come close to these utilities, but this will be verified during development of the final design. Before beginning work, the dredging contractor will be required to verify the presence and locations of utilities, including buried and overhead utilities that may affect implementation of the work.

3.3.4 Extent of Arsenic Requiring Sediment Remediation

Geostatistical Modeling Interpolation Method

A three-dimensional (3D) interpolation method was used to delineate total arsenic concentrations in the soft sediment, SCM, and glacial till units. The model was used to aid in developing the dredge plans and associated volumes. The computer application, Environmental Visualization System (EVS)-Pro Version 9.4 (Environmental Visualization System, produced by C-Tech Development Corporation) was used to interpolate arsenic concentrations from individual sampling points to a dense 3D mesh. The general procedures for mesh generation and for selecting the interpolation parameters are outlined below.

Key attributes of the EVS-Pro based interpolation approach for delineating the arsenic extent include the following:

- The dataset used includes analytical results from sediment core sampling and drill rig sampling collected by CH2M HILL during April-May 2010 (CH2M HILL 2010).
- Arsenic concentrations were represented as point values located at corresponding horizontal coordinates (for example, northing and easting) for each sample location. The vertical position was represented by the middle of the sampling interval—typically, there were multiple vertical locations for a given sample location on the map.

- The selected grid density used within each subarea was determined by distance between sample locations and the number of sample locations.
- The arsenic concentration distribution was modeled within the 3D mesh using a geostatistical process called kriging. The interpolation process utilized a gridding option best suited for the data and its location (rectilinear), and then kriging was performed.
- Each zone-specific model was built on convex hull-bounded grids limited to the areal extent of each subzone with Z spacing determined by sediment thickness and using the adaptive gridding option. Adaptive gridding automatically refines gridding in the cells surrounding measured samples to ensure the interpolated results and isosurfaces accurately honor measured sample data.

Results

Determination of the volume of sediment requiring remediation was based on a criterion of 50 mg/kg total arsenic, applied on a geostatistical basis as outlined above. Based on data collected during May-June 2010, approximately 227,000 yd^3 of arsenic-contaminated material (including an estimated average 6-inch overdredge allowance) will require remediation. Of this total, 90,000 yd^3 is present as soft sediment and 137,000 yd^3 is present as SCM. These volumes include the same average 6-inch overdredge depth, as well as a 4:1 (horizontal to vertical) sideslope stability allowance for soft sediment removal.

SECTION 4

Corrective Action Design—Project Delivery Strategy

4.1 Preliminary Design

The objectives of the preliminary design are to define, in detail, the technical parameters upon which the design will be based, develop the conceptual site remediation strategies for review with the agencies, and, to the extent possible, finalize the strategies so the final design may proceed with minimal changes (for example, minimal cost and schedule impacts). This PBOD document represents a refinement of the preliminary design as originally proposed in the SRWP in December 2010 (CH2M HILL 2010), and reflects implementation details developed through ongoing discussions between USEPA and Tyco. As discussed above, one of the more important remediation strategies for this site is related to the optimized risk management approach proposed by Tyco that USEPA is reviewing. This optimized remedy is more fully described in the proposed ESRP (CH2M HILL 2011).

4.2 Final Design

Final design activities have already commenced to ensure project timelines are achieved. Specifically, the conceptual remediation strategies developed during the preliminary design and described herein and in the ESRP (CH2M HILL 2011) are being expanded into a set of final design documents consisting of the following:

- Basis of design report
- Specifications
- Drawings
- Cost estimate
- Site-specific plans
- Contract award documents
- Biddability, operability, and constructability reviews
- Revised project delivery strategy
- Construction quality assurance plan

Detailed design drawings and specifications will be prepared for all key project components. Preliminary design drawings (schematic level) are included in Appendix C. A preliminary list of expected technical specifications is presented in Table 3. The successful bidder of the work will become the dredging contractor. The contractor will be required to develop a detailed work plan, describing how the work will be executed.

SECTION 5

Preliminary Design Approach, Assumptions, and Parameters

This PBOD document includes a description of the mechanical dredging support facilities, equipment, and activities. This approach will be submitted as part of the permitting process. During the bid process, bidders for the work will be required to provide a general description of their proposed site layout, dredging equipment, water treatment system, and procedures, so that significant proposed modifications can be discussed and evaluated before award of the contract. In addition, before starting the work, the dredging contractor will provide a detailed work plan that will describe the specifics of the proposed mechanical dredging activities.

5.1 Minimizing Environmental and Public Impacts

One of the primary objectives of the dredging operations is to minimize environmental and public impacts. This is achieved through permitting and planning during the design phase, as well as adherence to environmental controls and monitoring during execution of the dredging project. Permitting details are presented in Section 6.

5.1.1 Execution of Dredging Activities

Project information will be communicated with local property owners and other members of the general public before and during the corrective activities to limit the impacts of the project to residents and commercial and recreational activities.

During mechanical dredging and chemical isolation layer placement activities, BMPs will be employed to control the resuspension of sediment; BMPs are described later in this section. Turbidity will be monitored continuously, and by developing a site-specific relationship between turbidity and TSS, exceedances will be communicated to the dredging contractor so modifications to the process or equipment can be made as necessary, as described in Section 7. It is important to note that control of sediment resuspension does not correlate with control of potential dissolved arsenic release, and based on preliminary water quality modeling, exceedances of Wisconsin's acute toxicity water quality criterion for arsenic in surface water could occur even with implementation of all practicable BMPs. Air monitoring, post-dredging confirmation sampling, and post-dredging bathymetric surveys will be conducted as described in Section 7.

5.2 Site Preparation and Mobilization

5.2.1 Site Preparation and Mobilization Activities

Before mobilization to the site, the dredging contractor will verify necessary permits have been obtained and that corrective activities will be in compliance with the requirements of these permits. In addition, the contractor will deliver necessary preconstruction submittals to Tyco for approval before mobilization.

Before mechanical dredging, the contractor will perform site preparation activities at the Tyco property (the term "site" refers to the portion of the Tyco property used for the mechanical dredging and stabilization activities as shown on the drawings in Appendix C). These activities are necessary to allow heavy equipment to access all of the portions of the site and to ensure protection of the environment during the dredging activities. The former Salt Vault area (asphalt pad) and the former 8th Street Slip will be used as the staging, stockpiling, stabilization, and water treatment areas. Mobilization and site preparation activities will include the following:

- Mobilization of equipment and personnel
- Establishment of physical construction limits at the site with temporary fencing or other means of demarcation
- Set up of site trailers for the dredging contractor and oversight contractor
- Construction of temporary partitions on the existing asphalt surface in the former Salt Vault and former 8th Street Slip to create areas for staging, stabilization, stockpiling, and water treatment
- Construction of a temporary mooring structure at the shoreline of the site
- Construction of a temporary water treatment system
- Installation of turbidity monitoring equipment in the river

5.2.2 Asphalt Pad and Site Access Roadways

The corrective activities described in this PBOD document require modifying the existing asphalt pad and installing a temporary access ramp down into the dry excavation cell. The drawings (Appendix C) include an overall site plan and details. Separate areas will be established on the asphalt surface near the former Salt Vault to accommodate the reagent storage, temporary onsite water treatment plant, dredged material stabilization, pre- and post-stabilized material temporary stockpiling, and decontamination for trucks hauling stabilized sediment offsite. Designated haul routes will be demarcated on the existing asphalt areas. A description of each of these items is included below.

Asphalt Concrete Pad

The existing asphalt surface in the former Salt Vault and the former 8th Street Slip areas will be used as the staging area. In the former Salt Vault area, there is an existing 250-foot x 250-foot asphalt concrete staging pad with 2-foot-high sealed concrete sidewalls along with a 1 percent slope toward the drain outlet on the west sidewall. The pad area consists of a 6-inch-thick asphalt concrete layer constructed over a compacted fill and a gravel layer. The former 8th Street Slip area consists of a 4-inch-thick asphalt concrete layer constructed over a layer of compacted imported sand.

A 10-foot x 10-foot x 2-foot asphalt concrete-lined outfall sump with a maximum holding capacity of approximately 1,200 gallons will be constructed outside the asphalt pad as shown on the drawings (Appendix C). The bottom of the outfall sump will be constructed at least 2 feet below the existing asphalt concrete pad surface level. A pipe will be installed to connect the drain outlet located on the east sidewall of the asphalt pad to the outfall sump.

It is expected that free water from the offloaded dredged material and stormwater runoff will be collected in the outfall sump through the drain outlet, prior to pumping it out to the temporary water treatment system.

The southwestern corner of the pad will be used as the reagent storage and handling area. The remaining portion of the pad will be used as the sediment stabilization and temporary stockpile area, with temporary berms separating the sediment stabilization and storage area from the reagent storage and handling areas. Infiltration in the work area will be minimal because the surface is asphalt concrete, water that seeps through the asphalt concrete pad will be contained onsite by the VBW, and extracted and treated by the permanent site GWCT system.

Temporary Access Roads

Since the working area within the facility is covered with asphalt concrete, no construction of temporary access roads will be necessary in the vicinity of the staging area. For the safety of site personnel, traffic cones, barrels, or signage will be used to demarcate travel areas for trucks hauling materials to and from the site to keep truck traffic confined to these areas.

Asphalt Concrete Pad and Temporary Access Road Removal and Disposal

Once the dredging activities are completed, the asphalt concrete surfaces will be washed off, and the resulting wastewater will be captured and treated in the temporary onsite water treatment system. Areas where a permanent asphalt concrete surface has been damaged by the corrective activities will be repaired and resurfaced.

5.3 Mechanical Dredging

Approximately 41,000 yd^3 of soft sediment and 81,000 yd^3 of SCM containing arsenic greater than or equal to 50 mg/kg (including estimated overdredge volumes) will be mechanically dredged from the river using the PBOD approach as shown on the drawings in Appendix C. These volumes targeted for mechanical dredging do not include 49,000 yd^3 of soft sediment and 56,000 yd^3 of SCM that will be removed by dry excavation. The thickness of soft sediment to be mechanically dredged ranges from less than 1 foot to a maximum of 8 feet. The contaminated SCM thickness within the mechanical dredging area ranges from 6 to 25 feet. Water depth below low water datum within the mechanical dredging areas is up to 21 feet deep adjacent to the Main Channel. The water depth in the dry excavation area ranges between 1 and 5 feet. The water depth in the South Channel subarea is between 1 and 2 feet, which is too shallow for mechanical dredging.

The performance standards for the mechanical dredging consist of the following:

- Removing soft sediment to specified elevations
- Removing SCM to specified elevations
- Minimizing sediment resuspension below the specified TSS standard

The dredging contractor will perform bathymetric surveys before and after dredging. These bathymetric surveys will be used to determine if the specified dredge cuts have been achieved as well as providing a final dredged sediment volume for payment. Calculations of soft sediment and SCM volume in this PBOD document include an average 6-inch overdredge depth, except where contaminated SCM underlies contaminated soft sediment. In such cases, no overdredge depth is assumed for the soft sediment.

5.3.1 Dredging Equipment

Mechanical dredging of contaminated soft sediment will be performed with a crane and environmental clamshell bucket having the following capabilities and characteristics:

- Provides a level cut during the closing cycle
- Completely encloses the dredged sediment and water captured
- Has escape valves or vents that close when the bucket is withdrawn from the water
- Has a smooth cut surface, with no teeth
- Is controlled by the operator using global positioning system (GPS) equipment with integrated software that allows:
  - The bucket position to be monitored in real time
  - The specified horizontal and vertical accuracy requirements to be met
  - The operator to control bucket penetration to avoid overfilling and minimize sediment resuspension

An environmental bucket will be used to dredge the soft sediment. However, the compacted nature of the SCM, as evidenced by its high blow count, is expected to preclude the use of an environmental bucket for mechanically dredging much of the contaminated SCM. Therefore, most, if not all, of the SCM will be dredged with a conventional clamshell bucket with teeth having the following capabilities and characteristics:

- Can cut into the densely compacted SCM
- Is controlled by the operator using GPS equipment with integrated software that allows:
  - The bucket position to be monitored in real time
  - The specified horizontal and vertical accuracy requirements to be met
  - The operator to control bucket penetration to avoid overfilling and minimize sediment resuspension

5.3.2 Dredging Sequence

The sequence of mechanical dredging and other corrective activities were described in Section 3.2. Phases also are depicted on Figures 18A and 18B.

5.3.3 Dredging, Offloading, and Stabilization Processes

The mechanical dredging, offloading, and stabilization processes described here are conceptual and will be more specifically defined during design. The dredging contractor will be allowed to propose and utilize a different process if, after an evaluation, the proposed process is cost-effective and can reasonably be expected to meet performance criteria such as production rates and TSS standards, and new or revised permits can be obtained without negatively affecting the schedule.

The mechanically dredged material will be loaded into watertight scows that will be transported to the temporary docking platform to be constructed near the former 8th Street Slip. The decant water on top of the sediment will be pumped to and processed at the temporary water treatment facility; dredged material will then be offloaded using a material handler with a clamshell bucket and transferred onto a screen to separate oversized debris. The material passing the screen will fall onto a conveyor belt and be transported to the material stabilization and storage area on the asphalt pad where it will be either temporarily stockpiled or fed directly to the material stabilization process.

The dredged material will be processed through a pugmill where stabilization reagents will be added. Following reagent addition, the material will be moved by conveyors and/or a front-end loader(s) to a stockpiling area where the mixture will cure for approximately 1 week. Once the material has cured sufficiently, it will be sampled and analyzed for TCLP arsenic to confirm it is nonhazardous. The stabilized material must also pass the paint filter test. Additional analyses (such as unconfined compression test) also will be performed to meet disposal requirements.

After the tests show that the material has been successfully stabilized, the material will be picked up with a front-end loader and loaded into a truck for transportation offsite. The top of the truck will be covered with a tarp, the exterior of the truck will be decontaminated (if necessary), and the stabilized material will be transported to an offsite RCRA Subtitle D (nonhazardous) landfill for disposal.

Decant water pumped from the dredged material scows, free water from the dredged material stockpiles, decontamination water, and rainwater from contaminated areas will gravity drain to a sump located adjacent to the asphalt pad. Water collecting in the sump will be pumped directly to and treated in the temporary water treatment system. Section 5.6.3 contains water treatment details.

5.3.4 Debris

Debris encountered during mechanical dredging will be segregated as much as possible on the dredged material scow and handled separately once the scow is moved to the offloading area. If significant debris is encountered while dredging soft sediment that would potentially cause damage to the environmental bucket, a conventional clamshell bucket may be used until the debris is removed.

5.3.5 Stabilization Reagents

An initial treatability study was conducted to determine a cost-effective reagent mixture to stabilize the dredged material. The stabilized dredged material must meet three criteria:

- No free water (must pass paint filter test for disposal at the landfill)
- Leachable arsenic is less than 5 mg/L, as measured by the TCLP test
- Minimum strength of 12 pounds per square inch at 7 days of curing, as measured by the unconfined compression test

The initial phase treatability testing results indicated the reagents needed to stabilize the dredged materials were a cementitious reagent (that is, fluidized bed ash) to provide moderate strength gain and other reagents such as an oxidizing agent (that is, calcium hypochlorite), and an iron-based compound (that is, ferric sulfate) to create an insoluble arsenic compound and reduce leachability. Appendix D contains the initial phase treatability testing results.

A second phase treatability study is underway to optimize reagent mix ratios and the process to be implemented to stabilize the sediment.

5.3.6 Dredging Production Rate and Duration

The expected mechanical dredging rate for the soft sediment is estimated to be 1,300 yd^3 per day up to 24 hours per day/7 days per week. A dredging rate of 1,000 yd^3 per day (also on a 24/7 basis) is estimated for SCM because of its compacted nature and the associated difficulties that might be encountered in dredging this material. The mobilization, setup, and demobilization phases of the project cumulatively may take approximately 7 weeks. Based on these production rates, a duration of 5 weeks of soft sediment dredging and 12 weeks of SCM dredging (not including soft sediment and SCM dry excavation from the South Channel and Transition Areas) is anticipated. Because of the time required to dredge SCM, and the need to incorporate calendar restrictions for fish spawning, a temporary winter shutdown period is assumed to avoid issues with freezing temperatures.

5.3.7 Debris Handling

Oversized debris from the screen at the offloading area will be removed using a front-end loader and set aside for decontamination. Debris encountered during dredging that was segregated on the dredged material scows will be offloaded separately from the other dredged material and set aside for decontamination. After being washed with a pressure washer to remove significant sediment from the debris, the debris will be placed in a rolloff container for eventual transportation and disposal at an offsite RCRA Subtitle D landfill.

5.3.8 Dredging Positioning System

A system that continuously locates and records the horizontal and vertical position of the cutting face will be required. A real-time kinematic positioning system, or an alternative positioning system that can meet the specified tolerance requirements, will be used to provide the horizontal and vertical positioning for the dredge system. The positioning system shall employ software capable of monitoring the x, y, and z position of the dredge bucket in real time. The software will be required to provide the following:

- A real-time view of the barge and clamshell bucket position
- A display indicating the surface derived from the pre-dredge hydrographic survey data
- A display that provides real-time feedback showing current depth, final project depth, target depth, and current bucket depth

The following tolerances shall be met:

- Horizontal position accuracy shall be plus or minus 2 feet
- Vertical tolerance shall be plus 0, minus 0.5 foot

5.4 Dry Excavation – South Channel and Transition Areas

Approximately 49,000 yd^3 of soft sediment and 56,000 yd^3 of SCM with arsenic contamination greater than or equal to 50 mg/kg are present in the dry excavation area (Figure 18B). Dry excavation is necessary in the South Channel, because the water depth in the South Channel is typically 1 to 2 feet, meaning barge-based mechanical dredging equipment cannot be floated into the area. In addition, the South Channel is fairly wide (100 to 200 feet), and the shoreline is heavily vegetated, so using a crane from the shoreline would be problematic for the width of the channel. Underwater sediment removal is further complicated by the presence of woody debris from historical activities in the area. The physical setting of the South Channel allows for cost-effectively dewatering the channel. Therefore, dry excavation was selected as the best option for removing contaminated sediment from the South Channel in Phase III.

The dry excavation area was expanded beyond the South Channel to include the Transition Areas at USEPA's request to minimize the impact of dredging on surface water quality. The removal method for this area, however, is pending USEPA review. Soft sediment and SCM will be removed in the Transition Areas.

5.4.1 Site Preparation and Dewatering

A vibratory hammer will be used to install approximately 1,150 linear feet of sheet piling along the northern boundary of Transition Area 2. The sheets are estimated to be 25 feet long.

Once the sheet piling is installed to form the cell, free water on top of the sediment will be directly discharged to the Menominee River until the discharge water reaches 80 mg/L TSS. Water exceeding this threshold will be routed to the onsite temporary water treatment system.

To perform dry excavation, access to the cell will be established from the site. A ramp will be constructed of imported fill to provide access from the former 8th Street Slip area to the river bottom. Preparations (as necessary) for excavation equipment and haul trucks to work safely within the dry excavation area may include building temporary haul roads using crane mats or other surface preparation techniques.

5.4.2 Excavation and Stabilization Activities

Standard excavation equipment will be used to remove the materials from the dry excavation area. A track-mounted backhoe will be used to stabilize the soft sediment in situ as necessary to facilitate the material's removal, excavate the stabilized sediment, and load it into articulated trucks for transport back to the staging area on the Tyco property. Debris that interferes with soft sediment removal will be removed with a backhoe and transported to the site to be staged and eventually disposed offsite following appropriate analytical testing. In situ stabilization will be accomplished by dumping loads of a cementitious reagent (that is, fluidized bed ash) next to the mixing operation, using a backhoe to pick up and add the reagent to the soft sediment, and mixing the reagent into the sediment with the backhoe bucket.

Once the reagent has been mixed into the sediment and it has been sufficiently solidified, a backhoe will be used to load the sediment into articulated hauling trucks which will transport the material back to the dredged material stockpile at the onsite staging area. The material then will be processed through the pugmill where the remaining reagents will be added to stabilize the material before disposal.

Soft sediment will be targeted for excavation first. Once soft sediment removal has been completed, excavation of SCM will be performed. The same equipment and processes will be used to perform SCM removal and stabilization.

The estimated production rate for dry excavation of soft sediment and SCM is 700 yd^3 per day. A total of 10 weeks is estimated for soft sediment removal, and 12 weeks are estimated for SCM removal.

Following completion of activities in the dry excavation cell (including chemical isolation layer placement near the former 8th Street Slip as described below), the sheet piling will be removed. Water will be actively pumped into the cell, or weirs will be cut into a few sheets to allow controlled refilling of the cell. Once the water has equilibrated with the river, the sheets will be extracted, decontaminated, and transported offsite.

5.5 Chemical Isolation Layer

A chemical isolation layer will be placed over SCM adjacent to the former 8th Street Slip area. As described in Section 3.3.2, to maintain stability of the existing sheet pile wall, it is necessary to leave in-place SCM that may have arsenic concentrations exceeding 50 mg/kg. To ensure permanent protection, a protective chemical isolation layer will be installed over the SCM in the area shown on Figure 18B.

5.5.1 Extent of Chemical Isolation Layer

The total area of the proposed chemical isolation layer is approximately 38,000 square feet. Under this PBOD, approximately 12,000 yd^3 of potentially contaminated SCM will remain in place under the chemical isolation layer. (Note that a greater area of SCM would be isolated below the chemical isolation layer under the proposed ESRP [CH2M HILL 2011].)

5.5.2 Preliminary Design of Chemical Isolation Layer

The preliminary design of the chemical isolation layer was developed in accordance with USEPA and USACE cap design guidance documents (Palermo et al. 1998). The chemical isolation layer was designed to permanently contain the in-place arsenic concentrations while also considering river flooding events and potential sediment movement caused by propeller and jet pump action produced by vessels in the area.

Dr. Danny Reible of the University of Texas evaluated the preliminary design of the chemical isolation layer. This evaluation included performance modeling of the effectiveness of the design. The design and evaluation are described in detail in the ESRP (CH2M HILL 2011).

Based on the chemical isolation layer modeling and isolation layer stability evaluations, the proposed isolation layer will be approximately 39 inches (3.3 feet) thick and will consist of the following components: (Figure 21):

- 18–inch-thick sorptive layer comprised of clean river sediment
- 9–inch-thick filter layer of sand (6-inch minimum thickness) and gravel (3-inch minimum thickness)
- 12–inch-thick armor layer comprised of 6- inch-diameter cobble

5.5.3 Placement of Chemical Isolation Layer

The placement of this discrete area of chemical isolation will be fully developed during subsequent design phases but will consist primarily of mechanical placement with an environmental bucket to avoid resuspension and loss of material. Positioning equipment similar to that for the dredging activities will be used to ensure minimum thicknesses are achieved in the required area.

5.5.4 Monitoring of the Chemical Isolation Layer

Monitoring During Placement

Hydrographic surveys and/or other widely accepted methods (for example, coring and buckets) for monitoring placement of the sorptive, filtering, and armoring layers will be used to verify proper construction of the cap, including the chemical isolation layer. Turbidity also will be monitored to meet the water quality criteria during placement of the layers.

Initial Post-Construction Monitoring

Construction quality assurance surveys, including coring and bathymetry as appropriate, will be performed shortly after the placement of each layer to document proper construction of each layer. The initial post-construction surveys will verify that each layer's specifications and construction criteria have been met, including the aerial coverage and thickness. If the initial post-construction monitoring shows that the specifications and construction criteria have not been met, then the layers shall be augmented to meet the design. A post-construction, high-definition multi-beam bathymetry survey will be used as a baseline to monitor the initial 2 years of consolidation beneath the armor layer and as a baseline of the isolation layer's integrity over time. The extent of consolidation will depend on time elapsed after placement, thickness of the isolation layer, thickness of soft sediment beneath the isolation layer, and consolidation properties of the isolation layer and soft sediment. In addition, representative chemical sampling for arsenic at the top of the sorptive layer will be undertaken before adding the armor layer to establish baseline conditions and to confirm that this layer meets the arsenic remedial goal.

Long-Term Monitoring

The long-term monitoring of the isolation layer will be performed to ensure its integrity and protectiveness over time. The overall objective of this monitoring plan is to ensure the long-term integrity and protectiveness of the cap. To achieve that objective, two primary components of monitoring are incorporated:

- Physical integrity monitoring
- Chemical monitoring

Each of these monitoring elements is discussed below.

Physical Integrity Monitoring

To ensure the integrity of the physical and chemical isolation layers, a measured reduction in elevation of greater than 6 inches relative to the post-construction as-built (baseline) survey will trigger further evaluation to ensure the armor layer remains intact. Some elevation changes may be experienced because of settlement over time. The precision of differential bathymetric surveys between various years is limited to approximately 6 inches.

Thus, follow-on inspections will be performed in contiguous cap areas with more than 6 inches of differential reduction relative to as-built elevations. Physical inspections will be performed during the same monitoring year as the bathymetric survey to characterize the presence of the armor layer. If follow-on visual inspection verifies the armor layer is in place, physical integrity will be verified. If the armor layer is not verified by the inspection, the area will be identified on a map and USEPA will be notified that further investigation will be necessary.

Chemical Monitoring

For this site, arsenic is the appropriate focus for verifying the protectiveness of the chemical isolation layer. To ensure protectiveness on an ongoing basis, recently deposited sediment collected on the surface will be sampled and analyzed for arsenic. Maximizing sample quality will require the presence of at least 3 inches of recently deposited sediment over the coarse-grained aggregate used for armoring. If surface sediment remains (and is projected to remain) below 20 mg/kg, protectiveness will be verified. If the surface sediments exceed 20 mg/kg, USEPA will be notified that further work will be planned to address these findings.

5.6 Treatment of Remediation Wastewater

5.6.1 Wastewater Sources

Wastewater will be generated from several sources during the handling, stabilization, and disposal of the dredged material. The following wastewater sources, which include contaminated water generated during remediation activities, will be routed to the onsite temporary water treatment system:

- Free water from the dredged sediment that is gravity drained (Phases I, II, and V)
- Decontamination water (Phases I through V)
- Precipitation on the staging pad (Phases I through V)
- Direct discharge of water from the dry excavation prior to and during dry excavation once the concentration of TSS exceeds 80 mg/L (Phases III and IV)

The water treatment system itself will generate process wastewater, which will need to be hauled offsite for disposal.

5.6.2 Wastewater Volumes

The rate of water generation and treatment was calculated over a 24 hours per day, 7 days per week period since dredging activities also are assumed to occur over the same period. Volumes given below might not add up precisely because of rounding.

Free Water Removed from Sediment (Phases I, II, and V)

During Phase I, the dredging rate is estimated to be 1,300 yd^3 per day. The estimated volume of water draining from sediment dredged with an environmental bucket is 7,300 gallons per day (gpd), or 5.1 gallons per minute (gpm). During Phases II and V, the dredging rate is estimated to be 1,000 yd^3 per day. The estimated volume of water draining from sediment dredged with a conventional clamshell bucket is 16,000 gpd, or 11 gpm.

Total free water generated from dredging will be as follows:

- During Phase I: (7,300 gpd)*(32 days) = 0.2 million gallons
- During Phase II: (16,000 gpd)*(56 days) = 0.8 million gallons
- During Phase V: (16,000 gpd)*(25 days) = 0.4 million gallons

Decontamination Water (Phases I through V)

A 4 gpm pressure washer is assumed to be used for decontamination activities. Decontamination activities performed during the dredging work will include decontamination of debris, equipment, and trucks. Total volume is estimated to be 1,400 gpd, or 1.0 gpm. Wastewater generated from decontamination activities will be collected in the sump along with the other wastewater sources and sent to the water treatment system.

Total decontamination water generated will be as follows:

- During Phase I: (1,400 gpd)*(32 days) = 0.04 million gallons
- During Phase II: (1,400 gpd)*(56 days) = 0.08 million gallons
- During Phase III: (1,400 gpd)*(69 days) = 0.10 million gallons
- During Phase IV: (1,400 gpd)*(80 days) = 0.11 million gallons
- During Phase V: (1,400 gpd)*(25 days) = 0.04 million gallons

Water from Precipitation on Pad (Phases I through V)

Average monthly rainfall for the Green Bay, Wisconsin, area during the potential construction season is as follows (rssweather.com 2010):

- May: 2.75 inches
- June: 3.43 inches
- July: 3.44 inches
- August: 3.77 inches
- September: 3.11 inches
- October: 2.17 inches

A monthly rainfall of 3 inches was used to calculate rainwater that falls on the process pad and requires treatment. Using a proportionate average daily rate, the total volume is estimated to be 18,000 gpd, or 13 gpm, which applies to Phases I, II, and V. For Phases III and IV, rainfall in the dry excavation cell is included, so an estimated 64,000 gpd is generated.

Total water from precipitation generated will be as follows:

- During Phase I: (18,000 gpd)*(32 days) = 0.6 million gallons
- During Phase II: (18,000 gpd)*(56 days) = 1.0 million gallons
- During Phase III: (64,000 gpd)*(69 days) = 4.4 million gallons
- During Phase IV: (64,000 gpd)*(80 days) = 5.1 million gallons
- During Phase V: (18,000 gpd)*(25 days) = 0.5 million gallons

Direct Discharge of Water from the Dry Excavation Area (Phases III and IV)

The volume of wastewater generated during Phases III and IV from dewatering the dry excavation cell will be comprised of two components. The first source of wastewater will be the water remaining after the initial phase of dewatering, direct discharge of water to the river, is completed. Approximately 0.5 foot of water over the footprint of the cell will need to be pumped to the water treatment system, and this volume is estimated as 1.3 million gallons, which will be pumped out over 14 days, for an average flow rate of 93,000 gpd, or 64 gpm. Maintenance dewatering is estimated to be 31 gpm for the 149 days of active material excavation in the cell. This is an estimated 44,000 gpd. Total water generated by dewatering activities during Phases III and IV will be 1.3 million gallons + (44,000 gpd)* (149 days) = 7.9 million gallons, of which 3.6 million gallons will be generated during Phase III, and 4.2 million will be generated during Phase IV.

Summary of Wastewater Generated (Phases I through III)

- During Phase I, wastewater generated will be 0.2 million gallons (free water in sediment) plus 0.04 million gallons (decontamination water) plus 0.6 million gallons (precipitation), for a total of 0.8 million gallons.
- During Phase II, wastewater generated will be 0.8 million gallons (free water in sediment) plus 0.08 million gallons (decontamination water) plus 1.0 million gallons (precipitation), for a total of 1.9 million gallons.
- During Phase III, wastewater generated will be 0.1 million gallons (decontamination water) plus 4.4 million gallons (precipitation) plus 3.6 million gallons (direct discharge for South Channel cell dewatering activities), for a total of 8.1 million gallons.
- During Phase IV, wastewater generated will be 0.11 million gallons (decontamination water) plus 5.1 million gallons (precipitation) plus 4.2 million gallons (direct discharge for South Channel cell dewatering activities), for a total of 9.4 million gallons.
- During Phase V, wastewater generated will be 0.4 million gallons (free water in sediment) plus 0.04 million gallons (decontamination water) plus 0.5 million gallons (precipitation), for a total of 0.9 million gallons.

Total wastewater generated during the corrective activities is estimated to be 21 million gallons. Estimated flow to the water treatment system will vary, but will be at a maximum of 123 gpm during Phases III and IV. Therefore, the treatment system should be designed to handle a peak flow of approximately 150 gpm.

Reverse osmosis (RO) process waste will be approximately 20 percent of the total flow to the treatment system. This will be reduced further by using an RO reject concentrator, which will reduce the volume of water by another 75 percent. Therefore, total volume of reject water from the concentrator unit requiring disposal at an offsite hazardous waste facility will be 1.1 million gallons.

5.6.3 Water Treatment

The design for the temporary onsite water treatment system is shown on the process flow diagram drawing in Appendix B. This process flow diagram is based on an RO treatment process and represents a proven treatment process for water generated at the site. It is similar to the existing groundwater treatment system and the temporary water treatment system used at the site in 2010. The treated water will be discharged to the Menominee River through a permitted outfall.

It is anticipated that the water treatment system will be set up near Building 59 (Figure 22). Water from the stabilization area sump, dredge scow, and dry excavation area discharge will be combined in a pipe manifold, treated with a chemical coagulant, and pumped through geotextile tube filters installed in rolloff boxes to remove suspended solids. Weep water from the geotextile tubes will be collected and pumped into equalization tanks. Equalization tank water then will be pumped through a mobile treatment system containing microfiltration (MF) units. If needed, sulfuric acid and/or a scale inhibitor will be added to the MF permeate prior to entering the RO units. Reject water from the MF units will be pumped to an equalization tank equipped with the option to neutralize the MF reject water before being recycled back to the geotextile tube influent. The MF permeate will flow to another mobile treatment system containing RO units set up as two-stage units.

Water entering the first stage RO units will be separated into permeate and reject streams. The reject stream of the first stage RO units will be further treated by the second stage RO units, and the RO reject stream from the second stage RO units will be sent to an RO concentrator (for example, Vibratory Enhanced Shear Membrane process). The RO concentrator reject will be sent offsite for disposal. The purpose of the two-stage (rather than single-stage) RO process and using the RO reject concentrator is to ensure a cost-effective minimum amount of water will be sent offsite for disposal. Finally, the permeate water from the second stage RO units will be stored in holding tanks for use as process water, if needed, or discharged to the Menominee River through a permitted outfall.

The treatment system will include instrumentation to measure and monitor flow rate and volumes, liquid levels, pH (if needed), and pressure. The mobile treatment system trailers will include automation for controlling the equipment within the trailer as well as the capacity to accept control signals from outside sources. Automation will be used to control the operation of pumps and valves outside the mobile treatment trailer footprints.

Influent and effluent samples will be collected from the water treatment system to monitor and record the process performance. A Wisconsin Pollutant Discharge Elimination System (WPDES) permit will be obtained for discharge to the Menominee River. All discharge and sampling will be performed in compliance with the permit.

5.7 Dredged Material Disposal

As stated previously, the stabilized dredged material will be tested to verify it passes the paint filter test and leachable arsenic has been reduced to less than 5 mg/L. The stabilized material then will be directly loaded into trucks and hauled offsite for disposal at an approved facility. It is assumed that the stabilized dredged material will be disposed at an offsite RCRA Subtitle D landfill within 10 miles of the project site.

5.8 Surface Water Quality

5.8.1 Turbidity Control through Implementation of Best Management Practices

The potential to create turbidity and affect river water quality during mechanical dredging will be minimized by the dredging contractor's adherence to mechanical dredging BMPs. These BMPs will be modified slightly to account for using a conventional navigational bucket with teeth for dredging SCM and glacial till. A list of BMPs for dredging soft sediment is provided below:

- Scows shall be watertight and inspected to confirm water tightness before dredging operations and dredged material transport.
- An environmental clamshell bucket shall be used for mechanical dredging of soft sediment.
- “Sweeping” to contour the bottom of the dredge cut shall not be permitted.
- Dredging of slopes shall proceed from the top of slope to the toe of slope.
- The dredging contractor shall use positioning devices (such as GPS) to allow the operator to be aware of the location of the dredge bucket in relation to the top of sediment.
- The contractor shall use an experienced environmental dredging operator who is capable of implementing appropriate BMPs to limit resuspension of sediment.
- The operator shall minimize overfilling of the dredge bucket.
- The operator shall reduce the rate of bucket descent and retrieval as necessary.
- The operator shall perform single bites with the bucket, and each bucket shall be brought to the surface and emptied between bites.
- The operator shall release excess water slowly at the surface.
- The operator shall not overfill scows with dredged material.
- Oil booms shall be available for emergency use.

Turbidity curtains will be used for the mechanical dredging work. These curtains will be placed around the contiguous dredging areas as shown on the drawings in Appendix C. Silt curtains also will be used during placement of any cap materials that contain significant amounts of fines. The specific type and placement depths will be determined during subsequent levels of design.

The success of the contractor’s efforts to control the release of turbidity will be evaluated through river water monitoring activities as described in Section 7.1. If turbidity indicates the TSS requirement is exceeded, the dredging contractor will be consulted and the source of the turbidity will be identified. If dredging activities are suspected, the dredging process or equipment will be modified so the TSS requirement is met.

Additional BMPs may be identified and subsequently required as a result of permitting, water quality criteria, and other processes.

5.8.2 Release of Dissolved Phase Arsenic during Dredging Activities

The potential release of particulate arsenic during mechanical dredging operations will be minimized by using BMPs to minimize dredging-induced turbidity. However, turbidity control measures such as turbidity curtains are not anticipated to be effective in limiting release of dissolved-phase arsenic during dredging activities.

5.9 Working Season and Hours of Operation

Most activities associated with the dredging work will be performed up to 24 hours per day, 7 days per week. Water treatment operations will be performed up to 24 hours per day, 7 days per week. The dredging contractor will determine the actual hours of operation.

Mobilization is anticipated to start in summer 2012 (refer to the project schedule in Appendix E). It will be necessary to schedule activities to accommodate the current commercial and industrial uses of the Menominee River. The dredging schedule will be coordinated with USEPA, WDNR, and the U.S. Fish and Wildlife Service (USFWS) to minimize potential disturbance of fish spawning during the spring and fall seasons. The dredging contractor will be responsible to coordinate with local industrial facilities to accommodate the arrival and departure of commercial ships delivering raw materials and with the local agencies as necessary.

5.10 Decontamination and Site Restoration

After mechanical dredging activities have been completed, decontamination activities will be performed. Equipment to be removed from the river will be power washed in place or over the river with water, before transport, to remove sediment and invasive species such as mussels.

Land-based equipment will be washed on the asphalt pad with the wash water being captured and treated. Rinse water will be collected in the sump and will be pumped to the water treatment system. Following equipment decontamination, the asphalt pad will be washed to remove visible residual sediment.

Once decontamination has been completed, the temporary infrastructure built for the mechanical dredging work will be removed from the site. The docking platform, drip protection, and access walkway will be disassembled and taken offsite. The water treatment equipment will be decommissioned and taken offsite. Temporary access roadway materials will be sampled and taken offsite for reuse if not contaminated or disposed at an appropriate landfill if contaminated. Previously vegetated areas that were impacted by corrective activities will be restored to preconstruction conditions to the extent practical and replanted with native species.

5.10.1 South Channel Restoration

The South Channel is a narrow channel of the Menominee River located east of the facility, bounded on the north by Thyssen Krupp Waupaca Foundry property, and to the south by the City of Marinette property. The shoreline is comprised predominantly of wetland-type vegetation with water depths within the channel generally less than 2 feet. Portions of the riverbed contain debris such as wood scraps and metal shavings that are remnants of historical milling operations in the area.

Only soft sediment in the South Channel requires removal. Soft sediment in the South Channel is up to approximately 3 feet thick, with arsenic concentrations greater than or equal to 50 mg/kg, extending to a maximum depth of 2 feet below sediment surface. No semi-consolidated or other materials beneath the soft sediment require removal.

The planned remedial action in the South Channel includes:

- Installing a temporary cofferdam in the dry excavation area.
- Preparing a temporary access road along the south shore of the South Channel under USACE permit.
- Pumping surface water from the contained area into the river for dewatering. When suspended materials exceed discharge criteria, the remaining water will be transferred to the onsite water treatment plant for treatment.
- Removing debris from the area.
- Excavating impacted soft sediment as required by the AOC.

Soft sediment will be removed as described in Section 5.4. Following removal of impacted material within the dry excavation area, the area will be restored as follows:

- Allowing river water to refill the area by actively pumping it into the cell, or by cutting one or more overflow weirs in the sheet piling
- Removing the temporary sheet piling
- Allowing natural vegetation to repopulate area

Removal of debris and soft sediment as part of the remedial action will improve natural conditions within the South Channel riverbed. In addition, because of the limited removal depth, significant changes to the hydraulic and structural condition and the habitat within the South Channel are not anticipated as a consequence of removing contaminated soft sediment. In other words, the benthic habitat in this area will not be significantly disturbed by removing soft sediment. The existing benthic ecosystem is expected to be reestablished within 2 years upon completing the removal activities. As such, no additional restoration activities are planned or necessary.

SECTION 6

Compliance with Applicable Requirements

Tyco had developed a permitting strategy that is designed to meet permitting requirements from agency stakeholders on the federal, state, and local level. The agency stakeholders identified for this project and their associated permits are listed below and in Table 4. This table also indicates anticipated timeframes for review of applications and issuance of permits from each of the stakeholders. A detailed discussion on each of the permits anticipated to be necessary for the project follows below.

6.1 U.S. Army Corps of Engineers

6.1.1 Clean Water Act Section 404 and Section 10 Rivers and Harbors Act

The project will result in impacts to the Menominee River and adjacent onshore wetland areas. The federally authorized navigation channel in the Menominee River is under the jurisdiction of the USACE-Detroit District, whereas the onshore wetland areas and non-navigational channel areas are under the jurisdiction of the USACE- St. Paul District. Consequently, Tyco will coordinate with both District offices during the planning, application, and construction phases of the project. The USACE-Green Bay Office will be the point of contact for the Section 404 Clean Water Act (CWA) and Section 10 Rivers and Harbors Act permits required for the project. Tyco coordinated extensively with the USACE-Green Bay Office during installation of the sheet pile wall in 2010 and the slurry wall in 2009, and as a result, has a good working relationship with the staff. Preliminary conversations with Todd Losee of the USACE-Green Bay Office have indicated that an Individual Permit will likely be necessary for the project given the area of impact within the Menominee River and adjacent onshore wetlands, and the presence of impacted sediment. Based on recent project experiences, it is assumed that issuance of an Individual Permit by USACE may take between 120 and 150 days. To accommodate response time for comments that may be received during the public comment period, Tyco has built in a 180-day allowance in the project schedule for obtaining Section 404 and Section 10 authorization from USACE.

To further facilitate communication with USACE and prevent additional data requests during the application review process, Tyco has committed to a pre-application meeting with USACE to discuss the project goals, area of impact to federally jurisdictional resources, volumes of sediment to be removed, the proposed methods of removal, and any specific concerns from USACE. Following completion of the pre-application meeting, Tyco will prepare an application package for submittal that contains detailed information regarding wetland and waterway impacts and that addresses the specific concerns raised by USACE during the pre-application meeting.

6.1.2 RCRA Regulations and Administrative Order on Consent

As previously mentioned, this sediment removal action is being conducted pursuant to an RCRA 3008(h) AOC, administered by USEPA Region 5. The work described herein complies with the AOC, as well as the applicable RCRA regulations that govern the management and disposal of remediation waste.

The regulatory considerations associated with the sediment removal and disposal work are outlined below.

- In accordance with 40 Code of Federal Regulations (CFR) Section 261.4, because sediment removal is being done under a Section 404 permit, the dredged material exclusion states that the sediments are not considered a hazardous waste. The exclusion states:

  (g) Dredged material is not a hazardous waste. Dredged material that is subject to the requirements of a permit that has been issued under Section 404 of the Federal Water Pollution Control Act (33 United States Code [USC] 1344)…For this paragraph (g), the following definitions apply:

  (1) The term dredged material has the same meaning as defined in 40 CFR 232.2.

  (2) The term permit means:

  (i) A permit issued by USACE or an approved state under Section 404 of the Federal Water Pollution Control Act (33 USC 1344).

- Since the dredged materials at this point are not considered a hazardous waste, per the exclusion, they can be transported back onsite without being considered a hazardous waste.

Once the sediment dries out is ready to be moved, the materials become a new waste stream that needs to be characterized and profiled for the offsite disposal. Under RCRA, a generator does not have the responsibility to characterize its material until it is generated, so characterization samples of the dredged material will be taken when they are onsite to determine the next steps. If analytical results indicate the material passes TCLP criteria, the material will be stabilized to the extent necessary to pass a paint filter test and be accepted at an appropriately permitted RCRA Subtitle D facility. If sampling results indicate the materials fail TCLP criteria and would be considered as characteristic, the materials will need to be treated before transport to the disposal facility. In order to perform onsite treatment, the site, including the river sediment area and the uplands area, will be defined as an area of contamination.

6.2 U.S. Coast Guard

6.2.1 Project Notification and Buoy Placement Review

As designed, the project will require work within the limits of the federally authorized navigation channel of the Menominee River. Tyco will communicate with the U.S. Coast Guard and WDNR regarding the planned placement of marker buoys and safety lighting.

6.3 U.S. Fish and Wildlife Service

On August 26, 2011, a letter was sent to the USFWS Green Bay Field Office to request concurrence that no federally listed species would be impacted by the project. Written documentation was received on October 7, 2011, confirming there are no threatened or endangered species, or critical habitat in the project area (USFWS 2011).

6.4 Wisconsin Department of Natural Resources

6.4.1 Clean Water Act Section 401 Water Quality Certification and Chapter 30 Waterway Permitting and Shoreland Grading

The WDNR Peshtigo Office will be the point of contact for CWA Section 401 Water Quality Certification and Chapter 30 Waterway Permitting. Because of the Joint Permit Application (JPA) process used by USACE and WDNR in Wisconsin, Tyco is planning to include WDNR in all communications with USACE regarding the project and will anticipate its attendance at the pre-application meeting discussed previously. WDNR staff from the Bureau of Remediation, Fisheries, and Water Regulation will be included in communications to ensure adequate consideration is given to all state-regulated natural resources. Consequently, Tyco has allowed 180 days in the project schedule for obtaining CWA Section 401 Water Quality Certification and Chapter 30 Waterway permits.

6.4.2 Water Quality Variance Request

Based on initial water quality modeling evaluations, there is a potential to exceed established water quality criteria during dredging activities because of the nature of the arsenic, even using the most modern dredging methods and equipment to remove soft sediment and SCM. While BMPs will be used to minimize sediment resuspension, release of arsenic during removal is unavoidable (Bridges et al. 2010). Moreover, practices such as deploying silt curtains will do little to reduce the level of dissolved arsenic. Consequently, a water quality variance is needed for this project.

Therefore, a request to allow for the exceedances during remedial activities will be prepared for submittal, review, and approval by WDNR. Initial discussions and communications have been completed with WDNR representatives to determine information required to allow WDNR to consider the request. Based on discussion with WDNR, the water quality variance request will include the following:

- A summary of BMPs to be employed for turbidity and water quality control
- An evaluation as to why the turbidity and water quality control BMPs may not achieve general water quality standards as outlined in NR 105
- The anticipated timeframe for potential exceedances, based on current plans for in water activities
- A water quality monitoring plan
- A contingency plan (that is, what steps will be implemented to minimize the duration and concentration of any potential release)
- Anticipated river flow rate during dredging
- Anticipated rate of release of resuspended dredged material and dissolved arsenic into the water column

The completed variance request will be submitted to WDNR by November 14, 2011.

The development and evaluation of the information request for the variance will consider arsenic concentrations, equipment necessary to remove impacted materials, sediment resuspension, dredging rates, and river flow rates and characteristics. The water quality analysis will consider each of these factors.

Because of the characteristics of the soft sediment and SCM, dredging of the soft sediment will be conducted using an environmental dredge bucket, while SCM will be removed primarily using a clamshell dredge bucket with the required digging capabilities. Release of pore water and resuspension varies with the type of dredge bucket used.

For each material type, resuspension and release rates associated with BMPs to minimize resuspension will be used to estimate anticipated releases of dissolved arsenic into the water column. Information available on arsenic concentration in the various dredged materials will be used to determine anticipated arsenic releases and resulting water column concentrations from dredging-induced resuspension. As discussed in Bridges et al. (2010), detailed case studies of chemical releases from environmental dredging projects using all available BMPs reveals an expected release range of approximately 2 to 4 percent of contaminant mass dredged, with most of the release being in the bioavailable dissolved form. As these case studies demonstrate, there are no documented differences in these release rates between projects that use silt curtains or other barrier controls and those that do not. The expected release used in the analysis will be in this range with the selected range informed by the dredging equipment to be used.

Water quality modeling will be conducted under various river flow rates and sediment concentrations to determine arsenic concentration in the water. The concentration reduction from river flow dilution and dispersion will be estimated to determine how arsenic concentrations are expected to vary with distance from the dredging location. The concentrations then will be compared to water quality standards to determine the extent of the variance request. By using high and average values of arsenic concentration combined with variations in flow naturally occurring in the river, a range of conditions under which a water quality variance is needed will be determined.

The monitoring plan will incorporate the outcome of the arsenic water quality variance analysis. The monitoring is expected to include a site upstream for background concentration and at one or more locations downstream. Monitoring is expected to include parameters such as TSS and dissolved arsenic. TSS monitoring will occur continuously as previously mentioned through the establishment of a site-specific relationship between TSS and turbidity; dissolved arsenic monitoring is anticipated to include periodic composite sampling. The preliminary water quality sampling locations are included on Figure 23.

6.4.3 Waterway Marker Permit

As discussed previously, the project will require work within the limits of the federally authorized navigation channel of the Menominee River. Tyco intends to communicate with the U.S. Coast Guard and WDNR regarding the planned placement of marker buoys and safety lighting.

6.4.4 Wisconsin Pollutant Discharge Elimination System Construction Site Stormwater Runoff

The WDNR WPDES Program requires a Construction Site Stormwater Runoff Permit for any construction project that proposes to disturb 1 or more acres of land. The purpose of the program is to limit the discharge of pollutant-laden stormwater from construction projects into local waterways and wetlands. As currently proposed, the project is anticipated to disturb more than 5 acres, and consequently, Tyco will work with staff from the WDNR WPDES Program to identify the appropriate BMPs and obtain a Construction Site Stormwater Runoff Permit for the project.

6.4.5 Wisconsin Pollutant Discharge Elimination System Point Source Discharge Permit

Tyco currently holds a WPDES Point Source Discharge Permit from WDNR for the discharge of stormwater from storm sewers at the facility. Tyco intends to update the existing permit for the facility to incorporate the discharges of treated water from the onsite water treatment facility proposed as part of the project.

6.4.6 Natural Heritage Inventory Review

On August 26, 2011, a letter was sent to the WDNR Bureau of Endangered Resources requesting a review of state listed species managed under the Natural Heritage Inventory Program that have the potential to be present within the proposed workspaces. Once a response is received, Tyco will work with the appropriate WDNR staff to address concerns, if any, regarding state listed species.

6.4.7 National Historic Preservation Act Section 106 Review

Because of the presence of a federal permitting nexus, the project is required to meet the requirements of Section 106 of the National Historic Preservation Act of 1966. In Wisconsin, the Wisconsin State Historical Society (WSHS) is the point of contact for all Section 106 reviews. In order to facilitate effective communication with WSHS, Tyco will secure the services of a local cultural resources firm to conduct a literature review and onsite survey to evaluate the potential for culturally significant materials within the proposed workspace. Following completion of the survey activities, a detailed report will be prepared and submitted to WSHS for review and comment. If further documentation is requested, Tyco will work with WSHS to develop an appropriate course of action.

6.5 City of Marinette

6.5.1 Erosion Control Permit

An application for an Erosion Control Permit will be submitted to the City of Marinette Engineering Department for earth disturbances related to the project. It is anticipated that a copy of the WDNR WPDES permit application will be sufficient to address City of Marinette erosion control concerns. Tyco will work with the City of Marinette to supply additional information, if any, requested by the City.

6.5.2 Building Permit

Building permits will be required for sheet pile installation and temporary roadways associated with the dredging and dry excavation. Tyco will work with the City of Marinette to obtain the necessary permits.

6.6 Stakeholders

6.6.1 Access Agreements

The City of Marinette and Thyssen Krupp Waupaca Foundry own property adjacent to the South Channel of the Menominee River where dry excavation of soft sediment is planned. Tyco has conducted initial discussions with both property owners to discuss access needs, potential schedule for remedial actions, and the process for completing access agreements. Both parties have expressed a willingness to cooperate with Tyco. Tyco will continue to communicate and coordinate with the City and Thyssen Krupp Waupaca Foundry during the planning and implementation phases of the project.

6.6.2 Turning Basin Users

Marinette Marine Corporation (MMC) and K&K Integrated Logistics (K&K) represent industrial users of the Menominee River Turning Basin. Initial communications have been conducted with MMC and K&K regarding the planned use of the Turning Basin and the pending remedial action. In addition, Tyco has obtained a preliminary schedule for launching and field trials for ships operating out of the MMC facility. Tyco will communicate with MMC and K&K before and during dredging to accommodate usage of the Turning Basin.

SECTION 7

Performance Monitoring Requirements

This section provides a brief summary of the performance monitoring for the corrective actions. Additional details regarding sample collection, sampling methods, and data management will be developed as part of the final design.

7.1 Water Quality Monitoring

7.1.1 River Water Quality Monitoring

The effectiveness of the dredging contractor in performing mechanical dredging while using BMPs to minimize the associated water quality impacts will be determined by monitoring turbidity in the river. As described in Section 5.1.1, turbidity will be continuously monitored, and by developing a site-specific relationship between turbidity and TSS, exceedances will be communicated to the dredging contractor so modifications to the process or equipment can be made (as necessary) to meet the proposed control standard. The proposed control standard for work during mechanical dredging activities is no more than 80 mg/L TSS above the background reading.

Surface water monitoring for turbidity will be performed to collect data that will be used to evaluate the potential for sediment resuspension during dredging activities. Before commencing dredging activities, two turbidity monitoring stations will be installed for measuring turbidity during dredging and located as shown on the drawings in Appendix C. The first will be located on the southern side of the Menominee River, near the western boundary of the Tyco property. This location will be approximately 800 feet upstream of the Turning Basin and will be used to determine the daily average background turbidity level.

The second turbidity monitoring location will be approximately 1,000 feet east of the eastern side of the Turning Basin and positioned near the southern side of the Main Channel. This location will be used to monitor potential suspended sediment entering the river from dredging activities in the Turning Basin. The precise locations will be selected once dredging activities begin based upon observed responses of the upstream and downstream turbidity sensors to background turbidity, as well as the consideration of avoiding damage because of vessel traffic.

Turbidity sensors will be deployed at the background location and at the second location at mid-depth of the channel. Turbidity readings will be transferred by cellular modem telemetry, compiled, and made available on a password-protected Web site within 5 minutes of each reading. Data from the turbidity sensors also will be stored in an integrated data logger that can be accessed in the event the telemetry system is inoperable. The readings will be recorded once every 10 minutes at both turbidity monitoring stations. A rolling average of six consecutive readings (1 hour) for both locations will be used as the basis of comparison.

If the turbidity levels (and the correlation to TSS control standard) exceed the requirement for above the background location, additional turbidity measurements between the downstream project extent and the downstream monitoring location will be performed to assess the BMPs and determine the cause for increased turbidity. If the turbidity increase is determined to be caused from non-dredging activities, the dredging will continue. If the turbidity is determined to be elevated because of the dredging activities, modifications to the current activities, up to and including temporarily halting dredging, will be implemented until it is demonstrated that turbidity levels at the downstream monitoring location are below the project requirement.

If an obvious outlier appears, it shall be eliminated from the rolling average calculation. An outlier will be defined as a reading that is outside the range of 50 to 200 percent of the average of the three previous readings. In addition, to be considered an outlier, the following reading must return to a range of 75 to 133 percent of the average of the three readings preceding the outlier. In practice, it is common to get occasional one-time spikes that cannot be tied to activities in the water. If this happens regularly (that is, more frequently than twice per day), the sensor will be inspected and cleaned, repaired, or replaced.

7.1.2 Water Treatment System Monitoring

Influent and effluent from the water treatment system will be sampled daily for total arsenic concentrations. The treated water also will be sampled for other parameters as required for discharge in accordance with the WPDES permit. Additional points in the treatment system might be sampled and other analyses might be run as well to monitor system performance.

Samples for total arsenic analyses will be submitted to a nearby laboratory and immediate results (or 24-hour turnaround) will be requested. Alternatively, an onsite laboratory might be set up during the corrective action if the quantity of analyses and turnaround time justify the cost. This will be evaluated later in the design process. If sample results indicate arsenic concentrations or other chemicals above the WPDES permit criteria, discharge of water will stop immediately, and the system will be inspected and modified so that treated water is once again in compliance with the WPDES permit.

7.2 Post-Dredging Sediment Confirmation Sampling and Surveys

7.2.1 Surveys

A bathymetric or terrestrial survey will be performed after the completion of Phases I (only in areas where no SCM greater than 50 mg/kg underlies the soft sediment), II, IV, and V to document that the dredging cut lines have been achieved. If no SCM is to be excavated beneath the soft sediment in the Phase III dry excavation, soft sediment with arsenic concentrations exceeding 50 mg/kg will be removed based on visually determined limits of soft sediment.

7.2.2 Confirmation Sampling

Confirmation sampling will be performed after material removal in Phases I, II, III, IV, and V. Limited confirmation sampling will be performed following Phases I and III; that is, sampling will be performed only where soft sediment with arsenic concentrations above 50 mg/kg overlies soft sediment with arsenic concentrations less than 50 mg/kg and concentrations of arsenic do not exceed 50 mg/kg in the SCM beneath. If during confirmation sampling it is visually verified that glacial till has been reached in Phases II, IV, and V, no samples will be analyzed for arsenic. For Phase III, confirmation sampling for arsenic analysis will be performed, except in areas where all soft sediment has been removed based on visual observation.

Confirmation sampling locations and other details will be provided in the comprehensive confirmation sampling plan, which will be developed after acceptance of the final design and at least 90 days before completion of construction (per Attachment 2, Section IVA, 2nd paragraph of the AOC).

Per USEPA's direction, information on a potential surface weighted average concentration methodology is not presented here.

7.3 Monitoring Stabilized Sediment Disposal Parameters

The stabilized sediment will be sampled and analyzed for the parameters that are required for disposal at an offsite RCRA Subtitle D landfill (that is, TCLP, paint filter test, and, if necessary, unconfined compression test).

7.4 Air Monitoring

Air monitoring for particulate matter will be performed because of the possibility of particulates being released during dredged material and reagent handling. This air monitoring is proposed to be performed only during Phase III (excavation of soft sediment from the South Channel), because reagents will be directly mixed with sediment in situ, and this activity has potential to release particulates into the air. During the other phases, reagents will be added to wet materials in a pugmill, which will minimize the potential for particulate emissions. Materials that are temporarily stockpiled at the staging area will have minimal potential to release particulates into the air, as they will be either wet (pre-stabilized) or stabilized materials. The exposed surface of materials in the temporary stockpiles will be kept moist to reduce particulate release into the air.

Real-time monitors that measure particulate matter finer than 10 micrometers in diameter and smaller (PM_{10}) will be used for monitoring. Three locations will be used to record continuous data on the Tyco property in the west, south, and east directions between 300 and 400 feet away from the dredged material and reagent handling and operations area.

SECTION 8

Preliminary Construction Schedule

A preliminary project schedule for the sediment removal activities is provided in Appendix E.

SECTION 9

Preliminary Cost Estimate

A preliminary compensation schedule, which includes lines items and estimated quantities, is included in Appendix F. Implementation of the PBOD is estimated to cost between $24 million and $52 million. The cost estimate has been provided in Appendix F. Preliminary cost estimate assumptions are based on the best available information regarding the anticipated scope of work, previous experience, and general site knowledge. Changes in the cost elements are likely to occur as a result of new information and design results. This is an order-of-magnitude cost estimate that is expected to be within plus 50 to minus 30 percent of the actual project costs.

SECTION 10

Biddability, Constructability, and Operability Review

The activities proposed in this PBOD document have been reviewed with an emphasis on biddability, constructability, and operability. The final basis of design report will be reviewed using these criteria as well. Any concerns noted during these reviews regarding biddability, constructability, and operability will be addressed before completing the final design.

SECTION 11

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Tables

TABLE 1
Summary Statistics – Nature and Extent of Arsenic (mg/kg)
Tyco Fire Products LP Facility - Marinette, WI

Area/Matrix	Minimum	Maximum	Average (Arithmetic Mean)
Turning Basin			
Soft sediment	2.3	20,000	2,900
SCM	1.5	2,900	270
Glacial till	1.6	310	66
Weathered bedrock	3.3	3.3	3.3
Main Channel			
Soft sediment	1.8	850	62
SCM	1.4	97	6.3
Glacial till	1.6	140	11
Weathered bedrock	6.8	6.8	6.8
Transition Areas			
Soft sediment	0.71	5000	170
SCM	1.1	1300	54
Glacial till	1.6	3.3	2.6
South Channel			
Soft sediment	1.7	110	36
6th Street Slip			
Soft sediment	3.5	230	75

SCM – semi-consolidated material

TABLE 2
Sampled Locations with Clean Materials Overlying Impacted
Tyco Fire Products LP Facility - Marinette, WI

Sample Location Name	Area Assignment	Top of Sediment Surface Elevation (ft amsl)	Depth to Top of Sampled Interval (ft)	Depth to Bottom of Sampled Interval (ft)	Arsenic Concentration (mg/kg)	Midpoint elevation of Sampled Interval (ft amsl)	Layer Assignment
SD515	Turning Basin	569.9	0.0	-1.0	6.9	569.4	soft sediment
		569.9	-1.0	-2.0	4.6	568.4	soft sediment
		569.9	-2.0	-2.4	4.8	567.7	soft sediment
		569.9	-4.0	-5.0	3	565.4	semiconsolidated
		569.9	-6.0	-7.0	2.5	563.4	semiconsolidated
		569.9	-8.0	-9.0	2.5	561.4	semiconsolidated
		569.9	-9.0	-10.0	3.2	560.4	semiconsolidated
		569.9	-10.0	-11.0	3.8	559.4	semiconsolidated
		569.9	-12.0	-13.0	48.8	557.4	semiconsolidated
		569.9	-13.0	-14.0	**152**	556.4	semiconsolidated
		569.9	-14.0	-15.0	**262**	555.4	semiconsolidated
		569.9	-15.0	-16.0	**522**	554.4	semiconsolidated
		569.9	-16.0	-17.0	**631**	553.4	semiconsolidated
		569.9	-17.0	-18.0	**692**	552.4	semiconsolidated
		569.9	-18.0	-19.0	**332**	551.4	semiconsolidated
		569.9	-19.0	-20.0	**94.6**	550.4	till
		569.9	-20.0	-21.0	**246**	549.4	till
		569.9	-21.0	-22.0	22.1	548.4	till
		569.9	-22.0	-23.0	4.3	547.4	till
		569.9	-23.0	-24.0	3.3	546.4	till
		569.9	-24.0	-25.0	2.7	545.4	till
		569.9	-25.0	-26.0	3.3	544.4	weathered bedrock

TABLE 2
Sampled Locations with Clean Materials Overlying Impacted
Tyco Fire Products LP Facility - Marinette, WI

Sample Location Name	Area Assignment	Top of Sediment Surface Elevation (ft amsl)	Depth to Top of Sampled Interval (ft)	Depth to Bottom of Sampled Interval (ft)	Arsenic Concentration (mg/kg)	Midpoint elevation of Sampled Interval (ft amsl)	Layer Assignment
		576.6	0.0	-0.5	8.7	576.4	soft sediment
		576.6	-0.5	-1.0	8.5	575.9	soft sediment
		576.6	-1.0	-1.5	3.1	575.4	soft sediment
		576.6	-1.5	-2.0	2.5	574.9	soft sediment
		576.6	-2.0	-2.5	2.3	574.4	soft sediment
		576.6	-2.5	-3.0	2.6	573.9	soft sediment
		576.6	-5.0	-6.0	4.3	571.1	semiconsolidated
		576.6	-7.0	-8.0	4.8	569.1	semiconsolidated
		576.6	-9.0	-10.0	**61.7**	567.1	semiconsolidated
		576.6	-10.0	-11.0	**133**	566.1	semiconsolidated
		576.6	-11.0	-12.0	44	565.1	semiconsolidated
SD519	Turning_Basin	576.6	-12.0	-13.0	6.9	564.1	semiconsolidated
		576.6	-13.0	-14.0	30.9	563.1	semiconsolidated
		576.6	-14.0	-15.0	42.5	562.1	semiconsolidated
		576.6	-15.0	-16.0	2.3	561.1	semiconsolidated
		576.6	-16.0	-17.0	1.7	560.1	semiconsolidated
		576.6	-17.0	-18.0	2.3	559.1	semiconsolidated
		576.6	-18.0	-19.0	1.5	558.1	semiconsolidated
		576.6	-19.0	-20.0	2.3	557.1	semiconsolidated
		576.6	-20.0	-21.0	1.6	556.1	semiconsolidated
		576.6	-21.0	-22.0	6	555.1	semiconsolidated
		576.6	-22.0	-23.0	1.9	554.1	semiconsolidated
		576.6	-23.0	-24.0	6.3	553.1	semiconsolidated

TABLE 2
Sampled Locations with Clean Materials Overlying Impacted
Tyco Fire Products LP Facility - Marinette, WI

Sample Location Name	Area Assignment	Top of Sediment Surface Elevation (ft amsl)	Depth to Top of Sampled Interval (ft)	Depth to Bottom of Sampled Interval (ft)	Arsenic Concentration (mg/kg)	Midpoint elevation of Sampled Interval (ft amsl)	Layer Assignment
		576.6	-24.0	-25.0	1.8	552.1	semiconsolidated
		576.6	-25.0	-26.0	2.5	551.1	semiconsolidated
		576.6	-26.0	-27.0	2.4	550.1	semiconsolidated
		576.6	-27.0	-28.0	2.6	549.1	semiconsolidated
		576.6	-28.0	-29.0	3	548.1	semiconsolidated
		576.6	-29.0	-30.0	1.8	547.1	till
		576.6	-30.0	-31.0	1.6	546.1	till
		576.6	-31.0	-32.0	2	545.1	till
		576.6	-32.0	-33.0	2.4	544.1	till
		576.6	-33.0	-33.8	3.6	543.2	till
		575.1	0.0	-0.5	**101**	574.9	soft sediment
		575.1	-0.5	-1.0	**97.8**	574.4	soft sediment
		575.1	-1.0	-1.5	**111**	573.9	soft sediment
		575.1	-1.5	-2.0	**71.9**	573.4	soft sediment
		575.1	-2.0	-2.5	9.7	572.9	soft sediment
		575.1	-2.5	-3.0	5.9	572.4	soft sediment
SD562	Transition Area 3	575.1	-3.0	-3.5	29.8	571.9	soft sediment
		575.1	-5.0	-6.0	37	569.6	semiconsolidated
		575.1	-7.0	-8.0	23.3	567.6	semiconsolidated
		575.1	-8.0	-9.0	24.1	566.6	semiconsolidated
		575.1	-9.0	-10.0	28.8	565.6	semiconsolidated
		575.1	-11.0	-12.0	**65.6**	563.6	semiconsolidated
		575.1	-12.0	-13.0	34.6	562.6	semiconsolidated

TABLE 2
Sampled Locations with Clean Materials Overlying Impacted
Tyco Fire Products LP Facility - Marinette, WI

Sample Location Name	Area Assignment	Top of Sediment Surface Elevation (ft amsl)	Depth to Top of Sampled Interval (ft)	Depth to Bottom of Sampled Interval (ft)	Arsenic Concentration (mg/kg)	Midpoint elevation of Sampled Interval (ft amsl)	Layer Assignment
		575.1	-13.0	-14.0	19.5	561.6	semiconsolidated
		575.1	-14.0	-15.0	24.7	560.6	semiconsolidated
		575.1	-15.0	-16.0	12.5	559.6	semiconsolidated
		575.1	-16.0	-17.0	5.3	558.6	semiconsolidated
		575.1	-17.0	-18.0	4.1	557.6	semiconsolidated
		575.1	-18.0	-19.0	2.2	556.6	semiconsolidated
		575.1	-19.0	-20.0	5.8	555.6	semiconsolidated
		575.1	-20.0	-21.0	2.5	554.6	semiconsolidated
		575.1	-21.0	-22.0	3.4	553.6	semiconsolidated
		575.1	-22.0	-23.0	2.3	552.6	semiconsolidated
		575.1	-25.0	-26.0	2	549.6	semiconsolidated
		575.1	-26.0	-27.0	1.7	548.6	semiconsolidated
		575.1	-27.0	-28.0	1.9	547.6	semiconsolidated
		575.1	-28.0	-29.0	2.1	546.6	semiconsolidated
		575.1	-29.0	-30.0	2.4	545.6	semiconsolidated
		575.1	-30.0	-31.0	1.9	544.6	semiconsolidated
		575.1	-31.0	-32.0	1.6	543.6	till
SD574	Transition Area 2	576.7	-5.0	-6.0	13.2	571.2	semiconsolidated
		576.7	-7.0	-8.0	**62.4**	569.2	semiconsolidated
		576.7	-9.0	-10.0	**61.3**	567.2	semiconsolidated
		576.7	-10.0	-11.0	**108**	566.2	semiconsolidated
		576.7	-11.0	-12.0	**55.7**	565.2	semiconsolidated
		576.7	-12.0	-13.0	**145**	564.2	semiconsolidated

TABLE 2
Sampled Locations with Clean Materials Overlying Impacted
Tyco Fire Products LP Facility - Marinette, WI

Sample Location Name	Area Assignment	Top of Sediment Surface Elevation (ft amsl)	Depth to Top of Sampled Interval (ft)	Depth to Bottom of Sampled Interval (ft)	Arsenic Concentration (mg/kg)	Midpoint elevation of Sampled Interval (ft amsl)	Layer Assignment
		576.7	-13.0	-14.0	**79.1**	563.2	semiconsolidated
		576.7	-14.0	-15.0	**78.4**	562.2	semiconsolidated
		576.7	-15.0	-16.0	31.3	561.2	semiconsolidated
		576.7	-16.0	-17.0	5.5	560.2	semiconsolidated
		576.7	-17.0	-18.0	10.5	559.2	semiconsolidated
		576.7	-18.0	-19.0	5.1	558.2	semiconsolidated
		576.7	-19.0	-20.0	**66.3**	557.2	semiconsolidated
		576.7	-20.0	-21.0	**87.2**	556.2	semiconsolidated
		576.7	-21.0	-22.0	**53.8**	555.2	semiconsolidated
		576.7	-22.0	-23.0	**53.2**	554.2	semiconsolidated
		576.7	-23.0	-24.0	4.5	553.2	semiconsolidated
		576.7	-24.0	-25.0	2.8	552.2	semiconsolidated
		576.7	-25.0	-26.0	2.4	551.2	semiconsolidated
		576.7	-26.0	-27.0	2.1	550.2	semiconsolidated
		576.7	-27.0	-28.0	2	549.2	semiconsolidated
		576.7	-28.0	-29.0	2.3	548.2	semiconsolidated
		576.7	-29.0	-30.0	3.1	547.2	semiconsolidated
		576.7	-30.0	-31.0	3.1	546.2	till
		576.7	-31.0	-32.0	2	545.2	till
		576.7	-32.0	-33.0	2.1	544.2	till

Notes:
- (yellow) Arsenic Concentration above 20 mg/kg
- (red) Arsenic Concentration above 50 mg/kg

TABLE 3
Preliminary Specifications List
Tyco Fire Products LP Facility - Marinette, WI

Division	Specification Title	Section No.
1	Summary of Work	01 11 00
1	Health and Safety	01 11 01
1	Payment Procedures	01 29 00
1	Project Coordination	01 31 13
1	Project Meetings	01 31 19
1	Construction Progress Documentation	01 32 00
1	Surveying	01 32 23
1	Submittals	01 33 00
1	Manufacturers' Field Services	01 43 33
1	Construction Quality Control	01 45 16.13
1	Temperory Facilities and Controls	01 50 00
1	Closeout Procedures	01 77 00
1	Equipment Testing and Facility Startup	01 91 14
2	Demolition	02 41 00
2	Removal and Disposal of Contaminated Materials	02 61 00
3	Cast-in-place Concrete	03 30 00
26	Basic Electrical Requirements	26 05 02
26	Basic Electrical Materials and Methods	26 05 04
26	Conductors	26 05 05
26	Grounding and Bonding for Electrical Systems	26 05 26
26	Raceway and Boxes	26 05 33
31	Site Clearing	31 10 00
31	Subgrade Preparation	31 23 13
31	Excavation	31 23 16
31	Dewatering	31 23 19
31	Fill and Backfill	31 23 23
31	Excavation Support	31 41 00
31	Sheet Piling	31 41 16
31	Dredging	31 XX XX
31	Sediment Resuspension Control	31 XX XX
32	Asphalt Pavement	32 12 16
32	Turf and Grass	32 92 00
32	Plants	32 93 00
33	Cover Systems	33 47 XX
33	High Density Polyethylene Pipe & Fittings	33 05 01.10
40	Process Piping General	40 27 00
40	Polyvinyl Chloride Pipe and Fittings	40 27 00.10
40	Process Valves and Operators	40 27 02
40	Process Piping Leakage Testing	40 80 01
40	Package Control Systems	40 99 90
40	Flow Measurement Components	42 91 02.03
40	Level Measurement Components	43 91 02.05
40	Pressure Measurement Components	45 91 02.07
44	Horizontal End Suction Centrifugal Pumps	44 42 56.10
44	Air Operated Diaphragm Pumps	44 42 56.15
44	Chemical Metering Pumps	44 44 13.01
44	Mobil RO System	44 XX XX
44	Geotextile Tube Filters	44 XX XX

TABLE 4
Permitting / Clearance Status Table
Tyco Fire Products LP Facility - Marinette, WI

Permit	Agency	Contact	Budgeted Review Time	Notes
Federal				
Clean Water Act- Section 404	U.S. Army Corps of Engineers- Green Bay	Todd Losee Green Bay, WI 920-448-2824	180 days	Joint Permit Application package with Section 401
Section 10- Navigable Waterway	U.S. Army Corps of Engineers- Green Bay	Todd Losee Green Bay, WI 920-448-2824	180 days	Joint Permit Application package with Section 401
Coast Guard Bulletin	U.S. Coast Guard	LT Kevin M. Dugan Commanding Officer U.S. Coast Guard Marinette, WI 715-735-4100	30 days	Notify Coast Guard 2 to 4 weeks prior to commencing work within Menominee River. Coast Guard will prepare a bulletin notifying boat traffic. Also need to contact: Meredith Foster Security Officer Marinette, WI 715-735-4100
U.S. Fish and Wildlife Service	Section 7 Endangered Species Consultation	Ms. Jill Utrup Green Bay Field Office U.S. Fish and Wildlife Service 2661 Scott Tower Drive New Franken, WI 54229 920-866-1717	30 days	
Section 401- Water Quality Certification	Wisconsin Dept. of Natural Resources	Robert Rosenberger	180 days	Joint Permit Application package with Section 404
Chapter 30 Shoreland Grading Permit	Wisconsin Dept. of Natural Resources	Robert Rosenberger	180 days	Will be issued in conjunction with the Section 401 WQC
Waterway Marker Permit	Wisconsin Dept. of Natural Resources	Jeremy Cords Northeast Region Recreational Safety Warden - North 2984 Shawano Ave Green Bay, WI 54313 920-662-5129 jeremy.cords@wisconsin.gov	180 days	May require establishment of local ordinance for placement of buoys within Menominee River
Wisconsin Pollutant Discharge Elimination System- Construction Site Stormwater Runoff	Wisconsin Dept. of Natural Resources	David Bougie Northeast Regional Headquarters 2984 Shawano Avenue Green Bay, WI 54313-6727 920-662-5124	45 days	
Wisconsin Pollutant Discharge Elimination System- Point Source Discharge Permit	Wisconsin Dept. of Natural Resources	Jeff Brauer Wisconsin Department of Natural Resources Madison, WI 608-267-7643		
Natural Heritage Inventory Review	Wisconsin Dept. of Natural Resources	Bureau of Endangered Resources 608-266-7012	45 days	
Natural Historic Preservation Act-Section 106 Review	Wisconsin State Historical Society	Mr. Sherman Banker Wisconsin SHPO Historical Society 816 State Street, Room 306 Madison, WI 53706 608-264-6507	30 days	
Local				
Wastewater Coordination	City of Marinette	Tim Peterson	30 days	
Erosion Control Permit	City of Marinette	Brian Miller City Engineer 715-732-5134 bmiller@marinette.wi.us	30 days	
Building Permit	City of Marinette	Brian Miller City Engineer 715-732-5134 bmiller@marinette.wi.us	30 days	

Figures

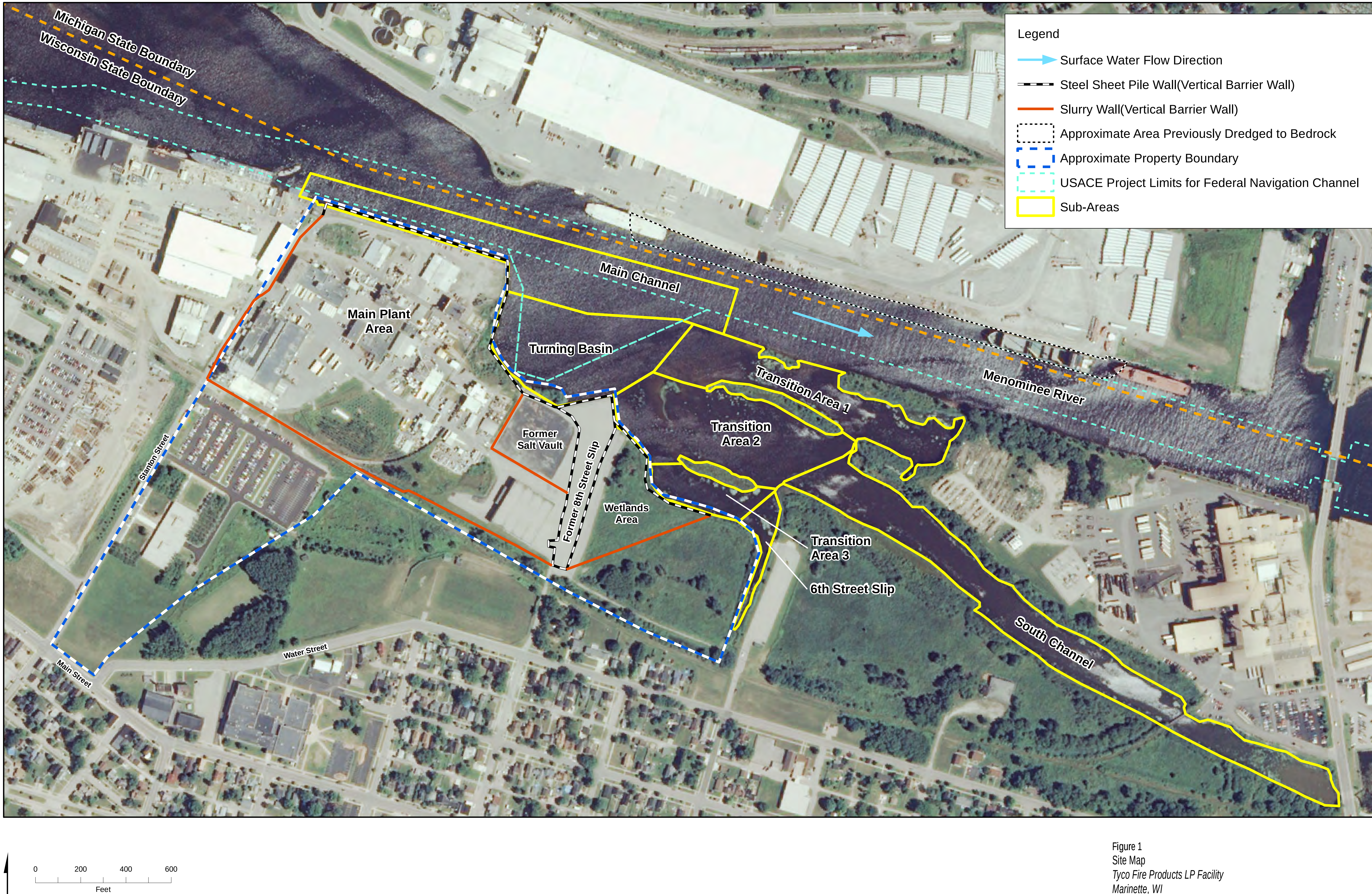

Figure 1
Site Map
Tyco Fire Products LP Facility
Marinette, WI

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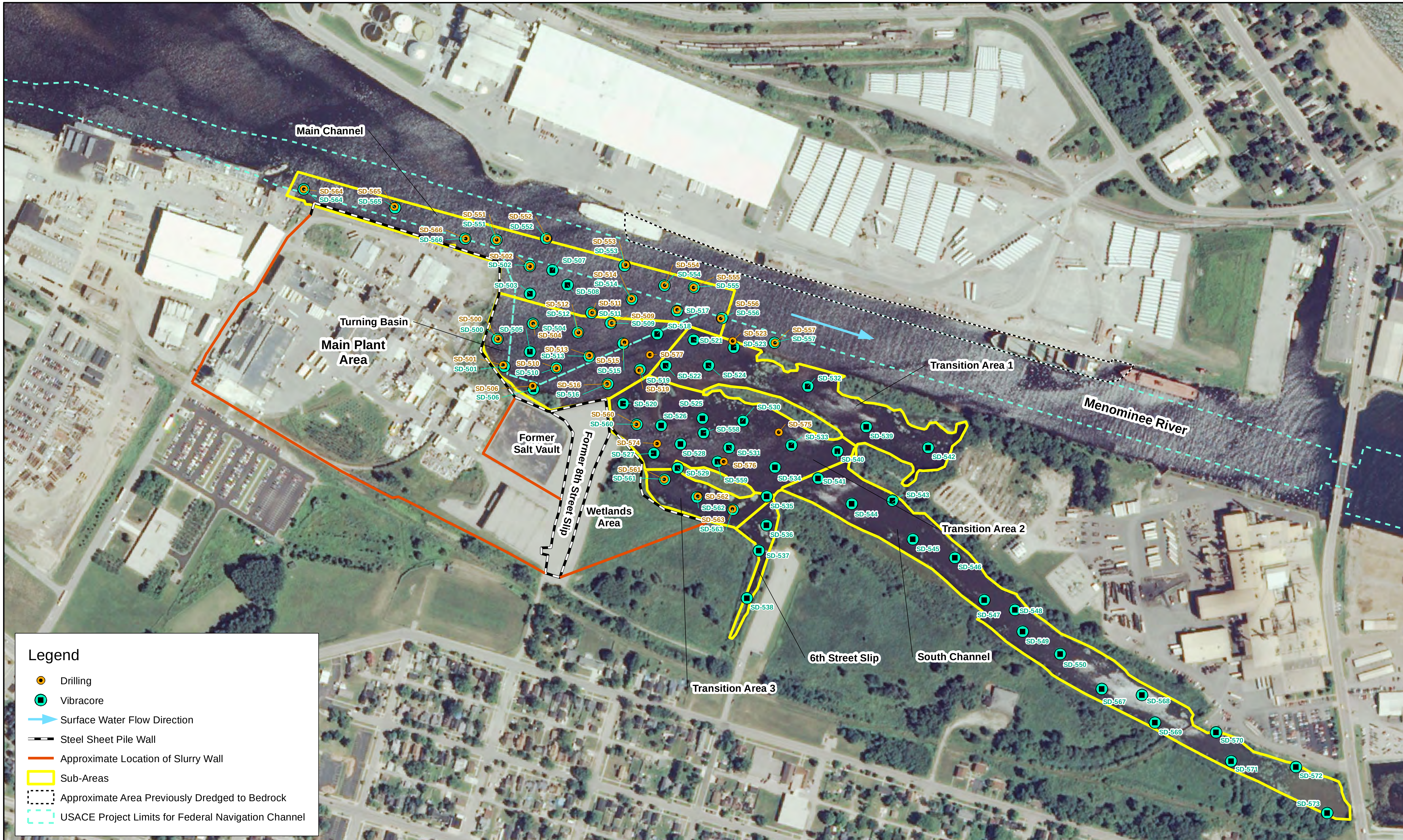
E:\TYCO\MAPFILES\DELIVERABLE_101411\FIGURE 01 - SITE MAP.MXD JHANSEN1 10/10/2011 11:32:40 AM



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Feet

Figure 2
2010 Menominee River Investigation Sampling Locations
Tyco Fire Products LP Facility
Marinette, WI

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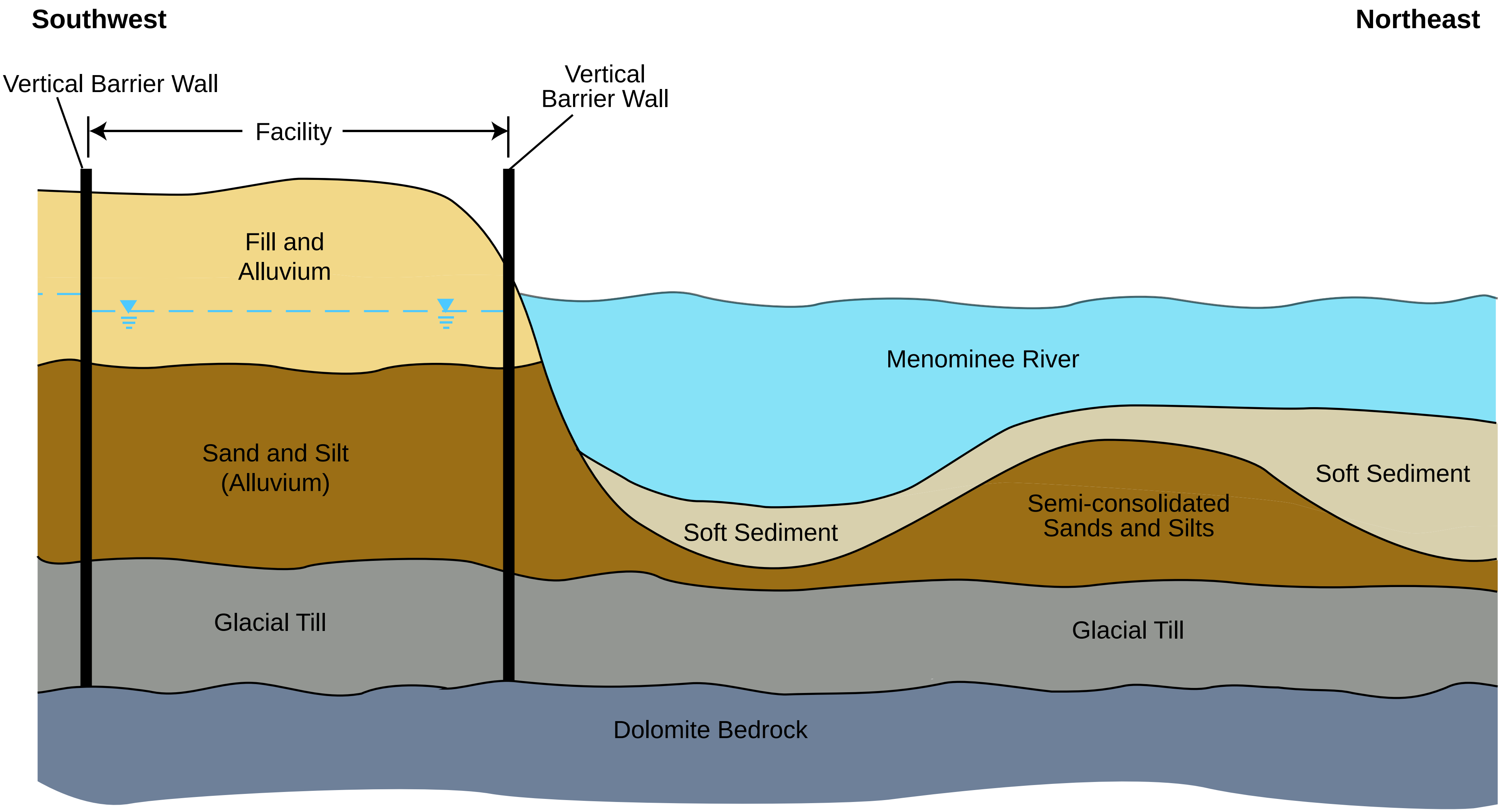
E:\TYCO\MAPFILES\DELIVERABLE_101411\FIGURE 02 - 2010 MENOMINEE RIVER INVESTIGATION SAMPLING LOCATIONS.MXD JHANSEN1 10/10/2011 12:19:09 PM



Not to scale.

FIGURE 3
Conceptual Site Model – Existing Conditions
Tyco Fire Products LP Facility and Menominee River Sediment

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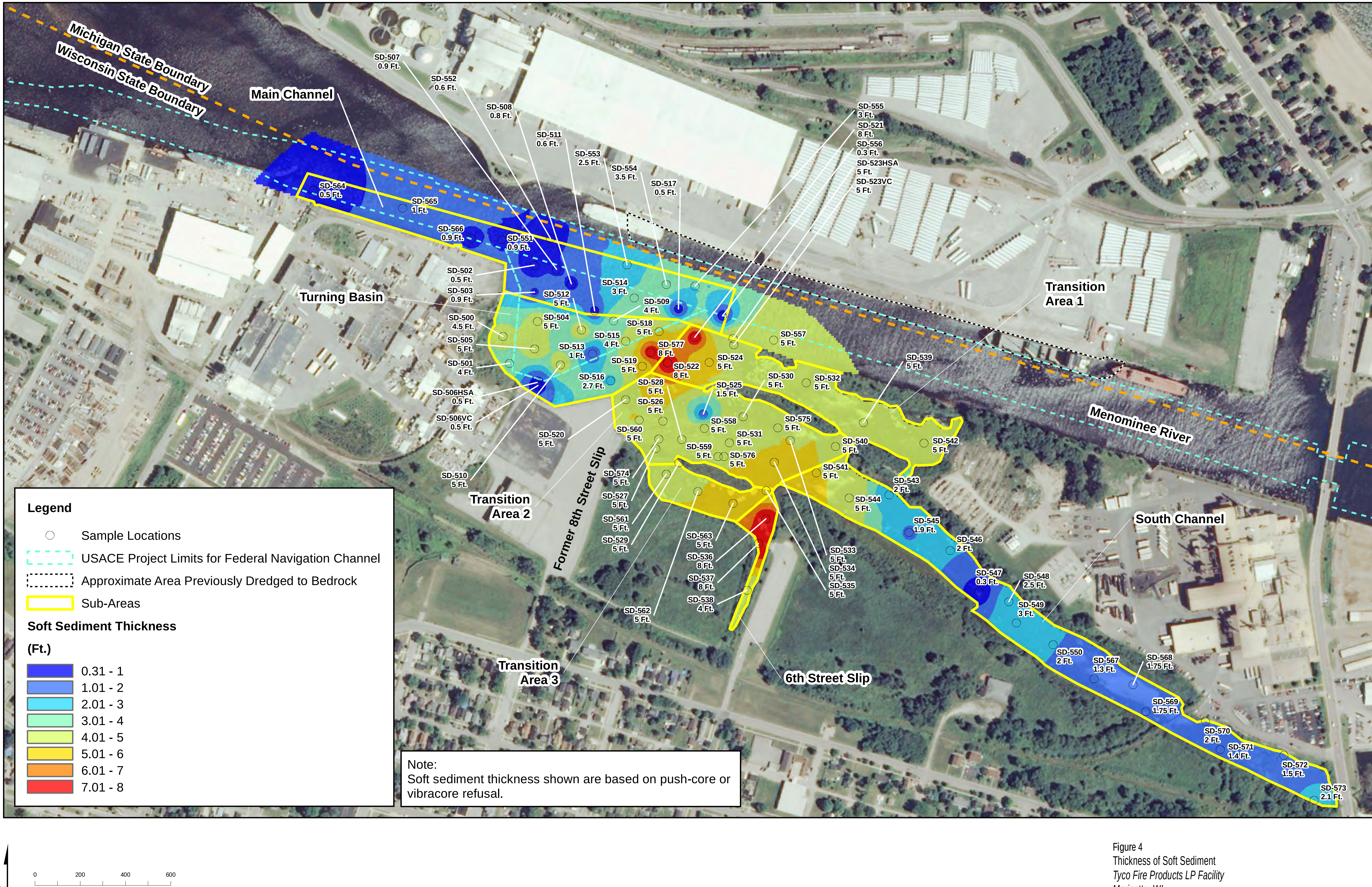

Figure 4
Thickness of Soft Sediment
Tyco Fire Products LP Facility
Marinette, WI

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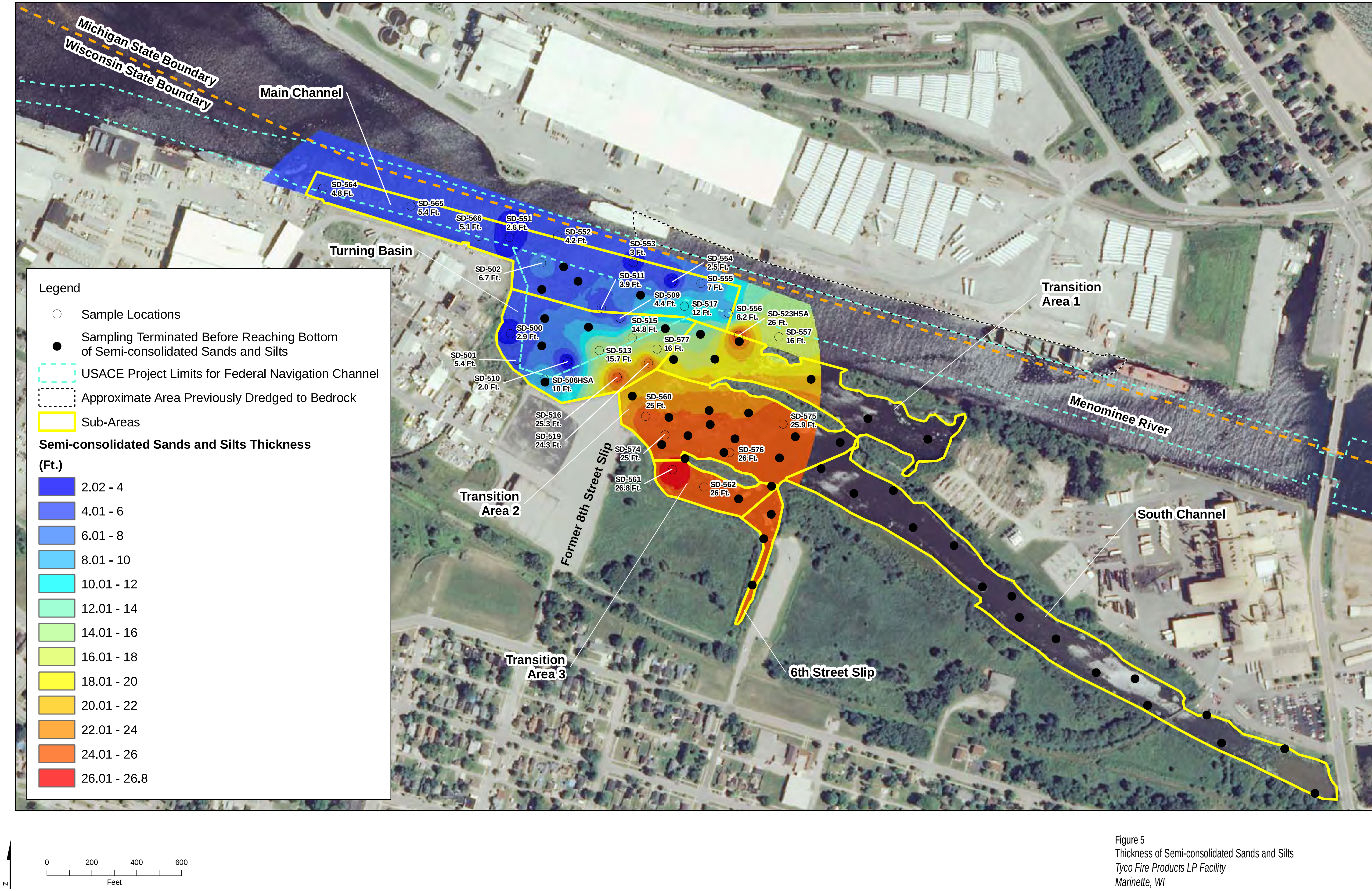

Figure 5
Thickness of Semi-consolidated Sands and Silts
Tyco Fire Products LP Facility
Marinette, WI

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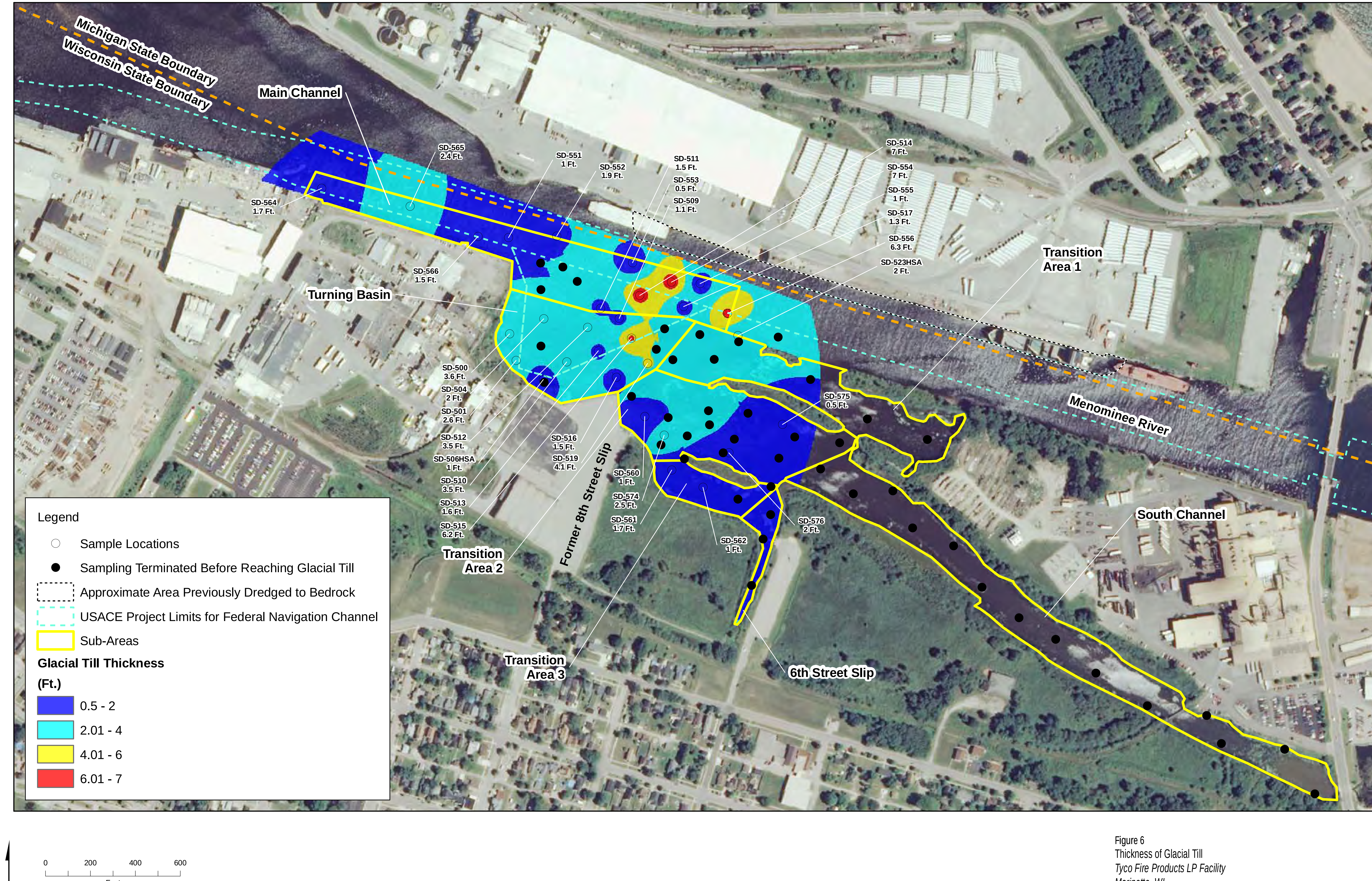

Figure 6
Thickness of Glacial Till
Tyco Fire Products LP Facility
Marinette, WI

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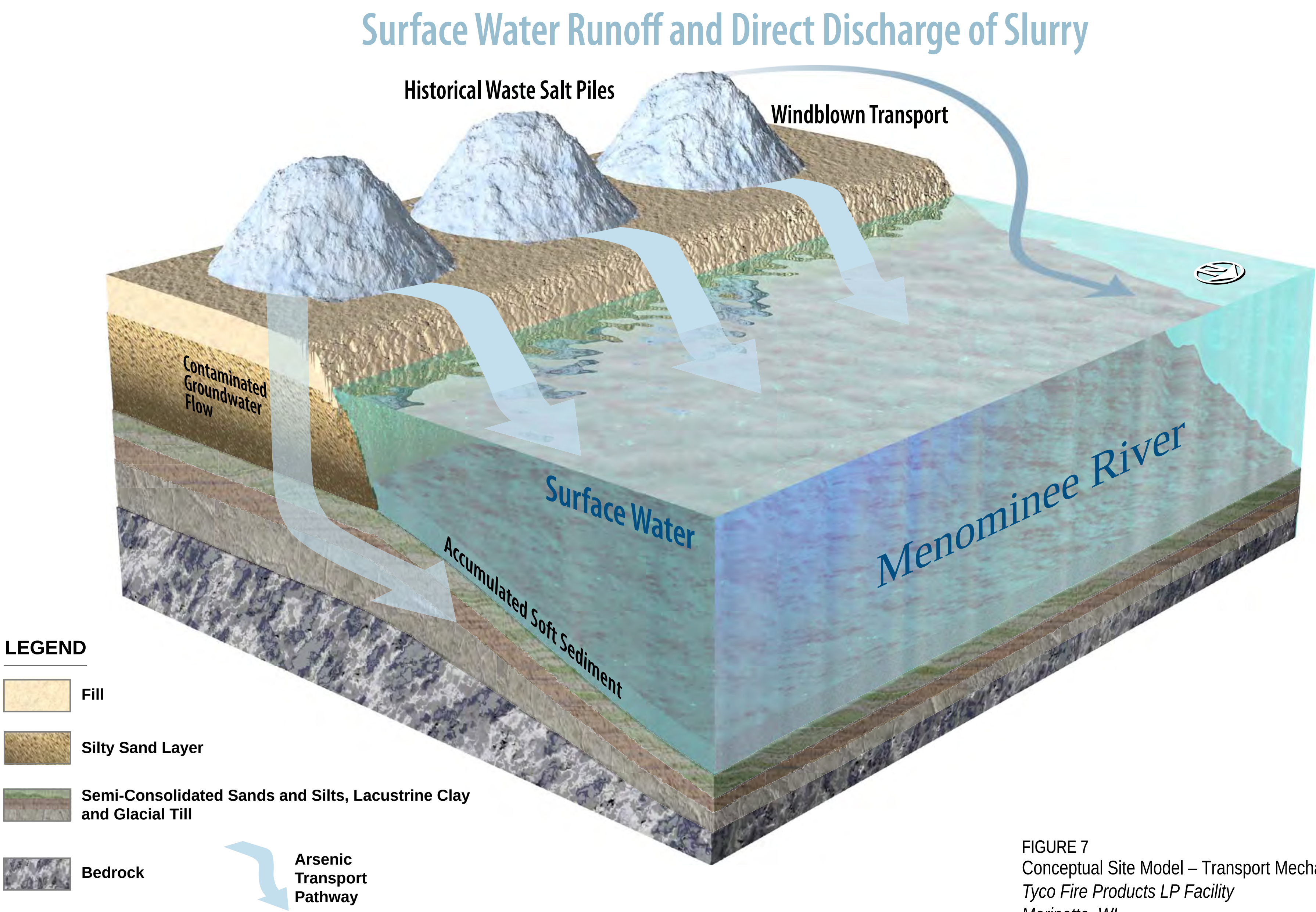

FIGURE 7
Conceptual Site Model – Transport Mechanisms
Tyco Fire Products LP Facility
Marinette, WI

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