

Removal Recommendation for the
Degradation of Benthos Beneficial Use Impairment
In the Lower Menominee River Area of Concern

September 7, 2016 DRAFT FOR PUBLIC REVIEW

**Submitted to
U.S. EPA-Region 5
77 W. Jackson Boulevard
Chicago, IL 60604
By
Wisconsin Department of Natural Resources
And
Michigan Department of Environmental Quality**

September 2016

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EXECUTIVE SUMMARY

In 1987, the lower three miles of the Menominee River, along with Green Island and the Green Bay shoreline three miles north and south of the river mouth, were designated a Great Lakes Area of Concern (AOC), primarily due to toxic chemical contamination. PAHs, heavy metals (specifically arsenic), and paint sludge associated with industrial activities were present in river and bay sediments at high levels within the AOC. Six impairments were assigned to the AOC, including the “Degradation of Benthos” BUI. This impairment indicates that organisms living in or on the river or lake bottom are being negatively affected by the toxic chemicals in the sediments. Therefore, a great deal of remediation work has been done in recent years and the Wisconsin Department of Natural Resources (WDNR) Office of the Great Lakes (OGL) and Michigan Department of Environmental Quality (MDEQ) OGL are now proposing to remove the benthos impairment.

To address the impairment, polluted sediments were removed from the river and bay by dredging them and disposing of them in approved locations. Cleanup efforts took place at the Green Bay paint sludge site from 1993 through 1998, the Ansul/Tyco arsenic site from 2012 through 2015 (river portion), the Wisconsin Public Service Corp. (WPSC) coal tar site from 2012 through 2015), and the Menekaunee Harbor site from 2014 through 2015. The projects are being monitored according to their approved plans and are meeting their remedial action goals to the extent practicable. In addition, sediment assessments in the Lower Scott Flowage and Rio Vista Slough show that no remediation is needed at those sites. Therefore, the sediment contamination that was degrading the benthos in the AOC has been addressed and restoration targets for this impairment have been met.

While the bulk of the worst contamination has been removed, some low level contamination will persist for some time. Clean sand cover was applied to this lower level contamination to enhance natural deposition that is likely to occur in certain areas of the river. Monitoring will continue at these sites to assure that the projects are meeting their sediment-related remedial action objectives.

Now that the contamination has been removed from their habitat, benthic organisms should recover and move into areas that before were too toxic for them to survive. Over time, there will be greater numbers and diversity of benthos in the formerly contaminated areas, and the benthos will also have less toxic chemicals in their bodies. This will benefit other animals that eat them, such as fish and birds, and the local ecosystem as a whole.

This BUI removal is proposed by the WDNR OGL and MDEQ OGL and supported by the Lower Menominee River AOC Technical Advisory Committee (TAC) and the Lower Menominee River AOC Citizens Advisory Committee (CAC). This document describes the contaminated sediment remediation actions and assessments and shows how the BUI targets are being met. The proposal also includes documentation of public involvement in the process.

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ISSUE

Removal of the Degradation of Benthos Beneficial Use Impairment (BUI) is proposed for the Lower Menominee River (LMR) Area of Concern (AOC). This document provides information supporting the recommendation and documents the actions completed to meet the locally established degraded benthos removal criteria found in the *Lower Menominee River AOC Beneficial Use Impairment Restoration Targets 12/22/2008* and hereafter referred to as “criteria.” These criteria can be found in Appendix D.

This BUI removal is proposed by the Wisconsin Department of Natural Resources (WDNR) Office of the Great Lakes (OGL) and Michigan Department of Environmental Quality (MDEQ) OGL and supported by the Lower Menominee River AOC Technical Advisory Committee (TAC) and the Lower Menominee River AOC Citizens Advisory Committee (CAC).

BACKGROUND

Rationale for Nominating the Lower Menominee River as an AOC

The LMR became an AOC primarily due to arsenic-contaminated sediments found in the turning basin portion of the river (Appendix B Figure 3, Segment 5) by the U.S. Army Corps of Engineers (USACE) navigational dredging sampling between 1980 and 1989, as shown in table IV.16 in the 1990 *Lower Menominee River Remedial Action Plan* (RAP), Stage I Report (WDNR and MDNR, 1990). The 1990 RAP identified potential contaminants, sources of contamination, and scope of contamination in the Menominee River and adjacent Green Bay shore. The 1990 RAP recognized two additional sites in the immediate area containing legacy sediment contamination requiring remedial action, including the Lloyd-Flanders paint sludge site along the Green Bay shoreline in Menominee, Michigan and the Wisconsin Public Service Corporation coal tar site in the Menominee River near Boom Landing in Marinette, Wisconsin (WDNR and MDNR, 1990).

Remaining BUIs

Five BUIs remain impaired in the Lower Menominee River AOC: Restrictions on Fish and Wildlife Consumption, Restrictions on Dredging Activities, Degradation of Benthos, Degradation of Fish and Wildlife Populations, and Loss of Fish and Wildlife Habitat. The Restrictions on Recreational Contact (Beach Closings) BUI was removed in 2011 (WDNR and MDEQ, 2011).

AOC Boundary

The AOC boundary includes the lower three miles of the river from the Park Mill Dam (Upper Scott Dam) to the river’s mouth. The AOC Boundary extends approximately three miles north of the river mouth to John Henes Park and approximately three miles south of the river mouth past Seagull Bar along the Bay of Green Bay. Seagull Bar is

part of the AOC. Green Island in Green Bay is also considered part of the AOC because of its strong habitat value and biological link to Seagull Bar State Natural Area. There are five permanent islands in the river within the AOC boundary. The AOC includes portions of Marinette County in Wisconsin and Menominee County in Michigan (WDNR and MDNR, 1990). Appendix B Figure 1 shows the AOC boundary and Appendix B Figure 2 shows the entire Menominee River watershed.

Rationale for Listing the Benthos BUI

The 1990 RAP attributes degradation of the benthos in otherwise suitable habitat to toxic conditions caused by contaminated sediment (WDNR and MDNR, 1990). A Wisconsin Board of Health Menominee River survey conducted in August 1957 found few bottom-dwelling organisms at a station just below the Ansul Chemical Company, and populations were composed of known pollution-tolerant varieties (Letter, Committee on Water Pollution, Theodore F. Wisniewski, Director, of the Division of Water Pollution Control). Studies conducted in the area over a period between 1974 and 1989 found degraded benthic communities in and around the turning basin (Appendix B Figure 3, Segment 5) and some studies determined there was an absence of benthic organisms. Elevated levels of arsenic, cadmium, and mercury were detected in subsequent benthic organism tissue analyses. Benthic impairments were due to a variety of causes, but heavy arsenic pollution was identified by the USEPA as the likely cause since adequate substrate and nutrients were available to support a diverse benthic population (WDNR and MDNR, 1990).

BUI REMOVAL CRITERIA

Criteria

From the *Lower Menominee River AOC Beneficial Use Impairment Restoration Targets 12/22/2008* (WDNR and MDEQ, 2008; Appendix D):

This BUI will be considered restored when: All remediation actions for known contaminated sediment sources are completed and monitored according to the approved plan and have met their remedial action goal.

Criteria Background

Wisconsin's and Michigan's Offices of the Great Lakes agreed that once the court-negotiated allowable contaminant levels were reached, the benthos BUI criteria would be met. These levels were set through the negotiations with the responsible parties and the state and federal programs with oversight of these projects, and were based on sediment toxicity to benthic-dwelling species. To clarify, the word "monitored" in the benthos criteria referred to the sediment sampling, also referred to as confirmation monitoring, required to confirm that final contaminant levels established for each

cleanup site were met. This confirmation monitoring was not intended to establish whether benthic organisms had recolonized the area through passive or active processes.

The benthos BUI removal criteria for this AOC are very similar to the second of two options in Michigan's statewide criteria (MDEQ, 2008). For AOCs where benthic degradation is caused by contaminated sediments, the BUI can be considered restored when remediation of those contaminated sediments is complete. The criteria assumed that benthic communities would re-establish in those areas where contaminated sediments were removed and target sediment contaminant levels for each remediation project were reached. These target levels were based on sediment toxicity to benthic-dwelling species; therefore, it is reasonable to assume that the completion of the projects would allow for benthic recovery in those areas. Numerous studies have shown that benthic organisms will recolonize riverine areas after disturbance from natural and anthropogenic events, and that recovery time is influenced by a variety of factors, including the following: characteristics of the disturbance and its impacts, such as type, duration, and scale; proximity to population sources (refugia); and characteristics of the colonizing organisms, such as life cycle and mobility (Wallace, 1990; Niemi et al., 1990; Yount and Niemi, 1990).

SEDIMENT CONTAMINATION SITES AND REMEDIAL ACTIVITIES

This section will discuss the known areas containing contaminated sediments within the AOC that contributed to one or more impairments to designated beneficial uses. This section will also discuss additional sediment sampling completed to assess the current status of suspected areas. Primary areas identified in the 1990 Stage One RAP include the following: Ansul Arsenic Site, including the turning basin and South Channel; Wisconsin Public Service Commission Coal Tar Site; and Lloyd-Flanders Paint Sludge Site (WDNR and MDNR, 1990). A secondary area, identified by Wisconsin DNR, was Menekaunee Harbor. Suspected areas investigated by state and federal agencies to determine if those areas were contributing to beneficial use impairments include Lower Scott Flowage, between the Menominee and Park Mill Dams, and Rio Vista Slough, in the City of Menominee.

Contaminated sediment management actions have been implemented at all known contamination sites to the extent practicable, as specified in the USEPA negotiated Administrative Order on Consent (AOOC) for each site. See Appendix A, Table 1 for a concise picture of the current status of the contamination sites in the AOC. Table 1 provides a summary of the remediation goals for each site, along with the actions taken to achieve those goals, monitoring and maintenance requirements, and whether the remedial action goals have been met. A detailed narrative for each sediment remediation site is provided below.

(Ansul) Tyco Arsenic Site

Contamination Background

The arsenic contamination resulted from arsenic salts produced by the Ansul Fire

Protection Company (now known as Tyco Fire Products LP) at their manufacturing site in Marinette adjacent to the turning basin in the river. Arsenic salts were produced as a byproduct of herbicide manufacturing between 1957 and 1977. The waste salts were stored on-site in uncovered piles and in a bunker area, and were discharged directly to the river via storm water runoff and wind erosion or leached into surficial and ground waters, which then flowed to the Menominee River along the turning basin. These discharges impaired water quality and contaminated river sediment (WDNR, 1996).

Tyco purchased Ansul in 2000, making them responsible for the arsenic contamination site. Tyco did not contribute to the contamination, which was already present on the site long before they purchased the facility.

Site Remediation/Source Control

Tyco International, owners of Ansul Incorporated, signed an AOC with the USEPA to remediate the site (USEPA, 2009). The AOC requires Tyco to implement the remedy selected in the USEPA's 2008 Statement of Basis and Final Decision Document for Ansul Inc. (USEPA, 2008). Tyco completed implementation of the USEPA approved work plan to remediate arsenic contaminated sediment in 2013.

In addition, Tyco worked with the USEPA to implement a Great Lakes Restoration Initiative - Great Lakes Legacy Act (GLLA) Betterment Action at the contaminated sediment site in 2014 with completion in 2015 (EQM, 2015).

Many remedial activities were conducted before the AOC was signed. See the USEPA web page <http://www.epa.gov/region5/cleanup/rcra/ansul/index.html> for additional information.

Components of the selected remedy are summarized and listed below (USEPA, 2008), and include an informal status.

Terrestrial

- Construct and maintain an impermeable below-ground barrier wall to control the flow of groundwater to the maximum extent practicable (Appendix C Map 1).
 - Status: Complete with ongoing maintenance and monitoring as needed.
- Cap surface soils on-site with arsenic concentrations equal to or above 32 ppm (Appendix C Map 1).
 - Status: Complete with ongoing maintenance and monitoring as needed.
- Remove surface soils near the railroad tracks with arsenic concentrations equal to or above 16 ppm (Appendix C Map 1).
 - Status: Complete.

Groundwater

- Contain contaminated groundwater on-site through the use of a barrier wall system. Utilize an on-site groundwater extraction system and phyto-pumping as a means to keep the site from flooding. Conduct a technical review of the latest science for treating groundwater containing large quantities of arsenic every five years.

- Status: Complete with ongoing activities as prescribed. The first five year review was completed in December 2013 (CH2MHill, 2013a). As a result of the five year review, an updated barrier wall groundwater monitoring plan was prepared and approved by USEPA RCRA in September 2015. The updated plan is being implemented and includes the installation of additional monitoring wells, dye testing after the completion of the outfall investigation, and the pump down program. Additional monitoring wells were installed in 2015. The pump down program to control hydraulic head within the former Salt Vault and the former 8th Street Slip began in June 2016.
- The next five year review will be completed in 2018.

Sediment

Sediment with Arsenic Levels Above 50 ppm

- Remove and properly dispose of all Menominee River soft sediment with arsenic concentrations equal to or greater than 50 ppm (Appendix C Map 2).
 - Status: Completed in 2013. See additional details below.
- Remove and properly dispose of all Menominee River semi-consolidated silts and clays with arsenic concentrations equal to or greater than 50 ppm (Appendix C Map 2) or, if removal is technically or economically impractical, provide an alternative to removal that protects human health and the environment, is legally implementable, and achieves arsenic concentrations of 20 ppm or less by November 1, 2023.
 - Status: Complete.
 - Removal began in July, 2012. Soft and semi-consolidated sediment containing total arsenic concentrations greater than or equal to 50 ppm were mechanically dredged using an environmental clamshell bucket and stabilized on-site (CH2MHILL, 2012). Dredging and treatment was completed December 7, 2013. A total of 232,133 cubic yards of contaminated sediment was removed from the river in 2013 (CH2MHill and Severson, 2014). Confirmation sampling determined that the remedial action goals for 2013 were reached (CH2MHill and Severson, 2014).

Sediment With Arsenic Levels Between 20 ppm and 50 ppm

- A GLLA Betterment Action Agreement between TYCO, the USEPA, and the WDNR was signed in May 2014. The agreement called for additional dredging of all soft and semi-consolidated sediment having arsenic concentrations greater than 20 ppm remaining after the 2013 completion of the Resource Conservation and Recovery Act (RCRA) component of the project. This agreement speeds recovery of the aquatic ecosystem and delisting of the Menominee River AOC by an estimated 10 years, because the required time for natural recovery / Monitored Natural Recovery (MNR) of the sediment surface from 50 ppm to 20 ppm arsenic will no longer be required due to the active removal of contaminated material.
 - Dredging for the Betterment Action began in late August 2014, with sediment processing, treatment, and disposal methods remaining the same as those used for the RCRA activities. Dredging was completed in mid-November 2014, with 42,000 additional cubic yards of arsenic contaminated sediment removed from the river (Appendix C Map 3). When processed, the material resulted in 73,000

tons of non-hazardous waste, which was hauled to Michigan for conventional landfilling. Of this waste, 556 tons was scrap debris, including lumber wood waste and old construction concrete (EQM, 2015).

- Post-dredge confirmation sampling and bathymetry were performed to ensure the project goal of 20 ppm or less of arsenic in remaining surface sediment was met. Due to the vast amount of data collected, please refer to the *Sampling Summary Report Great Lakes Legacy Act Lower Menominee River Tyco Site Adjacent to the Tyco Fire Products LP Facility, Marinette, Wisconsin* (CH2MHill, 2015b). Refer to Appendix E of the *Remedial Action Completion Report, Great Lakes Legacy Act Lower Menominee River Tyco Site* (EQM, 2015) for bathymetric Survey Data.
 - In those deep-water areas where dredging activities exposed glacial till, a covering of carbon-enhanced sand was layered on top of any till areas having >20 ppm arsenic. This cover is approximately 12 inches thick and is intended to physically and chemically attenuate any remaining arsenic that might migrate vertically through the till to the water column. The design cover required a minimum placement of 10 inches of sand and activated carbon. Because the majority of exposed till is found within the bounds of the federal navigation channel, the action must be approved through U.S. Code Title 33, sec. 408 permitting by the Army Corps of Engineers. That permit was approved on March 2, 2015, with cover placement occurring during the summer construction season. Sand cover placement was completed on June 24, 2015 (Appendix C Map 4; CH2MHill, 2015b). Pan tests, pre and post bathymetry and diver-assisted core sampling were performed to verify sediment placement and thickness (EQM, 2015).

Site Monitoring/Maintenance

The Ansul/TYCO Site is following the Operations and Maintenance Plan (*Revised Barrier Wall Groundwater Monitoring Plan Update (BWGMP)*) (CH2MHill, 2015a) agreed to with the WDNR and USEPA RCRA Program. The objective of the BWGMP is to provide the approach to long-term monitoring of the effectiveness of the barrier at containing on-site groundwater. The plan is required by the AOC between Tyco and USEPA RCRA Program.

Tyco agreed to implement the following activities:

- Barrier wall inspections, installation of additional groundwater monitoring wells, groundwater elevation monitoring, and water quality monitoring to demonstrate barrier wall effectiveness
- A pump-down program to lower water levels in the former Salt Vault and the former 8th Street Slip and ultimately maintain a constant groundwater elevation within these areas
- Enhanced monitoring of the Main Plant Area by calculating the potential amount of groundwater migration from the upland area that would impact the ability of the Menominee River sediment to remain less than the remedial action objective (RAO) of 20 ppm total arsenic and conducting groundwater dye testing, upon completion of an outfall investigation, to determine if any portion of the barrier wall is leaking

- Sample collection of post-dredging accumulated soft sediment in the main river channel outside the Main Plant Area, in the turning basin, and the Transition Area (CH2MHill, 2015a). The post-dredging sediment sampling will coincide with the five year review and will be completed in 2018.

Sediment-Related Remedial Action Goals

The sediment-related remedial action goals of this remediation project were to prevent arsenic-contaminated groundwater from migrating into the Menominee River and to achieve sediment contaminant levels in the river of less than or equal to 20 ppm of arsenic. The sediment-related remedial actions have been implemented to the extent practicable. Future planned monitoring activities will determine the long-term effectiveness of the remedial actions (see Sediment Remediation/Source Control Section above).

Green Bay Paint Sludge Site (Lloyd-Flanders, Menominee, Michigan)

Contamination Background

Since the early 1900s, a manufacturing plant in Menominee, Michigan has produced high end woven wicker furniture and metal seating. The furniture plant operations included the crafting, assembling, and finishing of seating components. Operations involved plating of metal parts or spray painting of metal and wicker components. Until the late 1980s, furniture production processes used water shields (curtains) to capture paint mists and overspray which generated large volumes of paint sludge. The painting and plating processes contained heavy metals, including high levels of lead, and other metals used as colorants. The overspray containing bulk paint wastes (paint sludge) collected at the bottom of the painting booths, and these paint wastes along with other manufacturing wastes were dumped behind the plant on shore, along the shore, or flushed out to Green Bay off shore of the property (WDNR and MDNR, 1990; WDNR, 1996). The majority of these wastes remained behind the plant or along the adjacent shoreline (Appendix C, Maps 5 and 6).

In 1982, Lloyd-Flanders Industries, Incorporated purchased the furniture manufacturing plant from the Heywood-Wakefield Company, making them responsible for the furniture production contamination source control at the Green Bay Paint Sludge Site. Lloyd-Flanders did not contribute to the contamination, which was already present on the site long before they purchased the facility.

MDEQ and MDNR site inspections from the early 1980s through the early 1990s documented the presence of the paint sludge contamination in upland areas behind the manufacturing plant, in waters and in sediment along approximately one half mile of the Menominee, Michigan portion of Green Bay, including shoreline properties adjacent to and including the area behind the Lloyd-Flanders Plant.

Site delineation by consultants for the company or MDNR found that immediately behind the plant these bulk paint wastes formed continuous multicolored layers. In some places, the waste was three feet thick on the sediment of the bay, covering approximately 0.5 acre (GZA-Donahue, 1989; Appendix C Map 5). Bits of these layers

eroded into fragments due to wave and ice actions, and these fragments—through natural water movements, including waves, ice flows, and off-shore currents—spread throughout an approximate half mile radius of the plant. These colorful, putty-like fragments of paint sludge are hydrophobic (fail to dissolve/mix in water), and will sometimes form balls (a.k.a. paint balls). Fragments can be found imbedded in the beaches or sediment and occasionally can be found floating just below the surface of the water.

Site Remediation/Source Control

In 1992 Lloyd-Flanders was ordered by the State of Michigan to investigate and remediate the paint sludge contamination and other manufacturing wastes connected to plant operations and processes. The Administrative Order required development of a Remedial Action Plan (RAP) for the Green Bay Paint Sludge Site (GBPS), Menominee Michigan. The RAP and the Administrative Order describe the remediation requirements for the site and also provide paint sludge contamination background, history, and required source control actions.

Shoreline Collections

The Lloyd-Flanders shore patrol began collection, removal, storage, and disposal of paint balls (nodules) and fragments in 1992. This collection continues as part of their ongoing responsibilities related to the bulk paint contamination. The purpose of collection is to minimize exposure to wastes washing up to shore. The company is required to collect and remove paint sludge pieces/paint balls after ice-out in the spring and after storm events because water or ice actions can loosen the wastes imbedded in the bottom of Green Bay or along the Bay's shoreline and bring them back to the surface and deposit them along the shore. Under the Administrative Order, these paint wastes were to be stored and disposed of appropriately.

At the end of 1995 the company had reported removal of 7,500 gallons of hardened paint sludge waste nodules/fragments. In personal communications to TAC and CAC by Mark Erickson, Lloyd-Flanders Plant Engineer/Manager and CAC Co-Chair, paintballs/nodules and fragment collections have decreased in volume since collections began. The shoreline collection data provided in 2010 to the Michigan DNRE-Upper Peninsula District Office showed a reduction of 40% of material collected during the 2006-2010 time period. The time period 2010-2015 also showed a 41% overall reduction in material collected in regular shoreline cleanup activities. Collection activities in 2015 resulted in a total measured volume of 33 gallons. (Mark Erickson, personal communication).

Shoreline/Terrestrial Source Control

A berm/rock dike was constructed in 1993 to enclose the submerged paint wastes to prevent further migration of the manufacturing wastes into Green Bay from the main disposal area. The core of this berm structure contains a series of membrane liners designed to hydraulically isolate the wastes from the bay. The original GBPS RAP required dewatering within the berm to facilitate waste removal and disposal, but testing indicated that dewatering was not feasible due to the conductivity of the sediment

underlying the berm. Waste removal plans were modified to allow removal by mechanical and hydraulic suction dredging.

Contaminant removal work was conducted during the summer and fall of 1995, and October 1998. Approximately 5,300 tons of bulk paint wastes were sent to a hazardous waste treatment and disposal facility and 10,500 tons of excavated contaminated sediment and soils were sent to the local landfill. Berm dismantling and shoreline restoration was completed in October and November 1998. Shoreline restoration included the installation of a 12-ounce non-woven polypropylene fabric liner, anchored and covered by rock-rip-rap, on a portion of the shoreline bordering the plant site. This shoreline barrier was intended to prevent further erosion of waste remnants and contaminated soil.

Additional actions were taken as described in the *Outstanding Issues Regarding the RAP, GBPS Site Menominee, Michigan* report to address issues described in the RAP Supplement response letter. Exposure barriers comprised of gravel and crushed limestone were placed on upland soil areas from October 30 to November 3, 2000 to prevent surface soil lead exposures on portions of the Lloyd Flanders plant site. To address elevated lead levels detected along the southern end of the shoreline bordering the plant site after shoreline restoration was completed, an additional 180 feet of liner and rock rip-rap barrier was installed November 6-9, 2000.

Site Monitoring/Maintenance

There were no reporting requirements negotiated under the Administrative Order-RAP for any parameters—such as the amount of paint wastes collected per year, water quality, groundwater quality, sediment contaminants, viability of the liner placed over the waste area after bulk paint wastes were removed, or stability of the rock berm—to insure site remediation was working as designed.

The GBPS Site exposure barriers are regularly inspected and maintained, as needed, and shoreline paint wastes are being collected for proper disposal, as required in the Operations and Maintenance Plan agreed to with the State of Michigan. A letter of credit is being maintained to ensure availability of funding for these activities for a period of 30 years. In the last fifteen years the upland barrier and shoreline rip rap have required no repair of any kind.

Remedial Action Goals

The goals of this remediation project were to remove paint waste and impacted sediment and soil from the site and collect and remove paint nodules that wash up along the shoreline. These goals were achieved through the removal of bulk paint waste, sediment, and soil, and ongoing shoreline paint nodule collection (see Sediment Remediation/Source Control Section above).

Wisconsin Public Service Corporation Marinette Coal Tar and PAHs Site

Contamination Background

The Wisconsin Public Service Corporation (WPSC) site is located in Marinette,

Wisconsin. The 4-acre former manufactured gas plant (MGP) is about 750 feet south of the Menominee River and about 1.5 miles upstream from the river mouth at Green Bay. The WPSC MGP was formerly located on the property currently known as the Marinette Wastewater Treatment Plant (WWTP). Boom Landing Park is between the river and the site. It is currently used as a boat launch facility operated by the city.

Former WPSC MGP operations have caused impacts to soil, groundwater, and sediment. Residual coal tars generated by the former MGP operations washed into the Menominee River via a former slough, contaminating sediment along the Wisconsin shoreline of the Menominee River near Boom Landing.

The WPSC Marinette MGP operated from 1910 to 1960 using two coal gasification methods: retort and carbureted. The retort gasification process operated from 1910 to 1928. Retort gasification involved heating and volatilizing coal in an airtight chamber (retort) at temperatures reaching 2,200°F so the coal decomposed into gas and tar and generated impurities, including sulfur, carbon dioxide, cyanide, and ammonia. During the carbureted coal gasification method, used from 1910 until operations ceased in 1960, air and steam were passed over incandescent coal in a brick-filled vessel to form a combustible gas, which was then enriched by injecting a fine oil mist over the bricks, purified, and stored in holders prior to distribution. Coal tars are a byproduct from coal gasification (manufactured gas) and form NAPL (non-aqueous phase liquid) and DNAPL (dense non-aqueous phase liquid). Coal tars contain polycyclic aromatic hydrocarbons (PAHs) and other site-specific processing contaminants including sulfur, heavy metals, and metalloids such as mercury and arsenic. PAHs can cause risks to human and environmental health.

Coal tar-affected soil and groundwater were identified on the property and reported to the WDNR during the 1989 WWTP expansion on the former MGP site. The City of Marinette excavated, removed a large amount of the impacted MGP residuals in the soil, and backfilled the excavations with clean material. The groundwater contaminant plume appears to be limited to the WWTP property, Boom Landing, and portions of Mann Street. The groundwater plume does not appear to extend to the Menominee River and is not impacting surface water.

PAHs pose a risk to human health when there is a pathway to exposure to the chemicals contained in the soil, sediment and groundwater. Exposure to these chemicals can possibly cause adverse health effects, depending on the degree of exposure. Chronic exposure to coal tars, by dermal contact or inhalation, produces lesions to skin and mucous membranes. Some PAH structures are carcinogenic with chronic exposure (US Department of Health and Human Services, 2005). A State of Wisconsin Committee on Water Pollution in 1960, in *An Investigational Report on Floating Tars on the Menominee River in Marinette, Wisconsin*, showed that there were tar droplets in the water of a former slough and two discharge pipes draining from the coal gasification plant area into the river. The tar and tar droplets were found in the former slough area and Menominee River sediment, adhered to anchored boats and equipment located downstream of the gasification plant area, and floating as far as 500 feet downstream.

Sediment-Related Site Remediation/Source Control

The USEPA's Docket Number V-W-13 • C-001 *Administrative Settlement Agreement and Order On Consent For Removal Action* negotiations between USEPA-Superfund Alternative Approach and WPSC resulted in a decision to remove the coal tar contaminated sediment (USEPA, 2012).

A total of 15,221 CY of PAH-impacted sediment was removed from the Menominee River from November 2012 through March 2013 as part of the Non-Time Critical Removal Action (NTCRA). As discussed in the Final Report - Focused NAPL and Sediment Removal Action Final Report - Revision 1, dated October 3, 2013, Natural Resource Technology (NRT, 2013a), due to an uneven bedrock surface the mechanical dredge equipment was unable to completely remove dredge residuals on the bedrock surface. Soft sediment was removed to the extent practicable (less than 6 inches) and NAPL was not observed.

As a result, per the approved Construction Quality Assurance Project Plan (CQAPP) a minimum of 6 inches of a residual sand cover was required. As discussed in Section 2.9.4 of the Final Report, a minimum thickness of 10 inches of sand was placed over approximately 12,250 square feet in areas of the river where post-dredge confirmation samples indicated residual total (13) PAH concentrations exceeded the RAO, for the NTCRA, of 22.8 milligrams per kilogram (mg/kg) (Appendix C Map 7; NRT, 2015).

A reactive core mat (RCM) was installed around the outfall structure and former slough to the river (Appendix C, Map 7) over an area of 19,500 square-feet (including mainly side slopes or bank areas) as a conservative contingency measure to prevent any potential small “stringers” of NAPL that may be sorbed to the upland soil and debris from migrating into the river.

The “(13)” above stands for the thirteen priority PAHs that were sampled versus the entire list of PAHs. Following is the list of PAHs sampled:

Acenaphthene	Benzo(b)fluoranthene	Naphthalene
Acenaphthylene	Benzo(k)fluoranthene	Phenanthrene
Anthracene	Chrysene	Pyrene
Benzo(a)anthracene	Fluoranthene	
Benzo(a)pyrene	Fluorene	

Sediment-Related Site Monitoring/Maintenance

The WPSC MGP Site is following the Residual Sand Cover Monitoring Plan agreed to with WDNR and USEPA Superfund Alternative Program (NRT, 2013b). The residual sand cover was monitored using a combination of bathymetric surveys and residual sand cover core sample results. Two sediment sampling events were completed on May 21, 2014 and October 27, 2014. All of the surface sand cover sample results were below 22.8 mg/kg total PAH (13) and are all below 1 mg/kg total PAH (13). Sand thickness was also measured during the sampling events. During each sampling event, a push core was advanced to refusal. Sand cover thickness was greater than 10 inches in all events with the exception of site A1B35 which was 9.6 inches. Overall, sand cover thickness measurements ranged from 9.6 to 18 inches (NRT, 2015).

In addition, bathymetric surveys were performed in 2013 post dredge prior to sand cover placement and again in 2015 post sand cover. Ninety-seven percent of the area contains a sand cover thickness of 10 inches or greater, indicating natural deposition on the sand cover (Appendix C Map 8; NRT, 2015).

As a result of the sediment quality data and bathymetry results, sampling is completed until the 5-year review in 2018, consistent with the decision tree presented in the USEPA-approved 2013 Residual Sand Cover Monitoring Plan (NRT, 2013b).

Discussions are ongoing between WPSC, USEPA Superfund Alternative Program, and WDNR with regard to future long-term monitoring of the sand cover and the RCM. In addition, the upland and river areas of the WPSC MGP site are being evaluated for the purpose of developing a Record of Decision (ROD). The ROD is not scheduled for completion until June 2017 and could likely impose continuing obligations associated with the soil, ground water, RCM, and other engineered controls, if necessary. This however, does not change the BUI removal status as the remedial goals for sediment removal action have been met to the extent practicable.

Sediment-Related Remedial Action Goals

The goal of this sediment-related remediation project was to achieve surface sediment contaminant levels of less than or equal to 22.8 mg/kg (ppm) of 13 priority PAHs. These goals were achieved to the extent practicable through sediment removal, sand cover placement, and an RCM (see Sediment-Related Remediation/Source Control Section above).

Menekaunee Harbor Heavy Metals and PAHs Site

Contamination Background

Menekaunee Harbor is a 13-acre natural embayment of the Menominee River. The City of Marinette owns the property around Menekaunee Harbor with the exception of a small parcel off the south break wall. Sediment quality in the Harbor was degraded and sediment deposition in the Harbor had a negative impact on the health and functionality of the aquatic ecosystem. Contamination was not as high as other segments of the AOC, but elevated concentrations of metals, PAHs, and nutrients had been reported (Weston Solutions, 2008). Since the harbor is located at the most downstream area of the watershed, it received contaminants from many historical industrial operations and, therefore, responsible parties could not be identified. Much of the Harbor's shoreline protection consisted of dilapidated vertical wooden seawalls, which were constructed in the early 1930s.

Site Remediation/Source Control

For many years, the City of Marinette planned to restore the harbor for recreation; however, due to the expense of handling contaminated sediment, the City was unable to move forward with the project. In 2010, the WDNR began partnering with the City and USEPA to move the harbor restoration project forward in an effort to meet the goals and objectives to remove beneficial use impairments with the ultimate goal of delisting the

AOC. After several years of planning and engineering, and with financial support through WDNR and the GLRI, the project moved into the implementation phase in 2014.

Dredging commenced August 21, 2014, with the goal of removing contaminants at or above Threshold Effect Concentrations identified in the Consensus Based Sediment Quality Guidelines (CBSQG) (WDNR, 2003) for heavy metals: total arsenic, copper, lead, mercury and zinc (Ayres, 2014a and 2014b). A total of 57,809 CY of material was removed from the harbor. Environmental material (27,129 CY) was placed at the Waste Management Landfill in Menominee, Michigan, and navigational dredge material (30,680 CY) was placed at the City-owned Lot 24. Lot 24 is located in the Sand Hill Industrial Park, west end of Murray Street, Tax Parcel # 251.08049.000, City of Marinette. Additional clean dredge material (termed beneficial-use fill) removed from the west side of the harbor was used to bring the southeast quadrant of the harbor to the desired restoration depths. 7,700 CY of this clean material from within the harbor was hydraulically pumped to the restoration area. The beneficial use material was far less than the 22,500 CY planned, as the contractor encountered large amounts of woody debris co-mingled in the sediment within the harbor, requiring disposal at the landfill or Lot 24.

Confirmation sampling indicated exceedances of heavy metals in the area near Harbor Town Marine Dock. To account for the material shortfall, clean, sand fill was placed to address low level metal contaminants and bring the habitat area to design elevation. Pan Testing and bathymetric surveys were conducted to ensure the 6-inch sand cover thickness was achieved over 12,500 square foot area (REL, 2016). Refer to Appendix C, Map 9 for the sand cover area. Dredging was complete in November 2014 and sand cover was finished in June, 2015.

Site Monitoring/Maintenance

Additional monitoring and maintenance of this site are not required.

Remedial Action Goals

The goals of this remediation project were to improve navigation in the harbor and achieve sediment contaminant levels of heavy metals and PAHs below TEC values of the CBSQGs. These goals were achieved through sediment removal and placement of sand cover over a limited area in the southeast section near the Harbortown Marine Dock (see Sediment Remediation/Source Control Section above).

SEDIMENT ASSESSMENTS

Lower Scott Flowage Sediment Investigation

The Lower Scott Flowage (LSF) is located between the Park Mill and Menominee Dams. Little historical information was available for the flowage. The 1996 RAP update (WDNR, 1996) indicated that the Scott Paper Company (located on the flowage between the dams) historically discharged its plant effluent, coal ash and other debris into the Flowage. Currently, there is a fish consumption advisory for PCBs and mercury specifically for the LSF, indicating a potential issue with sediment quality within the impoundment. In March 2012, the WDNR contacted GLNPO and requested a sediment

characterization to determine if there are any impairments due to sediment quality in the LSF. As a result, a sediment investigation was conducted in November 2013 for GLNPO under Task Order No. 0014, Contract No. EP-RS-11-09. (CH2MHill, 2013b).

The investigation included the following:

- Visual survey of shoreline to document outfalls and other shoreline features of interest
- Collection of water depth and sediment thickness measurements
- Collection of sediment samples for analysis of polychlorinated biphenyl (PCB) Aroclors and congeners, polycyclic aromatic hydrocarbons (PAHs), pesticides, dioxins, oil and grease, total metals, and acid volatile sulfide/simultaneously, extracted metals to provide information regarding the nature and extent of contaminant concentrations within site sediments.
- Collection of sediment samples for analysis of total organic carbon, particle size, specific gravity, and percent moisture to characterize the physical properties of the sediment.

Sediment thickness and water depth vary throughout the LSF. Water depth is shallow in the western portion of the flowage and the riverbed consists primarily of rock with thin sediment deposits less than 1 foot in isolated areas. Very little sediment was identified within the main river channel. The only sediment deposits identified along the south side of the river were located near the culverts located east of the hydroelectric plant property and near the downstream Menominee Dam. Sediment thicknesses up to 4 feet were identified in the northeastern portion of the flowage.

Analytical results were screened against Wisconsin Threshold Effect Concentrations (TECs) and Probable Effect Concentrations (PECs) (WDNR, 2003) and EPA Region 5 (USEPA, 2003) Resource Conservation and Recovery Act Ecological Screening Levels, which include screening values from MacDonald, et al. (2000a and 2000b).

PAHs, metals, PCBs, and dioxin compounds were detected at concentrations exceeding TEC concentrations at 11 of the 36 sample locations within the LSF. TEC exceedances of PAHs, PCBs, and dioxins were also detected at two of the three sample locations upstream of the Park Mill Dam. TEC exceedances are located in isolated pockets throughout the flowage and are not indicative of a large contaminated sediment mass. No distinguishable trends in TEC exceedances were observed with depth.

PECs exceedances were present at only 2 of the 36 sample locations within the flowage. There were no PEC exceedances upstream of the Park Mill Dam. PAHs and copper were the only compounds detected at concentrations exceeding PECs within the flowage. The two samples with PEC exceedances are located in close proximity to one another within an isolated sediment pocket immediately downstream of the culverts discharging from the vicinity of the former Scott Paper Mill (now called Kimberly Clark). The estimated volume of sediment exceeding PECs is approximately 200 cubic yards and covers a limited area (CH2MHill, 2014). The WDNR Storm Water Permit Program

staff have followed up with the owners and operators of the storm sewer system and requested that they (Kimberly Clark and the City of Marinette) evaluate their outfalls at the next required monitoring period to determine if they are an ongoing source of contaminants to the LSF. No further recommendations were made for remediation of this minor deposit nor the flowage overall. Therefore, the results of the sediment characterization show that the sediment in the LSF is not a source of PCBs, heavy metals, or PAHs in the AOC (Appendix C Map 10, Map 11, and Map 12; CH2M Hill, 2014).

Rio Vista Slough Sediment Investigation

MDEQ-Surface Water Assessment Section (SWAS) staff used a petite Ponar dredge to capture sediment samples at eight locations in Rio Vista Slough (RVS) in 2014 (Appendix C Map 13; Appendix A Table 2; MDEQ, 2015). The primary purpose of the study was to help answer the question: Is RVS acting as a partial source for PCBs found in fish tissues driving the fish consumption advisory in the AOC? PCBs were not found in any of these samples (Appendix A Table 3). As part of this analysis the samples were also analyzed for heavy metals and PAHs. PAHs were detected at above probable effects concentrations at three locations adjacent to storm drains that flowed into the slough (Appendix A Table 4). Sheen was observed at all locations during sample collections. Heavy metals were detectable at all locations, but varied greatly by location and were not above probable effects concentrations (Appendix A Table 5). The locations nearest the storm drain had the highest concentrations of metals.

MDEQ SWAS staff indicated that the PAHs and metals levels found in RVS were similar to other areas across the state associated with asphalt or tar topped parking lot areas, were not high enough to drive a removal action, and would be reviewed by appropriate state programs. The small size of RVS and its isolation from the main channel mean that the potential for sedimentation downstream is minimal and not likely to impact benthos. Therefore, the results of the sediment characterization show that the sediment in RVS is not a significant source of PCBs, heavy metals, or PAHs in the AOC.

BENTHOS-RELATED STUDIES

The benthos BUI removal criteria for this AOC were chosen assuming that benthic communities would re-establish in those areas where contaminated sediments were removed and target sediment contaminant levels for each remediation project were reached. These target levels were based on sediment toxicity to benthic-dwelling species; therefore, it is reasonable to assume that the completion of the projects would allow for benthic recovery in those areas.

Although the delisting target/criteria for the Lower Menominee River AOC does not require confirmation of benthos community recovery, we are including information on benthos-related studies in order to be thorough and better understand the story of benthos in this AOC.

The Degradation of Benthos BUI was listed for this AOC because several studies had documented low benthic diversity and abundance, particularly near the Ansul Fire Protection Company in the Eighth Street Slip area and the turning basin (Appendix B Figure 3, Segment 5.) Elevated levels of arsenic, cadmium, and mercury were detected in subsequent analyses of benthic organism tissues from those areas. Although unsuitable habitat was also an issue at some sites in the AOC—especially those with excessive saw mill wastes from the lumber industry boom of the late 1800s and early 1900s—sediment toxicity was determined to be the primary cause of impairment in the area of the Ansul plant. It was also suspected that the paint sludge wastes offshore of the Lloyd Flanders site were impacting benthic populations, but no monitoring had been done to confirm that suspicion. More details on these historic studies can be found in the 1990 RAP (WDNR and MDNR, 1990).

WDNR Benthos Monitoring

In spring of 1993, the WDNR collected four or five 3” core samples at each of four sites and five artificial substrate samples at each of three sites in the AOC. There were five sites sampled—both core and artificial substrate samples were collected at two of the sites. They also collected similar core and substrate samples at two more sites in the river upstream of the AOC. One of the five AOC sites was downstream of Highway 41 near the WPSC coal tar contamination area, three were near the Ansul plant in areas known to be contaminated with arsenic, and one was in the main channel 1000’ above Ogden Street Bridge. The artificial substrate samplers consisted of a number of concrete balls about the size of a baseball placed in a wire basket that was chained to a cement block and placed directly on the bottom of the river.

For the 1993 WDNR study, the modified Hilsenhoff Biotic Index (HBI-10; Hilsenhoff, 1998) ratings for the samples collected in the AOC ranged from “Very good” for one of the Eighth Street Slip core samples to “Very poor” for two core samples from near the Ansul outfall. The HBI-10 ratings for samples collected at the station near the WPSC site ranged from “Fair” to “Poor.”

Although the 1996 RAP Update (WDNR, 1996) described a plan to continue benthic macroinvertebrate monitoring in the AOC in order to assess long-term trends, this was not done, likely due to lack of funding and/or personnel. Hester-Dendy (H-D) artificial substrate samples were collected in 2005 and 2012 at another site downstream of Highway 41 but a bit further out from the WPSC site, and the HBI-10 values for those samples were in the “Fairly poor” range.

USGS Wisconsin Lake Michigan AOC Benthos and Plankton Study

More recently, the AOC was included in a GLRI-funded study, initiated by the WDNR and carried out by the USGS, to characterize benthic invertebrate and planktonic communities in Wisconsin’s four Lake Michigan AOCs and six reference sites. The Lower Menominee River AOC site was included to increase the statistical power of the

study. Ponar dredge and H-D artificial substrate samples were collected three times each year in 2012 and 2014 in the main river channel downstream of the turning basin (Appendix B Figure 4; Scudder Eikenberry et al., 2014; Scudder Eikenberry et al., 2016a).

Dredging of the arsenic-contaminated sediment in the turning basin and South Channel occurred from July to December in 2012 and May to December in 2013 for the RCRA project, and from September to November in 2014 for the GLLA Betterment project, followed by placement of an enhanced sand cover in the turning basin in June of 2015 (see “Ansul Arsenic Site” section for more details). The 2012 sampling report (Scudder Eikenberry et al., 2014) notes that between the spring and summer H-D sampler retrievals, the dredging contaminant curtain was placed such that it encompassed the samplers within the remediation dredging area, and that this may have adversely affected the benthos community in the samplers. In 2014, the H-D site was moved 0.4 km downstream in order to avoid such issues (Appendix B Figure 4; Scudder Eikenberry, Burns, Templar, Bell, and Mapel, 2016).

A comparison of benthos results from 2012 can be found in Scudder Eikenberry, Bell, Templar, and Burns, 2016. An interpretive report on the 2014 results is in progress. Preliminary analysis shows that the benthos Index of Biotic Integrity (IBI) metrics (calculated from the H-D samples) in both sampling years were significantly lower than their paired AOC comparison sites—Escanaba River and Oconto River—across all seasons (Barb Scudder Eikenberry, personal communication). IBI ratings for the AOC were “Very poor” for 2012 spring, summer, and fall samples and 2014 fall samples, and “Poor” for 2014 spring and summer samples. Since the sampling occurred during and downstream of the Ansul Arsenic Site sediment remediation and occurred two years ago, it is our assessment that these results do not adequately represent the current status of the benthic community in the AOC, or the ability of the benthos community in the river to recover over time, now that the contaminated sediments have been remediated.

The BUI removal target for this AOC does not require confirmation of benthos community recovery, and it is reasonable to assume that the benthos will recover and re-colonize the area over time now that the sediment remediation projects are complete (Wallace, 1990; Niemi et al., 1990; Yount and Niemi, 1990). Therefore, we will not hinge BUI removal on benthos monitoring results. Since no benthos sampling has occurred in the AOC since completion of the sediment remediation projects in 2015, we cannot confirm whether the communities have recovered. Other programs will continue to monitor the AOC.

USGS Birds as Indicators of Contaminant Exposure Study

Another GLRI-funded USGS study that could be useful in understanding benthic conditions in the AOC is GLRI Project 80, “Birds as Indicators of Contaminant Exposure in the Great Lakes.” This study uses the tree swallow (*Tachycienta bicolor*), an insectivorous bird residing alongside waterbodies, to study historic and newly emerging

contaminants in food chains around the Great Lakes. Since the swallows feed on the aerial stage of benthic aquatic insects, they can be used as an indicator of the bioavailability of contaminants in local waterways. The researchers worked in the Menominee River AOC site in 2011 and 2012. Nest boxes were located along the north side of the river, across from and upstream of the turning basin (Appendix B Figure 5; Christine Custer, personal communication). Arsenic was detected in relatively few samples and then only at low concentrations. Since no contaminants were detected at concerning levels, they decided to discontinue sampling after 2012 (Christine Custer, personal communication). The results of this study seem to indicate that—even before the sediment remediation projects were completed—arsenic levels in the benthos were not high enough to cause harm to the birds using them for food. More information is available online at http://www.umesc.usgs.gov/wildlife_toxicology/glri_project80.html.

CONCLUSIONS/REMOVAL STATEMENT

In conclusion, we have determined that the Lower Menominee River AOC Degradation of Benthos BUI is able to be removed. All remediation actions for known contaminated sediment sources are completed and monitored according to the approved plan and have met their remedial action goal. The following required actions have been completed:

- Remediation of Green Bay paint sludge site completed and meeting targets
- Remediation of WPSC coal tar site completed and meeting targets
- Remediation of Ansul/Tyco arsenic site completed and meeting targets
- Remediation of Menekaunee Harbor site completed and meeting targets
- Lower Scott Flowage sediment characterization showed no remediation needed
- Rio Vista Slough sediment characterization showed no remediation needed

This removal recommendation was discussed with the Lower Menominee River TAC and CAC at their regular meetings on August 24, 2016. The Lower Menominee River TAC and CAC concur with the recommendation, and the CAC has submitted a formal letter of support for removal of the BUI, dated ..., 2016 (Appendix E). The proposed action was public noticed via listing in the EagleHerald (www.ehextra.com), and also publicized via AOC e-mail distribution lists and the GovDelivery listserve for the AOC. Supporting documents were posted on the WDNR AOC website (dnr.wi.gov/topic/greatlakes/menominee.html) for public review and comment from September 8, 2016, through September 22, 2016. ... written or verbal comments were received during this period. A Lower Menominee River Area of Concern Open House was held on September 15, 2016, at UW-Marinette Campus as an additional opportunity for the public to review and comment on the BUI removal package.

Based on the review of all pertinent data, and input from the USEPA project staff, the TAC, the CAC, and the public, all remediation projects are complete and monitored, and there continues to be no evidence of sediment contamination significant enough to degrade the benthos and thus requiring further sediment characterization or sediment remediation in the Lower Menominee River AOC.

MDEQ and WDNR AOC Program staff request concurrence with our recommendation to remove the Degradation of Benthos BUI from the Lower Menominee River AOC.

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List of Acronyms and Initialisms

AOOC	Administrative Order on Consent
AOC	Area of Concern
BUI	Beneficial Use Impairment
CAC	Citizen's Advisory Committee
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. §§ 9601-9675
CQAPP	Construction Quality Assurance Project Plan
CSO	Combined Sewer Overflow
CY	Cubic Yards
DMU	Dredge Management Unit
DNAPL	Dense non-aqueous phase liquid
EQM	Environmental Quality Management, Inc.
GBPS	Green Bay Paint Sludge Site
GLLA	Great Lakes Legacy Act
GLNPO	Great Lakes National Program Office
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
LMR	Lower Menominee River
LSF	Lower Scott Flowage
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MGP	Manufactured Gas Plant
NAPL	Non-aqueous phase liquid
NRT	Natural Resource Technology
NTCRA	Non-Time Critical Removal Action
OGL	Office of the Great Lakes
PAH	Polycyclic Aromatic Hydrocarbon
PEC	Probable Effect Concentrations
PCB	Polychlorinated Biphenyls
ppm	parts per million
QAPP	Quality Assurance Project Plan
RAO	Remedial Action Objective
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act (Solid Waste Disposal Act, as amended, 42 U.S.C. § 6901. et seq.)
RVS	Rio Vista Slough
SWAS	Surface Water Assessment Section
TAC	Technical Advisory Committee
TEC	Threshold Effect Concentrations
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WDNR	Wisconsin Department of Natural Resources
WPSC	Wisconsin Public Service Corporation
WWTP	Wastewater Treatment Plant

DEFINITIONS

Area of Concern (AOC) - Defined by Annex 2 of the 1987 Protocol to the U.S.-Canada Great Lakes Water Quality Agreement (GLWQA, 1987) as “geographic areas that fail to meet the general or specific objectives of the Agreement where such failure has caused or is likely to cause impairment of beneficial use or of the area’s ability to support aquatic life.” These areas are, or were, the “most contaminated” areas of the Great Lakes, and the purpose of the AOC program is to bring these areas to a point at which they are not environmentally degraded more than other comparable areas of the Great Lakes. When that point has been reached, the AOC can be removed from the list of AOCs in the Annex, or “delisted.” The GLWQA can be found at <http://www.ijc.org/rel/agree/quality.html>

Beneficial Use Impairment (BUI) - Defined by the GLWQA as a reduction in the chemical, physical, or biological integrity of the waters of the Great Lakes sufficient to cause impairment to a designated use (GLWQA, 2013). The Lower Menominee River AOC has five BUIs remaining including: restrictions on fish and wildlife consumption; restrictions on dredging activities; degradation of benthos; degradation of fish and wildlife populations; and loss of fish and wildlife habitat.

Beneficial use(s) are ways that a water body can improve the quality of life for people or for fish and wildlife. For example, providing habitat for fish and wildlife is a beneficial use of a water body. If a beneficial use is suppressed or unavailable due to environmental problems, like loss of habitat, then that beneficial use is considered impaired. The International Joint Commission provided a list of 14 possible beneficial use impairments in the 1987 amendments to the GLWQA.

Benthos – A term that refers collectively to all aquatic organisms that live on, in, or near the bottom of water bodies. Some examples are clams, snails, worms, amphipods, crayfish, and the larvae of many aquatic insects.

Great Lakes Restoration Initiative (GLRI) - A federal program that provides unprecedented funding for protection and restoration efforts on the five Great Lakes. State and local governments and non-profit organizations are eligible to receive grants from the U.S. Environmental Protection Agency (USEPA) for projects addressing toxic substances, invasive species, non-point source pollution, habitat protection and restoration or accountability, monitoring, evaluation, communication, and partnership building.

Polychlorinated Biphenyls (PCBs) - A group of more than 200 compounds, PCBs have been manufactured since 1929 for uses including electrical insulation, hydraulics, fluorescent lights, and carbonless paper to name a few. In 1979, PCBs were banned because of their persistence in the environment and tendency to magnify up the food chain. They have been linked to reproductive problems in wildlife and are suspected of causing developmental problems in human infants.

Polycyclic Aromatic Hydrocarbons (PAHs) - Chemicals commonly associated with oils, greases, and other components derived from petroleum. Some PAH compounds have been identified as cancer or mutation causing.

Remedial Action Plan (RAP) - A RAP is developed for each AOC to identify the status of BUIs and their sources, document restoration targets, and list actions needed to reach those targets. RAPs are updated periodically to report progress toward achieving the restoration targets. This Plan, along with the most current RAP Update for the Lower Menominee River AOC, constitutes a complete strategy for removing all BUIs in the Lower Menominee River AOC.

Restoration Target - Specific goals and objectives established to track restoration progress of beneficial use impairments. Once targets have been met, the beneficial use is no longer considered impaired. Targets should be locally derived. Working with the Lower Menominee AOC Citizens Advisory Committee, delisting targets were developed in partnership with the WDNR and the MDEQ. Wisconsin and Michigan use different criteria when assessing BUIs. The agencies and CAC agreed to implement the most restrictive criteria from either state when developing the Menominee AOC specific delisting targets.

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APPENDICES

- Appendix A Tables
- Appendix B Figures
- Appendix C Sediment Project Maps
- Appendix D Lower Menominee River AOC BUI Removal Criteria
- Appendix E Letters of Support
- Appendix F Public Involvement Evidence

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APPENDIX A: TABLES

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Table 1. Lower Menominee River AOC Sediment Remediation Sites Summary of Goals, Actions, and Monitoring.

Site Name/ Contaminant of Concern	Media Type	Remediation Goals	Remedial Action	Remedial Action Implementation Status	Remediation Goal Met?	Monitoring and Maintenance
Ansul/Tyco (former Ansul Fire Protection) Arsenic	Terrestrial	Onsite Surface Soils ≤ 32 ppm Total Arsenic Adjacent Offsite Surface Soils $16 \leq$ ppm Total Arsenic	<ul style="list-style-type: none"> 90,000 Tons of Salt Waste Removal Limited Soil Removal Capping 	Complete	<ul style="list-style-type: none"> Verified 2015 Construction Completion Report 	<ul style="list-style-type: none"> Ongoing Maintenance & Monitoring 2018 5-Year Review
	Ground Water	Containment & Flood Control	<ul style="list-style-type: none"> Barrier Wall Ground Water Extraction & Treatment System Phyto Pumping Tree Plots 	Complete	<ul style="list-style-type: none"> 2010 Yes, with management plan implementation 	<ul style="list-style-type: none"> Ongoing Maintenance & Monitoring Barrier Wall Ground Water Monitoring Plan 2015 Update 2018 5-Year Review & Research new arsenic removal technologies
	Sediment	≤ 20 ppm Total Arsenic	<ul style="list-style-type: none"> Dredge 300,056 CY 12" Sand Cover Areas ≥ 20 ppm 	Complete	<ul style="list-style-type: none"> Verified 2015 Core Sampling Pan Testing Bathymetry 	<ul style="list-style-type: none"> Ongoing Monitoring Post Dredge Sand Cover Sediment Sampling 2018 2018 5-Year Review
Green Bay Paint Sludge (Lloyd Flanders, former Hayward-Wakefield) Heavy Metals	Sediment/Soil	Remove Paint Waste, Impacted Sediment & Soil and Install Shoreline Barrier	<ul style="list-style-type: none"> Remove 5,000 Tons Bulk Paint Waste (hazardous waste facility) Excavate 10,500 Tons Sediment & Soil (local landfill) 	Complete	Reported volumes to MDNR 1995 & 1998 under Public Act 307.	Ongoing Implementation of Operations and Maintenance Plan
	Paint Nodules	Remove Paint Nodules that wash up along shoreline	<ul style="list-style-type: none"> Collect & Remove Paint Nodules Report under Admin Order 	Ongoing	Verified Annually	Ongoing monthly and post storm events collection along shoreline
Menekaunee Harbor Heavy Metals & PAH's	Sediment	Threshold Effect Concentration (TEC) Values for Heavy Metals & Polynuclear Aromatic Hydrocarbons (PAH's)	<ul style="list-style-type: none"> Dredge 27,129 CY 6" Sand Cover Areas that exceed TEC for Metals. 	Complete	<ul style="list-style-type: none"> Verified 2015 Core Sampling Pan Testing Bathymetry 	Not Required
Wisconsin Public Service Corporation (former manufactured gas plant) Coal Tar – PAH's	Terrestrial	Limited Soil Removal During Construction of Wastewater Treatment Plant & Road Construction.	<ul style="list-style-type: none"> None at this Time Developing Record of Decision (ROD) 	Ongoing Evaluation	Removal documented & developing ROD to determine next steps.	Ongoing Maintenance & Monitoring
	Ground Water	Contamination plume defined	<ul style="list-style-type: none"> None at this Time Developing ROD 	Ongoing Evaluation	Verified Feasibility Study Report 2016 ROD to determine next steps.	Ongoing monitoring
	Sediment	≤ 22.8 ppm 13 Priority PAH's	<ul style="list-style-type: none"> Dredge 15,221 CY 10" Sand Cover Areas ≥ 22.8 ppm Reactive Core Mat (RCM) 	Complete (Non-Time Critical Removal Action)	<ul style="list-style-type: none"> Verified 2013 & 2015 Core Sampling Bathymetry ROD to determine continuing obligations for Sand Cover & RCM. 	<ul style="list-style-type: none"> Ongoing Maintenance & Monitoring Reactive Core Mat Sand Cover 2018 5-Year Review

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Table 4. Heavy metal results for surficial sediment samples taken in Rio Vista Slough, 6/24/14 (MDEQ, 2015). * PEC and TEC consensus-based values, Macdonald et. al., 2000. Bold values above PEC values. ND = not detectable

	PEC*	TEC*	Men 1	Men 2	Men 3	Men 4	Men 5	Men 6	Men 7 (Dup)	Men 8	Men 9
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	9.79	33	6.3	1.2	2.6	2	3.7	3	3.5	2.3	5
Cadmium	0.99	4.98	2.1	0.4	0.5	0.6	0.3	0.9	0.3	ND	0.8
Chromium	43.4	111	46	32	15	26	14	11	7.8	8.8	20
Copper	31.6	149	66	23	23	36	24	26	16	7.7	28
Lead	35.8	128	110	23	42	49	37	42	14	5.7	34
Mercury	0.18	1.06	1.1	ND	0.1	0.5	0.1	0.3	0.2	0.1	0.5
Zinc	121	459	410	180	220	300	89	120	85	38	150

Table 5. PAH results for surficial sediment samples taken in Rio Vista Slough, 6/24/14 (MDEQ, 2015). * PEC and TEC consensus-based values, Macdonald et. al., 2000. Bold values above PEC values. ND = not detectable

	PEC*	TEC*	Men 1	Men 2	Men 3	Men 4	Men 5	Men 6	Men 7 (Dup)	Men 8	Men 9
	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Benz[a] anthracene	108	1050	ND	3700	ND	4200	ND	ND	ND	ND	ND
Benz[b] fluoranthene	na	na	ND	7200	ND	10000	ND	ND	ND	ND	ND
Chrysene	166	1290	ND	6300	ND	8100	ND	ND	ND	ND	ND
Fluoranthene	423	2230	ND	14000	5600	17000	ND	ND	ND	ND	ND
Phenanthrene	204	1170	ND	6200	ND	6300	ND	ND	ND	ND	ND
Pyrene	195	1520	ND	10000	4100	12000	ND	ND	ND	ND	ND
Total PAHs	1610	22800		47400	9700	57600					

APPENDIX B: FIGURES

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Figure 1. The Lower Menominee River AOC as delineated by the USEPA. Green Island, which was included in the AOC in the 1996 RAP, is not visible on this map, and is located approximately 5 miles east from Seagull Bar.



Figure 2. Menominee River Watershed.

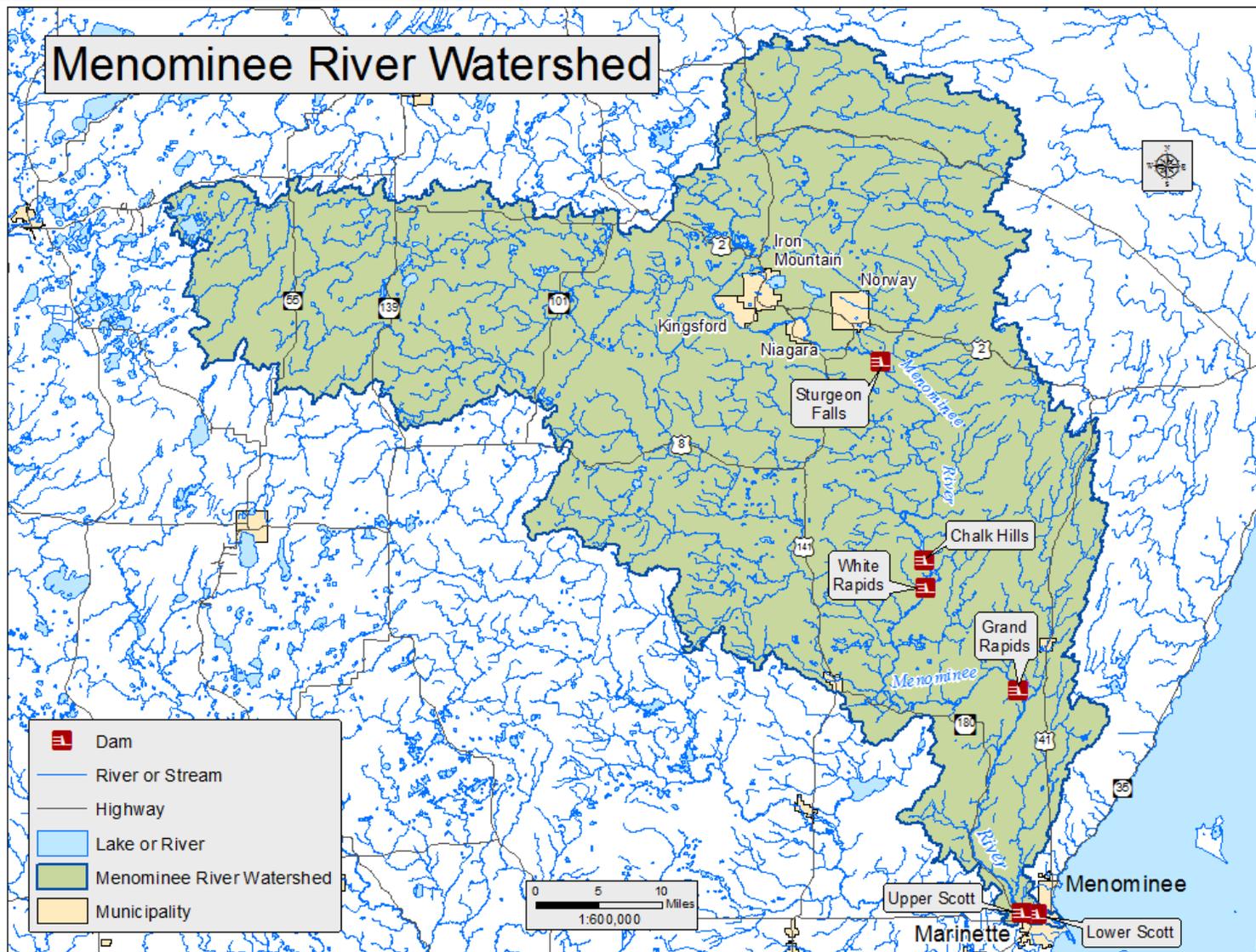


Figure 3. Segments of the Lower Menominee River AOC.



Figure 4. USGS 2012 and 2014 benthos sampling sites in the Lower Menominee River AOC (Barb Scudder Eikenberry, personal communication). “H-D” = Hester-Dendy artificial substrate samplers.

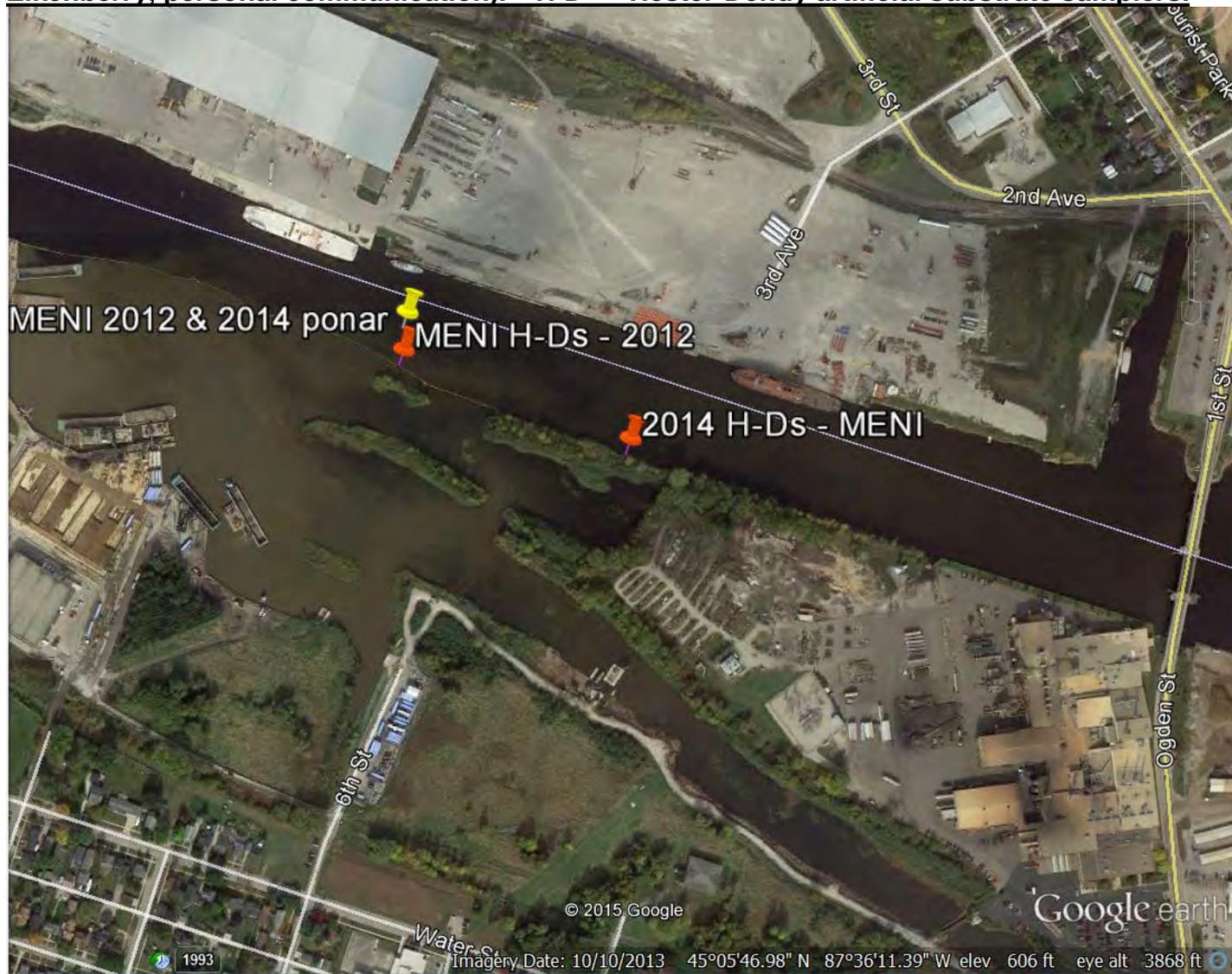
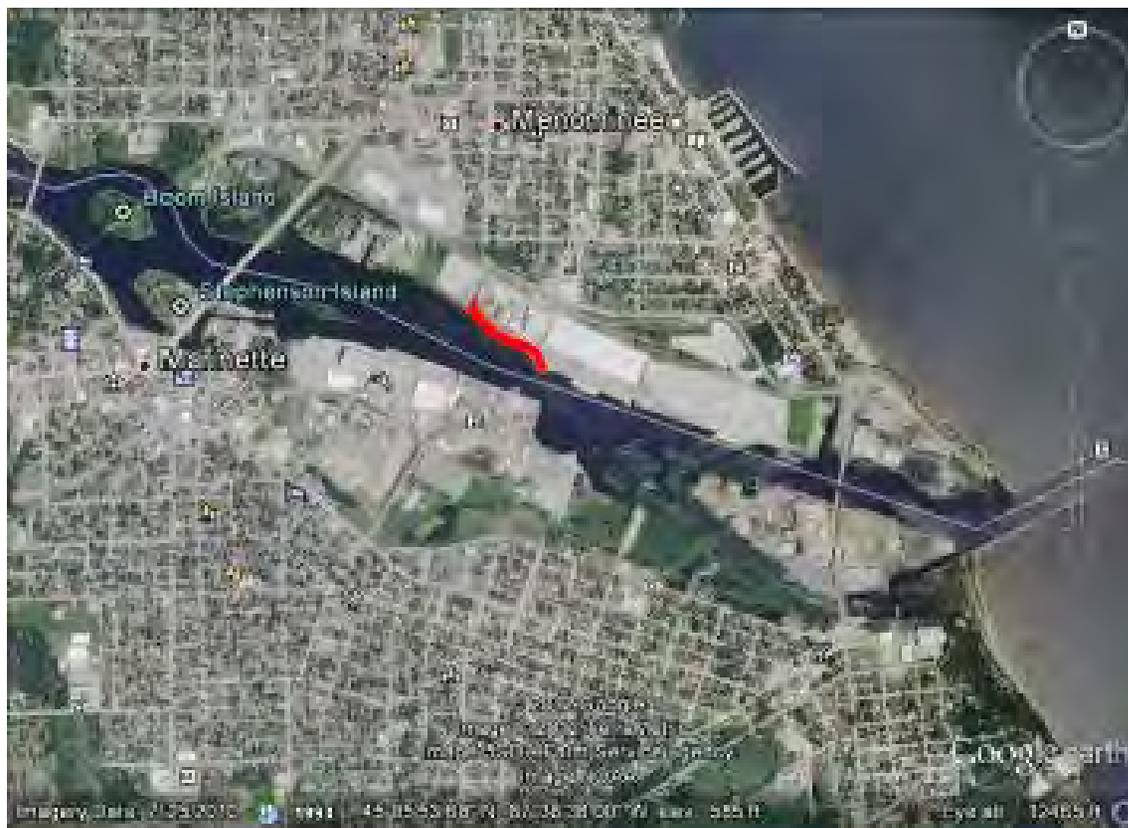


Figure 5. USGS 2011 and 2012 tree swallow nest box location (Christine Custer, personal communication).



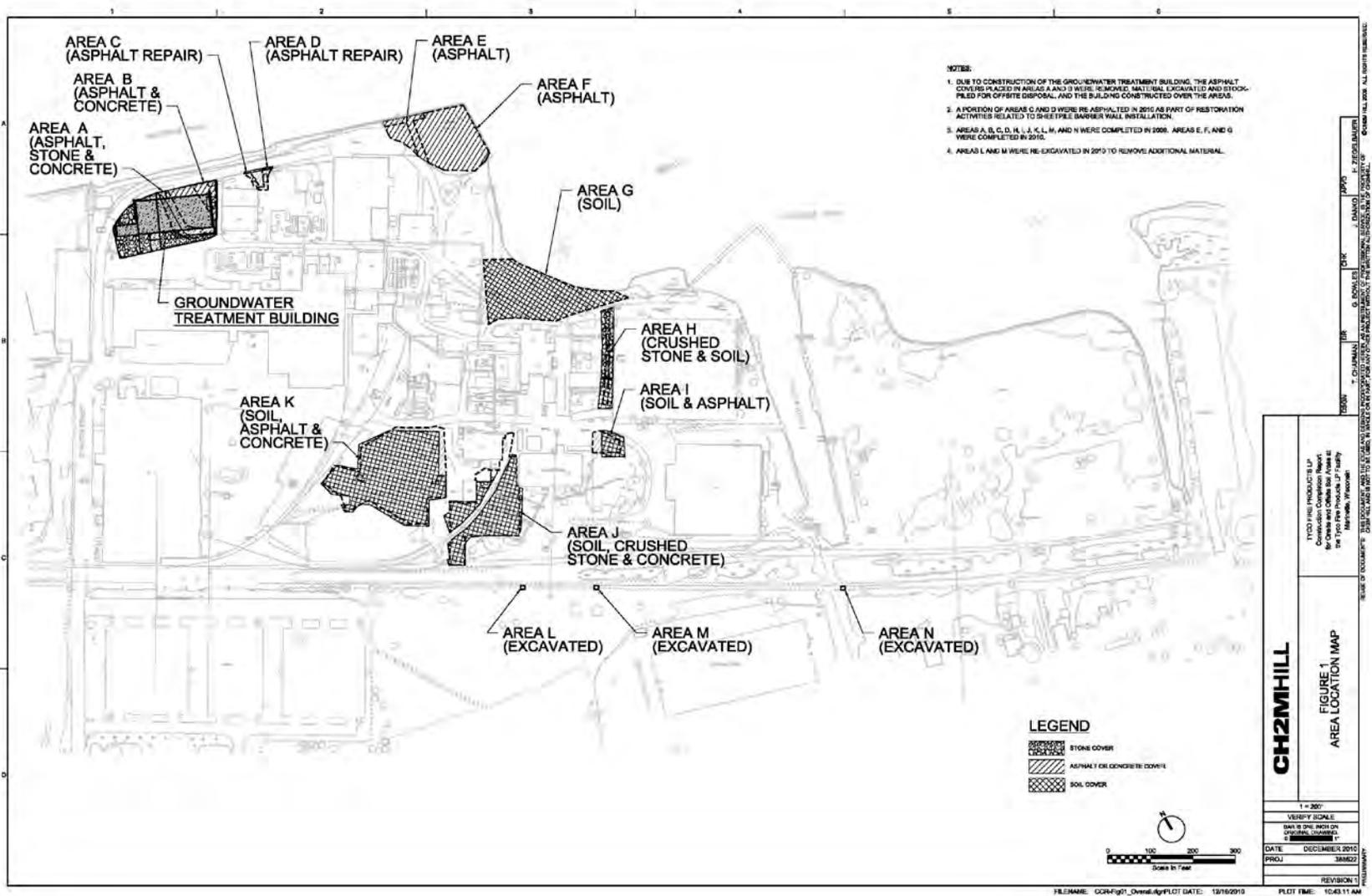
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APPENDIX C: SEDIMENT PROJECT MAPS

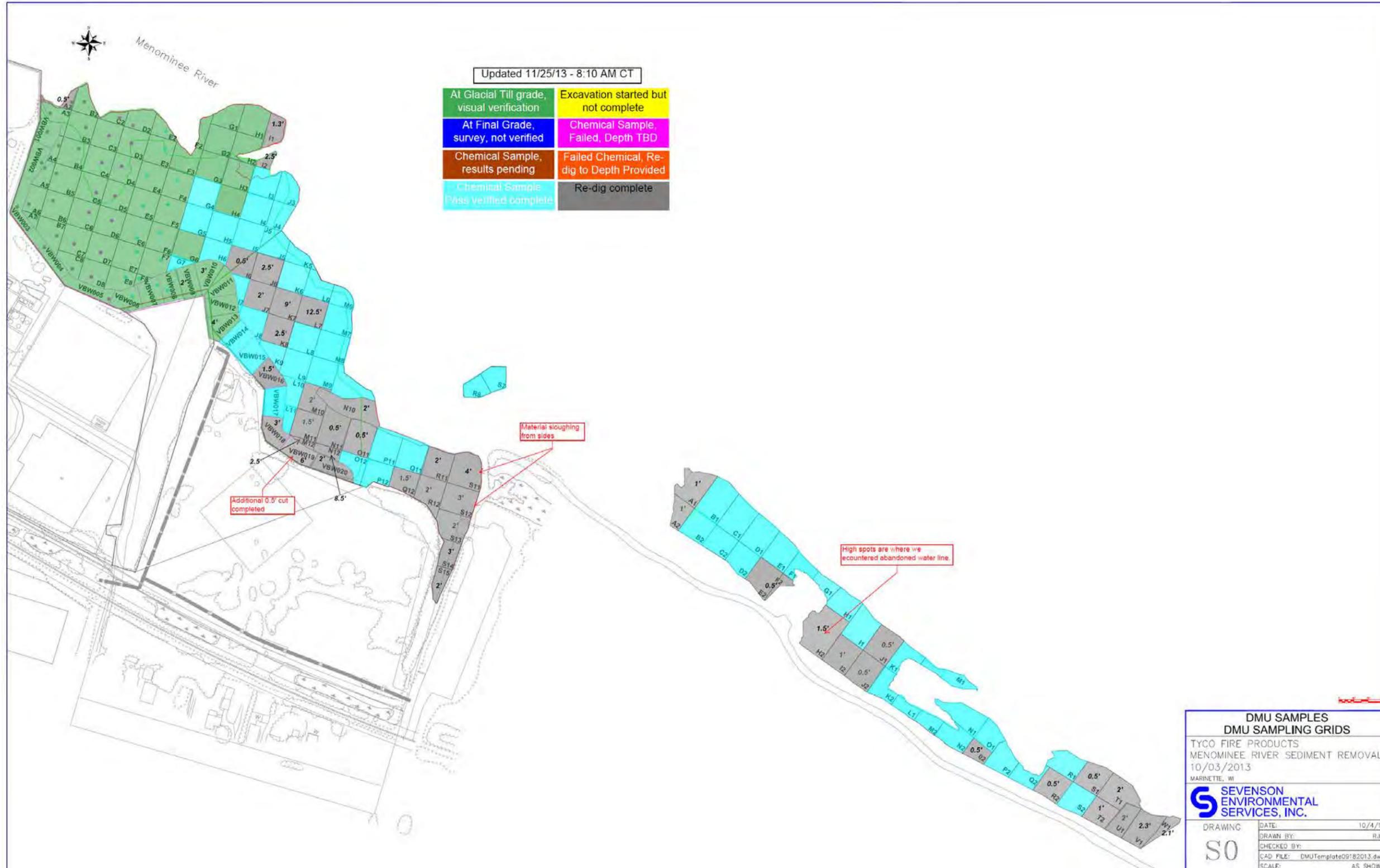
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Map 1. Ansul arsenic site, locations of upland soil remedies.



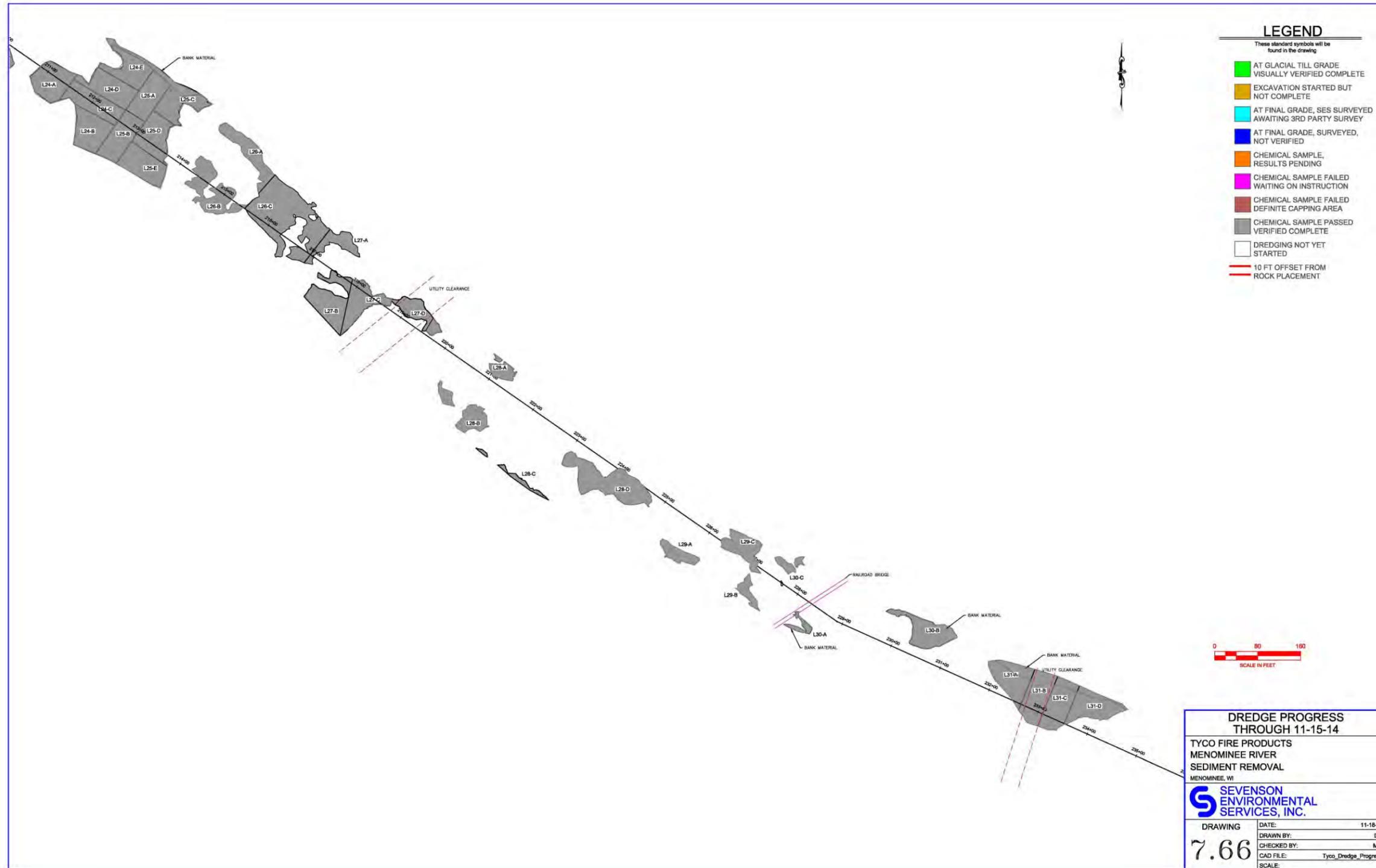
Map 2. Ansul arsenic site, November 25, 2013 status of the removal of Menominee River arsenic contaminated sediment delineated by dredge management unit (DMU).



Map 3. Page 1. Ansul arsenic site, November 15, 2014 status of the removal of Menominee River arsenic contaminated sediment delineated by dredge management unit (DMU).



Map 3. Page 2. Ansul arsenic site, November 15, 2014 status of the removal of Menominee River arsenic contaminated sediment delineated by dredge management unit (DMU).



Map 4. Ansul arsenic site Great Lakes Legacy Act sand cover placement area (CH2MHill, 2015b).

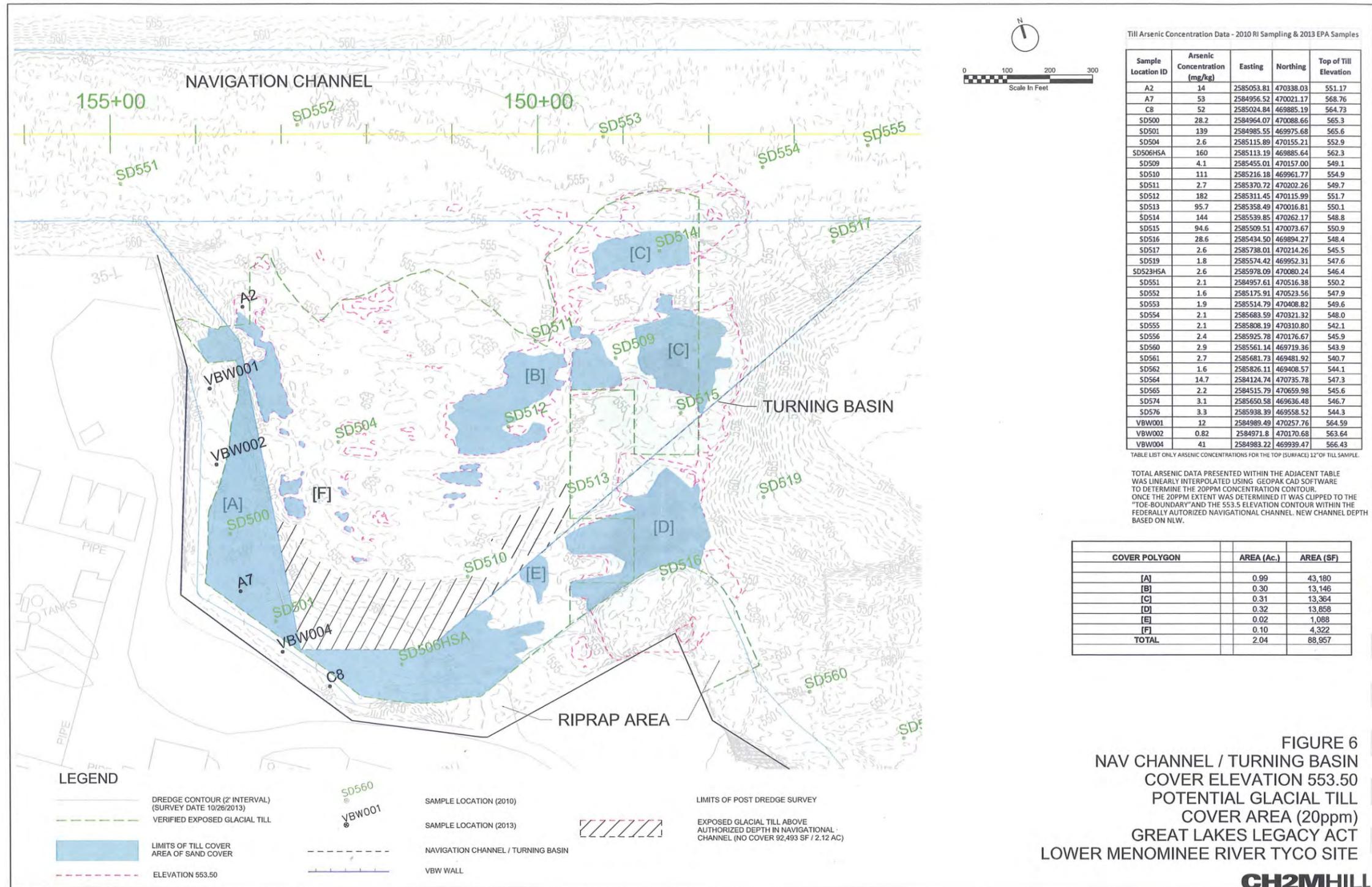
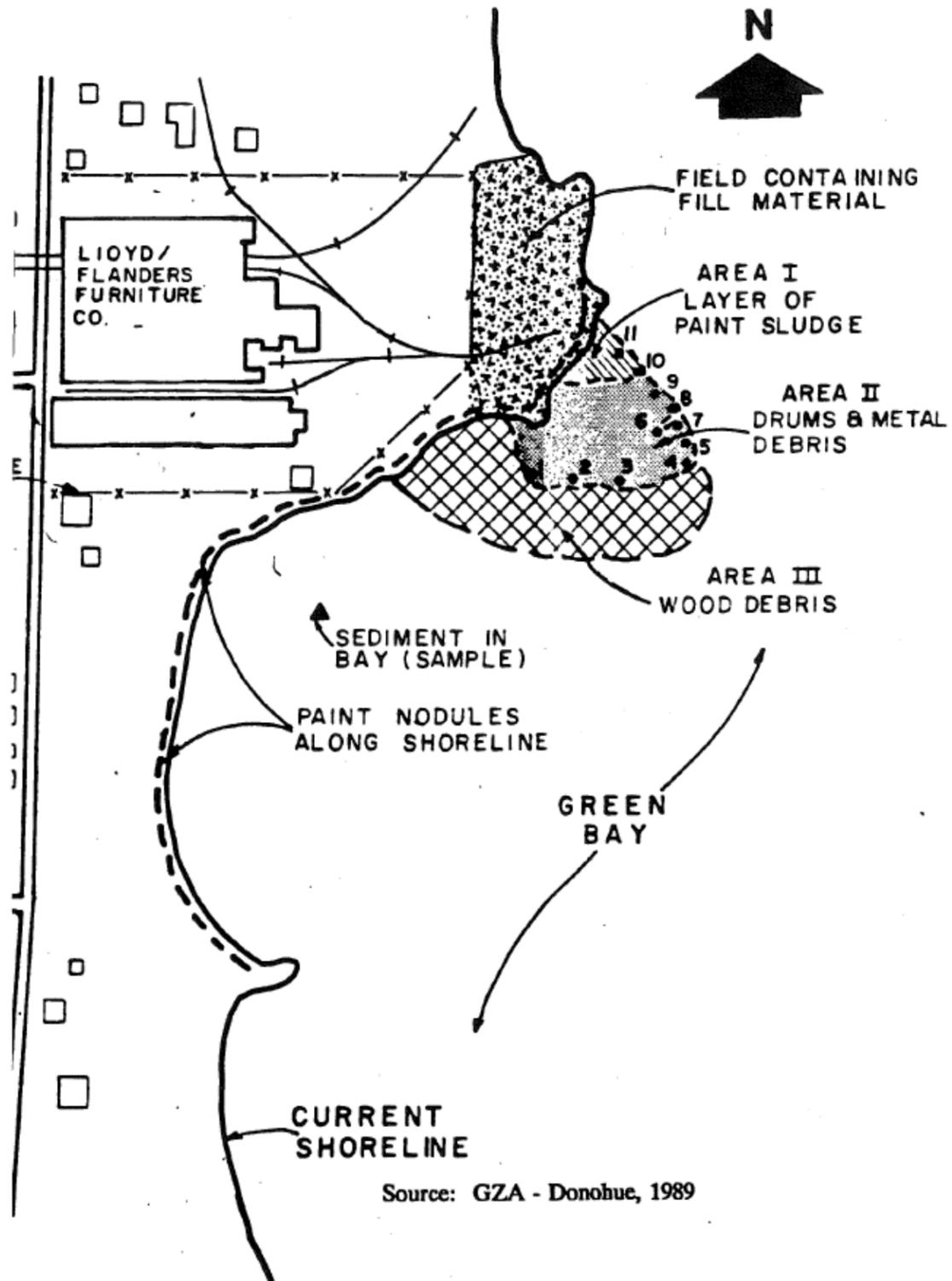


FIGURE 6
 NAV CHANNEL / TURNING BASIN
 COVER ELEVATION 553.50
 POTENTIAL GLACIAL TILL
 COVER AREA (20ppm)
 GREAT LAKES LEGACY ACT
 LOWER MENOMINEE RIVER TYCO SITE

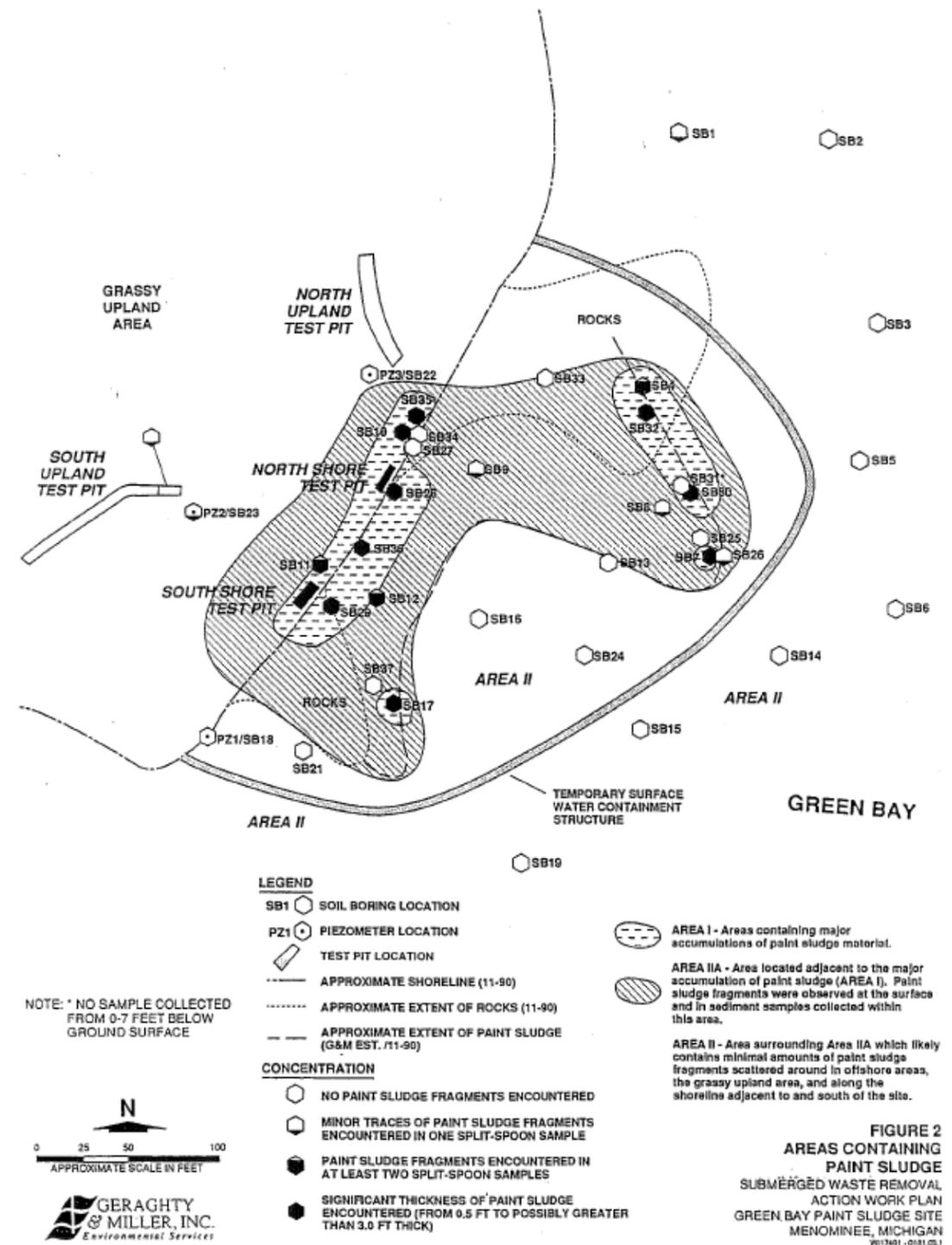
CH2MHILL

NOT FOR BID - FOR INFORMATION ONLY

Map 5. Green Bay paint sludge contaminated areas.



Map 6. Areas containing paint sludge before removal.



**FIGURE 2
AREAS CONTAINING
PAINT SLUDGE
SUBMERGED WASTE REMOVAL
ACTION WORK PLAN
GREEN BAY PAINT SLUDGE SITE
MENOMINEE, MICHIGAN
W17301-0101.02.1**

Map 9. Menekaunee Harbor sand cover area (REL, 2015).



NO.	DATE	APPROV.	REVISION	NO.	DATE	APPROV.	REVISION

MENEKAUNEE HARBOR DREDGE
CITY OF MARINETTE
MARINETTE COUNTY, WISCONSIN

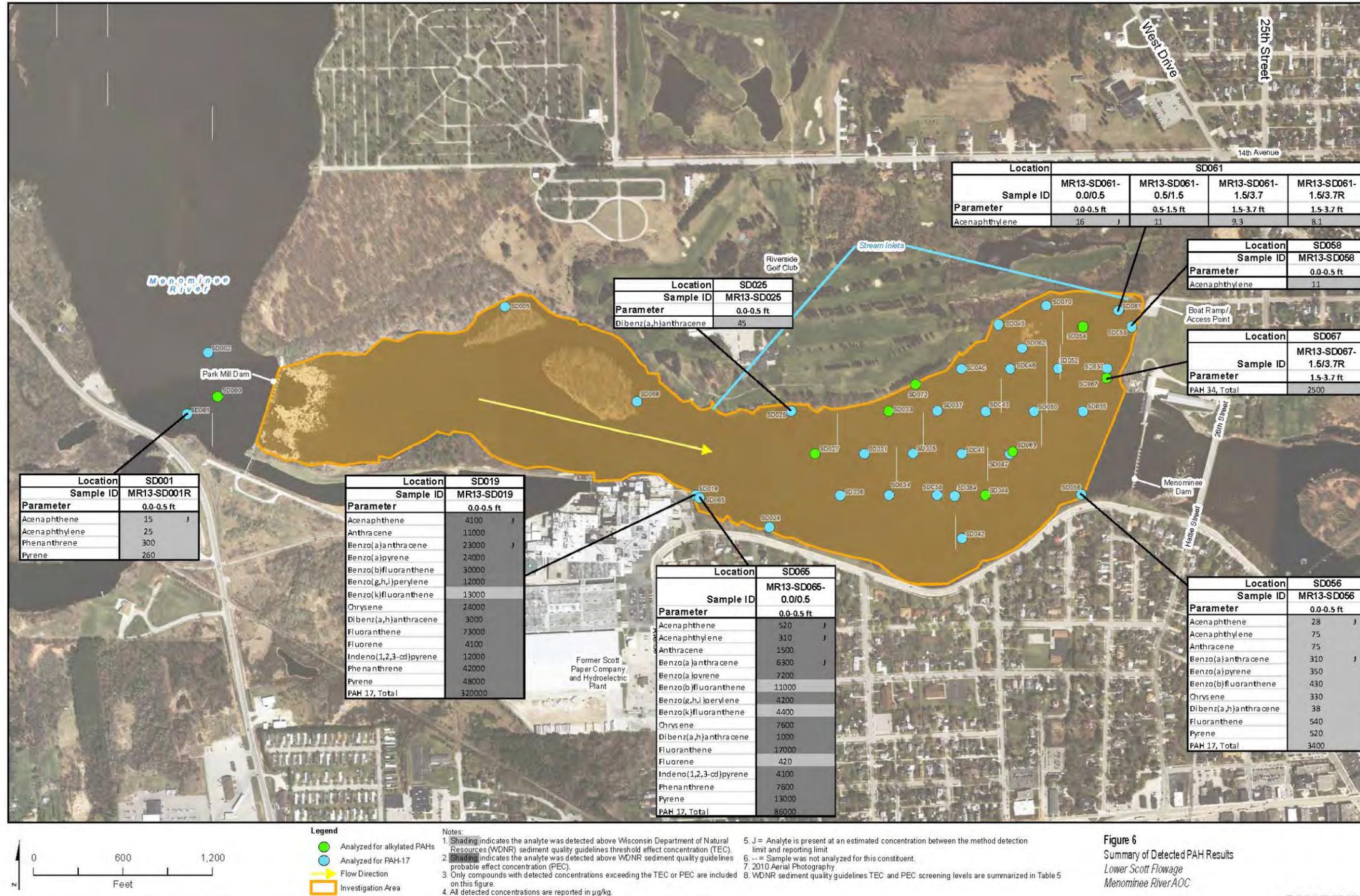
BENEFICIAL REUSE AREA AS-BUILT

DATE: 05/20/15
FILE: BCS-2-10
JOB NO. 15-0004

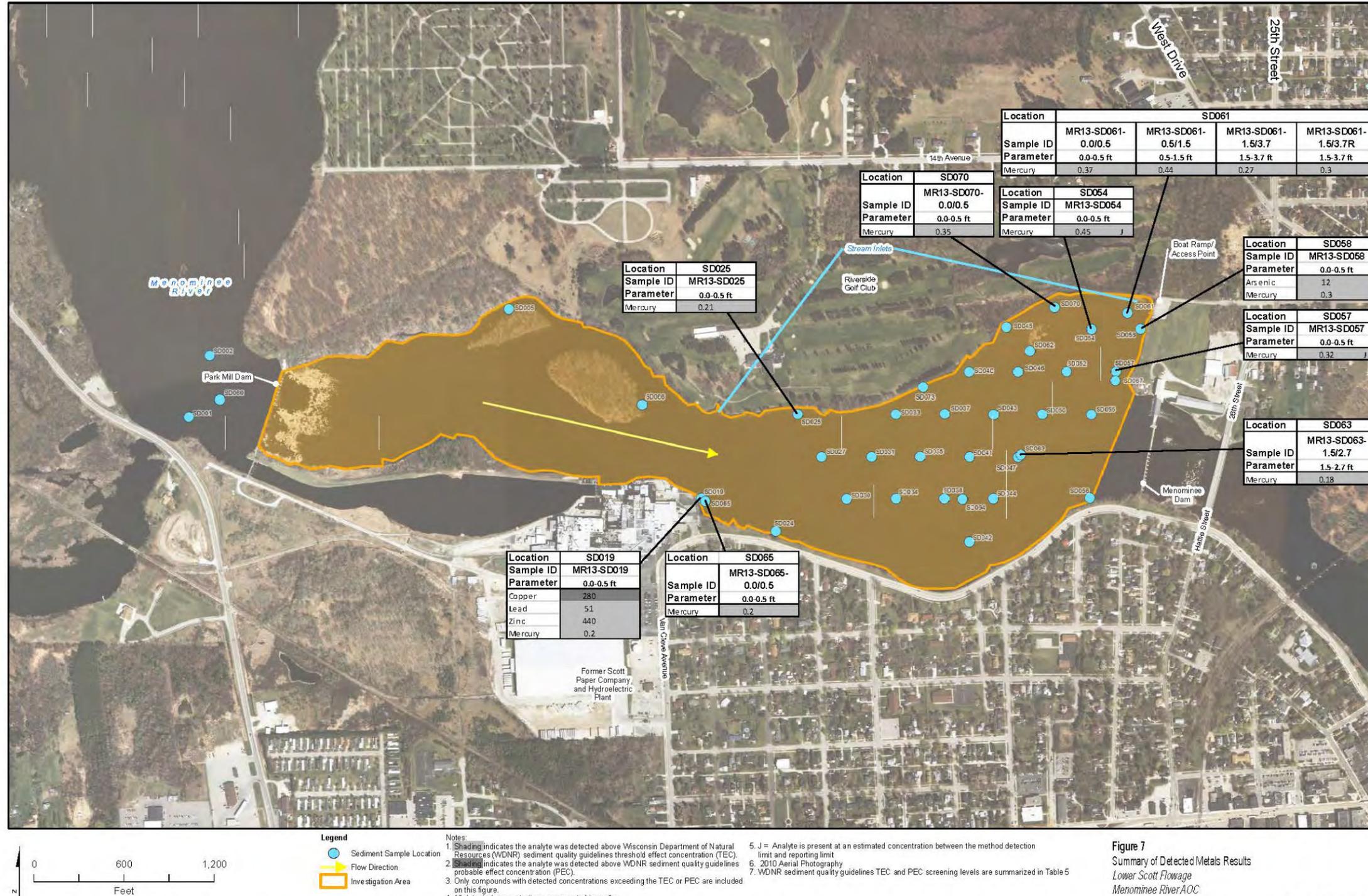
Robert E. Lee & Associates, Inc.
ENGINEERING, SURVEYING, ENVIRONMENTAL SERVICES
1250 CENTENNIAL CENTRE BOULEVARD
HOBART, WI 54155 PHONE: (920) 662-9641
INTERNET: www.releeinc.com FAX: (920) 662-9141

SHEET NO.
1

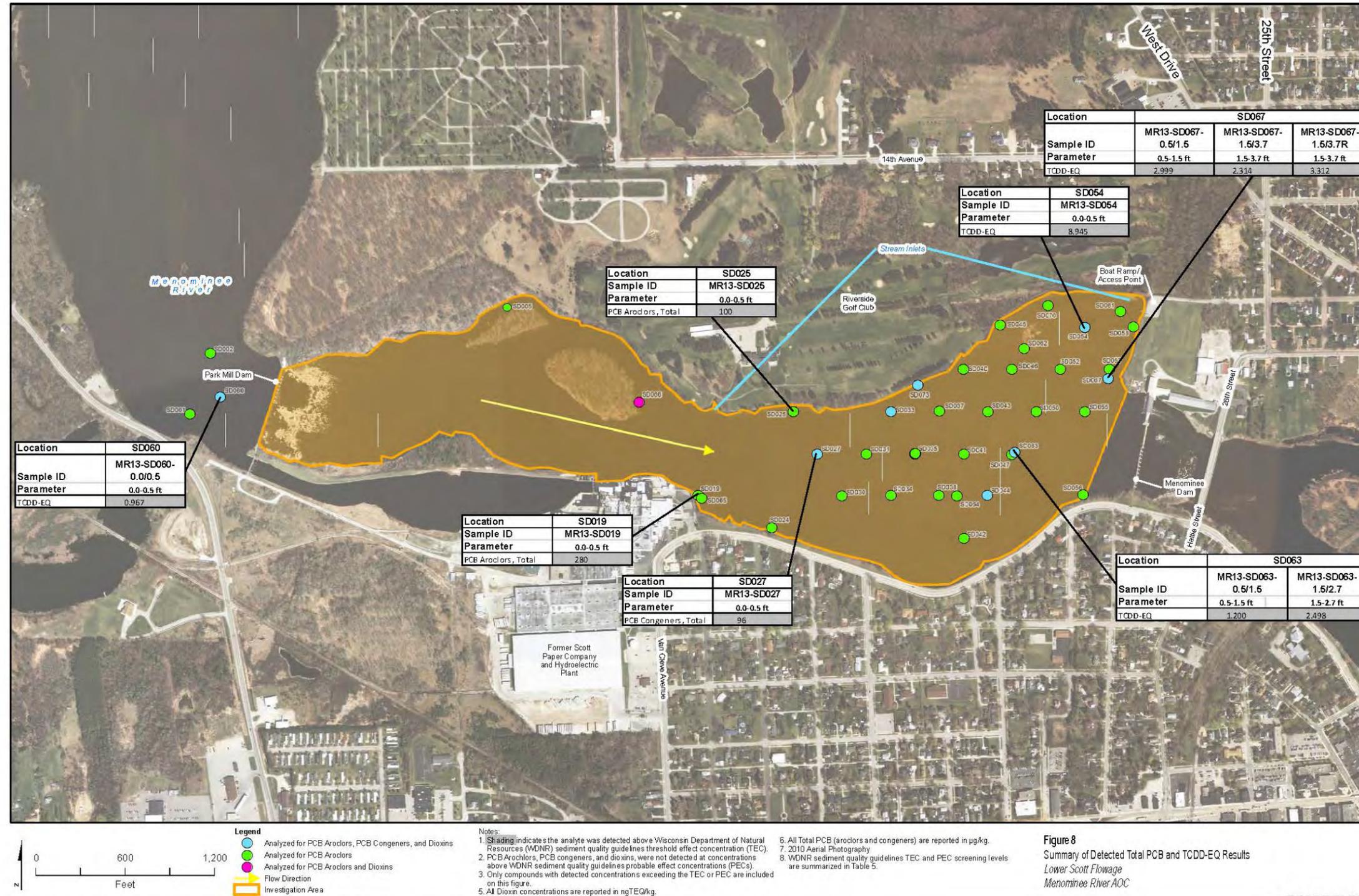
Map 10. Summary of detected PAH results, Lower Scott Flowage, Lower Menominee River AOC (CH2MHill, 2014).



Map 11. Summary of detected metals results, Lower Scott Flowage, Lower Menominee River AOC (CH2MHill, 2014).



Map 12. Summary of detected total PCB and TCDD-EQ results, Lower Scott Flowage, Lower Menominee River AOC (CH2MHill, 2014).



Map 13. Surficial sediment sampling locations in Rio Vista Slough, June 24th, 2014 (MDEQ, 2015).



APPENDIX D: Lower Menominee River AOC BUI Removal Criteria

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Lower Menominee River AOC Beneficial Use Impairment Restoration Targets

12/22/2008

Introduction

Areas of Concern (AOCs) were identified in the mid 1980's through work completed by the federal governments of the United States and Canada, in cooperation with state and provincial governments under the Great Lakes Water Quality Agreement (GLWQA). The 1987 amendments to the GLWQA further defined the Beneficial Use Impairments (BUIs). The BUIs in the Lower Menominee River AOC are primarily the result of historic industrial and municipal waste discharges leading to contaminated sediments and degradation to water quality. Some known ongoing contamination exists and these areas are currently in negotiations related to remedial actions. The primary industrial contaminants identified in the 1990 Lower Menominee River Remedial Action Plan (RAP) included paint sludge with associated heavy metals, PCBs, arsenic, and coal tars.

Data collected for the Wisconsin Department of Natural Resources (WDNR) and the Michigan Department of Natural Resources (MDNR) Fish Contaminant Monitoring Programs from 1976 through 1988 detected high levels of PCBs in carp and walleye resulting in fish consumption advisories beginning in 1986. These advisories resulted in the 1987 AOC designation. The BUIs identified for the Lower Menominee River AOC in the 1990 RAP are restrictions on fish consumption, degradation of benthos, restrictions on dredging activities, beach closings, degradation of fish populations, and loss of fish and wildlife habitat. Neither state has identified wildlife consumption advisories as a concern.

Purpose

The Great Lakes Regional Collaboration set a priority for having targets for delisting set for all BUIs by the end of 2008. Agency AOC program staff working with the Lower Menominee River AOC from the WDNR, Michigan Department of Environmental Quality (MDEQ), and United States Environmental Protection Agency (USEPA)-Great Lakes National Program Office (GLNPO) have cooperatively developed the following criteria for these BUIs based on the *Guidance for Delisting Michigan's Great Lakes Areas of Concern* and existing rules and criteria from Wisconsin. These targets are intended to guide local citizens, as well as state and federal agency staff, as they plan and work within the AOC. The states intend to jointly delist individual BUIs and the AOC. The AOC process for both states includes local citizen involvement.

Restrictions on Fish and Wildlife Consumption

Restoration Target for Restrictions on Fish Consumption for Michigan and Wisconsin

This BUI will be considered restored when:

- Sources of PCBs, mercury, and dioxins within the AOC have been controlled or eliminated; and
- Waters within the Lower Menominee River AOC are no longer listed as impaired due to PCB or dioxin fish consumption advisories in the most recent Impaired Waters (303(d)) list for either state; or
- Fish tissue contaminants causing advisories in the AOC are the same or lower than those in the associated Great Lake or appropriate control site.

Degradation of Fish Populations and Loss of Fish and Wildlife Habitat

Restoration Target for Degradation of Fish Populations and Loss of Fish and Wildlife Habitat Beneficial Use Impairments

The Degradation of Fish Populations BUI and Loss of Fish and Wildlife Habitat BUI are interrelated; consequently, the delisting of these two BUIs will be addressed together.

These two BUIs will be considered restored when: A local fish and wildlife habitat management and restoration plan has been developed and implemented for the Lower Menominee River AOC that:

- Defines the causes of fish and wildlife population and habitat impairments within the AOC
- Establishes site specific habitat and population objectives for fish and wildlife species within the AOC
- Identifies fish and wildlife population restoration programs and activities within the AOC and establishes a mechanism to assure coordination among states and programs for assessment monitoring, implementation activities and associated monitoring
- The programs and actions necessary to accomplish the recommendations are identified in the fish and wildlife management and restoration plan are implemented
- Monitoring conducted according to the Fish and Wildlife Plan shows consistent improvement in the quality and quantity of habitat or populations identified in the plan

Removal of this BUI will be based on achievement of implementation of actions in the steps above, including monitoring conducted according to site plans and showing consistent improvement in quantity or quality of habitat or populations addressed in the criteria. Habitat values and populations need not be fully restored prior to delisting, as some may take many years to recover after actions are complete. Actions already implemented in AOCs may be reported and evaluated as long as the reports contain all the elements above.

The habitat or population restoration plan will determine the type and extent of the restoration necessary to address habitat loss or population degradation issues identified in the RAP or other key documents. Sources of water quality contamination contributing to specific habitat or population degradation must be controlled before habitat or population restoration efforts in that area are conducted. In some circumstances, habitat degradation is actually contributing to water

quality problems, rather than vice versa. In those instances, the workplan should discuss this issue and the remedial actions should be targeted accordingly.

Beach Closings / Recreational Restrictions

Restoration Target for Beach Closings and Recreational Use Restrictions:

This BUI will be considered restored when:

1. No waterbodies within the AOC are included on the list of non-attaining waters due to contamination with pathogens in the most recent Clean Water Act Water Quality and Pollution Control in either states: Section 303(d) and 305(b) Integrated Report (Integrated Report), which are submitted to U.S. EPA every two years.
2. OR, in cases where the waterbodies within the AOC are on the list of non-attaining waters due to the presence of Combined Sewer Overflows (CSOs) or are impacted by upstream CSOs, this BUI will be considered restored when CSOs have been eliminated or are being treated.
3. OR, in cases where CSOs still exist and significant progress has been made towards their elimination or treatment, this BUI will be considered restored when:
 - o All known sources of bacterial contamination to the AOC originating in the AOC and tributary watersheds have been controlled or treated to reduce exposures; and
 - o No unpermitted sanitary sewer overflows have occurred within the AOC during the previous five year period as a result of a less than 25-year precipitation event or snow/ice melt conditions; and
 - o Marinette, WI and Menominee, MI have adopted and are implementing storm water reduction programs including an illicit discharge elimination program

Degradation of Benthos

Restoration Target for Degradation of Benthos Beneficial Use Impairment

This BUI will be considered restored when: All remediation actions for known contaminated sediment sources are completed and monitored according to the approved plan and have met their remedial action goal.

Restrictions on Dredging Activities

Restoration Target for Restrictions on Dredging Use Impairment

This BUI will be considered restored when:

- All remediation actions for known contaminated sediment sources are completed and monitored according to the approved remediation plans and the remedial action goals have been achieved; and

- An AOC dredge management plan is developed by the communities and agencies that includes an evaluation of:
 - Restrictions that must remain in place to protect human health and the environment
 - Restrictions that must remain in place due to RCRA requirements that are based upon state and federal law
 - Priority areas for navigational use
 - Priority areas for utility dredging, e.g. utility crossings
 - Identify costs and funding options for removing dredging restrictions in priority areas

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APPENDIX E: Letters of Support

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Lower Menominee River AOC CAC Letter of Support

(To be added to final draft)

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APPENDIX F: Public Involvement Evidence

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Lower Menominee River AOC TAC Meeting Minutes (where removal recommendation supported and referred to CAC)

(To be added to final draft)

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Lower Menominee River AOC CAC Meeting Minutes (where CAC supports removal recommendation)

(To be added to final draft)

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