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USACE, Detroit District

GLLA Sediment Cleanup Documentation Report

Howards Bay, Superior, Wisconsin

December 2023

Contract No. W911XK-16-C-0019
WDNR ID No. 02-16-563449 and 02-16-120591

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Certification Statement

USACE performed the necessary construction management and quality assurance for the Howards Bay SND & GLLA Dredging project. The work was performed per USACE regulations and contract requirements. I am an engineer working for the USACE, and I certify that my qualifications are functionally equivalent to the requirements of WIS. ADMIN. CODE NR712.

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Phillip C. Ross, P.E.
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Version Control

Revision No.	Date Issued	Description	Reviewed By
Draft	3/21/2022	Draft report submitted to USACE/Partners. Anticipated updates following completion in 2022 are identified in ***bold/italicized font*** in the applicable sections.	M. Gravelding, H. VanDewalker, S. Hill
Pre-Final	6/7/2023	Pre-final report submitted to USACE/Partners.	M. Gravelding, H. VanDewalker, S. Hill
Final	12/5/2023	Final report with as-built drawings.	M. Gravelding, H. VanDewalker, S. Hill

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Acronyms and Abbreviations

Arcadis	Arcadis U.S., Inc.
City	City of Superior
COCs	contaminants of concern
CS	Cummings Avenue Slip
CUGs	clean up goals
cy	cubic yards
DDR	Design Documentation Report
Decision Tree	Howards Bay Dredge Completion Decision Tree
DMU	dredge management unit
EDC	engineering during construction
ENR	enhanced natural recovery
Erie Pier	Erie Pier Confined Disposal Facility
Eurofins TA	Eurofins TestAmerica Laboratories
FC	federal channel
FFS	Focused Feasibility Study
FP	Frog Pond
Fraser	Fraser Shipyards, Inc.
FS	Fraser Slip
GLLA	Great Lakes Legacy Act
GLNPO	Great Lakes National Program Office
HS	Hughitt Avenue Slip
I-535	Interstate 535
IGLD 85	International Great Lakes Datum of 1985
LWD	low water datum
MPCA	Minnesota Pollution Control Agency
PAHs	polycyclic aromatic hydrocarbons
Partners	Howards Bay Project Partners
PEC	Probable Effect Concentration
PM10	particulate matter less than 10 microns in diameter
Project SharePoint	GLLA Howards Bay Dredging Team SharePoint Site
QA	quality assurance

QC	quality control
RA	remedial action
SCDR	Sediment Cleanup Documentation Report
sf	square feet
SLRAOC	St. Louis River Area of Concern
SND	Strategic Navigation Dredging
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WDNR	Wisconsin Department of Natural Resources
WPLF	Wisconsin Point Landfill

1 Introduction

Arcadis U.S., Inc. (Arcadis) has prepared this Great Lakes Legacy Act (GLLA) Sediment Cleanup Documentation Report (SCDR) to document the sediment cleanup project in Howards Bay. This SCDR has been prepared in accordance with United States Army Corps of Engineers (USACE) Engineer Regulation (ER)-1110-1-1901 and Wisconsin Administrative Code Chapter NR 724.15, as applicable. This SCDR was prepared under contract W911XK-16-C-0019 to the USACE Detroit District.

1.1 Purpose

This SCDR documents the sediment cleanup work performed in Howards Bay as described in the Design Documentation Report (DDR; Arcadis 2022). The remedial action (RA) activities identified in the DDR were designed considering that federal navigation channel maintenance would be completed by USACE as "Strategic Navigation Dredging" (SND) prior to the cleanup of contaminated sediment through environmental dredging. Funding for the SND was provided under the Great Lakes Restoration Initiative contingent on the cleanup of the contaminated sediment in Howards Bay, and the SND and environmental dredging were implemented under one construction contract that included one set of plans (USACE and Arcadis 2020a) and one set of specifications (USACE and Arcadis 2020b).

The elements of the project specific to the environmental dredging discussed in the DDR are documented in this SCDR and the attached as-built drawings (Appendix A). Documentation of the SND work was uploaded to the GLLA Howards Bay Dredging Team SharePoint Site (referred to herein as "project SharePoint")[a].

1.2 Project Authority

Implementation of this project was performed under direction of USACE and in coordination with the Howards Bay Project Partners (Partners), which include the United States Environmental Protection Agency (USEPA) Great Lakes National Program Office (GLNPO), the Wisconsin Department of Natural Resources (WDNR), the City of Superior (City), and Fraser Shipyards, Inc. (Fraser). USACE is providing technical and engineering support to USEPA for this project.

1.3 Project Location

The project is located in the City of Superior in Douglas County in northwest Wisconsin (Figure 1-1) and was performed predominately at two locations: Howards Bay and Wisconsin Point Landfill (WPLF). The public land survey system description and approximate latitude/longitude of these locations is provided in Table 1-1.

[a] *SND documentation including dredging data and charts can be found on the project SharePoint under the following folders: "Documents>USACE>2020 SND Surveys" and "Documents>USACE>2021 SND Surveys".*

Table 1-1. Project Location Details

Location	Public Land Survey System	Latitude/Longitude
Howards Bay	SE ¼ NE ¼, S10, T49N, R14W E 1/2 SE ¼, S10, T49N, R14W SW ¼ NW ¼, S11, T49N, R14W SW ¼, S11, T49N, R14W SW ¼ SE ¼, S11, T49N, R14W NW ¼ NE ¼, S14, T49N, R14W	46°44'23"N 92°05'35"W
WPLF	SW ¼ NW ¼, S35, T49N, R13W NW ¼ SW ¼, S35, T49N, R13W NE ¼ SW ¼, S35, T49N, R13W	46°41'00"N 91°58'08"W

1.3.1 Howards Bay

Howards Bay is located on the east side of the St. Louis River and is bisected by the Interstate 535 (I-535) Bridge (Blatnik Bridge) crossing over Howards Bay. Howards Bay includes the bay proper and three ship slips constructed along the south shore – the Fraser Slip (FS), Cummings Avenue Slip (CS), and Hughitt Avenue Slip (HS) – in addition to two dry docks along the south shore. The area at the head of Howards Bay is referenced as the Frog Pond (FP). The approximate size of the Howards Bay project area, including the three slips, is about 300 acres. Figure 1-2 shows the key features of Howards Bay.

Several shoreline types are present around the bay and the associated slips, including sheet pile, rip-rap, former wooden and concrete wharf structures (some of which are dilapidated), existing and former bridge approaches and abutments, and earthen banks. Water depths in Howards Bay vary from shallow along the north shore to approximately 33 feet below the Lake Superior low water datum (LWD) within the federal channel (FC) that runs nearly the entire length of the bay. The Lake Superior LWD is at an elevation of 601.1 feet using the International Great Lakes Datum of 1985 (IGLD 85).

Commercial maritime needs in Howards Bay are met by the federal navigation channel and access to the ship slips and dock areas. The federal channel ranges from approximately 100 to 275 feet wide with an authorized project depth of 27 feet below LWD (elevation of 574.1 feet) in the project area. Fraser, the City, and CHS Inc. own the large majority of land bordering Howards Bay. The HS is used for loading and unloading ships at the CHS Inc. grain elevators, and a private marina is situated at the south end of the slip. The CS has most recently been used by Fraser for long-term layup of ships and by Lake Assault Boats LLC for launching small, aluminum craft. Fraser also has installed a boat ramp in the southern end of the slip. Uses during construction by others was limited to mooring for work barges and smaller craft in approximately the northern one third of the slip. The FS is used by Fraser and local law enforcement for docking smaller boats and this is also the intended future use.

An outfall discharges stormwater drainage from the City into CS and a drainage ditch functions as a tributary at the far east end of Howards Bay. Additional stormwater outfalls exist in FS and the HS. Stormwater runoff from the Blatnik Bridge may enter Howards Bay as well (WDNR 2015).

The former Baxter Avenue Embayment which consists of an area along the south shore of Howards Bay between the CS and FS was previously open water; however, this area was infilled in 2016 and isolated from the bay with a sheet pile bulkhead through a separate project to create additional ship berthing space along the federal channel. The area along bulkhead at the former Baxter Avenue Embayment was utilized for staging and processing as part of the sediment RA as described in Section 3.4 and Section 7.

1.3.2 Wisconsin Point Landfill

WPLF is an approximately 23-acre property owned by the City that was operated as a municipal landfill from the 1950s until 1976 when the site was capped with clay and closed. The property is fenced to restrict access, monitoring wells are present, and routine mowing is performed to maintain vegetated cover and prevent tree growth on the cap. The City offered use of WPLF for dredged material placement to improve the site drainage, increase soil cover over the waste, and help sustain vegetative cover, with the intent to allow for future light recreational use of the property.

1.4 Project History and Background

Howards Bay is a priority area for remediation within the larger St. Louis River Area of Concern (SLRAOC) and has been the home of a series of shipyards, grain terminals, commercial fishing operations, and other industrial operations for over 100 years. The I-535 highway bridge crosses over Howards Bay and Howards Bay receives stormwater runoff from industrial areas and municipal outfalls. Contaminants of concern (COCs) identified in Howards Bay include polycyclic aromatic hydrocarbons (PAHs), tributyltin, lead, and mercury. Howards Bay sediment investigations performed in 2007, 2010, 2013, 2014, 2015, and 2017 were used to define the horizontal and vertical boundaries of the sediment cleanup design presented in the DDR. Concentrations of the COCs vary within Howards Bay sediments due to the history of various sources, dredging activity, construction projects and other activities within the bay, including but not limited to ship movements and ice breaking. Additional project history and background details are provided in the DDR.

1.5 Project Description

As discussed in the DDR, the Howards Bay sediment cleanup activities were designed to remediate impacted sediment and restore Howards Bay with the intent to ultimately achieve removal of beneficial use impairments identified for the SLRAOC. Project-specific RA objectives developed for the sediment cleanup project and the COC-impacted sediments in Howards Bay include:

- Reduce potential for human health risks associated with exposure to COCs through direct contact with sediments and incidental sediment ingestion.
- Reduce potential for risks to benthic organisms.
- Reduce potential for risks to other organisms (e.g., fish, birds, mammals).
- Reduce sediment concentrations of COCs to ultimately meet criteria, standards, and guidelines per International Joint Commission and the SLRAOC Stage I Remedial Action Plan documents (Minnesota Pollution Control Agency [MPCA] and WDNR 1992).
- Reduce the potential for contaminated sediment within Howards Bay to act as a source of contamination outside of Howards Bay in the St. Louis River Estuary.

1.5.1 Cleanup Goals

The cleanup goals (CUGs) for the project COCs are presented in Table 1-2 and additional detail on the CUGs can be found in the DDR.

Table 1-2. Cleanup Goals

COC	CUG
Total PAHs	12.205 mg/kg-TOC%
Tributyltin	0.0017 mg/kg-TOC%
Lead	83 mg/kg
Mercury	0.64 mg/kg

Notes: PAHs = polycyclic aromatic hydrocarbons; mg/kg = milligrams per kilogram; mg/kg-TOC% = milligrams of organic constituent per kilogram of dry-weight sediment normalized at 1% total organic carbon

1.5.2 Overview of Selected Remedy

The selected remedy addresses impacted sediment remaining following SND and included placement of an enhanced natural recovery [ENR] cover or removal through environmental dredging (with or without placement of a residuals cover). The selected remedy included transporting dredged material offsite for disposal at a commercial disposal facility or placement at WPLF as surface or subsurface cover.

As detailed in the DDR, areas of contaminated sediment were divided into dredge management units (DMUs; see Appendix A) based on COC extent and site characteristics. In identifying the actions to be taken for each DMU, consideration was given to the degree to which CUGs were exceeded in the deeper sediments below the uppermost sample layer, specifically in comparison to whether the concentration also exceeded the WDNR Probable Effect Concentration (PEC) sediment screening levels (WDNR 2003)[b] and the depth intervals within which the exceedances were observed. For each DMU, the DDR identified one of the following remedial actions:

- No Action: DMUs within the federal channel where contaminated sediment would be removed as part of the authorized SND depth of 27 feet below LWD (elevation of 574.1 feet) plus 1-foot of overdepth (elevation of 573.1 feet).
  - Three DMUs were considered as “no action” areas based on the assumption that the impacted sediment in these DMUs would be removed by the SND dredging and overdredging. USACE reviewed the data in the “no action” DMUs closely and agreed that the COC levels were low enough for material to be placed with other SND materials at USACE’s Erie Pier Confined Disposal Facility (Erie Pier) without regulatory concern.
  - As required by the DDR, completed SND dredge elevations were compared to the bottom of elevations of known impacts (Section 3.3) and confirmation sampling was performed (Section 4.2.4) within the “No

[b] Probable Effect Concentration sediment screening levels are levels at which the potential for toxicity to benthic organisms are predicted to be probable.

Action" DMUs to identify areas that required additional dredging and areas that required residual cover placement.

- ENR Cover Placement: DMUs identified in the DDR for placement of an ENR cover based on the average pre-construction surface sediment concentrations being below PEC values, as described in the approved Focused Feasibility Study for Sediment Cleanup in Howards Bay (FFS; Arcadis 2015).
- Environmental Dredging: Environmental dredging was the primary method identified in the FFS for addressing impacted sediments and DMUs that were not otherwise designated as "No Action" or "ENR Cover" (described above) were identified in the DDR for environmental dredging. Confirmation sampling was performed (Section 4.2.4) within the "Environmental Dredging" DMUs to identify areas that required additional dredging and areas that required residual cover placement. Debris encountered in these DMUs was removed and transported for offsite disposal at a commercial facility. For each environmental dredging DMU, the DDR identified one of the following disposal options for the dredged sediment from that DMU:
  - Sediment Requiring Offsite Disposal: Sediment removed from DMUs with an average in-situ COC concentration greater than the WPLF placement criteria identified in a WDNR memorandum dated April 18, 2017 was transported for offsite disposal at a commercial facility.
  - Sediment for Subsurface Cover Placement at WPLF: Sediment removed from DMUs with an average in-situ COC concentration that met the WPLF placement criteria for subsurface cover identified in a WDNR memorandum dated April 18, 2017 was transported to WPLF for placement as subsurface cover.
  - Sediment for Surface Cover Placement at WPLF: Sediment removed from DMUs with an average in-situ COC concentration that met the WPLF placement criteria for surface cover identified in a WDNR memorandum dated April 18, 2017 was transported to WPLF for placement as surface cover.

1.6 Implementation Team Roles

Key entities involved in the RA implementation documented in this SCDR include:

- Partners: Managed overall sediment cleanup project implementation to address contamination in Howards Bay.
- USACE: Led the SND of Howards Bay. Provided technical and engineering support to USEPA for the sediment cleanup project, including performing engineering during construction (EDC) services such as providing on-site representatives to observe construction activities at Howards Bay and WPLF, performing bathymetric and topographic surveys that were used in development of the as-built drawings (Appendix A), processing and evaluating survey results (including calculation of volumes), and reviewing Contractor submittals for compliance with contract documents.
- J.F. Brennan Company, Inc. (Brennan): Retained by USACE as the Contractor to perform the construction and quality control (QC) activities associated with the SND and GLLA sediment cleanup in Howards Bay. The term "Contractor" is used in Sections 2 through 10 to refer to Brennan or their key subcontractors. Key subcontractors retained by Brennan include:
  - Braun Intertec: Retained by Brennan to perform air monitoring and QC sampling.
  - Infrastructure Alternatives Inc.: Retained by Brennan to provide and operate the temporary on-site water treatment system.
  - Ulland Brothers: Retained by Brennan to perform dewatered material sediment hauling and placing of material at WPLF.
  - Eurofins TestAmerica Laboratories (Eurofins TA): Retained by Brennan to perform QC analytical testing.

  - ECS: Retained by Brennan to perform WPLF restoration related activities.
- Arcadis: Retained by USACE to support EDC services associated with the environmental dredging at Howards Bay, including reviewing select Contractor submittals for compliance with design intent, responding to requests for information (RFIs), providing technical assistance and design revisions, and performing quality assurance (QA) tasks described in Section 9.
  - Eurofins TA: Retained by Arcadis to perform QA analytical testing.

The information contained in this report is based on submittals provided by Brennan in accordance with the project specifications, information provided by USACE, and information collected by Arcadis as part of the QA efforts.

2 Material Sources

This section provides information on the materials incorporated into the work including quality control data submitted by the Contractor during construction. These materials included sand cover used for residual and ENR cover placement in Howards Bay and materials used in restoration of WPLF, including borrow material from Erie Pier, topsoil, and restoration materials (e.g., seed, erosion control fabric, geotextile).

2.1 Sand Cover

Sand cover used for residual cover, ENR cover, and backfill placement in Howards Bay consisted of sand material imported from two quarry/commercial sources: Iron River and the Duluth Ready Mix Plant. Prior to importing materials, gradation and analytical results for samples collected from each source were compared to requirements in the project specifications and submitted for USACE approval. Analytical testing included sampling for total PAHs, mercury, lead, arsenic, cadmium, chromium, copper, nickel, and zinc. Data summaries submitted during construction for sand cover materials were shared with the Partners during construction and are provided in Appendix B. Results of the sand cover testing are summarized below:

- Iron River:
  - Gradation: 13 samples submitted with 10 samples meeting specified requirements. Three samples were finer than the specified requirements but within a range acceptable to WDNR and USACE.
  - Analytical: 13 samples submitted with all samples meeting the specified requirements for clean material.
- Duluth Ready Mix Plant:
  - Gradation: 13 samples submitted with nine samples meeting the specified requirements and four samples containing fines contents outside the specified requirements but within a range acceptable to WDNR and USACE
  - Analytical: 14 samples submitted with:
    - 12 samples meeting the modified concentration requirements defined below.
      - Based on results received for samples from the Duluth Redi Mix Plant, WDNR approved the use of SLRAOC background concentration values for copper and nickel (50 mg/kg and 37.5 mg/kg, respectively) in lieu of the concentrations identified in the project specifications (32 mg/kg and 23 mg/kg, respectively).
    - One sample (HB21-SD-12) was accepted by USACE and WDNR for use based on the concentration being within the range of background concentration in SLRAOC sediments.

- The remaining sample (HB21-SD-25) results were received after placement of the sand material was complete and results were subsequently accepted by USACE.

Based on tracking information maintained by USACE, approximately 33,991 tons[c] (16,903 cubic yards [cy]) of sand were imported to Howards Bay between October 7 and November 19, 2021 for residual cover (32,350 tons placed [27,029 tons payable]) and ENR cover (1,641 tons placed [1,577 tons payable]). The number of samples submitted described above met the overall specified sampling frequency (one sample per 1,000 cy) for analytical testing and gradation testing of sand cover material. In November 2021 and November 2022, an additional 1,644 tons and 1,609 tons of sand cover material, respectively, was imported to Howards Bay for placement as backfill in Hughitt Slip. Sand cover material was temporarily stockpiled at the Brennan Duluth Storage Yard (Figure 2-1, 501 Helberg Dr.) before being loaded onto a hopper barge for transport to Howards Bay. Placement of sand cover material is discussed in Section 5.

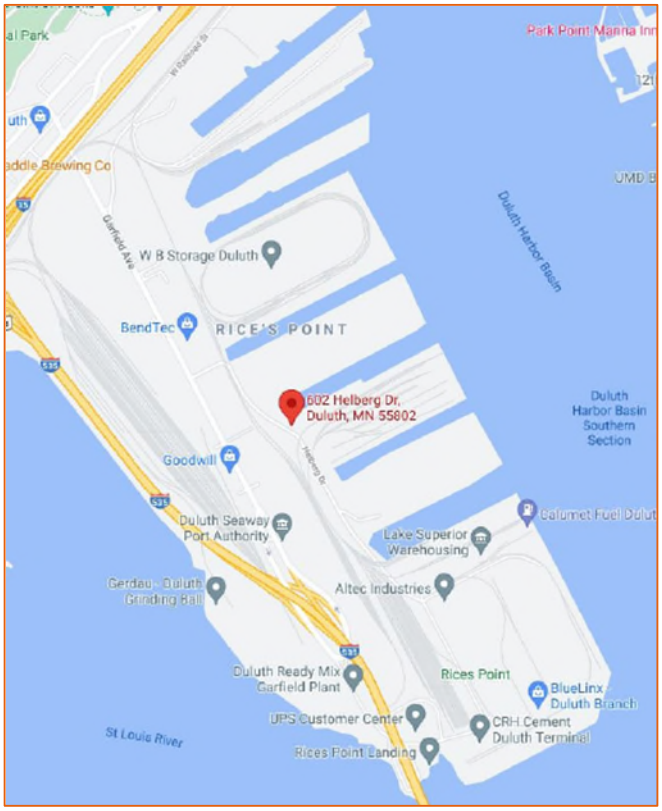

Figure 2-1. Brennan Duluth Storage Yard (from Contractor's Cover Placement Plan included in Transmittal 35 2024-1.1).

2.2 Erie Pier Borrow Material

Erie Pier borrow material consisted of stockpiled material at Erie Pier identified by USACE and WDNR as acceptable for use as cover at WPLF and no testing of the material was required prior to use. Prior to hauling the material to WPLF, vegetation was stripped and the material was loaded into trucks for transportation. No screening of the material was required as no significant debris greater than 2 inches was observed. Approximately 9,660 cy of Erie Pier borrow material was transported to WPLF by truck between November 29

[c] *Quantity is based on approximately 34,420 tons of sand delivered to the Brennan Duluth Storage Yard between October 7 and November 19, 2021 and a remaining stockpile quantity of approximately 429 tons.*

and December 8, 2021. Approximately 2,680 cy of additional Erie Pier borrow material was transported to WPLF by truck between August 2 and August 3, 2022. Material placement, including amendment of the Erie Pier borrow material, is discussed in Section 8.3.

On September 7, 2022, following completion of Erie Pier borrow material import to WPLF, a site visit at Erie Pier was performed by the Contractor and USACE to discuss the required regrading of the borrow area. Regrading of the Erie Pier borrow area was completed as required on September 22, 2022.

2.3 Topsoil

Topsoil material was sourced by the Contractor from Udeen Trucking. Prior to importing topsoil, samples were collected from the source and submitted for gradation testing, analytical testing, and agricultural testing. The results of these tests were compared to the requirements in the project specifications and submitted for USACE approval. Analytical testing required by the specifications included total PAHs, organotins, metals, pesticides, polychlorinated biphenyl, total organic carbon, full toxicity characteristic leaching procedure (TCLP) testing, organic content, and pH. Polychlorinated biphenyl and TCLP testing were removed from the testing requirements during construction based on WDNR comments on the Contractor's Sampling and Analysis Plan. Data summaries submitted during construction for topsoil testing were shared with the Partners during construction and are provided in Appendix B. Results of the topsoil testing are summarized below:

- Gradation Testing: Nine samples submitted that met specified maximum particle size.
- Analytical Testing:
  - Total PAHs: Twelve samples submitted with all meeting specified requirements for clean material.
  - Organotins: Twelve samples submitted with all meeting specified requirements for clean material.
  - Metals: Twelve samples submitted with all meeting specified requirements for clean material.
  - Pesticides: Twelve samples submitted with all meeting requirements for clean material.
  - Total Organic Carbon: Twelve samples submitted; no specified total organic carbon requirement.
  - pH: Eight tests were performed using the specified method and reported results were within the specified range. One sample was analyzed by the agricultural testing laboratory using a method other than the methods specified; results were within specified ranges. Results were accepted by USACE.
  - Organic Content: Eight tests were performed using the specified method and results for seven of the samples were within the specified range and the eighth was slightly outside the specified range. One sample analyzed by the agricultural testing laboratory using a method other than the method specified had a reported value within the specified range. Results were accepted by USACE.
- Agricultural Testing: Completed with recommended nutrient application of 45 pounds of potassium per acre and 15 to 30 pounds of nitrogen per acre.

Based on a survey performed by USACE, approximately 10,170 cy of topsoil were imported to WPLF between September 7 and September 30, 2022 for placement. The number of samples submitted as described above met the overall required sampling frequency for analytical testing (1 sample per source), agricultural testing (1 sample per source), gradation testing (1 sample per 2,000 cy imported), pH testing (1 sample per 2,000 cy imported), and organic content testing (1 sample per 2000 cy imported). Placement of topsoil is discussed in Section 8.3

2.4 Restoration Materials

Based on information provided by USACE, the following restoration materials[d] were incorporated into the work and remained in place at Wisconsin Point Landfill at the completion of construction:

- Fertilizer: Muriate of potash (potassium chloride), manufactured by the Mosaic Company, was imported to WPLF and used to amend Erie Pier borrow material and topsoil material as discussed in Section 8.3. Based on Contractor submittal (Transmittal 02 66 00-04), the material met the specified material requirements for high potassium fertilizer.
- Seed: Permanent Seed Mix was obtained from Ramy Turf Products and used for seeding vegetated surfaces as discussed in Section 8.3. Based on Contractor submittal (Transmittals 31 32 11-6.1 and 31 32 11-13.1), the permanent seed mix generally met the specified requirements, except for the following substitutions that were accepted by USACE and the City:
  - Showy sunflower (*Helianthus laetiflorus*) in lieu of the specified stiff sunflower (*Helianthus pauciflorus)*
  - Sky blue aster (*Aster azureus*) in lieu of the specified heath aster (*Aster ericoides*) due to supplier availability at the time of ordering of the seeds.
  - Ohio spiderwort (*Tradescantia ohiensis*) in lieu of the specified prairie violet (*Viola pedatifida*) due to supplier availability at the time of ordering of the seeds.
- Mulch: Hay mulch sourced from a supplier located in Meadowlands, Minnesota, was imported to WPLF and installed for erosion control of vegetated surfaces as discussed in Section 8.3. Based on Contractor submittal (Transmittals 31 32 11-15 and 31 32 11-16) and the August 8, 2022 status meeting between USACE and the Contractor, the mulch material was accepted as meeting the specified requirements with the understanding that any weeds from the mulch material that became an issue during vegetation establishment would be addressed by the Contractor.
- Erosion Control Blanket: EG-2s Natural Net (NN) manufactured by Ero-Guard, was imported to WPLF and installed as erosion control at in the drainage swale as discussed in Section 8.3. Based on Contractor submittal (Transmittal 31 32 11-3.1), the erosion control material did not meet the specified material requirements for channel erosion control blanket (Class II, Type C) but did meet the specification requirements for non-channel, steep grade erosion control blanket (Urban Type B). This material was approved for use in the drainage swale by USACE and the Partners based on acceptance of the Contractor's Erosion Control Plan (Transmittal 31 32 11-8.1) and issuance stormwater permits by both WDNR and the City.
- Geotextile: WINFAB® 2x2HF, a woven geotextile material manufactured by Willacoochee Industrial Fabrics, Inc., was imported to WPLF and installed as part of the riprap apron as discussed in Section 8.3. Based on Contractor submittal (Transmittal 31 32 11-1.2), the geotextile material met the specified requirements.
- Riprap: Riprap material was imported to WPLF and installed as part of the riprap apron as discussed in Section 8.3. Based on Contractor submittal (Transmittal 31 32 11-2.3) and onsite inspection performed October 5, 2022, the riprap material met the size requirements on the project plans (USACE and Arcadis 2020a).

[d] *Restoration material documentation and approval can be found on the project SharePoint under the following folders: "Documents>USACE>WPLF Topsoil and Fertilizer" and "Documents>USACE>WPLF Restoration Materials".*

3 Mobilization and Support Activities

Mobilization and related support activities performed as part of the sediment cleanup activities are described in this section. These activities were performed in accordance with the DDR and the Contractor's approved pre-construction submittals.

3.1 Mobilization

Prior to commencing work, necessary personnel, equipment, and materials were mobilized to the project area. Equipment was decontaminated prior to delivery to the site, including disinfecting equipment of potential invasive species for in-water equipment in accordance with the WDNR procedures[e]. Decontamination was visually confirmed upon arrival of the equipment to the site and documented in daily reports. Initial mobilization to the site began on September 14, 2020 for SND activities. During the 2020 construction season, only SND activities were performed in-water. Upland site preparation activities initiated in 2020 that were utilized as part of the environmental dredging activities included the following:

- Utility clearance (Section 3.2)
- Construction of the staging area pad at the former Baxter Avenue Embayment (Section 3.4)

Mobilization for the 2021 construction season began on April 28, 2021. The 2021 construction season included completion of the SND activities and performance of environmental dredging activities. As part of the 2021 mobilization efforts, inspections and photographic documentation of pre-construction conditions at the former Baxter Avenue Embayment, WPLF (including the road leading to WPLF), and Erie Pier were performed. Additional utility clearance and completion of the staging area construction was performed as part of the 2021 mobilization. The pre-construction condition documentation for these areas is provided in Appendix C.

3.2 Utility Clearance

As discussed in the DDR, there are no known utilities within the dredge areas or at WPLF based on a review of USACE and NOAA information. Known utilities in the vicinity of the upland staging area were shown on the plans (USACE and Arcadis 2020a). Prior to the start of construction, the Contractor contacted Diggers Hotline, Inc., the Wisconsin utility locating agency, for utility mark outs. Documentation received as part of the utility clearance is provided in Appendix C. No utilities were impacted during construction.

3.3 Survey

Survey data to document the environmental dredging related activities were collected and processed by USACE prior to and during construction as described below. Bathymetric surveys (multi-beam in areas with adequate water depth and single-beam in shallow water near shore) were referenced to North American Datum of 1983 (NAD83) State Plane Minnesota North horizontally and International Great Lakes Datum of 1985 (IGLD85) vertically. Upland surveys were referenced to NAD83 State Plane Minnesota North horizontally and North American Vertical Datum of 1988 (NAVD88) vertically. Survey data collected during the implementation of the project are included in the as-built drawings provided in Appendix A.

Pre-construction surveys included:

[e] Procedures provided at the following website: http://dnr.wi.gov/topic/Invasives/disinfection.html.

- Bathymetric survey of the in-water work areas performed periodically between May 11 and October 5, 2021 prior to start of environmental dredging in the area covered by the survey.
- Topographic survey of the work area at the WPLF performed on April 30, 2021.

The pre-dredge bathymetry survey of Howards Bay was performed following completion of SND dredging activities to document sediment surface conditions and elevations prior to the start of the environmental dredging activities. As part of the data processing of the pre-dredge bathymetry survey, USACE generated volume reports and cut/fill maps to show the dredge volumes and depths (in feet) required to achieve the design dredge prism shown in the design plans (USACE and Arcadis 2020a). These volume reports and cut/fill maps were created by comparing the survey data to a grid surface representing the design dredging prism. Additionally, elevations following completion of the SND dredging in "No Action" DMUs were compared to the bottom of elevations of known impacts by USACE to identify areas where potentially impacted sediments remained. Based on results of this comparison and post-SND samples collected as part of the confirmation sampling program (Section 4.2.4), USACE directed, as part of the sediment cleanup work, additional dredging in one "No Action" DMU (FC-7) and placement of residual cover in the three "No Action" DMUs. The additional dredging and cover placement was performed as discussed in Section 4.2 and Section 5.1, respectively.

Additional surveys performed by USACE during construction included:

- Howards Bay:
  - Bathymetric surveys performed between June 21 and November 11, 2021 of completed dredging to design limits presented in the design plans (base dredge).
  - Bathymetric surveys performed between August 20 and November 11, 2021 of completed additional dredging based on confirmation sampling
  - Bathymetric surveys performed between November 8 and December 6, 2021 of completed ENR and residual cover placement
  - Bathymetric surveys performed on November 19, 2021, May 6, 2022 and November 14, 2022 to document backfill placement in Hughitt Slip
- WPLF:
  - Topographic survey performed on July 21, 2021 of placed sub-surface cover sediment.
  - Topographic survey performed on September 15 and November 22, 2021 of placed surface cover sediment.
  - Topographic survey performed on December 10, 2021, June 6, 2022, and August 4, 2022 of placed Erie Pier borrow material.
  - Topographic survey performed on September 23 and 30, 2022 of placed topsoil material.

Processing and results of survey data collected during construction are discussed in the appropriate sections later in this report.

3.4 Support Area Construction

The support area for sediment cleanup activities was constructed at the former Baxter Avenue Embayment area. Support activities performed at this location generally included barge transfer, sediment staging and processing, and water treatment operations. An aerial photograph of the support area is shown in Figure 3-1.

Figure 3-1. Support Area Aerial Photograph (provided by USACE); additional aerial photographs can be found on the project SharePoint[f].

Prior to sediment cleanup activities, surface soils in the area to be used for sediment staging and processing at the former Baxter Avenue Embayment were sampled by the Contractor to document pre-construction conditions. Samples were collected on November 17, 2020 and April 13, 2021. The surface soil samples were analyzed for PAHs, tributyltin, mercury, and lead. Results of the pre-construction soil sampling are provided in Appendix D and were used to evaluate post-construction soil sample results (Section 8.2).

Construction of the temporary support area started in fall 2020 as part of the SND activities with construction of a gravel staging area pad. Expansion of this area and completion of the temporary support area construction for environmental dredging was performed in 2021. Construction performed in 2021 included expansion of the gravel pad and access route construction, leveling the 2020 gravel pad with sand, installing a geotextile liner, and placing 6 inches of gravel to create a lined gravel pad. An asphalt pad with concrete block perimeter barrier was also constructed for staging of sediment offloaded from barges and prior to loading into trucks for disposal (Section 7.2). A collection sump was installed within the asphalt pad for collection of water within the pad for subsequent treatment (Section 7.3). The staging area was maintained to control stormwater runon and runoff and limit the potential for erosion or migration of sediment or other materials from the work area.

3.5 Wisconsin Point Landfill Preparation

Prior to start of construction at WPLF, surface soils in the area to be used for sediment staging near the entrance to WPLF were sampled on April 13, 2021 by the Contractor to document pre-construction conditions. The surface

[f] *Additional aerial photographs can be found on the project SharePoint under the following folders: "Documents>USACE>Photos>2021-07-08 USACE Aerial Photos" and "Documents>USACE>Photos>2021-09-01 USACE Aerial Photos"*

soil samples were analyzed for PAHs, tributyltin, mercury, and lead. Results of the pre-construction soil sampling are provided in Appendix D and were used to evaluate post-construction soil sample results (Section 8.2).

Preparation of WPLF began on May 10, 2021. Preparation activities included installation of stormwater controls, improving the entrance roadway, construction of a sediment containment pad, and placement area surface preparation. Preparation of the existing surface within the sediment placement area was performed on a continuous basis as work proceeded into a new area. Surface preparation included compaction by performing two dozer track passes over an area; removal of existing topsoil and vegetation was not performed.

As part of the installation of stormwater controls, a temporary diversion trench was installed that exposed trash and debris materials. This trench was subsequently backfilled with clay sourced from the City's clay stockpile to meet regulatory permit requirements. Inspections of the installed stormwater controls were performed by the City and WDNR and deficiencies addressed prior to the start of importing dewatered sediment to WPLF (Section 7.2.2).

4 Environmental Dredging Activities

Environmental dredging was performed to remove impacted sediments (as identified in the DDR and project plans) from Howards Bay between May 21 and November 11, 2021. Environmental dredging and debris removal was performed as described in this section and in accordance with the DDR, plans, specifications, and the Contractor's approved Environmental Dredging Plan (Transmittal 35 20 23.53-2.2).

4.1 Debris Removal

Debris was encountered throughout the environmental dredging area and generally included woody vegetation, scrap metal, rubbish, and other items typically found in an industrial waterway. Areas of significant debris included a known debris field (timber piles and reinforced concrete) in the eastern portion of DMU FP-1 identified in the project plans and a sunken vessel in DMU HS-2 that was identified prior to environmental dredging. Except for the sunken vessel, debris removal was performed concurrent with dredging operations using the same equipment used for dredging described in Section 4.2.1 and transported with the dredged sediment to the former Baxter Avenue Embayment staging area. Debris was handled separately from dredged sediments at the former Baxter Avenue Embayment staging area as discussed in Section 7.1

The sunken vessel in DMU HS-2 was identified as a commercial fishing tug named A.E. Clifford. WDNR summarized the available history and information on this vessel in an April 2021 memorandum, a copy of which is provided in Appendix C. Removal of the sunken vessel from HS-2 required use of a dive team and was completed between October 4 and October 5, 2021. Once removed from the water, the vessel was secured to a trailer and transported offsite to the Brennan Duluth Storage Yard (Figure 2-1) in Duluth, Minnesota for processing and testing prior to disposal at AZCON metals.

4.2 Dredging

Dredging activities followed the general approach described in Section 4.2.1 and were performed to minimize resuspension during dredging as discussed in Section 4.2.2. Dredging was performed on a DMU basis and the dredge order is summarized in Section 4.2.3. Confirmation sampling was conducted to determine the need for further action (i.e., no action, residual cover, or additional dredging) as discussed in Section 4.2.4. Additional

dredging was performed in accordance with Sections 4.2.1 and 4.2.2. The total volume of material removed as part of the environmental dredging activities is summarized in Section 4.2.5.

4.2.1 General Approach

Environmental dredging was conducted via mechanical dredging in the wet using two dredge plants. Each dredge plant consisted of a barge mounted excavator equipped with an environmental bucket with closing lid. The excavators were also equipped with global positioning system- (GPS-) enabled guidance equipment to provide visual information that allowed the operator to control dredging operations to meet intended design elevations. Dredging was generally performed from higher to lower elevations within a DMU and started on side slopes, where present, to minimize sloughing of material into previously dredged locations. While dredging, the environmental bucket was generally brought to sediment grade before closing the lid. Once the bucket was closed, the bucket was moved through the water column avoiding any uncontrolled movements or stops within the water column. The contents of the dredge bucket were then placed into a hopper barge. Hopper barges were loaded evenly to maintain the stability of the barge and were not overfilled. Loaded barges were transported by tug to the former Baxter Avenue Embayment staging area and dredged material was handled as discussed in Section 7.

Once the Contractor indicated dredging was completed within a DMU, USACE performed post-dredge survey of the DMU and processed the survey data including generation of volume reports and cut/fill maps comparing the gridded surface representing the design dredging prism to the post-dredge survey. Areas on the cut/fill maps where the post-dredge survey was lower than the design surface (i.e., dredge prism met) were shaded gray. The cut/fill maps and volume reports were reviewed by USACE to verify target dredge elevations were achieved and met the tolerances specified in the project specifications (i.e., met target at over 90% of the area and tolerances did not exceed contiguous areas of 400 square feet). The following DMUs were identified by USACE as not meeting the target dredge elevations:

- FP-2: An artificial obstruction could not be removed and was left in place at the direction of USACE.
- Portions of OC-14, HS-3, and HS-2: Locations of high subgrade, as verified by USACE poling of hard bottom, that could not be removed with the Contractor's equipment and was left in place at the direction of USACE.
- HS-1: Due to slope failure issues along the western shoreline near the head of Hughitt Slip, material was left in place at the direction of USACE.

USACE shared results of the processed survey data and recommendations with the Partners prior to notifying the Contractor that dredging was completed in a DMU and the confirmation sampling (Section 4.2.4) could proceed.

4.2.2 Environmental Controls

During dredging, the Contractor was required to meet the water quality conditions of the permits, access agreements, and the action levels specified in the DDR and project specifications. This was achieved through operational means, engineering controls, or a combination of methods. Engineering controls implemented during construction generally included:

- Air Bubble Curtains: Air bubble curtains were installed at the entrances to FS, CS, and HS. The air bubble curtain consisted of an air compressor and a header pipe with air holes anchored at the base of the river. These bubble curtains were operated when active dredging was conducted in the slip without the presence of a turbidity curtain. The air bubble curtain equipment was left in place until dredging in a slip was confirmed complete by USACE.

- Turbidity Curtains: Turbidity curtains were used as needed at the mouth of slips in lieu of air curtains and around active dredging areas as needed based on results of turbidity monitoring. Turbidity curtains used during project implementation were a pre-assembled system consisting of permeable geomembrane, bottom weights, flotation mechanisms, joining mechanisms, and securing/tie-off mechanisms. Turbidity curtains were installed when needed across slip entrances (full depth curtain) and/or in a moon pool configuration (4-foot depth curtain) on each dredge plant as discussed in this section.
- Oil Booms: Oil booms were deployed by the Contractor as needed to control sheens produced during dredging. Depending on the location and quantity of sheen, oil booms were either deployed behind a work boat to collect sheens, deployed along stationary objects (e.g., along dock walls), or attached to turbidity curtains.

To verify that the water quality conditions were being met, a turbidity monitoring program was implemented and contingency resuspension control measures were deployed as necessary based on results of turbidity monitoring (Section 6.2).

On July 26, 2021, WDNR sent photographs taken on July 22 to the Partners and the Contractor that showed significant sheen in two locations near the mouth of the drydock and within Hughitt Slip. There were no containment measures readily apparent for these locations in the photographs and the photographs indicated that the bubble curtain was not effective in Hughitt Slip. The Contractor proposed deploying additional boom and continuing their monitoring process. Additional photographs were taken by the WDNR pilot on July 28 that showed significant sheen was present at both dredge plants and that any controls evident did not appear to be adequate to control and contain the sheen. WDNR indicated that effective environmental controls must be applied and requested additional actions from the Contractor be taken. USEPA Emergency Response was also contacted by the WDNR. To help mitigate the suspended sheen, on July 30 the Contractor proposed installing moon pool structures that encompass the dig area of each dredge plant. The moon pool structure includes a 50-foot by 50-foot frame consisting of capped pipe floats with a 4-foot depth turbidity curtain secured to the floats and oil boom surrounding the moon pool. Due to the need to import additional material and supplies to the site, the moon pool configuration would not be installed and operational until August 3. On August 2, the WDNR pilot took additional photographs of the project site that showed sheen being generated during dredging at both dredge plants in the Frog Pond and Hughitt Slip. The August 2 photographs also showed deployed oil booms that were not contiguous and did not appear adequate for containment. The Contractor shutdown the mechanical dredge in the Frog Pond work area on August 2 to complete the installation of the moon pool after receiving the photographs from the WDNR. The Contractor completed the construction of the second moon pool later in the afternoon on August 2 and it was installed in the morning of August 3. Both dredges with moon pools configurations were operational by August 3 and continued in operation for the remainder of the dredging operations. The WDNR pilot took additional aerial photographs on August 4 that showed that the moon pool containment was effective for resuspension and sheen control. The Contractor also implemented additional procedures to monitor for and capture sheen produced during dredging within Howards Bay. This included the deployment of oil absorbent boom near each plant, deployment of turbidity curtain and oil boom near the mechanical dredge in Hughitt Slip. The Contractor crew members stationed on the dredge plant were responsible for ongoing monitoring of environmental conditions, specifically sheen accumulation during dredging activities. Additional control measures were deployed as necessary based on results of turbidity monitoring (Section 6.2).

4.2.3 Sequence

Environmental dredging of DMUs shown on the as-built drawings (Appendix A) was performed following completion of SND. The dredging sequence identified in the specifications was modified during construction based on Partner input and considering analytical testing and turn-around times for results. The environmental

dredging was completed by DMU in the following sequence (grouped based on completion date in USACE's tracking documents):

- CS-1 through CS-5
- FS-1 and FS-2
- OC-6
- FP-2
- HS-3
- OC-4 and OC-5
- OC-2
- FP-1
- HS-1 and HS-2
- OC-1, OC-3, OC-8, OC-9, FC-1, FC-12, and FC-13
- OC-12 and FC-9
- OC-14
- OC-16, OC-17, and FC-14 through FC-17
- FC-6
- FC-5
- OC-7 and FC-2 through FC-4
- OC-11

After completing removal of dredge DMUs to target elevations, confirmation sampling was performed as discussed in Section 4.2.4. Based on the results of confirmation sampling, additional dredging in select DMUs was completed in the following sequence (grouped based on completion date identified in USACE's tracking documents):

- CS-1 through CS-3 and CS-5
- FS-1 and FS-2
- OC-6
- FP-2
- FC-1, OC-1, and OC-5
- FP-1
- FC-6
- OC-14 and HS-3
- OC-16, OC-17, and FC-14 through FC-16
- OC-2, FC-2, HS-1, and HS-2
- FC-7 (identified as discussed in Section 3.3)
- OC-11

4.2.4 Confirmation Sampling

Confirmatory sampling was conducted by the Contractor between June 23 and October 20, 2021 as summarized in this section and in accordance with the DDR, project specifications, and the Contractor's approved Sampling and Analysis Plan (Transmittal 01 35 13.10-2.6). QA samples were analyzed as described in Section 9.2.1.

Confirmation sampling was performed in environmental dredging areas to determine the need for further action (i.e., additional dredging, placement of a residuals cover, or no further action) to meet sediment cleanup objectives as described in the DDR. Each environmental dredging DMU was subdivided into smaller sub-DMUs (as shown in Appendix E) and one confirmation sample was collected from each of the smaller sub-DMUs. Confirmation sampling was also performed in "No Action" DMUs (post-SND samples) and in areas between environmental dredge limits and shorelines (i.e., "offset" samples). Prior to implementing the sampling program, the number of confirmation sample locations was reduced from the number of locations shown in the DDR and the analytes to be tested for were defined on a DMU basis. The modified sampling program was documented in figures provided by USACE and WDNR, which are included as Appendix E.

4.2.4.1 Sample Collection

After environmental dredging was confirmed complete to target elevation by USACE and no dredging occurred within 150 feet of the sample location within the last 24 hours, sediment confirmation samples were collected to refusal or underlying native clay using a vibracore system in accordance with the Contractor's approved Field Sampling Plan (Transmittal 01 35 13.10-2.6).

For each vibracore attempt, details were recorded on a core collection log and the recovered core length was compared with the core penetration to determine if an additional core attempt was necessary. If the recovered core depth was less than 75 percent of the penetration depth, the vessel was repositioned, and an additional sediment core was collected in the same manner. A maximum of three coring attempts were performed at each sampling location. If after three events the target penetration depth or minimum recovery length was not achieved, the core with the maximum recovery was retained for processing.

Sediment cores retained for processing were processed on shore at a designated area. Processing of the cores included cutting open the core liners, photographing the core, logging the core using the unified soil classification system, and collecting samples for laboratory analysis. Samples were collected at depths intervals of 0 to 6 inches and then each successive 12-inch interval until the end of the core or top of the native clay. For cores that were greater than 12 inches, bottom (partial) intervals less than 6 inches were combined with the overlying interval and partial intervals of 6 inches or more were retained individually (e.g., a 23 inch core would be divided into sample interval 0 to 6 inches, and 6 to 23 inches; a 24 inch core would be divided into sample interval 0 to 6 inches, 6 to 18 inches, and 18 to 24 inches). Prior to September 16, 2021, cores that were 12 inches or less in total length were submitted as a single sample interval based on field discussions between the Contractor, WDNR, and USACE during the first day of confirmation sampling and misinterpretation of the approved field sampling plan for the segmentation required when exactly 12 inches was recovered. This approach was inconsistent with the project specification to analyze the 0-to-6-inch interval separately. Results for these samples were accepted by the Partners, except for sample FP1-C, which was required to be re-collected and analyzed. After September 16, 2021, cores less than 12 inches were sampled from the 0-to-6-inch interval as required by the project specifications with a second sample interval from 6 inches to the end of core interval. For cores that were greater than 12 inches, partial intervals less than 6 inches were combined with the overlying interval and partial intervals of 6 inches or more were their own interval. Sediment from each identified sample interval was homogenized until the sediment was of a uniform color. The homogenized sediment was then placed in labeled,

pre-cleaned laboratory supplied jars and submitted for analysis (Section 4.2.4.2). Sediment core processing results were documented on processing logs and completed copies of the logs are provided in Appendix E.

4.2.4.2 Analytical Testing

Sediment confirmation samples collected as described in Section 4.2.4.1 were analyzed for total organic carbon, PAHs, tributyltin, lead, mercury, and percent moisture by Eurofins TA at the following laboratory locations:

- Eurofins TA Denver: Total organic carbon, PAHs, tributyltin, lead, mercury, and percent moisture
- Eurofins TA Chicago: Lead
- Eurofins TA Burlington: Organotins

Lead was analyzed at both the Denver laboratory and the Chicago laboratory due to laboratory certification requirements. The Denver laboratory was certified by the Department of Defense Environmental Laboratory Accreditation Program for all parameters and was a WDNR certified laboratory for all parameters except lead. The Chicago laboratory was used to provide lead results from a WDNR certified laboratory.

Analytical methods were as defined in the DDR and technical specifications, except for tributyltin which was analyzed using a laboratory specific method (BR-MS-012) and included air drying of the sample for a minimum of 12 hours in clean trays prior to analysis. The change in analysis for tributyltin was reviewed and approved by USACE and the Partners to allow for a lower detection level to be achieved. Confirmation sample results summary tables and laboratory reports submitted by the Contractor are provided in Appendix E.

4.2.4.3 Interpretation of Results

The confirmation sample results were reviewed by USACE, the Partners, and Arcadis as discussed in this section. Results associated with offset sample locations were reviewed but not evaluated for further action. Confirmation sample results for samples collected within “Dredging” and “No Action” DMUs were reviewed and evaluated to determine if any further action was needed in the sub-DMU area represented by each confirmation sample (confirmation area). The confirmation sampling data for each DMU and corresponding sub-DMU was provided by the Contractor to USACE. USACE reviewed the data against the Howards Bay Dredge Completion Decision Tree (Decision Tree; Appendix F) and developed initial re-dredge and sand cover decisions that were documented in a “Decision Tree Decisions” spreadsheet (Appendix F) for each DMU and corresponding sub-DMU. This “Decision Tree Decisions” spreadsheet and the confirmation sampling data was then sent to the Project Partners and Arcadis for review, and a meeting was scheduled to review the data and decisions as a team. Prior to these meetings, Arcadis performed an independent interpretation of the confirmation sampling data using review forms in accordance with the Arcadis Quality Assurance Plan (Arcadis 2021b); a summary table of the interpretation of confirmation sampling results based on these review forms is provided in Appendix F.

During the Decision Tree Decisions meetings, USACE and the Partners came to an agreement on re-dredging and sand cover placement decisions for each sub-DMU unit based on the data, the Decision Tree, recommendations from Arcadis, and interpretations by USACE and the Partners. During these meetings, the Partners introduced flexibility in interpretation of analytical results approaching target levels to reduce additional dredging and prioritize cover placement. This flexibility was introduced and agreed to by USACE and the Partners to limit overrun volumes so that the project could be completed within available funding while meeting the cleanup objectives. This interpretation was evaluated on a case-by-case basis considering COC concentrations (e.g., were less than 2 or 3 times the CUG) and the depth below dredge surface that the CUG exceedance was observed. Once agreement was achieved on further actions, if any, the “Decision Tree Decision” spreadsheet

was updated accordingly by USACE and included on the Arcadis review form summary table. Copies of the final "Decision Tree Decision" spreadsheet(s) and review form summary table are provided in Appendix F.

Where additional dredging was directed, the target depth for additional dredging was rounded to the nearest 6 inches (e.g., rounding 8 inches to 6 inches; rounding 10 inches to 12 inches) based on the assumption that in cases where depths were rounded down the deeper material would be removed as part of the overdredge.

USACE prepared re-dredge design surfaces and volumes for each sub-DMU where additional dredging was directed. The re-dredge design surfaces were developed by offsetting the post-dredge survey surface downwards by a uniform thickness (based on the additional dredging required). USACE also developed the 6-inch overdredge tolerance surface and volume for each sub-DMU that required re-dredge. These re-dredge volume reports, surface files, border files, and the "Decision Tree Decisions" Spreadsheet, which outlined the re-dredge depths with the exact payable quantities, for each sub-DMU were provided to the Contractor by USACE for the Contractor's use in re-dredging work. Additional dredging was performed by the Contractor as discussed in Sections 4.2.1 through 4.2.3. Once the Contractor indicated re-dredging was completed within a sub-DMU, USACE performed a post-re-dredge survey of the sub-DMU and processed the survey data including generation of volume reports and cut/fill maps by comparing the re-dredge design surface to the post-re-dredge survey. Areas on the cut/fill maps where the post-re-dredge survey was lower than the re-dredge design surface (i.e., re-dredging depth met) were shaded gray. The cut/fill maps and volume reports were reviewed by USACE to verify target re-dredge depths were achieved and met the tolerances specified in the project specifications. USACE shared results of the processed survey data and recommendations with the Partners prior to notifying the Contractor that re-dredging was completed in a sub-DMU and residual cover placement could proceed.

Where residual cover placement was directed, the Contractor developed their own residual cover placement surfaces for construction. These surfaces were developed by offsetting the after-dredge survey (or the after-re-dredge survey) surface upwards a uniform thickness based on the required residual cover thickness. USACE created their own residual cover design placement surfaces (with and without allowable overplacement tolerances) using a similar method to that described above. USACE used these surfaces to compare to the USACE collected after-sand cover placement surveys to determine whether the Contractor met placement requirements and to calculate placement quantities from. Residual cover placement, where directed, was performed as discussed in Section 5.1.

4.2.5 Removal Volumes

Removal volumes were calculated by USACE based on pre-dredge and post-dredge surveys conducted by USACE and documented in the as-built drawings (Appendix A). Post-dredge surveys were performed after dredging to the contract required limits and after additional dredging directed based on confirmation sampling. Approximately 91,141 cy of material was dredged as part of the sediment cleanup activities as summarized in Table 4-2, which represents an increase in total dredge volume compared to neatline design quantities included in the DDR. This increase in volume is associate with overdredging, dredging and sloughing outside the remediation footprint, and re-dredging based on confirmation sampling program (Section 4.2.4).

During construction, dredging and sloughing occurred outside the anticipated limits near the HS shoreline (referred to as "Approximate Backfill Location" on as-built drawing CN114b [Appendix A]). As discussed in the DDR, geotechnical analysis was performed to assess shoreline stability and develop a backfill design to address stability concerns. Backfill of this area in HS is discussed in Section 5.3.

Table 4-1. Environmental Dredging Removal Volumes

DMU	Base Dredge [1] (cy)	Additional Dredge [1] (cy)	Total Volume [1] (cy)
HS-1	9,998	379	10,377
HS-1 Slough [2]	513	0	513
HS-2	2,144	490	2,634
HS-3	1,325	323	1,648
CS-1	2,982	463	3,444
CS-2	4,659	639	5,298
CS-3	1,334	1,369	2,703
CS-4	865	0	865
CS-5	1,297	846	2,143
FS-1	1,760	564	2,324
FS-2	2,491	578	3,070
FP-1	4,681	994	5,675
FP-2	4,880	1,274	6,154
OC-1	2,237	402	2,639
OC-2	2,869	391	3,260
OC-3	746	0	746
OC-4	799	0	799
OC-5	793	305	1,099
OC-6	1,052	720	1,773
OC-7	0	0	0
OC-8	221	0	221
OC-9	2,278	0	2,278
OC-11	1,356	0	1,356
OC-11 Slough [2]	20	0	20
OC-12	533	0	533
OC-14	237	115	352
OC-16	791	114	905
OC-17	205	115	320
FC-1	1,657	284	1,941
FC-2	7,745	881	8,626
FC-3	3,194	0	3,194
FC-4	5,604	0	5,604
FC-5	506	0	506
FC-6	725	144	869
FC-7	0	921	921
FC-9	176	0	176
FC-12	131	0	131
FC-13	562	0	562
FC-14	896	229	1,124
FC-15	1,802	51	1,853
FC-16	2,049	361	2,411
FC-17	231	0	231
SND Overdepth [3]	-152	0	-152
Total	**78,189**	**12,952**	**91,141**

Notes:

[1] Quantities shown are estimated actual quantities removed during environmental dredging and are based on USACE calculated volumes for payable dredge quantities and unpaid overdredge using pre- and post-dredge survey data. Values are shown to the nearest cubic yard; the sum of individual values may not add up to the indicated total due to rounding errors.

[2] Volumes shown are associated with sloughing outside the anticipated limits associated with the referenced DMU.

[3] During SND in fall 2020, there was 152 cy of material left in place in FC-1 through FC-4. This material was removed during the environmental dredging work but is not considered a part of the environmental dredging removal volume.

5 Sand Cover Placement Activities

Sand cover material placement was performed between October 18 and December 3, 2021 and in November 2022. Sand cover placement was performed as described in this section and in accordance with the DDR, plans, specifications, and the Contractor's approved Cover Placement Plan (Transmittal 35 20 24-1.1). The sand cover material used is discussed in Section 2.1. Based on the gradation results, turbidity monitoring during sand cover material placement was not required by the WDNR permit.

5.1 Residual Cover Placement

Residual cover was installed in sub-DMUs identified based on confirmation sampling results and preparation of residual cover placement surfaces prepared by the Contractor and USACE as described in Section 4.2.4.3. Residual cover placement activities followed the general approach described in Section 5.1.1. Residual cover placement was sequenced on a DMU basis in the order summarized in Section 5.1.2. Verification of the cover thicknesses placed was performed as summarized in Section 5.1.3 and the total volume of material placed is summarized in Section 5.1.4.

5.1.1 General Approach

Residual cover was placed to achieve a target thickness of 6 inches, except in areas HS-1-J and HS-1-L which had a target cover thickness of 18 inches based on confirmation sample results and no additional dredging performed due to stability concerns. Residual cover was placed via a cover placement plant consisting of a modular float barge with spuds, excavator, and a spreader system; one cover placement plant was utilized during construction. Equipment used during the dredging activities was decontaminated as discussed in Section 8.1 prior to use for cover activities. A hopper barge was used to transport sand cover material from the temporary stockpile to the placement Area. The spuds on the placement plant were used to move the plant within a placement area consisting of one or more contiguous sub-DMUs. Placement activities generally worked from lower elevations to higher and the placement plant was moved such that depressions created by the spuds during the placement operations would be covered as the equipment moved out of the placement area.

Placement of sand cover was predominately performed by the spreader system to reduce mixing of the sand cover material with underlying sediment. Sand cover material was transferred by excavator from the hopper barge to the hopper that fed the spreader system. The spreader system spread material in an overlapping manner and used spinners to broadcast the material over the target placement area. Placement with the spreader system was tracked using positioning system data and material feed rates to the spreader system.

Where the spreader system was not able to efficiently operate (e.g., in shallow water depths, in focused areas along edge of placement area), mechanical placement was performed. Mechanical placement was performed by the placement plant excavator equipped with a clamshell bucket. Mechanical placement included loading the clamshell with the target material, maneuvering the bucket to a target location using the positioning control system and releasing the material in the water column just above the target top of cover elevation.

5.1.2 Sequence

Based on the results of confirmation sampling (Section 4.2.4) and evaluation of "No Action" DMUs, residual cover placement was completed in the following sequence (grouped based on completion date in USACE's tracking documents):

- CS-1 through CS-5
- FC-7
- FC-1, FC-4 through FC-6, FC-14 through FC-16, FP-1, FP-2, FS-1, FS-2, HS-1 through HS-3, OC-1, OC-6, OC-16, and OC-17
- OC-2, OC-5, OC-9, FC-2, FC-3, FC-8, and FC-11
- OC-14

5.1.3 Residual Cover Placement Confirmation Cores

Following placement of sand cover material in residual cover areas, residual cover placement confirmation cores were collected to verify that installed cover thicknesses met the placement thickness directed by USACE, within the specified tolerances (0 to +3 inches). Placement thicknesses directed by USACE were 6 inches, except in HS-1-J and HS-1-L which were directed to have a cover placement thickness of 18 inches (installed in one 6-inch and one 12-inch lift) due to elevated COC concentrations and additional dredging not performed due to stability concerns. Cover placement thicknesses were discussed with the Partners prior to USACE directing the Contractor. Residual cover placement confirmation cores were collected by push core equipped with a clear core tube and check valve system. The total number of placement confirmation cores collected in residual cover areas was 172 cores. After collection of residual cover placement confirmation cores, the thickness of the unmixed cover and mixing zone was measured and recorded by Arcadis. The total applied thickness was then calculated as the unmixed cover thickness plus 50% of the mixing zone thickness. The unmixed cover thickness and total applied thickness values were then compared to the specified requirements of 4 inches and 6 inches, respectively. Results of the collected placement confirmation cores and evaluation of data are provided in Appendix G. Table 5-1 summarizes the results of the residual cover placement cores with data grouped by contiguous DMUs. The placement core collection frequency was met for the contiguous DMU groupings, except at DMU OC-9 (actual frequency of 1 per 3,791 square feet [sf] versus specified 1 per 3,600 sf). USACE accepted the core collection frequency based on the overall cover placement area and total number of cores collected meeting 1 per 3,600 sf.

Table 5-1. Residual Cover Placement Confirmation Core Summary

DMU	Placement Area (sf)	Number of Placement Confirmation Cores (Frequency)	Unmixed Cover Thickness (inches)	Applied Cover Thickness (inches)	Placement Confirmation Cores That Did Not Meet Requirements
CS-1 to CS-5	70,814	25 (1 per 2,832 sf)	1.5 - 11.5	2.75 - 11.5	CS-CM-03
FP-1, FP-2, FC-1 to FC-4, OC-1, OC-2, OC-5, OC-6	246,340	74 (1 per 3,328 sf)	1.5 - 14	2 - 14	FC2-CM-07, FC3-CM-02, FC3-CM-03, FC3-CM-04, OC2-CM-15, OC2-CM-16, OC2-CM-17, OC2-CM-18, OC5-CM-01
FC-5 to FC-7	29,132	9 (1 per 3,237 sf)	7 - 11	7 - 11	--
FC-8	9,665	3 (1 per 3,222 sf)	5.25 – 6.25	5.25 - 6.25	FC8-CM-01, FC8-CM-03
FC-11	9,078	3 (1 per 3,026 sf)	4.5 – 8.75	4.5 - 8.75	FC11-CM-06
FC-14 to FC-16, OC-16, OC-17	33,163	12 (1 per 2,754 sf)	6 - 11	6 - 11	--
FS-1, FS-2	29,006	10 (1 per 2,901 sf)	6-13.5	6 - 13.5	--

DMU	Placement Area (sf)	Number of Placement Confirmation Cores (Frequency)	Unmixed Cover Thickness (inches)	Applied Cover Thickness (inches)	Placement Confirmation Cores That Did Not Meet Requirements
HS-1 to HS-3	78,409	29 (1 per 2,704 sf)	1.5 - 24	1.5 - 24	HS1-CM-04, HS1-CM-08, HS3-CM-25, HS1-CM-12, HS1-CM-13
OC-9	22,748	6 (1 per 3,791 sf)	5.5 - 8	5.5 – 8	OC9-CM-05
OC-14	2,105	1 (1 per 2,105 sf)	9.25	9.25	--
Total	**530,459**	**172 (1 per 3,084 sf)**	**1.5 - 24**	**1.5 - 24**	--

Seventeen (17) of the residual cover placement confirmation cores did not achieve the 6-inch total applied thickness and, of these, eight (8) cores also did not achieve the minimum unmixed sand cover thickness of 4 inches. Additionally, residual cover placement confirmation cores collected in HS-1-J (HS1-CM-12) and HS-1-L(HS1-CM-13) did not meet the 18-inch placement thickness directed by USACE; the applied cover thicknesses for these locations were 9.25 and 6 inches, respectively. Areas of over-placement were left in place at the discretion of USACE to avoid disturbance of the placed cover.

For cores that did not meet required placement thickness based on residual cover placement confirmation cores, the Contractor placed additional sand cover prior to USACE performing the post-cover bathymetric survey. As part of the post-cover survey data processing, USACE prepared volume reports and cut/fill maps by comparing the sand cover design surface to the post-cover survey[g]. Although the specifications required placement of required cover depths within 100% of the placement area, USACE accepted areas of cover placement where the cut/fill maps and volume reports reviewed by USACE showed cover depths being met at over 90 percent of the placement area. Per USACE, the post-cover survey data did not show that full thickness was achieved at all locations, which was attributed to:

- Intermixing of sand cover with underlying sediment and/or settlement and compaction of the underlying sediment
- Depressions created by spuds of equipment after dredging and prior to cover placement that would have had sand cover material placed over the depression as the placement plant moved out of the placement area as discussed in Section 5.1.1
- Steep slopes that would not support additional sand cover placement without sloughing.

Based on review of the residual cover placement confirmation cores, the Contractor performing internal check cores during additional material placement, and comparison of post-dredge and post-cover survey data[5], USACE determined that the sand cover placement was complete. USACE shared results of the processed survey data and residual cover placement confirmation cores with the Partners for agreement that cover placement activities were complete prior to notifying the Contractor that cover placement activities were approved within a DMU.

5.1.4 Placement Volumes

Residual cover placement volumes were calculated by USACE based on post-dredge and post-cover surveys conducted by USACE. Survey results and DMU limits are shown in the as-built drawings (Appendix A). Approximately 16,087 cy of material was placed as residual cover as part of the sediment cleanup activities as summarized in Table 5-2.

[g] *Survey data related to residual cover placement including cut/fill maps and volume reports can be found on the project SharePoint under the following folders: "Documents>USACE>ENV Dredging Surveys", "Documents>USACE>ENV Re-Dredging Surveys", and "Documents>USACE> Sand Cover Surveys & Coring".*

Table 5-2. Residual Cover Placement Volumes

DMU	Placement Volume (cy)
CS-1	347
CS-2	661
CS-3	526
CS-4	95
CS-5	423
FP-1	906
FP-2	944
FC-4	776
OC-6	199
FC-5	156
FC-6	159
OC-16	223
OC-17	142
FC-14	366
FC-15	279
FC-16	144

DMU	Placement Volume (cy)
FC-7	556
FS-1	379
FS-2	477
FC-1	383
OC-1	499
HS-1	1803
HS-2	377
HS-3	1123
OC-2	763
OC-5	130
OC-9	571
FC-2	1410
FC-3	833
FC-8	167
FC-11	210
OC-14	63
Total	**16,087**

5.2 ENR Cover Placement

ENR cover was installed at the locations identified in the DDR and shown on the design plans. USACE prepared sand cover design surfaces and provided these surfaces to the Contractor. ENR cover placement activities followed the general approach described in Section 5.2.1 and sequence summarized in Section 5.2.2. Verification of the cover thicknesses placed was performed as summarized in Section 5.2.3 and the total volume of material placed is summarized in Section 5.2.4.

5.2.1 General Approach

ENR cover was placed to achieve a target thickness of 6 inches and utilized the same equipment and approach as discussed in Section 5.1.1 for the residual cover placement.

5.2.2 Sequence

Cover placement in ENR DMUs identified in the DDR (i.e., FC-10, OC-10, OC-13, and OC-15) was performed following completion of residual cover placement activities in other DMUs as described in Section 5.1. ENR cover placement was completed on the same day in the ENR DMUs per USACE's tracking documents.

5.2.3 ENR Placement Cores

Following placement of sand cover material in ENR cover areas, placement cores were collected to verify that installed cover thicknesses met the 6-inch placement requirement and were within the specified tolerances (0 to +3 inches). Placement cores were collected by push core equipped with a clear core tube and check valve system. The total number of placement cores collected in ENR cover areas was 13 cores. Based on a total ENR cover area of 41,630 square feet, the average placement core collection frequency was one core per 3,203 square feet, which meets the required frequency of one core per 3,600 square feet.

After collection of placement cores, the thickness of the unmixed cover and mixing zone was measured and recorded by Arcadis. The total applied thickness was then calculated as the unmixed cover thickness plus 50% of the mixing zone thickness. The unmixed cover thickness and total applied thickness values were compared to the specified requirements of 4 inches and 6 inches, respectively. Results for the ENR placement cores are provided in Appendix G and summarized in Table 5-3. The results indicate that the ENR cover thicknesses in all DMUs meet the minimum requirements of the DDR. Areas of over-placement were left in place at the discretion of USACE to avoid disturbance of the placed cover.

Table 5-3. ENR Placement Cores Summary

DMU	Placement Area	Number of Placement Cores (Frequency)	Unmixed Cover Thickness (Inches)	Applied Cover Thickness (inches)
FC-10	4,636	2 (1 per 2,318 sf)	8 - 9.25	8 - 9.25
OC-10	17,776	5 (1 per 3,555 sf)	6.5 - 10.25	6.5 - 10.25
OC-13	12,206	4 (1 per 3,051 sf)	7.25 - 11	7.25 - 11
OC-15	5,748	2 (1 per 2,874 sf)	7.5 - 9.25	7.5 - 9.25
Total	40,366	13 (1 per 3,105 sf)	6.5 - 11	6.5 - 11

5.2.4 Placement Volumes

Cover placement volumes were calculated by USACE based on post-dredge and post-cover surveys conducted by USACE[h]. Survey results and DMU limits are shown in the as-built drawings (Appendix A). Approximately 816 cy of material was placed as ENR cover during the sediment cleanup activities as summarized in Table 5-4.

Table 5-4. ENR Cover Placement Volumes

DMU	Placement Volume (cy)
FC-10	131
OC-10	339
OC-13	235
OC-15	111
Total	**816**

5.3 Backfill Placement

As discussed in Section 4.2.5, dredging and sloughing of existing sediment occurred outside the anticipated limits near the HS shoreline. Backfilling of this area was performed in November 2021 and November 2022 to address shoreline stability concerns based on the geotechnical analysis documented in the DDR. Approximately 3,360 tons of backfill was estimated to be required to achieve the neatline grade provided in the DDR.

Backfill placement prior to the 2021 winter shutdown was performed using the same mechanical equipment and a similar approach as the cover material placement (Sections 5.1 and 5.2). Approximately 1,655 tons of sand was placed as backfill in 2021 as noted in Section 2.1. In 2022, mechanical placement of backfill in HS was performed using a similar barge setup and approach as 2021 for mechanical placement with the placement plant excavator

[h] *Survey data related to ENR cover placement including cut/fill maps and volume reports can be found on the project SharePoint under the following folders: "Documents>USACE>ENV Dredging Surveys", "Documents>USACE>ENV Re-Dredging Surveys", and "Documents>USACE>ENR Surveys".*

equipped with a clamshell bucket. Equipment for the 2022 backfill placement was mobilized to Howards Bay between October 31 and November 2, 2022. Staging and support operations for the 2022 backfill activities were completed from the Contractor's Duluth property. Placement of 1,609 tons of sand (Section 2.1) was performed between November 10 and November 12, 2022. The backfill was placed over the entire area of concern to create an even slope. The total backfill placement in HS was limited to the approximately 3,264 tons placed based on funding limitations for the project. Final backfill placement in HS was documented by USACE survey on November 14, 2022.[i]

6 Environmental Monitoring

Environmental monitoring was performed as described in this section during the dredging and handling of impacted sediments removed from Howards Bay to meet the requirements of the DDR and project permits. As noted in Section 5, turbidity monitoring during sand cover placement was not required by the WDNR permit.

6.1 Community Air Monitoring

Community air monitoring was performed between May 19 and November 19, 2021 in accordance with the Contractor's approved Sampling and Analysis Plan (Transmittal 01 35 13.10-2.6).

At the sediment staging area (former Baxter Avenue Embayment), fugitive dust migration was visually assessed during work activities and reasonable dust suppression techniques were implemented as necessary. Additionally, real-time community air monitoring was performed to monitor air quality for the protection of potential receptors at the surrounding properties. Community air monitoring was performed at three locations (one upwind and two downwind) near the boundaries of the work area to monitor for particulate matter less than 10 microns in diameter (PM10) and flammable vapors. The air monitoring stations were determined daily based on wind observations at the site or available meteorological forecasts and recorded on air monitoring forms (Appendix H).

Particulate monitoring was performed with real-time air quality monitoring systems at each air monitoring station to continuously monitor PM10 concentrations. Equipment was calibrated daily in accordance with manufacturer's recommendations. The particulate monitoring system instrumentation was equipped with an electronic data-logging capable of calculating 15-minute running average concentrations. Data from each unit were downloaded daily; however, due to technical issues with retrieving data from the equipment, USACE required PM10 readings be recorded manually every hour to correct this deficiency starting on June 19, 2021. Results of particulate monitoring were recorded on air monitoring forms (Appendix H) and compared to early warning action level (100 microgram per cubic meter) and stop work action level (150 microgram per cubic meter) defined in the DDR and project specifications. Exceedances of action levels were addressed through use of water trucks to wet surfaces (e.g., access roads) to control dust.

Flammable vapor monitoring was performed with a hand-held, direct-reading instrument calibrated in accordance with the manufacturer's recommendations. Flammable vapor readings were taken manually three times per day at each air monitoring station. Results of the flammable vapor reading were recorded on the air monitoring forms (Appendix H) and compared to the action levels defined in the DDR and project specifications. No exceedance of the flammable vapor action level (10% lower explosive limit) was recorded during the sediment cleanup activities.

[i] *Survey data related to backfill placement including comparison to design surface and volume reports can be found on the project SharePoint under the following folders: "Documents>USACE>Hughitt Slip Backfill".*

Community air monitoring was not performed at WPLF due to no potential receptors being present. However, visual observations were performed for dust migration from the WPLF work area and reasonable dust suppression techniques were applied as necessary.

6.2 Turbidity Monitoring

Performance and background turbidity monitoring were performed between May 3 and November 11, 2021 in accordance with the DDR, project specifications, and the Contractor's approved Turbidity Monitoring Plan (Transmittal 35 20 23.53-1.1). Background turbidity monitoring was performed in 2020 per WDNR request, however the Contractor was not able to recover the data.

Performance turbidity monitoring was conducted manually at the project site boundary and at three locations within 150 feet of active dredging. Manual turbidity measurements were collected with real-time meters at three depths within the water column (1/3-depth below the water surface, mid-depth of the water column, and 2/3-depth below the water surface) at each the sampling location twice per shift (at least 2 hours after work has started/resumed). Background turbidity monitoring was conducted using a continuous monitor from a background location positioned outside of the study area near the confluence of Howards Bay and the St. Louis River (approximately 500 feet beyond the I-535/Blatnik Bridge along the north shore). The background turbidity monitoring system allowed for remote data retrieval and results were reported as running averages. The specifications called for reporting results as a 10-minute running average; however, USACE allowed for 15-minutes running averages to be reported. To evaluate turbidity monitoring results against the compliance limits specified in the DDR and project specifications, an average value of readings obtained from the performance monitoring locations was compared against the background location reading at that time to determine the compliance value. Turbidity data collected during the sediment cleanup activities, including calculated compliance values, were documented in daily field reports and the turbidity tracking log that were posted to the project SharePoint for review by the Partners. A copy of the turbidity tracking log is provided in Appendix I. A summary of compliance level exceedances is provided in Table 6-1.

Table 6-1. Turbidity Monitoring Compliance Limit Exceedances

Compliance Limit (1)	Date	Action Taken in the Field
Warning Level (Increased Monitoring)	5/27/2021 (AM)	Dredge plant shutdown for unrelated GPS issue
	6/19/2021 (PM)	Readings from inside air bubble curtain, turbidity curtain installed interior to air bubble curtain
	6/24/2021(AM)	Dredge plant shutdown for 1 hour
	6/26/2021(PM)	Additional reading taken (above compliance limit); increased cycle time for dredging operations
	7/19/2021 (PM)	Additional reading taken (below compliance limit)
	8/12/2021 (AM)	Additional reading taken (below compliance limit)
Action Level (Implement Corrective Measures)	5/26/2021 (PM)	Dredge plant shutdown for remainder of day
	6/23/2021 (AM)	Dredge plant shut down for 30 minutes; additional reading taken (turbidity attributed to recent stormwater runoff)
Not-To-Exceed Level (Stop Work)	5/25/2021 (PM)	Dredge plant shut down
	6/1/2021 (PM)	Dredge plant shut down for remainder of day
	6/2/2021 (AM, PM)	Readings taken at 150 feet from dredge and within turbidity curtain; turbidity outside turbidity curtain visually low. No action taken, WDNR indicated future readings should be taken outside turbidity curtain
	6/3/2021 (AM)	Reading during barge movement when turbidity curtain was pulled to the side; turbidity curtain was redeployed after barge was swapped.

Compliance Limit [1]	Date	Action Taken in the Field
	6/23/2021 (PM)	Turbidity curtain installed, dredge plant shut down for 30 minutes, additional reading taken between air bubble curtain and turbidity curtain below compliance level

Note:
[1] Compliance limits were defined based on the difference between the performance turbidity value and the background value (expressed in nephelometric turbidity units [NTUs]). The Warning Level was 65 NTUs above background, Action Level was 87 NTU above background and the Not-To-Exceed Level was 110 NTUs above background. The response required by the specifications for each level is indicated in parentheses.

7 Material Handling

As indicated in Section 1.5.2, material handling included offsite disposal of debris encountered during environmental dredging at a commercial disposal facility (Vonco), offsite disposal at a commercial disposal facility (Vonco) of sediment from DMUs that did not meet WPLF placement criteria, and placement of sediment from DMUs that did meet the WPLF placement criteria for surface or subsurface cover. Material handling was performed as described in this section and in accordance with the DDR, plans, specifications, and the approved Onsite Material Handling Plan (Transmittal 02 61 13-2.5). Debris and dredged material handling were performed between May 21 and November 23, 2021 as described in Sections 7.1 and 7.2, respectively. Water handling was performed between April 30 and November 18, 2021 as described in Section 7.3.

7.1 Debris

Debris from the dredge areas was removed and transported to the staging area as discussed in Section 4.1. At the staging area, debris was offloaded from the barge separately from the dredged sediment and was segregated by type. Debris was offloaded into a temporary storage bin and decontaminated (Section 8.1) prior to being staged in the debris staging area of the gravel pad. Once sufficient quantity of debris was generated, the debris was loaded into trucks for transportation to Vonco Landfill (Vonco) for recycling or disposal. Between June 22 and November 23, 2021, 22 truckloads of debris totaling approximately 207 tons were disposed of at Vonco (Appendix J).

7.2 Dredged Material

Dredged material handling was performed between May 21 and November 21, 2021 as described in this section.

7.2.1 Material Handling and Dewatering

Sediment from the dredge areas was removed and transported to the staging area as discussed in Section 4.2. Upon arrival at the staging area, debris was segregated as discussed in Section 7.1 and water within the hopper barge was transferred to the onsite water treatment system for treatment as discussed in Section 7.3. The material within the hopper barge was then allowed to gravity dewater overnight. Water generated during gravity dewatering was also transferred to the onsite water treatment system for treatment.

After gravity dewatering, an excavator with mixing head attachment was used to mix solidification agent (Portland cement) at a rate of approximately 0.157 tons of solidification agent per cubic yard of dredged material in the hopper barge. Approximately 14,298 tons of solidification agent was used to solidify the 91,141 CY of dredged material. The quantity of solidification agent used was recorded in the Contractor's daily reports. Once the solidification agent was appropriately mixed with the sediment in the hopper barge, the material was allowed to sit

overnight before being transferred to the asphalt pad constructed as discussed in Section 3.4. A spill guard was used underneath the swing radius of the excavator used to transfer material from the barge to the offloading area to contain any material that may be spilled during transfer and prevent release to the water. Material within the asphalt pad was tested in the field to confirm that that material passed the paint filter test (USEPA Method 9095B) prior to transportation offsite.

After the material was sufficiently solidified to pass the paint filter test, it was loaded from the asphalt pad into over the road trucks for transportation offsite. A plastic spill guard was used between the asphalt pad and the truck loading location to contain potential falling material while loading trucks. Any spilled material was recovered and returned to the asphalt pad. A visual inspection of the trucks was performed, and any spilled material was removed prior to the truck leaving the site to prevent tracking of materials offsite. Dredged material was transported to either WPLF (Section 7.2.2) or Vonco (Section 7.2.3) based on the DMU the material was removed from.

7.2.2 Transportation and Placement at Wisconsin Point Landfill

As noted in Section 1.5.2, dredged material placed at WPLF was identified for use as subsurface cover or surface cover using the WPLF placement criteria identified in a WDNR memorandum dated April 18, 2017. Trucks loaded with material meeting requirements for placement at WPLF were transported by the Contractor in accordance with their approved Traffic Control Plan (Transmittal 01 35 13.10-3.3) and placed in accordance with the Contractor's approved Wisconsin Point Landfill Material Placement Plan (Transmittal 02 66 00-2.3).

Prior to placement of dredged material at WPLF, the area to receive fill was prepared as discussed in Section 3.5. As described in the Wisconsin Point Landfill Material Placement Plan, placement of material was performed in a phased manner to minimize the open active working area. In consideration of the requirement for at least 1.5 feet of surface cover material over subsurface cover material, initial placement of surface cover was performed to create a berm until a point was reached that subsurface cover material could be placed and have sufficient surface cover material installed over it. In areas where insufficient surface cover material was placed over subsurface cover material, additional Erie Pier borrow material was placed in August 2022 as discussed in Section 8.3. All placement was performed with a dozer equipped with GPS controls and material was installed in 1-foot lifts. No compaction was performed other than that resulting from the dozer tracks.

Topographic surveys of WPLF were performed by USACE to document the top of subsurface cover material and surface cover material placed (Section 3.3). Results of those surveys are provided in the as-built drawings (Appendix A). Based on calculations provided by USACE, approximately 15,957 cy of subsurface cover and 58,517 cy of surface cover material was placed at WPLF. Placement of imported fill over the dredged material and restoration of WPLF is discussed in Section 8.3.

7.2.3 Transportation and Disposal at Vonco

Material that did not meet the criteria for placement at WPLF was disposed of at Vonco. Prior to disposal, the Contractor received approval from Vonco to dispose of up to 30,000 cy of dredge sediment from Howards Bay (Appendix J). Trucks loaded with material for disposal at Vonco were transported by the Contractor in accordance with their approved Traffic Control Plan (Transmittal 01 35 13.10-3.3). Between June 1 and November 19, 2021, 809 truckloads totaling approximately 16,668 tons of stabilized sediment were disposed of at Vonco based on tracking provided by USACE. A copy of the Contractor's trucking log for transport of material to Vonco is provided in Appendix J.

7.3 Water Handling, Treatment, and Discharge

Water generated during sediment cleanup activities that required treatment included water removed from the sediment handling barges and water (including stormwater) that accumulated in the barges, asphalt pad, and decontamination areas. A temporary water treatment system was installed by the Contractor at the former Baxter Avenue Embayment staging area constructed as discussed in Section 3.4. Installation and operation of the temporary water treatment system occurred between April 28 and November 16, 2021.

The water treatment system included an influent frac tank, multi-media filters, granular activated carbon vessels, and effluent frac tank. Water from the effluent tanks was discharged to an existing sewer line near Cummings Slip as identified in the DDR. Discharge was coordinated with the City and performed under Permit No. 2021-LH010022. Approximately 1,441,790 gallons of water were discharged to the City's sewer between June 11 and November 16, 2021. To comply with the permit, effluent water samples were collected and submitted for analysis by the Contractor in accordance with their approved Sampling and Analysis Plan (Transmittal 01 35 13.10-2.6). Samples were collected prior to discharge of water treated from specific dredge locations as identified in the permit and analyzed for pH, total suspended solids, 5-day biological oxygen demand, phosphorus, oil and grease, cadmium, lead, copper, mercury, total PAHs and tributyltin. Results of the effluent water analytical testing were emailed to the City once received in accordance with the permit. Documentation associated with the water treatment operations are provided in Appendix K. QA water treatment sampling was performed as described in Section 9.2.2.

8 Project Completion

This section summarizes activities associated with completion of components of the sediment cleanup activities.

8.1 Decontamination

All equipment that came in contact with impacted material required decontamination prior to handling clean material or prior to leaving the site. Decontamination to visually clean was performed in accordance with the DDR, project specifications, and the Contractor's approved Decontamination Work Plan (Transmittal 01 35 29.13-2.1). Decontamination was performed first using tools such as shovels or brooms to remove dry materials from the equipment. Once dry removal was completed, pressure washers or detergents were used, as necessary, to remove remaining visual impacts. All decontamination was performed within a temporary decontamination pad or over similarly contained area capable of containing waste generated during decontamination. Dredge buckets were typically decontaminated over hopper barges. Decontaminated equipment was visually inspected prior to departure from the site and photographs included in daily field reports. Solid materials generated during decontamination activities were managed with dredged material (Section 7.2). Water generated during decontamination efforts were treated in the temporary onsite water treatment system (Section 7.3).

8.2 Support Area Restoration

Following completion of dredging and sediment processing, including decontamination of equipment, the support area installed at the former Baxter Avenue Embayment staging area (as discussed in Section 3.4) was dismantled. Debris generated from the removal of the pads was transported offsite for disposal at Vonco. After removal of the support area and demobilization of the equipment from the support area, surface soils in the area used for sediment staging were sampled by the Contractor to document post-construction conditions. Samples

were collected on December 9, 2021 and analyzed the same as the pre-construction samples discussed in Section 3.4. Post-construction sample results are provided in Appendix D. USACE received Fraser's acceptance of the support area restoration.

8.3 Wisconsin Point Landfill Restoration

During placement of dredged material at WPLF as discussed in Section 7.2.2, the existing monitoring wells and vents within the placement area of WPLF were extended as detailed in the approved monitoring well extension detail (Transmittal 02 66 00-2.3).

Following placement of dredged material (Section 7.2.2), imported fill was placed in accordance with the DDR, project plans, specifications, and Contractor's approved Wisconsin Point Landfill Material Placement Plan (Transmittal 02 66 00-2.3). Erie Pier borrow material discussed in Section 2.2, was imported to WPLF and placed over the dredged material using the same equipment and similar methods as described in Section 7.2.2. Approximately 9,660 cy of Erie Pier borrow material was placed at WPLF in 2021 before winter conditions prevented additional placement of material. Hydro-mulching of the placement area was performed between December 20 and 22, 2021 to act as a temporary erosion control during the winter shutdown.

In early June 2022, rills at WPLF were identified by the City and the Contractor was notified that repairs were necessary. Repairs of rill areas were performed on June 14, June 17, June 27, June 29, July 1, and July 20, 2022. Repair work included filling rills with material that deposited at the bottom of the rill, installation of coir logs, seeding, and/or placing of coconut fiber mats or hay as appropriate.

Re-mobilization to WPLF for completion of the restoration work began on July 27, 2022. Between August 2 and August 3, 2022, approximately 2,680 cy of additional Erie Pier borrow material was placed to achieve the minimum required thicknesses between top of subsurface cover material and final grade and to fill in the temporary diversion swale. Final survey of the Erie Pier material was performed on August 4, 2022[j] and application of high potassium fertilizer was completed over the entire site on August 29, 2022.

Topsoil placement over the finished Erie Pier material surface was performed between September 7 and October 5, 2022 and included grading of the permanent swale and berm between September 13 and 15, 2022. A total of 10,170 cy of topsoil was placed at WPLF[k]. Topsoil placement began in the northwestern portion of WPLF and generally proceeded to the southeast. In general, the Contractor targeted placement of 0.6 foot of topsoil in order to achieve the specified topsoil thickness of 0.5 foot. Topsoil amendment and permanent seeding was completed over the entire site on October 5, 2022 and verified by USACE. Mulch was applied, and areas were crimped to help stabilize the placed topsoil material. Construction of the permanent swale and berm including installation of erosion control material (Section 2.4) in the swale and installation of geotextile and riprap in the riprap apron was completed on October 5 and 6, 2022 and verified by USACE. The final surface restoration was accepted by USACE and met the specified requirements or USACE-approved modifications as identified in this section and Section 2.4

[j] *Survey documentation of the Erie Pier material placement including survey data, contour maps, and volume reports can be found on the project SharePoint under the following folders: "Documents>USACE>WPLF Surveys>5. Erie Pier Material After Survey 2021-12-10" and "Documents>USACE>WPLF Surveys>7. 2022 E.P. After Survey 2022-08-04".*

[k] *Survey documentation of the topsoil material placement including survey data, contour maps, and volume reports can be found on the project SharePoint under the following folder: "Documents>USACE>WPLF Surveys>9. 2022 Topsoil After Survey #2 2022-09-30".*

Furnishings for WPLF, including four steel park benches and one prefabricated steel shelter, meeting the specified requirements and City requested colors were furnished by the Contractor. These furnishings were delivered to the City Parks Department for storage and future installation by others.[l]

8.4 Demobilization

Demobilization from WPLF occurred between October 8 and October 28, 2022. Following the completion of work activities at WPLF, remaining support areas were leveled off and remaining equipment and materials were cleaned and removed from WPLF. As part of the demobilization efforts, repairs to Wisconsin Point Road were performed based on a September 29, 2022 inspection attended by USACE, the City, Wisconsin Department of Transportation, and the Contractor. Road repair activities began on October 19, 2022 with cutting of asphalt in areas of concern along Wisconsin Point Road. Removal of existing pavement and installation of new asphalt began on October 26 and was completed on October 28, 2022, with the line painting. The Wisconsin Point Road repairs also included reshaping of the landfill entrance road to improve City access.

9 Quality Assurance and Testing

QA observations and testing was performed by USACE, with Arcadis support, to observe and document construction activities specific to the GLLA sediment cleanup in Howards Bay. The QA sampling, analysis, and monitoring activities tasked to Arcadis included the following:

- Evaluating confirmation sediment samples as discussed in Section 4.2.4.3.
- Collecting split samples of confirmation sediment samples (Section 9.2.1), water treatment plant discharge sample (Section 9.2.2), and staging area soil samples (Section 9.2.3)
- Confirming performance and data checks of the turbidity monitoring program (Section 9.1.1), community air monitoring program (Section 9.1.2) and cover placement thickness (Section 9.1.3).
- Recording observations in field notes and photographing work activities; a photograph log is provided in Appendix L.

Arcadis was onsite between May 10 and November 19, 2021.

9.1 Quality Assurance Activities

9.1.1 Turbidity Monitoring Verification

While onsite, Arcadis confirmed with the Contractor that turbidity monitoring was being performed; reviewed available equipment calibration and maintenance logs; performed spot checks of the previous day's turbidity monitoring data calculations and results against compliance levels; and confirmed exceedances were reported and corrective measures implemented. Results of these reviews were documented in daily field reports or on monitoring record review forms, as appropriate. Any concerns or deficiencies noted by Arcadis were brought to the attention of USACE.

[l] *Correspondence confirming receipt of benches and shelter can be found on the project SharePoint under the following folder: "Documents>USACE>WPLF Benches & Shelter Delivery".*

9.1.2 Community Air Monitoring Verification

While onsite, Arcadis confirmed with the Contractor that community air monitoring was being performed; reviewed available equipment calibration and maintenance logs; performed spot checks of the previous day's air monitoring data calculations and results against compliance levels; and confirmed exceedances were reported and corrective measures implemented. Results of these reviews were documented in daily field reports or on monitoring record review forms, as appropriate. Any concerns or deficiencies noted by Arcadis were brought to the attention of USACE.

9.1.3 Cover Verification

Arcadis observed the collection of the cover placement cores and processed the cores as discussed in Sections 5.1.3 and 5.2.3. Results of the cover placement core verification are presented in Appendix G and Sections 5.1.3 and 5.2.3.

9.2 Quality Assurance Laboratory Testing

QA testing was performed in accordance with the approved Arcadis Quality Assurance Plan (Arcadis 2021b) unless otherwise indicated in this section. In general, QA samples were collected at 10% of the samples collected by the Contractor using the same analytical methods as the Contractor. Eurofins TA was used for all QA sample analysis and samples were submitted as blind samples to the laboratory. It should be noted that, due to the specialized nature of the tributyltin analysis, Eurofins TA was used by both Arcadis and the Contractor for this analysis.

9.2.1 Sediment Confirmation QA Sampling

Split sediment confirmation samples were collected by Arcadis from the homogenized material prepared by the Contractor as discussed in Section 4.2.4.1. A total of 37 split sediment samples were collected by Arcadis compared to 352 samples collected by the Contractor, meeting the target 10% for QA testing. The QA sediment samples were submitted for the same analyses as the parent sample collected by the Contractor (i.e., total organic carbon, PAHs, tributyltin, lead, mercury, and percent moisture). Results of the QA sediment samples are presented in Appendix M.

In accordance with the Arcadis Quality Assurance Plan, the results of the QA sediment sample were compared against the values for the parent sample collected by the Contractor to determine if the results of the samples were similar. The results of this evaluation are summarized and presented in Appendix M. Based on this evaluation, most of the results between the QA sample and the parent were generally similar. When considering the results that were not similar, the QA sample data would not have changed the recommendation for further action based on the data interpretation discussed in Section 4.2.4.3 nor would have resulted in a lesser action (e.g., residual cover only instead of re-dredging with residual cover).

9.2.2 Water Treatment (Liquid) QA Sampling

One split effluent water sample was collected by Arcadis. The effluent water sample was analyzed for pH, total suspended solids, cadmium, lead, copper, mercury, and total PAHs based on the list of parameters in the technical specifications. Results of the effluent water analytical testing are provided in Appendix M. In accordance with the Arcadis Quality Assurance Plan, the results of the QA effluent water sample were compared against the

values for the parent sample collected by the Contractor to determine if the results of the samples were similar. Based on results of this evaluation as provided in Appendix M, the QA sample and parent sample were similar. Note that the Contractor analyzed for a longer list of parameters based on permit requirements as discussed in Section 7.3 and the results for those additional parameters were not evaluated.

9.2.3 Staging/Support Area QA Sampling

Due to scheduling and direction from USACE, Arcadis was not onsite during the support area soil sampling; therefore, no QA samples were collected by Arcadis.

10 Conclusions

The information presented in this SCDR was compiled from documentation submitted by the Contractor, information and input from USACE, and performance of QA activities by Arcadis. An independent technical review of the prepared SCDR was performed in accordance with the EDC Quality Control Plan (Arcadis 2021a); documentation of this review is provided in Appendix N.

Based on the information presented in this SCDR, sediment cleanup work was completed in general conformance with the DDR, plans, and specifications and the following USACE-approved modifications and corrective measures agreed to by the Partners:

- Acceptance of sand gradations indicating more fines in the sand material than was specified (Section 2.1)
- Use of alternate sand cover criteria for copper and nickel (Section 2.1)
- Modified topsoil testing requirements including removal of TCLP and polychlorinated biphenyl testing and use of alternate testing methods for select parameters (Section 2.3)
- Substitution of select seed species based on market availability (Section 2.4)
- Use of Urban Type B erosion control blanket in the drainage swales based on based on acceptance of the Contractor's Erosion Control Plan (Transmittal 31 32 11-8.1) and issuance stormwater permits by both WDNR and the City.
- Collection of post-SND samples as part of the confirmation sampling program to identify additional action in "No Action" DMUs (Sections 3.3, Section 4.2.4),
- Installation of a temporary diversion swale and placement of clay to cover exposed waste at WPLF (Section 3.5)
- Identification and removal of a sunken vessel encountered in HS (Section 4.1)
- Final surface left above design dredge surface due to an artificial obstruction in DMU FP-2 that was left in place in accordance with the project specifications (Section 4.2.1)
- Dredge tolerances exceeded over contiguous areas of 400 square feet due to artificial obstructions, high subgrade, or slope failures as accepted by accepted by USACE and the Partners (Section 4.2.1)
- Oil boom for sheen control and turbidity curtain (moon pool and slip entrance) for turbidity controls required during dredging activities (Section 4.2.2)
- Modification of the dredging sequence during construction based on Partner input and considering analytical testing and turn-around times for results (Section 4.2.3)
- Modification of the confirmation sampling program including reducing the overall number of sample locations and modified analysis lists per DMU (Section 4.2.4)

- Approval to collect confirmation samples from 0 to 12-inch interval for select cores (Section 4.2.4.1)
- Use of alternate test methods for determining tributyltin concentrations in confirmation samples to achieve a lower detection limit (Section 4.2.4.2)
- Flexibility in interpretation of Decision Tree (Section 4.2.4.3)
- Increases in total dredge volume due to overdredging, dredging and sloughing outside the remediation footprint, and re-dredging based on confirmation sampling program (Section 4.2.5)
- Turbidity monitoring was not performed during sand cover placement based on gradation results of the sand cover material and the WDNR permit (Section 5)
- Placement of residual cover in HS-1-J and HS-1-L in more than one lift based on thickness of cover directed by USACE (Section 5.1.3)
- Acceptance of placement cores outside specified requirements and DMU core collection frequency (Section 5.1.3)
- Backfill placement to address stability concerns in HS due to dredging and sloughing outside the sediment remediation limits (Section 5.3)
- Manual recording of air monitoring data on an hourly basis due to technical issues with retrieving data from air monitoring equipment (Section 6.1)
- Use of a 15-minute running average for reporting background turbidity monitoring data (Section 6.2)
- QA sampling of support area soils was not performed at direction of USACE (Section 9.2.3)

11 References

Arcadis. 2015. Focused Feasibility Study for Sediment Cleanup in Howards Bay, Superior, WI. Prepared for the Great Lakes Legacy Act (GLLA) Howards Bay Focused Feasibility Study and Remedial Design Project on behalf of the Howards Bay Project Partners. June.

Arcadis. 2021a. Quality Control Plan, Engineering During Construction Support, GLLA Sediment Cleanup in Howards Bay, Superior, Wisconsin. Revision 1. March 2021.

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Arcadis. 2022. 100% Design Document Report, GLLA Sediment Cleanup in Howards Bay, Superior, WI. Revision 6. January 28.

MPCA and WDNR. 1992. The St. Louis River System Remedial Action Plan Stage One. Available at: http://www.stlouisriver.org/rap.html

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WDNR. 2003. Consensus-based sediment quality guidelines. Recommendations for use and application. Interim guidance. WT-732 2003. Contaminated Sediment Standing Team. Wisconsin Department of Natural Resources. Madison, Wisconsin.

WDNR. 2015. Evaluation of Sources, Contaminants in Sediment of Howards Bay, City of Superior, Wisconsin. October.

WDNR. 2017. Revisions to September 27, 2016 Memorandum with Subject Line, “Site-Specific Residual Contamination Levels for Dredge Material Proposed for Placement at the Closed Wisconsin Point Landfill in Superior, Wisconsin”. Memorandum. April 19.

Figures

Howards Bay

WISCONSIN POINT LANDFILL

DULUTH

SUPERIOR

Allouez

East End

South Superior

Park Point

Minnesota Point

Barkers Island

Superior Harbor Basin

Hog Island

Wisconsin Point

Richard I. Bong Airport

Sky Harbor Airport

LAKE SUPERIOR

Saint Louis River

Superior Front Channel

Superior Bay

Allouez Bay Channel

Superior Entry

Superior Entry Channel

Nemadji River

Bluff Creek

MINNESOTA
WISCONSIN

ST. LOUIS CO
DOUGLAS CO

T49N R14W

T49N R13W

Nemadji Cem

Saint Francis Cem

2000' 0 2000'

Approximate Scale: 1" = 2000'

Area Location

REFERENCE: BASE MAP USGS 7.5 MIN. QUADS., SUPERIOR, WI-MN, 2018 AND PARKLAND, WI-MN, 2018.

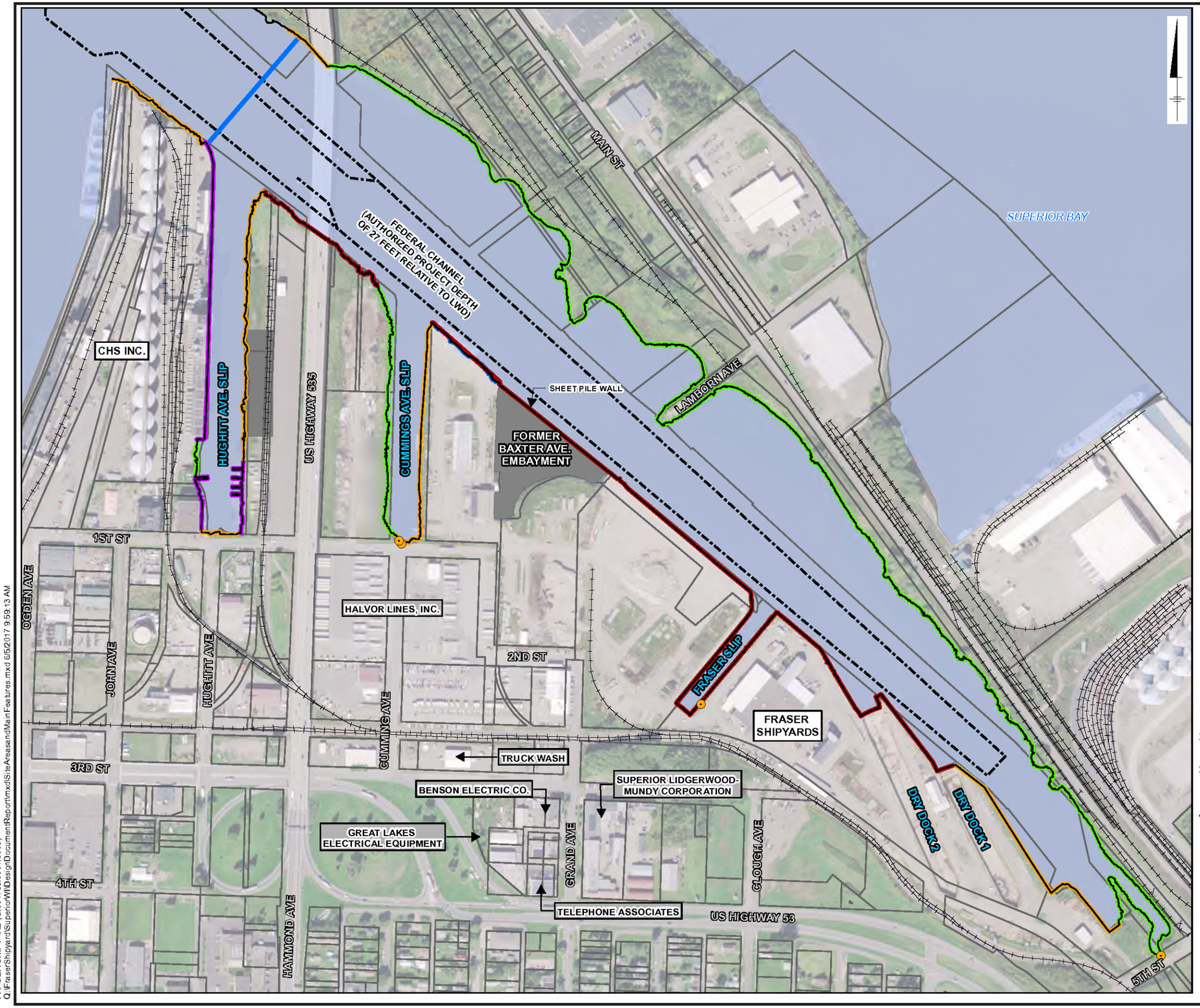
2/1/2022 3:45:32 PM

HOWARDS BAY, SUPERIOR, WISCONSIN
GLLA SEDIMENT CLEANUP DOCUMENTATION REPORT

PROJECT LOCATION MAP

ARCADIS

FIGURE
1-1



SITE LOCATION

LEGEND:

- STORMWATER OUTFALL
- SHORELINE (APPROXIMATE)
- RAILROAD
- FEDERAL CHANNEL

BANK TYPE:

- EARTHEN BANK (APPROXIMATE)
- EARTHEN WITH RIP RAP AND MASONARY RUBBLE AND WOOD PILING (APPROXIMATE)
- CONCRETE (APPROXIMATE)
- STEEL SHEET PILING (APPROXIMATE)
- PARCEL BOUNDARY
- BAXTER AVE EMBAYMENT
- EXTENT OF PROJECT IN HOWARDS BAY

0 400 800 Feet

GRAPHIC SCALE

NOTES:

1. JULY 6, 2011 IMAGERY PROVIDED BY ESRI IMAGE SERVICE.
2. PARCELS, RAILROADS, AND OUTFALLS OBTAINED FROM http://www.ci.superior.wi.us/
3. CHANNEL BOUNDARY AND BATHYMETRY PROVIDED BY THE US ARMY CORPS OF ENGINEERS - DETROIT DISTRICT http://www.lre.usace.army.mil
4. LWD = LOW WATER DATUM OF 601.1 FEET (IGLD 85)

HOWARDS BAY, SUPERIOR, WISCONSIN

GLLA SEDIMENT CLEANUP DOCUMENTATION REPORT

HOWARDS BAY KEY FEATURES

ARCADIS

FIGURE **1-2**

City: SYR Dwf/Group: SWG Created By: JRAPP Last Saved By: kives
FRASER SHIPYARD (30017796.0001.0003)
Q:\Fraser Shipyard\Superior\WI\Design\Document\Report\mxd\SiteAreasandMainFeatures.mxd 6/5/2017 9:59:13 AM

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