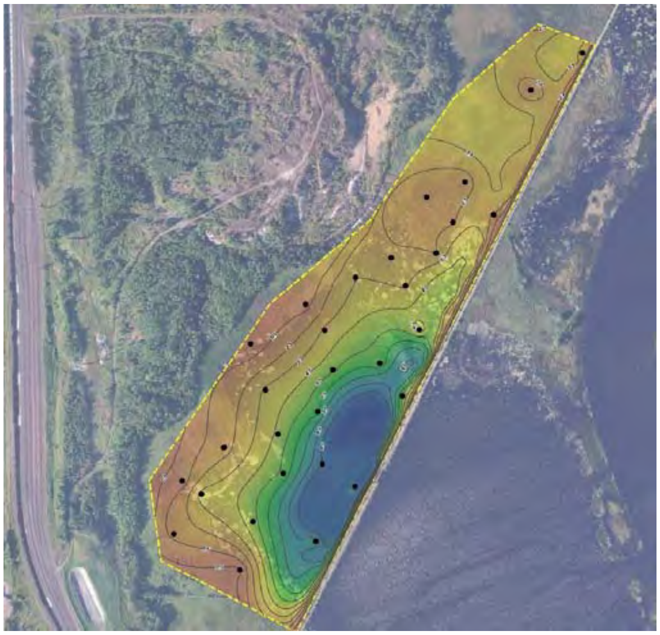
FINAL
FOCUSED FEASIBILITY STUDY
Mud Lake West

Duluth, Minnesota
MPCA Work Order #3000017807



Prepared for:

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CLEAN WATER LAND & LEGACY AMENDMENT

Prepared by:

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June 2017
Revision 01
BWJ160749

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Executive Summary

This Focused Feasibility Study (FFS) for Mud Lake West (the Site) presents: a summary of current Site conditions; a discussion of remedial action objectives (RAOs); and the identification, screening, evaluation, and comparison of potential alternatives. This report was prepared by Bay West LLC (Bay West) in accordance with the Minnesota Pollution Control Agency (MPCA) Contract Work Order No. 3000014275.

The Site was studied as a part of the St. Louis River (SLR) Area of Concern (AOC). Funding to complete an FFS was obtained through the United States Environmental Protection Agency (USEPA), Great Lakes Legacy Act (GLLA) and state funding through the Minnesota Legacy Fund and the Wisconsin Knowles-Nelson Stewardship Fund.

A remedial investigation (RI) was conducted for the Site during the spring and summer of 2015. Contaminants of concern (COCs) identified during the RI were evaluated as part of this FFS and are detailed in **Section 1.4.3.3**. COCs identified for the Site include nickel, zinc, and polychlorinated dibenzo-p-dioxins/dibenzofurans (dioxins). Sediments with elevated levels of the COCs were generally identified in open water areas of the Site and are considered to present a high likelihood of significant effects to benthic invertebrates from exposure to surficial sediments, fish from consumption of benthic invertebrates, and may present a human health risk through direct contact with sediments or ingestion of contaminated biota (i.e., fish consumption).

In 2016, data was collected in support of the 2015 RI to address data gaps identified in the 2015 RI regarding the extent and volume of contaminated sediment within the Site, and to evaluate risks to human health and the environment due to potential impacts by the benthic community (2017 Data Gap Investigation [DGI]). Nickel, zinc, and dioxins were assessed in this investigation. Sediment sample analysis indicates that zinc and dioxin/furan sediment contamination does not extend to deep sediment intervals; however, nickel contamination does extend to deep sediment intervals. Deposition of zinc and dioxin-contaminated sediment occurred more recently than deposition of nickel-contaminated sediment. Toxicity and bioaccumulation testing results indicate site sediments do not appear to be toxic to benthic organisms, and nickel and zinc do not appear to bioaccumulate in benthic tissue; however, dioxins do appear to bioaccumulate in benthic tissue and could migrate up the food chain to higher trophic levels that consume benthic organisms. Based on these results, dioxins are the driving COC for remediation at the Site.

As identified in the SLR Remedial Action Plans (RAPs): RAP Stage I, MPCA and Wisconsin Department of Natural Resources (WDNR), 1992; and RAP Stage II, MPCA and WDNR, 1995; and later proven with testing, Mud Lake West, Duluth Harbor, Duluth, Minnesota (**Figure 1**), is potentially contributing to two impairments in the SLR AOC:

- Fish consumption advisory; and
- Degradation of the benthos environment.

Areas that are contributing to river sediment impairments should be addressed through remedial activities, as recommended by the RAP. In addition, addressing the contaminated sediments at the Site would also help in the reduction of impaired water resulting from bioaccumulative toxins in the SLR.

Remedial Action Objectives Developed by the MPCA for the Site

RAOs for the Site were developed based on the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 Code of Federal Regulations

[CFR] §300.430[e][2][i]), which defines RAOs as a listing of the COCs and media of concern, potential exposure pathways, and remediation goals. Specific RAOs were developed from a review of the results of Site characterization activities, site-specific risk and fate and transport evaluations, and an initial review of Applicable or Relevant and Appropriate Requirements (ARARs). The following RAOs for the Site include goals for the protection of human health and the environment:

1. Reduce human health risks associated with exposure to COCs through direct contact with sediments, inhalation, and incidental sediment ingestion by reducing sediment concentrations of COCs to protective levels or by eliminating direct contact or exposure potential.
2. Minimize or remove exposure to sediment contaminants that bioaccumulate in the food chain and contribute to fish consumption advisories.
3. Minimize or remove exposure of the benthic organisms to contaminated sediments above sediment cleanup goals.
4. Enhance aquatic habitat, if conditions allow, in a manner that contributes to the removal of beneficial use impairments (BUIs).

The following subsections present preliminary sediment cleanup levels (CULs) developed to achieve these RAOs. Alternatives were identified and screened to determine if they could meet these RAOs. The following alternatives were evaluated in this FFS:

Alternative 1: No Action – The NCP at Title 40 CFR provides that a No Action Alternative should be considered at every site. The No Action Alternative should reflect the site conditions described in the baseline risk assessment and remedial investigation. The No Action Alternative included within this FFS does not include any treatment or engineering controls, institutional controls (ICs), or monitoring. There are no costs associated with the No Action Alternative.

Alternative 2: Enhanced Monitored Natural Recovery with Broadcasted Amendment – This enhanced monitored natural recovery (EMNR) alternative would consist of applying a thin 0.01-meter layer of amendment material directly on top of the sediment surface in areas with sediment concentrations of COCs exceeding the preliminary CULs (i.e., areas of the Site with exceedances of the Midpoint Sediment Quality Target [SQT] for dioxins), hereafter referred to as remedial areas. Amendment material would be mixed into the sediments over time through bioturbation. The chosen amendment would reduce exposure of aquatic life to COCs through sequestration of sediment contaminants. Monitoring of sediment chemical concentrations, sediment toxicity, and bioaccumulation of COCs in aquatic life would be conducted until sufficient contaminant sequestration, degradation, transformation, or other natural recovery processes reduce risks to acceptable levels.

Alternative 3: Enhanced Monitored Natural Recovery with Thin-Layer Amended Cover – This alternative would consist of constructing a 0.15-meter (6-inch) amended cover on top of the sediment surface in remedial areas, and thus adds a temporary isolation component to Alternative 2. This alternative would incorporate use of the same amendment material as incorporated into Alternative 2 and would likewise reduce exposure of aquatic life to COCs through sequestration of sediment contaminants. Long-term mixing of cover materials into underlying in situ sediments from bioturbation could be anticipated and would result in delivery of amendment materials to deeper sediment depths. Monitoring of chemical concentrations in sediment and cap material, sediment toxicity, and bioaccumulation of COCs in aquatic life would be conducted until sufficient contaminant sequestration, degradation, transformation, or other natural recovery processes reduce risks to acceptable levels.

Alternative 4: Dredging with Wetland Restoration – This alternative would consist of removing all sediments within remedial areas to the estimated average maximum depth of contamination of 0.5 meter (1.6 feet) in open water areas and 0.15 meter (0.5 feet) in wetland areas, plus an over-dredge of 0.30 meter (1 foot). Sediment removal would take place in both open water and wetland areas of the Site. A 0.15-meter (0.5-foot) sand cover would be constructed in open water areas upon completion of dredging activities to mitigate any potential negative effects of dredge residuals on aquatic life. A 0.46 meter (1.5 feet) sand cover would be constructed in wetland areas to replace the full thickness of dredged sediments. Plantings would be conducted to restore wetland areas.

Alternative 5: Dredge Open Water Areas/Enhanced Monitored Natural Recovery with Thin-Layer Amended Cover in Wetland Areas – This hybrid of Alternatives 3 and 4 would consist of removing all sediments within open water remedial areas to the estimated average maximum depth of contamination of 0.5 meter, plus an over-dredge of 0.30 meter. It would incorporate EMNR in wetland remedial areas through construction of a thin-layer amended cover. The purpose of this hybrid approach is to achieve contaminant removal yet minimize disturbances to established wetland areas.

Comparative Analysis Summary

The comparative analysis of alternatives narrative discussion and quantitation table identified Alternative 2: EMNR with Broadcasted Amendment and Alternative 3: EMNR with Thin-Layer Amended Cover as a highly appropriate alternative to address contamination at the Site; however, Alternative 3 is almost two times more expensive as Alternative 2. The modifying criteria, state/support agency acceptance, and community acceptance are assessed formally after the public comment period. Stakeholder and community input will provide valuable insight as the MPCA considers information for the selection of a preferred alternative. The MPCA will conduct outreach activities to resource managers, current Site users, the public and local units of government prior to the public comment period.

Further studies are recommended during the design phase of the selected alternative. These recommended studies, depending on the alternative selected, may include:

- Bench and/or pilot scale testing of amendment materials to determine the most appropriate material for use at the Site. Potential amendment materials include Sedimite ^{TM}, bauxite, biopolymers, permeable Organoclay^{TM}, phosphate additives (i.e., apatite), and zeolite (USEPA, 2013);
- Bench and/or pilot scale testing to determine appropriate application rates for the selected amendment material;
- Physical sediment characteristics assessment to aid in designing remedial actions involving dredging and/or capping; and
- Evaluation of potential dewatering areas within close proximity of the Site, including use of U.S. Steel property, if Alternative 4 or 5 is selected.

In addition, additional pre-design investigation and analysis might be warranted, in order to refine the remedial footprint, or to justify a need for a remedial action or provide basis for monitored natural recovery.

- Comparison of site sediment chemistry values to ambient sediment chemistry values developed for the U.S. Steel site.

- Biological assessments to evaluate effects of contaminated sediments on Site biota, which could include benthic toxicity and bioaccumulation testing, paired with sediment chemistry analysis for dioxins.
- Comparison of Site bioaccumulation data to similar data within the SLR estuary.

Pending the City of Duluth's decision on the preferred use of the Mud Lake causeway, additional data gaps might need to be addressed to evaluate the impact of partial or total causeway removal on the selected alternative:

- A hydrodynamic study to understand natural processes such as depositional and scouring forces to inform design and placement of cover materials.

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Acronyms and Abbreviations

%	percent
µg/kg	micrograms per kilogram
AC	activated carbon
amsl	above mean sea level
AOC	area of concern
ARAR	Applicable or Relevant and Appropriate Requirement
Bay West	Bay West LLC
bss	below sediment surface
BUI	beneficial use impairment
CAD	confined aquatic disposal
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
ch. or chs.	chapter or chapters
COC	contaminant of concern
CSM	conceptual site model
CUL	cleanup level
DEDA	Duluth Economic Development Authority
DGI	data gap investigation
dioxins	polychlorinated dibenzo-p-dioxins/dibenzofurans
DRO	diesel range organics
EMNR	Enhanced Monitored Natural Recovery
FFS	Focused Feasibility Study
GHG	Greenhouse Gas
GLI	Great Lakes Initiative
GLLA	Great Lakes Legacy Act
GSR	Green Sustainable Remediation
IC	institutional control
IDT	Interlake/Duluth Tar
ITRC	Interstate Technology and Regulatory Council
IZ	Isolation Zone
KM	Kaplan-Meier
LTM	long-term monitoring
MDH	Minnesota Department of Health
MDNR	Minnesota Department of Natural Resources
MERLA	Minnesota Environmental Response and Liability Act
mg/kg	milligrams per kilogram
MLE	Mud Lake East
MLW	Mud Lake West
MNR	Monitored Natural Recovery
MPCA	Minnesota Pollution Control Agency
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ng TEQ/kg	nanograms toxic equivalency per kilogram
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
OIRW	Outstanding International Resource Water
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclic aromatic hydrocarbon
PBAZ	potentially bioactive zone
PCB	polychlorinated biphenyl
RAO	Remedial Action Objective
RAP	Remedial Action Plan
RBSE	Risk Based Site Evaluation
RCRA	Resource Conservation and Recovery Act
RFP	Request for Proposal
RI	Remedial Investigation
RME	reasonable maximal exposure
ROD	Record of Decision
ROM	rough order of magnitude
SDS	State Disposal System
SLR	St. Louis River
SLRIDT	St. Louis River/Interlake/Duluth Tar
SQT	sediment quality target
SSV	Sediment Screening Value
SVOC	semi-volatile organic compound
TBC	to be considered
TCLP	Toxicity Characteristic Leaching Potential
TEF	toxicity equivalence factor
TEQ	toxic equivalency
U.S.	United States
UECA	Uniform Environmental Covenants Act
USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
WCA	Wetland Conservation Act
WDNR	Wisconsin Department of Natural Resources
WLSSD	Western Lake Superior Sanitary District

1.0 INTRODUCTION AND BACKGROUND

The St. Louis River (SLR), located on the border between Minnesota and Wisconsin, is the second largest United States (U.S.) tributary to Lake Superior and has a special significance in the region. The lower estuary empties into the Duluth-Superior Harbor, the largest freshwater seaport in North America. It serves as a geographic boundary for Wisconsin and Minnesota, and provides regional shipping access to Lake Superior.

Development along the SLR over the past 130 years has contributed to contaminated sediments. In 1987, concerns over environmental quality conditions prompted the designation of 73 miles of the lower SLR, which includes the segment from Cloquet, Minnesota, to the Duluth/Superior Harbor, as 1 of 43 Great Lakes Areas of Concern (AOCs). The Minnesota Pollution Control Agency (MPCA) and Wisconsin Department of Natural Resources (WDNR) worked together to divide the SLR AOC into Sediment Assessment Areas for the purposes of evaluation and prioritization of remediation and restoration activities. Contaminated sediments were identified and characterized through several studies that included the collection and analysis of sediments and biota samples throughout the AOC.

Historical sediment contamination in the SLR AOC has resulted in impaired uses, including degradation of bottom-feeding invertebrate communities, increased incidence of fish tumors and other abnormalities, fish consumption advisories, and restrictions on dredging, resulting in nine beneficial use impairments (BUIs; MPCA, 2008). BUIs are a change in the chemical, physical or biological integrity of the Great Lakes system sufficient to cause any 1 of the 14 established use impairments, or other related uses, such as the microbial objective for waters used for body contact recreational activities (joint commission). The MPCA and WDNR are currently working together to implement a comprehensive long-term plan to restore beneficial use and delist BUIs in the SLR AOC. Many of the BUIs in the AOC are linked to the presence of sediment contaminants. Some sediment-derived contaminants also appear suspended in the water column and carried by the SLR to Lake Superior.

As identified in the SLR Remedial Action Plans (RAPs): RAP Stage I, MPCA and WDNR, 1992; and RAP Stage II, MPCA and WDNR, 1995; and later proven with testing, Mud Lake West (the Site), Duluth, Minnesota (**Figure 1**), is potentially contributing to two impairments in the SLR AOC:

- Fish consumption advisory; and
- Degradation of the benthos environment.

Areas that are contributing to river and harbor sediment impairments should be addressed through remedial activities, as recommended by the RAPs. According to the MPCA, it is recommended by many programs that biotoxins be reduced within the SLR estuary and harbor. Removing or isolating the contaminated sediments from the surface water/sediment interface will help in the reduction of the impaired water resulting from bioaccumulative toxins in the SLR AOC.

This Focused Feasibility Study (FFS) was prepared to evaluate remedial alternatives for contaminated sediment at the Site. The scope of this FFS does not consider alternatives for any other matrix such as soil, surface water, or groundwater that may be impacted at the Site.

This report was developed pursuant to the Bay West LLC (Bay West) Master Contract No. 63186 and MPCA Contract Work Order No. 3000014275, dated July 21, 2015, and accompanying the Scope of Work/Cost Estimate for the Site. Funding to complete the FFS for the Site comes from the United States Environmental Protection Agency (USEPA), the Great

Lakes Legacy Act (GLLA), and state funding through the Minnesota Legacy Fund and the Wisconsin Knowles-Nelson Stewardship Fund.

This FFS was written in general accordance with the MPCA Site Response Section Guidance Document Draft Guidelines on Remedy Selection (MPCA, 1998), the Minnesota Environmental Response and Liability Act (MERLA), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, along with other Minnesota and Federal rules, statutes, and guidance.

1.1 Report Organization

Section 1.0 presents general background information including the Site history and a summary of current Site conditions. **Section 2.0** discusses Applicable or Relevant and Appropriate Requirements (ARARs) and summarizes Remedial Action Objectives (RAOs) to provide the framework for alternative evaluations for the Site. **Section 3.0** and **Section 4.0** present alternatives descriptions and the NCP remedy selection criteria used in this FFS. **Section 5.0** presents an evaluation of alternatives against standards and criteria. References are presented in **Section 6.0**.

1.2 Site Location and Current Use

The Site is bounded to the west by the Duluth, Missabe & Iron Range Railway (DM&IR) Mud Lake site, to the north by the U.S. Steel site, and to the east by the 75-acre Mud Lake East (MLE) site. Wisconsin Central Ltd owns multiple land parcels surrounding the Site to the north, west, and south per the Saint Louis County Land Explorer website (http://gis.stlouiscountymn.gov/planningflexviewers/County_Explorer/). The railroad tracks dividing the Mud Lake West (MLW) and MLE are owned by the City of Duluth and maintained by the Lake Superior and Mississippi Railroad Company (http://lsmrr.org), which operates historic train tours beginning near the Lake Superior Zoo in Duluth and ending at the southern end of the Gary and New Duluth neighborhoods. The train tours operate on Saturdays and Sundays from mid-June through mid-October. The City of Duluth is exploring the potential to remove the railroad causeway in order to open MLW and return the area to a more natural setting.

The Site comprises a 39-acre wetland area in the SLR estuary (**Figure 2**). The majority of the Site is marshland with open water located in the center of the lake and along the railroad embankment that divides MLW from MLE. The marshland areas were characterized during the 2015 RI as primarily cattails at the northern end of the Site and a mix of cattail and bog areas at the south and southwestern ends of the Site.

The Site is approximately 3,750 feet in length and 1,000 feet in width. Water depth at the Site ranged from 0.5 feet to 8.0 feet with a sediment elevation range of 594.00 feet to 601.76 feet above mean sea level (amsl) during the March and June 2015 RI sampling events; average water depth was 3.5 feet. **Figure 3** shows 2015 bathymetry created from field measurements of water depth. No storm sewer discharges have been identified in the vicinity of the Site (Bay West, 2015b).

1.3 Site History

Historical maps, aerial photographs, and drawings were reviewed for the Site as part of the 2015 RI (Bay West, 2015b). The 2015 RI presents the following description of the historical documentation review.

Merritt's sectional survey map, dated 1889, depicts the Site as a lake cut off from the main channel by a railroad, similar to present day. A railroad running northeast to southwest acts as a levee separating the Site from the rest of Mud Lake and the main river channel. The 1902

Frank's Atlas map depicts a wetland surrounding the Site. The surrounding area to the northwest of the Site appears to be residential. The 1909 Duluth Street Railway Co. transit map is similar to previous maps. The 1912 Welbanks map is similar to previous maps and depicts "New Duluth" to the southwest of the Site and the "Minnesota Steel Company location" to the north of the Site. Two slips are depicted on the east side of the railroad, south of the Site.

The 1915 and 1917 U.S. Geological Survey (USGS) Topographic Map depicts the previously noted wetland, which is apparent on subsequent maps. The inlet from the main river channel has narrowed. The north adjoining property (previously identified as the Minnesota Steel Company) appears to be residentially developed as part of the Morgan Park area. The two slips are not depicted south of the Site. The 1927 McGill Warner Map is similar to the 1915 and 1917 topographic map, although the "Minnesota Steel Company Plant" is depicted on the north adjacent property. The Welbanks Map, published in 1935, depicts two slips south of the Site. Surrounding land use is relatively unchanged from the 1927 map.

Aerial photographs are available for Mud Lake from 1952 to 2013. Due to the scale of the photographs, it is not possible to discern details about surrounding site activities. No significant changes were noted between 1952 and 2013. In general, the aerial photographs show marshland surrounding the Site to the north, west, and south sides of the lake. Industrial activity north of the marshland is apparent. West of the marshland appears to be undeveloped land, with a highway traveling north-south beyond. South of the marshland the area is predominantly undeveloped land. The Northern Pacific Railroad running northeast to southwest defines the boundary between the Site and MLE. The inlet to MLE has widened in comparison to the 1935 Welbanks Map.

The following Site history was presented within the DM&IR Railway RI Report compiled for the DM&IR Mud Lake Site (Arcadis, 2011).

In 1907, U.S. Steel subsidiaries Spirit Lake Transfer Railway Company (the original owner of the Site) and Interstate Transfer Railway Company were incorporated for purposes of providing rail service to U.S. Steel subsidiary Minnesota Steel Company. The Spirit Lake line was completed in 1915 and ran from Adolf, Minnesota to the border of Wisconsin. Upon completion of the Spirit Lake line, all of Spirit Lake Transfer Railway's property was leased to, and thereafter operated by, U.S. Steel subsidiary Duluth, Missabe & Northern Railway Company (DM&N). DM&N and Spirit Lake Railway were consolidated in 1937, and the combined company became the Duluth, Missabe & Iron Range Railway (DM&IR). Minnesota Steel Company constructed the plant that would later become the Duluth Works between 1910 and 1915. The plant began operations in 1915 to 1916.

Minnesota Steel leased the plant to U.S. Steel subsidiary American Steel & Wire (AS&W) in 1932, and conveyed the plant and associated property to AS&W in 1935. AS&W was merged into U.S. Steel in the early 1950s and operated for some years thereafter as the AS&W Division of United States Steel Corporation.

Between 1948 and 1974, the Site was leased or licensed to U.S. Steel for steel mill refuse disposal purposes. Aerial photographs reveal that, over time, filling occurred in a west to east direction and encroached into the wetland surrounding the Site. Slag reclamation reportedly occurred to a degree; however, a significant volume of slag and other steel mill refuse was left onsite after the reclamation activities ceased. Slag was placed within the water table at the toe of the main slag impoundment (bluff) and does not appear to have been reclaimed as part of this operation.

The Site is currently surrounded by undeveloped or abandoned industrial (i.e., U.S. Steel site) properties. The only current sanctioned use of the Site and its surrounding properties is weekly historic train tours that pass through the Site.

1.4 Site Characterization

1.4.1 Site Geology

Regional geology in the Duluth area consists primarily of materials deposited during the last glaciation, and more recently as river sediment, overlying Precambrian igneous and sedimentary bedrock. These materials consist of silts, sands, and gravels that were deposited as the glaciers retreated northward. Fine grained sediment, primarily red silt and clay, was deposited in the ancestral glacial Lake Duluth. This red silt and clay occurs over much of the lower elevations in the Duluth area.

Bedrock units underlying the area consist of olivine gabbro and anorthositic gabbro members of the Duluth Complex, and the sedimentary units of the Fond du Lac Formation. The Duluth Complex is lower Precambrian, and the Fond du Lac Formation is upper Precambrian in age. The gabbroic members of the Duluth Complex form the hills to the west of the SLR and Lake Superior shore (MPCA, 1995).

Sediment cores collected during the 2015 RI generally contained brown to black loam to depth, consisting of up to 70 percent (%) woody organics, fibrous roots, and other plant material. A firm blue-gray clay and potential confining layer was observed within the bottommost portion of several deep cores. This blue-gray clay was easily distinguishable from the overlying silt and peat sediments. Based on the depth of sampler advancement at these locations, the blue-gray clay layer could be as deep as 2.9 meters below sediment surface.

1.4.2 Site Hydrology

The regional groundwater flow system in the area generally flows from the Minnesota and Wisconsin uplands and discharges to Lake Superior and the SLR estuary.

The upper aquifer at the Site is located in the well graded sand unit. The groundwater flow direction is east from adjacent upland areas towards the Site. The sand is permeable and the hydraulic conductivity ranges from approximately 0.2 to 37.4 feet per day (feet/day). The hydraulic conductivity of the slag fill ranges from approximately 3 feet/day in adjacent upland areas to approximately 0.17 feet/day in wetland areas of the Site. Groundwater discharges to the Site, the base elevation (Arcadis, 2011).

While not measured during the 2015 RI, flow velocities are likely lower at the Site than the main stream channel. The Site is cut off from the eastern portion of Mud Lake and the main channel by a railroad embankment, with the exception of an approximately 75-foot railroad trestle that allows water to pass through from MLE and the main river channel to the Site. The City of Duluth is exploring options to remove the railroad causeway and open MLW to the rest of the SLR. The removal of the railroad causeway would likely result in significant impacts to the hydraulic conditions at the Site. High flow storm and Seiche events may be the primary mechanisms for flow into Mud Lake from the main channel. The relatively low flow velocities may result in sediment deposition after high flow storm and seiche events on the margins within areas of emergent vegetation.

1.4.3 Nature and Extent of Contamination

The nature and extent of contamination at the Site was investigated during several studies between 2011 and 2015. The most recent investigation was an RI conducted specifically for the Site during March and June of 2015. A summary of previous Site investigations, as presented within the 2015 RI report, is provided in **Section 1.4.3.1**. Screening criteria for application to sediment contaminants identified at the Site are discussed in **Section 1.4.3.2**. **Section 1.4.3.3** presents a discussion of the contaminants of concern (COCs) as identified in the 2015 RI report and **Section 1.4.3.4** presents the known depth, thickness, and volume of contaminated sediments at the Site.

1.4.3.1 Previous Investigations

The following are previous investigation reports completed for the Site:

- *St. Louis River Area of Concern Sediment Characterization: Final Report,* prepared by LimnoTech, July 11, 2013 (LimnoTech Report)

  The assessment of sediment chemistry in the MLW area, which included the analysis of metals, PAHs, and polychlorinated dibenzo-p-dioxins/dibenzofurans (dioxins) toxic equivalencies (TEQs) as contaminants of interest (COIs) at depths between 0.0 and 0.50 meters bss.

- *Sediment Investigation Report, Lower St. Louis River, Fond Du Lac Dam to Kingsbury Bay,* Duluth, Minnesota, prepared by SOMAT Engineering, Study ID 84, August 2012a (2012a SOMAT Report)

  Mud Lake, which includes the Site, was investigated during an SLR and bay area study completed in 2012 (2012a Somat Report). Analytical results from this investigation indicated that contaminants are present at Mud Lake at concentrations that are considered to pose a low to moderate risk to sediment dwelling organisms.

- *Remedial Investigation Report, DM&IR (Duluth Missabe & Iron Range Railway) Mud Lake Site (Mud Lake West),* Duluth, Minnesota, prepared by Arcadis U.S., Inc., August 2011 (Arcadis Report)

  DM&IR retained Arcadis to complete an RI for MLW. The investigation included groundwater, surface water, soils, and sediment. The sediment investigation included analysis of diesel-range organics (DRO), gasoline-range organics (GRO), volatile organic compounds (VOCs), PAHs, PCBs, Resource Conservation and Recovery Act (RCRA) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), calcium, magnesium, potassium, and sodium. Sixteen sediment samples were collected for MLW. Results analysis indicated PAHs, arsenic, cadmium, chromium, lead, and mercury exist at concentrations that may pose a risk to human health or the environment.

- *Sediment Remedial Investigation Report, Mud Lake West*, Duluth, Minnesota, prepared by Bay West LLC, December 2015 (2015 RI Report)

  The 2015 RI Report concluded that exposure pathways are complete or potentially complete for recreational users through direct contact with contaminated sediments and ingestion of biota (i.e., fish consumption) and for ecological receptors through ingestion and dermal contact. The RI identified chromium, mercury, and dioxins as potential COIs for risk to human health. Dioxins were also identified as a potential COI for risk to sediment dwelling organisms. Nickel and zinc were both identified as COIs for risk to human health and to sediment dwelling organisms.

- *Mud Lake West Technical Memorandum, Mud Lake West, Duluth, Minnesota, March 2017 (2017 Tech Memo)*

In 2016, data was collected in support of the 2015 RI to address data gaps identified in the 2015 RI regarding the extent and volume of contaminated sediment within MLW, and to evaluate risks to human health and the environment due to potential impacts by the benthic community (2017 Data Gap Investigation [DGI]). Nickel, zinc, and dioxins were assessed in this investigation. Sediment sample analysis indicates that zinc and dioxin/furan sediment contamination does not extend to deep sediment intervals; however, nickel contamination does extend to deep sediment intervals. Deposition of zinc and dioxin-contaminated sediment occurred more recently than deposition of nickel-contaminated sediment. Toxicity and bioaccumulation testing results indicate that site sediments do not appear to be toxic to benthic organisms, and nickel and zinc do not appear to bioaccumulate in benthic tissue; however, dioxins do appear to bioaccumulate in benthic tissue and could migrate up the food chain to higher trophic levels that consume benthic organisms. Based on these results, dioxins should be the driving COC for remediation at Mud Lake West. The 2017 Tech Memo is included in **Appendix A**.

1.4.3.2 Screening Criteria

Numerical sediment quality targets (SQTs), adopted for use in the SLR AOC to protect benthic invertebrates, can be used throughout Minnesota as benchmark values for making comparisons to surficial sediment chemistry measurements. Level I and Level II SQTs for the protection of sediment-dwelling organisms are available for 8 trace metals, 13 individual PAHs, total PAHs (all 13 priority PAHs), total PCBs, and 10 organochlorine pesticides. In addition, Level I and Level II SQTs for dioxins were adopted for the protection of fish, as insufficient information is available for sediment-dwelling organisms. The dioxins SQT is based on the dioxin TEQ value, which incorporates results of individual dioxin and furan congeners and toxicity equivalence factors (TEFs) for the protection of fish, denoted as TEQ Fish. SQTs are highly useful when evaluating risk for a specific compound or a group of compounds (i.e., total PCBs and total PAHs).

Contaminant concentrations below the Level I SQTs are unlikely to have harmful effects on sediment-dwelling organisms (i.e., benthic invertebrates). Contaminant concentrations above the Level II SQTS are more likely to result in harmful effects to benthic invertebrates (MPCA, 2007). Based on conversations with the MPCA, a qualitative comparison value midway between the Level I SQTs and Level II SQTs (i.e., Midpoint SQT) were used as criteria to identify, rank, and prioritize sediment-associated COCs within the Site.

Sediment Screening Values (SSVs) were developed to provide a human health-based toxicity value specifically related to sediment for the U.S. Steel Superfund site in the SLR (Minnesota Department of Health [MDH], 2013). The SSVs were developed using reasonable maximal exposures (RMEs) specific to the U.S. Steel site and the Lower SLR. The Updated Human Health Screening Values for SLR Sediments: U.S. Steel Site, dated April 2013, describes the updated SSVs. Chemical concentrations in water-covered sediments at or below the SSVs are considered safe for the general public; however, chemical concentrations in sediments exceeding the SSVs should not be considered unsafe because the SSVs were developed using conservative measures of exposure, bioavailability, and toxicity. Based on ongoing ambient concentration studies, some SSVs likely approach, or are less, than ambient concentrations in sediment, including SSVs for mercury, benzo(a)pyrene equivalents, PCBs, and dioxins. Further, the SSVs do not include RMEs specific to the Site and are not intended to be used as sediment cleanup values; therefore, SSVs will not be used to identify, rank, and prioritize sediment-associated COCs within the Site. Following finalization of the ambient concentration studies, SSVs for COCs may need to be reviewed for applicability to the Site.

1.4.3.3 Contaminants of Concern

Potential COIs are discussed in depth in the 2015 RI Report and 2017 DGI and are summarized as follows. Exposure pathways are complete or potentially complete for recreational users at the Site and identified chromium, mercury, and dioxins as potential COIs for risk to human health; however, these COIs were not carried forward as COCs for this FFS as discussed below.

Exposure pathways are complete or potentially complete for direct exposure of ecological receptors to sediment contaminants through ingestion and dermal contact and identified dioxins, nickel, and zinc as potential COIs for risks to ecological health. Based on the bioaccumulation and toxicity testing results, only dioxins are carried forward as COCs for the Site.

CULs for dioxins will be determined based comparison to anthropogenic influenced ambient levels due to legacy contamination that are being developed by the MPCA; however, for the purposes of this FFS, the Midpoint SQT for dioxins will serve as the CUL. Exceedance of the dioxin Midpoint SQT will be used to determine the remedial footprint and development of remedial alternatives. A summary of COCs is presented in **Table 1**.

Chromium

Sediment samples collected during the 2015 RI were analyzed for total chromium, which combines concentrations of Chromium III and Chromium VI, but were compared to the 2013 cancer SSV for chromium VI (no SSV for total chromium exists; therefore, the chromium VI SSV was used as a conservative comparison criterion). It is, therefore, likely that the actual concentrations of chromium VI in sediment samples are likely lower than the total chromium concentrations and may not exceed the chromium VI SSV. Additionally, it is unknown if chromium concentrations detected at the Site are greater than ambient chromium concentrations in the AOC. Comparison to ambient chromium concentrations and analysis of chromium VI in sediment may be necessary to appropriately assess risk to human health.

Mercury

Mercury-impacted sediments with concentrations exceeding the SSV for protection of human health were found to occur in 99% of the samples analyzed during the 2015 RI; however, low-level mercury contamination occurs throughout the AOC, and as discussed in **Section 1.4.3.2**, may approach or be less than ambient concentrations in sediment based upon ongoing ambient concentration studies. Comparison to ambient mercury concentrations should be performed prior to making determinations of mercury as a COC.

Dioxins

Dioxins concentrations exceeded the Midpoint SQT in 42% for all intervals sampled during the 2015 RI and 2017 DGI, with 61% of samples exceeding in the 0.0 to 0.15-meter interval. Bioaccumulation testing indicates that dioxins do appear to bioaccumulate in benthic tissue and could migrate up the food chain to higher trophic levels that consume benthic organisms. Based on these results, dioxins should remain the driving COC for remediation at Mud Lake West and the remediation footprint will be based on locations where dioxins exceed the Midpoint SQT in surface sediment.

Nickel

Nickel concentrations exceeded the Midpoint SQT in 29% for all intervals sampled during the 2015 RI and 2017 DGI, with 33% of samples exceeding in the 0.0 to 0.15-meter interval. All of the Midpoint SQT exceedances were within the upper 1.0 meter of sediment. The maximum concentration of nickel (70.5 milligrams per kilogram [mg/kg]) was identified in the 0 to 0.15-meter interval. Based on toxicity and bioaccumulation testing results, nickel-contaminated sediments do not appear to be toxic to benthic organisms and does not appear to bioaccumulate in benthic tissue; therefore, nickel will not be retained as a COC.

Zinc

Zinc concentrations exceeded the Midpoint SQT in 13% for all intervals sampled during the 2015 RI and 2017 DGI, with 27% of samples exceeding in the 0.0 to 0.15-meter interval. All of the Midpoint SQT exceedances were within the upper 1.0 meter of sediment. The maximum concentration of zinc (1850 mg/kg) was identified in the 0.15 to 0.5-meter interval. Based on toxicity and bioaccumulation testing results, zinc-contaminated sediments do not appear to be toxic to benthic organisms and does not appear to bioaccumulate in benthic tissue; therefore, zinc will not be retained as a COC.

1.4.3.4 Depth, Thickness, and Volume of Contaminated Sediment

The 2015 RI Report and 2017 DGI were used to define the COCs, remedial areas, and remedial volumes used to compile this FFS. Distribution of dioxins at the Site is discussed below. Historical sample locations and corresponding sample results shown as exceedances of the SQTs are presented in **Figure 4a** and **Figure 4b**. Areas to be considered for remedial action are those where dioxins exceeded their respective Midpoint SQT and are presented in **Figure 5**. The preliminary CUL established for the Site is the Midpoint SQT for dioxins.

The vertical chemical profile for dioxins concentrations exceeding the Midpoint SQT generally decrease with depth. Approximately 61% of samples exceeded the Midpoint SQT in the surface interval, decreasing to 17% in the 0.15 to 0.5-meter interval. Only 17% (one sample) exceeded the Midpoint SQT in the 0.5 to 1.0-meter interval and no samples exceeded the Midpoint SQT in the >1.00-meter interval. Dioxins-impacted sediments with concentrations exceeding the Midpoint SQT appear throughout the Site. Concentrations as high as 97.61 ng TEQ/kg (over four times the Level 2 SQT) in the top 0.5 meter suggest a possible ongoing source of dioxins contamination. This ongoing source may also be related to the adjacent U.S. Steel site. The following table summarizes the vertical distribution of dioxins SQT exceedances as TEQ KM Fish values.

TEQ KM FISH										
Interval (meters)	**0.0 to 0.15**		**0.15 to 0.5**		**0.5 to 1.0**		**>1.00**		**All Intervals**	
Number of samples	33		15		6		6		54	
Number of detections	33		15		6		6		54	
Max Concentration (ng TEQ/kg)	66.544		97.61		97.61		9.3		97.61	
Level 1 SQT Exceedances	100%	33	100%	15	100%	6	100%	6	100%	54
Midpoint SQT Exceedances	61%	20	20%	3	17%	1	0%	0	43%	23
Level 2 SQT Exceedances	48%	16	13%	2	0%	0	0%	0	31%	17

Results combined from 2015 RI and 2017 DGI.
ng TEQ/kg = nanograms of dioxin toxicity equivalency per kilogram

Poor sample recovery was observed during the March 2015 RI sampling event and may have resulted in core shortening as described within **Section 3.3** of the RI Report. Core shortening, if present, would result in contaminated sediments existing at a deeper in situ sediment profile than suggested by the data. The 2017 DGI sampling utilized a Russian peat-borer sediment sample collection device to reduce core shortening.

Figure 5 identifies remedial areas based on exceedances of the Midpoint SQT for dioxins at any of the sampled depth intervals and subsequent kriging of sample results. Contaminated sediments are located in both open water and wetland areas of the Site, which could drive the use of different remedial actions in these areas if established wetland areas are to be protected from intrusive remedial activities.

The open water portion of the remedial area totals approximately 32 acres as presented in **Figure 7** through **Figure 10.** The majority of COC contamination extends down to 0.15 meter bss throughout the open water portion, as shown in **Figure 5**; however, dioxins concentrations exceeding the Midpoint SQT were observed as deep as the 0.5 to 1.0-meter interval. The total volume of contaminated sediments within the open water portion is estimated at approximately 84,300 cubic yards based on the conservative average estimated depth of contaminated sediment of 0.5 meter.

The wetland portions of the remedial area total approximately 8 acres as presented in **Figure 7** through **Figure 10**. The majority of COC contamination extends down to 0.15 meter bss throughout the majority of both the southwestern and northeastern wetland area, as shown in **Figure 5**. The total volume of contaminated sediments within the wetland portions is estimated at approximately 6,600 cubic yards. Contaminant depth was estimated at 0.15 meter bss throughout the total 8-acre wetland area.

The total remedial area is approximately 40 acres with a contaminated sediment volume of approximately 91,000 cubic yards.

1.4.4 Exposure Pathways

Exposure pathways represent the linkages among contaminant sources, release mechanisms, exposure pathways and routes, and receptors to summarize the current understanding of the risks to human health and the environment due to contamination. The 2015 RI concluded that the incidental ingestion and dermal contact exposure routes were complete for human recreational users of the Site. The lands surrounding the Site are privately owned and thus Site access is highly limited; however, trespassers have been observed at the Site and it is anticipated that these trespassers use the Site for recreational purposes, such as fishing, dog walking, etc. Conversations between Bay West, MPCA, and the City of Duluth on April 27, 2016, revealed potential future recreational development at the Site to include a recreational trail for walking, biking, etc. Construction of a trail at the Site would increase exposure risks to humans.

The 2015 RI also concluded that the ingestion and dermal contact exposure routes were complete for ecological receptors. Based on the 2017 DGI which indicates that COCs can bioaccumulate in benthic invertebrates, COCs could be released from sediments through uptake by biota and could result in subsequent consumption of exposed biota by animals or humans; therefore, the ingestion of biota pathway was also found to be complete for ecological and human receptors (i.e., fish consumption).

Reduction or isolation of sediment contamination at the Site will likely reduce contaminate concentrations found in biota tissue; therefore, addressing the ecological risk pathway identified for the Site will concurrently address the ingestion of biota via fish consumption pathway for human health.

Further discussions of human and ecological health risks posed by contaminated sediments at the Site are provided within the 2015 RI and 2017 Tech Memo reports.

1.4.5 Conceptual Site Model

The development of a conceptual site model (CSM) allows data obtained during ongoing investigations to be integrated in an iterative approach that increases the understanding of the physical and environmental setting of the Site and the fate and transport of COCs. The CSM provides a baseline for consideration of how remedy alternatives could be implemented to protect human and environmental health at the Site. The CSM is provided within the 2015 RI report and is illustrated in **Figure 6**.

The 2015 RI Report states that suspected sources of COCs observed at the Site are likely associated with widespread legacy contamination from upstream sources. The Site is generally cut off from the main channel of the SLR by the railroad embankment that separates the Site from Mud Lake East. During high flow storm events re-suspended sediment carrying legacy contaminants may enter MLW and redeposit in the low energy environment. It should be noted that the City of Duluth is exploring options to remove the railroad causeway that separate the Site from the SLR. If the City of Duluth decides to remove or modify the railroad causeway, the CSM should be updated for future investigations and remedial actions.

A potential source of upland contamination exists adjacent to, and west and north of the Site, as a result of steel processing operations dating back to at least 1912 and referred to as the U.S. Steel Superfund Site. Dioxins are known contaminants at the U.S. Steel Superfund Site. It is possible that contaminants from upland sources on the site have eroded and deposited into the Site. Elevated concentrations of dioxins within the upper 0.5 meter of Site sediments indicate that insignificant sediment deposition has occurred at the Site since industrial activities ended and/or that an ongoing source is present. Additional details regarding the CSM are contained within the 2015 RI Report. If ongoing sources are present, additional upland investigation and remedial actions may be necessary to protect any remedial actions taken at the Site from future contaminant inputs.

2.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND REMEDIAL ACTION OBJECTIVES

Remedial actions for releases and threatened releases of hazardous substances, pollutants, or contaminants must be selected and carried out in accordance with state and federal requirements. These requirements are referred to as ARARs. RAOs specify COCs, media of concern, potential exposure pathways, and remediation goals. Initially, Site remediation goals for the COCs are developed based on readily available information such as chemical-specific ARARs or other reliable information. The Site RAOs are modified, as necessary, as more information becomes available during the FFS process.

This section presents the preliminary ARARs, RAOs, and COCs to be used in the development of this FFS. The final ARARs, RAOs, and COCs will be developed in the Record of Decision (ROD) for the Site.

2.1 Applicable or Relevant and Appropriate Requirements

This preliminary ARAR section summarizes the MPCA, Minnesota Department of Natural Resources (MDNR), and MDH ARARs, and to be considered (TBC) criteria for aquatic sediment associated with the Site. Local and Federal ARARs have also been included; however, the list may not include all applicable local and Federal ARARs.

The NCP (40 CFR 300.5) defines “applicable” requirements as: “those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA [Comprehensive Environmental Response, Compensation, and Liability Act] site.” Only those promulgated state standards identified by a state in a timely manner that are substantive and equally or more stringent than federal requirements may be applicable.

The NCP (40 CFR 300.5) further defines “relevant and appropriate” requirements as: “those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.” Like “applicable” requirements, the NCP also provides that only those promulgated state requirements that are identified in a timely manner and are more stringent than corresponding federal requirements may be relevant and appropriate.

ARARs generally fall into one of the following three classifications:

- **Chemical-specific:** These ARARs are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in numerical values. These values establish an acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. These requirements provide the basis for protective Site remediation levels for the COCs in the designated media.
- **Location-specific:** These ARARs generally restrict certain activities or limit concentrations of hazardous substances solely because of geographical or land use concerns. Requirements addressing wetlands, historic places, floodplains, or sensitive ecosystems and habitats are potential location-specific ARARs.

- **Action-specific:** These ARARs are restrictions on the conduct of certain activities or the operation of certain technologies at a particular site. Examples of action-specific ARARs would be regulations dictating the design, construction, and/or operating procedures for dredging, on-site landfilling, or capping. Action-specific requirements do not themselves determine the cleanup alternative, but define how the chosen cleanup alternative should be achieved.

In addition, criteria, advisories, guidance, and proposed standards developed by federal and state environmental and public health agencies that are not legally enforceable, but contain helpful information, are collectively referred to as TBCs. TBCs can be helpful in carrying out selected remedies or in determining the level of protectiveness of selected remedies. TBCs are meant to complement the use of ARARs, not compete with or replace them. TBCs are included, where appropriate, in the chemical-, location-, and action-specific discussions.

Several federal and state laws govern or provide the framework for remedial actions. Remedial actions must comply with substantive portions of these laws or acts, which were also reviewed during the ARAR development process. The following provides a summary of laws and acts that do not readily fall into one of the chemical-, location-, or action-specific classifications, but are applicable to the Site:

ARAR/TBC	Citation	Description/Potential Application
CERCLA	42 United States Code (USC) §§9601 et seq.	Federal Superfund Law.
NCP	40 CFR Part 300	Provides organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.
MERLA	Minn. Stat. §§115B.01 to 115B.20	State Superfund Law.
Water Pollution Control Act	Minn. Stat. chapter (ch.) 115	Administration and enforcement of all laws relating to the pollution of any waters of the state.
Duty to Notify and Avoid Water Pollution	Minn. Stat. §115.061	Requires notification and recovery of discharge pollutants to minimize or abate pollution of the waters of the state.
Pollution Control Agency	Minn. Stat. ch. 116	Provides organizational structure and procedures for responding to problems relating to water, air, and land pollution.
Water Law	Minn. Stat. chs. 103A, 103B, 103C, 103D, 103E; 103F, and 103G	Provides regulations pertaining to any waters of the state, including surface water, wetlands and groundwater.
Safe Drinking Water Act	42 USC §§300f et seq.	Established to protect the quality of drinking water (above or underground).
Clean Water Act	33 USC §§1251 et seq.	Establishes structure for regulating discharges of pollutants and regulating quality standards for surface waters.
Resource Conservation and Recovery Act (RCRA)	42 USC §§6901 et seq.	Establishes RCRA Program and Regulations.

ARAR/TBC	Citation	Description/Potential Application
Clean Air Act	42 USC §§7401 et seq.	Regulates air remissions from stationary and mobile sources.
Federal Energy Regulatory Commission (FERC)	FERC was established by congress through various laws.	An independent agency that regulates transmission and wholesale sale of electricity and natural gas in interstate commerce. FERC authorizes and regulates non-federal hydropower projects.

2.1.1 Chemical-Specific ARARs and TBCs

The COCs associated with the sediments includes nickel, zinc, and dioxins. The following are the chemical-specific ARARs and TBCs associated with the sediments and shall be used to develop site-specific CULs:

ARAR/TBC	Citation/Source	Description/Application
Sediment		
SSVs	MDH, 2013. Public Health Consultation, Updated Human Health Screening Values for SLR Sediments: U.S. Steel Site, April.	To be used as benchmark values for making comparisons to surficial sediment chemistry measurements.
SQTs	Guidance for the Use and Application of SQTs for the Protection of Sediment-dwelling Organisms in Minnesota.	To be used as benchmark values for making comparisons to surficial sediment chemistry measurements.
All Media		
Contaminated Sediments Remediation	Contaminated Sediments Remediation. http://www.itrcweb.org/contseds_remedy-selection/	Guidance to assist in selecting remedial technology most appropriate for a specific site.
Contaminated Sediment Remediation	Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, USEPA, December 2005.	Guidance to assist in selecting remedial technology most appropriate for a specific site.
Contaminated Sediment Remediation	Use of Amendments for In Situ Remediation at Superfund Sediment Sites, USEPA, April 2013.	Guidance to assist in situ remediation.
Site screening guidelines	Working Draft Site Screening Evaluation Guidelines. MPCA Risk-Based Site Evaluation (RBSE) Manual (09/98).	Guidelines and criteria for screening human health and ecological risks.

Sediment

Human Health Risk

SSVs are tools for screening contaminated sediments for potential impacts to human health; however, as described in **Section 1.4.3.2**, SSVs will not be used to evaluate sediment contamination at the Site. Further, the potentially complete human health exposure pathway will be mitigated by addressing ecological exposure pathways.

Ecological Risk

Preliminary Sediment Remediation Goals were developed for use in this FFS to achieve protection and restoration of habitat, minimize exposure of the benthic organisms to contaminated sediments and movement of contaminants up the food chain. The MPCA does not have sediment quality standards. SQTs, adopted for use in the SLR AOC, can be used throughout the state as benchmark values for making comparisons to surficial sediment chemistry measurements as described in **Section 1.4.3.2**. The Midpoint SQT will be used to identify, evaluate, and prioritize sediment-associated risk to ecological health.

All Media

This guidance document assists in selecting remedial technology most appropriate for a specific site based on contaminated sediment and site specific characteristics (http://www.itrcweb.org/contseds_remedy-selection/).

The USEPA document *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* presents remedial options available for contaminated sediments discussing advantages and limitations associated with the options.

The USEPA document *Use of Amendments for In Situ Remediation at Superfund Sediment Sites* presents remedial options using amendments available for contaminated sediments discussing advantages and limitations associated with the options.

The MPCA *Site Screening and Evaluation Document* presents an overall process for conducting a Tier 1 evaluation of the various exposure pathways at a site. The screening criteria worksheet can be found at the MPCA website (https://www.pca.state.mn.us/waste/risk-based-site-evaluation-guidance).

2.1.2 Location-Specific ARARs and TBCs

The Location-Specific ARARs and TBCs for the Site are as follows:

ARAR/TBC	Citation/Source	Description/Application
Waters of the State and Groundwater Protection	Minn. Stat. 103G and 103H	Groundwater protection, nondegredation, and best management practices.
Floodplain Management and Wetlands Protection	40 CFR Part 6, Appendix A, §6.a.(1)	Requires agencies to evaluate potential effects of actions in a floodplain to avoid adverse impacts.
Shoreland and Floodplain Management	Minn. Rules ch. 6120	Conserves economic and natural environmental values (MDNR).
St. Louis County Land Use Ordinances	St. Louis County Zoning Ordinances, ch. 1003	Floodplain management, Manages on-site waste disposal and other site activities
Shoreland Management	Duluth City Code §51-26 et seq.	The City of Duluth requires a permit for any excavation or grading above the Ordinary High Water Mark within 300 feet of a river.
Endangered Species Act	16 USC §1531 et seq. 50 CFR §17.11-12	Conservation of threatened and endangered plants and animals and their habitats.
Endangered, Threatened, Special Concern Species	Minn. Rules ch. 6134 Minn. Statute, Section 84.0895	Protection of endangered, threatened, special concern species (MDNR).
Migratory Bird Treaty Act	16 USC Chapter 7, Subchapter II §§703 and 712.2	Protects migratory birds and their ecosystems.
MDH Advisory for SLR	MDH	Provides fish consumption advisories.

The Site is located within the Lake Superior Drainage Basin. Surface water quality standards and provisions for Class 2B and 3B waters apply. In addition, USEPA and the Great Lakes states agreed in 1995 to a comprehensive plan to restore the health of the Great Lakes. The Final Water Quality Guidance for the Great Lakes System, also known as the Great Lakes Initiative (GLI), includes criteria for states to use when setting water quality standards for 29 pollutants, including bioaccumulative chemicals of concern, and prohibits the use of mixing zones for these toxic chemicals. Because the surface water at the Site is within the drainage basin of Lake Superior, the ARARs specified in the GLI, Minn. Rules ch. 7052 are applicable to the Site. Requirements of the Great Lakes Water Quality Agreement of 2012 apply to the Site. In addition, the surface waters adjacent to the Site are identified as an Outstanding International Resource Water (OIRW). The objective for OIRW is to maintain water quality at existing conditions when the quality is better than the water quality standards. Generally, OIRWs are considered surface water quality standards applicable to the SLR for Class 2B and OIRWs, as set forth in Minn. Rules, chs. 7050 and 7052, and to the additional surface water quality standards for the SLR, as set forth in Minn. Rules ch. 7065. The OIRW was established after the ROD was issued.

As stated in Minn. Rules ch. 7050.0210 Subp. 2:

> *Nuisance conditions prohibited. No sewage, industrial waste, or other wastes shall be discharged from either point or nonpoint sources into any waters of the state so as to cause any nuisance conditions, such as the presence of significant amounts of floating solids, scum, visible oil film, excessive suspended solids, material discoloration, obnoxious odors, gas ebullition, deleterious sludge deposits, undesirable slimes or fungus growths, aquatic habitat degradation, excessive growths of aquatic plants, or other offensive or harmful effects.*

Title 40 CFR Part 6, Appendix A, Section 6 Requirements: Requires federal agencies to evaluate the potential effects of actions taken within a floodplain to avoid adversely impacting floodplains wherever possible.

Title 40 CFR Part 6, Appendix A, Section 6.a.(1) Floodplain/Wetlands Determination: Before undertaking an Agency action, each program office must determine whether or not the action will be located in or affect a floodplain or wetlands. The Agency shall utilize maps prepared by the Federal Insurance Administration of the Federal Emergency Management Agency (Flood Insurance Rate Maps or Flood Hazard Boundary Maps), Fish and Wildlife Service (National Wetlands Inventory Maps), and other appropriate agencies to determine whether a proposed action is located in or will likely affect a floodplain or wetlands. If there is no floodplain/wetlands impact identified, the action may proceed without further consideration of the remaining procedures set in this section. If floodplain/wetlands impact is identified, this section presents procedures that must be taken.

Shoreland and Floodplain Management (Minn. Rules ch. 6120): Provides standards and criteria intended to preserve and enhance the quality of surface waters, conserve the economic and natural environmental values of shorelands, and provide for the wise use of water and related land resources of the state. St. Louis County Zoning Ordinances, ch. 1003, establish additional floodplain management and manage site activities such as on-site waste disposal.

Shoreland Management Permit (Duluth City Code §51-26 et seq.), as defined by the City of Duluth: Requires a permit for any excavation or grading above the Ordinary High Water Mark within 300 feet of a river. Each alternative will involve some of these activities. The substantive requirements of this permit are found in the ordinance and may govern removal of natural vegetation, grading and filling, placement of roads, sewage and waste disposal, and setbacks.

The Endangered Species Act (16 USC §1531 et seq.) and the Minnesota Endangered, Threatened, Special Concern Species Act (Minn. Rules ch. 6134): Protect threatened and endangered plants and animals and their habitats.

Title 16 USC Chapter 7, Subchapter II §§703 and 712.2. (The Migratory Bird Treaty Act): Protects migratory birds and their ecosystems by specifying the taking, killing, or possessing migratory birds unlawful. Public Law 95-616, an amendment to this act, provides measures to protect identified ecosystems of special importance to migratory birds such as bald eagles against pollution, detrimental alterations, and other environmental degradations.

The MDH has established various fish consumption advisories for the SLR due to the presence of PAHs, PCBs, and RCRA metals in water and sediments.

2.1.3 Action-Specific ARARs and TBCs

The following summarizes the Action-Specific ARARs for the Site. In addition, Occupational Safety and Health Standards (Minn. Rules ch. 5205) for worker health, safety, and training are applicable to remedial actions performed at the Site.

ARAR/TBC	Citation/Source	Description/Application
Waters of the State (both surface and underground)	Minn. Rules ch. 7050 and 7052	Surface water quality during remedy construction.
Wetland Conservation Act (WCA)	Minn. Stat. §§103G.221-.2373	Protection of wetlands.
Wetlands Conservation	Minn. Rules 8420	Protection of wetlands, wetland functions for determining public values.
Floodplain Management Order	Executive Order 11988 and 40 CFR Part 6, Appendix A	Regulates remedial action implementation in floodplains.
Section 404 Permit and Section 401 Certification (Clean Water Act)	33 CFR parts 320 and 323; 33 USC §1341	Applies to discharge of dredged or fill material into waters of the United States.
National Pollutant Discharge Elimination System (NPDES)/ State Disposal System (SDS) permits	Clean Water Act 33 USC §1342	Surface water quality requirements for discharges of pollutants to waters of the state.
Section 10 (Rivers and Harbors Act of 1899)	33 USC 403	Applies to activities that will obstruct or alter any navigable water of the United States.
Work in Public Waters	Minn. Stat. §103G.245	Permit requirements applicable to work in public waters that will change or diminish its course, current, or cross-section.
Public Water Resources	Minn. Rules ch. 6115	Water appropriation permitting, standards and criteria for alterations to structure of public water (MDNR).
Minnesota Sediment Quality Targets	Guidance for the Use and Application of Sediment Quality Targets for the Protection of Sediment-dwelling Organisms in Minnesota, MPCA Document Number: tdr-gl-04	Establishes procedures for potentially bioactive zone (PBAZ) caps and covers.

ARAR/TBC	Citation/Source	Description/Application
Western Lake Superior Sanitary District (WLSSD)	WLSSD Industrial Pre-Treatment Ordinance	Requirements for any dredge water discharged into public sanitary sewers.
Construction and Use of Public Sewers	Minn. Rules ch. 4715	Governs the use of sewers and public water systems if any dredge water is disposed of in public sewers.
MDNR Invasive Species Management	Minn. Statutes 84D.02	Requirements for sediment transportation if invasive species are present
Solid Waste	Minn. Rules ch. 7035	Requirements and standards for solid waste facilities.
Hazardous Waste	Minn. Rules ch. 7045	Hazardous waste listing, and generator, transport, and facility standards.
Air Pollution Emissions and Abatement	Minn. Stat. §116.061	Duty to notify and abate excessive or abnormal unpermitted air emissions.
Ambient Air Quality Standards	Minn. Rules ch. 7009	Provides air quality standards.
Preventing Particulate Matter From Becoming Airborne and Emission Standards	Minn. Rule parts 7011.0150 and 7011.8010	Provides measures to control dust and emission standards for hazardous air pollutants.
Noise Pollution Control	Minn. Rules ch. 7030	Noise standards applicable to remedy construction.

Water Quality

If any activity associated with the remedial actions results in an unregulated release, in accordance with the Water Pollution Control Act and Minn. Stat. 115.061, Duty to Notify, a notification and recovery of any pollutants discharged to minimize or abate pollution of the waters of the state is required.

In accordance with Minn. Rules ch. 7050, surface water quality standards for the maintenance and preservation of surface water quality during remedy construction, including discharges from treatment/work and stormwater runoff zones, shall be based on surface water quality standards that currently apply to Class 2B and OIRWs, as set forth in Minn. Rules, chs. 7050 and 7052, and to the additional surface water quality standards for the SLR set forth in Minn. Rules ch. 7065. Therefore, if water is discharged directly to the waters on or adjacent to the Site, it shall be treated to a level that meets applicable surface water discharge standards. Groundwater non-degradation and standards for the protection of groundwater during remedy construction are presented in Minn. Rules 7060.

During remediation, the MPCA would consider the areas in which work is performed as “treatment/work zones,” to which the surface water quality standards normally applicable to the SLR would temporarily not apply. These treatment/work zones would be physically separated from adjacent waters through the use of engineering controls such as single or multiple silt curtains, inflatable dams, sheet piling, or other measures. During construction of the remedy, any discharges occurring within those controlled treatment/work zones, such as the discharge of capping material during capping operations, the release of contaminants during dredging operations, or runoff from activities on shore, would not be subject to water quality standards. Rather, water quality standards would apply outside of the treatment/work zone, beyond the outermost engineering control structure where the water from the treatment/work zone is discharged. Other discharges occurring during remedy construction that are not included in a treatment/work zone, including discharges of treated dredge water, and discharges of stormwater runoff from shoreland modifications outside of the treatment/work zones, would also be subject to regulation.

If water is discharged, it would be treated to a level that meets applicable surface water discharge standards. The MPCA water quality standards may apply to these discharges. Final standards would be determined by the MPCA prior to implementation of the remedial actions. In the event that a standard is exceeded, further management practices would likely be required during remedy construction to reduce the amount of suspended contaminants escaping the treatment/work zone.

Wetlands, Shoreland, and Floodplain Management

In accordance with Minn. Rules ch. 7050, wetlands at the Site are classified as unlisted wetlands, Class 2B and 3B waters. In accordance with Minn. Rules ch. 8420, compliance with wetland ARARs will involve consultation with the MDNR to determine the category of wetlands present at the Site and any avoidance, mitigation, and replacement that may be necessary. Water quality standards for the maintenance and preservation of surface water quality during remedy construction including discharges from treatment/work and stormwater runoff zones shall be based on surface water quality standards that currently apply to Class 2B and 3B waters and shall comply with Minn. Stat. §§103G.221-.2373. Standards and specifications applicable to shoreland and floodplain management can be found in Executive Order 11988 and 40 CFR Part 6, Appendix A, Minn. Rules ch. 6120.

Minn. Stat. §103G.222 provides that a wetland replacement plan must be approved by the Local Governmental Unit before any Wetland Conservation Act (WCA) wetlands may be drained or filled, unless draining or filling falls within the “De Minimis” exemption or another exemption of Minn. Stat. §103G.2241. WCA wetlands are those wetlands that are not public water wetlands regulated by the MDNR and United States Army Corps of Engineers (USACE). WCA wetlands would be located above the Ordinary High Water Mark. The South St. Louis Soil and Water Conservation District provides additional guidance regarding WCA requirements for the Site at the following website: http:// www.southstlouisswcd.org/wcact.html.

Permits and Certifications

Possible permits for cleanup activities include the following:

Section 404 Permit (Clean Water Act): Required for discharge of dredged or fill material into waters of the United States. The substantive requirements of this permit shall be met for alternatives that dredge or fill waters of the state. USACE evaluates applications for Section 404 permits. Substantive requirements that may be incorporated within a Section 404 permit for off-site activities can be found in 33 CFR Parts 320 and 323.

Section 401 Certification: The Clean Water Act, 33 USC §1341, requires that any application for a federal permit that may result in a discharge to a navigable water must be accompanied by a certification from the affected state indicating that the discharge will comply with all applicable water quality standards and effluent limitations of the Act. Thus, a Section 401 certification or a 401 certification waiver for remedial action at the Site would be necessary before the USACE may issue a Section 404 permit, and a certification may be necessary before the USACE may issue a Section 10 permit if that permit authorizes a “discharge.”

National Pollutant Discharge Elimination System (NPDES; Clean Water Act 33 USC §1342): Discharges of pollutants to waters of the state associated with construction of the selected remedy would be subject to the requirements applicable to a NPDES permit. Discharges could include the discharge of capping material, the discharge of contaminants released and suspended by dredging operations, the discharge of treated dredge water during dredging operations, and the discharge of stormwater runoff from shoreland modifications. These types of discharges would be subject to the same regulatory standards and controls that would apply under an MPCA permit. In addition, NPDES General Permit number MNG990000 has been required for managing dredged materials; however, this permit has expired and has not been renewed. According to Managing Dredged Materials in the State of Minnesota (MPCA, 2009), an individual NPDES/State Disposal System (SDS) Dredge Materials Management permit may be required. A NPDES Construction Permit and a Stormwater Pollution Prevention Plan are required by the MPCA if more than one acre of land is disturbed by excavation activities.

Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403): A Section 10 permit is required from the USACE for any construction in or over any navigable water, or the excavation or discharge of material into such water, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters. The substantive requirements that may be incorporated within a Section 10 permit can be found in 33 CFR Parts 320 and 322.

Work in Public Waters (Minn. Stat. §103G.245): A permit from the MDNR is necessary for any work in public waters that will change or diminish its course, current, or cross-section. If an alternative under consideration involves dredging or capping, a public waters permit from the MDNR may be required. The substantive requirements that the MDNR may incorporate within its public waters permit are codified in statute and at Minn. Rules, ch. 6115. These requirements include compensation or mitigation for the detrimental aspects of any major change in the resource. The MDNR permits may require restoration of bathymetry (water depth) and habitat substrate (bottom) as part of the public waters permit. The MDNR would set the specific cover depth and composition requirements.

Additionally, if capping of contaminated sediments is conducted, requirements would include specifications for cap construction. In situ caps constructed for the containment of contaminated sediment must contain an isolation zone (IZ) and a potentially bioactive zone (PBAZ). The IZ is the portion of the cap that is applied directly over the contaminated sediments and is designed to isolate and attenuate the Site contaminants that could potentially be transported upward into the PBAZ at concentrations above the CULs by diffusion or advection transport mechanisms. The PBAZ is the area within the cap above the IZ where significant biological activity may potentially be present. The thickness and material specifications for the IZ and PBAZ should be determined based on pore water transport and attenuation modeling.

Air Emissions and Waste Management Permits: In accordance with Minn. Stat. §116.081, a permit is required for the construction, installation or operation of an emission facility, air contaminant treatment facility, treatment facility, potential air contaminant storage facility, storage facility, or system or facility related to the collection, transportation, storage, processing, or disposal of waste, or any part thereof, unless otherwise exempted by any agency rule now in force or hereinafter adopted, until plans have been submitted to the agency, and a written permit granted by the agency.

On-Site Disposal: The placement of dredged sediment into an on-site confined aquatic disposal (CAD) area and any subsequent seepage from the CAD, if implemented, would be regulated by the MPCA under the requirements applicable to an SDS permit. The legal requirements for an SDS are found in Minn. Stat. §115.07, Minn. Rules, Parts 7065.0100 to 7065.0160 and in other MPCA water quality rules including Minn. Rules chs. 7050 and 7052.

Discharge into Sewers: A permit from the Western Lake Superior Sanitary District (WLSSD) will be necessary if any dredge water is discharged into the public sewers. Pretreatment standards that would likely apply can be found at:

http://www.wlssd.duluth.mn.us/pdf/WLSSDPretreatmentOrdinance.pdf.

The permit will also include requirements to ensure that there will be no detrimental effects to their bio-solids program. A WLSSD permit would also represent compliance with Minn. Rule, Part 4715.1600 and the MPCA water rules governing indirect discharges.

Invasive Species: A prohibited/regulated invasive species permit will be required to transport sediment to a landfill, if invasive species are present near the proposed work area.

CERCLA provides for waiving of necessary permits for on-site work, provided the work is conducted in compliance with the substantial conditions of such permits. Although the permits themselves may not be required on CERLCA Sites, compliance with the substantial conditions of these identified permits shall be met.

Construction and Use of Public Sewers

Minn. Rules ch. 4715 governing the use of sewers and public water systems would apply if any water associated with remedial activities is disposed of in public sewers.

Waste Management

Solid and hazardous waste management requirements and standards can be found in Minn. Rules chs. 7035 and 7045, respectively. USEPA guidance has consistently stated that Superfund remedies involving movement of contaminated material within the area of a Site where such material is already located (sometimes referred to as an AOC) do not create a “waste” that is subject to RCRA (42 USC §§6901 et seq.) or other waste management requirements. Remedy alternatives that require contaminated materials to be moved to an off-site land disposal site are considered to generate waste that must be managed under applicable waste management requirements.

St. Louis County Zoning Ordinances, ch. 1003, establish additional floodplain management and manage site activities such as on-site waste disposal.

Ambient Air Quality Standards

Air quality standards applicable to releases into the air from cleanup activities include Min. Stat. 116.061, Air Pollution Emissions and Abatement. During remedy construction, activities such as transportation, storage and placement of capping material may result in particulate matter becoming airborne. Minn. Rules ch. 7009 establishes ambient air quality standards for criteria pollutants regulated under the Clean Air Act. Compliance points shall be selected in accordance with Minn. Rules ch. 7009. The ambient air quality standards for particulate matter that apply to remedial actions are found at: https://www.revisor.mn.gov/rules/?id=7009.0080.

Control of the generation of airborne particulate matter during remedy construction is regulated in Minn. Rule part 7011.0150, *Preventing Particulate Matter from Becoming Airborne*, which includes measures to control dust that may be generated during remedy construction activities such as transportation, storage, and placement of capping material, which shall be addressed in the remedial design plan. Minn. Rules part 7011.8010, Site Remediation, incorporates the National Emission Standards for Hazardous Air Pollutants applicable during Site remediation activities.

Noise Pollution Control

Minn. Rules ch. 7030 establishes noise standards for various land uses. Compliance points will be selected in accordance with Minn. Rules ch. 7030. The noise standards that will apply to the selected remedial action can be found at:

https://www.revisor.leg.state.mn.us/rules/?id=7030.0040.

2.1.4 Other Considerations

Other considerations under MERLA set forth the regulatory requirements, RAOs and CULs that must be met by a remedy to meet the legal standard for a remedy under MERLA and the threshold criterion for protection of public health and welfare and the environment. A remedy, as defined under MERLA, must also include any monitoring, maintenance and institutional controls (ICs) and other measures that MPCA determines are reasonably necessary to ensure the protectiveness of the selected remedy over the long term.

It is particularly important to consider the requirements for long-term assurance of protectiveness where the remedy alternatives involve the use of capping or containment to manage contaminated media within the Site. Some requirements may also be necessary to ensure long-term protectiveness of alternatives that involve excavation or dredging and off-site disposal of contaminated soil or sediment.

In addition, MERLA requires the MPCA to consider the planned use of the property where the release of contaminants is located when determining the appropriate standards to be achieved by a remedy.

Long-Term Assurance of Protectiveness

MERLA requires that a remedy include measures that are reasonably required to ensure the ongoing protectiveness of a remedy once the components of the remedy have been constructed and entered their operational phase. Such measures may include, but are not limited to, ICs and monitoring and maintenance requirements. This section discusses the measures that MPCA determines are reasonably necessary to ensure long-term protectiveness.

Institutional Controls

Institutional controls are legally enforceable restrictions, conditions or controls on the use of property, groundwater or surface water at a property that are reasonably required to ensure the protectiveness of a remedy or other response actions taken at the Site. Areas of the Site where contaminated media remains in place after remedial construction will be subject to ICs (such as easements and restrictive covenants) that are legally binding on current and future owners of the property to ensure ongoing protection from disturbance of or exposure to the contamination. Restrictions on use may also be required for areas of the Site where contaminated media are treated and/or removed and where some residual contamination may remain.

Minn. Stat. §115B.16, subd. 2, requires an Affidavit Concerning Real Property Contaminated with Hazardous Substances to be recorded with the St. Louis County recorder by the owner of the property. The Uniform Environmental Covenants Act (UECA) and the authority for requiring environmental covenants can be found in Minn. Stat. ch. 114E. This statute requires MPCA approval of environmental covenants (which include restrictive covenants and access) when there is an environmental response project (which includes superfund cleanups) is overseen by the MPCA. Because the Site is not platted, the UECA may not apply and other ICs such as a City Ordinance may be required to prevent anchoring, fishing, dredging, and other activities that may disturb a cap or contaminated sediments left in place.

Long-Term Operation and Maintenance, Monitoring, and Contingency Action

On-site containment facilities and capping of impacted media (sediment) or any other alternative that may leave impacted media on-site will require post-construction monitoring, operation and maintenance (O&M), and contingency action plan to ensure that ARARs, RAOs and CULs that apply to the alternative are fully achieved and maintained over time.

General details of the post-construction monitoring, O&M, and contingency action plan requirements would be set forth in the FFS, along with an estimate of the cost to carry out each activity.

Planned Use of Property

In a provision entitled “Cleanup Standards” (Minn. Stat. §115B.17, subd. 2a), MERLA provides that when MPCA determines the standards to be achieved by response actions to protect public health and welfare and the environment from a release of hazardous substances, the agency must consider the planned use of the property where the release is located. The purpose of this provision of MERLA is to allow the MPCA to select cleanup standards that provide a level of protection that is compatible with the uses of the Site property that can be reasonably foreseen.

2.2 Remedial Action Objectives

The RAOs developed by the MPCA for the Site are:

1. Reduce human health risks associated with exposure to COCs through direct contact with sediments, inhalation, and incidental sediment ingestion by reducing sediment concentrations of COCs to protective levels or by eliminating direct contact or exposure potential.
2. Minimize or remove exposure to sediment contaminants that bioaccumulate in the food chain and contribute to fish consumption advisories.
3. Minimize or remove exposure of the benthic organisms to contaminated sediments above sediment cleanup goals.
4. Enhance aquatic habitat, if conditions allow, in a manner that contributes to the removal of BUIs.

The following subsection presents preliminary sediment CULs developed to achieve these RAOs.

2.2.1 Preliminary Sediment Cleanup Levels

The selected remedy should meet the Preliminary CULs and provide protection of ecological and human health. The CULs should also provide cleanup standards consistent with any planned or potential future uses of the Site. The Midpoint SQT for dioxins will serve as the CULs for the Site. The SQTs for dioxins are greater than the SSV. The SSV for dioxins is likely less than ambient concentrations, according to the MDH Guidance (MDH, 2014); therefore, the Midpoint SQT will serve as a reasonable CUL. The following table presents the CULs for the COCs identified in **Section 1.4.3.3**.

Contaminant	Units	CUL	Maximum Concentration Detected
Dioxins	ng TEQ/kg	11.2	29

Notes:
ng TEQ/kg = nanograms toxic equivalency per kilogram

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

3.1 Remedial Technology Identification and Screening Process

Potential technologies for addressing conditions at the Site were identified based upon professional experience of Bay West staff, discussions between Bay West and MPCA staff, and guidance developed for the remediation of contaminated sediment sites (USEPA, 2005; Interstate Technology and Regulatory Council [ITRC], 2014). Information collected during the 2015 RI was used to compile the CSM and identify feasible technologies for the Site.

A qualitative approach was used to screen technologies using a three-part ranking system where each technology was evaluated on effectiveness, implementability, and relative cost:

- Effectiveness was evaluated by the predicted ability of the technology under consideration to ensure long-term protection of human health and the environment while minimizing short-term impacts during implementation, as well as the technology's ability to meet RAOs.
- Implementability was evaluated by considering the technical and administrative feasibility of the technology. Technical feasibility includes the ability to achieve RAOs and the avoidance of creating additional risk during implementation, including the degree of disruption in the project area. Administrative feasibility includes the consideration of permits required for technology implementation, availability of disposal facilities and equipment necessary for the technology, and coordination with applicable agencies and stakeholders.
- Relative costs used for technology screening were based on engineering judgment, rather than detailed estimates. Detailed cost estimates were compiled for each individual alternative, which incorporate technologies meeting screening criteria, and are presented in **Section 3.3**.

Table 2 presents a summary of the technology screening results. The following sections describe the technologies that were screened using the three-part ranking system.

3.1.1 Institutional Controls

ICs are legally enforceable restrictions, conditions, or controls on the use of property, ground water, or surface water at a contaminated site that are reasonably required to ensure the protectiveness of a remedy or other response actions taken at the Site. If contaminated sediments remain in place after remedial actions are taken, the Site would be subject to ICs (such as easements and restrictive covenants) that are legally binding on current and future owners of the property to ensure ongoing protection from disturbance of or exposure to the contamination. Most remedial alternatives include ICs until long-term monitoring (LTM) indicates that risk reduction has been achieved and the RAOs have been met (ITRC, 2014). The following information obtained from USEPA sediment remediation guidance (USEPA, 2005) details ICs likely appropriate for use at the Site.

Fish consumption advisories are informational devices that are frequently already in place and incorporated into sediment site remedies. Commercial fishing bans are government controls that ban commercial fishing for specific species or sizes of fish or shellfish. Usually, state departments of health are the governmental entities that establish these advisories and bans. An advisory usually consists of informing the public that they should not consume fish from an area, or consume no more than a specified number of fish meals over a specific period of time from a particular area. Sensitive sub-populations or subsistence fishers may be subject to more stringent advisories. Advisories can be publicized through signs at popular fishing locations, pamphlets, or other educational outreach materials and programs. Consumption advisories are not enforceable controls and their effectiveness can be extremely variable (USEPA, 2005).

Waterway use restrictions may be necessary to ensure the integrity of the alternative for any alternative where subsurface contamination remains in place (e.g., capping, MNR, or an in-water confined disposal site). Examples include restricting boat traffic in an area to establish a no-wake zone, or prohibiting anchoring of vessels. In considering boating restrictions, it is important to determine who can enforce the restrictions, and under what authority and how effective such enforcement has been in the past. In addition, a restriction on easements for installing utilities, such as fiber optic cables, can be an important mechanism to help ensure the overall protectiveness of a remedy (USEPA, 2005).

It may be necessary to work with private parties, state land management agencies, or local governments to implement use restrictions on nearshore areas and adjacent upland properties where contamination remains in place. For example, construction of boat ramps, retaining walls, or marina development can expose subsurface contamination and compromise the long-term effectiveness of a remedy. Where contaminated sediment exceeding CULs is identified in proximity to utility crossings or other infrastructure and temporary or permanent relocation of utilities in support of a dredging remedy may not be feasible or practical, capping may be desirable even though temporary cap disruption may be necessary periodically (USEPA, 2005).

3.1.2 Monitoring

Monitoring is the collection and analysis of data (chemical, physical, and/or biological) over a sufficient period of time and frequency to determine the status and/or trend in one or more environmental parameters or characteristics. Monitoring should not produce a “snapshot in time” measurement, but rather should involve repeated sampling over time in order to define the trends in the parameters of interest relative to clearly defined management objectives. Monitoring is recommended for all types of sediment remedies both during and after remedial action and can be classified as construction monitoring and performance monitoring (also referred to as LTM), respectively. Monitoring should be conducted for a variety of reasons, including: 1) to assess compliance with design and performance standards; 2) to assess short-term remedy performance and effectiveness in meeting sediment CULs; and/or 3) to evaluate long-term remedy effectiveness in achieving RAOs and in reducing human health and/or environmental risk. In addition, monitoring data are usually needed to complete the five-year review process where a review is conducted.

Monitoring activities applicable to the Site could include one or more of the following based on the selected remedy:

- Collection of sediment chemical data to ensure that CULs have been achieved (due to dredging, in situ treatments, or degradation);
- Measurements of cover/cap thicknesses to ensure continued isolation of contaminants;
- Measurement of COC concentrations in cover/cap material to ensure that contaminants are not migrating into or through the cover/cap; and
- Measurement of toxicity to and bioaccumulation of COCs within aquatic organisms such as benthics and fish in order to evaluate reduction trends.

Construction monitoring may also be performed to ensure that contamination or nuisance materials are not released during construction activities. Construction monitoring activities applicable to the Site include one or more of the following:

- Turbidity monitoring to ensure that the off-site release of suspended sediments containing COCs is mitigated during dredging and/or cover/cap placement;
- Air monitoring to ensure that the off-site release of nuisance and/or contaminated dusts is mitigated during construction activities such as the mixing of sediments and amendment materials, hauling over dirt or gravel roadways, and excavation or other intrusive Site work;
- Periodic sampling of treated dredge contact water to mitigate contaminant inputs to water bodies or local sewage systems and to ensure that treated water meets permit or municipality requirements;
- Periodic sampling of dredged materials to ensure that landfill requirements for acceptance are achieved;
- Periodic sampling of imported materials (e.g., cover/cap materials, shoreline restoration materials, etc.) to mitigate impacts to water bodies or upland areas as a result of placement; and
- Pre- and post-construction soil sampling to access impacts of construction activities on lands used during the construction phase.

Both construction and performance monitoring (referred to as LTM) are incorporated into each of the remedial alternatives developed for this FFS.

3.1.3 Monitored Natural Recovery

MNR is defined by the National Research Council as a remediation practice that relies on natural processes to protect the environment and receptors from unacceptable exposures to contaminants. This remedial approach depends on natural processes to decrease chemical contaminants in sediment to acceptable levels within a reasonable time frame. With MNR, contaminated sediments are left in place and monitored for ongoing physical, chemical, and biological processes that transform, immobilize, isolate, or remove contaminants until they no longer pose a risk to receptors. Natural processes that contribute to MNR may include sediment burial, sediment erosion or dispersion, and contaminant sequestration or degradation (for example, precipitation, adsorption, or transformation). These natural processes can reduce exposure to receptors (and thus reduce risk) and contribute to the recovery of the aquatic habitat and the ecological resources that it supports. MNR can be used alone or in combination with active remediation technologies to meet RAOs (ITRC, 2014).

3.1.4 Enhanced Monitored Natural Recovery

Enhanced Monitored Natural Recovery (EMNR) relies on the same natural processes as MNR to decrease chemical contaminants in sediment but includes the application of material or amendments to enhance these natural recovery processes. EMNR can use several technologies including, but not limited to, thin-layer capping and introduction of reactive amendments such as activated carbon (AC). Thin-layer caps (typically up to 1 foot) are often applied as part of an EMNR approach. These caps enhance ongoing natural recovery processes, while minimizing effects on the aquatic environment. Thin-layer caps are not intended to completely isolate the affected sediment, as in a conventional isolation capping remedy. This layer also accelerates the process of physical isolation, which continues over time by natural sediment deposition (ITRC, 2014).

3.1.5 In Situ Treatment

In situ sediment treatment involves applying or mixing of an amendment into sediments. Mixing may be achieved either passively, through natural biological processes such as bioturbation, or actively through mechanical means such as augers. In situ treatment technologies can achieve risk reduction in environmentally sensitive environments such as wetlands and submerged aquatic vegetation habitats, where sediment removal or containment by capping might be harmful. Treatment amendments typically reduce concentrations of freely dissolved chemicals that are available for exposure to organisms or that may be mobilized and transferred from sediment to the overlying water column (ITRC, 2014). The following in situ treatment technologies were screened in this evaluation:

- Immobilization – Immobilization treatments add chemicals or cements to reduce the leachability of contaminants. Mechanisms include solidification (encapsulation) or stabilization (chemical or absorptive reactions that convert contaminants to less toxic or mobile forms);
- Enhanced bioremediation – Microbial degradation by bacteria or fungi is enhanced by adding materials such as oxygen, nitrate, sulfate, hydrogen, nutrients, or microorganisms to the sediment;
- Oxidation/reduction – Chemicals are injected into sediment to act as an oxidant/electron acceptor to facilitate aerobic decomposition of organic matter;
- Chemical oxidation – The addition of chemical oxidizers to sediment can cause the rapid and complete chemical destruction of many toxic organic chemicals;
- Phytoremediation – Phytoremediation uses plant species to remove, transfer, stabilize, and destroy contaminants in sediment. Generally limited to sediments in shallow water zones and low concentrations; and
- Adsorption – Adsorbents can be used as sediment amendments for in situ treatment of contaminants. Sorption of metals and organics can take place simultaneously with a suitable combination of sorbents. Adsorbents or other amendments can be contained in a mat, applied in bulk onto the sediment surface, mixed in the sediment, added as part of a sand cap, or as a layer within a sand cap. When used as a direct sediment amendment, rather than as an amended cap, mixing of amendments by benthic organisms is desired to incorporate the amendment into the sediment. In such cases, mixing may be promoted by injecting the amendment into the sediment with hollow tines or using equipment similar to a rototiller.

3.1.6 Capping

Capping is the process of placing a clean layer of sand, sediments, or other material over contaminated sediments in order to mitigate risk posed by those sediments. The cap may also include geotextiles to aid in layer separation or geotechnical stability, amendments to enhance protectiveness, or additional layers to armor and maintain its integrity or enhance its habitat characteristics.

When amendments are mixed directly into sediments, the resulting remedy is termed “in situ treatment.” When these amendments are added to cap material, the remedy is called an “amended cap,” and the amendments enhance the performance of the cap material. The same amendment used in the same proportions is generally more effective at isolating contaminants when used in a cap than when placed directly into sediments. The amended cap provides the benefits of capping in addition to the benefits of the treatment amendment (ITRC, 2014).

A cap should consist of at least two parts; an IZ and a PBAZ. The IZ is the portion of the cap that is applied directly over the contaminated sediments and is designed to isolate and attenuate contaminants that could potentially be transported upward into the PBAZ by diffusion or advection transport mechanisms. The PBAZ is the area within the cap above the IZ where biological activity may potentially be present. The PBAZ thickness can be estimated based on the potential organisms (both plant and animal) that may be present or take up residency once the cap is constructed. Contaminant levels should not exceed CULs for COCs throughout the entire thickness of the PBAZ.

3.1.7 Dredging and Excavation

Dredging consists of the removal of contaminated sediment from water bodies in order to reduce risks to human health and the environment. Removal is particularly effective for source control (mass removal of hot spots) but potentially less effective for overall risk reduction because of resuspension and residual contamination. The three methods of contaminated sediment removal are mechanical dredging, hydraulic dredging, and excavation. As with any type of removal operation, additional technologies are required to appropriately handle the removed sediment. Dredged material handling technologies may involve transport, dewatering, treatment, and or disposal of sediment (ITRC, 2014). Mechanical dredging, hydraulic dredging, and excavation were screened independently in this evaluation.

After removal, the contaminated sediment can be treated or disposed of in a controlled setting, such as an off-site landfill or other treatment, storage, and disposal facility, an on-site aquatic or terrestrial confined disposal facility (CDF), or a facility that converts the sediment to a reusable product. Disposal methods were evaluated independently from dredging and excavation and are described further in **Section 3.1.9**.

3.1.8 Dewatering

Dewatering may be necessary to prepare dredged materials for disposal. Dewatering reduces the water content and hence the volume and weight of the disposed sediment. If the material is to be reused or further treated, dewatering also leads to reduced transportation cost and improves handling properties. The nature and extent of dewatering needed depends on the sediment characteristics and the type of dredging, transport, and disposal methods planned for the removed material (ITRC, 2014). Dewatering technologies may rely upon gravity draining and evaporation processes (e.g., spreading and geotextile bags), mechanical processes (e.g., filter presses), and chemical conditioning (e.g., polymer additions and stabilization additives). The type of dewatering technology selected for use may depend upon the amount of space available for dewatering, the distance of the dewatering space from dredging operations, discharge options for treated dredge contact water, project scope, and cost of implementing the technology.

3.1.9 Disposal

Disposal of dredged or excavated sediment is the placement of materials into a controlled site or facility to permanently contain contaminants within the sediment. Management is achieved through the placement of materials into facilities such as sanitary landfills, hazardous material landfills, CDFs, or CAD facilities. Off-site landfills are generally used for dredged material disposal when on-site disposal is not feasible or when off-site disposal is more cost effective.

Landfills have been used for sediment volumes of over 1 million cubic yards. Typically, some type of on-site or near-site disposal facility is used at sites where dredged material volumes greater than 200,000 cubic yards are generated. Landfilling is also favored at smaller or moderately sized sites, where transportation is feasible. The associated hazards and cost of transporting and landfilling large volumes of sediment make this disposal method somewhat less desirable than other solutions. Other considerations, such as public and stakeholder acceptance, lack of access to suitable on-site land- or water-based disposal facilities, and proximity to an existing off-site landfill may support the landfilling option.

CDFs are constructed to isolate dredged sediment from the surrounding environment. CDFs can be located upland, near shore, or in the water (as an island). Material staging or a temporary CDF may be necessary for dewatering dredged sediment. CDFs represent a common disposal method and typically are built for larger volume sites (200,000 cubic yards or more of sediment).

The CAD method deposits dredged material within a nearby body of water. A pre-existing depression within the sediment surface is preferred, though one can be created if necessary. Dredged sediment is deposited in the depression and capped with clean material. This process carries with it the same risks associated with using capping as a remedy. The goal of moving the contaminated sediment to the aquatic disposal site is to reduce the risk of exposure to contaminated materials (ITRC, 2014).

Disposal at landfills, CDFs, and CADs were screened independently in this evaluation.

3.1.10 Remedial Technology Screening Results

Table 2 documents the technology screening process and results. The following remedial technologies were determined to be the most effective, implementable, and cost-effective and were retained for assembling the alternatives described in **Section 3.3**:

- ICs;
- Monitoring;
- Enhanced Monitored Natural Recovery;
- In Situ Treatment;
- Dredging;
- Gravity and Chemical Conditioning Dewatering; and
- Landfill Disposal.

3.2 Implementation Assumptions

This section describes important factors and assumptions for implementing one or more of the alternatives presented in **Section 3.3**.

3.2.1 Staging Area Identification

Implementation of alternatives involving placement of sand and/or amendment materials would require identification and construction of a staging area in which to receive and stockpile imported materials and for loading of materials into barges for transport to the Site. Based on conversations between Bay West and the Duluth Seaway Port Authority, City of Duluth, and MPCA, the most likely staging area location would be Hallett Dock #7. Hallett Dock #7 is located approximately 7 miles downriver of the Site and is located adjacent to part of the Interlake/Duluth Tar (IDT) Superfund site. It is currently being considered for purchase by the Duluth Seaway Port Authority and, therefore, could serve as a staging facility for future remediation projects throughout the Duluth/Superior Harbor. Although previous remedial activities have resulted in capping of sediments between Hallett Dock #7 and lands to the west, the end of the dock is nearly 500 feet in width and could potentially be used as a mooring location for sediment/cap material transport barges operating between Hallett Dock #7 and remediation sites (Sharrow, 2016).

Hallett Dock #7 is not currently used for barge mooring, berthing, or as a staging area, but has served similar purposes in the past. The facilities are currently in fair to poor condition and may require repairs before use. Inspection of the dock walls and their suitability for use should be conducted prior to the design phase. For the purposes of this FFS, the dock end wall was assumed to be in acceptable condition for mooring barges and the dock suitable for use as a staging area for all alternatives. Satellite imagery indicates the presence of a large paved area at the end of Hallett Dock #7, which is appropriately sized for stockpiling materials.

3.2.2 Sediment Dewatering Area Identification

Implementation of an alternative involving dredging would require identification and construction of a sediment dewatering area in which to stage dredged sediments until they are sufficiently dewatered and can be excavated and sent to a landfill for disposal.

The most suitable geographic location in which to construct a dewatering pad is the U.S. Steel site located immediately north/northwest of the Site. The U.S. Steel site is currently abandoned industrial property and contains forested and open lands sufficiently sized for construction of a dewatering pad. The U.S. Steel site is currently serving this purpose for ongoing dredging of sediments from Radio Tower Bay, which is located south of the Site.

It was assumed for the purposes of this FFS that construction of a dewatering pad could be conducted on U.S. Steel property. Costs for construction of a dewatering pad were included within the cost analyses; however, use of the existing dewatering basin may be a possibility if the Radio Tower Bay sediments are dewatered, excavated, and hauled off-site prior to commencement of remedial activities at the Site.

3.3 Development of Alternatives

This section describes the alternatives developed for the Site. The alternatives were developed using the selected remedial technologies discussed in **Section 3.1**, Site data collected during the 2015 RI/2017 DGI, and the CSM. Site sediment chemical data was used to estimate the depth and spatial extent of the remedial areas for dioxins (the COCs) as presented in **Figure 5**. A summary of the proposed alternatives is presented in **Table 3**. Calculations used to determine volumes, rates, and time frames related to remedy construction are presented in Table 1 in **Appendix B**. Assumptions made to compile cost estimates were incorporated into a Technical Analysis and are also included in **Appendix B**.

The total present value costs for alternatives presented within this FFS should be considered to be rough order of magnitude (ROM) costs. Based on the Association for the Advancement of Cost Engineering ROM classification chart, estimates presented in this FFS are considered Class 4. Class 4 estimates are considered Schematic Designs; 15 to 20% of the level of effort required to have a complete estimate has been done. Actual cost of the project could be 50% greater or 30% less (+50/-30) than the estimates developed thus far. ROM cost estimates for the FSS were compiled using a variety of sources. These sources include construction cost data from RSMeans estimating software for open shop pricing in Duluth, Minnesota; current Bay West and state contract rates for labor, equipment, and sample analysis; personal communication with vendors; historic cost data from projects similar in size and scope; other FFS documents, presentations, or technical papers that provided estimated or real construction cost data; and available online vendor pricing of materials. Preset value calculations are included in Table 5 in **Appendix B**.

3.3.1 Alternative 1: No Action

The NCP at Title 40 CFR provides that a No Action alternative should be considered at every site. A No Action alternative should reflect the site conditions described in the baseline risk assessment and remedial investigation. The No Action Alternative included within this FFS does not include any treatment or engineering controls, ICs, or monitoring. There are no costs associated with the No Action alternative. The No Action alternative could potentially be a viable alternative if a future toxicity/bioaccumulation study indicates that concentrations of Site COCs in sediments pose no significant detrimental effects to aquatic life (i.e., benthics and fish).

3.3.2 Alternative 2: Enhanced Monitored Natural Recovery with Broadcasted Amendment

This alternative would consist of broadcasting an amendment material over sediments with COC concentrations exceeding the Midpoint SQT (i.e., the CULs). Areas of the Site exceeding the CULs are presented in **Figure 7** and equal approximately 40 acres. The objective of applying an amendment material to in situ sediments at the Site is to reduce availability of Site COCs in sediments and sediment pore water to aquatic organisms and thereby limit the exposure and affects to the organisms, and transfer of chemical contaminants to higher trophic organisms. This alternative was developed to minimize intrusive remedial action construction activities within wetland areas already established at the Site.

ICs would be implemented and LTM would commence following application of the selected amendment to remedial areas. The major components of Alternative 2 are described in the following sections.

3.3.2.1 Amendment Selection and Application Rate

This alternative consists of applying a thin layer of amendment material directly on top of in situ contaminated sediments. It is anticipated that the amendment material would be mixed into the underlying sediments over time through natural bioturbation processes caused by burrowing organisms, larger animal life, and rooting plants; therefore, this alternative is intended to reduce contaminant availability rather than provide isolation from contaminants as in a traditional capping scenario. The chosen amendment material would reduce exposure of aquatic life to COCs through sequestration of COCs in sediments and sediment pore water. Selection of an amendment material would be conducted during the design phase and would likely be selected based on results of bench and/or pilot scale testing. Potential amendment materials for consideration include permeable Sedimite^{TM}, Organoclay^{TM}, phosphate additives (e.g., apatite), bauxite, biopolymers, and zeolite (USEPA, 2013). Any potential negative effects of these amendments, such as the potential for increased levels of eutrophication for phosphate additives, should also be considered during amendment selection. For the purposes of this FFS, the selected amendment material will be Sedimite^{TM}.

The chosen application rate (i.e., thickness) of amendment to be applied should be capable of sequestering COCs in sediments and sediment pore water for an indefinite period of time, assuming that no ongoing source of contamination is present. It was assumed that a 0.01-meter layer of amendment material would be applied to in situ sediments strictly for cost analysis purposes. The final amendment application rate would be determined during the design phase and may largely depend upon COC sediment concentrations, depth of contamination, and the presence or absence of groundwater upwelling.

Implementation of this alternative assumes that approximately 2,073 cubic yards of amendment material would be broadcasted over a 40-acre area at an average thickness of 0.01 meter.

3.3.2.2 Long-Term Monitoring

LTM would commence after remedy implementation and would include collection of Site data to: monitor mixing of the amendment material throughout the sediment column over time; monitor sequestration of Site COCs in sediments; monitor reduction trends in sediment toxicity to benthic organisms and COC bioaccumulation in benthic and fish tissue; and to ensure that ICs continue to be enforced as long as COCs remain in sediments above the CUL.

LTM data collection would be conducted periodically for an indefinite period of time or until concentrations of COCs in sediments attenuate to levels below the CULs and are deemed protective of human health and the environment. For the purposes of this FFS, it was assumed that data collection would occur once every 5 years for a period of 30 years. If attenuation of COC concentrations to levels below the CULs does not occur after 30 years then monitoring will likely continue.

Data collection will consist of the following:

- Collection of sediment cores or sediment profile imagery to observe mixing of amendment material throughout the sediment column;
- Collection of sediment samples to be analyzed for Site COCs;
- Collection of sediment samples for benthic toxicity and bioaccumulation analysis;
- Collection of fish tissue samples for bioaccumulation analysis; and
- Review of IC enforcement status.

Potential monitoring locations are presented in **Figure 7**.

3.3.2.3 Institutional Controls

ICs applicable to this alternative include those that would protect against direct human contact with contaminated sediments and ingestion of contaminants through fish consumption. The MDH currently communicates fish consumption guidelines for the lakes and rivers of Minnesota. Advisories for consumption of fish within the SLR and below the Fond du Lac Dam are in place for 11 species of fish due to the presence of mercury and PCBs within fish tissue. No specific advisories are in place related to COCs. It is currently unknown whether the meal advice provided within the fish consumption guidelines is protective for these compounds; therefore, the applicability of meal guidelines to COCs would require investigation. Postings warning of contaminated sediments would be posted near potential Site access locations and would be modified according to changes in Site use (e.g., placed along walking/biking paths if developed in the future).

3.3.2.4 Cost

Calculations used to determine unit rate costs for each of the alternatives are presented in Table 2 in **Appendix B**. Other project costs determined on a lump sum basis are presented in Table 3 in **Appendix B**. The monitoring and evaluation program and associated costs developed for each alternative are presented in Table 4 in **Appendix B**. The costs associated with each alternative are presented as Class 4 (+50/-30) estimates and are appropriate for remedial design alternative evaluations only.

The estimated total present value cost for Alternative 2 is $6,800,000. **Table 4** presents a breakdown of the estimated costs associated with Alternative 2.

3.3.3 Alternative 3: Enhanced Monitored Natural Recovery with Thin-Layer Amended Cover

This alternative would consist of constructing a 0.15-meter (0.5-foot) amended cover over sediments with COC concentrations exceeding the CULs (**Figure 8**). The objective of this alternative is to reduce the availability of Site COCs to aquatic organisms through addition of an amendment material and subsequent sequestration of contaminants as discussed for Alternative 2, and to provide some immediate isolation of contaminated sediments through construction of 0.15 meters of clean substrate. Construction of the amended cover would take place in both open water and wetland areas of the Site.

ICs would be implemented and LTM would commence following construction of the thin-layer amended cover. The major components of Alternative 3 are described in the following sections.

3.3.3.1 Cover Design

It was assumed for the purposes of this FFS that a 0.15-meter amended cover would be constructed and that the cover would consist of sand with 5 percent carbon amendment by weight. It is anticipated that a single layer of a sand/amendment mix would be constructed rather than separate amendment and sand layers. Amendments mixed into and applied with soil or sand may provide better dispersion, uniformity, placement controls, and contact time when the required quantity of amendment is small, versus bulk placement of amendment materials (USEPA, 2013). The assumed cover thickness and amendment ratio was selected strictly for the purposes of the cost analysis and should be refined during the design phase. The chosen application rate (i.e., mix ratio) of amendment to be applied should be capable of sequestering COCs migrating upward through the cover material and should account for mixing of cover material into underlying sediments over time through bioturbation processes. The chosen amendment material would reduce exposure of aquatic life to COCs through sequestration of COCs in sediments and sediment pore water, as discussed for Alternative 2, and should be selected during the design phase based on bench or pilot scale testing.

Implementation of this alternative assumes that approximately 2,246 cubic yards of amendment material and 31,060 cubic yards of sand would be mixed and applied over a 40-acre area at an average thickness of 0.15 meter. The need for burning, mowing, or laying down of vegetation in wetland areas prior to construction of the cover should be determined during the design phase.

3.3.3.2 Long-Term Monitoring

LTM would commence after remedy implementation and would include collection of Site data to: monitor concentrations of COCs in cover material; monitor mixing of cover materials throughout the sediment column over time; monitor attenuation and/or sequestration of Site COCs in sediments; monitor reduction trends in sediment toxicity to benthic organisms and COC bioaccumulation in benthic and fish tissue; and to ensure that ICs continue to be enforced as long as COCs remain in sediments above the CUL.

LTM data collection would be conducted periodically for an indefinite period of time or until concentrations of COCs in sediments attenuate to levels below the CULs and are deemed protective of human health and the environment. For the purposes of this FFS, it was assumed that data collection would occur once every 5 years for a period of 30 years. If attenuation of COC concentrations to levels below the CULs does not occur after 30 years then monitoring will likely continue.

Data collection will consist of the following:

- Collection of cover samples (0 to 0.15 meter bss) to be analyzed for Site COCs;
- Collection of sediment samples below 0.15 meter bss to be analyzed for Site COCs;
- Collection of sediment cores or sediment profile imagery to observe mixing of cover materials throughout the sediment column;
- Collection of sediment samples for benthic toxicity and bioaccumulation analysis;
- Collection of fish tissue samples for bioaccumulation analysis; and
- Review of IC enforcement status.

Potential monitoring locations are presented in **Figure 8**.

3.3.3.3 Institutional Controls

ICs applicable to Alternative 3 are the same as presented in **Section 3.3.2.3** for Alternative 2. No ICs are necessary for maintenance of the cover as cover material is anticipated to mix with underlying sediments; any intrusive activities conducted at the Site in the future would likely serve to further mix cover materials with underlying sediments.

3.3.3.4 Cost

Calculations used to determine unit rate costs for each of the alternatives are presented in Table 2 in **Appendix B**. Other project costs determined on a lump sum basis are presented in Table 3 in **Appendix B**. The monitoring and evaluation program and associated costs developed for each alternative are presented in Table 4 in **Appendix B**. The costs associated with each alternative are presented as Class 4 (+50/-30) estimates and are appropriate for remedial design alternative evaluations only.

The estimated total present value cost for Alternative 3 is $13,800,000. **Table 5** presents a breakdown of the estimated costs associated with Alternative 3.

3.3.4 Alternative 4: Dredging with Wetland Restoration

This alternative would consist of complete removal of all sediments with COC concentrations exceeding the CULs. Removal of contaminated sediments would mitigate exposure of aquatic and human receptors to sediment contaminants, thus allowing for achievement of RAOs. The dredged sediments would be slurried and pumped via pipeline to a sediment dewatering area, stabilized over a period of several months, excavated, loaded onto trucks, and disposed of at an off-site landfill. Dredging would take place in both open water and wetland areas of the Site. Following sediment removal, a sand cover would be placed to reduce the surface concentration of dredge residuals through mixing of the upper sediment layer and to restore wetland areas. ICs and a LTM program would not be implemented following completion of remedy construction if complete removal of contaminated sediments is achieved. Complete removal was assumed for the purposes of this FFS and, therefore, IC/LTM costs are not incorporated into the cost analysis.

The major components of Alternative 4 are described in the following sections.

3.3.4.1 Dredging and Sand Cover Implementation

A dredging alternative would include removal of all sediments with COC concentrations exceeding the CUL. Areas of the Site exceeding the CUL are presented in **Figure 9** and equal approximately 40 acres. Dredging was assumed to be conducted in the 32-acre open water portions of the Site down to 0.5 meter (1.6 feet) bss – the average maximum depth of observed sediment contamination in the open water portion of the Site – for purposes of the cost analysis. Dredging was assumed to be conducted in 8-acre wetland portions of the Site down to 0.15 meter (0.5 feet) bss – the average maximum depth of observed sediment contamination in the wetland portion of the Site – for purposes of the cost analysis. The total volume of in situ sediments requiring removal is estimated to be 91,000 cubic yards. Over-dredging of sediments was assumed as a means of increasing dredge efficiency and reducing the mass of dredge residuals remaining after dredging completion. A 0.30 meter (1 foot) over-dredge was assumed, which would increase the total dredge volume to approximately 156,000 cubic yards.

A 0.15-meter (6-inch) sand cover would be constructed in previously dredged open water areas of the Site to manage dredge residuals and to improve benthic habitat. A sand cover would be constructed in previously dredged wetland areas to pre-dredge elevations; therefore, 0.46 meters (1.5 feet) of sand would to be placed to restore wetland areas following dredging. If restoring wetlands to pre-dredge elevations is not necessary then the amount of sand to be placed in wetland areas could be reduced. Final cover specifications would be determined during the design phase. The total volume of sand required to construct the cover is estimated at 45,700 cubic yards. Wetland plantings would be conducted following construction of the sand cover to restore wetland areas.

Implementation of a dredge and cover alternative would require access to properties in which to stage materials as described in **Section 3.1.1** and for construction of a sediment dewatering area as described in **Section 3.2.2**. Wetland areas that comprise the outer boundaries of the Site to the north, west, and south limit the potential areas in which these support facilities can be constructed. A railroad embankment that defines the Site to the east limits the ease of transferring materials between the Site and Hallett Dock #7, a potential material staging area and/or sediment dewatering area. It was assumed for the purposes of this FFS that sediments would be staged (i.e., dewatered and staged until excavation and disposal) at the U.S. Steel site located immediately adjacent to and north/northwest of the Site. The off-Site location of the sediment dewatering area necessitates that sediments be hydraulically dredged or mechanically dredged and slurried, and subsequently pumped to the dewatering area.

Hydraulic pumping of sediments often results in a solids content of less than 5% and large flow rates for incoming slurry; therefore, a large volume of slurry would require dewatering and large volumes of dredge contact water would require “handling” and likely treatment as well prior to being discharged. It was assumed for the purposes of the cost analysis that geotextile bags would be used for sediment dewatering and costs to construct a sediment dewatering pad to stage the geotextile bags, sump, and water treatment plant were incorporated into the cost analysis. Discharge options for treated dredge contact water could include discharging to the WLSSD sanitary sewer or back into the SLR. The selected discharge location would determine the extent of treatment required to meet acceptance or permit requirements. Discharge location and treatment method can have a significant effect on total project cost and should be investigated further during the design phase.

The disposal option evaluated for alternatives involving dredging is off-site landfill disposal. It is assumed that sediments dredged from the Site will be classified as non-hazardous based on historic sample concentrations. Potential off-site landfills evaluated for this FFS include Vonco V Waste Management Campus located at 1100 West Gary Street in Duluth, Minnesota (approximately 2 miles northwest of the Site) and Shamrock Environmental Landfill located at 761 Highway 45 in Cloquet, Minnesota (approximately 13 miles west of the Site).

ICs and a LTM program would not be implemented following completion of remedy construction if complete removal of contaminated sediments is achieved. Complete removal was assumed for the purposes of this FFS and, therefore, IC/LTM costs are not incorporated into the cost analysis.

3.3.4.2 Cost

Calculations used to determine unit rate costs for each of the alternatives are presented in Table 2 in **Appendix B**. Other project costs determined on a lump sum basis are presented in Table 3 in **Appendix B**. The costs associated with each alternative are presented as Class 4 (+50/-30) estimates and are appropriate for remedial design alternative evaluations only.

The estimated total present value cost for Alternative 4 is $29,252,000. **Table 6** presents a breakdown of the estimated costs associated with Alternative 4.

Dewatering of hydraulically pumped sediments and subsequent treatment of dredge contact water is the single largest cost for Alternative 4 and totals over $6,000,000. Costs related to sediment dewatering and treatment of dredge contact water is based on professional experience of Bay West staff and is considered an “all-in” value consisting of mob/demob, material procurement, material disposal, labor, and equipment costs. Due to the estimated treatment volume, each $10 in the per cubic yard cost of dewatering and treatment increases or decreases overall construction costs by approximately $2,000,000. Contingency, design, and project management costs were calculated on a percentage basis of total construction costs and, therefore, the impact is amplified. Further analysis of sediments, permit requirements, options and sizes of available staging areas, and analysis of dewatering technologies appropriate for available staging areas will be required to refine dewatering and treatment costs.

3.3.5 Alternative 5: Dredge Open Water Areas/Enhanced Monitored Natural Recovery with Thin-Layer Amended Cover in Wetland Areas

This alternative presents a hybrid approach utilizing dredging elements from Alternative 4 and EMNR elements from Alternative 3. This alternative would consist of complete removal of all sediments with COC concentrations exceeding the CULs, as was proposed for Alternative 4, in open water areas of the Site. Removal of contaminated sediments would mitigate exposure of aquatic and human receptors to sediment contaminants, thus allowing for achievement of RAOs in open water areas. Sediment removal would not be conducted within wetland areas in order to minimize intrusive construction activities. Instead, an EMNR approach would be utilized within wetland areas and would consist of constructing a 0.15-meter amended cover on top of the sediment surface, as was proposed for Alternative 3. Construction of an amended thin-layer cover would allow for sequestration of sediment contaminants as cover material mixes into in situ sediments or as groundwater upwelling forces contaminants into the cover. The cover could also provide some immediate isolation of contaminated sediments through placement of 0.15 meter of clean substrate.

3.3.5.1 Dredging and Enhanced Monitored Natural Recovery Implementation

The dredging element of this alternative would include removal of all sediments with COC concentrations exceeding the CUL in open water areas of the Site only. Open water areas of the Site with sediments exceeding the CUL are presented in **Figure 10** and equal approximately 32 acres. Dredging was assumed to be conducted down to 0.5 meter (1.6 feet) bss – the average maximum depth of observed sediment contamination across the Site – for purposes of the cost analysis. The total volume of in situ sediments requiring removal from open water areas is estimated to be 84,000 cubic yards. Over-dredging of sediments was assumed as a means of increasing dredge efficiency and reducing the mass of dredge residuals remaining after dredging completion. A 0.30 meter (1 foot) over-dredge was assumed, which would increase the total dredge volume to approximately 136,000 cubic yards. Following dredging, a 0.15-meter (6-inch) sand cover would be constructed in previously dredged open water areas of the Site to manage dredge residuals and to improve benthic habitat. Construction of a 0.15-meter cover over 32 acres would require 25,000 cubic yards of sand.

Dredged sediments would be handled, dewatered, excavated, and disposed of in the same manner as described for Alternative 4.

The thin-layer amended cover element of this alternative would include construction of a 0.15-meter amended cover over wetland areas with sediment concentrations of COCs exceeding the CUL. Wetland areas of the Site with sediments exceeding the CUL are presented in **Figure 10** and equal approximately 8 acres. The thin-layer cover was assumed to consist of sand with 5 percent carbon amendment by weight and mixed prior to placement rather than constructed using separate amendment and sand layers. Construction of such a sand cover in wetland areas of the Site would require approximately 266 cubic yards each of amendment and 6,300 cubic yards of sand materials. The final cover design and amendment application rate would be determined during the design phase, as discussed in **Section 3.3.3.1** for Alternative 3.

3.3.5.2 Long-Term Monitoring

LTM would commence after remedy implementation and would include collection of Site data within wetland areas only. No LTM activities would be conducted within dredged areas if complete removal of contaminated sediments is achieved, which was assumed for the purposes of this FFS. LTM data will be collected within wetland areas as described in **Section 3.3.3.2** for Alternative 3. Potential monitoring locations are presented in **Figure 10**.

3.3.5.3 Cost

Calculations used to determine unit rate costs for each of the alternatives are presented in Table 2 in **Appendix B**. Other project costs determined on a lump sum basis are presented in Table 3 in **Appendix B**. The costs associated with each alternative are presented as Class 4 (+50/-30) estimates and are appropriate for remedial design alternative evaluations only.

The estimated total present value cost for Alternative 5 is $28,594,000. **Table 7** presents a breakdown of the estimated costs associated with Alternative 5.

4.0 REMEDY SELECTION CRITERIA

The alternatives were evaluated and compared using the NCP remedy selection criteria outlined below and in general accordance with USEPA guidelines for feasibility studies (USEPA, 1990). The NCP remedy selection criteria are divided into three groups based on the function of the criteria in remedy selection. The NCP definitions of each criterion are included below. Green Sustainable Remediation (GSR) criteria were also evaluated during this FFS and are included as a fourth group of criteria. Additional detail may be added from MPCA and/or USEPA guidance where appropriate.

4.1 Threshold Criteria

The Threshold Criteria relate to statutory requirements that each alternative must satisfy in order to be eligible for selection and include the following:

4.1.1 Overall Protection of Human Health and the Environment

Alternatives shall be assessed to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals. Overall protection of human health and the environment draws on the assessment of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

4.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

The alternatives shall be assessed to determine whether they attain applicable or relevant and appropriate requirements under federal environmental laws and state environmental or facility citing laws or provide grounds for invoking a waiver.

4.2 Primary Balancing Criteria

The Primary Balancing Criteria are the technical criteria upon which the detailed analysis is primarily based and include the following.

4.2.1 Long-Term Effectiveness and Permanence

Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following:

1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. The characteristics of the residual should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

2. Adequacy and reliability of controls, such as containment systems and ICs, necessary to manage treatment residuals and untreated waste. This factor addresses, in particular, the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risks posted should the remedial action need replacement.

4.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the Site. Factors that shall be considered, as appropriate, include the following:

1. The treatment or recycling processes the alternatives employ and materials they will treat;
2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated or recycled;
3. The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment or recycling and the specification of which reductions(s) are occurring;
4. The degree to which the treatment is irreversible;
5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents; and
6. The degree to which treatment reduces the inherent hazards posed by principal threats at the Site.

4.2.3 Short-Term Effectiveness

The short-term impacts of alternatives shall be assessed considering the following:

1. Short-term risks that might be posed to the community during implementation of an alternative;
2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures;
3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigating measures during implementation; and
4. Time until protection is achieved.

4.2.4 Implementability

The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors, as appropriate:

1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy;
2. Administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions); and
3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and the availability of prospective technologies.

4.2.5 Costs

The types of costs that shall be assessed include the following:

1. Capital costs, including both direct and indirect costs;
2. Annual O&M costs; and
3. Net present value of capital and O&M costs.

The USEPA guidance document *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA, 2000) was used to develop cost estimates presented in this FFS. The cost estimates developed for this FFS are primarily for the purpose of comparing remedial alternatives during the remedy selection process, not for establishing project budgets. As previously described, cost estimates are considered Class 4 estimates, Schematic Design.

4.3 Modifying Criteria

The third group is made up of the Modifying Criteria specified below. These last two criteria are assessed formally after the public comment period, although to the extent that they are known will be factored into the identification of the preferred alternative.

4.3.1 State/Support Agency Acceptance

Assessment of state/agency concerns may not be completed until comments on this FFS are received, but may be discussed, to the extent possible, in the document issued for public comment (FFS or proposed plan). The state/agency concerns that shall be assessed include the following:

1. The state's/agency's position and key concerns related to the preferred alternative and other alternatives; and
2. State/agency comments on ARARs or the proposed use of waivers.

4.3.2 Community Acceptance

This assessment includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. This assessment may not be completed until comments on the document submitted for public review are received.

4.4 Green Sustainable Remediation

The last group is made up of the GSR criteria specified below. There are six criteria included with this analysis, which are then summarized to provide each alternative with an overall GSR rating. The six GSR criteria evaluated with this FFS include the following:

- Greenhouse Gas (GHG) Emissions;
- Toxic Chemical Usage and Disposal;
- Energy Consumption;
- Use of Alternative Fuels;
- Water Consumption; and
- Waste Generation.

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The purpose of the comparative analysis is to identify and compare advantages and disadvantages of each evaluated alternative relative to one another with respect to remedy selection criteria presented in **Section 4.0** in order to determine which of the alternatives best meets those criteria. The comparative analysis is documented in this section and summarized in **Table 8** and **Table 9**. **Table 10** presents a numerical comparison of the evaluated alternatives.

5.1 Threshold Criteria

5.1.1 Overall Protection of Human Health and the Environment

Only those alternatives that would meet the threshold criteria of providing overall protection of human health and the environment were carried forward with the comparative analysis. Alternative 1 would not meet the threshold criteria, but was carried forward as it is required for analysis under the NCP. Alternatives 2, 3, 4, and 5 would adequately protect human health and the environment from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the Site; however, contaminated sediment would remain in place under Alternatives 2, 3, and 5 requiring monitoring to ensure long-term effectiveness. Alternative 4 would provide the highest level of protection, since contaminated sediments would be removed from the aquatic environment.

5.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Only alternatives that meet threshold criteria were carried forward, as stated previously. Alternative 1 does not meet the threshold criteria, but was carried forward as it is required for analysis under the NCP. Alternatives 2, 3, 4, and 5 comply with the ARARs identified in **Section 2**.

5.2 Balancing Criteria

5.2.1 Long-Term Effectiveness and Permanence

Alternative 1 is not effective in the long-term or permanent. Alternatives 2, 3, 4, and 5 are effective in the long-term; however, contaminated sediment would remain in place under Alternatives 2, 3, and 5, requiring long-term O&M and ICs to ensure long-term effectiveness and, therefore, they are not as permanent. Disposal of sediment at an off-site landfill would be equally effective in the long-term. Since all contaminated sediments would be removed, Alternative 4 would provide the most permanence, even though contaminants would not be permanently destroyed in the landfill.

In summary, Alternative 4 would provide a high achievement of this criterion by removing all of the contaminated sediment in the aquatic environment above the SQTs. Alternatives 2 and 3 would provide a moderate achievement of this criterion, since amendment materials would eventually mix into the sediment column and sequester contaminants within the most biologically active sediment zone; however, deeper contamination may remain and future addition of amendment material may be required. Alternative 5 would provide a moderate to high achievement of this criterion as it combines dredging in certain areas of the Site and amendment placement in others.

5.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternatives 1 and 4 would not provide a reduction in the toxicity, mobility, or volume through treatment; however, Alternative 4 would remove all contaminated sediment from the aquatic environment and place it in a maintained landfill. Alternatives 2, 3, and 5 would reduce the toxicity, mobility, or volume of sediment contaminants through sequestration of sediment contaminants in contact with amendment materials (i.e., near the sediment surface) rendering them unavailable to biota; however, it is unlikely that bioturbation processes would mix amendment materials to the maximum depth of contamination and, therefore, some contamination would remain in place indefinitely. Amendment materials applied on the sediment surface would also reduce contaminant mobility into the water column by providing a sorptive barrier between contaminated sediments and the water column.

In summary, Alternatives 2 and 3 would provide a moderate to high achievement of this criterion by reducing the toxicity and mobility of sediment contaminants through treatment via amendment materials mixed into the sediment column. Alternative 5 would provide a moderate achievement as amendment materials would only be placed in a portion of the Site. Alternatives 1 and 4 would provide a low level of achievement of this criterion since no reduction of toxicity, mobility, or volume would take place.

5.2.3 Short-Term Effectiveness

There are no short-term risks associated with Alternative 1 as no actions would be implemented at the Site. The rest of the alternatives would have some short-term risks during implementation of the remedy. Alternative 4 requires dredging of 1.3 meters (4.3 feet) of sediment and would result in removal of the entire PBAZ and temporary destruction of plant and animal habitat over the entire remedial area. Additionally, dredging of sediments would remove contamination from beneath the water column and require multiple transfers of contaminated sediments (and dredge contact water) by Site workers until eventual landfill disposal, thus creating additional opportunities for exposure to Site workers. Alternative 5 also requires dredging in open water areas of the Site to 1.3 meters, but does not require dredging in wetland areas and, therefore, has fewer short-term adverse effects to aquatic communities and Site workers than Alternative 4.

Short-term adverse effects to aquatic habitat and biota would be similar among Alternatives 2 and 3 and would include displacement of fish and smothering of benthic organisms. Alternative 2 would provide the least adverse effects of these alternatives because only a thin 0.05-meter (2-inch) layer of amendment material would be placed rather than a 0.15-meter (6-inch) cover as in Alternative 3. Alternative 5 would fall between Alternative 4 and Alternatives 2 and 3 as it is a hybrid approach and utilizes elements of each of these alternatives. The effects from Alternatives 2, 3, 4, and 5 would occur during remedy construction and during the recovery period thereafter. Benthic organisms would be expected to be re-established for all alternatives within several growing seasons.

In summary, Alternative 1 would provide a high achievement of the short-term effectiveness criterion as there would be no impact to surrounding community and aquatic habitat and no risk to Site workers. Alternatives 2 and 3 would have a moderate to high achievement of the short-term effectiveness criterion due to an increase in short-term adverse effects to aquatic biota during cover construction; however, impacts are anticipated to be small. Alternative 5 would have a moderate achievement of the short-term effectiveness criterion due to the adverse effects to benthic organisms and Site workers through handling of contaminated sediments dredged from open water areas. Alternative 4 would have a low to moderate achievement of the short-term effectiveness criterion as it presents the greatest adverse effects to benthic organisms and the greatest risks to Site workers through handling of contaminated sediments over a longer duration of time as compared to Alternative 5.

5.2.4 Implementability

There are no implementability concerns associated with Alternative 1.

Application of cover materials to wetland areas requires specialized equipment such as marsh buggies that are capable of both navigating open water and traversing upland areas. Such equipment is available but somewhat specialized. Additionally, application of cover materials would require barging of materials from a nearby staging area or a staging area located along the SLR, such as Hallett Dock #7. It is anticipated that Hallett Dock #7 would be available as a staging area but this assumption assumes purchase of Hallett Dock #7 by the Duluth Seaway Port Authority and successful coordination of future access agreements. For these reasons Alternatives 2 and 3 provide a moderate to high level of achievement of the implementability criterion.

Dredging, dewatering, and water treatment that would be required under Alternatives 4 and 5 are all technically feasible and implementable from an engineering perspective. These technologies have been implemented successfully at other sediment sites and could be readily implemented at the Site; however, implementation of these alternatives would require more time and resources than Alternatives 2 and 3. Additionally, access to properties in which to dewater sediments and treat dredge contact water would be essential to implementation of these alternatives. It is unknown if adjacent properties are available for use. For these reasons Alternatives 4 and 5 would provide a moderate level of achievement of the implementability criterion.

Weather could significantly impact productivity, particularly if done in the early spring or late fall. High winds in the late fall produce large waves that could impact productivity. Barge traffic and any Site activities would be postponed in the spring until ice melt is completed. Winter or freezing conditions in the fall could shorten the construction season. Alternatives 4 and 5 have the longest estimated time to complete and, therefore would stand to be the most impacted by weather.

Implementability also includes administrative feasibility of the remedy. As with most sediment remediation activities, multiple state and federal agencies and other stakeholder input is required, providing a lower achievement of administrative feasibility of implementing a remedy. Additional time would be required to obtain any necessary approvals and permits from other agencies. Alternatives 4 and 5 would likely require more coordination with other regulatory agencies than Alternatives 2 and 3, as off-site disposal is required for Alternatives 4 and 5.

In summary, Alternative 1 has no actions to be implemented and thus provides a high achievement of the implementability criterion. Alternatives 2 and 3 are the next easiest to implement since they only require cover construction and provide a moderate to high achievement of this criterion. Alternatives 4 and 5 provide a moderate achievement of the implementability criterion due to increased coordination with other regulatory agencies and landowners, and due to increased time and materials required for implementation of dredging. **Table 10** presents a numerical score that provides a scale to compare all alternatives.

5.2.1 Cost

Cost estimates developed for each alternative are included in **Section 3.3** and summarized in **Table 3**. The cost estimates include: capital costs, including both direct and indirect costs; annual O&M costs; and net present value of capital and O&M costs.

In summary, Alternative 1 provides the most cost-effective option, followed by Alternative 2 because it requires the least amount of time and materials of any active remedy. Alternative 3 is the next most cost effective as no dredging is required. Alternative 5 is the next most cost effective as dredging of the wetland areas is avoided and a much lower volume of sand is required to construct the remedy. Additionally, fewer cubic yards of sediment are dredged in comparison to Alternative 4, which results in lower dewatering, water treatment, hauling, and disposal costs. Alternative 4 is the least cost effective as it requires dredging of all contaminated sediments within the remedial area and subsequent dewatering, water treatment, hauling, and disposal costs associated with the larger dredge volume. Additionally, a large volume of sand is required to restore the wetland areas, which adds to the total project cost. **Table 10** presents a numerical score that compares the costs for all alternatives.

5.3 Modifying Criteria

The modifying criteria, State/support agency acceptance and community acceptance, are assessed formally after the public comment period, and to the extent that they are known will be factored into the identification of the preferred alternative.

5.3.1 State Support/Agency Acceptance

State/agency input will be assessed to assist in determining the appropriate alternative for the Site. Key factors that will influence alternative selection include but are not limited to knowledge of future Site use, Site remediation prioritization, and funding source availability. Alternatives 1 through 5 will be formally assessed after public comment period.

5.3.2 Community Acceptance

Lands surrounding the Site are privately owned and access is limited to trespassers and a historic train tour that travels through the Site on weekends from mid-June through mid-October. The Superior and Mississippi Railroad Company (http://lsmrr.org) operates the tours on railroad tracks owned by the City of Duluth. Recent conversations between Bay West, the MPCA, and the City of Duluth revealed that a future recreational path may be constructed through the Site.

Any remediation work completed at the Site involving application of amendments or construction of a cover would require construction of a mooring area adjacent to the railroad embankment (i.e., driving of dolphin pilings) and passing of materials over the railroad tracks; therefore, coordination with the City of Duluth and the Superior and Mississippi Railroad Company would be required for implementation of Alternatives 2, 3, and 5, which incorporate amendment placement or sand cover construction. Train tour interruptions could be minimized by working weekdays only or performing construction activities prior to mid-June, when tours begin. As noted previously, the City of Duluth is exploring the possibility of removing some or all of the railroad causeway at the Site; therefore, this consideration should be examined further during the design phase.

Additional coordination would be required with the current or future owners of Hallett Dock #7 for use as a material staging area. The total estimated time required for on-site construction activities for Alternatives 2 and 3 is shorter than Alternatives 4 and 5, at 5 and 22 weeks, respectively. The majority of work related to implementation of Alternatives 2 and 3 would take place directly on-Site and presumably at a privately-owned staging area. It is anticipated that community acceptance of Alternatives 2 and 3 will be high based on the factors outlined above.

Any remediation work completed at the Site involving dredging would require sourcing of a nearby dewatering area in which to pump and subsequently dewater dredged sediments; therefore, coordination with a nearby property owner such as U.S. Steel would be required for implementation of Alternatives 4 and 5. Implementation of Alternatives 4 and 5 would also result in increased truck traffic in the nearby neighborhood of Gary, and may require additional coordination with City of Duluth officials. Alternatives 4 and 5 have substantially longer construction durations than Alternatives 2 and 3, at 49 weeks and 56 weeks, respectively. It is anticipated that community acceptance of Alternatives 4 and 5 will be high because these alternatives involve complete removal of contamination in at least a portion of the Site and because the Site is not widely used by the community.

Mechanical dredging of sediments and subsequent barging of sediments to an off-site sediment dewatering area such as Hallett Dock #7 was not evaluated as part of this FFS. Additionally, construction of a material staging and/or sediment dewatering area at the western shoreline of the Site within wetland areas was not evaluated for this FFS. These scenarios could be considered depending on stakeholder and community acceptance of the proposed alternatives.

5.4 Green Sustainable Remediation Criteria

5.4.1 Greenhouse Gas Emissions

Alternative 1 would have no GHG emissions. Alternatives 2, 3, 4, and 5 would result in GHG emissions from the mobilization, operation, and demobilization of all fuel-powered construction equipment required to construct the cover and/or dredge. Alternatives 4 and 5 would also produce emissions during transport of sediments by truck to the disposal facility. Reduction of emissions can be accomplished by using equipment that is compliant with the latest USEPA non-road engine standards and retrofitting older equipment with appropriate filters.

5.4.2 Toxic Chemical Usage and Disposal

There are no known toxic chemicals associated with these alternatives.

5.4.3 Energy Consumption

Alternative 1 would consume no additional energy. Alternatives 2, 3, 4, and 5 would result in the consumption of fossil fuels for the mobilization, operation, and demobilization of all gas- and diesel-powered construction equipment associated with the dredging, hauling, and disposal of the contaminated sediment and the installation of cover materials. Only placement of cover materials is required for Alternatives 2 and 3 whereas Alternatives 4 and 5 require dredging and cover placement, resulting in more fossil fuel consumption.

5.4.4 Use of Alternative Fuels

Alternative 1 would not require the use of alternative fuels. Biodiesel blended fuels (B10 or B20) could be used as a supplemental fuel source for all diesel-powered construction equipment associated with Alternatives 2, 3, 4, and 5.

5.4.5 Water Consumption

Alternative 1 would not require the consumption of water. A minimal quantity of water would be required to decontaminate personnel and equipment during sediment dredging activities associated with Alternatives 4 and 5.

5.4.6 Waste Generation

Alternatives 1, 2, and 3 would not generate waste. Alternatives 4 and 5 would generate waste that includes the dredged contaminated sediments, contaminated dewatering pad materials, and any non-recyclable water treatment media that would be removed from the Site and disposed of.

5.5 Comparative Analysis Summary

The comparative analysis of alternatives narrative discussion and quantitation table identified Alternatives 2 and 3 as more appropriate alternatives than Alternatives 1, 4, and 5 to address contamination at the Site. Alternative 1 does not achieve overall protection of human health and the environment, does not achieve ARARs, is not effective in the long-term, does not reduce toxicity, mobility, or volume of contamination, and is not effective in the short term; however, this alternative is implementable and cost effective. Alternatives 2, 3, 4, and 5 are all protective of human health and the environment and achieve ARARs. Alternatives 2, 3, and 5 have similar long-term effectiveness and reductions in toxicity, mobility, or volume of contaminants. Alternatives 2 and 3 are superior in the short-term effectiveness criterion because durations to implement these alternatives are the shortest, with the exception of Alternative 1. Alternatives 2 and 3 are also the least complex of the alternatives with exception of Alternative 1, making Alternatives 2 and 3 also the most implementable. Of Alternatives 2, 3, 4, and 5, Alternative 2 is the most cost effective.

The modifying criteria, State/support agency acceptance, and community acceptance are assessed formally after the public comment period. Stakeholder and community input will provide valuable insight as the MPCA considers information for the selection of a preferred alternative. The MPCA will conduct outreach activities to resource managers, current Site users, the public and local units of government prior to the public comment period.

Further studies are recommended during the design phase of the selected alternative. These recommended studies, depending on the alternative selected, may include:

- Bench and/or pilot scale testing of amendment materials to determine the most appropriate material for use at the Site. Potential amendment materials include AC, bauxite, biopolymers, permeable Organoclay, phosphate additives (i.e., apatite), and zeolite (USEPA, 2013);
- Bench and/or pilot scale testing to determine appropriate application rates for the selected amendment material;
- Physical sediment characteristics assessment to aid in designing remedial actions involving dredging and/or capping; and
- Evaluation of potential dewatering areas within close proximity of the Site, including use of U.S. Steel property, if Alternative 4 or 5 is selected.

In addition, additional pre-design investigation and analysis might be warranted, in order to refine the remedial footprint, or to justify a need for a remedial action or provide basis for monitored natural recovery.

- Comparison of site sediment chemistry values to ambient sediment chemistry values developed for the U.S. Steel site.
- Biological assessments to evaluate effects of contaminated sediments on Site biota, which could include benthic toxicity and bioaccumulation testing, paired with sediment chemistry analysis for dioxins.
- Comparison of Site bioaccumulation data to similar data within the SLR estuary.

Pending the City of Duluth's decision on the preferred use of the Mud Lake causeway, additional data gaps might need to be addressed to evaluate the impact of partial or total causeway removal on the selected alternative:

- A hydrodynamic study to understand natural processes such as depositional and scouring forces to inform design and placement of cover materials.

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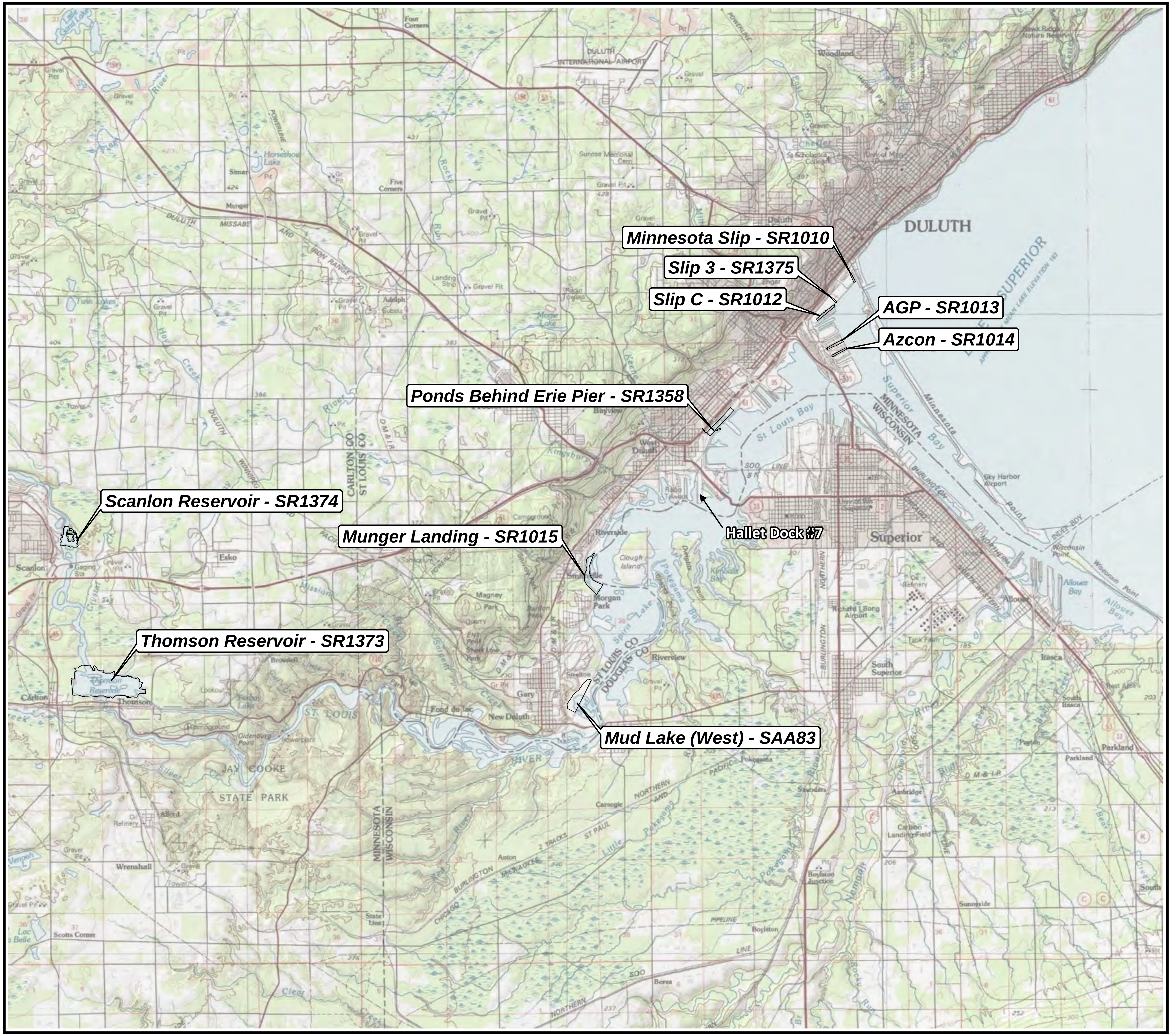
Figures



Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\001_FFS_2017\J160749 FIG 1 Mud Lake West Site Location Map.mxd

Figure 1

Site Location Map

Mud Lake West
SLR Sediment AOCs

Duluth, MN

N
W E
S

Map Projection: NAD 1983 UTM Zone 15 N
Basemap: National Geographic Society, i-cubed

0 2 4 Miles
0 3 6 Kilometers

☐ Site Location (Labeled on map)

CLEAN WATER LAND & LEGACY AMENDMENT

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: SG Date Drawn/Revised:5/11/2017 Project No.J160749

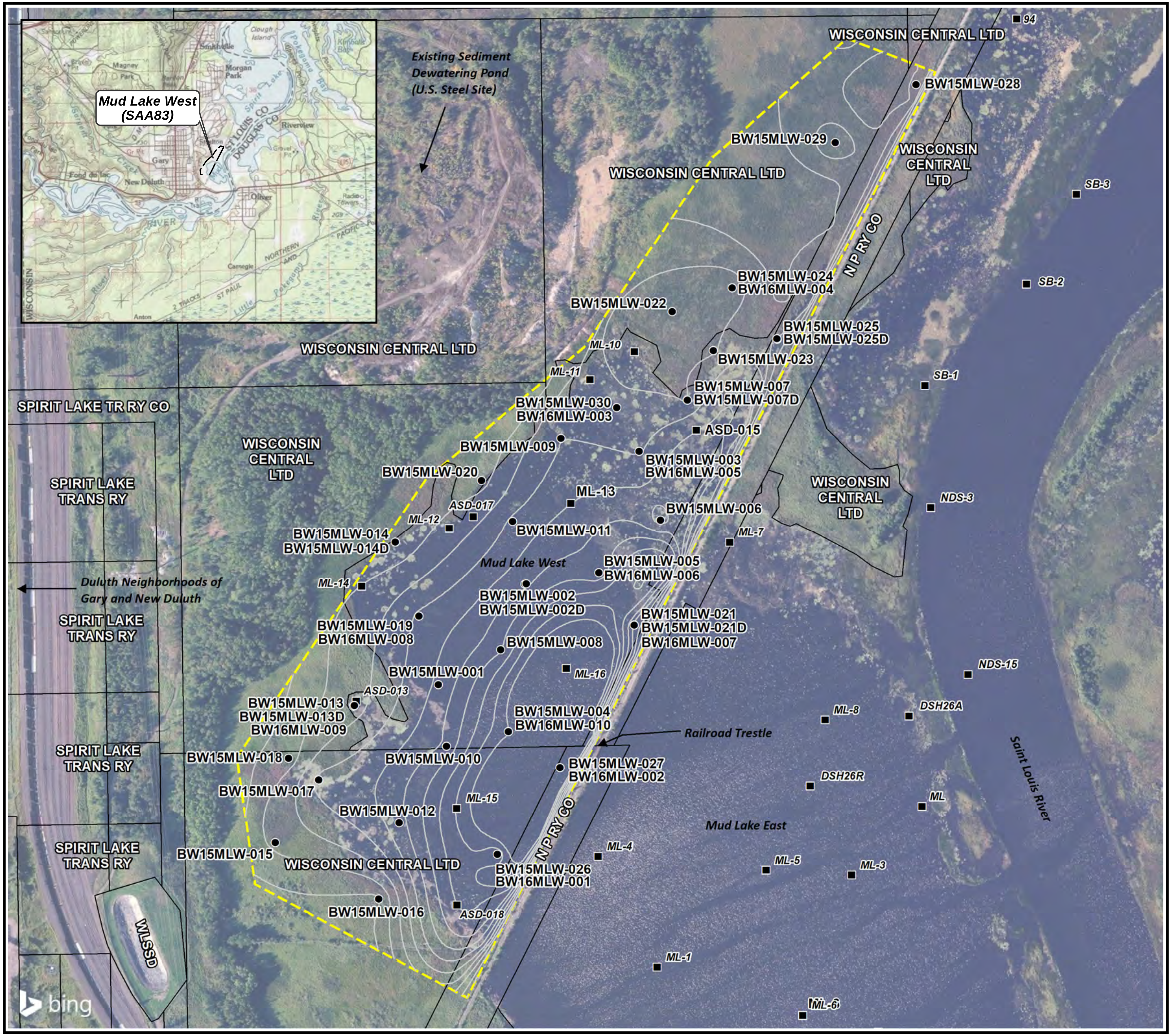
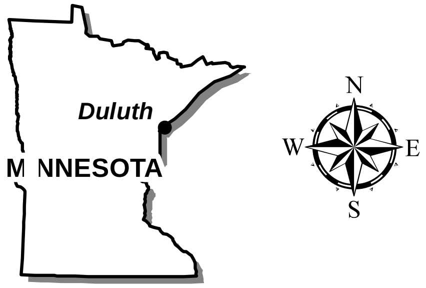


Figure 2

Site Map

Mud Lake West
SLR Sediment AOCs

Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

●	Sediment Sample (Bay West 2015/2016)
■	Historical Sediment Sample (2010)
—	Bathymetry Elevation Contour
▭	Mud Lake West Site Boundary
▭	Parcel Boundary (With Property Owners)

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:5/11/2017 Project No.J160749

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\001_FFS_2017\J160749 FIG 2 Mud Lake West Site Map.mxd

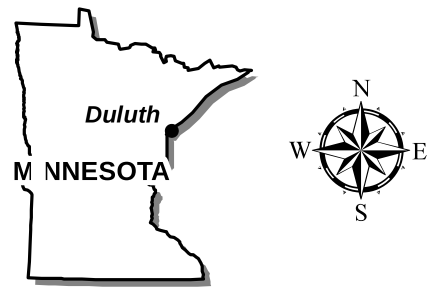
Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\001_FFS_2017\J160749 FIG 3 Mud Lake West Bathymetry.mxd

Figure 3

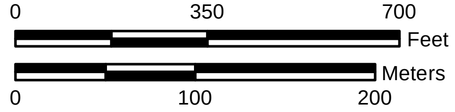
Bathymetry

Mud Lake West
SLR Sediment AOCs

Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

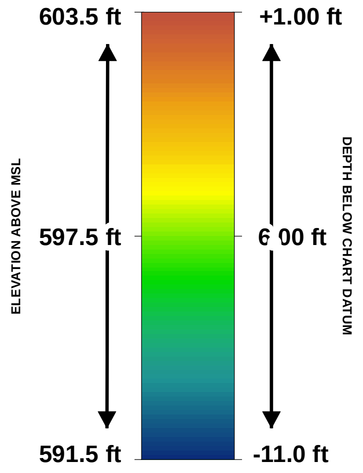


● Sediment Sample (Bay West 2015/2016)

Bathymetric Contour Line

Mud Lake West Site Boundary

Water Depth



NOTE: Bathymetery compiled from water level measurements collected during March/June 2015 Remedial Investigation

Bay West
Customer-Focused Environmental & Industrial Solutions

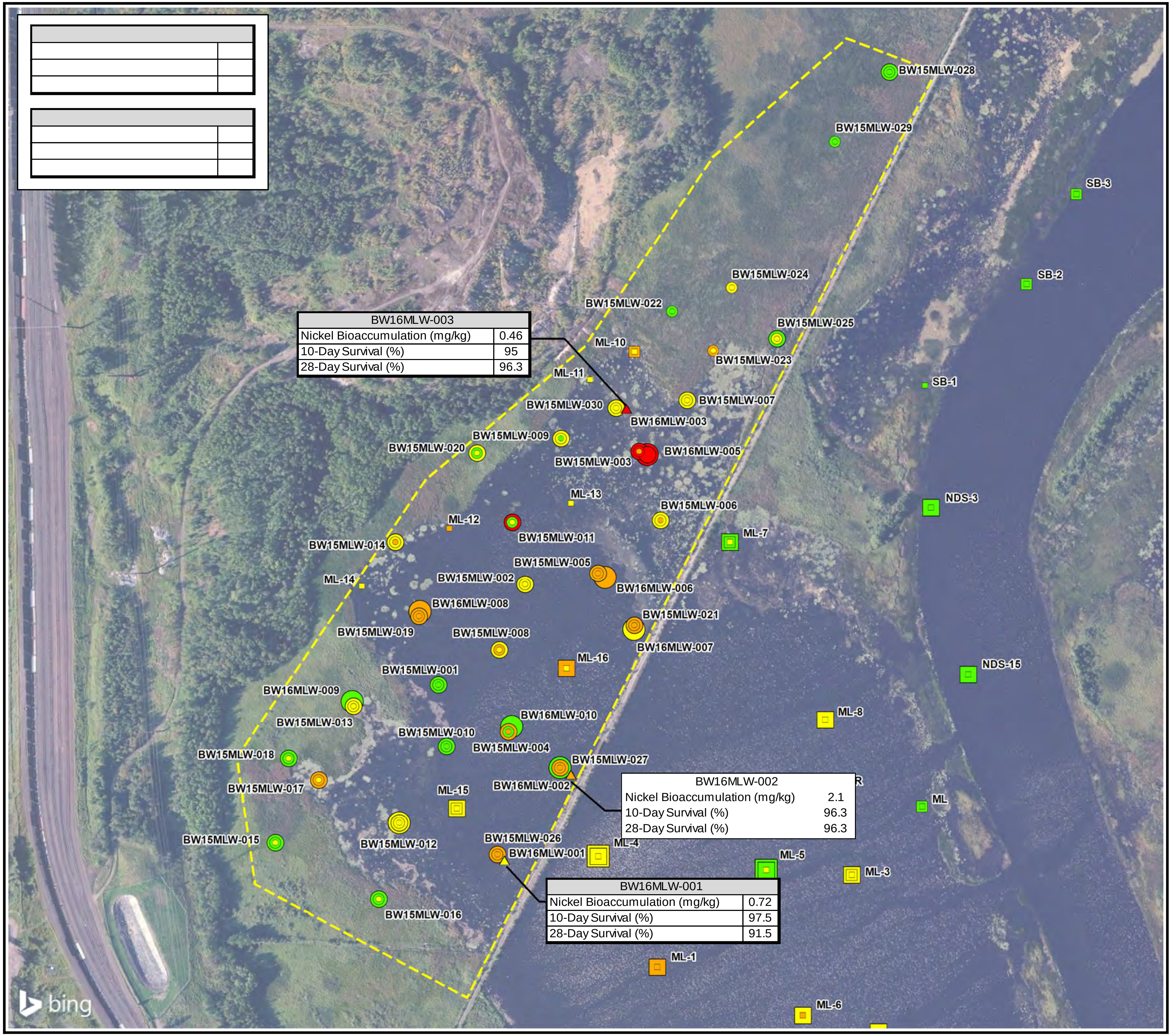
Drawn By: S.G. Date Drawn/Revised:5/11/2017 Project No.J160749

Figure 4A

Nickel SQT and Bioaccumulation/Toxicity Results

Mud Lake West
SLR Sediment AOCs

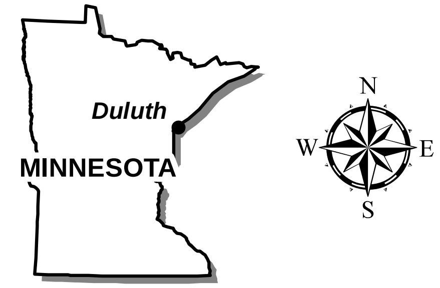
Duluth, MN



BW16MLW-003	
Nickel Bioaccumulation (mg/kg)	0.46
10-Day Survival (%)	95
28-Day Survival (%)	96.3

BW16MLW-002	
Nickel Bioaccumulation (mg/kg)	2.1
10-Day Survival (%)	96.3
28-Day Survival (%)	96.3

BW16MLW-001	
Nickel Bioaccumulation (mg/kg)	0.72
10-Day Survival (%)	97.5
28-Day Survival (%)	91.5



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

0 350 700 Feet
0 100 200 Meters

Mud Lake West Site Boundary

Sample Type

- △ Sediment Sample, Including Tox/Bio Testing
- ○ Sediment Sample (Bay West 2015/2016)
- ☐ Sediment Sample (Historical)

Sample Interval

- ○ ☐ 0-0.15 m
- ○ ☐ 0.15-0.50 m
- ○ ☐ 0.50-1.0 m
- ○ ☐ >1.0 m

Nickel SQT Comparison

- 🟩 Does not exceed Level 1 SQT (23 mg/kg)
- 🟨 Exceeds Level 1 SQT (23 mg/kg)
- 🟧 Exceeds Midpoint SQT (36 mg/kg)
- 🟥 Exceeds Level 2 SQT (49 mg/kg)

Note: Sample location BW16MLW-004 was inaccessible during the time of sampling - Not sampled.

Bay West
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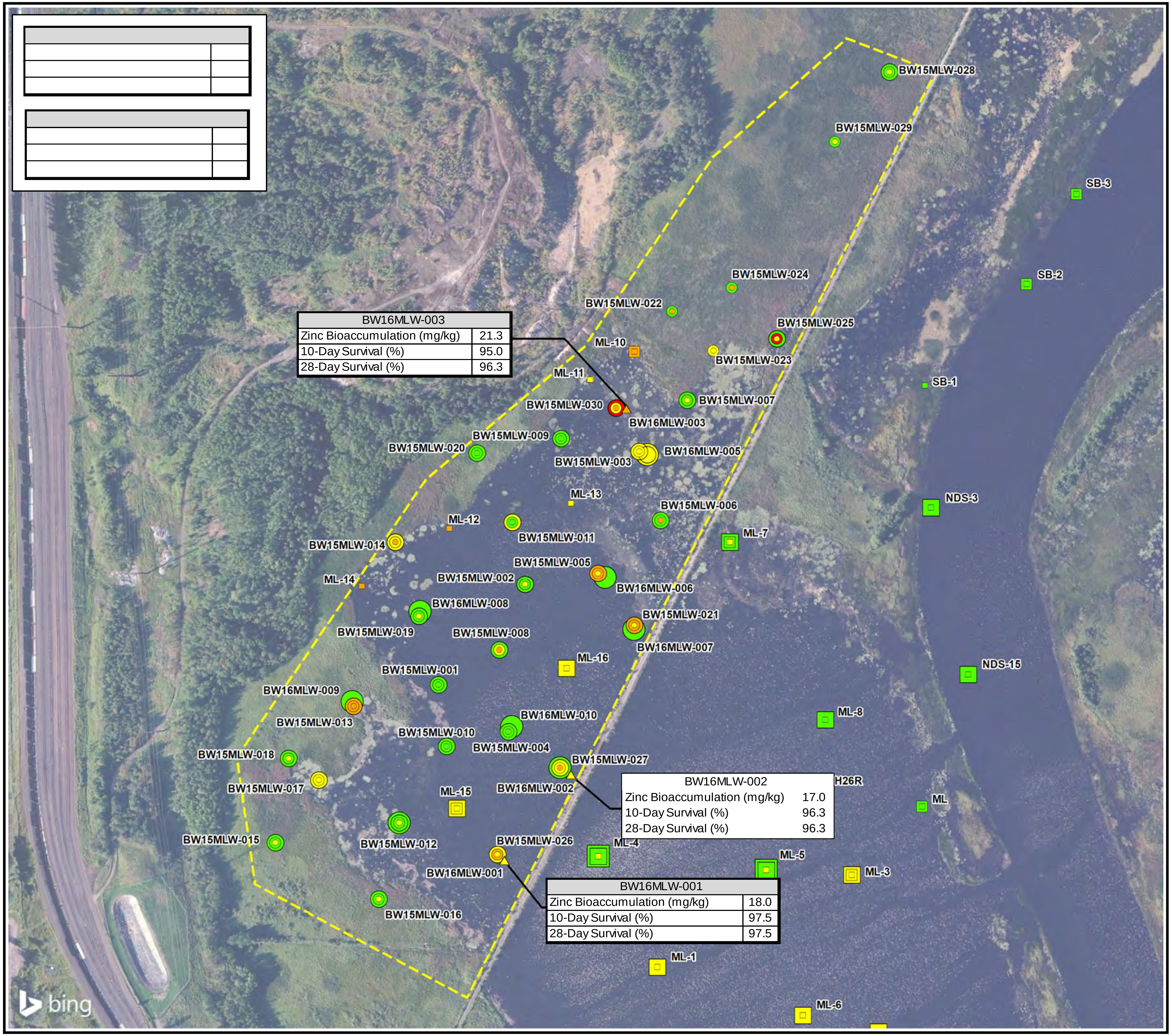
Drawn By: S.G. Date Drawn/Revised:5/11/2017 Project No.J160749

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\001_FFS_2017\J160749 FIG 4A Mud Lake West Nickel SQT and Bioaccumulation Toxicity Results.mxd



BW16MLW-003	
Zinc Bioaccumulation (mg/kg)	21.3
10-Day Survival (%)	95.0
28-Day Survival (%)	96.3

BW16MLW-002	
Zinc Bioaccumulation (mg/kg)	17.0
10-Day Survival (%)	96.3
28-Day Survival (%)	96.3

BW16MLW-001	
Zinc Bioaccumulation (mg/kg)	18.0
10-Day Survival (%)	97.5
28-Day Survival (%)	97.5

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\001_FFS_2017\J160749 FIG 4B MLW Zinc SQT and Bioaccumulation Toxicity Results.mxd

Figure 4B

Zinc SQT and Bioaccumulation/Toxicity Results

Mud Lake West SLR Sediment AOCs

Duluth, MN

N
W E
S

Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

0 350 700 Feet
0 100 200 Meters

Mud Lake West Site Boundary

Sample Type

- △ Sediment Sample, Including Tox/Bio Testing
- ○ Sediment Sample (Bay West 2015/2016)
- □ Sediment Sample (Historical)

Sample Interval

- ○ □ 0-0.15 m
- ○ □ 0.15-0.50 m
- ○ □ 0.50-1.0 m
- ○ □ >1.0 m

Zinc SQT Comparison

- 🟩 Does not exceed Level 1 SQT (120 mg/kg)
- 🟨 Exceeds Level 1 SQT (120 mg/kg)
- 🟧 Exceeds Midpoint SQT (290 mg/kg)
- 🟥 Exceeds Level 2 SQT (460 mg/kg)

Note: Sample location BW16MLW-004 was inaccessible during the time of sampling - Not sampled.

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:5/11/2017 Project No.J160749

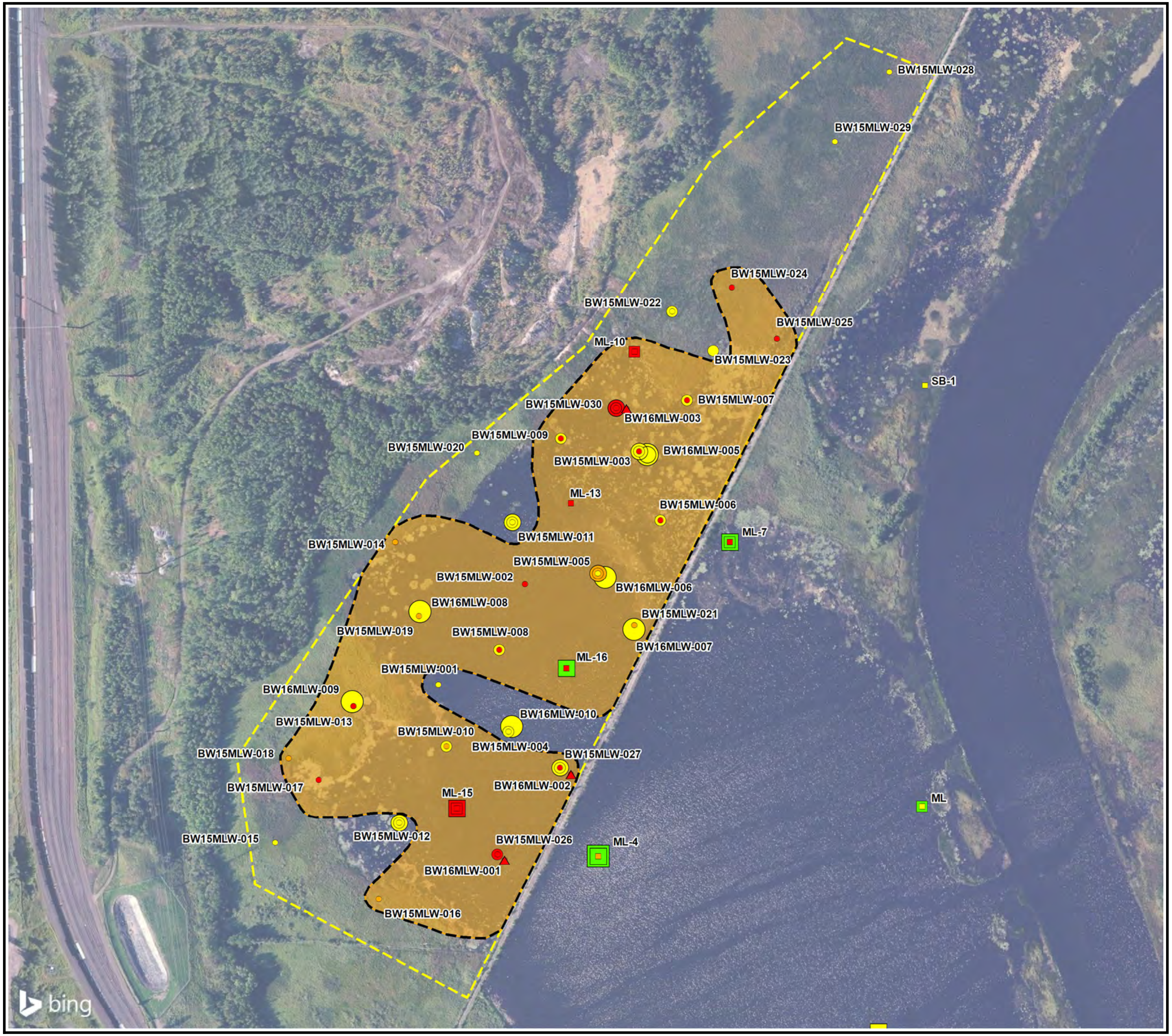
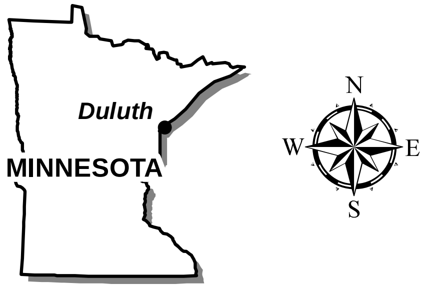


Figure 5

Remedial Footprint

Mud Lake West
SLR Sediment AOCs

Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

0 350 700 Feet
0 100 200 Meters

▭	Mud Lake West Site Boundary
▭	Remedial Footprint (40.11 Acres)

Sample Type

△	Sediment Sample, Including Tox/Bio Testing
○	Sediment Sample (Bay West 2015/2016)
□	Sediment Sample (Historical)

Sample Interval

○	□	0-0.15 m
○	□	0.15-0.50 m
○	□	0.50-1.0 m
○	□	>1.0 m

TEQ KM Fish SQT Comparison

🟩	Does not exceed Level 1 SQT (0.85 ng TEQ/kg)
🟨	Exceeds Level 1 SQT (0.85 ng TEQ/kg)
🟧	Exceeds Midpoint SQT (11.2 ng TEQ/kg)
🟥	Exceeds Level 2 SQT (21.5 ng TEQ/kg)

TEQ KM Fish SQT Exceedance Areas

🟧	Estimated Area Exceeding Midpoint SQT (40.11 Acres)

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:5/12/2017 Project No.J160749

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\001_FFS_2017\J160749 FIG 5 Mud Lake West Remedial Footprint.mxd

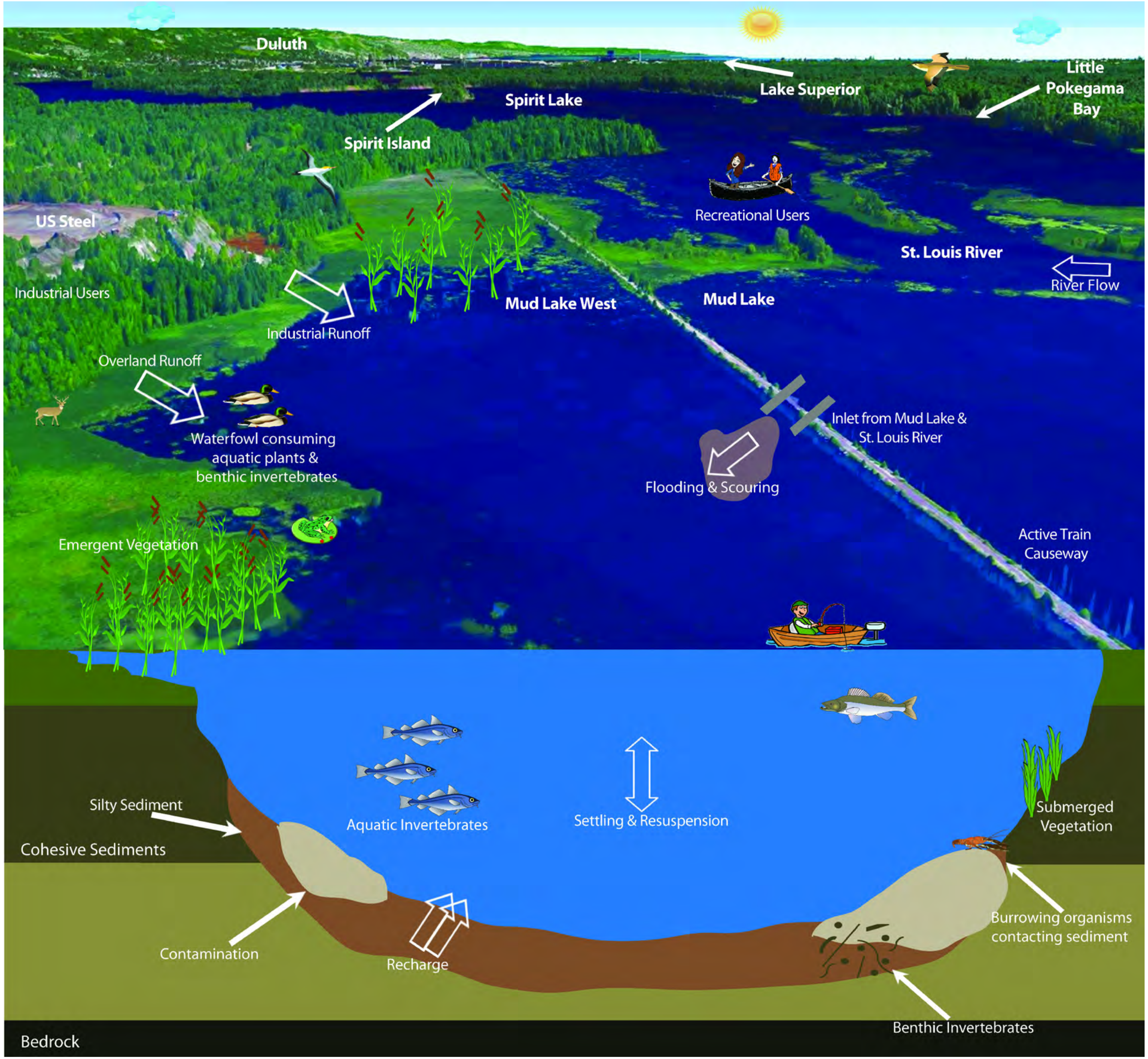
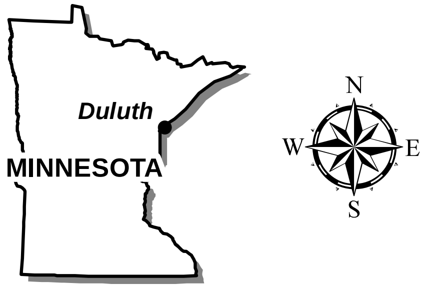


Figure 6

Conceptual Site Model

Mud Lake West
SLR Sediment AOCs
Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:5/11/2017 Project No.J160749

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\001_FFS_2017\J160749 FIG 6 Mud Lake West Conceptual Site Model.mxd

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\001_FFS_2017\J160749 FIG 7 Mud Lake West Alternative 2 Enhanced MNR with Broadcasted Amendment.mxd

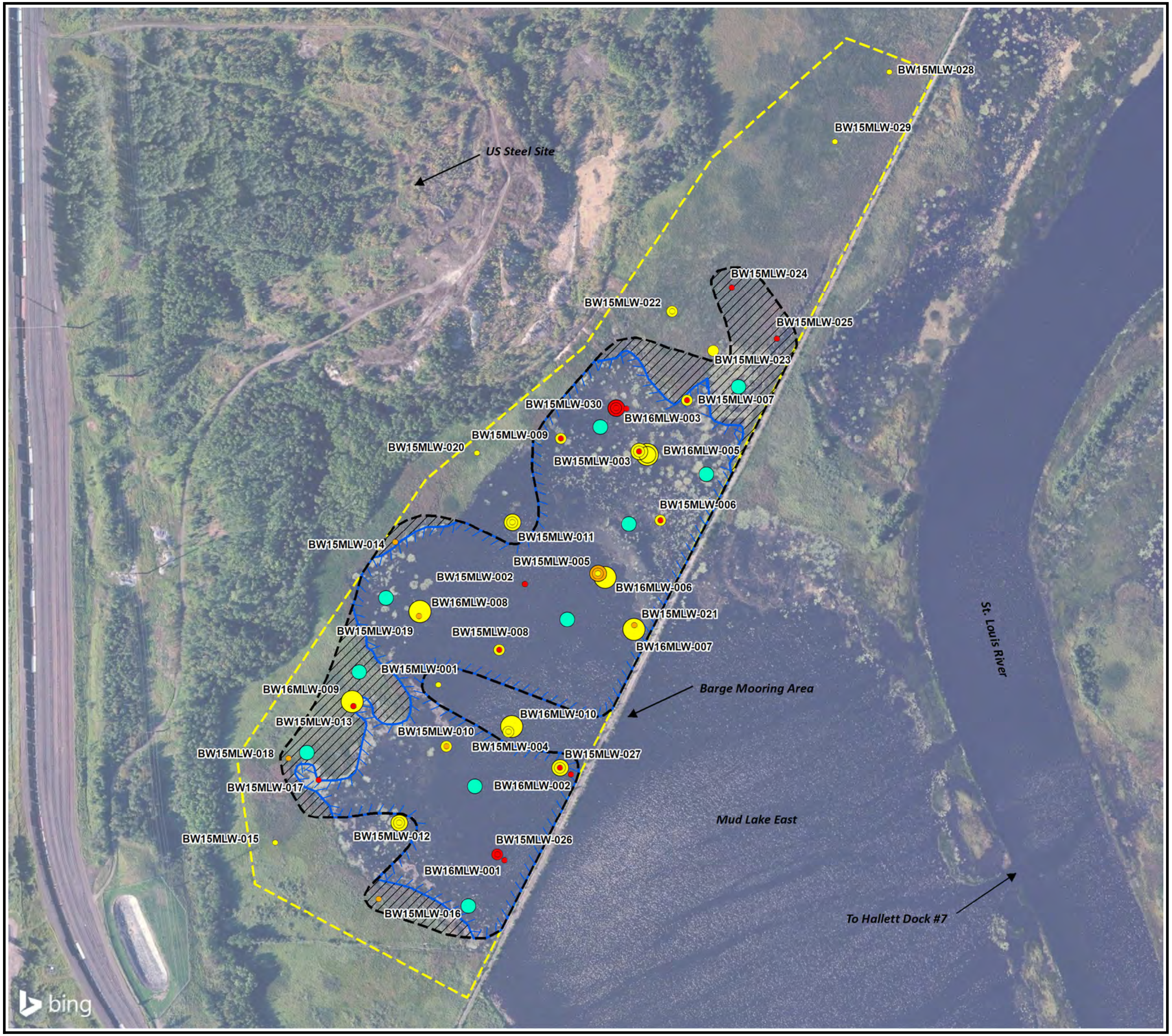
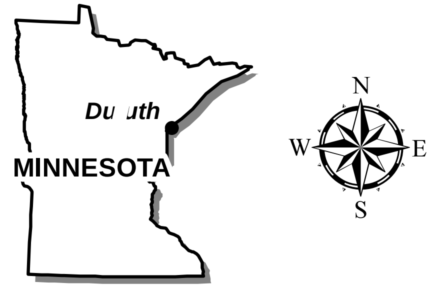


Figure 7

Alternative 2 - Enhanced MNR with Broadcasted Amendment

Mud Lake West
SLR Sediment AOCs
Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

0 350 700 Feet
0 100 200 Meters

●	Proposed Monitoring Location
▨	Open Water Areas - 31.87 Acres (0.05m Broadcasted Amendment)
▨	Wetland Areas - 8.24 Acres (0.05m Broadcasted Amendment)
☐	Remedial Areas (40.11 Acres)
☐	Mud Lake West Site Boundary

Sample Type

○	Sediment Sample (Bay West 2015/2016)

Sample Interval

○	0-0.15 m
○	0.15-0.50 m
○	0.50-1.0 m
○	>1.0 m

TEQ KM Fish SQT Comparison

🟩	Does not exceed Level 1 SQT (0.85 ng TEQ/kg)
🟨	Exceeds Level 1 SQT (0.85 ng TEQ/kg)
🟧	Exceeds Midpoint SQT (11.2 ng TEQ/kg)
🟥	Exceeds Level 2 SQT (21.5 ng TEQ/kg)

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:5/22/2017 Project No.J160749

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\001_FFS_2017\J160749 FIG 8 Mud Lake West Alternative 3 Enhanced MNR with Thin-Layer Amended Cover.mxd

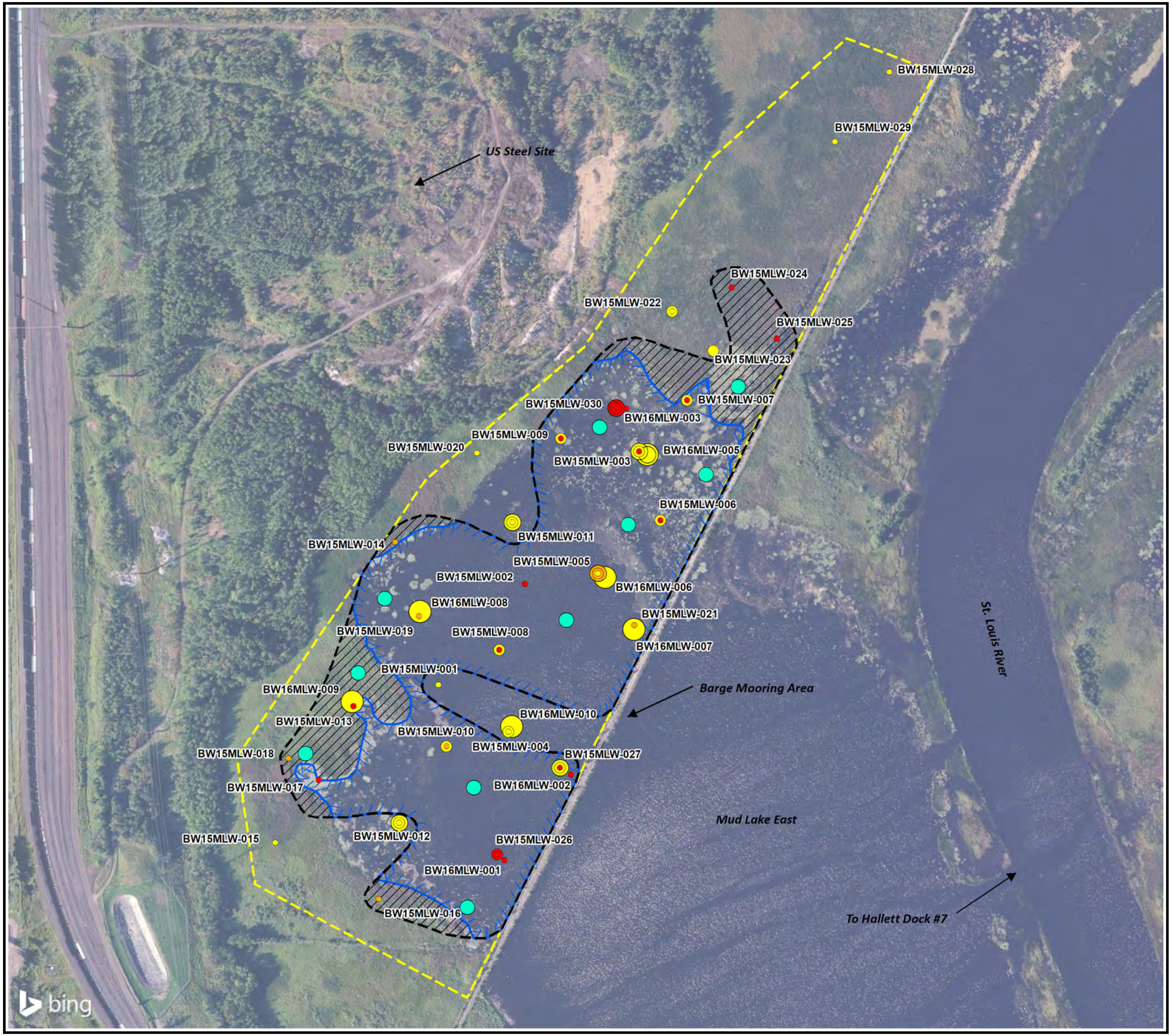
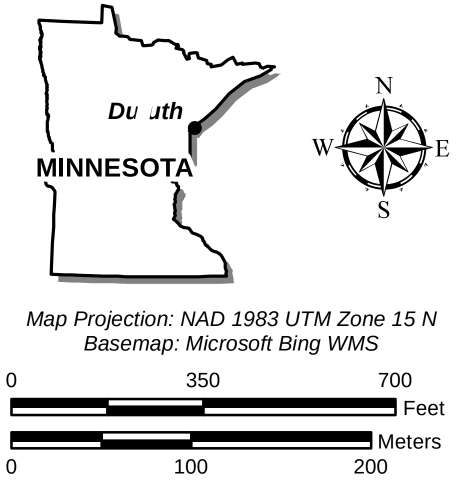


Figure 8

Alternative 3 - Enhanced MNR with Thin-Layer Amended Cover

Mud Lake West
SLR Sediment AOCs

Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

●	Proposed Monitoring Location
▨	Open Water Areas - 31.87 Acres (0.15m amended cover)
▨	Wetland Areas - 8.24 Acres (0.15m amended cover)
⬚	Remedial Areas (40.11 Acres)
⬚	Mud Lake West Site Boundary

Sample Type

○	Sediment Sample (Bay West 2015/2016)

Sample Interval

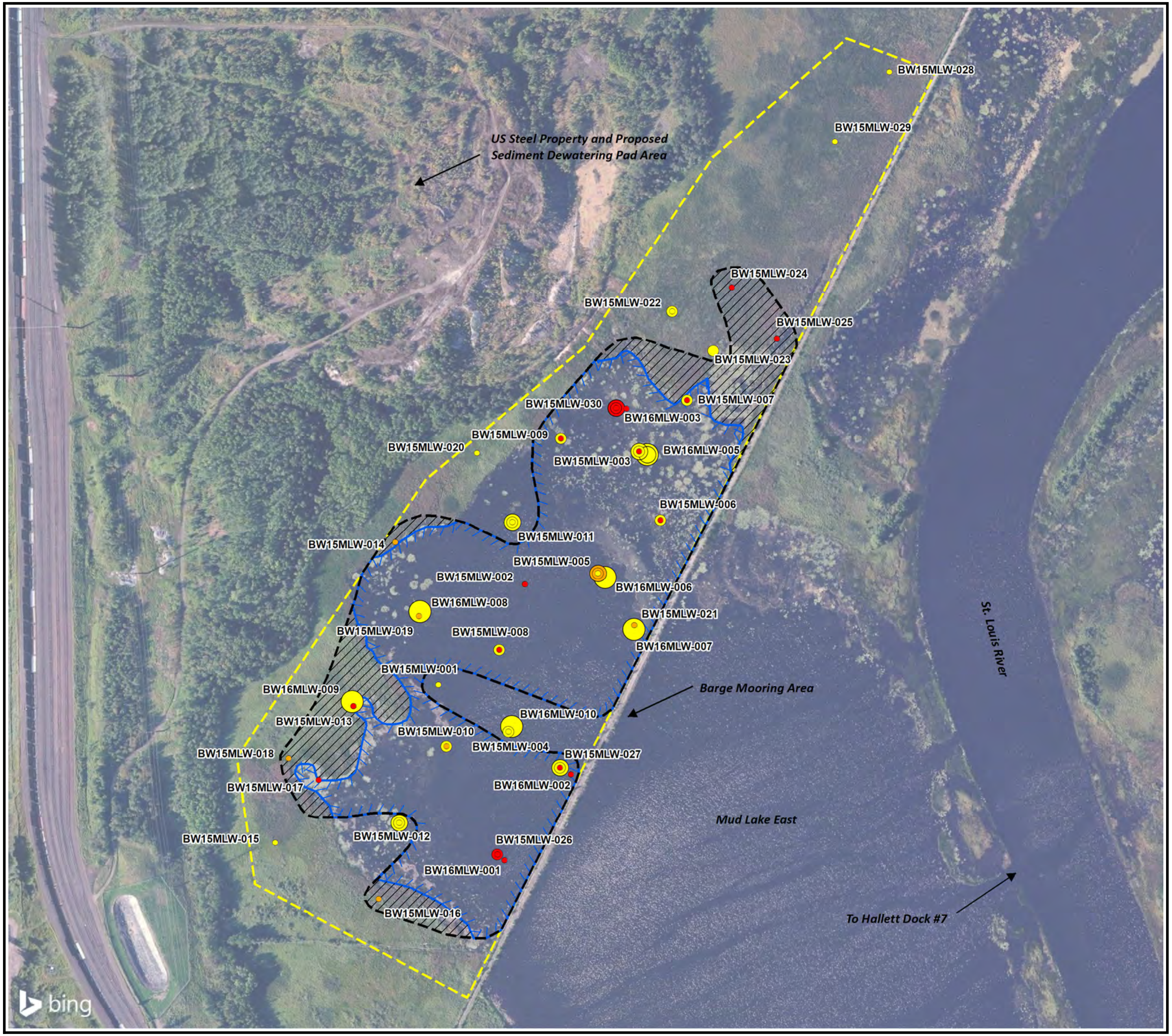
○	0-0.15 m
○	0.15-0.50 m
○	0.50-1.0 m
○	>1.0 m

TEQ KM Fish SQT Comparison

🟩	Does not exceed Level 1 SQT (0.85 ng TEQ/kg)
🟨	Exceeds Level 1 SQT (0.85 ng TEQ/kg)
🟧	Exceeds Midpoint SQT (11.2 ng TEQ/kg)
🟥	Exceeds Level 2 SQT (21.5 ng TEQ/kg)

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:5/22/2017 Project No.J160749



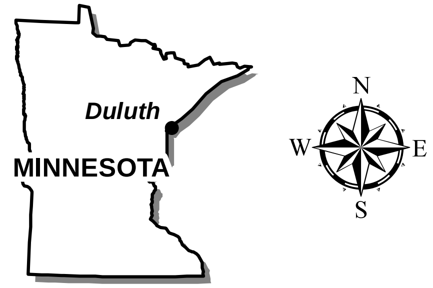
Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_LakeMapDocs\J160749\001_FFS_2017\J160749 FIG 9 Mud Lake West Alternative 4 Dredging with Wetland Restoration.mxd

Figure 9

Alternative 4 - Dredging with Wetland Restoration

Mud Lake West
SLR Sediment AOCs

Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

▨	Open Water Areas - 31.87 Acres (Dredge 1.3m; 0.15m sand cover)
▨	Wetland Areas - 8.24 Acres (Dredge 1.3m; 1.3m sand cover)
⬚	Remedial Areas (40.11 Acres)
⬚	Mud Lake West Site Boundary

Sample Type

○	Sediment Sample (Bay West 2015/2016)

Sample Interval

○	0-0.15 m
○	0.15-0.50 m
○	0.50-1.0 m
○	>1.0 m

TEQ KM Fish SQT Comparison

🟩	Does not exceed Level 1 SQT (0.85 ng TEQ/kg)
🟨	Exceeds Level 1 SQT (0.85 ng TEQ/kg)
🟧	Exceeds Midpoint SQT (11.2 ng TEQ/kg)
🟥	Exceeds Level 2 SQT (21.5 ng TEQ/kg)

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:5/12/2017 Project No.J160749

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\001_FFS_2017\J160749 FIG 10 Mud Lake West Alternative 5 Dredge Open Water Areas of Site_Enhanced MNR with ThinLayer Amended Cover in Wetland Areas.mxd

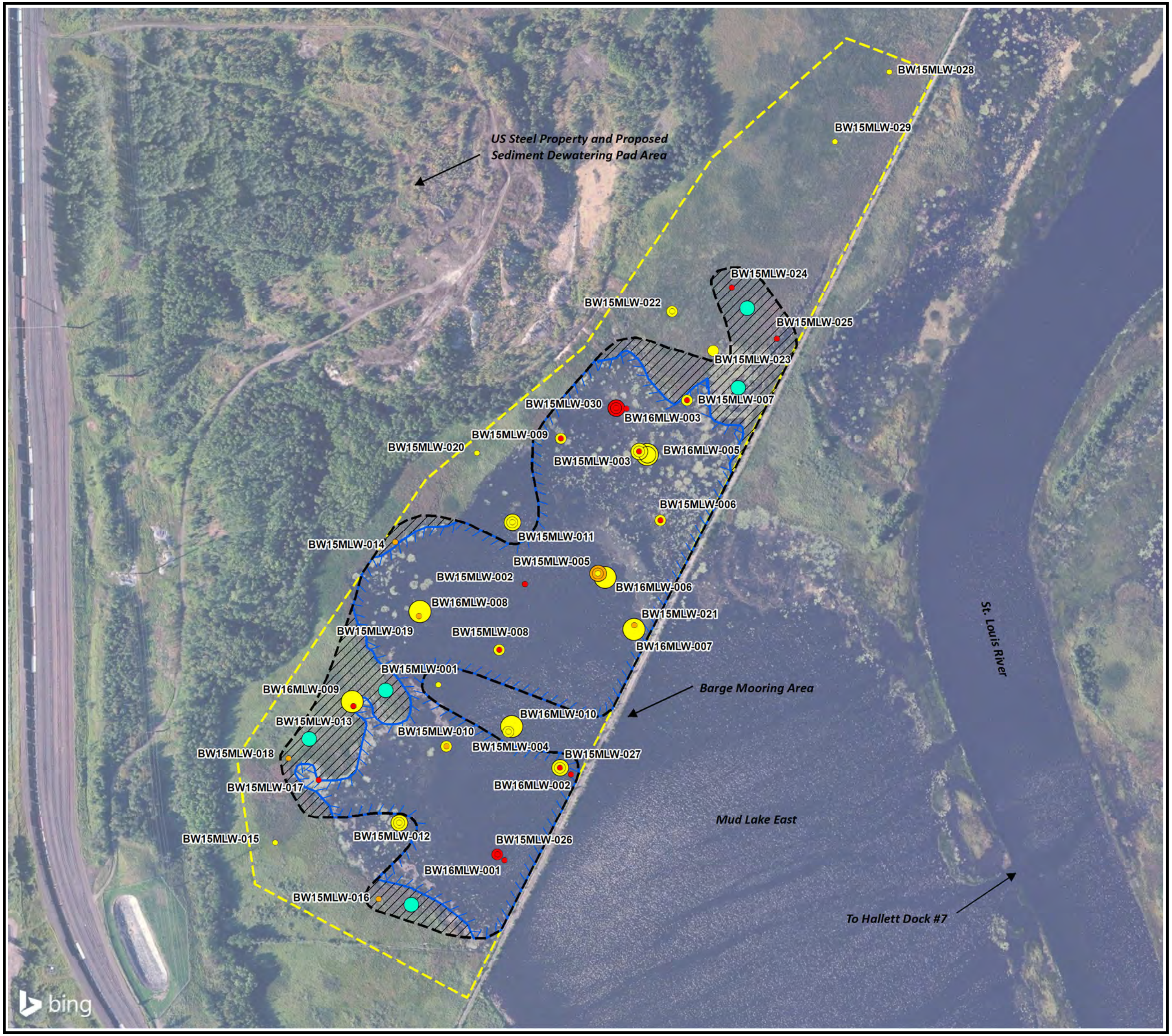


Figure 10

Alternative 5 - Dredge Open Water Areas of Site/Enhanced MNR with Thin-Layer Amended Cover in Wetland Areas

Mud Lake West
SLR Sediment AOCs

Duluth, MN

N
W E
S

Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

0 350 700 Feet
0 100 200 Meters

●	Proposed Monitoring Location
▨	Open Water Areas - 31.87 Acres (Dredge 1.3m; 0.15m sand cover)
▨	Wetland Areas - 8.24 Acres (0.15m amended sand cover)
☐	Remedial Areas (40.11 Acres)
☐	Mud Lake West Site Boundary

Sample Type

○	Sediment Sample (Bay West 2015/2016)

Sample Interval

○	0-0.15 m
○	0.15-0.50 m
○	0.50-1.0 m
○	>1.0 m

TEQ KM Fish SQT Comparison

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Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:5/22/2017 Project No.J160749

Tables

Table 1
Contaminant of Concern Summary
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Contaminant	Units	Cleanup Level	Maximum Concentration Detected
Dioxins	ng TEQ/kg	11.2	50.5

Notes:

mg/kg = milligrams per kilogram

ng TEQ/kg = nanograms toxic equivalency per kilogram

Table 2
Technologies Screening Summary
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Category	Technology	Description	Applicability	Ranking						Retained for Consideration	Rationale
				Effectiveness		Implementablility		Relative Cost			
Institutional Controls	Institutional Controls	Institutional controls in the form of an environmental restrictive covenant or conditions of future permits may be used to prevent exposure and contact with impacted soil or sediment by restricting land uses or disturbances to the material.	May consist of fish consumption advisories, commercial fishing bans, waterway use restricitons, or deed restrictions	○	Effective in meeting RAOs when combined with other remedies.	●	Easily implemented with little distruption to the Site.	$	Minimal but there are long term costs associated with initiating and maintaining institutional controls.	Yes.	Some institutional controls already in place; however, additional controls are expected to be a required component of any remedy.
Monitoring and Evaluation	Monitoring	The collection and analysis chemical, physical, and/or biological data over a sufficient period of time and frequency to determine the status and/or trend in one or more environmental parameters or characteristics.	Monitoring should be conducted to asses compliance with design and performance standards; to assess short-term remedy performance and effectiveness in meeting sediment cleanup levels; and/or to evaluate long-term remedy effectiveness in achieving RAOs and in reducing human health and/or environmental risk.	○	Effective in meeting RAOs when combined with other remedies.	●	Highly implementable with no disturbance to the Site.	$	The main cost is associated with laboratory analysis.	Yes.	Monitoring is expected to be a required component of any remedy.
Natural Recovery	Monitored Natural Recovery	MNR leaves impacted sediment in place and relies on ongoing, naturally occurring processes to isolate, destroy, or reduce exposure or toxicity of impacted sediment.	Burial of contaminated sediments does not appear to be occuring at the Site and depsotion rates are not likely sufficient to isolate COCs in reasonable timeframe and concentrations do not appear to be reducing.	⊗	Burial does not appear to be occuring and current data does not indicated the extent of MNR effectiveness in COC reduction.	●	Highly implementable with no disturbance to the Site.	$	The main cost of NR is associated with monitoring.	No.	Effectiveness at the Site has not been demonstrated and does not appear to be effective under current conditions.
	Enhanced Monitored Natural Recovery	EMNR adds amendments to the sediment to accelerate physical isolation process and facilitates re-establishment of benthic or plant habitat. May include a granular or carbon sorbent cover (over sediments) or biological stimulants (to soil).	Use of an amendment may increase the rate at which sediment contaminant concentrations are reduced/made less available over time. Natural bioturbation processes will assit in mixing amendments into in-situ sediments.	●	Sediment amendments have been used successfully in the past to reduce the availability of contaminants to biota.	◉	Implementable; however, requires site access, staging area, and placement equipment. Impact to Site operation can be minimal with advanced planning.	$$	Greater initial cost than NR due to thin cover or amendment placement, but less expensive than conventional cap or sediment removal.	Yes.	Effectiveness of chemical contaminant sequestration in sediments via addition of amendments has been demonstrated. Allows for remedial action with limited disturbance to established wetland areas.
Capping	Capping	Capping provides a physical barrier and chemical isolation from COCs. Caps may be constructed from clean sediment, sand, gravel, geotextiles, liners, reactive or absorptive material and may consist of multiple layers. Granular sediment caps can provide erosion protection and limit bioturbation.	Cap thickness depends on bioactive zone (BAZ) thickness requirements, which vary by habitat, substrate and water depth. A cap may alter hydrologic conditions and Site use.	◉	Highly effective and proven technology. Solubililty and eventual migration of COCs through capping material is possible. Would reduce water depth significantly in already shallow areas and may turn wetland areas into upland areas.	◉	Implementable, but would likely permanently reduce the size of wetland areas.	$$$	Capping costs are generally less than sediment removal, and depend on cap thickness, material, lateral extent and surface water engineering factors. Material costs for a synthetic cap are generally higher than a granular cap.	No.	Would likely turn wetland areas into upland areas and therefore was not retained for consideration.

Table 2
Technologies Screening Summary
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Category	Technology	Description	Applicability	Ranking						Retained for Consideration	Rationale
				Effectiveness		Implementablility		Relative Cost			
Excavation and Removal	Mechanical Dredging	Sediment is lifted to the surface using a mechanical excavator or crane and placed on a barge for transport. Removed sediment has a similar moisture content as the in situ material, requiring dewatering prior to disposal. Residual cover is typically needed to manage remaining impacts.	Mechanical dredging is implementable at the Site but no staging area locations are present in which to stabilize sediments. Sediments must be slurried and pumped to an off-site staging area. Sediment controls expected to be required.	●	Highly effective and proven technology; however, resuspension may limit effectiveness.	◉	Requires dredging equipment and upland staging infrastructure for sediment dewatering and transportation. Less staging space required than hydraulic dredging.	$$$	Main capital costs include equipment mobilization, staging area devlopment, equipment operation, residual cover materials, and construction and operation of a containment area for dredged material.	Yes.	Suitible for use at the Site, but mechanically dredged sediments must be slurried with water and pumped to an off-site staging area.
	Hydraulic Dredging	Hydraulic dredging captures water with the sediment and removes it by pumping the sediment slurry typically through a pipeline to the dewatering location or final disposal site. High water content of slurry requires significant dewatering. Residual cover is typically needed to manage remaining impacts.	Hydraulic dredging is implementable at the Site. Sediments must be pumped to an off-site staging area. Sediment controls expected to be required.	●	Highly effective and proven technology; however, resuspension may limit effectiveness.	◉	Implementable; however, requires large staging area for dewatering equipment, requires more water treatment than mechanical dredging.	$$$$	Additional treatment and disposal costs due to greater water content of the slurried sediment.	Yes.	Suitable for use at the Site, but dredged sediments must be pumped to an off-site staging area.
	Mechanical Removal in Dry Conditions	Water is diverted or drained from the excavation area using a containment barrier such as a cofferdam to allow for excavation of dry sediment with conventional equipment (e.g. backhoe). Typically limited to shallow areas.	Well suited for shallow areas and geometry that allows for construction of containment barrier and water diversion.	●	Effective and proven technology. Allows for visual inspection during removal. Minimal resuspension/redeposition. High degree of accuracy.	○	Feasible in small-volume removal areas. Site preparation difficult due to water management.	$$$	Costs are similar to mechanical dredging, with the added cost to construct diversion or containment structures.	No	Not suitable when compared to mechanical or hydraulic dredging.
Disposal	Off-Site	Removed sediment is transported to an offsite disposal location that will accept the waste. Dewatering of sediments is generally required before transport.	Transportation of large volumes of sediment would create significant truck traffic through the surrounding community for a long duration.	●	Effective at meeting RAOs, low risk of spills during transportation.	◉	Disruption to neighbors during trucking, may result in limited work hours. Seasonal restrictions may also apply.	$$$$	Costs for offsite disposal include dewatering, water treatment, loading and transportation costs and landfill disposal fees. Transportation costs depend on distance to the landfill.	Yes.	Suitable with proper truck routing. Onsite storage facilities are not available.
	Confined Disposal Facility (CDF)	CDFs are engineered structures enclosed by dikes and specifically designed to contain sediment. CDFs may be located either upland (above the water table), near-shore (partially in the water), or completely in the water (island CDFs).	Creation of a CDF would result in destruction of wetland areas.	●	Most widely used method for disposal and has been demonstrated effective.	○	Requires high level of design, detailed knowledge of dredge plans, requires large permanent area for construction, and treatment of discharge.	$$$	Costs for a CDF include engineering and design costs, materials for dikes and suspended solids control, and construction equipment and labor.	No	Based on the surrounding wetland areas and large dredge volumes, consolidation areas are not feasible.
	On-site Contained Aquatic Disposal (CAD)	Dredged or excavated sediment is disposed within a natural or excavated depression elsewhere in the water body.	A suitable location to accommodate entire sediment volume is not available.	○	Would likely be effective at maintaining COCs if propertly designed.	⊗	A suitable location to accommodate entire sediment volume is not available.	$$$	Specialized equipment for a CAD may be required, especially if the disposal site is in deep water. Dredging to create a CAD would add cost.	No	Based on the Site charateristics, a suitable location is not available at the Site to accommodate the required disposal volume.

Table 2
Technologies Screening Summary
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Category	Technology	Description	Applicability	Ranking						Retained for Consideration	Rationale
				Effectiveness		Implementablility		Relative Cost			
In Situ Treatment	Immobilization	Immobilization treatments add chemicals or cements to reduce the leachability of COCs. Mechanisms include solidification (encapsulation) or stabilization (chemical or absorptive reactions that convert COCs to less toxic or mobile forms).	Implementation at a sediment site is difficult due to submerged work requirement and restricting future Site use.	○	Is effective for COCs. Stabilization of sediments reduces erosion potential. May result in poor environment for benthic community.	⊗	Sediment mixing can be difficult. May require dewatering. Requires equipment for mixing. Solidified sediment would restrict future Site use.	$$$	Costs for solidification or stabilization affected by the quantity and type of reagents added to the waste and the need for specialized equipment for mixing reagents with sediment.	No	Not proven to be effective for sediments. Costly and more difficult to implement than other technologies.
	Enhanced Bioremediation	Microbial degradation by bacteria or fungi is enhanced by adding materials such as oxygen, nitrate, sulfate, hydrogen, nutrients, or microorganisms to the sediment.	Can be effective for COCs.	○	Requires specific geochemical parameters to be successful (temperature, Ph, nutrient availability)	⊗	Sub-aqueous implementation difficult, requires site access, staging area, and placement equipment. Impact to Site operation can be minimal with advanced planning.	$$$	Costs of enhanced bioremediation are relatively low, but several treatments and monitoring similar to MNR may be required.	No	Difficult to implement sub aqueously.
	Oxidation/Reduction	Chemicals are injected into sediment to act as an oxidant/electron acceptor to facilitate aerobic decomposition of organic matter.	Chemical addition may create toxic conditions.	○	Chemical addition may create toxic conditions. Not proven safe for subaqueous conditions.	○	Bench-scale testing and pilot-scale testing required to determine the type, concentration, and quantity of oxidant and amendments required.	$$$	Costs include bench- or pilot-scale tests. Monitoring may be required.	No	Not proven safe for subaqueous conditions.
	Chemical Oxidation	The addition of chemical oxidizers to sediment can cause the rapid and complete chemical destruction of many toxic organic chemicals.	Effectiveness for Site COCs.	⊗	Addition of chemicals may form temporarily toxic conditions for benthic or aquatic organisms. COCs may become more bioavailable.	◉	Pilot studies would be required to determine the effectiveness of specific oxidants for COCs.	$$$	Costs include bench- or pilot-scale tests to determine effectiveness, oxidants for injection, and a delivery system. Monitoring may also be required.	No	Chemical addition may create toxic conditions and COCs may become more bioavailable
	Phytoremediation	Phytoremediation uses plant species to remove, transfer, stabilize, and destroy COCs in soil and sediment. Generally limited to sediments in shallow water zones and low concentrations.	Habitat restoration not likely necessary, technology not effective in open water areas of Site.	○	Effective only in shallow contaminated areas, which comprise only 1/3 of the Site area.	●	Implementation involves planting and in some cases harvesting with little disruption to the Site.	$$	Primary costs are purchasing and planting applicable species. Monitoring may also be required.	No	May be implemented for habitat restoration, but not effective alone.
	Adsorption	Adsorbents can be used as sediment amendments for in situ treatment of COCs. Sorption organics can take place simultaneously with a suitable combination of sorbents.	May be useful as EMNR amendment.	◉	Sorption of COCs possible with amendment materials.	◉	Amendments can be delivered to the sediment in the form of pellets or mixed into other media (i.e., sand) to resist re-suspension.	$$	The main costs include the adsorbent material, and a method for depositing it on the surface sediment. Monitoring may also be required.	Yes.	Effectiveness of chemical contaminant sequestration in sediments via addition of amendments has been demonstrated. Allows for remedial action with limited disturbance to established wetland areas.

Table 2
Technologies Screening Summary
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Category	Technology	Description	Applicability	Ranking						Retained for Consideration	Rationale
				Effectiveness		Implementablility		Relative Cost			
Dewatering	Passive Dewatering	Passive dewatering relies on natural evaporation and drainage to remove moisture from the sediment. Drainage may be driven by gravity or assisted with a vacuum pump. Passive dewatering may occur in CDFs, lagoons, tanks, or temporary holding/rehandling facilities.	Could be utilized if sufficient space is available off-site for long-term passive dewatering to take place. Adjacent U.S. Steel Site is currently serving this purpose for Radio Tower Bay sediments.	○	Passively dewatered sediments may not have low enough water content for landfill disposal, so supplemental technologies may be required.	◉	Implementable if adjacent staging area can be located. Time frames for passive dewatering likely longer than for mechanical dewatering.	$$	Costs to consider include construction of a dewatering facility or adequately sized CDF.	Yes.	Appropriate for off-site disposal when used with hydruospoic amendment addition and/or sufficient dewatering timeframe.
	Sediment Reworking	Reworking sediments to promote drainage, and mixing sediments with excavation equipment can enhance passive dewatering.	If a CDF is constructed, sediment reworking could be performed within the CDF.	○	Sediment mixing and reworking would facilitate a timelier and more complete dewatering, but may not be sufficient for off-site disposal.	○	Hydraulically pumped sediments would result in excessive water content for sediment reworking initially. May be feasible after sediments have dewatered for a period of time.	$$	Cost savings are expected over passive dewatering alone due to time saved.	No	Not appropriate for offsite disposal.
	Hydrospoic Amendment Addition	Dredged sediments are mixed with amendments such as slags or cementitious materials to remove moisture and improve strength and stability.	Could be used to enhance dewatering in conjunction with passive dewatering	◉	Effectiveness of amendments depend on the moisture content of removed sediment. Pre-treatment dewatering likely required due to hydraulic dredging for maximum effectiveness and to achieve desired geotechnical properties.	○	Would require staging, mixing, and curing areas. Amendment addition creates a greater volume and mass, which needs to be considered in disposal options. Likely requires pre-treatment dewatering. May not be time and energy efficient for hydraulically pumped sediments.	$$	Costs include amendment materials and mixing equipment. Costs increase with increased moisture content. Both the addition rate and the bulking factor of treated material should be considered when evaluating costs of amendment material.	No	Likely not time and energy efficient for hydraulically pumped sediments due to high water content of dredge slurry.
	Geotextile Tube Dewatering	Sediment slurry from hydraulic dredging is pumped into the geotextile tube and filtered by the geotextile fabric. Sediment is retained within the geotextile tube, while free liquids pass through the exterior of the tube.	Applicable to hydraulically dredged sediments or mechancially dredged sediments if slurried and pumped to dewatering area.	●	Proven technology and widely used for slurried dredge sediments.	◉	Implementable if a nearby dewatering area can be located. Currently, the adjacent U.S. Steel Site is serving this purpose for Radio Tower Bay sediments.	$$$	Costs include flocculent and coagulant materials, cost of geotextile tubes and construction of staging area.	Yes.	Appropriate for slurried dredge sediments and large dredge volume.
	Mechanical Dewatering	Mechanical dewatering technologies include use of plate filters, presses, centrifuges or other equipment to squeeze, press, or draw water from dredged sediment.	Requires homogeneous waste stream provided by hydraulic dredging methods and site sediments.	●	Generally works best with a homogeneous waste stream produced via hydraulic dredging. Selection of specific mechanical dewatering equipment depends on treatment or disposal methods that follow.	◉	Faster than passive dewatering and requires less space. Production rates depend on size and quality of the dewatering device and on the solids content of the input stream.	$$$$	Costs of mechanical dewatering are generally higher than passive dewatering due to the energy and equipment requirement.	No	Likely not cost effective for project dredge volumes.
	Rapid Dewatering Systems	A system that continuously processes the slurry from a hydraulic dredge and separates solids into piles of debris; shells; and gravel, sand, and fines. Includes polymer addition and flocculation, which may remove some COCs.	Applicable to hydraulically dredged sediments or mechancially dredged sediments if slurried and pumped to dewatering area.	●	Highly effective and proven technology but typically utilized for large-scale and long-term dredging operations.	◉	Faster than passive dewatering and requires less space. Production rates depend on size and quality of the dewatering device and on the solids content of the input stream.	$$$$	Costs of mechanical dewatering are generally higher than passive dewatering due to the energy and equipment requirement.	No	Likely not cost effective for project dredge volumes.

Table 2
Technologies Screening Summary
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Category	Technology	Description	Applicability	Ranking						Retained for Consideration	Rationale
				Effectiveness		Implementablility		Relative Cost			
Water Treatment	Filtration	Filters remove solids and sediments from wastewater, also removing absorbed COCs from the waste stream. Flocculants may be added to the waste stream to facilitate solids removal.	Filtration is a standard method for water treatment and would be effective at removing site COCs sorbed to suspended sediments in the waste stream.	○	Filters can be selected based on the required particulate size. Treatability study to determine if filtration is effective at reducing the COC concentration.	◉	Filtration is a widely used method for water treatment. Selection of the filtration methods and type requires engineering design and site specific knowledge of the waste stream. Would require a dewatering area	$$$	Costs depend on change out frequency of filtration material.	Yes.	Effective for COC removal when used in combination with liquid adsorption.
	Liquid Adsorption	Involves pumping water through a vessel containing granular activated carbon (GAC), organoclay, or another adsorbent material; dissolved compounds to adsorb to its surface.	Conventional adsorptive materials would remove COCs.	◉	Sorptive clay vessels are appropriate for treating COCs.	◉	Liquid adsorption systems are widely available, have a relatively small footprint, and require a relatively short timeframe for treatment.	$$$	Costs include media, vessels, and disposal/recyling costs for media. The adsorbent must be recharged or replaced periodically. Power is required for pumping.	Yes.	Effective for COC removal.
	Advanced Oxidation	Advanced oxidation uses UV light and the addition of strong oxidizers to primarily destroy organic constituents in water.	Advanced oxidation is applicable for treating most organics, including COCs.	○	Advanced oxidation is applicable for treating most organics.	◉	Advanced oxidation systems are widely available, have a relatively small footprint, and require a relatively short timeframe for treatment. Handling and storage of oxidizers would require special safety precautions.	$$$$	Costs may be higher because of energy requirements to power UV lights.	No	Cost likely too high.

	Effectiveness	Implementability	Relative Cost
⊗	Not effective at reaching RAOs	Not implementable at the Site	$$$$ - High
○	Partially effective for some COCs or Site areas	Difficult to implement	$$$ - Medium-high
◉	Effective under certain conditions	Implementable, requires technical knowledge	$$ - Moderate
●	Demonstrated effective technology	Readily implemented	$ - Low

Table 3
Alternatives Summary
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Alternative	Alternative 1: No Action	Alternative 2: Enhanced MNR with Broadcasted Amendment	Alternative 3: Enhanced MNR with Thin-Layer Amended Cover	Alternative 4: Dredging with Wetland Restoration	Alternative 5: Dredge Open Water Areas of Site/Enhanced MNR with Thin-Layer Amended Cover in Wetland Areas
Total Present Worth Cost	$0	$6,834,000	$13,878,000	$29,252,000	$28,594,000
Cover/Cap Area	0 acres	32.1 acres (0.05-meter [2-inch] amendment "cover")	32.1 acres (0.15-meter [6-inch] amended cover)	7.9 wetland acres (1.30-meter [4.3-feet] sand cover); 24.2 open water acres (0.15-meter [6-inch] sand cover)	7.9 wetland acres (0.15-meter [6-inch] amended cover); 24.2 open water acres (0.15-meter sand cover)
Dredge Area	0 acres	0 acres	0 acres	40.1 acres (dredge 0.7 meters)	31.9 acres (dredge 0.7 meters)
Cover Volume - Sand/Amendment	0 CY/ 0 CY	0 CY/ 2,073 CY	31,060 CY/ 2,246 CY	45,649 CY/ 0 CY	32,089 CY/ 266 CY
Dredge Volume	0 CY	0 CY	0 CY	155,682 CY	135,741 CY
Construction Timeframe	0 weeks	5 weeks	22 weeks	25 weeks 1st season (dredge); 25 weeks 2nd season (place cover; excavation and disposal of dewatered sediments)	37 weeks 1st season; 19 weeks 2nd season (excavation and disposal of dewatered sediments)
Monitoring Program	None	Chemical and physical sediment; benthic toxicity and bioaccumulation; fish tissue	Chemical and physical sediment and cover; benthic toxicity and bioaccumulation; fish tissue	None	Chemical and physical sediment and cover; benthic toxicity and bioaccumulation; fish tissue; wetland areas only

Table 4
Cost Estimate - Alternative 2: Enhanced MNR with Broadcasted Amendment
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Description	Unit	Estimated Unit Cost	Estimated Quantity	Extended Value	Present Value	Comments
Construction Costs						
Mobilization/Demobilization	Lump Sum	$ 206,000	1	$ 206,000	$ 192,523	All construction occurs on Year 1
Rent Hallett Dock #7 for Staging Area	Month	$ 10,000	3	$ 30,000	$ 28,037	
Install and Remove Dolphin Pilings	Lump Sum	$ 95,000	1	$ 95,000	$ 88,785	
Purchase Amendment Materials and Stockpile at Staging Area	ton	$ 4,000	1243.41	$ 4,973,640	$ 4,648,262	
Load and Barge Materials Between Staging Area and Site	CY	$ 50.00	2073	$ 103,650	$ 96,869	
Broadcast Amendment in Wetland Areas	CY	$ 91.00	426	$ 38,766	$ 36,230	
Broadcast Amendment in Open Water Areas	CY	$ 79.04	1647	$ 130,182	$ 121,665	
Construction Monitoring/CQA and Oversight	Week	$ 12,802	5	$ 64,010	$ 59,822	
Monthly Operating Expenses and Site Security	Month	$ 21,000	3	$ 63,000	$ 58,879	
Implement Institutional Controls	Lump Sum	$ 5,000.00	1	$ 5,000	$ 4,673	Site postings
			SUBTOTAL	$ 5,709,248	$ 5,335,745	
Long-Term Monitoring						
Monitoring and Evaluation Report	Each	$ 4,000	6	$ 24,000	$ 8,631	Every 5 years for 30 years
Field Sampling	Event	$ 34,000	6	$ 204,000	$ 73,366	Every 5 years for 30 years
Sample Analysis	Event	$ 55,520	6	$ 333,120	$ 119,802	Every 5 years for 30 years
			SUBTOTAL	$ 561,120	$ 201,799	
			TOTAL	$ 6,270,368	$ 5,537,544	
			25% Contingency	$ 324,182	$ 222,321	Contingency does not include amendment materials
			CONSTRUCTION GRAND TOTAL	$ 6,594,550	$ 5,759,865	
Professional and Technical Services						
Remedial Design (6%)	Lump Sum	$ 396,000	1	$ 396,000	$ 396,000	Year 0
Project Management and Permitting (5%)	Lump Sum	$ 330,000	1	$ 330,000	$ 308,411	Year 1
Construction Management (6%)	Lump Sum	$ 396,000	1	$ 396,000	$ 370,093	Year 1
			SUBTOTAL	$ 1,122,000	$ 1,074,505	
			TOTAL	**$ 7,717,000**	**$ 6,834,000**	

Notes:

All values are based on 2016 dollars with an assumed discount rate of 7 percent per year. See Appendix A for present value calculations.

Assumptions are based on professional judgment and experience of specialists at Bay West. Actual project costs will be highly dependent upon final design.

Table 5
Cost Estimate - Alternative 3: Enhanced MNR with Thin-Layer Amended Cover
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Description	Unit	Estimated Unit Cost	Estimated Quantity	Extended Value	Present Value	Comments
Construction Costs						
Mobilization/Demobilization	Lump Sum	$ 213,000	1	$ 213,000	$ 199,065	All construction occurs on Year 1
Rent Hallett Dock #7 for Staging Area	Month	$ 10,000.00	5	$ 50,000	$ 46,729	
Install and Remove Dolphin Pilings	Lump Sum	$ 95,000.00	1	$ 95,000	$ 88,785	
Purchase Amendment Materials and Stockpile at Staging Area	Ton	$ 3,000.00	2246	$ 6,738,480	$ 6,297,645	
Purchase Sand and Stockpile at Staging Area	CY	$ 20.80	31060	$ 646,054	$ 603,789	
Load and Barge Materials Between Staging Area and Site	CY	$ 50.00	32355	$ 1,617,770	$ 1,511,935	
Construct Cover in Wetland Areas	CY	$ 91.00	6647	$ 604,871	$ 565,300	6 inch cover; sand and amendment (5 percent by weight)
Construct Cover in Open Water Areas	CY	$ 32.07	25708	$ 824,507	$ 770,568	6 inch cover; sand and amendment (5 percent by weight)
Construction Monitoring/CQA and Oversight	Week	$ 12,802	22	$ 281,644	$ 263,219	
Monthly Operating Expenses and Site Security	Month	$ 21,000	5	$ 105,000	$ 98,131	
Implement Institutional Controls	Lump Sum	$ 5,000	1	$ 5,000	$ 4,673	Site postings
			SUBTOTAL	$ 11,181,326	$ 10,449,838	
Long-Term Monitoring						
Monitoring and Evaluation Report	Each	$ 4,000	6	$ 24,000	$ 8,631	Every 5 years for 30 years
Field Sampling	Event	$ 34,000	6	$ 204,000	$ 73,366	Every 5 years for 30 years
Sample Analysis	Event	$ 61,470	6	$ 368,820	$ 132,641	Every 5 years for 30 years
			SUBTOTAL	$ 596,820	$ 214,638	
			TOTAL	$ 11,778,146	$ 10,664,476	
			25% Contingency	$ 1,259,917	$ 1,091,708	Contingency does not include amendment materials
		CONSTRUCTION GRAND TOTAL		$ 13,038,063	$ 11,756,183	
Professional and Technical Services						
Remedial Design (6%)	Lump Sum	$ 782,000	1	$ 782,000	$ 782,000	Year 0
Project Management and Permitting (5%)	Lump Sum	$ 652,000	1	$ 652,000	$ 609,346	Year 1
Construction Management (6%)	Lump Sum	$ 782,000	1	$ 782,000	$ 730,841	Year 1
			SUBTOTAL	$ 2,216,000	$ 2,122,187	
			TOTAL	**$ 15,254,000**	**$ 13,878,000**	

Notes:

All values are based on 2016 dollars with an assumed discount rate of 7 percent per year. See Appendix A for present value calculations.

Assumptions are based on professional judgment and experience of specialists at Bay West. Actual project costs will be highly dependent upon final design.

Table 6
Cost Estimate - Alternative 4: Dredging with Wetland Restoration
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Description	Unit	Estimated Unit Cost	Estimated Quantity	Extended Value	Present Value	Comments
Construction Costs						
Mobilization/Demobilization	Lump Sum	$ 190,000	1	$ 190,000	$ 177,570	All construction occurs on Year 1
Site Work	Lump Sum	$ 796,000	1	$ 796,000.00	$ 743,925	
Rent Hallett Dock #7 for Staging Area	Month	$ 10,000	9	$ 90,000	$ 84,112	
Install and Remove Dolphin Pilings	Lump Sum	$ 95,000	1	$ 95,000	$ 88,785	
Mechanically Dredge Sediments and Pump to Staging Area	CY	$ 17.83	155682	$ 2,775,671	$ 2,594,085	
Turbidity Controls	Lump Sum	$ 30,000	1	$ 30,000	$ 28,037	
Treat Dredge Contact Water (per CY sediment removed)	CY	$ 40.00	155682	$ 6,227,260	$ 5,819,869	"All-in" ROM estimate including mob/demob, materials, equipment, labor, and disposal
Purchase Sand and Stockpile at Staging Area	CY	$ 20.80	45649	$ 949,495	$ 887,379	
Load and Barge Materials Between Staging Area and Site	CY	$ 50.00	45649	$ 2,282,440	$ 2,133,121	
Construct Cover in Wetland Areas	CY	$ 32.07	19941	$ 639,530	$ 597,692	
Construct Cover in Open Water Areas	CY	$ 32.07	25708	$ 824,492	$ 770,554	
Wetland Restoration	Lump Sum	$ 139,000	1	$ 139,000	$ 129,907	
Excavate and Load Dewatered Sediments	CY	$ 6.90	155682	$ 1,074,306	$ 1,004,024	
Transportation and Disposal of Dewatered Sediments	Ton	$ 17.66	217954	$ 3,848,030	$ 3,596,289	1.4 tons per cubic yard
Construction Monitoring/CQA and Oversight (Labor/Equipment)	Week	$ 12,802	71	$ 908,942	$ 849,479	
Construction Monitoring and Sample Analysis	Lump Sum	$ 99,000	1	$ 99,000	$ 92,523	
Monthly Operating Expenses and Site Security	Month	$ 21,000	17	$ 357,000	$ 333,645	
			SUBTOTAL	$ 21,326,167	$ 19,930,997	
			25% Contingency	$ 5,331,542	$ 4,982,749	
			CONSTRUCTION GRAND TOTAL	$ 26,657,709	$ 24,913,746	
Professional and Technical Services						
Remedial Design (6%)	Lump Sum	$ 1,600,000	1	$ 1,600,000	$ 1,600,000	Year 0
Project Management and Permitting (5%)	Lump Sum	$ 1,330,000	1	$ 1,330,000	$ 1,242,991	Year 1
Construction Management (6%)	Lump Sum	$ 1,600,000	1	$ 1,600,000	$ 1,495,327	Year 1
			SUBTOTAL	$ 4,530,000	$ 4,338,318	
			TOTAL	**$ 31,188,000**	**$ 29,252,000**	

Notes:

All values are based on 2016 dollars with an assumed discount rate of 7 percent per year. See Appendix A for present value calculations.

Assumptions are based on professional judgment and experience of specialists at Bay West. Actual project costs will be highly dependent upon final design.

Table 7

Cost Estimate - Alternative 5: Dredge Open Water Areas/Enhanced MNR with Thin-Layer Cover in Wetland Areas

Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Description	Unit	Estimated Unit Cost	Estimated Quantity	Extended Value	Present Value	Comments
Construction Costs						
Mobilization/Demobilization	Lump Sum	$ 214,000	1	$ 214,000	$ 200,000	All construction occurs on Year 1
Site Work	Lump Sum	$ 796,000	1	$ 796,000	$ 743,925	
Rent Hallett Dock #7 for Staging Area	Month	$ 10,000	10	$ 100,000	$ 93,458	
Install and Remove Dolphin Pilings	Lump Sum	$ 95,000	1	$ 95,000	$ 88,785	
Mechanically Dredge Sediments and Pump to Staging Area	CY	$ 17.83	135741	$ 2,420,149	$ 2,261,821	Open water areas only
Turbidity Controls	Lump Sum	$ 30,000	1	$ 30,000	$ 28,037	
Treat Dredge Contact Water (per CY sediment removed)	CY	$ 50.00	135741	$ 6,787,050	$ 6,343,037	
Purchase Sand and Stockpile at Staging Area	CY	$ 20.80	32089	$ 667,449	$ 623,784	Wetland sand (95 percent of 6-inch cover by volume) and open water area sand (6 inches)
Purchase Amendment Materials and Stockpile at Staging Area	Ton	$ 3,000.00	461	$ 1,384,320	$ 1,293,757	Wetland areas only (5 percent of 6-inch cover by volume)
Load and Barge Materials Between Staging Area and Site	CY	$ 50.00	32550.31204	$ 1,627,516	$ 1,521,043	
Construct Cover in Wetland Areas	CY	$ 91.00	6647	$ 604,871	$ 565,300	6-inch amended cover
Construct Cover in Open Water Areas	CY	$ 32.07	25708	$ 824,507	$ 770,568	6 inches sand, no amendment
Excavate and Load Dewatered Sediments	CY	$ 6.90	135741	$ 936,703	$ 875,424	
Transportation and Disposal of Dewatered Sediments	Ton	$ 17.66	190037	$ 3,355,156	$ 3,135,659	
Construction Monitoring/CQA and Oversight (Labor/Equipment)	Week	$ 12,802.00	37	$ 473,674	$ 442,686	
Construction Monitoring and Sample Analysis	Lump Sum	$ 99,000.00	1	$ 99,000	$ 92,523	
Monthly Operating Expenses and Site Security	Month	$ 21,000.00	10	$ 210,000	$ 196,262	
Implement Institutional Controls	Lump Sum	$ 5,000.00	1	$ 5,000	$ 4,673	Site postings
			SUBTOTAL	$ 20,630,394	$ 19,280,742	
Long-Term Monitoring						
Monitoring and Evaluation Report	Each	$ 4,000	6	$ 24,000	$ 8,631	Every 5 years for 30 years
Field Sampling	Event	$ 34,000	6	$ 204,000	$ 73,366	Every 5 years for 30 years
Sample Analysis	Event	$ 37,082	6	$ 222,000	$ 80,016	Every 5 years for 30 years
			SUBTOTAL	$ 450,000	$ 162,013	
			TOTAL	$ 21,080,394	$ 19,442,755	
			25% Contingency	$ 5,270,099	$ 4,860,689	
			CONSTRUCTION GRAND TOTAL	$ 26,350,493	$ 24,303,444	
Professional and Technical Services						
Remedial Design (6%)	Lump Sum	$ 1,581,000	1	$ 1,581,000	$ 1,581,000	Year 0
Project Management and Permitting (5%)	Lump Sum	$ 1,318,000	1	$ 1,318,000	$ 1,231,776	Year 1
Construction Management (6%)	Lump Sum	$ 1,581,000	1	$ 1,581,000	$ 1,477,570	Year 1
			SUBTOTAL	$ 4,480,000	$ 4,290,346	
			TOTAL	**$ 30,830,000**	**$ 28,594,000**	

Notes:

All values are based on 2016 dollars with an assumed discount rate of 7 percent per year. See Appendix A for present value calculations.

Assumptions are based on professional judgment and experience of specialists at Bay West. Actual project costs will be highly dependent upon final design. 0.22014434

Table 8
Comparative Analysis Summary - Threshold, Balancing, and Modifying Criteria
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Evaluation Criteria	**Alternative 1: No Action**	**Alternative 2: Enhanced MNR with Broadcasted Amendment**	**Alternative 3: Enhanced MNR with Thin-Layer Amended Cover**	**Alternative 4: Dredging with Wetland Restoration**	**Alternative 5: Dredge Open Water Areas/Enhanced MNR with Thin-Layer Amended Cover in Wetland Areas**
Threshold Criteria					
Overall Protection of Human Health & Environment	Provides **no achievement** of protection of Human Health and the Environment as contaminant concentrations remain with minimal controls to prevent exposure.	Provides a **moderate achievement** of protection of Human Health and the Environment. Sediment contaminants would be reduced through addition of an amendment material and controlled by providing an amendment layer between contaminated sediments and the water column. May require monitoring to ensure effectiveness and future additions of amendment material.	Provides a **moderate achievement** of protection of Human Health and the Environment. Sediment contaminants would be reduced through addition of an amendment material and controlled by providing an amendment layer between contaminated sediments and the water column. May require monitoring to ensure effectiveness and future additions of amendment material.	Provides a **high achievement** of protection of Human Health and the Environment. Only residual contaminated sediment would remain in place; however, it is anticipated that the residual contamination will not exceed the RAOs.	Provides a **moderate to high** achievement of protection of Human Health and the Environment. Sediment contaminants would be reduced through addition of an amendment material and controlled by providing an amendment layer between contaminated sediments and the water column. Includes complete removal of sediments within a portion of the Site.
ARARs	Provides **no achievement** of ARARs since chemical-specific TBCs are not met for sediment. Location and action-specific ARAR s do not apply to this alternative.	Provides a **moderate achievement** of ARARs if implemented properly; however, COCs may not be reduced to concentrations less than RAOs in a reasonable time frame.	Provides a **moderate achievement** of ARARs if implemented properly; however, COCs may not be reduced to concentrations less than RAOs in a reasonable time frame.	Provides a **high achievement** of ARARs if implemented properly. Contaminants above the RAOs would be removed.	Provides a **moderate to high achievement** of ARARs if implemented properly; however, COCs may not be reduced to concentrations less than RAOs in a reasonable time frame.
Primary Balancing Criteria					
Long-term Effectiveness and Permanence	Provides **no achievement** of long-term effectiveness and remedy is not long-term effective or permanent.	Provides a **moderate achievement** of long-term effectiveness and permanence because sediment contaminants would eventually be sequesterd by amendment materials and rendered unavailable to biota within the most biologically active zone; however, sequestration of contaminants at deeper intervals may not occur and monitoring and possible reapplication of amendment material may be necessary as contaminants would remain in place.	Provides a **moderate achievement** of long-term effectiveness and permanence because sediment contaminants would eventually be sequesterd by amendment materials and rendered unavailable to biota within the most biologically active zone; however, sequestration of contaminants at deeper intervals may not occur and monitoring and possible reapplication of amendment material may be necessary as contaminants would remain in place.	Provides a **high achievement** of long-term effectiveness. Contaminated sediments would be permanently removed from the Site; however, contaminated sediments would be placed in a disposal facility requiring long-term O&M.	Provides a **moderate to high achievement** of long-term effectiveness and permanence because sediment contaminants would eventually be sequesterd by amendment materials and rendered unavailable to biota; however, sequestration of contaminants at deeper intervals may not occur and monitoring and possible reapplication of amendment material may be necessary as contaminants would remain in place. Contaminated sediments would be permanently removed from a portion of the Site.
Reduction of Toxicity, Mobility or Volume through Treatment	Provides a **low achievement** of this criterion as no reduction in toxicity, mobility, or volume is provided.	Provides a **moderate to high achievement** of this criterion as the toxicity and mobility of sediment contaminants would be reduced through addition of an amendment material near the sediment surface; however, it is possible that deeper sediment contamination could remain in place indefinitely.	Provides a **moderate to high achievement** of this criterion as the toxicity and mobility of sediment contaminants would be reduced through addition of an amendment material near the sediment surface; however, it is possible that deeper sediment contamination could remain in place indefinitely.	Provides a **low** achievement of this criterion as no reduction in toxicity, mobility, or volume is provided.	Provides a **moderate achievement** of this criterion as the toxicity and mobility of sediment contaminants would be reduced through addition of an amendment material near the sediment surface within a portion of the Site; however, it is possible that deeper sediment contamination could remain in place indefinitely.
Short-term effectiveness	Provides a **high achievement** of this criterion as no actions are implemented, so no risks to the community would result from remedy implementation; however, receptors would continue to be exposed to contaminated sediment.	Provides a **moderate to high achievement** of this criterion since cover placement would temporarily displace the benthic community. Risks to workers is low.	Provides a **moderate to high achievement** of this criterion since cover placement would temporarily displace the benthic community. Risks to workers is low.	Provides a **low to moderate achievement** of this criterion since dredging and removal of the PBAZ would take place across the entire remedial area. Risks to Site workers is moderate, but for a longer duration of time than Alternative 5.	Provides a **moderate achievement** of this criterion since dredging would remove the PBAZ in open water areas of the Site. No dredging would occur in wetland areas. Risks to workers is moderate.
Implementability	Provides a **high achievement** of this criterion as no actions would be implemented.	Provides a **moderate to high achievement** of implementability since it only requires placement of cover material using proven methods with a low to moderate level of complexity.	Provides a **moderate to high achievement** of implementability since it only requires placement of cover material using proven methods with a low to moderate level of complexity.	Provides a **moderate achievement** of implementability since it requires a large amount of dredging and staging coordination.	Provides a **moderate achievement** of implementability since it requires a large amount of dredging and staging coordination.
Cost (1)	$0	$6,834,000	$13,878,000	$29,252,000	$28,594,000
Modifying Criteria					
State Support / Agency Acceptance	TBD	TBD	TBD	TBD	TBD
Community Acceptance	TBD	TBD	TBD	TBD	TBD

Notes

(1) Cost are presented as Present Value.

M = Million

** Not included in numerical comparison on (Table 5-2).*

TBD = To Be Determined

Table 9
Comparative Analysis Summary - Green Sustainable Remediation Criteria
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Evaluation Criteria	**Alternative 1: No Action**	**Alternative 2: Enhanced MNR with Broadcasted Amendment**	**Alternative 3: Enhanced MNR with Thin-Layer Amended Cover**	**Alternative 4: Dredging with Wetland Restoration**	**Alternative 5: Dredge Open Water Areas/Enhanced MNR with Thin-Layer Amended Cover in Wetland Areas**
Threshold Criteria					
Green House Gas (GHG) Emissions	None.	Total GHG emissions produced during cover material delivery and placment and equipment mobilization related to sampling activities.	Total GHG emissions produced during cover material delivery and placment and equipment mobilization related to sampling activities.	Total GHG emissions produced during mob/demob activities, cover material delivery and placement, dredging, and mobilization related to sampling activities.	Total GHG emissions produced during mob/demob activities, cover material delivery and placement, dredging, and mobilization related to sampling activities.
Toxic Chemical Usage and Disposal	None.	No toxic chemicals are used or disposed.	No toxic chemicals are used or disposed.	No toxic chemicals are used or disposed.	No toxic chemicals are used or disposed.
Energy Consumption	None.	Fossil fuels are limited to the equipment mobilization for sampling activities and cover placement operations.	Fossil fuels are limited to the equipment mobilization for sampling activities and cover placement operations.	Fossil fuels are limited to mob/demob activities, cover material delivery and placement, dredging, and mobilization related to sampling activities.	Fossil fuels are limited to mob/demob activities, cover material delivery and placement, dredging, and mobilization related to sampling activities.
Use of Alternative Fuels	None.	Alternative fuels could be used to run heavy construction equipment.	Alternative fuels could be used to run heavy construction equipment.	Alternative fuels could be used to run heavy construction equipment.	Alternative fuels could be used to run heavy construction equipment.
Water Consumption	None.	No water consumption is necessary.	Little water consumption is necessary.	Little water consumption is necessary.	Little water consumption is necessary.
Waste Generation	None.	No waste generation.	No waste generation.	Contaminated sediments, dewatering pad materials, media	Contaminated sediments, dewatering pad materials, media
GSR Criteria Summary	Provides a **high achievement** of the GSR criterion.	Provides a **moderate to high achievement** of the GSR criterion.	Provides a **moderate to high achievement** of the GSR criterion.	Provides a **low achievement** of the GSR criterion.	Provides a **low achievement** of the GSR criterion.

Notes
(1) Cost are presented as Present Value.
M = Million
** Not included in numerical comparison on (Table 5-2).*
TBD = To Be Determined

Table 10
Numerical Comparative Analysis Summary
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Enhanced MNR with Broadcasted Amendment	Alternative 3: Enhanced MNR with Thin-Layer Amended Cover	Alternative 4: Dredging with Wetland Restoration	Alternative 5: Dredge Open Water Areas/Enhanced MNR with Thin-Layer Amended Cover in Wetland Areas
Overall Protection of Human Health & Environment	0	2	2	3	2.5
ARARs	0	2	2	3	2.5
Long-term Effectiveness and Permanence	0	2	2	3	2.5
Reduction of Toxicity, Mobility or Volume through Treatment	1	2.5	2.5	1	2
Short-term effectiveness	3	2.5	2.5	1.5	2
Implementability	3	2.5	2.5	2	2
Cost (1)	3	3	2.5	0.5	1
State Support / Agency Acceptance	TBD	TBD	TBD	TBD	TBD
Community Acceptance	TBD	TBD	TBD	TBD	TBD
Total Numerical Value	**10**	**16.5**	**16**	**14**	**14.5**

Notes

(1) Cost are presented as Present Value.

Ratings are based on achievement of criterion: no achievement, low achievement; moderate achievement; and high achievement.

Scores are based on 0 = no achievement; 1 = low achievement; 2 = moderate achievement; and 3 = high achievement.

Scoring for cost are based on the following cost breakpoints: > $ 20 million = low achievement; $5-20 Million = moderate achievement; and < $5 million = high achievement.

GSR criteria not included in this numerical comparison.

See Table 6 for a discussion of each criterion.

Appendix A

2017 Mud Lake West Technical Memorandum

Final
Mud Lake West Technical Memorandum

Mud Lake West
Duluth, Minnesota

June 2017

Final
Mud Lake West Technical Memorandum

Mud Lake West
Duluth, Minnesota

June 2017

CLEAN
WATER
LAND &
LEGACY
AMENDMENT

Prepared for:

Minnesota Pollution
Control Agency

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St. Paul, Minnesota 55155

Prepared by:

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Customer-Focused Environmental & Industrial Solutions

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Acronyms and Abbreviations

%	percent
µg/kg	micrograms per kilogram
amsl	above mean sea level
AOC	Area of Concern
ASTM	American Society for Testing and Materials
BARR	Barr Engineering Company
Bay West	Bay West LLC
BAZ	bioactive zone
bss	below sediment surface
BUI	beneficial use impairments
CAC	Citizen Advisory Committee
CoC	chain of custody
COC	contaminants of concern
COI	Constituent of Interest
CSM	conceptual site model
DM&IR	Duluth Missabe & Iron Range Railway
DPT	direct push technology
DQO	data quality objectives
DRO	diesel-range organics
EDL	estimation detection limit
ELAP	Environmental Laboratory Accreditation Program
ESB	Equilibrium Partitioning Sediment Benchmarks
FS	feasibility study
FSP	Field Sampling Plan
GC/MS	gas chromatograph/mass spectrometer
GPR	ground penetrating radar
GPS	Global Positioning System
GRO	gasoline-range organics
HH	human health
ID	identification
IDW	investigation derived waste
IGLD 85	International Great Lakes Datum of 1985
IJC	International Joint Commission
KM	Kaplan Meier
LCS	laboratory control sample
LCSD	laboratory control sample duplicates
LDB	left descending bank
LWD	low water datum
MDH	Minnesota Department of Health
MDL	method detection limit
mg/kg	milligrams per kilogram
MLE	Mud Lake East
MLW	Mud Lake West
mm	millimeters
MPCA	Minnesota Pollution Control Agency
MS	matrix spike
MS/MSD	matrix spike/matrix spike duplicate
MSD	matrix spike duplicate
msl	mean sea level
NCDC	National Climatic Data Center
NE	not established
ng	nanograms
NOS	National Ocean Service
NPDES	National Pollutant Discharge Elimination System
Pace	Pace Analytical Services, Inc.
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD/F	polychlorinated dibenzo-p-dioxins/dibenzo furans
PEC	probable effects concentration
PEC-Q	probable effect concentration quotient
PHC	Public Health Consultation
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROW	right of way
SAA	Sediment Assessment Area
SLR	St. Louis River
SLRCAC	St. Louis River Citizen Advisory Committee
SOMAT	SOMAT Engineering
SOP	standard operating procedure
SQG	Sediment Quality Guidelines
SQT	Sediment Quality Target
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TEQ	toxicity equivalent
TEQ/kg	toxicity equivalent per kilogram
TOC	total organic carbon
U.S.	United States
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	volatile organic compound
WDNR	Wisconsin Department of Natural Resources
WHO	World Health Organization

1.0 INTRODUCTION

Bay West LLC (Bay West) has completed a Technical Memorandum to support the Mud Lake West (MLW), also designated as SAA #83 (the Site), Sediment Remedial Investigation Report completed in April 2016 (2016 RI) and the MLW Focused Feasibility Study (FFS), completed in June 2016 by Bay West under contract with the Minnesota Pollution Control Agency (MPCA). The FFS will be updated with the results from this investigation; resulting in a Final 2017 FFS. Limited field activities were conducted as part of ongoing work to investigate the extent and volume of contaminated sediment within MLW, and to evaluate risks to human health and the environment due to potential impacts to the benthic community. A site location map is included as **Figure 1**, and a site map is included as **Figure 2**.

This Technical Memorandum describes investigation field activities conducted during the mobilization event that occurred in October of 2016, presents chemical, physical, bioaccumulation, and toxicity site data collected during this event, discusses data results, conclusions, and presents recommendations. This Technical Memorandum is intended to be a supplement to the 2016 RI and FFS; therefore, only data from the October 2016 investigation will be presented in this document.

1.1 Purpose and Objectives

Historical sediment contamination in the St. Louis River Area of Concern (SLR AOC) has resulted in impaired uses, including degradation of bottom-feeding invertebrate communities, increased incidence of fish tumors and other abnormalities, fish consumption advisories, and restrictions on dredging, resulting in nine beneficial use impairments (BUIs; MPCA, 2008). BUIs are a change in the chemical, physical or biological integrity of the Great Lakes system sufficient to cause any one of the 14 established use impairments, or other related uses, such as the microbial objective for waters used for body contact recreational activities (2013 Joint Commission). The MPCA and WDNR are currently working together to implement a comprehensive long-term plan to restore beneficial use and delist BUIs in the SLR AOC. Many of the BUIs in the AOC are linked to the presence of sediment contaminants. Some sediment-derived contaminants also appear suspended in the water column and are carried by the river to Lake Superior.

The purpose of this Technical Memorandum was to collect new and supplement existing information gathered during the 2016 RI regarding sediment quality at the Site, including chemical, bioaccumulation, toxicity, and physical site data. Data collected will ultimately be used to develop a course for remedial action, if needed, to restore and delist the Site BUIs.

Specific objectives for the October 2016 investigation are to:

- Provide site-specific information regarding benthic organisms and the toxicity of the contaminants of concern (COCs; i.e., nickel, zinc, and dioxins/furans as defined within the FFS) to benthic organisms.
- Conduct limited benthic macroinvertebrate community assessments to assess the "health" of the benthic community at locations with elevated COC concentrations and to provide an additional line of evidence regarding contaminant impacts at the Site using the sediment quality triad approach.
- Collect and analyze sediment samples for Site COCs to corroborate findings of toxicity and bioaccumulation testing and to further define the vertical extent of contamination at the Site.
- Refine the 2016 RI conceptual site model (CSM) that evaluates contaminant fate and transport, and provides a comparison between SLR AOC-specific risk-based screening

values and existing conditions to identify unacceptable risks to human health and/or the environment.

1.2 Report Organization

Section 1.0 – Introduction – This section provides a brief overview of the Saint Louis River AOC, MLW, and summarizes previous investigations and COIs relative to the Site.

Section 2.0 – Field Activities and Methods – This section describes the field activities and methods utilized.

Section 3.0 – Summary of Results – This section summarizes the results of the data collection, including chemical and physical site data.

Section 4.0 – Data Quality Review – This section describes the data quality review process and the results of quality assurance (QA)/quality control (QC) review of chemical data.

Section 5.0 – Discussion – This section discusses the results and conclusions.

Section 6.0 – References– This presents references for the report.

1.3 Site Setting

This document serves as a supplement to the 2016 RI, which provides a full description of the site settings and history.

1.4 Investigation History and COIs

Numerous investigations of sediment quality have occurred at the Site, resulting in various report documents, which have been summarized in the 2016 RI. Prior to reading this document, a review of the 2016 RI should be completed to provide a better understanding of the Site history. Those investigations and reports not summarized in the 2016 RI are summarized as follows.

Data Gap Investigation Field Sampling Plan (FSP) Field Sampling Plan, Mud Lake West, prepared by Bay West, October 2016 (FSP)

The FSP was completed to provide sampling protocol to collect new data regarding toxic and bioaccumulative effects of Site sediments on benthic organisms and to assist in determining the relationship between SQT exceedances and observed toxicity at the Site. To assess the benthic macroinvertebrate community “health” at locations with elevated COC concentrations and to provide additional lines of evidence regarding contaminant impacts at the Site using the sediment quality triad approach. Finally, sediment samples were collected and analyzed for Site COCs to corroborate findings of toxicity and bioaccumulation testing and to further define the vertical extent of contamination at the Site.

Focused Feasibility Study (FFS), Mud Lake West, prepared by Bay West, June 2016

Nickel, zinc, and dioxins/furans were carried forward as Site COCs within the FFS. The FFS identified five remedial action alternatives which were developed to meet remedial action objectives (RAOs) for the Site. A comparative analysis of the alternatives presented in the FFS identified Alternative 2: Enhanced Natural Recovery (EMNR) with Broadcasted Amendment and Alternative 3: EMNR with Thin Layer Amended Cover as viable alternatives to be implemented at the Site. However, the FFS recommends additional studies to determine the most appropriate design alternative including: Complete pilot scale amendment testing to determine the most appropriate amendment and amendment application rates for the site, complete a physical sediment characteristic assessment to aid in designing remedial actions at the Site, and evaluate a potential dewatering area near the Site, should Alternative 4 or 5 be selected.

2.0 FIELD ACTIVITIES AND METHODS

Sampling activities and procedures were conducted in accordance with the October 2016 MLW Site-Specific Data Gap Investigation Field Sampling Plan (FSP), the 2014 Bay West Quality Assurance Project Plan (QAPP) for the RI at the SLR Areas of Concern, and applicable Bay West standard operating procedures (SOPs). The following section describes applicable physical site data, sediment sampling and procedure, and analytical results evaluation procedure used in the October 2016 investigation.

All sample locations were pre-determined and aerial background maps were loaded onto a Trimble Global Positioning System (GPS) unit with sub-meter accuracy prior to site mobilization. The GPS was used to navigate as close to the pre-determined sample locations as possible, and GPS locational data was also collected at each of the sampled locations

2.1 Sediment Sampling Overview

October 4, 2016 Bay West conducted a field sampling event within MLW. In total, 3 bulk sediment samples were collected from surface sediment for toxicity and bioaccumulation testing, community assessment, and physical and chemical analysis. These samples were collected from locations BW16MLW-001 through BW16MLW-003.

Deep interval sediment samples were collected for physical and chemical analysis at the following locations: BW16MLW-005 through BW16MLW-010. No sample was collected from BW16MLW-004, this location was inaccessible due to its location in the marsh. The following sections contain additional information on the sampling event, and the methods, procedures, and equipment used during sediment sample collection, if not already covered in the FFS or FSP. Sample locations are shown on Figure 3.

2.1.1 Ponar Equipment Description and Procedure.

All surface sediment samples were collected using a Wildco Petite Ponar grab sampler (ponar). The ponar was used to collect sediments from the sediment/water interface for submission as a toxicity/bioaccumulation testing media, for benthic community assessments, and for physical and chemical analysis.

The ponar has a maximum sediment penetration depth of 2.75 inches (0.07 meter) and a total jaw volume of 2.4 liters. Due to the small size of the sampler, multiple “grabs” of sediment were performed at each location to collect a sufficient volume of sediment for testing/analysis (up to 5 gallons of sediment per location). After each grab of sediment, the team repositioned the sampler so that the next grab was collected approximately 0.25 – 0.50 meter away from the previous grab. This method of sediment collection was repeated to ensure that the final composite samples were representative of a single in-situ sediment elevation (i.e., 0 – 0.07 meter).

Collected sediment was transferred directly from the ponar into clean, laboratory supplied, 5-gallon buckets. Once a sufficient volume of sediment had been collected, overlying water was decanted and the sediment was thoroughly homogenized within the buckets. A sub-sample was then collected and placed within Ziploc-type bags (double bagged) for grain size analysis.

2.1.2 Russian Peat Borer Equipment Description and Procedure

A Russian peat borer was used to collect deep sediment samples. The Russian peat borer is described in the 2016 RI Report along with associated sampling procedures utilized in the field. Specific sampling procedure utilized during the October sampling event is described as follows.

Once the boat was anchored above the sample location, the water depth was recorded and electrical tape used to mark out the desired length of each push. For instance, if water depth was recorded at 1.0 meter, electrical tape was used to mark distances of 3.0 meters on the sampler's extension rods, as measured from the bottom of the side filling chamber.

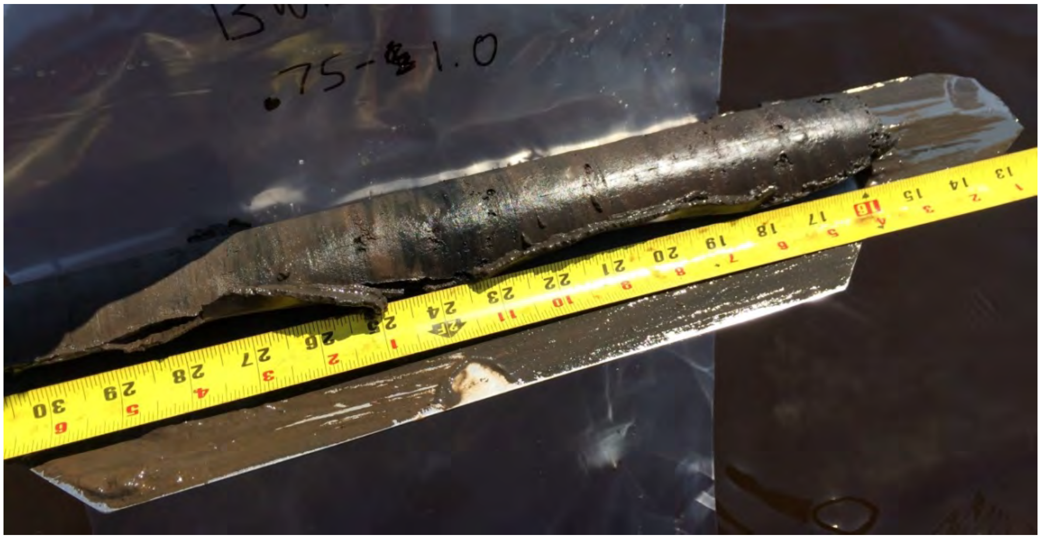

Photo showing discrete sample collected with Russian Peat Borer.

Deep interval sediment samples were collected using the Russian Peat Borer from varied depths depending on the location and the depth of refusal. To collect the deep interval samples, the sampler was advanced into the sediment until the mark reached the water's surface, indicating that the sampler had been advanced a distance of 2.0 meters into the sediment. The "T" handle was then turned to collect the sample, and the sampler retrieved. The sampler was laid horizontal within the boat and the side filling chamber was opened. The sample was then retrieved from the bottommost 0.25 meter. All samples were placed directly into separate Ziploc bags and labeled with identifying information, and later stored on ice until they could be processed.

2.1.3 Equipment Decontamination

After each grab or coring attempt, all materials in contact with sediments were washed with lake water to remove visible sediments (i.e., Wildco Petite Ponar and chamber of Russian Peat Borer). After each sample location, sampling equipment was decontaminated using Alconox, water and a stiff bristled brush.

2.2 Ex Situ Benthic Macroinvertebrate Tissue Sampling Overview

Sediment was also collected for the purpose of performing laboratory controlled 28-day (28-d) Lumbriculus variegatus bioaccumulation testing. These samples will be referred to as "ex situ" tissue samples. Sediment was collected using the Ponar grab sampler and stored in laboratory supplied buckets. The sediment was submitted to the laboratory for bioaccumulation analysis, and chemical and physical analysis. Sediment for ex situ analysis was collected at BW16MLW-001, BW16MLW-002, and BW16MLW-003.

2.3 Community Assessment Equipment Description and Procedure

Community assessments were completed by collecting approximately three ponar grabs of sediment from each sample location. The sediment was sieved through a 425-micron (35 mesh) screen. All material captured on the screen was placed into white plastic trays with fresh, cool water. Benthic organisms were removed from the tray, separated by organism type, and placed into smaller ice cube trays.

Photo showing a community assessment in progress.

Search and removal of organisms from each plastic tray took place for 15 minutes to retain consistency across all sample locations. A count of each species identified was recorded on community assessment worksheets, a field notebook, or an electronic log. Benthic organisms were released back into the water once assessments were complete. Additional information regarding benthic community assessments is included in the Bay West Site-Specific Benthic Macroinvertebrate Community Assessment SOP found in the FSP, and as an appendix to the QAPP addendum. Sediment for community assessments was collected at BW16MLW-001, BW16MLW-002, and BW16MLW-003.

2.4 Sample Processing

Collected sediment was brought back to shore for processing for submittal to a laboratory as a media during toxicity and bioaccumulation testing, for physical and chemical analysis, and for community assessment. Sediment to be used as media and for physical and chemical analysis from each location either remained in the 5-gallon bucket or was transferred into the appropriate laboratory supplied containers, dependent on sampling parameters for that particular sample location. Once a sample was collected and the container sealed, the container (not the lid) was labeled with the sample location ID, sample date, and time of collection using an indelible ink marker.

Sediment samples were processed and submitted for chemical analysis in accordance with the approved site-specific FSPs.

All sample processing was conducted following the sampling event. The following activities were conducted during sample processing:

- Sample collection information (e.g., location ID, sample time, water depth, push, recovery, interval depth, etc.) was transferred from each 5-gallon bucket or Ziploc bag to Bay West's Sediment Sampling Log Sheet;
- Each sample was photographed during field sampling or during processing;
- Visual and physical observations of the sample were recorded on the log sheet in accordance with the site-specific FSPs following the American Society for Testing and

Materials (ASTM) D 2488 and the United States Department of Agriculture (USDA) descriptor classification, including sample color, material composition, grain size, firmness, cohesiveness, odor, and any other notable observations such as sheen.

- Analytical sample intervals were determined for core samples in accordance with the site-specific FSPs;
- Sample material was placed in appropriate laboratory-supplied containers, labeled, and placed on ice for delivery to either Pace Analytical Services, Inc. (Pace), Axys, or Great Lakes Environmental Center, Inc. (GLEC); and
- All reusable sampling tools used for homogenization or other purposes were decontaminated after processing in a solution of Alconox and distilled water using the procedures described in **Section 2.4**.

2.4.1 Sample Collection and Analysis

2.4.1.1 Sediment Physical/Chemical Analysis

Samples for Vertical Delineation of Site Contaminants

Sediment samples from BW16MLW-005 through BW16MLW-010 were collected to gather additional vertical sediment chemical data using a Russian Peat Borer sampler as detailed in **Section 2.1.2**.

Samples collected for vertical delineation of contamination were submitted to the following laboratories using the following methods:

- Dioxins/furans as congeners (Pace, United States Environmental Protection Agency [USEPA] 8290A);
- Nickel and zinc (Pace, USEPA 6020A); and
- TOC (Pace, USEPA 9060A).

Four of the six samples were submitted for the following:

- Grain size (Pace, ASTM D422 with hydrometer).

All samples were collected, prepared, and handled in accordance with the FSP, project QAPP and QAPP addendum, and Bay West SOPs.

The specific analysis for each sample is detailed in **Table 1**. Each sample was accounted for on the chain of custody (CoC) completed during sample processing. All samples were stored on ice and delivered to the appropriate laboratory.

QC samples collected by the processing team consisted of duplicates and matrix spike/matrix spike duplicates (MS/MSDs). Field duplicates and matrix MS/MSD samples were collected for sediments at a frequency of 10 percent (%) and 5%, respectively, for dioxins/furans, nickel, and zinc. No duplicate or MS/MSD sample was collected for TOC or grain size analysis. Field equipment rinsate blanks were collected at a frequency of 1 per day for each day the ponar sampler was used and analyzed for nickel and zinc. No duplicates or MS/MSD samples were collected in relation to benthic tissue analysis due to constraints in available tissue mass and project budget.

2.4.1.2 Community Assessments

Site benthic macroinvertebrates were collected from locations BW16MLW-001, BW16MLW-002, and BW16MLW-003, for community assessments. Community assessments were completed as described in **Section 2.3** and the community assessment findings are discussed in **Section 3.5**.

2.4.1.3 Toxicity & Bioaccumulation Testing

Site sediments from locations BW16MLW-001 through BW16MLW-003 were collected for in situ toxicity and bioaccumulation testing as outlined in the FSP. Sediments were contained within and delivered to the GLEC Laboratory in laboratory-supplied containers. The specific analysis for each sample is detailed in **Table 1**.

The GLEC laboratory conducted the following tests:

- 10-d *Chironomus tentans* toxicity testing (USEPA Method 100.2 and laboratory SOP);
- 28-d *Hyalella azteca* toxicity testing (USEPA Method 100.1 and laboratory SOP); and
- 28-d *Lumbriculus variegatus* bioaccumulation testing (USEPA Method 100.3 and laboratory SOP).

Following the 28-d *Lumbriculus variegatus* bioaccumulation testing, *Lumbriculus variegatus* tissue was extracted from the sediment substrate by GLEC. Subsamples from the sediment samples and *Lumbriculus variegatus* tissue samples were submitted by GLEC to the following laboratories using the following methods:

- Tissue Analysis - Dioxins/furans as congeners and lipids content (Axys Analytical, USEPA 1613B or 8290A);
- Sediment Analysis - Dioxins/furans as congeners (Pace, USEPA 1613B or 8290A);
- Tissue and Sediment Analysis - Nickel (Pace; USEPA method such as 6020A);
- Tissue and Sediment Analysis - Zinc (Pace, USEPA method such as 6020A);
- Sediment Analysis - TOC (Pace; USEPA method such as 9060A); and
- Sediment Analysis - Grain size (Pace, ASTM D422 with hydrometer).

Toxicity and bioaccumulation testing samples were collected, prepared, and handled in accordance with the laboratory's SOPs on collection and handling of environmental samples. For a detailed description of toxicity and bioaccumulation testing, procedures, and results see the December 16, 2016, GLEC Draft Report: Results for the 10-day *Chironomus dilutus*, 28-day *Hyalella azteca*, and the 28-day *Lumbriculus variegatus* Whole Sediment Toxicity Testing, Bay West LLC; Mud Lake West-St. Louis River AOC Project (GLEC Report) in **Appendix B**.

2.4.2 Rinsate Blanks

Rinsate blank samples were collected by pouring distilled water over non-disposable sampling equipment and into bottles provided by the analytical laboratory to verify proper decontamination of sampling equipment. Two rinsate blanks were collected for Mud Lake West sampling. One was collected from the ponar and one was collected from the Russian Peat Borer to verify proper decontamination of sampling equipment. The rinsate blanks were labeled BW16-RB01-100416 and BW16-RB02-100516 and analyzed for mercury. Mercury was not detected at concentrations exceeding the laboratory reporting limit for both rinsate blanks.

2.4.3 Waste Characterization and Disposal

IDW consisting of excess sediment and disposable sampling supplies was placed in two 55-gallon steel drums along with the investigation-derived waste (IDW) generated during the sampling event and two additional sampling events completed at Thomson and Scanlon Reservoirs. A total of two drums of waste were generated during the three sampling events. An IDW sample was collected from the drums at the completion of the sampling and submitted for analysis of landfill disposal parameters. The drums were transported to Bay West, under MPCA approval, and stored until IDW sample results were obtained. All IDW was characterized as non-hazardous waste and disposed of by Veolia ES Technical Solutions. Disposal documentation is included in **Appendix C**.

2.5 Data Interpretation

2.5.1 Treatment of Non-Detect Data

Scaling censored (non-detected) data was performed for dioxin/furan toxic equivalents (TEQ) calculations for sediment and tissue with the goal of eliminating false positives and false negatives from the final data set.

For sediment and tissue, the dioxin/furan data was input into a USEPA TEQ Kaplan Meier (KM) calculator which includes calculations that support a simple, quasi-sensitivity analysis that examines the effect of various ways of handling non-detect or rejected (R-flagged) analytical data results within a sample's congener profile. The TEQ KM Calculator utilized 1998 World Health Organization (WHO) toxicity equivalence factors (TEFs) for fish (TEQ KM Fish value). The calculator was used to determine the TEQ KM Fish value for dioxin/furan sediment analysis, as described in the 2016 RI Report.

2.5.2 Sediment Quality Targets (SQTs)

Numerical SQTs adopted for use in the SLR AOC to protect benthic invertebrates can be used throughout Minnesota as benchmark values for making comparisons to sediment chemistry measurements. Level 1 and Level 2 SQTs for the protection of sediment-dwelling organisms are available for 8 trace metals, 13 individual polycyclic aromatic hydrocarbons (PAHs), total PAHs (all 13 priority PAHs), total polychlorinated biphenyls (PCBs), and 10 organochlorine pesticides. In addition, Level 1 and Level 2 SQTs for COCs were adopted for the protection of fish, as insufficient information is available for sediment-dwelling organisms. SQTs are highly useful when evaluating risk for a specific compound or a group of compounds (i.e., total PCBs and total PAHs).

Contaminant concentrations below the Level 1 SQTs are unlikely to have harmful effects on sediment-dwelling organisms (i.e., benthic invertebrates). Contaminant concentrations above the Level 2 SQTS are more likely to result in harmful effects to benthic invertebrates (MPCA, 2007). Based on conversations with the MPCA, a qualitative comparison value midway between the Level 1 SQTs and Level 2 SQTs (i.e., midpoint SQT) will be used as conservative criteria to identify, rank, and prioritize sediment-associated contaminants within the Site.

2.5.3 Data Qualifiers

Routine analytical laboratory procedures involve evaluation and quantitation of concentrations at levels below the stated reporting limits, but greater than the stated method detection limit (MDL) or estimation detection limit (EDL; for dioxins). In these cases, data are qualified with a “J.” All estimated concentrations were reported as detects for the purposes of summations, calculations and risk-screening evaluation.

2.5.4 Sample Interval Categorization

Sediment samples were collected from horizons (A, B, and C) within the sediment core, in accordance with the FSP. Horizons were determined by core length, recovery, and the observation of anthropogenic materials, such as sheens, staining, or non-native debris. Because of varying core lengths and recovery, sediment sample collection depth was not consistent between sample locations. In order to spatially evaluate analytical results and sediment screening criteria comparisons between sample locations, sediment samples were categorized into depth intervals. Sediment intervals and the methods for categorizing sediment samples into intervals were determined through discussions with the MPCA. Sediment samples were categorized into four intervals based on the depth of collection. The intervals focus on the stratigraphy of contamination within the bioactive zone (BAZ), which is assumed to be the upper meter of sediment. The intervals are as follows:

- 0.0 to 0.15 meter;
- 0.15 to 0.50 meter;
- 0.50 to 1.00 meter; and
- >1.0 meter.

Each sediment sample was categorized into one of the three intervals if at least 25% of the sample length was within an interval. For example, if a sample was collected from 0.30 to 0.55 meter below the sediment surface, the sample would be categorized in the 0.15- to 0.50-meter category. Occasionally, 25% of a sample was collected within two intervals. For example, if a sample was collected from 0.64 to 1.15 meters, 71% of the upper portion of the sample is within the 0.50- to 1.00-meter interval, and 29% of the lower portion of the sample is within the >1.00-meter interval. In these cases, the sample was considered in the discussion and evaluation of both the 0.5- to 1.00-meter interval and the >1.00-meter interval.

2.6 Sediment Quality Guidelines

Consensus-based SQGs, community assessment comparison/evaluation procedures, and chemical comparison/evaluation procedures are discussed in detail in the 2016 RI Report and the FSP.

3.0 SUMMARY OF RESULTS

This section summarizes the results obtained from field activities.

3.1 Sample Depth and Sediment Recovery

The sampling objective at the Site, as outlined within the FSP, was to collect surface sediment samples and deep sediment samples.

As stated in **Section 2.1.1.1**, surface sediment samples were collected using a Wildco Petite Ponar grab sampler and Jon boat. Grab sample recovery was a 100%.

As stated in **Section 2.1.1.2**, deep sediment samples were collected using a Russian Peat Borer sampler and Jon boat. The sampler was advanced from the sediment surface to a depth of at least 1 meter bss at all locations. Refusal was encountered at four of the six locations sampled. Refusal appeared to be due to a clay layer encountered below 1.85 meter bss, creating increased resistance as the sampler was advanced. The average sediment recovery was approximately 80%, achieving sediment recovery goals for the Site.

Completed sediment collection logs and photographs of sediment prior to processing are included in **Appendix A**. **Table 2** through **Table 4** provide a summary of sample locations, water depths, sediment elevations, type of sample collected, analytical parameters, and number of samples from each location.

3.2 Sediment Chemistry Data

The following discussion presents the summarized analytical results from 9 samples obtained from 9 locations collected during the October 2016 sampling event at the Site.

Table 1 provides a summary of sediment samples and laboratory analyses selected for each sample. Analytical results are presented in **Table 7** and **Table 8**, and laboratory analytical reports are included in **Appendix D**. The following sections present a summary of analytical results.

3.2.1 Metals (Sediment)

Sediment samples were analyzed for nickel and zinc and results for the samples were screened against their respective SQT values. **Table 7** presents the detailed analytical results for nickel and zinc. The following sections summarize the analytical results and screening criteria comparisons for each metal analyte with respect to the following depth intervals: 0.0 to 0.15 meters, 0.15 to 0.5 meters, 0.5 to 1.0 meters, and >1.0 meter. An explanation of sample interval calculations can be found in the 2016 RI Report. **Figures 4** through **5** present analytical results for nickel and zinc, respectively, at distinct intervals compared to their respective SQTs.

3.2.1.1 Nickel

Analytical results for nickel were compared to the respective SQTs. The following table summarizes the results for nickel.

Sample Name	Sample Interval (meters)	Result (mg/kg)
BW16MLW-001-0.0-0.15	0.0-0.15	32.5
BW16MLW-002-0.0-0.15	0.0-0.15	40
BW16MLW-003-0.0-0.15	0.0-0.15	50.6
BW16MLW-005-0.90-1.15[1]	0.5-1.0 and >1.0	62
BW16MLW-006-1.75-2.0	>1.0	39
BW16MLW-007-1.6-1.85	>1.0	28.4

Sample Name	Sample Interval (meters)	Result (mg/kg)
BW16MLW-008-1.15-1.40	>1.0	38.7
BW16MLW-009-1.75-2.0	>1.0	13.5
BW16MLW-010-1.45-1.70	>1.0	17.1

Notes:
*[1] 25% of the sample was collected within two intervals, the sample was evaluated for both intervals, as described in **Section 2.5.4**.*
SQT – Sediment Quality Target
Values highlighted in yellow indicate concentration exceeding SQT Level I (23 mg/kg)
Values highlighted in orange indicate concentration exceeding the midpoint between SQT Level I and SQT Level II (36 mg/kg)
Values highlighted in red indicate concentration exceeding SQT Level II (49 mg/kg)

Level 1 SQT exceedances occurred in sample BML16MLW-001 and BML16MLW-007. SQT Midpoint was exceeded in sample BML16MLW-002, BML16MLW-006, and BML16MLW-008. Level 2 SQT was exceeded in sample BML16MLW-003 and BML16MLW-005. The maximum concentration of nickel (62 mg/kg) was identified at location BML16MLW-005.

3.2.1.2 Zinc

Analytical results for zinc were compared to the respective SQTs. The following table summarizes the results for zinc.

Sample Name	Sample Interval (meters)	Result (mg/kg)	Results Qualifier
BW16MLW-001-0.0-0.15	0.0-0.15	165	
BW16MLW-002-0.0-0.15	0.0-0.15	185	
BW16MLW-003-0.0-0.15	0.0-0.15	328	
BW16MLW-005-0.90-1.15[1]	0.5-1.0 and >1.0	176	
BW16MLW-006-1.75-2.0	>1.0	108	
BW16MLW-007-1.6-1.85	>1.0	84.5	
BW16MLW-008-1.15-1.40	>1.0	67.3	
BW16MLW-009-1.75-2.0	>1.0	27.4	J
BW16MLW-010-1.45-1.70	>1.0	30.9	J

Notes:
*[1] 25% of the sample was collected within two intervals, the sample was evaluated for both intervals, as described in **Section 2.5.4**.*
J – estimated value
SQT – Sediment Quality Target
Values highlighted in yellow indicate concentration exceeding SQT Level I (120 mg/kg)
Values highlighted in orange indicate concentration exceeding the midpoint between SQT Level I and SQT Level II (290 mg/kg)
Values highlighted in red indicate concentration exceeding SQT Level II (460 mg/kg)

Level 1 SQT exceedances occurred in sample BML16MLW-001, BML16MLW-002, and BML16MLW-005. SQT Midpoint was exceeded in sample BML16MLW-003. No sample exceeded the Level II SQT. The maximum concentration of zinc (328 mg/kg) was identified at location BML16MLW-003.

3.2.1.3 Dioxins/Furans

The following tables summarize the TEQ KM Fish results for Site sediment samples, calculated as described in the 2016 RI Report and compared to their respective SQTs.

Table 8 presents a complete table of Site dioxins/furans results. When estimated values were reported by the laboratory, those values were used. All other dioxin/furans results were handled as outlined in 2016 RI Report, when calculating the TEQ KM Fish values.

Analytical results were evaluated for the following depth intervals: 0.0 to 0.15 meters, 0.15 to 0.5 meters, 0.5 to 1.0 meters, and <1.0 meter. An explanation of sample interval calculations can be found in the 2016 RI Report. **Figures 6** presents TEQ KM Fish SQT results.

Sample Name	Sample Interval (meters)	Results[1]	Result Qualifier
BW16MLW-001-0.0-0.15	0.0-0.15	25.7	
BW16MLW-002-0.0-0.15	0.0-0.15	23.9	
BW16MLW-003-0.0-0.15	0.0-0.15	50.6	
BW16MLW-005-0.90-1.15[2]	0.5-1.0 and >1.0	0.93	J
BW16MLW-006-1.75-2.0	>1.0	4.72	J
BW16MLW-007-1.6-1.85	>1.0	9.33	J
BW16MLW-008-1.15-1.40	>1.0	1.41	J
BW16MLW-009-1.75-2.0	>1.0	3.4642	J
BW16MLW-010-1.45-1.70	>1.0	1.4571	J

Notes:
1 – Result units are ng TEQ/kg
[2]25% of the sample was collected within two intervals, the sample was evaluated for both intervals, as described in ***Section 2.5.4****.*
J – estimated value
ng TEQ/kg – nanograms of dioxin toxicity equivalency per kilogram
SQT – Sediment Quality Target
TEQ – dioxin toxicity equivalency
Values highlighted in yellow indicate concentration exceeding SQT Level I (0.85 ng TEQ/kg)
Values highlighted in orange indicate concentration exceeding the midpoint between SQT Level I and SQT Level II (11.2 ng TEQ/kg)
Values highlighted in red indicate concentration exceeding SQT Level II (21.5 ng TEQ/kg)
TEQ values calculated using the USEPA Advanced Kaplan Meier TEQ Calculator
Dioxins analyzed by EPA Method SW8290

For TEQ KM Fish, Level 1 SQT exceedances occurred in BW16MLW-005 through BM16MLW-010. Level II exceedances occurred in BW16MLW-001 through BM16MLW-003. The maximum concentration of TEQ KM FISH (50.546 ng TEQ/kg) was identified in the 0.15 to 0.5-meter interval at location BW16MLW-003.

3.3 Physical Sediment Characterization

Surface sediment samples collected at the Site generally contained brown to dark brown silt loam, consisting of up to 15% fibrous woody debris.

Deeper sediment samples collected at the Site, up to a maximum depth of 2.00 meters, generally contained brown to dark brown silty peat, consisting of up to 100% fibrous woody debris. A firm tan clay to silty clay was observed within the bottommost sediments in core samples collected from locations BW16MLW-005 through BW16MLW-008. Based on the depth of sampler advancement at these locations, the tan clay layer depth varied between 1.15 meters bss at location BW15MLW-005 and 2.00 meters at location BW16MLW-006.

3.3.1 Grain Size

Seven samples were analyzed for grain size distribution to meet site investigation objectives presented in the site-specific FSP for MLW. The following table summarizes grain size analysis.

Grain size distribution charts are presented in laboratory analytical reports included in **Appendix D**.

Sample ID (depth interval [meters])	Soil Classification	Percent +3 inches	Percent Gravel		Percent Sand			Percent Fines		d10
			Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	Percent Finer
BW16MLW-001 (0 – 0.15)	Silt	0	0	0	1	2	6	78	13	99.0
BW16MLW-002 (0.0 – 0.15)	Sandy Silt	0	0	0	0	0	1	80	19	100.0
BW16MLW-003 (0.0 – 0.15)	Silt with Sand	0	0	0	0	2	1	70	27	100
BW16MLW-005 (0.90 – 1.15)	Silty with Sand	0	0	0	1	9	12	42	36	99.0
BW15MLW-006 (1.75 – 2.00)	Silty with Sand	0	0	0	0	12	12	41	35	100.0
BW15MLW-007 (1.6 – 1.85)	Silty with Sand	0	0	0	0	7	14	52	27	100
BW15MLW-008 (1.15 – 1.40)	Silt with Sand	0	0	0	0	10	16	47	27	100.0

3.3.2 Total Organic Carbon

TOC analyses were performed on all sediment samples collected. The TOC results are summarized in **Table 5** and as follows.

TOC results ranged from 26,100 to 153,000 milligrams per kilogram (mg/kg); the average TOC value was 87,922 mg/kg.

Sample Name	Sample Interval (meters)	Result (mg/kg)
BW16MLW-001-0.0-0.15	0.0-0.15	26,100
BW16MLW-002-0.0-0.15	0.0-0.15	24,500
BW16MLW-003-0.0-0.15	0.0-0.15	30,200
BW16MLW-005-0.90-1.15	0.5-1.0 and >1.0	104,000
BW16MLW-006-1.75-2.0	>1.0	85,300
BW16MLW-007-1.6-1.85	>1.0	117,000
BW16MLW-008-1.15-1.40	>1.0	99,200
BW16MLW-009-1.75-2.0	>1.0	152,000
BW16MLW-010-1.45-1.70	>1.0	153,000

Notes:
mg/kg – milligram/kilogram

3.4 Tissue Chemistry Data

3.4.1 Bioaccumulation Tissue Data

Site sediment samples were collected by Bay West and provided to GLEC where they were used as growing media for benthic macroinvertebrates. GLEC performed the bioaccumulation test by exposing *Lumbriculus variegatus* to sediment samples collected from the Site for a period of 28 days. A 4-day survival screening was performed at the start of the 28-day bioaccumulation test to determine if the bioaccumulation test would be successful. Following the 28-day growth period, the *Lumbriculus variegatus* was extracted from the sediment samples for tissue analysis. GLEC or other specified laboratories completed tissue analysis on the benthic macroinvertebrates to determine potential bioaccumulative impacts of sediment COCs on benthic macroinvertebrates. The following sections present the bioaccumulation study tissue results and sediment chemistry results for the sediment samples used as growing media. The following table presents a summary of the general physical characteristics of the sediment samples used in the bioaccumulation study and the results of the 4-day survival screening test.

Sample ID	**Background L. variegatus Tissue Day 0 10/25/2016**	**West Bear Skin Laboratory Control**	**BW16MLW-001-0.0-0.15**	**BW16MLW-002-0.0-0.15**	**BW16MLW-003-0.0-0.15**
Sediment Chemistry Results					
Percent Moisture (%)	NA	86.6	84.8	79.9	87.7
Mean Total Organic Carbon (mg/kg-dry)	NA	14900	26100	24500	30200
***Lumbriculus variegatus* 4-Day Toxicity Screening Sediment Tests Conducted October 14 – October 18, 2016**					
4-Day Screening Test Percent Survival[1]	NA	100	97.5	97.5	95.0
***Lumbriculus variegatus* 28-Day Bioaccumulation Whole Sediment Toxicity Tests Conducted October 25 – November 22, 2016**					
Average Wet Depurated Weight (g)	NA	18.27	15.08	15.60	15.48

Notes:
[1] Replicates initiated with 10 organisms each
Initiated 28-day test with 18 grams of L. variegatus per replicate
Percent Moisture: Method ASTM D2974-87 and a reporting limit of 0.10%
Total Organic Carbon: Method EPA 9060 in quadruplicate and a reporting limit of 100 mg/kg dry
NA – not applicable
mg/kg – milligram per kilogram

3.4.1.1 Metals

The following table, **Table 10**, and **Figures 7** through **9** summarize bioaccumulation data provided in the GLEC Report, see the GLEC Report for additional details.

***Lumbriculus variegatus* 28-Day Bioaccumulation Tests Conducted October 25 – November 22, 2016 Metals**					
Sample ID	**Background L. variegatus Tissue Day 0 10/25/2016**	**West Bear Skin Laboratory Control**	**BW16MLW-001-0.0-0.15**	**BW16MLW-002-0.0-0.15**	**BW16MLW-003-0.0-0.15**
Nickel (mg/kg)	1.00	1.10	0.72	2.10	0.46
Zinc (mg/kg)	21.4	18.2	18.0	17.0	21.3
Corresponding Sediment Chemistry					
Nickel (mg/kg)	NA	NA	32.5	40.0	50.6
Zinc (mg/kg)	NA	NA	165	185	328

Notes:
Nickel & Zinc: Method: EPA 6020; Preparation Method: EPA 3050B
NA – not applicable
g – grams
mg/kg – milligram per kilogram
Values highlighted in yellow indicate sediment concentration exceeding SQT Level I
Values highlighted in orange indicate sediment concentration exceeding the midpoint between SQT Level I and SQT Level II
Values highlighted in red indicate sediment concentration exceeding SQT Level II

3.4.1.2 Dioxins/Furans

The following table summarizes the TCDD equivalent results for Site tissue samples with respect to the dioxin TEQ KM for fish. The TEQ KM calculator for Fish could not be used as described in the 2016 RI Report because the data set had too few detected congeners to make the calculation statistically sound. To develop a TEQ KM Fish value range for the data set the 1998 TEFs were used and the calculation was completed three times as follows: All non-detect results were set equal to the detection limit and multiplied by the TEFs, all non-detect results were set equal to half of the detection limit and multiplied by the TEFs, and finally all non-detect results were set equal to zero and multiplied by the TEFs. The following table summarizes the TEQ KM for Fish data ranges developed and is also presented in **Table 9** and in **Figure 9**.

Lumbriculus variegatus 28-Day Bioaccumulation Tests Conducted October 25 – November 22, 2016
Dioxins/Furans

Sample ID	**Background L. variegatus Tissue Day 0 10/25/2016**	**West Bear Skin Laboratory Control**	**BW16MLW-001-0.0-0.15**	**BW16MLW-002-0.0-0.15**	**BW16MLW-003-0.0-0.15**
No-Detect = Detection Limit	0.20	0.20	0.59	0.58	0.95
Non-detect = 0.5* Detection Limit	0.11	0.11	0.55	0.54	0.92
Non-detect = Zero	0.01	0.00	0.51	0.50	0.90
Corresponding Sediment Chemistry					
TEQ KM Fish	NA	NA	25.70	23.85	50.55

Notes:
ng TEQ/kg – nanograms of dioxin toxicity equivalency per kilogram
Values highlighted in yellow indicate concentration exceeding SQT Level I (0.85 ng TEQ/kg)
Values highlighted in orange indicate concentration exceeding the midpoint between SQT Level I and SQT Level II (11.2 ng TEQ/kg)
Values highlighted in red indicate concentration exceeding SQT Level II (21.5 ng TEQ/kg)
TEQ values for sediment calculated using the USEPA Advanced Kaplan Meier TEQ Calculator
NA – not analyzed

Tissue TEQ KM Fish data ranges for BW16MLW-001 through BW16MLW-003 ranged from 0.50 to 0.95 ng TEQ/kg. Background and Control data ranged from 0.00 to 0.20 ng TEQ/kg. Corresponding sediment data at each sample location exceed the Level II TEQ KM Fish SQT.

3.4.2 Toxicity Testing

Site sediment samples were collected by Bay West and provided to GLEC where they were used as growing media for benthic macroinvertebrates. The following table presents percent survival rates for two benthic macroinvertebrate species, *Chronomus dilutes* and *Hyallela Azteca*, grown in Site sediment supplied to GLEC as compared to a control sample from West Bear Skin Lake. The *Chronomus dilutes* were exposed to the sediment samples for 10 days and the *Hyallela Azteca* were exposed to the sediment samples for 28 days. No significant differences between the survival rates are apparent for either species. **Table 11** and **Figures 7** through **9** summarize toxicity data provided in the GLEC Report, see the GLEC Report for additional details.

Sample ID	**West Bear Skin Laboratory Control**	**BW16MLW-001-0.0-0.15**	**BW16MLW-002-0.0-0.15**	**BW16MLW-003-0.0-0.15**	**Water Only Secondary Control**
***Chronomus dilutus* 10-Day Whole Sediment Toxicity Tests Conducted October 14 – October 24, 2016**					
Average[1] Ash-Free-Dry Weight (AFDW) (mg)	0.99208	1.41660	1.33997	1.26304	0.94908
Biomass[2] Weight (AFDW) (mg)	0.96762	1.37525	1.28650	1.19675	0.9235
10-Day Percent Survival	97.5	97.5	96.3	95.0	97.5
***Hyallela azteca 28*-Day Whole Sediment Toxicity Tests Conducted October 19 – November 16, 2016**					
Average[1] Ash-Free-Dry Weight (AFDW) (mg)	0.16913	0.18442	0.16769	0.18462	0.33775
Biomass[2] Weight (AFDW) (mg)	0.16700	0.179737	0.16075	0.17550	0.33387
28-Day Percent Survival	98.8	97.5	96.3	96.3	98.8

Notes:
Average Ash-Free-Dry Weight (AFDW) of Chironomus dilutus at test initiation = .33313 mg
Average Dry Weight of Hyallela azteca at test initiation = 0.01950 mg
[1]Average Ash-Free-Dry-Weight (AFDW) is the total ash-free-dry weight of surviving organisms
[2]Biomass weight is the total Ash-Free-Dry-Weight of surviving organisms divided by the initial number of organisms

3.5 Community Assessment Comparison Data

Community assessments were completed as described in **Section 2.3**. A summarized results table is presented as follows, the full table with specific benthic macroinvertebrate species identified can be found in **Table 6**.

Location	Collection Information				Result	
	Date	Number of Ponar Grabs	Approximate Collection Area (cm^2)[1]	Community Assessment Duration (min)	Biotic Index Score[2]	Biotic Health Score[3]
BW16MLW-001	10/4/2016	3	675	15	1.6	Poor
BW16MLW-002	10/4/2016	3	675	15	1.3	Poor
BW16MLW-003	10/4/2016	3	675	15	1	Poor
Boulder Lake Reservoir (Reference Sample)						
BW16BLR-001	9/20/2016	3	675	15	0.0	Poor

Notes:
[1] *Each grab = 15.2 cm x 15.2 cm (225 cm^2)*
[2] *Biotic Index Score Calculation: http://watermonitoring.uwex.edu/pdf/level1/datasheets/data-Biotic2014.pdf*
[3] *Biotic Health Score: Good: 2.6–2.5, Fair: 2.1–2.5, and Poor: 2.0–1.0*
cm = centimeters
min = minutes

4.0 DATA QUALITY REVIEW

4.1 Analytical Data QA/QC Review

In accordance with the St. Louis River Sediment Area of Concern QAPP dated July 2014 and the QAPP Addendum dated February 2015, data verification was performed on the following organic and inorganic analyses: total metals, dioxin/furans, and TOC. A cursory review was performed on grain size. All data was collected and samples were analyzed by Pace, Axys, or GLEC, MDH Environmental Laboratory Accreditation Program (ELAP)-accredited laboratories. The following table describes methods and percentage of total samples for each parameter.

Parameter	Media	Total Samples	Percentage	Analytical Method
Nickel	Sediment	9	100%	SW-846 Method 6020A
Zinc	Sediment	9	100%	SW-846 Method 6020A
Dioxins/Furans	Sediment	9	100%	SW-846 Method 8290A
TOC	Sediment	9	100%	SW-846 Method 9060A
Grain size	Sediment	7	100%	ASTM D422
Percent Moisture	Sediment	9	100%	ASTM D2974-07
Nickel	Tissue	3	100%	SW-846 Method 6020A
Zinc	Tissue	3	100%	SW-846 Method 6020A
Dioxins/Furans	Tissue	3	100%	SW-846 Method 8290A

In general, the areas covered by the data verification process included reviewing the following:

- CoC records;
- Technical holding times and preservation;
- Laboratory and field QC reporting forms (method blanks, rinsate blanks, surrogates, laboratory control samples [LCSs], laboratory control sample duplicates [LCSDs], and MS/MSDs, as appropriate);
- Required analytical methods;
- Reporting limits;
- Case narrative;
- Completeness of Results; and
- Data usability (compliance with data quality objectives [DQOs]).

Level II Laboratory reports were provided by the laboratory and reviewed, so the following areas were not covered by the data verification:

- Tune summaries (gas chromatograph/mass spectrometer [GC/MS] only);
- Initial calibrations;
- Continuing calibrations;
- Internal standards;

- Target compound/analyte ID;
- Target Compound/analyte quantitation; and
- System performance.

As per the approved QAPP, data verification was performed by a Bay West Chemist and documented using the MPCA Laboratory Data Review Checklist. Data verification was performed by comparing the contents of the data packages and QA/QC results to the requirements in the QAPP, the respective analytical methods, and the laboratory SOPs. Additional qualifiers were added, as needed, and summarized in the MPCA Laboratory Data Review Checklists, included in **Appendix D**. All metals samples analyzed by SW-846 Method 6020A were analyzed at 20-fold dilution in accordance with the Pace SOP.

Field duplicates, MS/MSDs, method blanks, and rinsate blanks were collected and/or analyzed at required frequencies specified in the approved QAPP as follows. Field duplicates met or exceeded the required frequencies of 10% for the samples analyzed for selected metals and dioxins/furans. MS/MSDs analysis met or exceeded the required frequency of 5% for selected metals and dioxins/furans. Rinsate blanks were collected daily for selected metals as discussed in the FSP. Analytes detected in samples at concentrations less than 10% of the method blank or rinsate blank concentrations were qualified "U" as undetected.

Samples results were considered estimated if the sample results were associated with LCSs/LCSDs or MS/MSDs recoveries outside QC limits. When LCS or MS/MSD recoveries were biased low, both detected and undetected sample results were flagged with a "J" or "UJ" to indicate that the concentration or reporting limit is considered estimated. When LCS or MS/MSD recoveries were biased high, only the detected results were qualified "J" as estimated. Only detected results were qualified "J" when relative percent differences were high in field duplicates, MS/MSDs, and LCS/LCSDs. All non-detect values were flagged with a "U."

4.2 Interpretation of Concentrations Less Than Detection Limits

The MPCA Guidance: Laboratory Quality Control and Data Policy requires concentrations less than the reporting limit but above the MDLs to be qualified with a "J" because they are considered estimated. Samples below the MDL were qualified with a "U." Bay West replaced all "E", "I", and "P" Pace qualifiers with a "J" flag to indicate that the sample concentrations are considered estimated.

Since guidance for calculations of toxicity quotients do not prescribe which scaling factor for non-detect results should be used, non-detection values were set equal to one-half of the reporting limit for metals, PAHs, and Dioxin/Furans.

4.3 Summary

Overall, no significant data quality discrepancies were observed. All data were verified and found acceptable, as qualified, and met DQOs. Additional information regarding data verification can be found in Laboratory Data Review Checklists in **Appendix D**.

5.0 DISCUSSION AND CONCLUSION

The following section describes the results obtained during the limited field activities.

All Community Assessment Comparisons completed for BW16MLW – 001 through 003 surface sediment indicated that the sediment health at these locations was poor. Macroinvertebrate species diversity was low and species consisted only of pollutant tolerant macroinvertebrates. However, this assessment was completed at the very end of the growing season which may have skewed the outcome of the assessment; therefore, this data is considered inconclusive. Additional assessments would need to be completed during the growing season to develop a clear conclusion of sediment quality at these locations.

Sediment samples were collected and analyzed for Site COCs to further define the vertical extent of contamination at the Site. Zinc and dioxin/furan sediment concentrations in deep interval samples did not exceed Midpoint SQTs, indicating deposition of the contaminants occurred relatively recently. Nickel sediment concentrations in deep interval samples exceeded the Midpoint SQT in 50% of the samples, indicating deposition of nickel-contaminated sediment occurred .

28-Day *Lumbriculus variegatus* bioaccumulation Testing was completed on the surface sediment samples from BW16MLW-001 to BW16MLW-003. Results showed similar levels of both nickel and zinc in tissue as compared to control samples. Nickel in tissue exposed to site sediments ranged from 0.46 to 2.10 mg/kg while control and background ranged from 1 to 1.10 mg/kg. Zinc in tissue exposed to site sediments ranged from 17 to 21.3 mg/kg while control and background ranged from 18.2 to 21.4 mg/kg. Nickel and zinc in site sediments do not appear to bioaccumulate in benthic tissue, indicating that these contaminants would not migrate up the food chain to higher trophic levels.

28-Day *Lumbriculus variegatus* Bioaccumulation Testing results for dioxins/furans ranged from 0.51-0.95 ng TEQ/kg, while the control and background ranged from 0.00 to 0.20 ng TEQ/kg. TEQ KM Fish results for BW16MLW-001 to BW16MLW-003 were at least twice the level of dioxin/furans as compared to the background/control. These results indicate that dioxins/furans appear to bioaccumulate in benthic tissue could migrate up the food chain to higher trophic levels that consume benthic organisms.

Toxicity Testing completed on surface sediments with Midpoint SQT exceedances were completed. *Chronomus dilutus* 10-Day Toxicity Tests and *Hyallela azteca 28*-Day Toxicity Tests both had survival rates ranging between 97.5% and 95%. Control survival rates for the same Toxicity Tests ranged from 98.8% to 97.5%. There was no significant difference in survival rate between the two indicating that observed Midpoint SQT exceedances do not appear to have an impact on survival rates for benthic health at Mud Lake.

Since site sediments do not appear to be toxic to benthic organisms, and because nickel and zinc do not appear to bioaccumulate in benthic tissue, nickel and zinc do not appear to pose a significant risk to the environment and should no longer be considered COCs for the Site. The exposure pathway to high trophic levels appears to be complete for dioxins/furans, which could pose a risk to the environment; therefore, dioxin/furans should remain a COC for Mud Lake West.

6.0 REFERENCES

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Tables

Table 1 - Sample Analysis Summary
Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Location	Sample ID	Sediment												Community Assessment
		Chemical/Physical									Toxicity		Bioaccumulation	
		Sample Interval (m)	Sample Type (G or C)	Dioxins and furans by SW-846 8290A	Mercury by SW-846 7471B	Nickel by SW-846 6020A	Zinc SW-846 6020A	TOC by SW-846 9060A	Grain size by ASTM D422	Percent moisture by ASTM D2216	10-d	28-d	28-d	
BW16MLW-001	BW16MLW-001-0.0-0.15	0.0-0.15	G	X		X	X	X	X	X	X	X	X	X
BW16MLW-002	BW16MLW-002-0.0-0.15	0.0-0.15	G	X		X	X	X	X	X	X	X	X	X
BW16MLW-003	BW16MLW-003-0.0-0.15	0.0-0.15	G	X		X	X	X	X	X	X	X	X	X
BW16MLW-005	BW16MLW-005-0.90-1.15	0.90-1.15	G	X		X	X	X	X					
BW16MLW-006	BW16MLW-006-1.75-2.0	1.75-2.0	G	X		X	X	X	X					
BW16MLW-007	BW16MLW-007-1.6-1.85	1.6-1.85	G	X		X	X	X	X					
BW16MLW-008	BW16MLW-008-1.15-1.40	1.15-1.40	G	X		X	X	X	X					
BW16MLW-009	BW16MLW-009-1.75-2.0	1.75-2.0	G	X		X	X	X						
BW16MLW-010	BW16MLW-010-1.45-1.70	1.45-1.70	G	X		X	X	X						

Notes:

▨ Sampled

Summary does not include fish tissue or EPA-collected benthic tissue

Grab (G)

Composite (C)

Table 1 - Sample Analysis Summary
Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Location	Sample ID	Tissue								
		In Situ (Mayfly, Dragonfly, & Crawfish)	In Situ Hester Dendy (Macrobenthos & Crawfish)	Laboratory Exposed (Lumbriculus)	Grams Collected	Dioxins and furans by SW-846 8290A	Mercury by SW-846 7471B	Methyl Mercury EPA 1630	% LIPIDS	Type
BW16MLW-001	BW16MLW-001-0.0-0.15			X						
BW16MLW-002	BW16MLW-002-0.0-0.15			X						
BW16MLW-003	BW16MLW-003-0.0-0.15			X						
BW16MLW-005	BW16MLW-005-0.90-1.15									
BW16MLW-006	BW16MLW-006-1.75-2.0									
BW16MLW-007	BW16MLW-007-1.6-1.85									
BW16MLW-008	BW16MLW-008-1.15-1.40									
BW16MLW-009	BW16MLW-009-1.75-2.0									
BW16MLW-010	BW16MLW-010-1.45-1.70									

Notes:
Sampled
Summary does not include fish tissue or EPA-collected
Grab (G)
Composite (C)

Table 2 - Sample Locations

Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Location	Sample ID	Easting	Northing	Water Elevation (ft)	Water Depth (ft)	Top of Sediment Elevation (ft)	Date Sampled
BW16MLW-001	BW16MLW-001-0.0-0.15	-92.212131	46.662074	603.5	7	596.5	10/4/2016
BW16MLW-002	BW16MLW-002-0.0-0.15	-92.21123	46.66294	603.5	8.2	595.3	10/4/2016
BW16MLW-003	BW16MLW-003-0.0-0.15	-92.210372	46.666488	603.5	3.25	600.25	10/4/2016
BW16MLW-005	BW16MLW-005-0.90-1.15	-92.21008	46.666051	603.5	4.2	599.3	10/4/2016
BW16MLW-006	BW16MLW-006-1.75-2.0	-92.210608	46.66486	603.5	6.4	597.1	10/4/2016
BW16MLW-007	BW16MLW-007-1.6-1.85	-92.210161	46.664347	603.5	6.1	597.4	10/4/2016
BW16MLW-008	BW16MLW-008-1.15-1.40	-92.21321	46.664461	603.5	4.6	598.9	10/4/2016
BW16MLW-009	BW16MLW-009-1.75-2.0	-92.214144	46.663581	603.5	2.6	600.9	10/4/2016
BW16MLW-010	BW16MLW-010-1.45-1.70	-92.211963	46.663311	603.5	8.9	594.6	10/4/2016

NR- Not recorded

Table 3 - Core Summary

Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Location	Sample ID	Date Sampled	Sample Method	Depth of Push (m)	Depth of Push (ft)	Recovery (m)	Recovery (ft)	Percent Recovery
BW16MLW-001	BW16MLW-001-0.0-0.15	10/4/2016	Ponar	0.15	0.5	0.15	0.5	100
BW16MLW-002	BW16MLW-002-0.0-0.15	10/4/2016	Ponar	0.15	0.5	0.15	0.5	100
BW16MLW-003	BW16MLW-003-0.0-0.15	10/4/2016	Ponar	0.15	0.5	0.15	0.5	100
BW16MLW-005	BW16MLW-005-0.90-1.15	10/4/2016	Russian Peat	1.2	3.8	0.5	1.6	100
BW16MLW-006	BW16MLW-006-1.75-2.0	10/4/2016	Russian Peat	2.0	6.6	0.5	1.6	100
BW16MLW-007	BW16MLW-007-1.6-1.85	10/4/2016	Russian Peat	1.85	6.1	0.5	1.6	100
BW16MLW-008	BW16MLW-008-1.15-1.40	10/4/2016	Russian Peat	1.4	4.6	0.5	1.6	100
BW16MLW-009	BW16MLW-009-1.75-2.0	10/4/2016	Russian Peat	2.0	6.6	0.5	1.6	100
BW16MLW-010	BW16MLW-010-1.45-1.70	10/4/2016	Russian Peat	1.7	5.6	0.5	1.6	100

Table 4 - Analytical Parameters Summary

Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Analytical Parameters	Chemical Abstract Number or Analyte Code	Analytical Method
Metals		
Nickel	7440-02-0	SW-846 6020A
Zinc	7440-66-6	SW-846 6020A
Polychlorinated Dibenzo-p-dioxins (Dioxins)/Polychlorinated Dibenzofurans (Furans)		
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	SW-846 8290A
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4	SW-846 8290A
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	57653-85-7	SW-846 8290A
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	39227-28-6	SW-846 8290A
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	19408-74-3	SW-846 8290A
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	35822-46-9	SW-846 8290A
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	3268-87-9	SW-846 8290A
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9	SW-846 8290A
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6	SW-846 8290A
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4	SW-846 8290A
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9	SW-846 8290A
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	72918-21-9	SW-846 8290A
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	70648-26-9	SW-846 8290A
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5	SW-846 8290A
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4	SW-846 8290A
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7	SW-846 8290A
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-0	SW-846 8290A
TCDD Equivalent	--	
General Chemistry		
Total Organic Carbon	--	SW-846 9060A
Physical Testing		
Grain Size	--	ASTM D422

Table 5 - Total Organic Carbon Results

Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Sample Name	Sample Depth Start (m)	Sample Depth End (m)	Sample Interval (m)	Result (mg/kg)	Results Qualifier
BW16MLW-001-0.0-0.15	0.0	0.15	0.0-0.15	26,100	
BW16MLW-002-0.0-0.15	0.0	0.15	0.0-0.15	24,500	
BW16MLW-003-0.0-0.15	0.0	0.15	0.0-0.15	30,200	
BW16MLW-005-0.90-1.15	0.9	1.15	0.5-1.0 and >1.0	104,000	
BW16MLW-006-1.75-2.0	1.75	2	>1.0	85,300	
BW16MLW-007-1.6-1.85	1.6	1.85	>1.0	117,000	
BW16MLW-008-1.15-1.40	1.15	1.4	>1.0	99,200	
BW16MLW-009-1.75-2.0	1.75	2	>1.0	152,000	
BW16MLW-010-1.45-1.70	1.45	1.7	>1.0	153,000	

Notes:
TOC - Total organic carbon
J - estimated value
U - indicates non-detet because of TOC contamination in the method blank
m - meters
TOC analyzed by EPA Method SW9060

Table 6 - Community Assessment
Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Location	Collection Information				Benthic Macroinvertebrates												
	Date	Number of Ponar Grabs	Approximate Collection Area (cm^2)[1]	Community Assessment Duration (min)	Alderfly (Sensitive)	Mayfly (Semi-Sensitive)	Fingernail Clam (Semi-Senstive)	Non-Red Midge (Semi-Tolerent)	Horsefly (Tolerant)	Horsehair Worm (Tolerant)	Thread Worm (Tolerant)	Snails (Semi-Tolerant)	Blood Worm (Tolerant)	Tubifex Worm (Tolerant)	Needle Worm (Tolerant)	Biotic Index Score[2]	Biotic Health Score[3]
BW16MLW-001	10/4/2016	3	675	15	0	0	1	1	2	0	0	0	0	0	1	1.6	Poor
	Weighted Group Score				0	0	3	2	2	0	0	0	0	0	1		
BW16MLW-002	10/4/2016	3	675	15	0	0	1	0	5	0	0	0	0	0	0	1.3	Poor
	Weighted Group Score				0	0	3	0	5	0	0	0	0	0	0		
BW16MLW-003	10/4/2016	3	675	15	0	0	0	0	0	0	0	3	6	0	0	1.0	Poor
	Weighted Group Score				0	0	0	0	0	0	0	3	6	0	0		
Boulder Lake Reservoir (Reference Sample)																	
BW16BLR-001	9/20/2016	3	675	15	0	0	0	0	0	0	0	0	0	0	0	0.0	Poor
	Weighted Group Score				0	0	0	0	0	0	0	0	0	0	0		

[1] Each grab = 15.2 cm x 15.2 cm (225 cm2)

[2] Biotic Index Score Calculation: http://watermonitoring.uwex.edu/pdf/level1/datasheets/data-Biotic2014.pdf

[3] Biotic Health Score:

	Good	2.6-3.5
	Fair	2.1-2.5
	Poor	1.0-2.0

Table 7 - Metals Results

Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Chemical	Sample Name				BW16MLW-001-0-0.15		BW16MLW-002-0-0.15		BW16MLW-003-0-0.15		BW16MLW-005-0.90-1.15		BW16MLW-006-1.75-2.0		BW16MLW-007-1.6-1.85		BW16MLW-008-1.15-1.40		BW16MLW-009-1.75-2.0		BW16MLW-010-1.45-1.70	
	Sample Depth Start (meters)				0		0		0		0.9		1.75		1.6		1.15		1.75		1.45	
	Sample Depth End (meters)				0.15		0.15		0.15		1.15		2		1.85		1.4		2		1.7	
	Sample Interval (meters)				0.0-0.15		0.0-0.15		0.0-0.15		0.5-1.0 and >1.0		>1.0		>1.0		>1.0		>1.0		>1.0	
	SQT Level 1	SQT Midpoint	SQT Level 2	Result unit	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Nickel	23	36	49	mg/kg	32.5		40.0		50.6		62.0		39.0		28.4		38.7		13.5		17.1	
Zinc	120	290	460	mg/kg	165		185		328		176		108		84.5		67.3		27.4	J	30.9	J

Notes:

Q - Qualifiers

J - estimated value

NE - not estabilshed

SQT - Sediment Quality Target

U - concentration did not exceed laboratory reporting limit

Values highlighted in yellow indicate concentration exceeding SQT Level I

Values highlighted in orange indicate concentration exceeding the midpoint between SQT Level I and SQT Level II

Values highlighted in red indicate concentration exceeding SQT Level II

Mercury was anlayzed by EPA Method SW7471B

Table 8 - Dioxin/Furan Results - Sediment

Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Chemical	Sample Name				BW16MLW-001-0.0-0.15		BW16MLW-002-0.0-0.15		BW16MLW-003-0.0-0.15		BW16MLW-005-0.90-1.15		BW16MLW-006-1.75-2.0		BW16MLW-007-1.6-1.85		BW16MLW-008-1.15-1.40		BW16MLW-009-1.75-2.0		BW16MLW-010-1.45-1.70	
	Sample Depth Start (meters)				0		0		0		0.9		1.75		1.6		1.15		1.75		1.45	
	Sample Depth End (meters)				0.15		0.15		0.15		1.15		2		1.85		1.4		2		1.7	
	Sample Interval (meters)				0.0-0.15		0.0-0.15		0.0-0.15		0.5-1.0 and >1.0		>1.0		>1.0		>1.0		>1.0		>1.0	
	SQT Level I	SQT Midpoint	SQT Level II	Result unit	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
1,2,3,4,6,7,8-HpCDD	NE	NE	NE	ng/Kg	350		250		460		7.8	J	39		79		12	J	35	J	11	J
1,2,3,4,6,7,8-HpCDF	NE	NE	NE	ng/Kg	580		560		1300		14		94		230		23		71		19	J
1,2,3,4,7,8,9-HpCDF	NE	NE	NE	ng/Kg	5.5	J	5.5	J	11	J	0.51		1.1	J	2.6	J	1.5		1.8		3	
1,2,3,4,7,8-HxCDD	NE	NE	NE	ng/Kg	3.4	J	3.1	J	5.4	J	0.14		1		0.67	J	0.62		0.74		1.7	
1,2,3,4,7,8-HxCDF	NE	NE	NE	ng/Kg	9.5	J	9.1	J	19		0.4	J	1.7	J	3.3	J	0.87		1.7	J	1.3	
1,2,3,6,7,8-HxCDD	NE	NE	NE	ng/Kg	21		20		39		0.56	J	3.2	J	6	J	1.1	J	3.2	J	0.85	
1,2,3,6,7,8-HxCDF	NE	NE	NE	ng/Kg	28		28		84		1	J	8.4	J	18	J	0.92	J	2.8	J	1.5	
1,2,3,7,8,9-HxCDD	NE	NE	NE	ng/Kg	10	J	9.6	J	18		0.3	J	1.9	J	3.4	J	0.64	J	1.5	J	1.3	
1,2,3,7,8,9-HxCDF	NE	NE	NE	ng/Kg	3	J	3.3	J	5.7	J	0.15		0.39		0.37		0.36		0.5		0.73	
1,2,3,7,8-PeCDD	NE	NE	NE	ng/Kg	3.6	J	2.9	J	5.5	J	0.24	J	0.39	J	1	J	0.24		0.61	J	0.64	
1,2,3,7,8-PeCDF	NE	NE	NE	ng/Kg	2.8	J	2.9	J	8.3	J	0.22	J	0.52	J	1.2	J	0.3		0.58		0.63	
2,3,4,6,7,8-HxCDF	NE	NE	NE	ng/Kg	10	J	9.8	J	20		0.14		2.1	J	3.8	J	0.66		1.1	J	1	
2,3,4,7,8-PeCDF	NE	NE	NE	ng/Kg	6.2	J	5.9	J	10	J	0.26	J	0.92	J	1.5	J	0.34	J	0.86	J	0.59	J
2,3,7,8-TCDD	NE	NE	NE	ng/Kg	1.6	J	1.3	J	2.6	J	0.18		0.47	J	0.6	J	0.35		0.66		0.51	
2,3,7,8-TCDF	NE	NE	NE	ng/Kg	6.9		5.8		11		0.83	J	2.2	J	2.6	J	1.7	J	2.7	J	2.9	J
OCDD	NE	NE	NE	ng/Kg	3900	J	2800		5400		74		410		840		130		380		95	
OCDF	NE	NE	NE	ng/Kg	250		270		570		6.6	J	47		110		11	J	34	J	13	J
Total HpCDD	NE	NE	NE	ng/Kg	770		530		990		16		84		170		28		70		22	J
Total HpCDF	NE	NE	NE	ng/Kg	1000		970		2200		25		170		400		40		120		32	J
Total HxCDD	NE	NE	NE	ng/Kg	190		180		330		6.1	J	21		44		9.4	J	24	J	9.1	J
Total HxCDF	NE	NE	NE	ng/Kg	400		370		810		11	J	57		150		15	J	50		11	J
Total PeCDD	NE	NE	NE	ng/Kg	43		45		76		3	J	4	J	15	J	3.2	J	5	J	2.5	J
Total PeCDF	NE	NE	NE	ng/Kg	130		120		230		2.9	J	15	J	35		4.5	J	15	J	3.4	J
Total TCDD	NE	NE	NE	ng/Kg	15		13		34		3.6		3	J	4.3		0.52	J	1.5	J	2.9	J
Total TCDF	NE	NE	NE	ng/Kg	68		64		110		3.7		9.4		18		5.1		10		8.2	
TEQ KM Fish	0.85	11.2	21.5	ng TEQ/Kg	25.699	J	23.848	J	50.546		0.9279	J	4.718	J	9.3313	J	1.4143	J	3.4642	J	1.4571	J

Notes:
Q - Qualifier
J - estimated value
NE - Not estabilshed
NA- Not established
ng TEQ/kg - nanograms of dioxin toxicity equivalency per kilogram
ng/kg - nanograms per kilogram
SQT - Sediment Quality Target
TEQ - dioxin toxicity equivalency
U - concentration did not exceed laboratory reporting limit
Values highlighted in yellow indicate concentration exceeding SQT Level I
Values highlighted in orange indicate concentration exceeding the midpoint between SQT Level I and SQT Level II
Values highlighted in red indicate concentration exceeding SQT Level II
TEQ values calculated using the US EPA Advanced Kaplan Meier TEQ Calculator
Dioxins analyzed by EPA Method SW8290

Table 9 - Dioxin/furans Results - Tissue

Thomson Reservoir
St. Louis River Area of Concern
Carlton, Minnesota

Chemical	Units	BW16MLW-001		BW16MLW-002		BW16MLW-003		Control-CS136 West Bear		Background Day 0	
		9.98		9.99		10.0		10.0		10.1	
		Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
1,2,3,4,6,7,8-HpCDD	ng/kg	1.7	U	1.88	U	3.45	J	0.147	U	0.173	U
1,2,3,4,6,7,8-HpCDF	ng/kg	3.67	J	3.65	J	8.72		0.0575	U	0.0572	U
1,2,3,4,7,8,9-HpCDF	ng/kg	0.0576	U	0.0581	U	0.0893	J	0.0575	U	0.0572	U
1,2,3,4,7,8-HxCDD	ng/kg	0.0867	J	0.102	J	0.155	J	0.0575	U	0.0572	U
1,2,3,4,7,8-HxCDF	ng/kg	0.219	KJ	0.206	J	0.322	J	0.0575	U	0.0572	U
1,2,3,6,7,8-HxCDD	ng/kg	0.415	KJ	0.521	J	0.797	J	0.0575	U	0.061	KJ
1,2,3,6,7,8-HxCDF	ng/kg	0.45	J	0.535	J	1.23	J	0.0575	J	0.0572	U
1,2,3,7,8,9-HxCDD	ng/kg	0.162	U	0.205 U	U	0.287	J	0.0575	U	0.0572	U
1,2,3,7,8,9-HxCDF	ng/kg	0.0576	U	0.0581 U	U	0.0578	U	0.0575	U	0.0572	U
1,2,3,7,8-PeCDD	ng/kg	0.216	J	0.155 J	J	0.333	J	0.0575	U	0.0575	KJ
1,2,3,7,8-PeCDF	ng/kg	0.206	KJ	0.212 J	J	0.427	J	0.0575	U	0.0572	U
2,3,4,6,7,8-HxCDF	ng/kg	0.0867	KJ	0.101 K J	KJ	0.158	J	0.0575	U	0.0572	U
2,3,4,7,8-PeCDF	ng/kg	0.27	KJ	0.23 J	J	0.372	J	0.0575	U	0.0572	U
2,3,7,8-TCDD	ng/kg	0.2	KJ	0.350 J	J	0.305	J	0.0575	U	0.0685	KJ
2,3,7,8-TCDF	ng/kg	0.492	J	0.436 J	J	0.624	J	0.0575	U	0.141	J
OCDD	ng/kg	9.14	J	9.28 J	J	22.7		0.716	J	0.256	KJ
OCDF	ng/kg	1.02	J	0.999 J	J	2.26	J	0.0677	J	0.0572	U
Total HpCDD	ng/kg	3.71		3.90		7.40	U	0.0575	U	0.276	U
Total HpCDF	ng/kg	7.24		7.42		16.1		0.0575	U	0.0572	U
Total HxCDD	ng/kg	1.09	U	2.57		3.84		0.0575	U	0.0572	U
Total HxCDF	ng/kg	5.36	U	5.95		10.3		0.0575	U	0.0572	U
Total PeCDD	ng/kg	0.774		1.29		2.00		0.0575	U	0.0572	U
Total PeCDF	ng/kg	5.59		5.99		8.03		0.0575	U	0.0572	U
Total TCDD	ng/kg	1.24		2.11		1.93		0.138		0.0572	U
Total TCDF	ng/kg	6.10		5.35		8.16		0.0575	U	0.0713	
TEQ Fish (ND=DL)	ng TEQ/kg	0.59		0.58		0.95		0.2		0.2	
TEQ Fish (ND=0.5DL)	ng TEQ/kg	0.55		0.54		0.92		0.11		0.11	
TEQ Fish (ND=0)	ng TEQ/kg	0.51		0.50		0.90		0.00		0.01	

Notes:

Q - Qualifier

J - estimated value

K-peak detected but did not meet quantification criteria, result reported

NE - not estabilshed

NA - Not Established

ng TEQ/kg - nanograms of dioxin toxicity equivalency per kilogram

ng/kg - nanograms per kilogram

TEQ - dioxin toxicity equivalency

U - concentration did not exceed laboratory reporting limit

TEQ values calculated using the TEF 1998 factors for fish in accordance with MPCA SQT guidance,

non-detects were set equal to detection level, 0.5 detection level, and zero

Dioxins analyzed by EPA Method SW8290

Table 10 - Biaccumulation Summary

Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Sample ID	Background L. variegatus Tissue Day 0 10/25/2016	West Bear Skin Laboratory Control	BW16MLW-001-0.0-0.15	BW16MLW-002-0.0-0.15	BW16MLW-003-0.0-0.15
Lumbriculus variegatus 4 -Day Toxicity Screening Sediment Tests Conducted October 14 - October 18, 2016					
4-Day Screening Test Percent Survival[r]	NA	100	97.5	97.5	95.0
Lumbriculus variegatus 28 -Day Biaccumulation Whole Sediment Toxicity Tests Conducted October 25 - November 22, 2016					
Average Wet Depurated Weight (g)	NA	18.27	15.08	15.60	15.48
Nickel (mg/kg)	1.00	1.10	0.72	2.10	0.46
Zinc (mg/kg)	21.4	18.2	18.0	17.0	21.3
Sediment Chemistry Results					
Percent Moisture (%)	NA	86.6	84.8	79.9	87.7
Mean Total Organic Carbon (mg/kg-dry)	NA	14900	26100	24500	30200

Notes: [r]Replicates initiated with 10 organisms each
Initiated 28-day test with 18 grams of L. variegatus per replicate
Nickel & Zinc: Method:EPA 6020; Preparation Method: EPA 3050B
Percent Moisture: Method ASTM D2974-87 and a reporting limit of 0.10%
Total Organic Carbon: Method EPA 9060 in quadruplicate and a reporting limit of 100 mg/kg dry
NA - not applicable
g - grams
mg - milligrams
mg/kg - milligram per kilogram

Table 11 - Toxicity Summary

Mud Lake West
St. Louis River Area of Concern
Duluth, Minnesota

Sample ID	West Bear Skin Laboratory Control	BW16MLW-001-0.0-0.15	BW16MLW-002-0.0-0.15	BW16MLW-003-0.0-0.15	Water Only Secondary Control
Chronomus dilutus 10-Day Whole Sediment Toxicity Tests Conducted October 14 - October 24, 2016					
Average[1] Ash-Free-Dry Weight (AFDW) (mg)	0.99208	1.41660	1.33997	1.26304	0.94908
Biomass[2] Weight (AFDW) (mg)	0.96762	1.37525	1.28650	1.19675	0.9235
10 -Day Percent Survival	97.5	97.5	96.3	95.0	97.5
Hyallela azteca 28 -Day Whole Sediment Toxicity Tests Conducted October 19 - November 16, 2016					
Average[1] Ash-Free-Dry Weight (AFDW) (mg)	0.16913	0.18442	0.16769	0.18462	0.33775
Biomass[2] Weight (AFDW) (mg)	0.16700	0.179737	0.16075	0.17550	0.33387
28 -Day Percent Survival	98.8	97.5	96.3	96.3	98.8

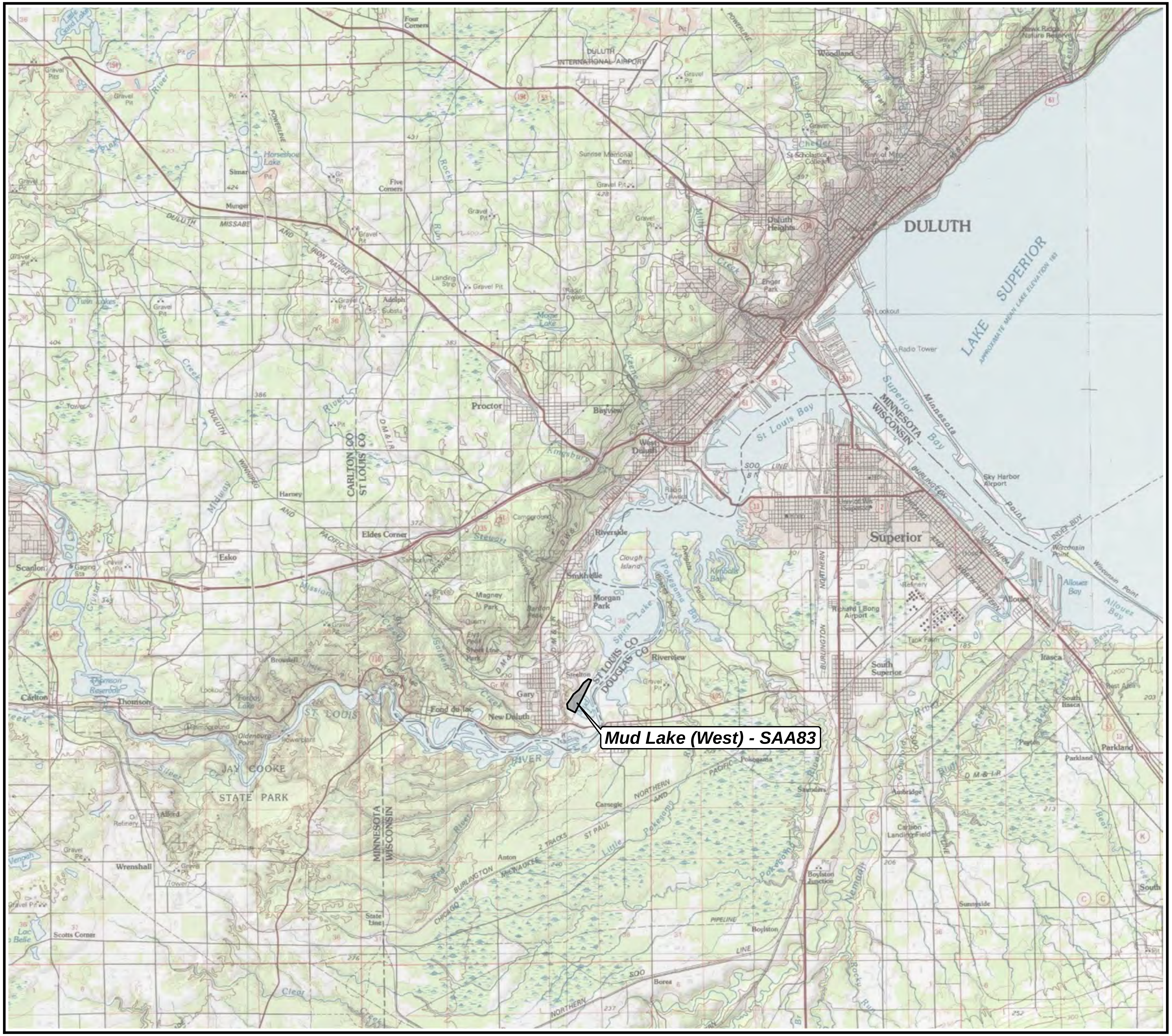
Notes: Average Ash-Free-Dry Weight (AFDW) of *Chironomus dilutus* at test initiation = .33313 mg

Average Dry Weight of Hyallela azteca at test initiation = 0.01950 mg

[1] Average Ash-Free-Dry-Weight (AFDW) is the total ash-free-dry weight of surviving organisms

[2] Biomass weight is the total Ash-Free-Dry-Weight of surviving organisms divided by the initial number of organisms

Figures



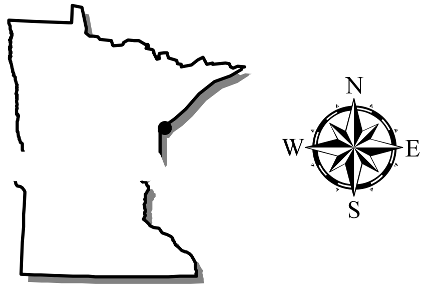
Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\J160749 FIG 1 MLW Site Location Map.mxd

Figure 1

Site Location Map

Mud Lake West
SLR Sediment AOCs

Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: National Geographic Society, i-cubed

0 2 4 Miles

0 3 6 Kilometers

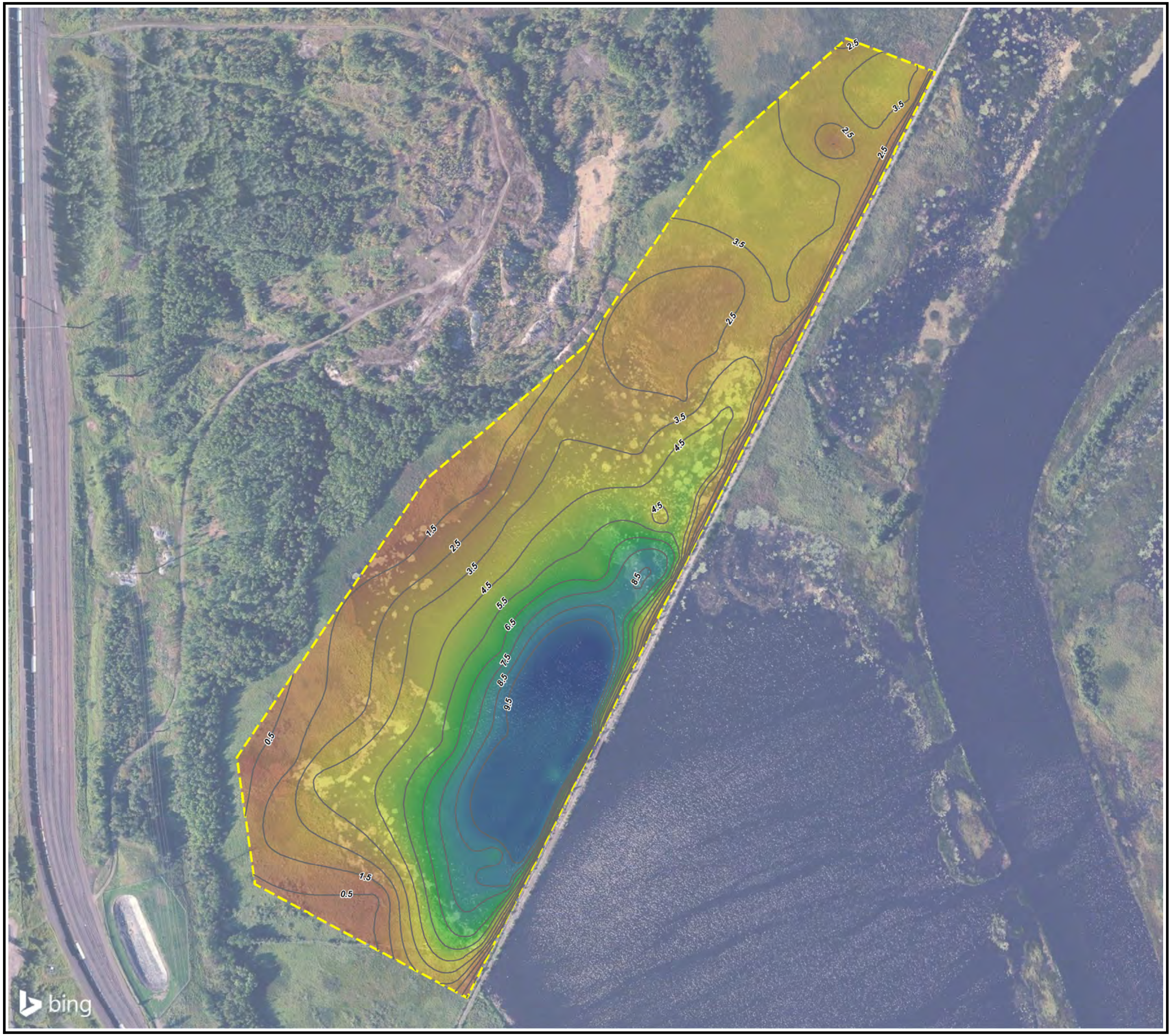
1 inch = 10,000 feet

▨ Mud Lake West Site Location

CLEAN WATER LAND & LEGACY AMENDMENT

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: SG Date Drawn/Revised:3/13/2017 Project No.J160749

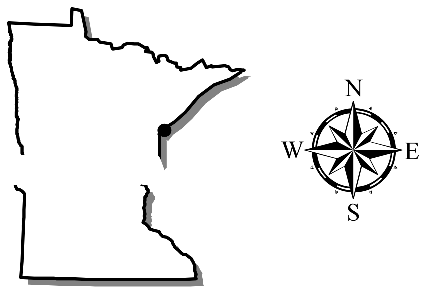


Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\J160749 FIG 2 MLW Site Map.mxd

Figure 2

Site Map

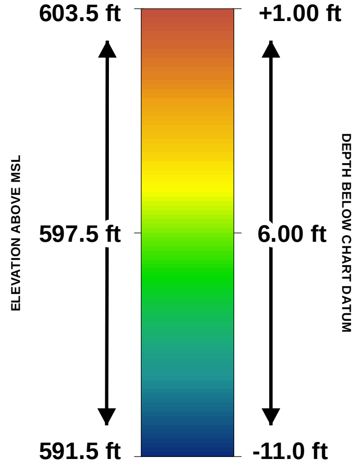
Mud Lake West
SLR Sediment AOCs
Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

―	Bathymetric Contour Line
▭	Mud Lake West Site Boundary

Water Depth



NOTE: Bathymetery compiled from water level measurements collected during March/June 2015 Remedial Investigation

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:3/13/2017 Project No.J160749

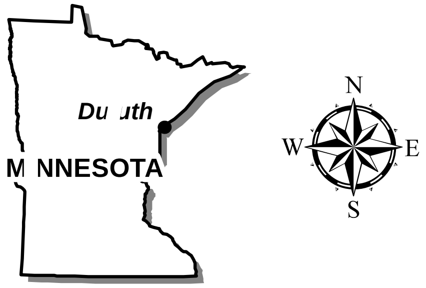
Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\J160749 FIG 3 MLW Sample Locations.mxd

Figure 3

Sample Locations

Mud Lake West
SLR Sediment AOCs

Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

0 350 700 Feet
0 100 200 Meters

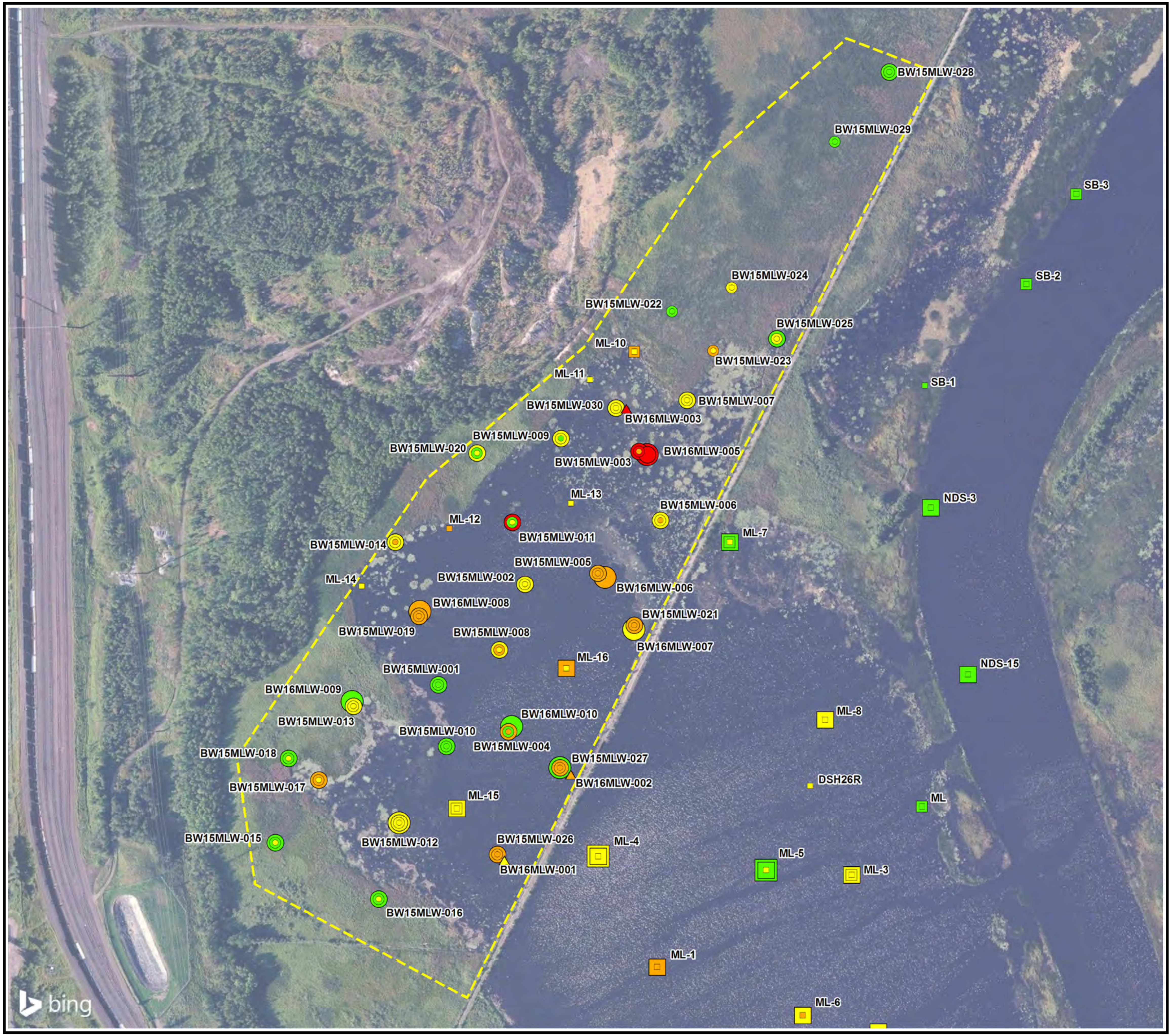
● 2016 Sediment Sample Locations

▲ 2016 Toxicity/Bioaccumulation Testing and Community Assessment Locations

▭ Mud Lake West Site Boundary

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:3/13/2017 Project No.J160749



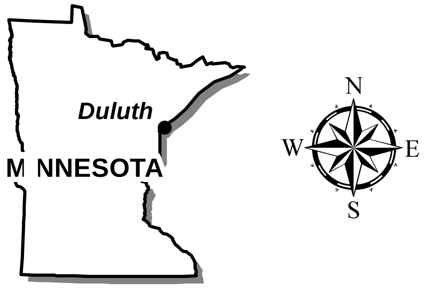
Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\J160749 FIG 4 MLW Nickel SQT Results.mxd

Figure 4

Nickel SQT Results

Mud Lake West
SLR Sediment AOCs

Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

Mud Lake West Site Boundary

Sample Type

- △ Sediment Sample, Including Tox/Bio Testing
- ○ Sediment Sample (Bay West 2015/2016)
- □ Sediment Sample (Historical)

Sample Interval

- ○ □ 0-0.15 m
- ○ □ 0.15-0.50 m
- ○ □ 0.50-1.0 m
- ○ □ >1.0 m

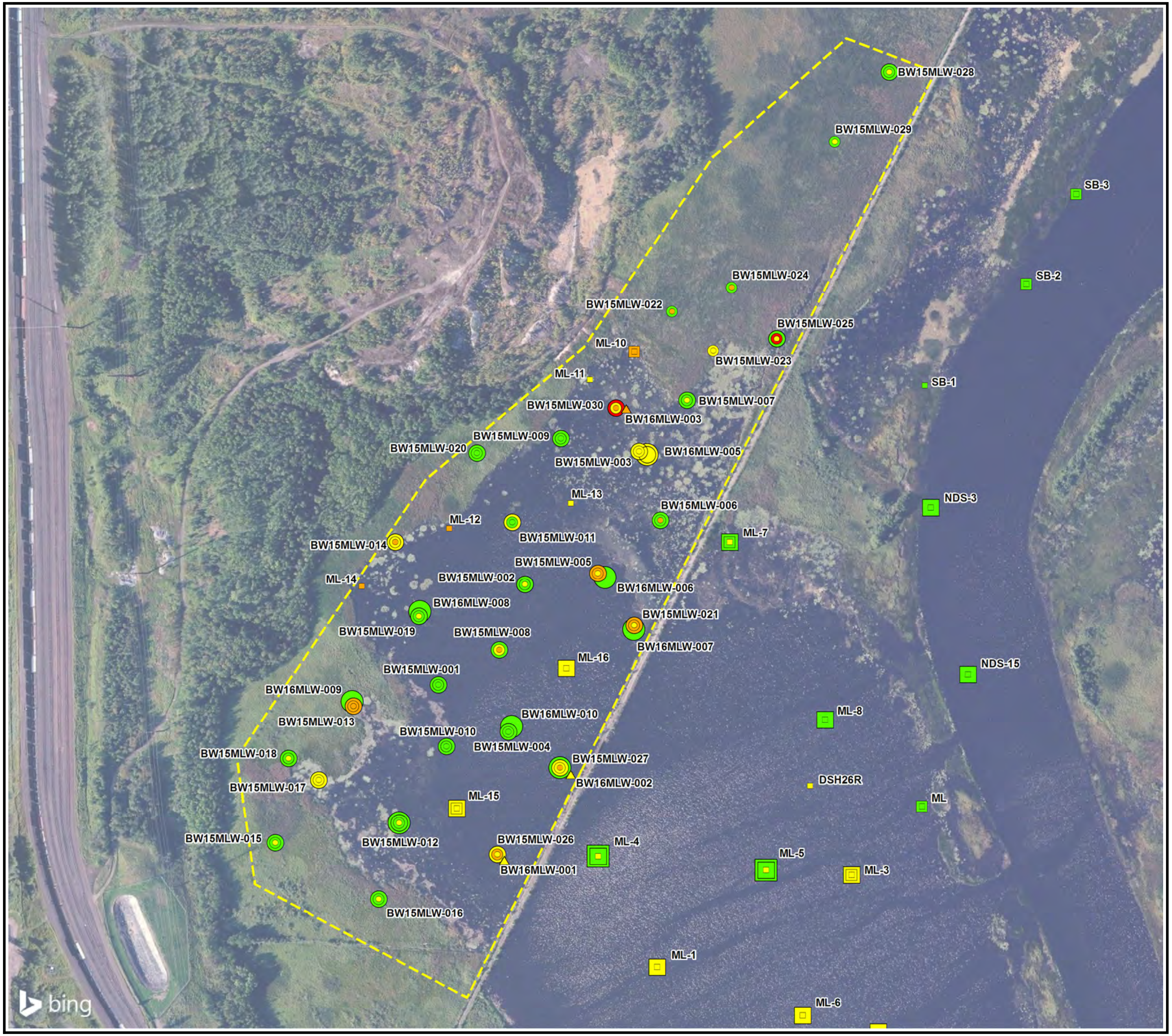
Nickel SQT Comparison

- 🟩 Does not exceed Level 1 SQT (23 mg/kg)
- 🟨 Exceeds Level 1 SQT (23 mg/kg)
- 🟧 Exceeds Midpoint SQT (36 mg/kg)
- 🟥 Exceeds Level 2 SQT (49 mg/kg)

Note: Sample location BW16MLW-004 was inaccessible during the time of sampling - Not sampled.

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:3/13/2017 Project No.J160749

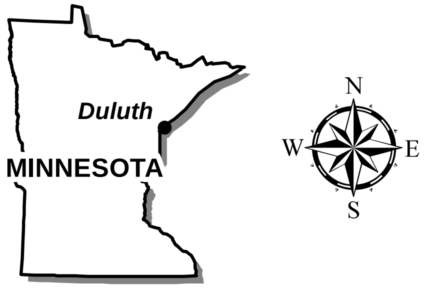


Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\J160749 FIG 5 MLW Zinc SQT Results.mxd

Figure 5

Zinc SQT Results

Mud Lake West
SLR Sediment AOCs
Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

0 350 700 Feet
0 100 200 Meters

▭ Mud Lake West Site Boundary

Sample Type

- △ Sediment Sample, Including Tox/Bio Testing
- ○ Sediment Sample (Bay West 2015/2016)
- □ Sediment Sample (Historical)

Sample Interval

- ○ □ 0-0.15 m
- ○ □ 0.15-0.50 m
- ○ □ 0.50-1.0 m
- ○ □ >1.0 m

Zinc SQT Comparison

- 🟩 Does not exceed Level 1 SQT (120 mg/kg)
- 🟨 Exceeds Level 1 SQT (120 mg/kg)
- 🟧 Exceeds Midpoint SQT (290 mg/kg)
- 🟥 Exceeds Level 2 SQT (460 mg/kg)

Note: Sample location BW16MLW-004 was inaccessible during the time of sampling - Not sampled.

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:3/13/2017 Project No.J160749

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\J160749 FIG 6 MLW Dioxin Furans TEQ KM Fish SQT Results.mxd

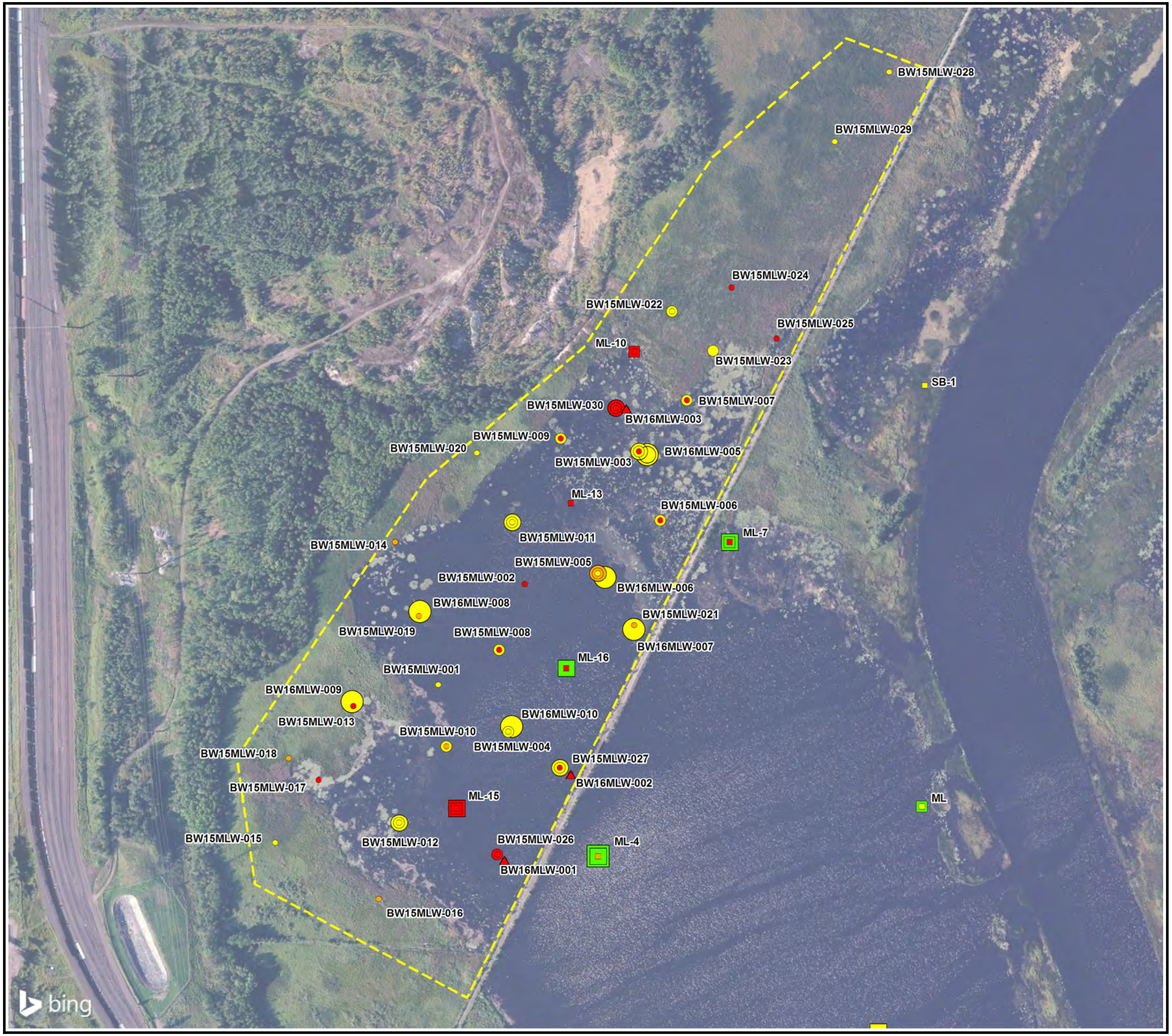
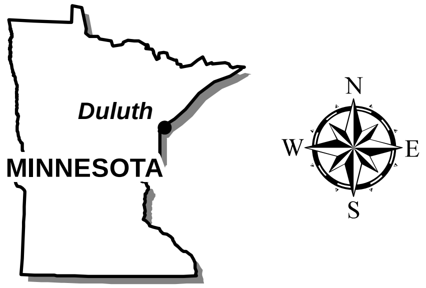


Figure 6

TEQ KM Fish SQT Results

Mud Lake West
SLR Sediment AOCs

Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

0 350 700 Feet
0 100 200 Meters

▭ Mud Lake West Site Boundary

Sample Type

- △ Sediment Sample, Including Tox/Bio Testing
- ○ Sediment Sample (Bay West 2015/2016)
- □ Sediment Sample (Historical)

Sample Interval

- ○ □ 0-0.15 m
- ○ □ 0.15-0.50 m
- ○ □ 0.50-1.0 m
- ○ □ >1.0 m

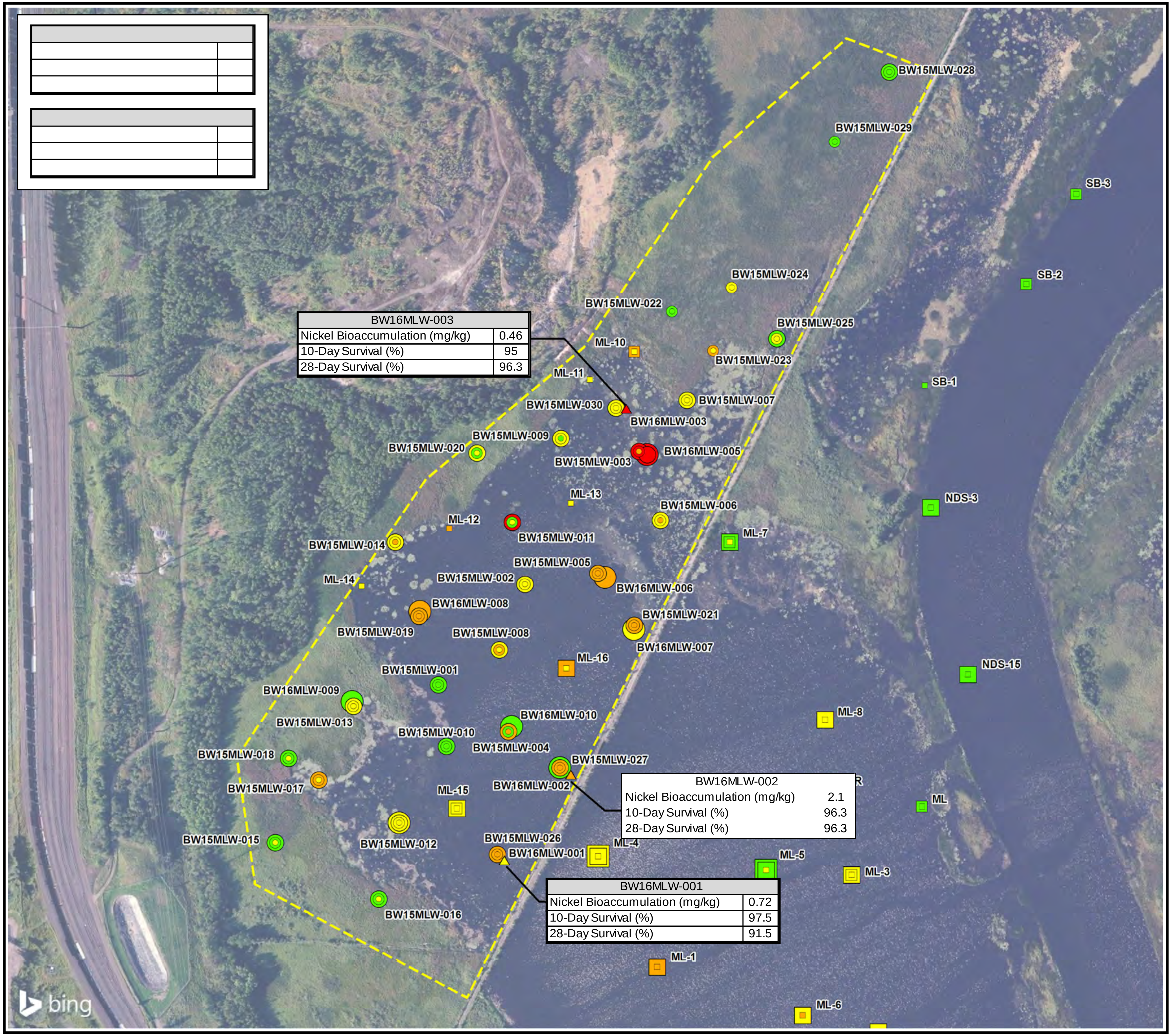
TEQ KM Fish SQT Comparison

- 🟩 Does not exceed Level 1 SQT (0.85 ng TEQ/kg)
- 🟨 Exceeds Level 1 SQT (0.85 ng TEQ/kg)
- 🟧 Exceeds Midpoint SQT (11.2 ng TEQ/kg)
- 🟥 Exceeds Level 2 SQT (21.5 ng TEQ/kg)

Note: Sample location BW16MLW-004 was inaccessible during the time of sampling - Not sampled.

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:3/13/2017 Project No.J160749



BW16MLW-003	
Nickel Bioaccumulation (mg/kg)	0.46
10-Day Survival (%)	95
28-Day Survival (%)	96.3

BW16MLW-002	
Nickel Bioaccumulation (mg/kg)	2.1
10-Day Survival (%)	96.3
28-Day Survival (%)	96.3

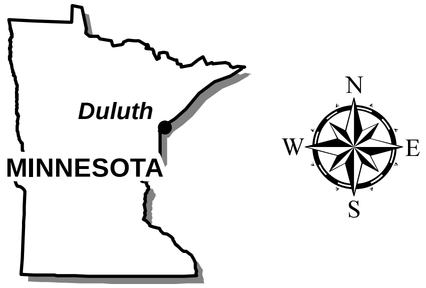
BW16MLW-001	
Nickel Bioaccumulation (mg/kg)	0.72
10-Day Survival (%)	97.5
28-Day Survival (%)	91.5

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\J160749 FIG 7 MLW Nickel Bioaccumulation Toxicity Results.mxd

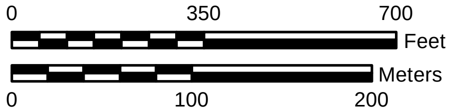
Figure 7

Nickel Bioaccumulation/Toxicity Results

Mud Lake West
SLR Sediment AOCs
Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS



Mud Lake West Site Boundary

Sample Type

- △ Sediment Sample, Including Tox/Bio Testing
- ○ Sediment Sample (Bay West 2015/2016)
- ☐ Sediment Sample (Historical)

Sample Interval

- ○ ☐ 0-0.15 m
- ○ ☐ 0.15-0.50 m
- ○ ☐ 0.50-1.0 m
- ○ ☐ >1.0 m

Nickel SQT Comparison

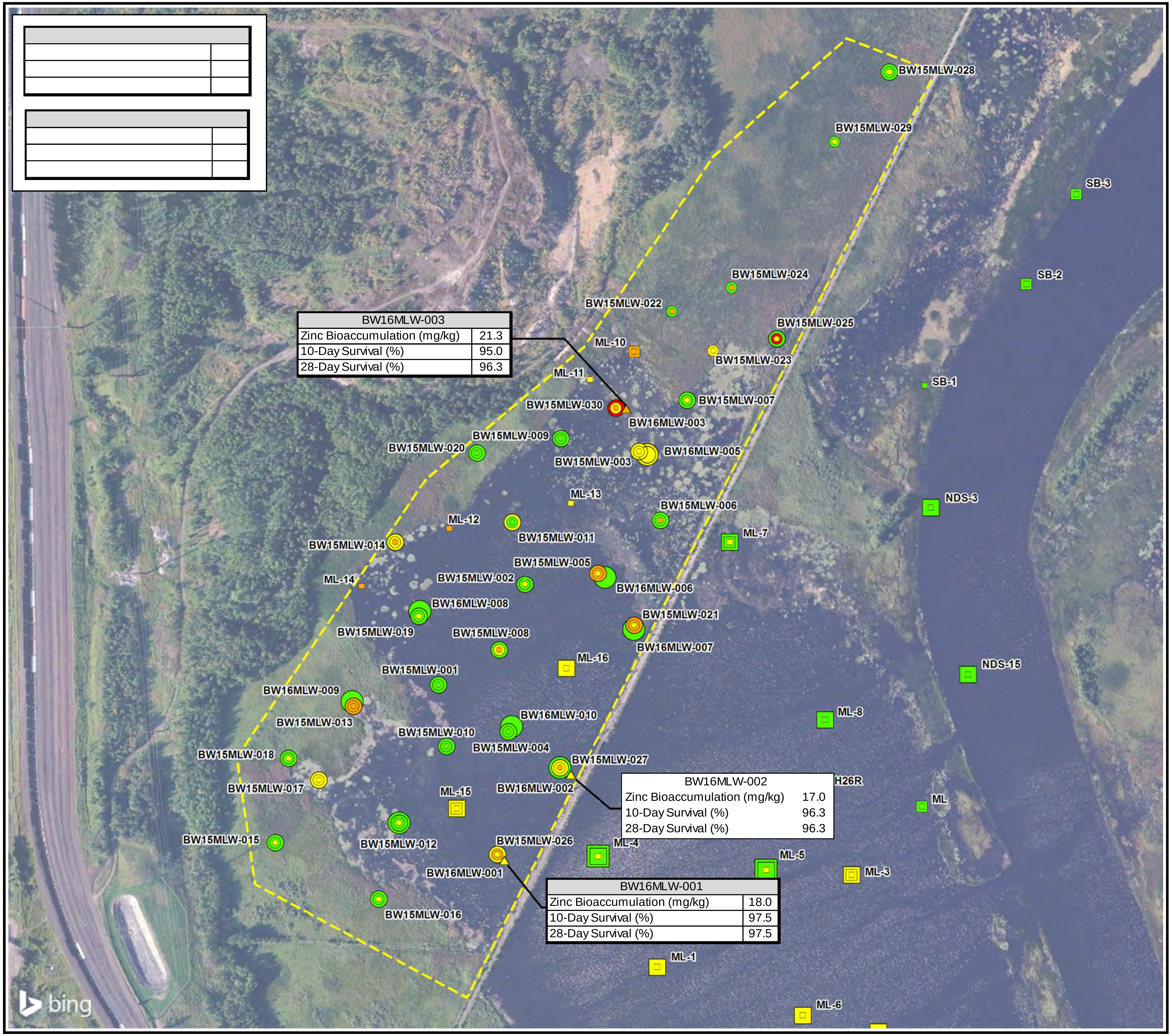
- 🟩 Does not exceed Level 1 SQT (23 mg/kg)
- 🟨 Exceeds Level 1 SQT (23 mg/kg)
- 🟧 Exceeds Midpoint SQT (36 mg/kg)
- 🟥 Exceeds Level 2 SQT (49 mg/kg)

Note: Sample location BW16MLW-004 was inaccessible during the time of sampling - Not sampled.

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:3/13/2017 Project No.J160749

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\J160749 FIG 8 MLW Zinc Bioaccumulation Toxicity Results.mxd



BW16MLW-003	
Zinc Bioaccumulation (mg/kg)	21.3
10-Day Survival (%)	95.0
28-Day Survival (%)	96.3

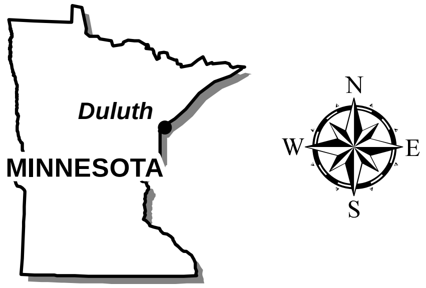
BW16MLW-002	
Zinc Bioaccumulation (mg/kg)	17.0
10-Day Survival (%)	96.3
28-Day Survival (%)	96.3

BW16MLW-001	
Zinc Bioaccumulation (mg/kg)	18.0
10-Day Survival (%)	97.5
28-Day Survival (%)	97.5

Figure 8

Zinc Bioaccumulation/Toxicity Results

Mud Lake West
SLR Sediment AOCs
Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS

0 350 700 Feet
0 100 200 Meters

▭ Mud Lake West Site Boundary

Sample Type

- △ Sediment Sample, Including Tox/Bio Testing
- ○ Sediment Sample (Bay West 2015/2016)
- □ Sediment Sample (Historical)

Sample Interval

- ○ □ 0-0.15 m
- ○ □ 0.15-0.50 m
- ○ □ 0.50-1.0 m
- ○ □ >1.0 m

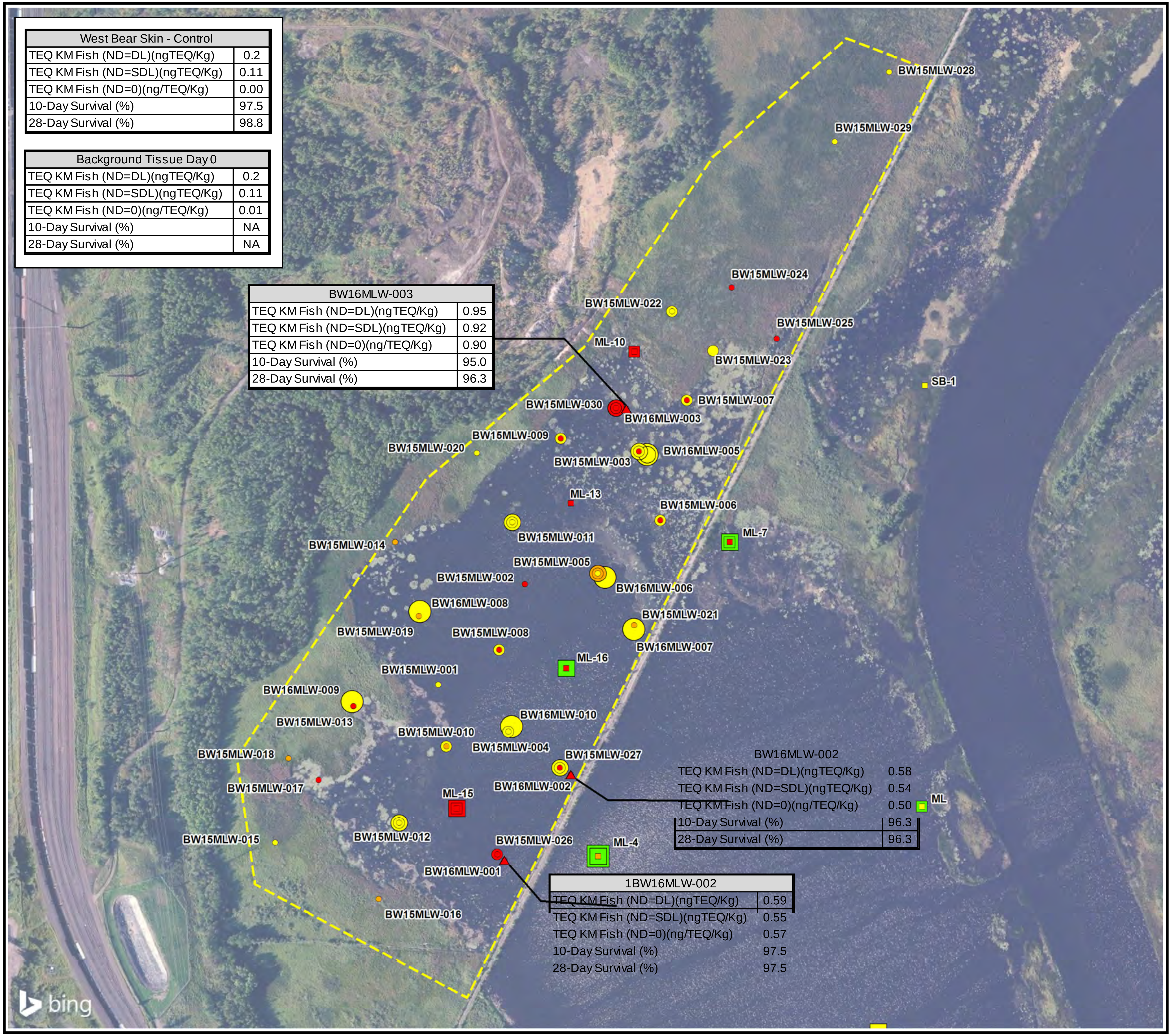
Zinc SQT Comparison

- 🟩 Does not exceed Level 1 SQT (120 mg/kg)
- 🟨 Exceeds Level 1 SQT (120 mg/kg)
- 🟧 Exceeds Midpoint SQT (290 mg/kg)
- 🟥 Exceeds Level 2 SQT (460 mg/kg)

Note: Sample location BW16MLW-004 was inaccessible during the time of sampling - Not sampled.

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:3/13/2017 Project No.J160749



West Bear Skin - Control	
TEQ KM Fish (ND=DL)(ngTEQ/Kg)	0.2
TEQ KM Fish (ND=SDL)(ngTEQ/Kg)	0.11
TEQ KM Fish (ND=0)(ng/TEQ/Kg)	0.00
10-Day Survival (%)	97.5
28-Day Survival (%)	98.8

Background Tissue Day 0	
TEQ KM Fish (ND=DL)(ngTEQ/Kg)	0.2
TEQ KM Fish (ND=SDL)(ngTEQ/Kg)	0.11
TEQ KM Fish (ND=0)(ng/TEQ/Kg)	0.01
10-Day Survival (%)	NA
28-Day Survival (%)	NA

BW16MLW-003	
TEQ KM Fish (ND=DL)(ngTEQ/Kg)	0.95
TEQ KM Fish (ND=SDL)(ngTEQ/Kg)	0.92
TEQ KM Fish (ND=0)(ng/TEQ/Kg)	0.90
10-Day Survival (%)	95.0
28-Day Survival (%)	96.3

BW16MLW-002	
TEQ KM Fish (ND=DL)(ngTEQ/Kg)	0.58
TEQ KM Fish (ND=SDL)(ngTEQ/Kg)	0.54
TEQ KM Fish (ND=0)(ng/TEQ/Kg)	0.50
10-Day Survival (%)	96.3
28-Day Survival (%)	96.3

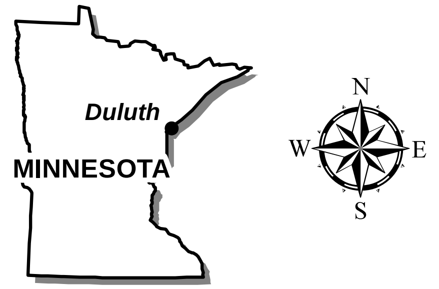
1BW16MLW-002	
TEQ KM Fish (ND=DL)(ngTEQ/Kg)	0.59
TEQ KM Fish (ND=SDL)(ngTEQ/Kg)	0.55
TEQ KM Fish (ND=0)(ng/TEQ/Kg)	0.57
10-Day Survival (%)	97.5
28-Day Survival (%)	97.5

Y:\Clients\MPCA\SLR_Sediment_AOCs\Mud_Lake\MapDocs\J160749\J160749 FIG 9 MLW TEQ KM Fish Bioaccumulation Toxicity Results.mxd

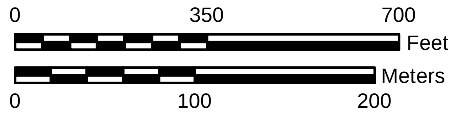
Figure 9

TEQ KM Fish Bioaccumulation/Toxicity Results

Mud Lake West
SLR Sediment AOCs
Duluth, MN



Map Projection: NAD 1983 UTM Zone 15 N
Basemap: Microsoft Bing WMS



Mud Lake West Site Boundary

Sample Type

- △ Sediment Sample, Including Tox/Bio Testing
- ○ Sediment Sample (Bay West 2015/2016)
- ☐ Sediment Sample (Historical)

Sample Interval

- ○ ☐ 0-0.15 m
- ○ ☐ 0.15-0.50 m
- ○ ☐ 0.50-1.0 m
- ○ ☐ >1.0 m

TEQ KM Fish SQT Comparison

- 🟩 Does not exceed Level 1 SQT (0.85 ng TEQ/kg)
- 🟨 Exceeds Level 1 SQT (0.85 ng TEQ/kg)
- 🟧 Exceeds Midpoint SQT (11.2 ng TEQ/kg)
- 🟥 Exceeds Level 2 SQT (21.5 ng TEQ/kg)

Note: Sample location BW16MLW-004 was inaccessible during the time of sampling - Not sampled.

Bay West
Customer-Focused Environmental & Industrial Solutions

Drawn By: S.G. Date Drawn/Revised:3/13/2017 Project No.J160749

Appendix A

Field Notes, Core Logs, and Photos

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Boulder Lake Reservoir
Location ID: BW16BLR-001

Core & Polling Collection Information

Sample Collectors: ACB | SMC | JMB
Date Collected: September 20, 2016
Time Collected: 12:16 PM
Above/Below LWD (ft):
Water Elevation (ft):
Water Depth (ft): 8.0
Sediment Elevation (ft):

Poling Collection Information

Equipment: Rods

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
PL-01	254	289	315	61	Woody Debris	Silt Loam
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Ponar/Grab

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
-			0	—
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB | JMB | CJM
Length of Core (m): 0.15
Date Processed: September 20, 2016
Time Processed: 12:10 PM

Sediment Characterization Log

Location ID: BW16BLR-001

Layer 1: Start Depth (m): 0.0 End Depth (m): 0.15

Primary Color: Very Dark Brown (10YR 2/2)

Secondary Color: Dark Brown (10YR 3/3)

USCS: PT

USDA: Peat

Grains: Rounded

Organics: Woody

%: 75 - 100

Odor: No Odor

Rocks: None

%: N/A

Moisture: Saturated

Petrochemical: None

Cohesiveness: Loose

Description/ Notes: Very woody, 90%, some silt, <5%.

Layer 2: Start Depth (m): End Depth (m):

Primary Color: —

Secondary Color: —

USCS: —

USDA: —

Grains: —

Organics: —

%: —

Odor: —

Rocks: —

%: —

Moisture: —

Petrochemical: —

Cohesiveness: —

Description/ Notes:

Layer 3: Start Depth (m): End Depth (m):

Primary Color: —

Secondary Color: —

USCS: —

USDA: —

Grains: —

Organics: —

%: —

Odor: —

Rocks: —

%: —

Moisture: —

Petrochemical: —

Cohesiveness: —

Description/ Notes:

Benthic Macroinvertebrate Worksheet

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR

Project #: J160139

Client: MPCA

Contractor: Bay West

Site Name: Boulder Lake Reservoir

Sample/Location Name: BW16BLR-001

Processors: ACB | JMB

Date: September 20, 2016

Time: 10:49 AM

Weather: Temperature (deg F): 70

Skies: Partly Cloudy

Wind Speed (mph) & Direction: 5-10

Sample Collection Information

Method: Ponar

Number of Grabs: 3

Approximate Collection Area (cm2): 675

Notes:

Each grab = 15.2 cm x 15.2 cm (225 cm2)

Multiple grabs

Habitat Information

Primary Color: Very Dark Brown (10YR 2/2)

Secondary Color: Dark Brown (10YR 3/3)

USCS: PT

USDA: Peat

Grains: Well Rounded

Organics: Woody

%: 75 - 100

Odor: No Odor

Rocks: None

%: N/A

Moisture: Saturated

Petrochemical: None

Cohesiveness: Loose

Description/Notes: Natural sheen, woody, 90%, some silt (<5%)

Notes:

Very woody organics, 90%, with some silt.

Bay West

Benthic Macroinvertebrate Community Assessment

Each grab = 15.2 cm x 15.2 cm (225 cm2)

	Group 1 *(Sensitive)*		**Group 2** *(Semi-Sensitive)*		**Group 3** *(Semi-Tolerant)*		**Group 4** *(Tolerant)*
	Alderfly		Caddisfly		Black Fly		Bloodworm Midge
	Dobsonfly		Crane Fly		Non-Red Midge		Isopod/Sowbug
	Stonefly		Crawfish		Scud		Leech
	Water Snipe Fly		Damselfly		Snails		Tubifex Worm
			Dragonfly				
			Fingernail Clam				
			Mayfly				
			Riffle Beetle				
			Water Penny				
Total # of Organisms:	0	Total # of Organisms:	0	Total # of Organisms:	0	Total # of Organisms:	0
Total # of Taxa:		Total # of Taxa:		Total # of Taxa:		Total # of Taxa:	

Miscellaneous Benthic Macroinvertebrates

(Not included in lists above.)

	Other		
	Other		
	Other		

Total # of Organisms: 0

Total # of Taxa:

Notes:

15 minute assessment performed no macroinvertebrates found.

TOTAL # of TAXA: 0

TOTAL # of ORGANISMS: 0

v.082016

Benthic Macroinvertebrate Sample Collection

Sample Location: BW16BLR-001

Target Macroinvertebrate Organism: Other (See notes)

Date: September 20, 2016

Organism Size	Quantity	Wet Weight (g)	Individual Wet Weight (g)
Large (>/= 20 mm)			0
Medium (10-19 mm)			0
Small (< 9 mm)			0
	Total	**Total**	**Average**
	0	0	0

Notes:

No macroinvertebrates were submitted for analysis.

Sample Processing - **Depuration**

Start Date/Time:

End Date/Time:

Duration (hours):

Laboratory Sample Analysis

Sample ID:

Sample Date/Time:

Laboratory: —

☐ PAHs 17 ☐ VOCs ☐ Dioxins ☐ PCBs ☐ pH ☐ Moisture ☐ TOC ☐ Grain Size

☐ Select Metals ☐ Ar ☐ Cd ☐ Cr ☐ Cu ☐ Hg ☐ Ni ☐ Pb

☐ MS/MSD —

☐ Other Compound: —

☐ Duplicate —

Sample ID:

Dup Time:

Notes:

v.082016

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: September 20, 2016

Sample Location: BW16BLR-001

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 5:

Photo 6:

v.082016

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Boulder Lake Reservoir
Location ID: BW16BLR-002

Core & Polling Collection Information

Sample Collectors: ACB | SC | JMB

Date Collected: September 20, 2016
Time Collected: 1:25 PM
Above/Below LWD (ft):
Water Elevation (ft):
Water Depth (ft): 14.2
Sediment Elevation (ft):

Poling Collection Information

Equipment: Rods

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
PL-01	432	549	605	173	Sediment	Silt
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Ponar/Grab

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
—			0	—
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB | JMB | CJM

Length of Core (m): 0.15
Date Processed: September 20, 2016
Time Processed: 2:10 PM

v.072016

Sediment Characterization Log

Location ID: BW16BLR-002

Layer 1:

Start Depth (m): 0.0
End Depth (m): 0.15

Primary Color: Very Dark Brown (10YR 2/2)
Secondary Color: Black (10YR 2/1)
USCS: ML
USDA: Silt Loam
Grains: Rounded
Organics: Woody
%: 0 - 5
Odor: No Odor
Rocks: None
%: N/A
Moisture: Saturated
Petrochemical: None
Cohesiveness: Loose
Description/ Notes: Soft clayey silt, loose.

Layer 2:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —
USCS: —
USDA: —
Grains: —
Organics: —
%: —
Odor: —
Rocks: —
%: —
Moisture: —
Petrochemical: —
Cohesiveness: —
Description/ Notes:

Layer 3:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —
USCS: —
USDA: —
Grains: —
Organics: —
%: —
Odor: —
Rocks: —
%: —
Moisture: —
Petrochemical: —
Cohesiveness: —
Description/ Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: September 20, 2016

Location ID: BW16BLR-002

Photo 1:

Photo 2:

Photo 3:

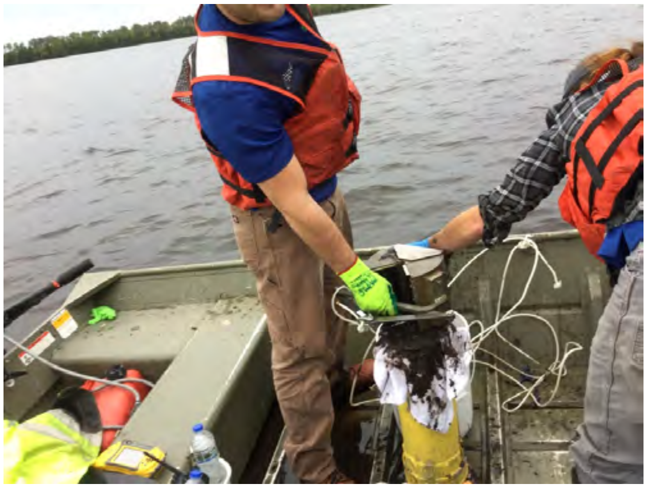


Photo 4:

Photo 5:

Photo 6:

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Boulder Lake Reservoir
Location ID: BW16BLR-003

Core & Polling Collection Information

Sample Collectors: ACB | JMB | SC

Date Collected: September 21, 2016
Time Collected: 10:17 AM
Above/Below LWD (ft):
Water Elevation (ft):
Water Depth (ft): 7.5
Sediment Elevation (ft):

Poling Collection Information

Equipment: Rods

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
PL-01	239	249	272	33	Sediment	Silt Loam
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Ponar/Grab

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
—			0	—
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB | JMB | CJM

Length of Core (m): 0.15
Date Processed: September 20, 2016
Time Processed: 10:30 AM

Sediment Characterization Log

Location ID: BW16BLR-003

Bay West

Layer 1:

Start Depth (m): 0.0

End Depth (m): 0.15

Primary Color: Very Dark Brown (10YR 2/2)

Secondary Color: Black (10YR 2/1)

USCS: ML

USDA: Silt Loam

Grains: Rounded

Organics: Fibrous

%: 10 - 25

Odor: No Odor

Rocks: None

%: N/A

Moisture: Saturated

Petrochemical: None

Cohesiveness: Loose

Description/ Notes: Silty with some fine sand, loose with long fibrous woody material.

Layer 2:

Start Depth (m):

End Depth (m):

Primary Color: —

Secondary Color: —

USCS: —

USDA: —

Grains: —

Organics: —

%: —

Odor: —

Rocks: —

%: —

Moisture: —

Petrochemical: —

Cohesiveness: —

Description/ Notes:

Layer 3:

Start Depth (m):

End Depth (m):

Primary Color: —

Secondary Color: —

USCS: —

USDA: —

Grains: —

Organics: —

%: —

Odor: —

Rocks: —

%: —

Moisture: —

Petrochemical: —

Cohesiveness: —

Description/ Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: September 21, 2016

Location ID: BW16BLR-003

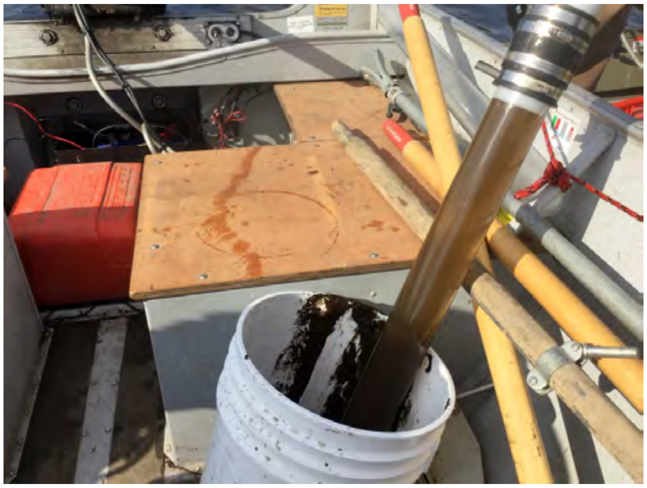


Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 5:

Photo 6:

Bay West
Customer-Focused Environmental & Industrial Solutions

Bay West LLC
5 Empire Drive
St. Paul, Minnesota 55103-1867

651/291-0456
FAX 651/291-0099
1-800-279-0456

DAILY DIARY

To be completed by Crew Leader

*Page _1_ of _2_*

Job Name **SLR AOC**	**Job No.** **J160139**	**Date** **October 4, 2016**
Project Manager **Paul Raymaker**	**Bay West Crew** **Chris Musson, Alex Blel, Jonna Bjelland**	

Personnel on Site ***(Client, Visitors, Bay West staff other than listed above)***

Andrew Peterson

Detailed description of work performed:

Crew members mobilized to the Duluth office and gathered equipment and supplies, and then mobilized to Mud Lake West. The small jon boat was launched and the team collected: bulk sediments for laboratory toxicity/bioaccumulation testing using a petite ponar dredge from the 0.0 – 0.15m interval; sediment surface samples using a petite ponar dredge from the 0.0 – 0.15m interval; and deep interval sediment samples using a Russian peat borer sampler (intervals varied depending on location and refusal). Location BW16MLW-004 was not collected as it is located within the marsh area. Previous experience sampling within the marsh area suggests a push depth greater than 1.0 meter would not be achievable due to the lack of sediment and the presence of dense, rooty material that makes up the lake bottom in that area.

Following sample collection, the team prepared the bulk sediment samples for shipment to the toxicity/bioaccumulation testing laboratory (GLEC) and processed the remaining sediment samples collected from Mud Lake West. Samples destined for GLEC were delivered to Fed Ex for overnight shipping to GLEC.

Note –Collected and depurated organisms are being held awaiting determination of how samples should be composited (potentially with Hester Dendy tissue) and what locations/species should be analyzed. Sediment samples collected from the reservoirs are also awaiting shipment to the laboratory. These samples are waiting on determination of whether or not sufficient benthic tissue can be collected at a particular location and which locations will have sediments submitted for laboratory bioaccumulation testing.

Waste Generated:

None.

Change in Conditions (if any):

None.

Sample Summary:

Samples Taken: _X_ Yes ___ No	BW16MLW-001, 002, and 003 (bulk sediments from the sediment surface for toxicity/bioaccumulation testing and physical/chemical analysis) BW16MLW-005 through 010 (surface and deep interval sediments for physical/chemical analysis)	COC: SLR-GLEC-1 (toxicity/bioaccumulation testing, d/f, nickel, zinc, TOC) SLR-MLW-1 (d/f, nickel, zinc) SLR-MLW-2 (TOC, grain size)

Sample Destination:

Benthic tissue – Organisms will be depurated and jarred, then sent to EPA-designated lab.
Sediment – Dioxins/furans, mercury, TOC, and grain size samples will be sent to Pace.

Benthic Macroinvertebrate Worksheet

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Project #: J160139
Client: MPCA
Contractor: Bay West
Site Name: Mud Lake West
Sample/Location Name: BW16MLW-001
Processors: ACB JMB CJM
Date: October 4, 2016
Time: 10:30 AM
Weather: Temperature (deg F): 61 Skies: Partly Sunny Wind Speed (mph) & Direction: 0-5

Sample Collection Information

Method: Ponar
Number of Grabs: 3
Approximate Collection Area (cm2): 675
Notes: **Each grab = 15.2 cm x 15.2 cm (225 cm2)**

Habitat Information

Primary Color: Very Dark Brown (10YR 2/2)
Secondary Color: Dark Brown (10YR 3/3)
USCS: ML
USDA: Silt Loam
Grains: Well Rounded
Organics: Fibrous
%: 0 - 5
Odor: No Odor
Rocks: None
%: N/A
Moisture: Saturated
Petrochemical: None
Cohesiveness: —
Description/Notes: Very soft sediment, <5% fibrous woody debris

Notes:

v.082016

Benthic Macroinvertebrate Community Assessment

Each grab = 15.2 cm x 15.2 cm (225 cm2)

Group 1 *(Sensitive)*		**Group 2** *(Semi-Sensitive)*		**Group 3** *(Semi-Tolerant)*		**Group 4** *(Tolerant)*	
	Alderfly		Caddisfly		Black Fly		Bloodworm Midge
	Dobsonfly		Crane Fly	1	Non-Red Midge		Isopod/Sowbug
	Stonefly		Crawfish		Scud		Leech
	Water Snipe Fly		Damselfly		Snails		Tubifex Worm
			Dragonfly				
		1	Fingernail Clam				
			Mayfly				
			Riffle Beetle				
			Water Penny				
Total # of Organisms:	0	Total # of Organisms:	1	Total # of Organisms:	1	Total # of Organisms:	0
Total # of Taxa:		Total # of Taxa:	1	Total # of Taxa:	1	Total # of Taxa:	

Miscellaneous Benthic Macroinvertebrates

(Not included in lists above.)

			2	Other	Horsefly	Total # of Organisms:	3
	Other		1	Other	Needleworm	Total # of Taxa:	2

Notes:

15 min assessment

TOTAL # of TAXA: 4

TOTAL # of ORGANISMS: 5

v.082016

Benthic Macroinvertebrate Sample Collection

Sample Location: BW16MLW-001

Target Macroinvertebrate Organism: Other (See notes)

Date: October 4, 2016

Organism Size	Quantity	Wet Weight (g)	Individual Wet Weight (g)
Large (>/= 20 mm)			0
Medium (10-19 mm)			0
Small (< 9 mm)			0
	Total	**Total**	**Average**
	0	0	0

Notes:

No macroinvertebrates were submitted for analysis.

Sample Processing - **Depuration**

Start Date/Time:

End Date/Time:

Duration (hours):

Laboratory Sample Analysis

Sample ID:

Sample Date/Time:

Laboratory: —

☐ PAHs 17 ☐ VOCs ☐ Dioxins ☐ PCBs ☐ pH ☐ Moisture ☐ TOC ☐ Grain Size

☐ Select Metals ☐ Ar ☐ Cd ☐ Cr ☐ Cu ☐ Hg ☐ Ni ☐ Pb

☐ MS/MSD —

☐ Other Compound: —

☐ Duplicate —

Sample ID:

Dup Time:

Notes:

v.082016

Photographic Log

Project Name:	SLR	Project Number:	J160139	Photographs taken on:	October 5, 2016
Sample Location:	BW16MLW-001				

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 5:

Photo 6:

v.082016

Benthic Macroinvertebrate Worksheet

Project/Site Information

Project Name: SLR **Project #:** J160139 **Client:** MPCA **Contractor:** Bay West

Site Name: Mud Lake West **Sample/Location Name:** BW16MLW-002

Processors: ACB JMB CJM **Date:** October 4, 2016 **Time:** 10:54 AM

Weather: Temperature (deg F): 61 Skies: Partly Sunny Wind Speed (mph) & Direction: 0-5

Sample Collection Information

Method: Ponar

Number of Grabs: 3 **Approximate Collection Area (cm2):** 675

Notes: **Each grab = 15.2 cm x 15.2 cm (225 cm2)**

Habitat Information

Primary Color: Very Dark Brown (10YR 2/2) Secondary Color: Dark Brown (10YR 3/3)

USCS: ML USDA: Silt Loam Grains: Well Rounded

Organics: Fibrous %: 5 - 10 Odor: No Odor

Rocks: None %: N/A Moisture: Saturated

Petrochemical: None Cohesiveness: Loose

Description/Notes: Very soft silty sediment, 7% fibrous woody

Notes:

v.082016

Bay West

Benthic Macroinvertebrate Community Assessment

Each grab = 15.2 cm x 15.2 cm (225 cm2)

Group 1 *(Sensitive)*		**Group 2** *(Semi-Sensitive)*		**Group 3** *(Semi-Tolerant)*		**Group 4** *(Tolerant)*	
	Alderfly		Caddisfly		Black Fly		Bloodworm Midge
	Dobsonfly		Crane Fly		Non-Red Midge		Isopod/Sowbug
	Stonefly		Crawfish		Scud		Leech
	Water Snipe Fly		Damselfly		Snails		Tubifex Worm
			Dragonfly				
		1	Fingernail Clam				
			Mayfly				
			Riffle Beetle				
			Water Penny				
Total # of Organisms:	0	Total # of Organisms:	1	Total # of Organisms:	0	Total # of Organisms:	0
Total # of Taxa:		Total # of Taxa:	1	Total # of Taxa:		Total # of Taxa:	

Miscellaneous Benthic Macroinvertebrates

(Not included in lists above.)

	Other		5	Other: Horsefly
				Other:

Total # of Organisms: 5

Total # of Taxa: 1

Notes:

15 min assessment

TOTAL # of TAXA: 2

TOTAL # of ORGANISMS: 6

v.082016

Benthic Macroinvertebrate Sample Collection

Sample Location: BW16MLW-002

Target Macroinvertebrate Organism: Other (See notes)

Date: October 4, 2016

Organism Size	Quantity	Wet Weight (g)	Individual Wet Weight (g)
Large (>/= 20 mm)			0
Medium (10-19 mm)			0
Small (< 9 mm)			0
	Total	Total	Average
	0	0	0

Notes:

No macroinvertebrates were submitted for analysis.

Sample Processing - **Depuration**

Start Date/Time:

End Date/Time:

Duration (hours):

Laboratory Sample Analysis

Sample ID:

Sample Date/Time:

Laboratory: —

☐ PAHs 17 ☐ VOCs ☐ Dioxins ☐ PCBs ☐ pH ☐ Moisture ☐ TOC ☐ Grain Size

☐ Select Metals ☐ Ar ☐ Cd ☐ Cr ☐ Cu ☐ Hg ☐ Ni ☐ Pb

☐ MS/MSD —

☐ Other Compound: —

☐ Duplicate —

Sample ID:

Dup Time:

Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: October 5, 2016

Sample Location: BW16MLW-002

Photo 1:

Photo 2:

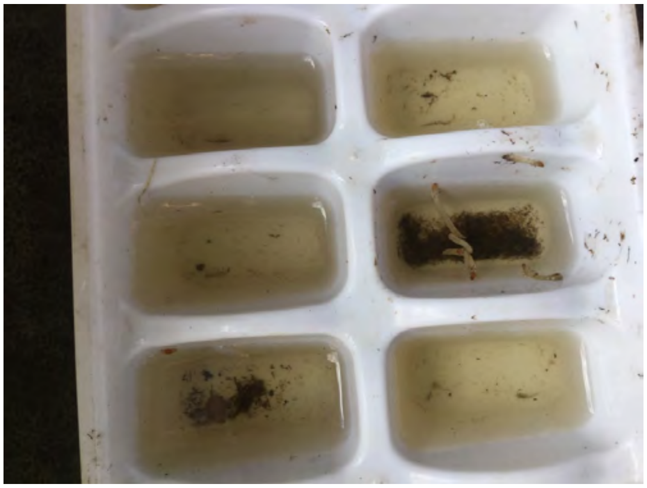


Photo 3:

Photo 4:

Photo 5:

Photo 6:

Benthic Macroinvertebrate Worksheet

Project/Site Information

Project Name: SLR **Project #:** J160139 **Client:** MPCA **Contractor:** Bay West

Site Name: Mud Lake West **Sample/Location Name:** BW16MLW-003

Processors: ACB JMB CJM **Date:** October 4, 2016 **Time:** 11:13 AM

Weather: Temperature (deg F): 61 Skies: Partly Sunny Wind Speed (mph) & Direction: 5-10

Sample Collection Information

Method: Ponar

Number of Grabs: 3 **Approximate Collection Area (cm2):** 675

Notes: **Each grab = 15.2 cm x 15.2 cm (225 cm2)**

Habitat Information

Primary Color: Very Dark Brown (10YR 2/2) Secondary Color: Dark Brown (10YR 3/3)

USCS: ML USDA: Silt Loam Grains: Well Rounded

Organics: Fibrous %: 10 - 25 Odor: No Odor

Rocks: None %: N/A Moisture: Saturated

Petrochemical: None Cohesiveness: Loose

Description/Notes: Very soft silty sediment, 15% fibrous woody material

Notes:

Benthic Macroinvertebrate Community Assessment

Each grab = 15.2 cm x 15.2 cm (225 cm2)

Group 1 *(Sensitive)*		**Group 2** *(Semi-Sensitive)*		**Group 3** *(Semi-Tolerant)*		**Group 4** *(Tolerant)*	
	Alderfly		Caddisfly		Black Fly	6	Bloodworm Midge
	Dobsonfly		Crane Fly		Non-Red Midge		Isopod/Sowbug
	Stonefly		Crawfish		Scud		Leech
	Water Snipe Fly		Damselfly	3	Snails		Tubifex Worm
			Dragonfly				
			Fingernail Clam				
			Mayfly				
			Riffle Beetle				
			Water Penny				
Total # of Organisms:	0	Total # of Organisms:	0	Total # of Organisms:	3	Total # of Organisms:	6
Total # of Taxa:		Total # of Taxa:		Total # of Taxa:	1	Total # of Taxa:	1

Miscellaneous Benthic Macroinvertebrates

(Not included in lists above.)

	Other			Other	
	Other			Other	

Total # of Organisms: 0

Total # of Taxa:

Notes:

15 minute assessment

TOTAL # of TAXA: 2

TOTAL # of ORGANISMS: 9

Benthic Macroinvertebrate Sample Collection

Sample Location: BW16MLW-003

Target Macroinvertebrate Organism: Other (See notes)

Date: October 4, 2016

Organism Size	Quantity	Wet Weight (g)	Individual Wet Weight (g)
Large (>/= 20 mm)			0
Medium (10-19 mm)			0
Small (< 9 mm)			0
	Total	**Total**	**Average**
	0	0	0

Notes:

No macroinvertebrates were submitted for analysis.

Sample Processing - **Depuration**

Start Date/Time:

End Date/Time:

Duration (hours):

Laboratory Sample Analysis

Sample ID:

Sample Date/Time:

Laboratory: —

☐ PAHs 17 ☐ VOCs ☐ Dioxins ☐ PCBs ☐ pH ☐ Moisture ☐ TOC ☐ Grain Size

☐ Select Metals ☐ Ar ☐ Cd ☐ Cr ☐ Cu ☐ Hg ☐ Ni ☐ Pb

☐ MS/MSD —

☐ Other Compound: —

☐ Duplicate —

Sample ID:

Dup Time:

Notes:

v.082016

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: October 5, 2016

Sample Location: BW16MLW-003

Photo 1:

Photo 2:

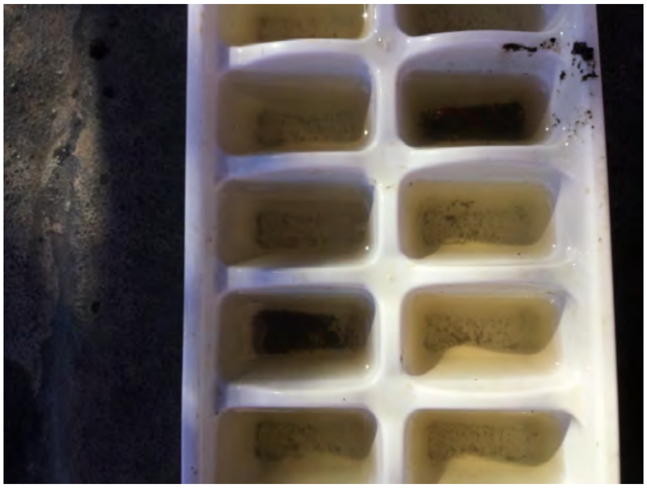


Photo 3:

Photo 4:

Photo 5:

Photo 6:

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Mud Lake West
Location ID: BW16MLW-001

Core & Polling Collection Information

Sample Collectors: ACB | JMB | CJM
Date Collected: October 4, 2016
Time Collected: 10:08 AM
Above/Below LWD (ft): 2.4
Water Elevation (ft): 601.1
Water Depth (ft): 7.0
Sediment Elevation (ft): 596.5

Poling Collection Information

Equipment: N/A

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
				0	—	—
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Ponar/Grab

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
—			0	—
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB | CJM | JMB
Length of Core (m): 0.15
Date Processed: October 4, 2016
Time Processed: 10:08 AM

Sediment Characterization Log

Location ID: BW16MLW-001

Bay West

Layer 1:

Start Depth (m): 0.0
End Depth (m): 0.15

Primary Color: Very Dark Brown (10YR 2/2)
Secondary Color: Dark Brown (10YR 3/3)

USCS: ML
USDA: Silt Loam
Grains: Well Rounded

Organics: Fibrous
%: 0 - 5
Odor: No Odor

Rocks: None
%: N/A
Moisture: Saturated

Petrochemical: None
Cohesiveness: Loose

Description/ Notes: Very soft silty sediment, <5% fibrous woody

Layer 2:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —

USCS: —
USDA: —
Grains: —

Organics: —
%: —
Odor: —

Rocks: —
%: —
Moisture: —

Petrochemical: —
Cohesiveness: —

Description/ Notes:

Layer 3:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —

USCS: —
USDA: —
Grains: —

Organics: —
%: —
Odor: —

Rocks: —
%: —
Moisture: —

Petrochemical: —
Cohesiveness: —

Description/ Notes:

Photographic Log

Bay West

Project Name: SLR

Project Number: J160139

Photographs taken on: October 4, 2016

Location ID: BW16MLW-001

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 5:

Photo 6:

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Mud Lake West
Location ID: BW16MLW-002

Core & Polling Collection Information

Sample Collectors: ACB JMB CJM
Date Collected: October 4, 2016
Time Collected: 10:48 AM
Above/Below LWD (ft): 2.4
Water Elevation (ft): 601.1
Water Depth (ft): 8.2
Sediment Elevation (ft): 595.3

Poling Collection Information

Equipment: N/A

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
				0	—	—
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Ponar/Grab

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
—			0	—
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB CJM JMB
Length of Core (m): 0.15
Date Processed: October 4, 2016
Time Processed: 10:48 AM

Sediment Characterization Log

Location ID: BW16MLW-002

Layer 1:

Start Depth (m): 0.0
End Depth (m): 0.15

Primary Color: Very Dark Brown (10YR 2/2)
Secondary Color: Dark Brown (10YR 3/3)
USCS: ML
USDA: Silt Loam
Grains: Well Rounded
Organics: Fibrous
%: 5 - 10
Odor: No Odor
Rocks: None
%: N/A
Moisture: Saturated
Petrochemical: None
Cohesiveness: Loose
Description/ Notes: Very soft silty sediment, 7% fibrous woody

Layer 2:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —
USCS: —
USDA: —
Grains: —
Organics: —
%: —
Odor: —
Rocks: —
%: —
Moisture: —
Petrochemical: —
Cohesiveness: —
Description/ Notes:

Layer 3:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —
USCS: —
USDA: —
Grains: —
Organics: —
%: —
Odor: —
Rocks: —
%: —
Moisture: —
Petrochemical: —
Cohesiveness: —
Description/ Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: October 4, 2016

Location ID: BW16MLW-002

Photo 1:

Photo 2:

Photo 3:

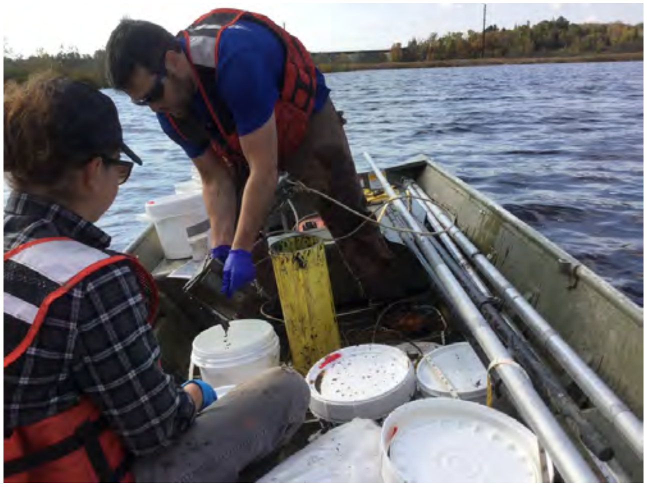


Photo 4:

Photo 5:

Photo 6:

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR

Client: MPCA

Contractor: Bay West

Project #: J160139

Site Location: Mud Lake West

Location ID: BW16MLW-003

Core & Polling Collection Information

Sample Collectors: ACB JMB CJM

Date Collected: October 4, 2016

Time Collected: 11:07 AM

Above/Below LWD (ft): 2.4

Water Elevation (ft): 601.1

Water Depth (ft): 3.25

Sediment Elevation (ft): 600.25

Poling Collection Information

Equipment: N/A

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
				0	—	—
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Ponar/Grab

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
—			0	—
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB CJM JMB

Length of Core (m): 0.15

Date Processed: October 4, 2016

Time Processed: 11:07 AM

v.072016

Sediment Characterization Log

Location ID: BW16MLW-003

Bay West

Layer 1:

Start Depth (m): 0.0
End Depth (m): 0.15

Primary Color: Very Dark Brown (10YR 2/2)
Secondary Color: Dark Brown (10YR 3/3)

USCS: ML
USDA: Silt Loam
Grains: Well Rounded

Organics: Fibrous
%: 10 - 25
Odor: No Odor

Rocks: None
%: N/A
Moisture: Saturated

Petrochemical: None
Cohesiveness: Loose

Description/ Notes: Very soft silty sediment, 15% fibrous woody material

Layer 2:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —

USCS: —
USDA: —
Grains: —

Organics: —
%: —
Odor: —

Rocks: —
%: —
Moisture: —

Petrochemical: —
Cohesiveness: —

Description/ Notes:

Layer 3:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —

USCS: —
USDA: —
Grains: —

Organics: —
%: —
Odor: —

Rocks: —
%: —
Moisture: —

Petrochemical: —
Cohesiveness: —

Description/ Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: October 4, 2016

Location ID: BW16MLW-003

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 5:

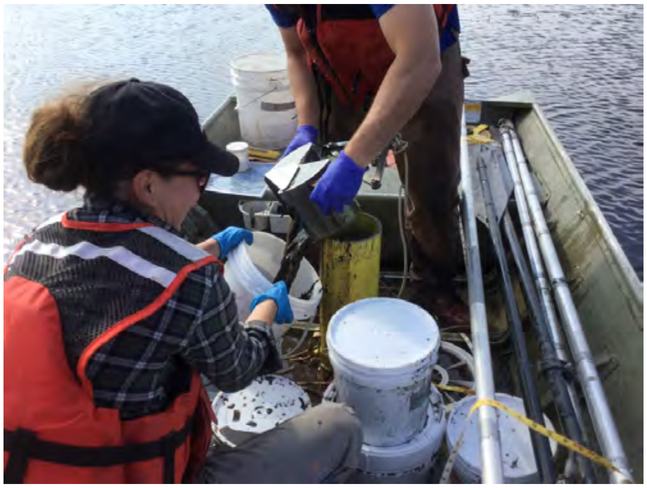


Photo 6:

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Mud Lake West
Location ID: BW16MLW-005

Core & Polling Collection Information

Sample Collectors: ACB | JMB | CJM
Date Collected: October 4, 2016
Time Collected: 1:09 PM
Above/Below LWD (ft): 2.4
Water Elevation (ft): 601.1
Water Depth (ft): 4.2
Sediment Elevation (ft): 599.3

Poling Collection Information

Equipment: N/A

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
				0	—	—
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Russian Peat Sampler

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
1			0	Yes
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB | CJM | JMB
Length of Core (m): 0.50
Date Processed: October 4, 2016
Time Processed: 1:09 PM

Sediment Characterization Log

Location ID: BW16MLW-005

Layer 1: Start Depth (m): 0.65 End Depth (m): 1.15

Primary Color: Reddish Brown
Secondary Color: Dark Brown (10YR 3/3)
USCS: PT
USDA: Peat
Grains: Well Rounded
Organics: Woody
%: 75 - 100
Odor: No Odor
Rocks: None
%: N/A
Moisture: Saturated
Petrochemical: None
Cohesiveness: Loose
Description/Notes: Refusal @ 1.15
Silty peat
Sample at 0.90-1.15 m

Layer 2: Start Depth (m): End Depth (m):

Primary Color: —
Secondary Color: —
USCS: —
USDA: —
Grains: —
Organics: —
%: —
Odor: —
Rocks: —
%: —
Moisture: —
Petrochemical: —
Cohesiveness: —
Description/Notes:

Layer 3: Start Depth (m): End Depth (m):

Primary Color: —
Secondary Color: —
USCS: —
USDA: —
Grains: —
Organics: —
%: —
Odor: —
Rocks: —
%: —
Moisture: —
Petrochemical: —
Cohesiveness: —
Description/Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: October 4, 2016

Location ID: BW16MLW-005

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 5:

Photo 6:

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Mud Lake West
Location ID: BW16MLW-006

Core & Polling Collection Information

Sample Collectors: ACB | JMB | CJM

Date Collected: October 4, 2016
Time Collected: 12:58 PM
Above/Below LWD (ft): 2.4
Water Elevation (ft): 601.1
Water Depth (ft): 6.4
Sediment Elevation (ft): 597.1

Poling Collection Information

Equipment: N/A

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
				0	—	—
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Russian Peat Sampler

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
1			0	Yes
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB | CJM | JMB

Length of Core (m): 0.5
Date Processed: October 4, 2016
Time Processed: 12:58 PM

Sediment Characterization Log

Location ID: BW16MLW-006

Bay West

Layer 1:

Start Depth (m): 1.50
End Depth (m): 2.0

Primary Color: Reddish Brown
Secondary Color: Very Dark Brown (10YR 2/2)

USCS: PT
USDA: Peat
Grains: Well Rounded

Organics: Woody
%: 75 - 100
Odor: No Odor

Rocks: None
%: N/A
Moisture: Saturated

Petrochemical: None
Cohesiveness: Loose

Description/ Notes:
Soft refusal @ 2 m
Sample @ 1.75-2.0 m
Silty clay peat with tan clay streak at 1.9 m

Layer 2:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —

USCS: —
USDA: —
Grains: —

Organics: —
%: —
Odor: —

Rocks: —
%: —
Moisture: —

Petrochemical: —
Cohesiveness: —

Description/ Notes:

Layer 3:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —

USCS: —
USDA: —
Grains: —

Organics: —
%: —
Odor: —

Rocks: —
%: —
Moisture: —

Petrochemical: —
Cohesiveness: —

Description/ Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: October 4, 2016

Location ID: BW16MLW-006

Photo 1:

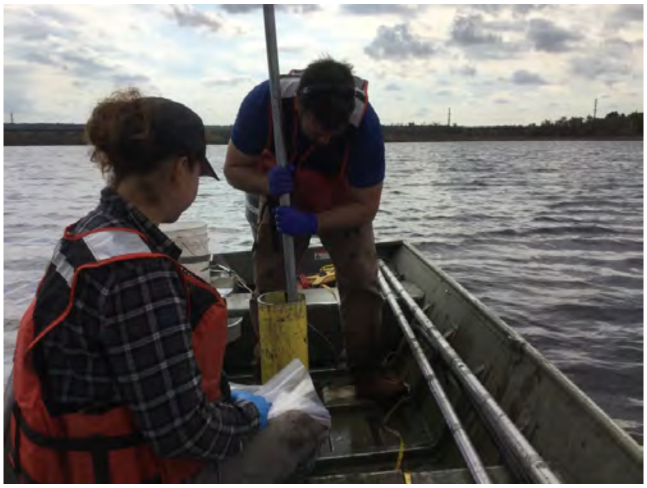


Photo 2:

Photo 3:

Photo 4:

Photo 5:

Photo 6:

Sediment Collection & Characterization Core Log

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Mud Lake West
Location ID: BW16MLW-007

Core & Polling Collection Information

Sample Collectors: ACB JMB CJM
Date Collected: October 4, 2016
Time Collected: 12:42 PM
Above/Below LWD (ft): 2.4
Water Elevation (ft): 601.1
Water Depth (ft): 6.1
Sediment Elevation (ft): 597.4

Poling Collection Information

Equipment: N/A

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
				0	—	—
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Russian Peat Sampler

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
1			0	Yes
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB CJM JMB
Length of Core (m): 0.5
Date Processed: October 4, 2016
Time Processed: 12:42 PM

Sediment Characterization Log

Location ID: BW16MLW-007

Layer 1: Start Depth (m): 1.6 End Depth (m): 1.85

Primary Color: Brown (10YR 5/3) Secondary Color: Dark Brown (10YR 3/3)

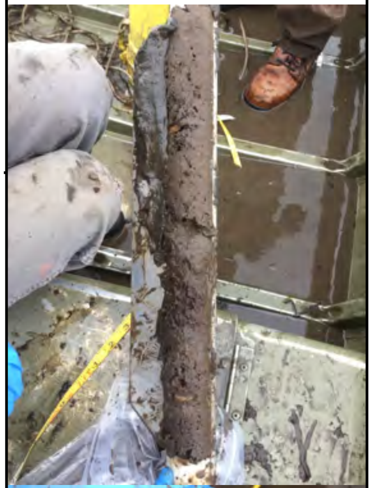
USCS: CL-ML USDA: Silty Clay Grains: Well Rounded

Organics: Woody %: 25 - 50 Odor: No Odor

Rocks: None %: N/A Moisture: Saturated

Petrochemical: None Cohesiveness: Stiff

Description/ Notes:
Firm refusal @ 1.85m (felt like clay)
Sample @ 1.6-1.85
Silty clay with peat ~50%
Light tan clay streaks at very bottom



Layer 2: Start Depth (m): End Depth (m):

Primary Color: — Secondary Color: —

USCS: — USDA: — Grains: —

Organics: — %: — Odor: —

Rocks: — %: — Moisture: —

Petrochemical: — Cohesiveness: —

Description/ Notes:

Layer 3: Start Depth (m): End Depth (m):

Primary Color: — Secondary Color: —

USCS: — USDA: — Grains: —

Organics: — %: — Odor: —

Rocks: — %: — Moisture: —

Petrochemical: — Cohesiveness: —

Description/ Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: October 4, 2016

Location ID: BW16MLW-007

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 5:

Photo 6:

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Mud Lake West
Location ID: BW16MLW-008

Core & Polling Collection Information

Sample Collectors: ACB | JMB | CJM
Date Collected: October 4, 2016
Time Collected: 12:26 PM
Above/Below LWD (ft): 2.4
Water Elevation (ft): 601.1
Water Depth (ft): 4.6
Sediment Elevation (ft): 598.9

Poling Collection Information

Equipment: N/A

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
				0	—	—
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Russian Peat Sampler

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
1			0	Yes
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB | CJM | JMB
Length of Core (m): 0.5
Date Processed: October 4, 2016
Time Processed: 12:26 PM

Sediment Characterization Log

Location ID: BW16MLW-008

Bay West

Layer 1:

Start Depth (m): 0.80

End Depth (m): 1.30

Primary Color: Reddish Brown

Secondary Color: Dark Brown (10YR 3/3)

USCS: PT

USDA: Peat

Grains: Well Rounded

Organics: Woody

%: 75 - 100

Odor: No Odor

Rocks: None

%: N/A

Moisture: Saturated

Petrochemical: None

Cohesiveness: Loose

Description/ Notes:
Fine peat with some fine grains (silty clay)
Soft Refusal at 1.4m
Sample @ 1.05-1.30m

Layer 2:

Start Depth (m): 1.30

End Depth (m): 1.40

Primary Color: Very Dark Brown (10YR 2/2)

Secondary Color: —

USCS: —

USDA: Silty Clay

Grains: Well Rounded

Organics: Woody

%: 25 - 50

Odor: No Odor

Rocks: None

%: N/A

Moisture: Saturated

Petrochemical: None

Cohesiveness: Loose

Description/ Notes:
Silty clay loam with 50% woody material.

Layer 3:

Start Depth (m):

End Depth (m):

Primary Color: —

Secondary Color: —

USCS: —

USDA: —

Grains: —

Organics: —

%: —

Odor: —

Rocks: —

%: —

Moisture: —

Petrochemical: —

Cohesiveness: —

Description/ Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: October 4, 2016

Location ID: BW16MLW-008

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 5:

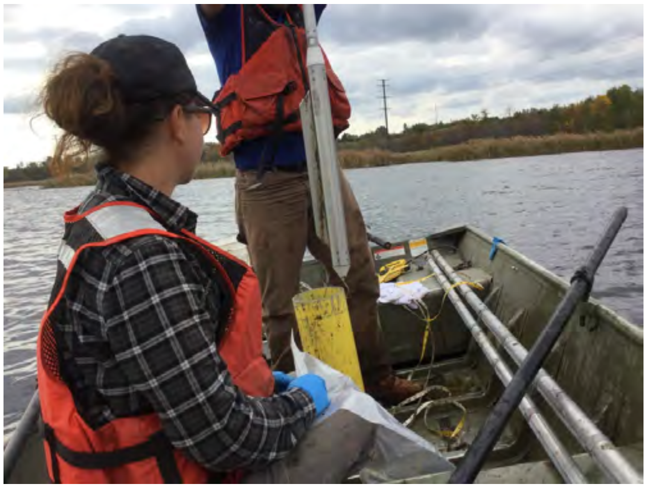


Photo 6:

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Mud Lake West
Location ID: BW16MLW-009

Core & Polling Collection Information

Sample Collectors: ACB JMB CJM
Date Collected: October 4, 2016
Time Collected: 12:03 PM
Above/Below LWD (ft): 2.4
Water Elevation (ft): 601.1
Water Depth (ft): 2.6
Sediment Elevation (ft): 600.9

Poling Collection Information

Equipment: N/A

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
				0	—	—
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Russian Peat Sampler

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
—	2		0	—
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB CJM JMB
Length of Core (m): 0.5
Date Processed: October 4, 2016
Time Processed: 12:03 PM

Sediment Characterization Log

Location ID: BW16MLW-009

Layer 1:

Start Depth (m):	1.5	End Depth (m):	2.0

Primary Color:	Reddish Brown	Secondary Color:	Dark Brown (10YR 3/3)		
USCS:	PT	USDA:	Peat	Grains:	Well Rounded
Organics:	Woody	%:	75 - 100	Odor:	No Odor
Rocks:	None	%:	N/A	Moisture:	Saturated
Petrochemical:	None	Cohesiveness:	Loose		

Description/ Notes:
Still very soft at 2 meters
What little sediment is available silty loam
1.75-2.0

Layer 2:

Start Depth (m):		End Depth (m):	

Primary Color:	—	Secondary Color:	—		
USCS:	—	USDA:	—	Grains:	—
Organics:	—	%:	—	Odor:	—
Rocks:	—	%:	—	Moisture:	—
Petrochemical:	—	Cohesiveness:	—		

Description/ Notes:

Layer 3:

Start Depth (m):		End Depth (m):	

Primary Color:	—	Secondary Color:	—		
USCS:	—	USDA:	—	Grains:	—
Organics:	—	%:	—	Odor:	—
Rocks:	—	%:	—	Moisture:	—
Petrochemical:	—	Cohesiveness:	—		

Description/ Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: October 4, 2016

Location ID: BW16MLW-009

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 5:

Photo 6:

Sediment Collection & Characterization Core Log

Bay West
Customer-Focused Environmental & Industrial Solutions

Project/Site Information

Project Name: SLR
Client: MPCA
Contractor: Bay West
Project #: J160139
Site Location: Mud Lake West
Location ID: BW16MLW-010

Core & Polling Collection Information

Sample Collectors: ACB JMB CJM
Date Collected: October 4, 2016
Time Collected: 11:38 AM
Above/Below LWD (ft): 2.4
Water Elevation (ft): 601.1
Water Depth (ft): 8.9
Sediment Elevation (ft): 594.6

Poling Collection Information

Equipment: N/A

Location ID	Depth of Water (cm)	Depth to Resistance (cm)	Depth to Refusal (cm)	"Soft" Sediment Thickness (cm)	Refusal Type	Sediment Type Approaching Refusal
PL-01	*74*	*90*	*101*	*27*	*Sediment*	*Silty Clay*
				0	—	—
				0	—	—
				0	—	—

Core Collection Information

Collection Method: Russian Peat Sampler

Push Attempts	Push Depth (ft)	Push Recovery (ft)	% Recovery	Retained?
1			0	Yes
—			0	—
—			0	—
—			0	—
—			0	—

Core Processing Information

Sample Processors: ACB CJM JMB
Length of Core (m): 0.5
Date Processed: October 4, 2016
Time Processed: 11:38 AM

Sediment Characterization Log

Location ID: BW16MLW-010

Bay West

Layer 1:

Start Depth (m): 1.2
End Depth (m): 1.7

Primary Color: Brown (10YR 5/3)
Secondary Color: Dark Brown (10YR 3/3)

USCS: PT
USDA: Peat
Grains: None

Organics: Woody
%: 75 - 100
Odor: No Odor

Rocks: None
%: N/A
Moisture: —

Petrochemical: None
Cohesiveness: Loose

Description/ Notes:
Straight peat
0.25m sample 1.45-1.7m

Layer 2:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —

USCS: —
USDA: —
Grains: —

Organics: —
%: —
Odor: —

Rocks: —
%: —
Moisture: —

Petrochemical: —
Cohesiveness: —

Description/ Notes:

Layer 3:

Start Depth (m):
End Depth (m):

Primary Color: —
Secondary Color: —

USCS: —
USDA: —
Grains: —

Organics: —
%: —
Odor: —

Rocks: —
%: —
Moisture: —

Petrochemical: —
Cohesiveness: —

Description/ Notes:

Photographic Log

Project Name: SLR

Project Number: J160139

Photographs taken on: October 4, 2016

Location ID: BW16MLW-010

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 5:

Photo 6:

Appendix B
GLEC Report

Great Lakes Environmental Center

Applied
Environmental
Sciences
www.glec.com

Traverse City Operations
739 Hastings St.
Traverse City
MI 49686

231 941-2230
231 941-2240 fax

Columbus Operations
1295 King Ave.
Columbus
OH 43212

614 487-1040
614 487-1920 fax

December 16, 2016

Paul Raymaker, P.G.
Geologist
Bay West LLC
5201 East River Road #313
Minneapolis, MN 55421

RE: **DRAFT REPORT: Results for the 10-day *Chironomus dilutus*, 28-day *Hyalella azteca*, and 28-day *Lumbriculus variegatus* Whole Sediment Toxicity Testing**
Bay West, LLC; Mud Lake West-St. Louis River AOC Project
Project Number: 2386

Dear Mr. Raymaker:

Great Lakes Environmental Center, Inc. (GLEC) has completed our analysis of three sediment samples that were collected by Bay West personnel on October 4th, 2016 for the Mud Lake West-St. Louis River AOC Project in Minnesota. Our analysis included the following whole sediment toxicity tests: *Chironomus dilutus* (*C. dilutus)* 10-day growth and survival, *Hyalella azteca* (*H. azteca*) 28-day growth and survival, and *Lumbriculus variegatus* (*L. variegatus)* 28-day bioaccumulation tests which included 4-day acute toxicity screening tests.

During the whole sediment toxicity tests with *C. dilutus* and *H. azteca*, the organisms were exposed to whole sediment samples and the effects on survival and growth were measured. The *L. variegatus* 28-day bioaccumulation analysis included the exposure of *L. variegatus* to whole sediment samples and the measurement of nickel, zinc, dioxins, furans, and percent lipids in the collected tissue samples. Total Organic Carbon (TOC), percent moisture, nickel, zinc, dioxins, and furans were also analyzed in the whole sediment samples.

The whole sediment toxicity tests were completed at GLEC's laboratory in Traverse City, Michigan. Sediment and tissue chemistry analysis was completed by Pace Analytical Laboratories in Green Bay, Wisconsin.

Whole Sediment Toxicity

The sample identification numbers, survival, and growth test results for the whole sediment toxicity assessments for the three sediment samples and laboratory controls are summarized and provided in the following tables:

Table 1:	10-Day *C. dilutus* Average Percent Survival
Table 2:	10-Day *C. dilutus* Average Growth and Biomass Estimates (expressed as average ash-free-dry-weight (AFDW))
Table 3:	28-Day *H. azteca* Average Percent Survival
Table 4:	28-Day *H. azteca* Average Growth and Biomass Estimates
Table 5:	4-Day *L. variegatus* Average Percent Survival
Table 6:	28-Day *L. variegatus* Average Depurated Wet Weight
Table 7:	28-Day *L. variegatus* Tissue Analyte Results: Nickel and Zinc
Table 8:	Sediment Percent Moisture and Total Organic Carbon (TOC) of the Sediment Samples

Water quality data for the overlying water for each sediment sample tested are summarized in Tables 9 through 12 for the *C. dilutus*, *H. azteca*, 4-day *L. variegatus,* and 28-day *L. variegatus* tests, respectively.

A detailed summary of the overlying water quality measurements are provided in Appendices B1 (*C. dilutus*), B2 (*H. azteca*), B3 (4- day *L. variegatus)*, and B4 (28-day *L. variegatus)*.

The survival, growth, and statistical data sheets and summaries for the *C. dilutus* and *H. azteca* tests are shown in Appendices C1 through C2, and D1 through D2, respectively. The day 4 laboratory bench data sheets for the 4-day percent survival are provided in Appendix E and 28-day depurated wet weights of the *L. variegatus* are provided in Appendix F.

The analytical chemistry data for the 28-day *L. variegatus* tissue collected from the whole sediment bioaccumulation tests are summarized in Table 7 and provided in Appendix G. The analytical chemistry data for the whole sediment samples is summarized in Table 8 and provided in Appendix H.

The daily laboratory bench data sheets and analytical chemistry data for both the sediment and tissue samples are kept on file at GLEC and are also provided on the enclosed compact diskettes. Chain of Custody forms and reference toxicant data are provided in Appendices A and I, respectively.

METHODS

The whole sediment toxicity tests were conducted at our Traverse City, Michigan laboratory following GLEC's written Standard Operating Procedures (SOPs) which are based on the procedures outlined in U.S. EPA Method, EPA/600/R-99/064 *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates*, Second Edition and American Society for Testing and Materials (ASTM) 1706-05, *Standard Test Methods for Measuring the Toxicity of Sediment Associated Contaminants with Freshwater Invertebrates* (ASTM 2010).

The three sediment samples were collected by Bay West and delivered via courier to GLEC. The sediment samples were received at GLEC, where they were assigned a unique GLEC laboratory identification number and stored at 0≤6°C, but not frozen, until test initiation (see table below).

Sample I.D.	Sample Description	GLEC Lab. ID Number	Date Sampled	Date Received	Temperature Upon Receipt (°C)
BW16MLW-001-0.0-0.15	Site Sample	11,080	October 04, 2016	October 05, 2016	7.5
BW16MLW-002-0.0-0.15	Site Sample	11,081	October 04, 2016	October 05, 2016	8.0
BW16MLW-003-0.0-0.15	Site Sample	11,082	October 04, 2016	October 05, 2016	8.1

Upon receipt the samples exceeded the recommended temperature requirement of 0≤6°C, but not frozen. An e-mail was sent October 5, 2016 detailing the condition and temperature of the sediment samples upon receipt. All shipping containers had a sufficient amount of ice still packed on top of the sediment samples and the ice was not melted. GLEC did not receive a stop work request and in response, GLEC continued as planned and used the sediment samples to conduct the whole sediment toxicity and bioaccumulation tests.

All toxicity testing and bioaccumulation tests included a natural sediment control as outlined in the Minnesota Pollution Control Agency (MPCA) Specification for Services Form; i-admin9-07: 1/30/2016). The natural sediment control is referred in this report as a laboratory control.

The 10-day *C. dilutus* toxicity tests and the 28-day *H. azteca* toxicity tests were initiated on October 14, 2016 and October 19, 2016, respectively, for each of the three sediment samples, one laboratory control and one water only exposure, per test organism.

On October 14, 2016, the three investigative sediment samples and a laboratory control sediment were used to initiate 4-day *L. variegatus* sediment toxicity screening tests. *L. variegatus* survival after 4-days of exposure in the three investigative samples and laboratory control sediment were all greater than 90 percent survival (Table 5). Consequently, the 28-day *L. variegatus* bioaccumulation tests were initiated with the three investigative sediments and one laboratory control sediment on October 25, 2016.

10-DAY *CHIRONOMUS DILUTUS* AND 28-DAY *HYALELLA AZTECA* WHOLE SEDIMENT TOXICITY TESTS

Summary of Test Procedures: 10-Day *Chironomus dilutus* and 28-Day *Hyalella azteca*

Second to third instar *C. dilutus* (10-11 days old at test initiation; provided by an outside supplier: Aquatic Bio Systems) were used to initiate the 10-day whole sediment toxicity tests and water only exposure. Juvenile *H. azteca* (7-8 days old; cultured in house) were used to initiate the 28-day whole sediment toxicity tests and water only exposure. All organisms were randomly placed in test chambers using a large bore pipette. The *C. dilutus* and *H. azteca* were continuously exposed for the duration of the test (10-days and 28-days, respectively) to each of the sediment samples, one laboratory control sediment and one water only exposure.

In the water only exposures, test organisms were exposed to the overlying water with no sediment. There were eight replicate beakers for each sediment sample, the water only exposure, and the laboratory control sediment; each replicate contained 10 test organisms. The laboratory control sediment (as per the MPCA Specification for Services Form) is a natural sediment control from West Bear Skin Lake, an oligotrophic glacial lake near the Boundary Waters Canoe Area (BWCA) in Minnesota.

The *C. dilutus* and *H. azteca* were exposed in 470 mL glass test chambers, each containing 100 mL of whole sediment and 175 mL of overlying water.

Prior to adding the whole sediment to each test chamber, the laboratory control sediment as well as each investigative sediment sample were thoroughly homogenized using a pre-cleaned stainless steel all purpose mixer or spoon until a uniform color and texture was achieved.

As per the MPCA Service Form, a subsample from each of the homogenized sediment samples was collected for chemistry analysis: Total Organic Carbon and percent moisture (analyzed at PACE Analytical in Green Bay, Wisconsin, Table 8 and Appendix H), dioxins, furans, nickel, zinc, and percent moisture (shipped to PACE Analytical, Minneapolis, Minnesota, as per client request and results sent directly to the client).

The homogenized sediment was then added to each test chamber using a pre-cleaned stainless steel spoon. After the addition of the sediment to the test chambers, overlying water was immediately added; this was considered test day -1, the test day prior to day 0 (October 13, 2016 for the *C. dilutus* tests and October 18, 2016 for the *H. azteca* tests). Test organisms were randomly added to each replicate test chamber the following day (test day 0), October 14, 2016 for the *C. dilutus* tests and October 19, 2016 for the *H. azteca* tests.

Overlying water was intermittently supplied to each test chamber at least twice daily (once every 12-hours) via a static-renewal water delivery system. The overlying water for each sediment sample, the laboratory control sediment, and the water only exposure consisted of de-chlorinated municipal (Traverse City, Michigan) (Lake Michigan sourced) water, with an average hardness of 129 mg/L and an average alkalinity of 100 mg/L. Temperature, dissolved oxygen, pH, and specific conductance of the overlying water was measured daily prior to use.

The *C. dilutus* test chambers were fed 1.5 mL of Tetrafin® goldfish food slurry (4 mg/mL dry solids) once daily. The *H. azteca* test chambers were fed 1.0 mL mixture of yeast, trout food, and wheat grass (YTC; ~1800 (1700-1900 +/- 5%) mg/L solids) once daily.

The test chambers were placed in a temperature controlled water bath under the specified conditions of 23 ± 1°C; photoperiod 16 hours light: eight hours dark; and light intensity of 100-1000 lux.

Temperature (23 ± 1ºC) and the DO (≥ 2.5 mg/L) concentrations of the overlying water in the test chambers were measured daily in two alternating replicates for each test sediment, and the results were recorded on the laboratory bench data sheets. There were no instances of decreased DO or temperature exceedances in either the *C. dilutus* or the *H. azteca* whole sediment toxicity tests.

Alkalinity, hardness, pH, conductance, and total ammonia (as N) were measured in the overlying water on test days 0 and 10 for the *C. dilutus* tests (Table 9 and Appendix B1) and on days 0 and 28 for the *H. azteca* tests (Table 10 and Appendix B2). For the 28-day *H. azteca* whole sediment toxicity tests, conductivity was measured weekly, and pH was measured at least three times per week from two randomly selected test chambers. The alkalinity, hardness, and total ammonia (as N) samples were a composite sample collected from all replicates of a given treatment. All test exposure water quality measurements were recorded on the laboratory bench data sheets (see enclosed compact disc).

Observations of organism behavior and anomalies observed within the sediment were made daily for each test chamber and recorded on the laboratory bench data sheets.

The number of *C. dilutus* surviving in each replicate test chamber was recorded at test termination (10 days), and a summary of the percent survival at test termination is provided in Tables 1 and 2. The average ash free dry weight [AFDW in milligrams (mg)] of the surviving organisms for each *C. dilutus* replicate, and the biomass [AFDW (mg) of the surviving organisms divided by the initial number of organisms] was also determined at test termination, and the results are summarized in Table 2.

The number of surviving *H. azteca* in each replicate chamber was recorded at test termination (28 days) and the survival data are summarized in Tables 3 and 4. The average dry weight [in milligrams (mg)] of the surviving organisms for each *H. azteca* replicate, and the biomass [dry weight (mg) of the surviving organisms divided by the initial number of organisms] was also determined at test termination, and the data are summarized in Table 4.

A statistical procedure, using the program TOXCALC (version 5.0.32) and following statistical guidelines provided in U.S. EPA Method 600/R-99/064 and ASTM Method 1706-95B (2010), was used to compare the 10-day *C. dilutus* and the 28-Day *H. azteca* survival and growth data from the three investigative sediment samples to survival and growth data from the laboratory control sample (West Bear Skin natural sediment sample). Prior to analysis, all percent survival data were transformed using an arc sine-square root transformation.

All transformed data were then tested for normality and homogeneity of variances. Next, an analysis of variance (ANOVA) was conducted using the most appropriate parametric (e.g., Dunnet's or Bartlett's t-tests) or nonparametric (e.g., Steel's Many-One Rank or Wilcoxon with Bonferroni's) t-test. If the data failed to meet the assumptions of normality or homogeneity, the nonparametric tests were used to analyze the data. Additional statistical analysis would be conducted using homoscedastic or heteroscedastic t-tests, when an investigative sediment sample was significantly different from the laboratory control. The homoscedastic or heteroscedastic t-tests, are used for comparing a single treatment to a single control.

The homoscedastic t-test assumes the data are normally distributed (Shapiro-Wilk Test or Kolmogorov D Test) and the variances are equal (F-test). If the variances are not equal, the data are analyzed using the heteroscedastic t-test. If the data are not normally distributed, then the data are analyzed using a nonparametric t-test (e.g., Steel's Many-One Rank Test or Wilcoxon Rank Sum Test with Bonferroni's Adjustment).

Growth data were initially evaluated for normal distribution and homogeneity of variances. In those cases where the data were not normally distributed or homogenous, the data were analyzed using either the nonparametric test or the heteroscedastic t-test. In addition to growth being evaluated as average dry weight of the surviving organisms, growth was also analyzed as biomass (average dry weight of surviving organisms divided by the number of initial organisms).

The survival and growth for each investigative sample was considered statistically different when significantly lower ($p< 0.05$) than observed in the laboratory control sediment (CS# 136).

Organisms exposed to the laboratory control sediment and the water only exposure achieved acceptable survival and growth, as specified in the U.S. EPA manual EPA/600/R-99/064. In this instance, the laboratory control sediment and water only exposure results confirmed test acceptability and the health of the test organisms.

RESULTS

10-Day *Chironomus dilutus* and 28-Day *Hyalella azteca* Whole Sediment Toxicity Tests

10-Day *Chironomus dilutus*

The organisms exposed to the laboratory control sediment and to the water only exposure exceeded the minimum survival (70 percent) and growth (0.48 mg AFDW at test termination) criteria for acceptable controls for the *C. dilutus* tests (Tables 1 and 2). The acceptability requirements for survival and growth for the *C. dilutus* test can be found in U.S. EPA manual EPA/600/R-99/064, Test Method 100.2; Table 12.1. There was 97.5 percent survival in the laboratory control.

The overlying water quality measurements (Table 9) were also within the acceptable limits following the U.S. EPA testing protocol. Daily mean temperatures were 23°C ± 1 °C; dissolved oxygen (DO) was maintained above 2.5 mg/L in the overlying water; and there were no variations greater than 50% in overlying water hardness or alkalinity measurements within each test type. Total ammonia over the duration of ten days varied between 0.08 mg/L and 0.68 mg/L in the overlying water among all sediment types. Consequently, the *C. dilutus* whole sediment toxicity tests were conducted following the standard protocols and are valid assessments of sediment toxicity.

All test chambers were observed daily to assess organism behavior and no unusual observations were noted with the test organisms in these sediment samples.

Statistical Analysis for 10-Day *Chironomus dilutus* Tests

Laboratory Control Sediment Compared to Investigative Sediment Samples

C. dilutus survival and growth results (Appendix C1) from the laboratory control sediment sample CS # 136 (West Bear Skin Lake) were compared statistically to the three investigative sediment samples. After 10 days of exposure when compared to the laboratory control sediment sample, *C. dilutus* survival was not significantly reduced ($p \geq 0.05$) in any of the three investigative sediment samples (see Tables 1, 2, and Appendix C2).

When compared to the laboratory control sediment sample (see Table 2 and Appendix C2), *C. dilutus* growth measured as AFDW of surviving organisms (mg) and biomass [AFDW of surviving organisms divided by the initial number of organisms (mg)] was not significantly reduced ($p \geq 0.05$) in any of the three sediment samples.

Outputs for the survival and growth statistical analyses for the *C. dilutus* whole sediment toxicity tests are provided in Appendix C2.

28-Day *Hyalella Azteca*

The *H. azteca* test organisms exposed to the laboratory control sediment and to the water only exposure exceeded the minimum survival criteria (80%), and displayed acceptable measurable growth (Tables 3 and 4). The requirements for acceptable survival and growth for the *H. azteca* can be found in U.S. EPA manual EPA/600/R-99/064, Test Method 100.4; Table 14.3. There was 98.8 percent survival in the laboratory control.

The overlying water quality measurements (Table 10) were also within the acceptable limits following the U.S. EPA testing protocol. Daily mean temperatures were 23 ± 1 °C; dissolved oxygen (DO) was maintained above 2.5 mg/L in the overlying water, and there were no variations greater than 50% in overlying water hardness or alkalinity measurements within each test type. Total ammonia over the duration of twenty-eight days varied between 0.05 mg/L and 0.37 mg/L in the overlying water among all sediment types.

All test chambers were checked daily to assess organism behavior and no unusual observations were noted with the test organisms in these sediment samples. The *H. azteca* whole sediment toxicity tests are valid assessments of sediment toxicity.

Statistical Analysis for 28-Day *Hyalella azteca* Tests

Laboratory Control Sediment Compared to Investigative Sediment Samples

Survival and growth results (Appendix D1) from the laboratory control sediment were compared statistically to the three investigative sediment samples. After 28 days of exposure when compared to the laboratory control sediment sample: CS#136 (see Tables 3, 4, and

Appendix D2) *H. azteca* survival was not significantly reduced ($p \geq 0.05$) in any of the three investigative sediment samples.

After 28 days of exposure there was no significant reductions ($p \geq 0.05$) in *H. azteca* growth (expressed as average dry weight) or biomass in any of the three investigative sediment samples when compared to laboratory control sediment sample (see Table 4 and Appendix D2).

Outputs for the survival and growth statistical analyses for the *H. azteca* whole sediment toxicity tests are provided in Appendix D2.

28-DAY *LUMBRICULUS VARIEGATUS* *WHOLE SEDIMENT BIOACCUMULATION TOXICITY TEST*

Summary of Test Procedures: 4-day *Lumbriculus variegatus* Acute Whole Sediment Toxicity Screening Test

Prior to conducting the 28-day bioaccumulation studies, 4-day *L. variegatus* acute toxicity screening tests were conducted. The 4-day *L. variegatus* acute toxicity screening tests were initiated with each of the three investigative sediment samples (as listed in the previous table) and one laboratory control sediment, on October 14, 2016.

Adult *L. variegatus* (purchased from California Blackworm Company) were used to initiate the 4-day whole sediment toxicity screening tests. *L. variegatus* were continuously exposed for 4-days to each of the three investigative sediment samples and to the laboratory control sediment.

Consistent with the EPA method 100.3, there were four replicate samples for each investigative sediment sample and the laboratory control sample; each *L. variegatus* replicate was initiated with 10 animals.

The *L. variegatus* were exposed in 470 mL glass test chambers, each containing 100 mL of whole sediment and 175 mL of overlying water.

Prior to adding the whole sediment to each test chamber, the laboratory control as well as each investigative sediment sample were thoroughly homogenized using a pre-cleaned stainless steel all purpose mixer or spoon until a uniform color and texture was achieved.

The homogenized sediment was then added to each test chamber using a pre-cleaned stainless steel spoon. After the addition of the sediment to the test chambers, the overlying water was immediately added; this was considered to be test day -1 (October 13, 2016). Test organisms were randomly added to each replicate test chamber the following day (test day 0).

Overlying water was intermittently supplied to each test chamber at least twice daily (once every 12-hours) via a static-renewal water delivery system. The overlying water for each sediment sample and the laboratory control sediment consisted of de-chlorinated municipal (Traverse City, Michigan) tap (Lake Michigan sourced) water, with an average hardness of 129 mg/L and an average alkalinity of 100 mg/L. Temperature, dissolved oxygen, pH, and specific conductance of the overlying water was measured daily prior to use.

The test chambers were placed in a temperature controlled water bath under the specified conditions of 23 ± 1°C; photoperiod 16 hours light: eight hours dark; and light intensity of 100-1000 lux.

Temperature and the dissolved oxygen (DO) concentration of the overlying water in the test chambers were measured daily in two alternating replicates for each test sediment, and the results were recorded on the laboratory bench data sheets. If the DO dropped below 2.5 mg/L, the number of daily overlying water renewals was increased (up to 4 times per day) for all treatments until the DO recovered to greater than 3.0 mg/L. Once the DO had increased to above 3.0 mg/L, additional water renewals were suspended, until the DO values dropped below 2.5 mg/L, at which time the additional water renewals were re-initiated. There were no instances in the whole sediment toxicity tests of decreased DO and increased overlying water renewals.

Alkalinity, hardness, pH, conductivity, and total ammonia (as N) were measured on test days 0 and 4, in the overlying water for the *L. variegatus* tests (Table 11 and Appendix B3).

Observations of organism behavior and anomalies observed within the sediment were made daily for each test chamber and recorded on the laboratory bench data sheets.

The number of *L. variegatus* surviving in each replicate test chamber was recorded at test termination (4 days), and a summary of the percent survival at test termination is provided in Table 5.

A statistical analysis was not performed on the survival of the 4 day *L. variegatus* whole sediment toxicity screening tests. The percent survival of the *L. variegatus* after 4 days in the laboratory control and the three investigative sediment samples were all greater than 90 percent survival (see Table 5).

Results: 4-Day *L. variegatus* Acute Whole Sediment Toxicity Screening Test

The organisms exposed to the laboratory control sediment exceeded 90 percent survival after 4-days of exposure (see Table 5).

The laboratory controls for each toxicity test met the minimum survival requirements as specified in the EPA method and those requirements are acknowledged in the following results section for each set of toxicity tests. For the purpose of this study, the laboratory control sediment was used as a measure of test acceptably and the health of the test organisms.

The overlying water quality measurements (Table 11 and Appendix B3) were also within the acceptable limits following the U.S. EPA testing protocol (i.e., daily mean temperatures were 23 ± 1 °C; dissolved oxygen (DO) was maintained above 2.5 mg/L in the overlying water and there were no variations greater than 50% in overlying water hardness or alkalinity measurements within each test type. Total ammonia over the duration of 4 days varied between 0.07 mg/L and 0.39 mg/L in the overlying water among all sediment types). Consequently, the *L. variegatus* 4-day whole sediment toxicity tests were conducted following the standard protocols and are valid assessments of sediment toxicity screening.

All test chambers were observed daily to assess organism behavior and no unusual observations were noted with the test organisms in these sediment samples.

The laboratory bench sheets with the recorded 4-day *L. variegatus* survival are provided in Appendix E.

Summary of Test Procedures: 28-Day *L. variegatus* Whole Sediment Bioaccumulation Tests

On October 25, 2016 the 28-day bioaccumulation test was initiated with the three investigative sediment samples and one laboratory control. Adult *L. variegatus* were used to initiate the test and were continuously exposed for 28-days to the three investigative sediment samples.

Adult *L. variegatus* were exposed in 3 liter (L) glass tanks, each containing 1.5L of whole sediment and 1.5 L of overlying water. Temperature-controlled overlying water was supplied to each test chamber via a continuous-renewal water delivery system at a rate of 5 mL/min (± 2 mL/min). All test chambers were aerated at approximately 100 bubbles per minute for the full duration of the test. The overlying water consisted of de-chlorinated municipal (Lake Michigan) water of moderate hardness (~140 mg/L). Consistent with the test procedure, there were five replicate tanks for each sediment sample. On day 0 (October 25, 2016) each test replicate was initiated with a 18 grams wet weight of *L. variegatus* in order to meet the required 12 grams of wet tissue at test termination. The recommended addition of *L. variegatus* to minimize depletion of sediment contaminates during the bioaccumulation test follows a 50:1 ratio; TOC in the sediment to dry weight of organisms (EPA method 100.3)

In the 28-day *L. variegatus* bioaccumulation test, GLEC balanced the TOC ratio with the varying TOC concentrations between the laboratory control sediment and the investigative sediment samples, the minimum tissue requirements per replicate analysis (outlined in the MPCA Service Form), the volume of sediment available, the absolute need for equal replication, and the potential biases in the biota-sediment accumulation factors. To accomplish this, GLEC modified the SOP for these toxicity tests by; increasing the volume of sediment per replicate while maintaining an adequate overlying water renewal volume per day, and by decreasing the wet weight of *L. variegatus* exposed per replicate at test initiation, resulting in a practical TOC/organism ratio of approximately 27:1 or greater, given the limitation of the method [1] [2].

The test chambers were placed in a temperature controlled water bath under the specified conditions of 23 ± 1°C; photoperiod of 16 hours light and 8 hours dark; and light intensity of 100-1000 lux. Water temperature and dissolved oxygen were monitored daily in two random replicates for each test sample. Alkalinity, hardness, pH, dissolved oxygen (D.O.), conductivity, temperature, and total ammonia were measured at Day 0 (test initiation) and on days 7, 14, 21, and 27 (Table 12 and Appendix B4).

All test chambers were checked daily to assess organism behavior and no unusual observations were noted with the test organisms. Consequently, the *L. variegatus* whole sediment toxicity tests are valid assessments of sediment toxicity.

The overlying water quality measurements (Table 12) were also within the acceptable limits following the U.S. EPA testing protocol (i.e., daily mean temperatures were 23 ± 1 °C; dissolved oxygen (DO) was maintained above 2.5 mg/L in the overlying water and there were no variations greater than 50% in overlying water hardness or alkalinity measurements within each test type. Total ammonia over the duration of 28 days varied between 0.11 mg/L and 1.33 mg/L in the overlying water among all sediment types.). Consequently, the *L. variegatus* 28-day bioaccumulation sediment toxicity tests were conducted following the standard protocols and are valid assessments of sediment toxicity.

At test termination, the test organisms were recovered from each replicate chamber using reasonable effort until a minimum of 12 grams of *L. variegatus* per replicate or 60 grams of *L. variegatus* composited per sediment sample (requested per MPCA Service Form) was recovered.

After 28 days of exposure, the surviving *L. variegatus* were depurated for 24 hours in overlying water to purge all gut contents. The final total depurated wet weight (g) of surviving *L. variegatus* was also determined at test termination and is provided in Table 6 and Appendix F.

After the 24-hour depuration period, the surviving *L. variegatus* were weighed, homogenized, then frozen in glass jars (supplied by the analytical laboratories). The tissue samples were sent to two different laboratories; Pace Analytical for tissue analysis on the following analytes: nickel and zinc (Table 7 and Appendix G) and AXYS Laboratory for tissue analysis on the following analytes: dioxins, furans, and percent lipids (results delivered directly to Bay West).

The analyte result data supplied by Pace Analytical is provided in Appendix G and electronically on the enclosed compact diskette.

Results: 28-Day *L. variegatus* Tissue Analysis

L. variegatus tissue that was harvested from the 28-day bioaccumulation toxicity tests was analyzed by Pace Laboratories, Inc. for the following parameters:

- **Nickel:** Analytical Method; EPA 6020
- **Zinc;** Analytical Method; EPA 6020

All analyses are reported on a wet weight basis. Quality Control data and reporting are provided with the raw analytical data on the attached diskette. No statistical analysis was performed with the *L. variegates* tissue analysis.

Total Organic Carbon (TOC) and percent moisture were also analyzed in whole sediment samples (Table 8). TOC in the sediment was analyzed using the test method EPA 9060-in quadruplicate.

SUMMARY

In summary, GLEC completed whole sediment toxicity testing and analysis of three sediment samples. Each whole sediment toxicity test was performed following acceptable methods, without exception, and is accurate and complete. Whole sediment toxicity test results are in compliance with the requirements of the National Environmental Laboratory Accreditation Conference (NELAC).

Statistical analyses were completed for the whole sediment toxicity tests with *C. dilutus* and *H. azteca*. All data are summarized in the following tables and raw data reported in the appendices to this report.

C. dilutus survival and growth were not significantly reduced in any of three sediment samples when compared to the laboratory control sediment sample (Tables 1 and 2).

H. azteca survival and growth were also not significantly reduced any of three sediment samples when compared to the laboratory control sediment sample (Tables 3 and 4).

No statistical comparisons were completed with the *L. variegatus* analytical tissue data. *L. variegatus* analytical tissue data is summarized in Table 7. Sediment chemistry results for TOC and percent moisture are summarized in Table 8.

If you have any questions, or if you would like additional information, please contact either myself or Dennis McCauley at (231) 941-2230. Thank you for the opportunity to provide this service to Bay West. We look forward to continue providing environmental services to you in the future.

Sincerely,

Mailee W. Garton

Dennis J McCauley

Mailee W. Garton
Laboratory Coordinator

Dennis J. M^{c}Cauley
President/Senior Environmental Scientist

MWG:mg

ACCREDITED IN ACCORDANCE WITH
nelac

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TABLE 1. **Comparison of Number of Surviving *Chironomus dilutus* per Replicate and Percent Survival; Between the Laboratory Control Sediment and the Investigative Sediments; *Chironomus dilutus* 10-Day Whole Sediment Toxicity Tests Conducted October 14 - October 24, 2016; Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.**

REPLICATE NUMBER	West Bear Skin Laboratory Control CS# 136	BM16MLW-001-0.0-0.15 GLC No. 11,080	BM16MLW-002-0.0-0.15 GLC No. 11,081	BM16MLW-003-0.0-0.15 GLC No. 11,082	Water Only Secondary Control
1	10	10	9	10	9
2	10	10	10	10	10
3	10	10	10	9	10
4	10	10	10	10	10
5	10	9	10	10	9
6	9	10	8	9	10
7	9	10	10	9	10
8	10	9	10	9	10
10-Day Percent Survival[r]	**97.5**	**97.5**	**96.3**	**95.0**	**97.5**

[r] Replicates initiated with 10 organisms each

TABLE 2. **Comparison of Average[1] Dry Weight (mg), Biomass[2] (mg) and Percent Survival;**
Between the Laboratory Control Sediment and the Investigative Sediments;
Chironomus dilutus **10-Day Whole Sediment Toxicity Tests Conducted October 14 - October 24, 2016;**
Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.

GLC Number	**West Bear Skin Laboratory Control CS#136**		**BM16MLW-001-0.0-0.15 11,080**		**BM16MLW-002-0.0-0.15 11,081**		**BM16MLW-003-0.0-0.15 11,082**		**Water Only Secondary Control**	
Replicate Number	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**
1	1.09000	1.09000	1.47100	1.47100	1.44000	1.29600	1.05200	1.05200	1.04444	0.94000
2	0.94100	0.94100	1.11000	1.11000	1.34500	1.34500	1.30900	1.30900	0.88000	0.88000
3	1.06300	1.06300	1.34200	1.34200	1.29700	1.29700	1.55111	1.39600	0.95400	0.95400
4	0.96700	0.96700	1.47600	1.47600	1.13200	1.13200	1.18700	1.18700	0.98800	0.98800
5	0.94200	0.94200	1.94667	1.75200	1.23900	1.23900	1.25300	1.25300	1.00222	0.90200
6	0.92444	0.83200	1.24600	1.24600	1.41875	1.13500	1.23111	1.10800	0.84000	0.84000
7	1.03222	0.92900	1.38000	1.38000	1.49400	1.49400	1.32000	1.18800	0.94900	0.94900
8	0.97700	0.97700	1.36111	1.22500	1.35400	1.35400	1.20111	1.08100	0.93500	0.93500
Average[1] Ash-Free-Dry Weight (AFDW) (mg)	**0.99208**		**1.41660**		**1.33997**		**1.26304**		**0.94908**	
Biomass[2] Weight (AFDW) (mg)		**0.96762**		**1.37525**		**1.28650**		**1.19675**		**0.92350**
10-Day Percent Survival	**97.5**		**97.5**		**96.3**		**95.0**		**97.5**	

Note: Average Ash-Free-Dry Weight (AFDW) of *Chironomus dilutus* at test initiation = 0.33313 mg

[1] Average Ash-Free-Dry-Weight (AFDW) is the total ash-free-dry weight of surviving organisms

[2] Biomass weight is the total Ash-Free-Dry-Weight of surviving organisms divided by the initial number of organisms.

TABLE 3. Comparison of Number of Surviving *Hyalella azteca* per Replicate and Percent Survival; Between the Laboratory Control Sediment and the Investigative Sediments; *Hyallela azteca* 28-Day Whole Sediment Toxicity Tests Conducted October 19 - November 16, 2016; Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.

REPLICATE NUMBER	West Bear Skin Laboratory Control CS# 136	BM16MLW-001-0.0-0.15 GLC No. 11,080	BM16MLW-002-0.0-0.15 GLC No. 11,081	BM16MLW-003-0.0-0.15 GLC No. 11,082	Water Only Secondary Control
1	10	10	10	10	10
2	10	10	9	10	9
3	9	9	9	10	10
4	10	10	10	10	10
5	10	9	10	9	10
6	10	10	10	8	10
7	10	10	9	10	10
8	10	10	10	10	10
28-Day Percent Survival[r]	**98.8**	**97.5**	**96.3**	**96.3**	**98.8**

[r] Replicates initiated with 10 organisms each

TABLE 4. **Comparison of Average[1] Dry Weight (mg), Biomass[2] (mg) and Percent Survival;**
Between the Laboratory Control Sediment and the Investigative Sediments;
Hyallela azteca **28-Day Whole Sediment Toxicity Tests Conducted October 19 - November 16, 2016;**
Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.

GLC Number	**West Bear Skin Laboratory Control CS#136**		**BM16MLW-001-0.0-0.15 11,080**		**BM16MLW-002-0.0-0.15 11,081**		**BM16MLW-003-0.0-0.15 11,082**		**Water Only Secondary Control**	
Replicate Number	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**
1	0.19100	0.19100	0.18500	0.18500	0.15500	0.15500	0.20500	0.20500	0.25900	0.25900
2	0.17600	0.17600	0.16100	0.16100	0.17333	0.15600	0.17000	0.17000	0.31000	0.27900
3	0.17000	0.15300	0.20889	0.18800	0.19556	0.17600	0.17600	0.17600	0.34900	0.34900
4	0.16300	0.16300	0.20500	0.20500	0.14700	0.14700	0.14600	0.14600	0.45800	0.45800
5	0.16900	0.16900	0.19444	0.17500	0.16300	0.16300	0.18444	0.16600	0.36800	0.36800
6	0.17200	0.17200	0.16200	0.16200	0.16500	0.16500	0.27250	0.21800	0.33600	0.33600
7	0.16300	0.16300	0.19000	0.19000	0.18667	0.16800	0.14700	0.14700	0.33000	0.33000
8	0.14900	0.14900	0.16900	0.16900	0.15600	0.15600	0.17600	0.17600	0.29200	0.29200
Average[1] Dry Weight (mg)	**0.16913**		**0.18442**		**0.16769**		**0.18462**		**0.33775**	
Average Biomass[2] Weight (mg)		**0.16700**		**0.17937**		**0.16075**		**0.17550**		**0.33387**
28-Day Percent Survival	**98.8**		**97.5**		**96.3**		**96.3**		**98.8**	

Note: Average Dry Weight of *Hyallela azteca* at test initiation = 0.01950 mg

[1] Average Dry Weight is the total dry weight of surviving organisms

[2] Biomass weight is the total dry weight of surviving organisms divided by the initial number of organisms.

TABLE 5. Comparison of Number of Surviving *Lumbriculus variegatus* per Replicate and Percent Survival; Between the Laboratory Control Sediment and the Investigative Sediments; *Lumbriculus variegatus* 4-Day Toxicity Screening Sediment Tests Conducted October 14 - October 18, 2016; Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.

REPLICATE NUMBER	West Bear Skin Laboratory Control CS# 136	BM16MLW-001-0.0-0.15 GLC No. 11,080	BM16MLW-002-0.0-0.15 GLC No. 11,081	BM16MLW-003-0.0-0.15 GLC No. 11,082
1	10	10	9	8
2	10	9	10	10
3	10	10	10	10
4	10	10	10	10
4-Day Screening Test Percent Survival[r]	**100**	**97.5**	**97.5**	**95.0**

[r] Replicates initiated with 10 organisms each

TABLE 6. Summary of *Lumbriculus variegatus* Average Depurated Wet Weight (g) for the Laboratory Control and Investigative Sediment Samples;
***Lumbriculus variegatus* 28-Day Bioaccumulation Whole Sediment Toxicity Tests Conducted October 25 - November 22, 2016;**
Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.

REPLICATE NUMBER	West Bear Skin Laboratory Control CS# 136	BM16MLW-001-0.0-0.15 GLC No. 11,080	BM16MLW-002-0.0-0.15 GLC No. 11,081	BM16MLW-003-0.0-0.15 GLC No. 11,082
1	19.72	17.29	15.62	16.63
2	19.00	14.22	16.17	14.67
3	19.30	15.28	14.30	15.43
4	17.36	15.09	15.74	15.04
5	15.99	13.52	16.19	15.63
Average Wet Depurated Weight (g)	**18.27**	**15.08**	**15.60**	**15.48**

Note: Initiated 28-day test with 18 grams of *L. variegatus* per replicate.

TABLE 7. **Analytical *Lumbriculus variegatus* Tissue Chemistry Results: Nickel (mg/Kg) and Zinc (mg/Kg);**
Results Reported on a "Wet Weight" Basis;
***Lumbriculus variegatus* 28-Day Bioaccumulation Whole Sediment Toxicity Tests Conducted October 25 - November 22, 2016;**
Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.

	Background *L. variegatus* Tissue Day 0 10/25/2016	**West Bear Skin Laboratory Control CS# 136**	**BM16MLW-001-0.0-0.15 GLC No. 11,080**	**BM16MLW-002-0.0-0.15 GLC No. 11,081**	**BM16MLW-003-0.0-0.15 GLC No. 11,082**
Nickel (mg/Kg)	1.00	1.10	0.72	2.10	0.46
Zinc (mg/Kg)	21.4	18.2	18.0	17.0	21.3

Nickel and Zinc : Method: EPA 6020; Preparation Method: EPA 3050B

TABLE 8. **Sediment Chemistry Results: Percent Moisture (%) and Total Organic Carbon (TOC) for; Laboratory Control Sediment and the Investigative Sediments; Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.**

	West Bear Skin Laboratory Control **CS# 136**	**BM16MLW-001-0.0-0.15** **GLC No. 11,080**	**BM16MLW-002-0.0-0.15** **GLC No. 11,081**	**BM16MLW-003-0.0-0.15** **GLC No. 11,082**
Percent Moisture (%)	86.6	84.8	79.9	87.7
Mean Total Organic Carbon (mg/kg-dry)	14,900	26,100	24,500	30,200

Percent Moisture: Method ASTM D2974-87 and a reporting limit of 0.10%.

TOC: Method EPA 9060 in quadruplicate and a reporting limit of 100 mg/Kg dry

TABLE 9. **Summary of Mean Water Quality Parameters of Overlying Water Collected Prior to Renewal; *Chironomus dilutus* 10-Day Whole Sediment Toxicity Tests Conducted October 14-October 24, 2016; Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.**

Sample ID GLC No.	**Temperature (°C)** (range) n=22	**pH (s.u.)** (range) n=4	**Dissolved Oxygen (mg/L)** (range) n=22	**Specific Conductivity (µmhos/cm)** (range) n=4	**Hardness (CaCO3 mg/L)** (range) n=2; n=4 GLC 11082	**Alkalinity (CaCO3 mg/L)** (range) n=2; n=4 GLEC 11082	**Ammonia (mg/L as N)** (range) n=2; n=4 GLEC 11082
West Bearskin Lake CS #136	**22.5** (22.4-22.7)	**7.37** (7.28-7.45)	**5.0** (3.1-7.7)	**290** (274-302)	**118** (116-120)	**84** (78-90)	**0.50** (0.33-0.67)
Water Only Control NA	**22.7** (22.3-22.9)	**7.91** (7.52-8.3)	**6.0** (3.7-8.6)	**319** (316-323)	**138** (136-140)	**104** (102-106)	**0.34** (0.08-0.59)
BW16MLW-001-0- 11080	**22.7** (22.4-22.8)	**7.50** (7.43-7.59)	**4.5** (2.3-6.8)	**310** (298-324)	**132** (120-144)	**96** (90-102)	**0.38** (0.18-0.58)
BW16MLW-002-0- 11081	**22.6** (22.3-22.7)	**7.56** (7.33-7.96)	**4.7** (2.3-7.8)	**309** (296-314)	**136** (128-144)	**93** (88-98)	**0.29** (0.15-0.43)
BW16MLW-003-0- 11082	**22.5** (22.3-22.8)	**7.47** (7.42-7.56)	**4.3** (2.7-6.6)	**309** (296-320)	**134** (128-140)	**99** (94-106)	**0.53** (0.39-0.68)

n= Number of measurements

TABLE 10. Summary of Mean Water Quality Parameters of Overlying Water Collected Prior to Renewal; *Hyalella azteca* 28-Day Whole Sediment Toxicity Tests Conducted October 19-November 16, 2016; Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.

Sample ID GLC No.	**Temperature (°C)** (range) n=58	**pH (s.u.)** (range) n=28	**Dissolved Oxygen (mg/L)** (range) n=58	**Specific Conductivity (µmhos/cm)** (range) n=12	**Hardness (CaCO3 mg/L)** (range) n=2, GLC #11080 n=4	**Alkalinity (CaCO3 mg/L)** (range) n=2, GLC #11080 n=4	**Ammonia (mg/L as N)** (range) n=2, GLC #11080 n=4
West Bearskin Lake CS #136	**22.7** (22.2-23.3)	**7.57** (7.42-7.76)	**6.9** (6.1-8)	**303** (267-319)	**124** (112-136)	**90** (82-98)	**0.20** (0.09-0.3)
Water Only Control NA	**22.7** (22.1-23.2)	**8.01** (7.76-8.25)	**7.7** (6.9-8.9)	**314** (308-319)	**134** (132-136)	**103** (102-104)	**0.06** (0.05-0.06)
BW16MLW-001 11080	**22.7** (22.1-23.1)	**7.91** (7.47-8.52)	**6.4** (5.3-7.7)	**320** (292-340)	**131** (124-136)	**94** (88-98)	**0.14** (0.06-0.22)
BW16MLW-002 11081	**22.7** (22.2-23.2)	**7.84** (7.48-8.12)	**6.5** (5.7-7.8)	**318** (288-362)	**130** (124-136)	**98** (90-106)	**0.12** (0.05-0.18)
BW16MLW-003 11082	**22.6** (22.2-23.2)	**7.81** (7.26-8.49)	**6.0** (4.1-7.8)	**319** (304-339)	**128** (124-132)	**98** (98-98)	**0.21** (0.05-0.37)

n= Number of measurements

TABLE 11 . Summary of Mean Water Quality Parameters of Overlying Water Collected Prior to Renewal; *lumbriculus variegatus* 4-Day Screening Survival Tests Conducted October 14-October 18, 2016; Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.

Sample ID GLC No.	**Temperature (°C)** (range) n=10	**pH (s.u.)** (range) n=4	**Dissolved Oxygen (mg/L)** (range) n=10	**Specific Conductivity (µmhos/cm)** (range) n=4	**Hardness (CaCO3 mg/L)** (range) n=2, GLC # 11082 n=4	**Alkalinity (CaCO3 mg/L)** (range) n=2, GLC # 11082 n=4	**Ammonia (mg/L as N)** (range) n=2, GLC # 11082 n=4
Laboratory Control West Bearskin Lake	**22.6** (22.4-22.8)	**7.38** (7.26-7.46)	**6.9** (6.6-7.6)	**286** (272-302)	**122** (116-128)	**83** (78-88)	**0.25** (0.16-0.33)
BW16MLW-001-0.0-11080	**22.7** (22.5-22.8)	**7.55** (7.47-7.62)	**6.6** (6.2-7.1)	**303** (297-309)	**128** (120-136)	**95** (90-100)	**0.13** (0.07-0.18)
BW16MLW-002-0.0-11081	**22.6** (22.3-22.9)	**7.59** (7.49-7.66)	**6.7** (6-7.2)	**300** (290-307)	**132** (128-136)	**94** (88-100)	**0.11** (0.07-0.15)
BW16MLW-003-0.0-11082	**22.6** (22.3-22.8)	**7.59** (7.49-7.68)	**6.3** (5.3-7)	**310** (304-316)	**133** (128-144)	**97** (94-100)	**0.27** (0.15-0.39)

n= Number of measurements

TABLE 12. Summary of Mean Water Quality Parameters of Overlying Water; *Lumbriculus variegatus* 28-Day Bioaccumulation Whole Sediment Toxicity Tests Conducted October 25-November 22, 2016; Bay West LLC; MPCA; Mud Lake West-Saint Louis River Area of Concern, Duluth, Minnesota.

Sample ID GLC No.	**Temperature (°C)** (range) n=58	**pH (s.u.)** (range) n=10	**Dissolved Oxygen (mg/L)** (range) n=58	**Specific Conductivity (µmhos/cm)** (range) n=10	**Flows (mLs/minute)** (range) n=145	**Hardness (CaCO3 mg/L)** (range) n=5, GLC #11080 n=6, GLC #11082 n=9	**Alkalinity (CaCO3 mg/L)** (range) n=5, GLC #11080 n=6, GLC #11082 n=9	**Ammonia (mg/L as N)** (range) n=5, GLC #11080 n=6, GLC #11082 n=9
West Bearskin Lake CS #136	**22.6** (22.0-23.4)	**8.02** (7.81-8.26)	**7.7** (6.9-8.5)	**309** (303-317)	**4.4** (3.2-6.8)	**131** (128-132)	**103** (98-106)	**0.57** (0.13-0.84)
BW16MLW-001 11080	**22.4** (22.0-23.1)	**8.03** (7.87-8.17)	**7.6** (5.9-8.7)	**312** (305-319)	**4.1** (3.0-5.8)	**134** (124-140)	**99** (94-104)	**0.68** (0.11-1.21)
BW16MLW-002 11081	**22.6** (22.1-23.2)	**7.97** (7.80-8.19)	**7.4** (6.6-8.6)	**310** (299-317)	**4.2** (3.0-7.0)	**133** (124-140)	**98** (94-102)	**0.78** (0.20-1.19)
BW16MLW-003 11082	**22.6** (22.0-23.3)	**8.01** (7.69-8.22)	**7.3** (5.8-8.6)	**311** (304-320)	**4.4** (3.0-7.0)	**131** (120-140)	**99** (96-102)	**0.90** (0.22-1.33)

n= Number of measurements

Appendix A
Chain of Custodies

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A **Required** Client Information:	**Section B** **Required** Project Information:	**Section C** Invoice Information:	**Section D** EQuIS Information:	
Company: Bay West, LLC	Report To: Nancy McDonald	Attention: Accounts Payable	Facility_Name: St. Louis River Sediment Areas of Concern	Page 1 of 1
Address: 5 Empire Drive	Copy To: Paul Raymaker	Company Name: Bay West, LLC	Facility_Code: St Louis River Sed	
St. Paul, MN 55103		Address: 5 Empire Drive	Facility_ID: 547023	COC# SLR-GLEC-1
Email To: nmcdonald@baywest.com	Purchase Order No.:	Lab Quote Reference:	Subfacility_code:	
Phone: 651-291-3483	Project Name: SLR Sediment AOCs	Lab Project Manager: Mailee Garton		Site Location STATE: MN
Requested Due Date/TAT: Standard	Project Number: J160139			

Section E
Required Client Information

Valid Matrix Codes

MATRIX	CODE
Drinking Water	DW
Waste Water	W
Product	WW
Soil/Solid	P
Oil	SO
Wipe	OL
Air	WP
Tissue	AR
Other	TS
	OT

ITEM #	Sample Location ID (sys_loc_code)	Sample ID (sys_sample_code)	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	Collection		# OF CONTAINERS	Preservatives								Requested Analysis												Comments
					DATE	Time		Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	10-d toxicity (C. dilutes)	28-d toxicity (H. azteca)	28-d bioaccumulation (L. variegatus)	Nickel (6020A)	Zinc (6020A)	TOC (9060A)	Dioxins/furans (8290A)					GLEC#	
Ex.	BW15MLW-005	BW14MLW-005-0-0.15	SO	G	3/12/15	1204																						
1	BW16MLW-001	BW16MLW-001-0.0-0.15	SO	G	10/4/16	1008	2	2								x	x	x	x	x	x	x	temp		7.5		11080	Dioxins/furans to Pace Analytical
2	BW16MLW-002	BW16MLW-002-0.0-0.15	SO	G	10/4/16	1048	2	2								x	x	x	x	x	x	x	temp		8.0		11081	Dioxins/furans to Pace Analytical
3	BW16MLW-003	BW16MLW-003-0.0-0.15	SO	G	10/4/16	1107	2	2								x	x	x	x	x	x	x	temp		8.1		11082	Dioxins/furans to Pace Analytical
4																												
5																												
6																												
7																												
8																												
9																												
10																												
11																												
12																												

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
	Chris Musson/Bay West	10/4/16	1900	Fed Ex	10/4/16	1900
Rec	Kelly Stratton GLEC	10/5/16	1013			

SAMPLE CONDITIONS

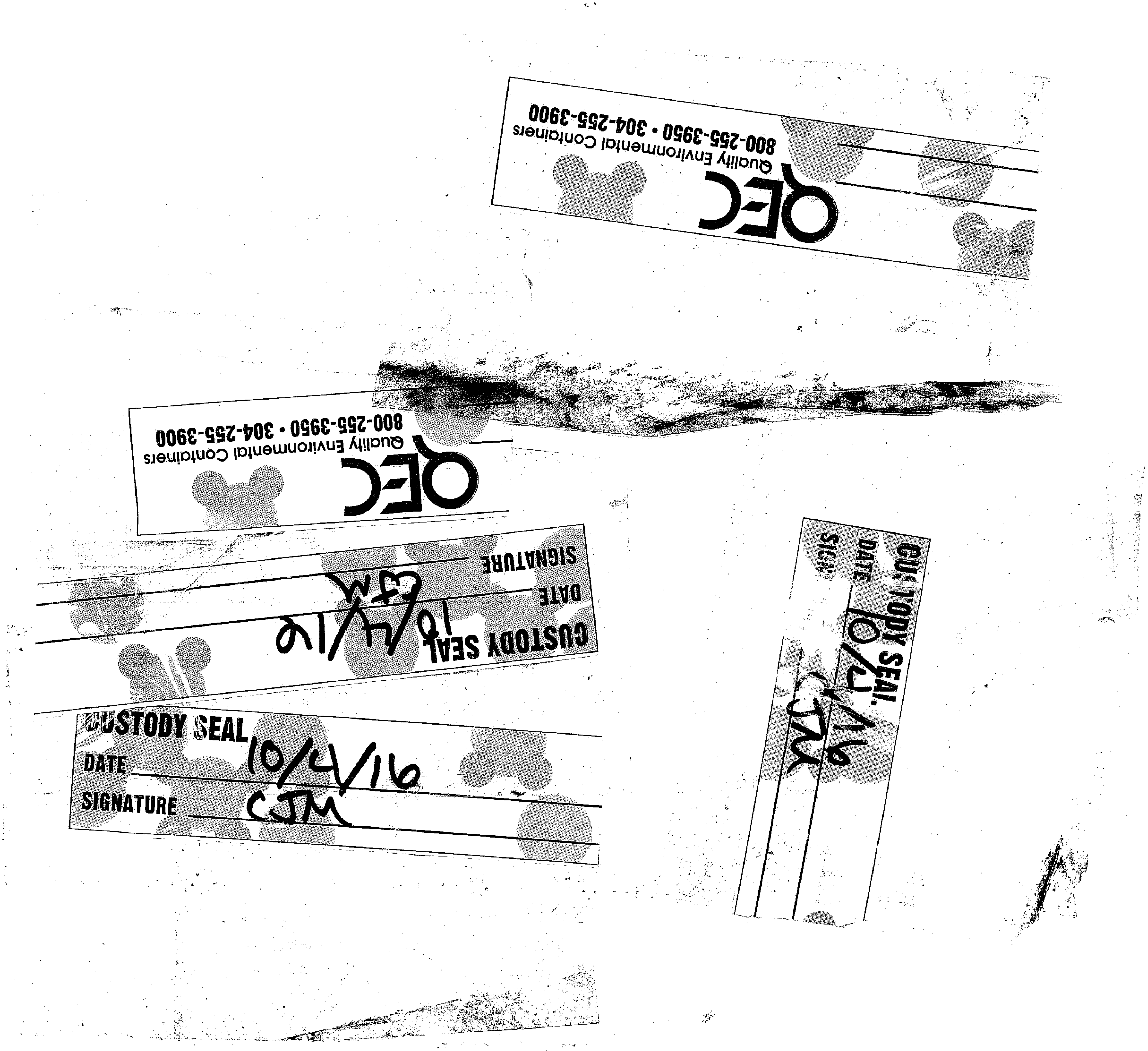
Temp (°C)	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
See above	Y		Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Chris Musson

SIGNATURE of SAMPLER:

DATE Signed (MM/DD/YY): 10/4/16


QEC
Quality Environmental Containers
800-255-3950 • 304-255-3900
CUSTODY SEAL
DATE 10/4/16
SIGNATURE CJM

GLEC
Great Lakes Environmental Center

Sample
CHECK-IN FORM

CLIENT: Bay West

PROJECT NUMBER: 2386-06

INITIAL SAMPLE CHEMISTRY (UPON RECEIPT)

DATE RECEIVED	10/5/16	10/5/16	10/5/16		KS	INITIALS
SAMPLE ID	BW16MLW-001-0.0-0.15	BW16MLW-002-0.0-0.15	BW16 MLW-003-0.0-0.15			
TYPE (W=water, SED=sediment, M=material)	Sed	Sed	Sed			
COLLECTION (G=grab, C=composite)	G	G	G			
GLC NUMBER	11080	11081	11082			
COLLECTION DATE	10/4/16	10/4/16	10/4/16			
COLLECTION TIME	1006	1048	1107			
TEMPERATURE ($\leq$6 degrees Celsius[1])	7.5	8.0	8.1			
SAMPLE DESCRIPTION/OBSERVATIONS (clarity, color, odor)	Brown Pudding Roots	Muddy, some roots, Brown	Muddy Brown slight odor		KS	

[1] If out of range see project manager

INITIAL SAMPLE CHEMISTRY (UPON RECEIPT)

DATE RECEIVED						Initials
SAMPLE ID						
TYPE (W=water, SED=sediment, M=material)						
COLLECTION (G=grab, C=composite)						
GLC NUMBER						
COLLECTION DATE						
COLLECTION TIME						
TEMPERATURE ($\leq$6 degrees Celsius[1])						
SAMPLE DESCRIPTION/OBSERVATIONS (clarity, color, odor)						

Sample Check-In Discrepancy/Comment Form

Project Name: Bay West
Project Number: 2386
GLC Number: 11080 - 11081 - 11082
Date: 10/5/16
Date Sampled: 10/4/16
Technician Initials KS / MW
Project Manager: MW

Discrepancy: Please mark one or more of the following in the box below. Anomalies other than what is listed below can be described in the Comment Section.

Any questions associated with the samples (i.e., damaged containers, improper preservation, unlabeled/illegible sample labels, document discrepancies, insufficient sample volume) must be corrected prior to analysis by contacting the project manager, client and/or state authority. All correspondence shall be documented and discrepancies will be solved as quickly as possible.

Cooler Condition:

- ☐ Samples were not received on wet ice
- ☐ No temperature blank submitted
- ☒ Temperature of samples outside of acceptable range, or samples show evidence of freezing.

Container Label Condition:

- ☐ Not the same ID/info. as on COC
- ☐ Incomplete or missing information: sample ID, collection date/time
- ☐ Other: label smeared, torn, or otherwise illegible

Chain of Custody Discrepancies:

- ☐ No custody seal
- ☐ Custody seal not intact
- ☐ No relinquish signature or name
- ☐ No date/time relinquished
- ☐ No signature
- ☐ Incomplete information

Container Condition:

- ☐ Leaking
- ☐ Broken
- ☐ Loose caps, or without labels

Sample Documentation Discrepancies:

- ☐ Samples not received, but listed on COC
- ☐ Samples received, but not listed on COC
- ☐ Mislabeled toxicology tests, preservatives, etc.
- ☐ Holding time expired
- ☐ Insufficient quantity for analysis

Comments:

Contacted client via email. 10/5/16
See attached sheet.

Corrective Actions: (*please use include dates and names when documenting*)

As per email will proceed with testing

Laboratory Technician Signature: Date: 10/5/16

Project Manager/Laboratory Supervisor Signature: Date: 10/5/16

Receipt temperature of sediment samples

1 message

Mailee Garton <mgarton@glec.com>
Wed, Oct 5, 2016 at 12:22 PM
To: Paul Raymaker <praymaker@baywest.com>, Nancy McDonald <nmcdonald@baywest.com>, Chris Musson <cmusson@baywest.com>

Good Afternoon,

The three sediment samples arrived in good condition. The temperatures of the sediment samples upon receipt were 7.5, 8.0, and 8.1 degrees Celsius (C). All shipping containers had a sufficient amount of ice still packed on top of the samples, not melted. Future suggestion would be to open the bags of ice and place around the samples.

Target temperatures upon receipt is 0 to ≤ 6 degrees C , not frozen. With that being said the temperatures were just slightly above the maximum allowable temperature. This slight temperature deviation most likely will not cause an issue with the samples. The recommended temperature is to inhibit microbial degradation, chemical transformations, and loss of highly volatile toxic substances.

Were the samples pre-chilled prior to shipment? If not, we recommend chilling the samples prior to shipment.

Unless we hear otherwise, GLEC will continue as planned and use the sediment samples to conduct the whole sediment toxicity and bioaccumulation tests.

Thank you and take care,

Mailee

--
Mailee Garton
Co Manager of Operations - Toxicology Laboratory/Coordinator
Great Lakes Environmental Center
739 Hastings Street
Traverse City, MI 49686
Phone: 231-941-2230
Fax: 231-941-2240
Cell: 231-590-0043

Appendix B1
Overlying Water Quality Summaries

- *Chironomus dilutus*

Project Name: Bay West
Project Number: 2386

Test Dates: 10/14/2016 - 10/24/2016
Test Type: 10 Day Whole Sediment Toxicity Survival and Growth
Test Species: C. dilutus

100% Data Entry

Date	Initials	Data Entered
11/4/2016	MP	All

100% Data Quality Check

Date	Initials	Data QC'ed	Errors Found Y	Errors Corrected:Y
11/18/2016	DS	ALL	N	N

100% Error Corrected Quality Check

Date	Initials	Data QC'ed
	Not applicable no errors found	

Data QC 10%

Date	Initials	Data QC'ed
11/30/2016	mwg	All data on days 1,2,7,8 and 10

Project Name: Bay West
Project Number: 2386-00
Sample ID: **West Bearskin Lake**
GLEC ID: **CS #136**

Test Dates: 10/14/2016-10/24/2016
Test Type: 10 Day Whole Sediment Toxicity Survival and Growth
Test Species: C. dilutus

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
25-Sep-15	0	22.6	7.45	7.7	282	116	78	0.33
		22.7	7.43	7.4	274			
26-Sep-15	1	22.5		5.7				
		22.5		5.7				
27-Sep-15	2	22.4		5.6				
		22.6		5.6				
28-Sep-15	3	22.6		6.3				
		22.6		6.0				
29-Sep-15	4	22.4		5.2				
		22.5		4.9				
30-Sep-15	5	22.4		4.2				
		22.5		4.6				
1-Oct-15	6	22.4		4.6				
		22.5		4.6				
2-Oct-15	7	22.6		6.1				
		22.6		5.0				
3-Oct-15	8	22.4		3.1				
		22.4		3.2				
4-Oct-15	9	22.4		3.5				
		22.6		4.0				
5-Oct-15	10	22.7	7.28	3.6	302	120	90	0.67
		22.7	7.32	3.5	301			
MEAN		**22.5**	**7.37**	**5.0**	**290**	**118**	**84**	**0.50**
N=		**22**	**4**	**22**	**4**	**2**	**2**	**2**
Min #		**22.4**	**7.28**	**3.1**	**274**	**116**	**78**	**0.33**
Max #		**22.7**	**7.45**	**7.7**	**302**	**120**	**90**	**0.67**

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386-00
Sample ID: **Water Only**
GLEC ID: **N/A**

Test Dates: 10/14/2016-10/24/2016
Test Type: 10 Day Whole Sediment Toxicity Survival and Growth
Test Species: C. dilutus

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (µmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
25-Sep-15	0	22.8	8.25	8.4	316	136	102	0.08	J
		22.9	8.30	8.6	316				
26-Sep-15	1	22.7		6.4					
		22.7		6.0					
27-Sep-15	2	22.6		6.1					
		22.6		6.3					
28-Sep-15	3	22.7		7.6					
		22.7		7.5					
29-Sep-15	4	22.9		6.1					
		22.8		6.1					
30-Sep-15	5	22.5		5.3					
		22.6		5.3					
1-Oct-15	6	22.6		5.3					
		22.6		5.2					
2-Oct-15	7	22.8		6.7					
		22.9		6.7					
3-Oct-15	8	22.7		4.3					
		22.7		4.7					
4-Oct-15	9	22.7		5.7					
		22.7		5.6					
5-Oct-15	10	22.3	7.52	4.2	323	140	106	0.59	
		22.6	7.58	3.7	319				
MEAN		**22.7**	**7.91**	**6.0**	**319**	**138**	**104**	**0.34**	
N=		**22**	**4**	**22**	**4**	**2**	**2**	**2**	
Min #		**22.3**	**7.52**	**3.7**	**316**	**136**	**102**	**0.08**	
Max #		**22.9**	**8.30**	**8.6**	**323**	**140**	**106**	**0.59**	

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386-00
Sample ID: **BW16MLW-001-0-0.15**
GLEC ID: **11080**

Test Dates: 10/14/2016-10/24/2016
Test Type: 10 Day Whole Sediment Toxicity Survival and Growth
Test Species: C. dilutus

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (µmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
25-Sep-15	0	22.8	7.53	6.8	298	120	90	0.18	J
		22.8	7.59	6.8	299				
26-Sep-15	1	22.4		6.1					
		22.6		5.8					
27-Sep-15	2	22.7		5.3					
		22.5		5.2					
28-Sep-15	3	22.7		6.2					
		22.7		5.4					
29-Sep-15	4	22.8		4.1					
		22.8		4.1					
30-Sep-15	5	22.6		4.4					
		22.6		3.8					
1-Oct-15	6	22.5		4.6					
		22.6		4.2					
2-Oct-15	7	22.5		4.9					
		22.5		5.1					
3-Oct-15	8	22.7		2.8					
		22.6		2.8					
4-Oct-15	9	22.7		2.8					
		22.7		2.7					
5-Oct-15	10	22.8	7.43	2.3	324	144	102	0.58	
		22.8	7.44	2.6	320				
MEAN		**22.7**	**7.50**	**4.5**	**310**	**132**	**96**	**0.38**	
N=		**22**	**4**	**22**	**4**	**2**	**2**	**2**	
Min #		**22.4**	**7.43**	**2.3**	**298**	**120**	**90**	**0.18**	
Max #		**22.8**	**7.59**	**6.8**	**324**	**144**	**102**	**0.58**	

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386-00
Sample ID: **BW16MLW-002-0-0.15**
GLEC ID: **11081**

Test Dates: 10/14/2016-10/24/2016
Test Type: 10 Day Whole Sediment Toxicity Survival and Growth
Test Species: C. dilutus

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
25-Sep-15	0	22.7	7.96	7.8	313	128	88	0.15	J
		22.7	7.58	6.8	296				
26-Sep-15	1	22.7		5.8					
		22.7		5.3					
27-Sep-15	2	22.6		5.7					
		22.7		5.5					
28-Sep-15	3	22.6		5.3					
		22.6		5.5					
29-Sep-15	4	22.6		5.2					
		22.7		5.1					
30-Sep-15	5	22.6		4.4					
		22.4		4.3					
1-Oct-15	6	22.5		5.0					
		22.4		4.6					
2-Oct-15	7	22.3		5.6					
		22.5		5.1					
3-Oct-15	8	22.6		2.7					
		22.6		3.0					
4-Oct-15	9	22.7		2.9					
		22.6		3.2					
5-Oct-15	10	22.7	7.33	2.3	314	144	98	0.43	
		22.7	7.37	2.7	312				
MEAN		**22.6**	**7.56**	**4.7**	**309**	**136**	**93**	**0.29**	
N=		**22**	**4**	**22**	**4**	**2**	**2**	**2**	
Min #		**22.3**	**7.33**	**2.3**	**296**	**128**	**88**	**0.15**	
Max #		**22.7**	**7.96**	**7.8**	**314**	**144**	**98**	**0.43**	

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386-00
Sample ID: **BW16MLW-003-0-0.15**
GLEC ID: **11082**

Test Dates: 10/14/2016-10/24/2016
Test Type: 10 Day Whole Sediment Toxicity Survival and Growth
Test Species: C. dilutus

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
25-Sep-15	0	22.6	7.47	6.6	302	128	94	0.39
		22.6	7.56	6.6	296	128	94	0.39
26-Sep-15	1	22.5		3.1				
		22.5		4.4				
27-Sep-15	2	22.6		5.5				
		22.6		5.3				
28-Sep-15	3	22.6		5.8				
		22.6		5.3				
29-Sep-15	4	22.3		4.5				
		22.4		4.4				
30-Sep-15	5	22.3		3.7				
		22.4		4.3				
1-Oct-15	6	22.3		3.9				
		22.4		3.9				
2-Oct-15	7	22.6		4.1				
		22.6		4.5				
3-Oct-15	8	22.6		2.8				
		22.6		2.7				
4-Oct-15	9	22.6		3.3				
		22.6		2.8				
5-Oct-15	10	22.7	7.42	3.3	320	140	106	0.66
		22.8	7.43	3.6	318	140	102	0.68
MEAN		**22.5**	**7.47**	**4.3**	**309**	**134**	**99**	**0.53**
N=		**22**	**4**	**22**	**4**	**4**	**4**	**4**
Min #		**22.3**	**7.42**	**2.7**	**296**	**128**	**94**	**0.39**
Max #		**22.8**	**7.56**	**6.6**	**320**	**140**	**106**	**0.68**

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

GLEC
Great Lakes Environmental Center

Project Name: Bay West
Project Number: 2386

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

100% Data Entry

Date	Initials	Data Entered
11/10/2016	MLV	Days 0-6
11/11/2016	MLV	Days 7-22
11/14/2016	MLV	Days 23-24
11/17/2016	MLV	Days 25-28

100% Data Quality Check

Date	Initials	Data QC'ed	Errors Found Y	Errors Corrected:Y
11/17/2016	DS	ALL	Y	Y

100% Error Corrected Quality Check

Date	Initials	Data QC'ed
12/4/2016	mwg	water day 1 pH,

Data QC 10%

Date	Initials	Data QC'ed
12/4/2061	mwg	days 1, 7, 8, 13, 18, 19, 23, 24

Appendix B2
Overlying Water Quality Summaries

- *Hyalella azteca*

GLEC

Project Name: Bay West
Project Number: 2386
Sample ID: **West Bearskin Lake**
GLEC ID: **CS #136**

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

Date	**Test Day**	**Temperature (°C)**	**pH (s.u.)**	**D.O. (mg/L)**	**Conductivity (µmos)**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Ammonia (mg/L)**
19-Oct-16	0	22.7	7.42	6.5	272	112	82	0.30
		22.7	7.42	6.5	267			
20-Oct-16	1	22.5	7.52	7.2				
		22.6	7.55	7.2				
21-Oct-16	2	22.2		8.0				
		22.2		8.0				
22-Oct-16	3	22.5	7.46	7.1				
		22.6	7.55	7.0				
23-Oct-16	4	22.6		7.0				
		22.7		7.0				
24-Oct-16	5	23.1		6.6				
		23.1		6.8				
25-Oct-16	6	22.3	7.49	6.9	319			
		22.3	7.53	6.8	305			
26-Oct-16	7	22.7		7.4				
		22.7		7.3				
27-Oct-16	8	22.2	7.45	7.1				
		22.2	7.49	7.0				
28-Oct-16	9	22.6		7.3				
		22.6		7.2				
29-Oct-16	10	23.0	7.46	6.4				
		22.9	7.56	6.4				
30-Oct-16	11	22.8		6.8				
		22.8		6.8				
31-Oct-16	12	22.9		6.9				
		22.7		6.9				
1-Nov-16	13	22.6	7.66	6.4	303			
		22.6	7.62	6.3	299			
2-Nov-16	14	22.5		6.4				
		22.6		6.6				
3-Nov-16	15	23.3	7.57	6.7				
		23.3	7.60	6.9				
4-Nov-16	16	22.7		6.4				
		22.7		6.4				

Project Name: Bay West
Project Number: 2386
Sample ID: **West Bearskin Lake**
GLEC ID: **CS #136**

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

Date	**Test Day**	**Temperature (°C)**	**pH (s.u.)**	**D.O. (mg/L)**	**Conductivity (μmos)**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Ammonia (mg/L)**	
5-Nov-16	17	22.6	7.55	6.7					
		22.7	7.62	6.5					
6-Nov-16	18	22.6		6.8					
		22.6		6.1					
7-Nov-16	19	22.7		7.3					
		23.0		7.2					
8-Nov-16	20	22.9	7.56	7.2	313				
		22.9	7.66	6.9	307				
9-Nov-16	21	22.7		6.5					
		22.7		6.6					
10-Nov-16	22	22.6	7.68	6.7					
		22.5	7.65	6.5					
11-Nov-16	23	23.1		7.3					
		23.1		7.3					
12-Nov-16	24	22.5	7.72	6.8					
		22.5	7.76	6.9					
13-Nov-16	25	22.5		6.8					
		22.5		6.8					
14-Nov-16	26	22.8		7.8					
		22.9		7.4					
15-Nov-16	27	22.9	7.64	7.0	315				
		22.9	7.69	6.7	311				
16-Nov-16	28	23.1	7.57	7.2	311	136	98	0.09	J
		23.1	7.64	7.0	308				
MEAN		**22.7**	**7.57**	**6.9**	**303**	**124**	**90**	**0.20**	
N=		**58**	**28**	**58**	**12**	**2**	**2**	**2**	
Min #		**22.2**	**7.42**	**6.1**	**267**	**112**	**82**	**0.09**	
Max #		**23.3**	**7.76**	**8.0**	**319**	**136**	**98**	**0.30**	

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386
Sample ID: **Water Only**
GLEC ID: **N/A**

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

Date	**Test Day**	**Temperature (°C)**	**pH (s.u.)**	**D.O. (mg/L)**	**Conductivity (μmos)**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Ammonia (mg/L)**	
19-Oct-16	0	22.7	8.15	7.5	308	132	102	0.05	J
		22.6	8.21	7.7	309				
20-Oct-16	1	22.6	7.95	7.4					
		22.6	7.93	7.2					
21-Oct-16	2	22.4		8.9					
		22.5		8.8					
22-Oct-16	3	22.9	8.01	7.8					
		22.9	8.11	8.0					
23-Oct-16	4	22.9		7.5					
		22.9		7.6					
24-Oct-16	5	22.7		8.0					
		22.9		8.0					
25-Oct-16	6	22.6	8.02	7.9	317				
		22.6	8.05	7.9	318				
26-Oct-16	7	22.8		8.4					
		22.7		8.5					
27-Oct-16	8	22.4	7.95	8.5					
		22.1	7.99	8.3					
28-Oct-16	9	22.4		8.3					
		22.5		8.3					
29-Oct-16	10	22.8	7.96	7.3					
		22.9	7.95	7.3					
30-Oct-16	11	22.8		7.2					
		22.9		7.2					
31-Oct-16	12	22.7		7.1					
		22.7		7.2					
1-Nov-16	13	22.7	8.05	7.3	309				
		22.6	8.08	7.2	309				
2-Nov-16	14	22.5		7.0					
		22.6		6.9					
3-Nov-16	15	23.0	7.76	7.4					
		23.1	7.82	6.9					
4-Nov-16	16	22.8		7.0					
		23.0		6.9					

Project Name: Bay West
Project Number: 2386
Sample ID: **Water Only**
GLEC ID: **N/A**

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

Date	**Test Day**	**Temperature (°C)**	**pH (s.u.)**	**D.O. (mg/L)**	**Conductivity (µmos)**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Ammonia (mg/L)**	
5-Nov-16	17	22.9	8.25	7.5					
		22.9	8.14	7.0					
6-Nov-16	18	22.9		7.4					
		23.0		7.4					
7-Nov-16	19	23.1		8.1					
		23.2		8.2					
8-Nov-16	20	22.3	8.01	8.0	315				
		22.5	7.99	7.7	314				
9-Nov-16	21	22.6		7.3					
		22.6		7.1					
10-Nov-16	22	22.6	8.02	7.3					
		22.6	8.01	7.4					
11-Nov-16	23	23.2		8.3					
		23.2		8.2					
12-Nov-16	24	22.5	7.98	7.4					
		22.5	8.06	7.4					
13-Nov-16	25	22.6		7.2					
		22.6		7.3					
14-Nov-16	26	23.0		8.2					
		23.0		8.1					
15-Nov-16	27	22.8	7.90	7.9	315				
		23.0	7.91	7.5	315				
16-Nov-16	28	22.9	7.97	7.9	315	136	104	0.06	J
		22.8	7.94	8.0	319				

MEAN		**22.7**	**8.01**	**7.7**	**314**	**134**	**103**	**0.06**
N=		**58**	**28**	**58**	**12**	**2**	**2**	**2**
Min #		**22.1**	**7.76**	**6.9**	**308**	**132**	**102**	**0.05**
Max #		**23.2**	**8.25**	**8.9**	**319**	**136**	**104**	**0.06**

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386
Sample ID: **BW16MLW-001**
GLEC ID: **11080**

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
19-Oct-16	0	22.7	7.52	6.7	292	128	90	0.21
		22.6	7.47	6.4	293	124	88	0.22
20-Oct-16	1	22.5	7.61	6.9				
		22.5	7.62	6.9				
21-Oct-16	2	22.5		7.7				
		22.5		7.7				
22-Oct-16	3	23.0	7.67	5.7				
		23.0	7.59	6.1				
23-Oct-16	4	22.9		6.4				
		22.9		6.4				
24-Oct-16	5	22.8		6.2				
		22.8		6.3				
25-Oct-16	6	22.7	8.16	6.3	322			
		22.7	8.20	6.3	329			
26-Oct-16	7	23.0		6.6				
		22.9		6.4				
27-Oct-16	8	22.2	8.51	6.0				
		22.1	8.42	6.5				
28-Oct-16	9	22.6		7.0				
		22.7		6.4				
29-Oct-16	10	22.8	8.52	6.3				
		22.8	8.45	5.8				
30-Oct-16	11	22.8		6.2				
		22.8		5.9				
31-Oct-16	12	22.6		5.6				
		22.7		5.7				
1-Nov-16	13	22.6	8.44	6.5	333			
		22.6	8.45	5.9	340			
2-Nov-16	14	22.6		6.1				
		22.6		6.2				
3-Nov-16	15	23.1	7.92	6.1				
		23.1	8.13	6.2				
4-Nov-16	16	22.8		5.3				
		22.9		5.5				

Project Name: Bay West
Project Number: 2386
Sample ID: **BW16MLW-001**
GLEC ID: **11080**

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
5-Nov-16	17	22.6	7.89	6.0					
		22.6	7.74	6.5					
6-Nov-16	18	22.7		5.4					
		22.6		6.1					
7-Nov-16	19	23.0		5.8					
		23.1		6.0					
8-Nov-16	20	22.5	7.76	6.6	329				
		22.6	7.78	6.2	335				
9-Nov-16	21	22.4		6.5					
		22.4		6.0					
10-Nov-16	22	22.5	7.74	6.5					
		22.6	7.77	6.6					
11-Nov-16	23	22.4		7.0					
		22.6		6.9					
12-Nov-16	24	22.4	7.73	6.4					
		22.4	7.73	6.5					
13-Nov-16	25	22.5		6.3					
		22.3		6.5					
14-Nov-16	26	22.8		7.1					
		22.8		6.9					
15-Nov-16	27	22.8	7.69	7.0	312				
		22.8	7.65	6.3	317				
16-Nov-16	28	22.8	7.64	7.3	319	136	98	0.06	J
		22.8	7.79	7.0	321	136	98	0.06	J
MEAN		**22.7**	**7.91**	**6.4**	**320**	**131**	**94**	**0.14**	
N=		**58**	**28**	**58**	**12**	**4**	**4**	**4**	
Min #		**22.1**	**7.47**	**5.3**	**292**	**124**	**88**	**0.06**	
Max #		**23.1**	**8.52**	**7.7**	**340**	**136**	**98**	**0.22**	

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386
Sample ID: **BW16MLW-002**
GLEC ID: **11081**

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
19-Oct-16	0	22.6	7.48	6.3	288	124	90	0.18	J
		22.6	7.48	6.1	288				
20-Oct-16	1	22.5	7.51	6.8					
		22.4	7.55	6.8					
21-Oct-16	2	22.7		7.6					
		22.7		7.4					
22-Oct-16	3	22.8	7.60	6.9					
		22.7	7.59	7.1					
23-Oct-16	4	22.9		6.6					
		22.8		6.7					
24-Oct-16	5	22.8		6.3					
		22.8		6.3					
25-Oct-16	6	22.6	7.64	6.1	308				
		22.6	7.65	6.1	310				
26-Oct-16	7	22.9		7.8					
		22.8		7.7					
27-Oct-16	8	22.3	7.82	6.9					
		22.2	7.83	6.6					
28-Oct-16	9	22.3		6.3					
		22.6		5.8					
29-Oct-16	10	22.8	7.89	6.9					
		22.8	7.94	6.5					
30-Oct-16	11	22.8		6.6					
		22.8		6.5					
31-Oct-16	12	22.6		7.0					
		22.6		6.7					
1-Nov-16	13	22.6	8.09	6.4	313				
		22.6	8.12	6.1	362				
2-Nov-16	14	22.6		6.4					
		22.6		6.0					
3-Nov-16	15	23.1	7.99	6.1					
		23.1	8.01	6.2					
4-Nov-16	16	22.8		5.7					
		22.8		5.8					

Project Name: Bay West
Project Number: 2386
Sample ID: **BW16MLW-002**
GLEC ID: **11081**

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (µmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
5-Nov-16	17	22.6	7.91	5.9					
		22.5	7.99	6.1					
6-Nov-16	18	22.5		6.3					
		22.5		6.4					
7-Nov-16	19	23.1		6.0					
		23.2		6.1					
8-Nov-16	20	22.4	7.90	6.7	322				
		22.5	8.01	6.5	324				
9-Nov-16	21	22.6		6.2					
		22.7		6.1					
10-Nov-16	22	22.4	7.96	6.4					
		22.4	7.95	6.4					
11-Nov-16	23	22.7		7.1					
		22.9		7.0					
12-Nov-16	24	22.4	7.98	6.7					
		22.4	7.99	6.6					
13-Nov-16	25	22.5		6.4					
		22.5		6.3					
14-Nov-16	26	22.7		7.1					
		22.7		6.8					
15-Nov-16	27	22.7	7.84	6.4	322				
		22.8	7.88	6.2	324				
16-Nov-16	28	22.8	7.91	7.3	325	136	106	0.05	J
		22.8	7.93	7.0	327				
MEAN		**22.7**	**7.84**	**6.5**	**318**	**130**	**98**	**0.12**	
N=		**58**	**28**	**58**	**12**	**2**	**2**	**2**	
Min #		**22.2**	**7.48**	**5.7**	**288**	**124**	**90**	**0.05**	
Max #		**23.2**	**8.12**	**7.8**	**362**	**136**	**106**	**0.18**	

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386
Sample ID: **BW16MLW-003**
GLEC ID: **11082**

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
19-Oct-16	0	22.5	7.26	4.2	304	124	98	0.37
		22.5	7.31	4.1	306			
20-Oct-16	1	22.5	7.47	6.5				
		22.5	7.41	6.4				
21-Oct-16	2	22.7		7.7				
		22.7		7.1				
22-Oct-16	3	22.8	7.64	7.0				
		22.8	7.62	6.9				
23-Oct-16	4	22.9		6.5				
		22.9		6.6				
24-Oct-16	5	22.8		5.9				
		22.9		5.5				
25-Oct-16	6	22.7	7.82	6.5	317			
		22.6	7.80	6.1	317			
26-Oct-16	7	22.8		7.8				
		22.5		7.3				
27-Oct-16	8	22.2	7.73	6.7				
		22.2	7.87	6.8				
28-Oct-16	9	22.5		6.4				
		22.6		6.2				
29-Oct-16	10	22.8	8.24	6.5				
		22.8	8.04	4.9				
30-Oct-16	11	22.8		5.9				
		22.8		5.8				
31-Oct-16	12	22.7		5.8				
		22.7		5.5				
1-Nov-16	13	22.6	8.49	5.6	335			
		22.6	8.41	5.2	339			
2-Nov-16	14	22.6		5.8				
		22.5		5.7				
3-Nov-16	15	23.2	7.97	6.0				
		23.2	8.02	6.2				
4-Nov-16	16	22.7		5.1				
		22.7		5.3				

Project Name: Bay West
Project Number: 2386
Sample ID: **BW16MLW-003**
GLEC ID: **11082**

Test Dates: 10/19/16 - 11/16/16
Test Type: 28-Day Whole Sediment Toxicity Survival and Growth
Test Species: *H.azteca*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (µmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
5-Nov-16	17	22.5	8.19	4.7					
		22.5	8.16	5.2					
6-Nov-16	18	22.6		6.0					
		22.5		5.9					
7-Nov-16	19	22.6		4.7					
		22.9		4.8					
8-Nov-16	20	22.4	7.97	6.5	336				
		22.6	7.86	6.0	322				
9-Nov-16	21			6.7					
		22.7		6.0					
10-Nov-16	22	22.4	7.75	5.8					
		22.5	7.72	5.3					
11-Nov-16	23	22.3		5.8					
		22.6		6.0					
12-Nov-16	24	22.3	7.70	6.5					
		22.4	7.76	6.5					
13-Nov-16	25	22.4		5.8					
		22.4		5.7					
14-Nov-16	26	22.7		6.5					
		22.7		5.9					
15-Nov-16	27	22.6	7.57	6.0	312				
		22.7	7.57	5.9	311				
16-Nov-16	28	23.0	7.60	6.8	317	132	98	0.05	J
		23.0	7.67	6.3	317				
MEAN		**22.6**	**7.81**	**6.0**	**319**	**128**	**98**	**0.21**	
N=		**57**	**28**	**58**	**12**	**2**	**2**	**2**	
Min #		**22.2**	**7.26**	**4.1**	**304**	**124**	**98**	**0.05**	
Max #		**23.2**	**8.49**	**7.8**	**339**	**132**	**98**	**0.37**	

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Appendix B3
Overlying Water Quality Summaries

- 4-Day *Lumbriculus variegatus*

GLEC
Great Lakes Environmental Center

Project Name: Bay West
Project Number: 2386-00

Test Dates: 10/14/2016-10/18/2016
Test Type: 4-Day Screening Survival Test
Test Species: L. variegatus

100% Data Entry

Date	Initials	Data Entered
11/10/2016	MP	All

100% Data Quality Check

Date	Initials	Data QC'ed	Errors Found Y	Errors Corrected:Y
11/17/2016	DS	ALL	N	N

100% Error Corrected Quality Check

Date	Initials	Data QC'ed
licable no errors found		

Data QC 10%

Date	Initials	Data QC'ed
11/30/2016	mwg	10% days 0 and 3 all sheets

Project Name: Bay West
Project Number: 2386-00
Sample ID: **West Bearskin Lake**
GLEC ID: **CS #136**

Test Dates: 10/14/2016-10/18/2016
Test Type: 4-Day Screening Survival Test
Test Species: L. variegatus

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (µmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
14-Oct-16	0	22.8	7.26	7.6	272	116	78	0.33	
		22.8	7.43	7.4	275				
15-Oct-16	1	22.5		7.1					
		22.6		7.0					
16-Oct-16	2	22.5		6.6					
		22.5		6.8					
17-Oct-16	3	22.4		6.9					
		22.5		6.8					
18-Oct-16	4	22.5	7.35	6.6	302	128	88	0.16	J
		22.6	7.46	6.6	295				

MEAN	**22.6**	**7.38**	**6.9**	**286**	**122**	**83**	**0.25**
N=	**10**	**4**	**10**	**4**	**2**	**2**	**2**
Min #	**22.4**	**7.26**	**6.6**	**272**	**116**	**78**	**0.16**
Max #	**22.8**	**7.46**	**7.6**	**302**	**128**	**88**	**0.33**

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

GLEC
Great Lakes Environmental Center

Project Name: Bay West
Project Number: 2386-00
Sample ID: **BW16MLW-001-0.0-0.15**
GLEC ID: **11080**

Test Dates: 10/14/2016-10/18/2016
Test Type: 4-Day Screening Survival Test
Test Species: L. variegatus

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
14-Oct-16	0	22.8	7.47	6.6	298	120	90	0.18	J
		22.8	7.48	6.6	297				
15-Oct-16	1	22.8		7.0					
		22.8		6.8					
16-Oct-16	2	22.6		6.6					
		22.6		6.7					
17-Oct-16	3	22.5		7.1					
		22.6		6.3					
18-Oct-16	4	22.8	7.62	6.2	309	136	100	0.07	J
		22.8	7.62	6.2	309				
MEAN		**22.7**	**7.55**	**6.6**	**303**	**128**	**95**	**0.13**	
N=		**10**	**4**	**10**	**4**	**2**	**2**	**2**	
Min #		**22.5**	**7.47**	**6.2**	**297**	**120**	**90**	**0.07**	
Max #		**22.8**	**7.62**	**7.1**	**309**	**136**	**100**	**0.18**	

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name:	Bay West	**Test Dates:**	10/14/2016-10/18/2016
Project Number:	2386-00	**Test Type:**	4-Day Screening Survival Test
Sample ID:	**BW16MLW-002-0.0-0.15**	**Test Species**:	L. variegatus
GLEC ID:	**11081**		

Date	**Test Day**	**Temperature (°C)**	**pH (s.u.)**	**D.O. (mg/L)**	**Conductivity (μmos)**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Ammonia (mg/L)**	
14-Oct-16	0	22.9	7.57	7.0	297	128	88	0.15	J
		22.9	7.49	6.8	290				
15-Oct-16	1	22.7		7.0					
		22.7		6.9					
16-Oct-16	2	22.5		6.9					
		22.7		6.4					
17-Oct-16	3	22.3		7.2					
		22.5		6.4					
18-Oct-16	4	22.3	7.66	6.0	304	136	100	0.07	J
		22.5	7.65	6.2	307				

MEAN	**22.6**	**7.59**	**6.7**	**300**	**132**	**94**	**0.11**
N=	**10**	**4**	**10**	**4**	**2**	**2**	**2**
Min #	**22.3**	**7.49**	**6.0**	**290**	**128**	**88**	**0.07**
Max #	**22.9**	**7.66**	**7.2**	**307**	**136**	**100**	**0.15**

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386-00
Sample ID: **BW16MLW-003-0.0-0.15**
GLEC ID: **11082**

Test Dates: 10/14/2016-10/18/2016
Test Type: 4-Day Screening Survival Test
Test Species: L. variegatus

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
14-Oct-16	0	22.7	7.49	6.8	306	128	94	0.39	
		22.7	7.54	6.6	304	128	94	0.39	
15-Oct-16	1	22.6		7.0					
		22.7		6.8					
16-Oct-16	2	22.7		6.6					
		22.8		6.5					
17-Oct-16	3	22.3		6.4					
		22.5		6.0					
18-Oct-16	4	22.7	7.64	5.4	316	144	100	0.15	J
		22.7	7.68	5.3	312	132	98	0.15	J

MEAN	**22.6**	**7.59**	**6.3**	**310**	**133**	**97**	**0.27**
N=	**10**	**4**	**10**	**4**	**4**	**4**	**4**
Min #	**22.3**	**7.49**	**5.3**	**304**	**128**	**94**	**0.15**
Max #	**22.8**	**7.68**	**7.0**	**316**	**144**	**100**	**0.39**

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Appendix B4

Overlying Water Quality Summaries

- 28-Day *Lumbriculus variegatus*

Project Name: Bay West
Project Number: 2386-01

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival
Test Species: *Lumbriculus variegatus*

100% Data Entry

Date	Initials	Data Entered
11/14/2016	MLV	Days 0-18
11/17/2016	MLV	Days 19-21
11/21/2016	MLV	Days 22-27
11/30/2016	MWG	Days 28

100% Data Quality Check

Date	Initials	Data QC'ed	Errors Found; Y or N	Errors Corrected: Y or N	
11/18/2016	DS	0-21	n	n	
11/30/2016	MWG	22-27	n	n	
12/5/2016	MLV	Day 28	y	y	ammonia data not entered 11080, alkalinity value was in the hardness column under the hardn

100% Error Corrected Quality Check

Date	Initials	Data QC'ed
12/5/2016	NS	day 28

Data QC 10%

Date	Initials	Data QC'ed
11/30/2016	mwg	all data on days: 3,4,8,9,14,17,18

Project Name: Bay West
Project Number: 2386-01
Sample ID: **Control - West Bearskin Lake**
GLEC ID: **CS # 136**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	**Test Day**	**Temperature (°C)**	**pH (s.u.)**	**D.O. (mg/L)**	**Conductivity (μmos)**	**Flow ml/min**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Ammonia (mg/L)**	
25-Oct-16	0	22.2	7.96	8.5	303	3.8	132	102	0.13	J
		22.2	7.92	8.4	303	3.6				
						4.0				
						4.0				
						4.0				
26-Oct-16	1	22.0		7.2		4.4				
		22.0		7.0		4.6				
						4.4				
						4.4				
						4.4				
27-Oct-16	2	22.3		8.0		4.4				
		22.3		8.4		4.6				
						4.4				
						4.8				
						4.8				
28-Oct-16	3	22.4		7.6		4.4				
		22.5		8.1		4.6				
						4.4				
						4.4				
						4.8				
29-Oct-16	4	22.6		7.6		4.0				
		22.6		7.3		4.0				
						4.4				
						4.4				
						3.8				
30-Oct-16	5	22.6		7.2		4.0				
		22.6		7.7		4.0				
						4.4				
						4.4				
						4.0				
31-Oct-16	6	22.2		7.8		4.2				
		22.1		7.6		4.5				
						4.7				
						4.4				
						4.2				
1-Nov-16	7	22.3	7.81	6.9	305	4.1	132	98	0.84	
		22.5	7.85	6.9	304	4.3				
						4.5				
						4.4				
						4.1				
2-Nov-16	8	22.4		7.7		4.2				
		22.5		7.9		4.4				
						4.4				
						4.4				
						4.0				
3-Nov-16	9	23.4		7.7		4.2				
		23.3		7.4		4.3				
						4.6				
						4.7				
						4.0				
4-Nov-16	10	22.8		7.9		4.0				
		22.8		7.9		4.3				
						4.4				
						4.4				
						4.0				
5-Nov-16	11	22.5		7.7		4.1				
		22.6		7.6		3.9				
						4.4				
						4.5				
						4.2				
6-Nov-16	12	22.6		7.6		4.1				
		22.6		7.7		4.3				
						4.0				
						3.7				
						4.0				
7-Nov-16	13	23.1		7.8		3.3				
		23.1		7.6		3.7				
						3.8				
						3.8				
						3.7				

Project Name: Bay West
Project Number: 2386-01
Sample ID: **Control - West Bearskin Lake**
GLEC ID: **CS # 136**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Flow ml/min	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
8-Nov-16	14	23.1	8.02	7.8	310	4.0	132	104	0.75
		22.8	8.09	7.8	308	4.2			
						4.4			
						4.4			
						4.4			
9-Nov-16	15	22.6		7.1		3.9			
		22.5		7.2		4.2			
						3.8			
						4.1			
						4.2			
10-Nov-16	16	22.3		7.6		3.2			
		22.3		7.5		3.6			
						3.8			
						3.9			
						3.6			
11-Nov-16	17	22.7		8.1		3.9			
		22.6		8.0		3.9			
						4.8			
						4.4			
						4.0			
12-Nov-16	18	22.2		7.8		5.6			
		22.2		7.7		5.6			
						5.4			
						5.6			
						4.8			
13-Nov-16	19	22.4		7.7		5.0			
		22.4		7.7		5.0			
						4.6			
						4.6			
						5.0			
14-Nov-16	20	23.3		7.9		3.8			
		23.1		7.7		3.8			
						4.8			
						4.4			
						6.0			
15-Nov-16	21	22.5	8.09	7.9	317	4.0	132	106	0.64
		22.5	8.03	7.6	313	4.3			
						4.8			
						4.8			
						6.4			
16-Nov-16	22	22.8		7.0		5.0			
		22.9		7.0		5.0			
						5.4			
						5.2			
						6.8			
17-Nov-16	23	22.7		7.2		4.2			
		22.7		7.3		4.6			
						4.8			
						4.4			
						6.0			
18-Nov-16	24	23.0		7.1		4.3			
		22.9		7.3		4.8			
						5.1			
						5.2			
						6.4			
19-Nov-16	25	22.2		7.6		3.6			
		22.3		7.6		4.4			
						4.4			
						4.8			
						6.0			

Project Name: Bay West
Project Number: 2386-01
Sample ID: **Control - West Bearskin Lake**
GLEC ID: **CS # 136**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Flow ml/min	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
20-Nov-16	26	22.0		8.1		4.0			
		22.2		8.1		4.0			
						4.4			
						4.4			
						5.6			
21-Nov-16	27	22.1		8.2		4.0			
		22.2		8.0		4.2			
						4.2			
						4.2			
						4.5			
22-Nov-16	28	22.7	8.26	8.3	315	4.0	128	106	0.48
		22.7	8.21	8.0	316	4.2			
						4.2			
						4.0			
						4.0			
MEAN		**22.6**	**8.02**	**7.7**	**309**	**4.4**	**131**	**103**	**0.57**
N=		**58**	**10**	**58**	**10**	**145**	**5**	**5**	**5**
Min #		**22.0**	**7.81**	**6.9**	**303**	**3.2**	**128**	**98**	**0.13**
Max #		**23.4**	**8.26**	**8.5**	**317**	**6.8**	**132**	**106**	**0.84**

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386-01
Sample ID: **BW16MLW-001**
GLEC ID: **11080**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (µmos)	Flow ml/min	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)	
25-Oct-16	0	22.2	8.17	8.6	306	3.8	140	100	0.12	J
		22.2	8.13	8.7	307	4.0	140	98	0.11	J
						4.2				
						4.2				
						4.2				
26-Oct-16	1	22.1		6.9		4.2				
		22.0		6.7		4.2				
						4.0				
						3.8				
						3.6				
27-Oct-16	2	22.3		8.6		4.4				
		22.3		8.6		4.2				
						4.0				
						3.8				
						3.8				
28-Oct-16	3	22.4		8.1		4.0				
		22.2		8.0		4.0				
						3.8				
						3.8				
						3.6				
29-Oct-16	4	22.6		7.7		3.8				
		22.6		7.7		3.8				
						3.8				
						3.6				
						4.8				
30-Oct-16	5	22.4		7.7		4.0				
		22.3		7.7		3.6				
						3.8				
						3.0				
						4.0				
31-Oct-16	6	22.0		7.4		4.2				
		22.0		7.1		3.8				
						5.8				
						3.1				
						4.4				
1-Nov-16	7	22.7	7.87	7.3	305	4.0	124	94	1.16	
		22.6	7.90	7.2	305	4.1				
						5.6				
						3.1				
						4.4				
2-Nov-16	8	22.3		8.0		4.0				
		22.4		7.8		3.8				
						5.6				
						3.0				
						4.4				
3-Nov-16	9	23.1		7.4		3.9				
		23.1		7.5		3.6				
						5.2				
						3.0				
						4.2				
4-Nov-16	10	22.6		7.6		3.9				
		22.6		7.4		3.6				
						5.2				
						3.2				
						4.2				
5-Nov-16	11	22.6		7.4		4.0				
		22.3		7.4		4.3				
						4.9				
						4.4				
						4.1				
6-Nov-16	12	22.6		7.2		3.8				
		22.5		7.2		4.3				
						3.6				
						4.0				
						4.1				
7-Nov-16	13	22.6		7.7		3.7				
		22.8		7.3		3.2				
						4.4				
						4.0				
						3.5				

Project Name: Bay West
Project Number: 2386-01
Sample ID: **BW16MLW-001**
GLEC ID: **11080**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Flow ml/min	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
8-Nov-16	14	22.7	7.93	7.4	312	4.0	128	98	1.21
		22.8	7.92	7.3	312	4.0			
						5.2			
						3.2			
						4.4			
9-Nov-16	15	22.5		7.4		4.3			
		22.3		7.5		4.9			
						3.9			
						4.1			
						3.8			
10-Nov-16	16	22.3		7.8		3.2			
		22.3		7.6		3.0			
						4.6			
						3.0			
						3.7			
11-Nov-16	17	22.3		7.9		4.0			
		22.2		7.7		3.6			
						5.2			
						3.4			
						4.4			
12-Nov-16	18	22.1		7.8		5.6			
		22.1		7.7		5.2			
						5.8			
						5.4			
						5.2			
13-Nov-16	19	22.3		7.7		4.8			
		22.3		7.3		4.4			
						4.4			
						4.2			
						4.6			
14-Nov-16	20	22.3		7.8		3.6			
		22.3		7.7		3.6			
						3.6			
						3.2			
						4.4			
15-Nov-16	21	22.4	8.02	7.7	319	4.0	136	104	0.95
		22.3	8.01	7.5	318	4.0			
						4.4			
						3.5			
						4.8			
16-Nov-16	22	22.8		7.0		4.8			
		22.8		7.0		4.2			
						4.6			
						3.8			
						4.4			
17-Nov-16	23	22.5		7.6		4.4			
		22.4		7.6		4.0			
						4.4			
						5.2			
						5.4			
18-Nov-16	24	22.3		5.9		4.8			
		22.5		6.8		4.6			
						4.7			
						3.9			
						3.6			
19-Nov-16	25	22.0		7.9		4.0			
		22.0		7.9		4.0			
						4.4			
						3.6			
						3.6			

Project Name: Bay West
Project Number: 2386-01
Sample ID: **BW16MLW-001**
GLEC ID: **11080**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	**Test Day**	**Temperature (°C)**	**pH (s.u.)**	**D.O. (mg/L)**	**Conductivity (µmos)**	**Flow ml/min**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Ammonia (mg/L)**
20-Nov-16	26	22.0		8.1		4.0			
		22.0		8.0		4.0			
						4.0			
						4.0			
						3.6			
21-Nov-16	27	22.1		8.2		4.0			
		22.0		8.1		3.6			
						4.0			
						3.2			
						3.2			
22-Nov-16	28	22.6	8.16	8.2	317	4.0	136	102	0.52
		22.6	8.14	8.2	316	4.2			
						3.8			
						3.8			
						3.8			
MEAN		**22.4**	**8.03**	**7.6**	**312**	**4.1**	**134**	**99**	**0.68**
N=		**58**	**10**	**58**	**10**	**145**	**6**	**6**	**6**
Min #		**22.0**	**7.87**	**5.9**	**305**	**3.0**	**124**	**94**	**0.11**
Max #		**23.1**	**8.17**	**8.7**	**319**	**5.8**	**140**	**104**	**1.21**

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386-01
Sample ID: **BW16MLW-002**
GLEC ID: **11081**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (µmos)	Flow ml/min	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
25-Oct-16	0	22.2	8.15	8.5	306	4.6	136	100	0.20
		22.4	8.19	8.5	306	4.6			
						5.2			
						5.2			
						5.0			
26-Oct-16	1	22.1		6.9		5.0			
		22.1		7.2		4.8			
						4.8			
						4.6			
						4.6			
27-Oct-16	2	22.8		8.6		4.4			
		22.9		8.4		4.4			
						4.6			
						4.4			
						4.4			
28-Oct-16	3	22.7		7.9		4.0			
		22.6		7.6		4.0			
						3.8			
						3.8			
						3.6			
29-Oct-16	4	22.7		7.7		5.4			
		22.8		7.4		5.6			
						5.4			
						5.4			
						5.0			
30-Oct-16	5	22.4		7.0		6.4			
		22.6		6.9		6.4			
						7.0			
						6.8			
						5.6			
31-Oct-16	6	22.5		7.4		4.0			
		22.6		7.2		4.0			
						4.0			
						4.3			
						3.2			
1-Nov-16	7	22.8	7.81	6.7	304	4.2	124	94	1.06
		22.8	7.80	6.8	299	4.2			
						4.3			
						4.0			
						3.2			
2-Nov-16	8	22.9		7.3		3.6			
		22.9		7.2		3.4			
						3.4			
						3.3			
						3.2			
3-Nov-16	9	23.0		7.3		3.9			
		23.2		7.1		3.8			
						4.0			
						3.9			
						3.1			
4-Nov-16	10	22.8		7.3		3.9			
		22.9		6.7		3.7			
						4.3			
						4.2			
						3.9			
5-Nov-16	11	22.8		7.3		3.6			
		22.8		7.3		3.9			
						3.7			
						3.7			
						4.1			
6-Nov-16	12	22.7		6.6		4.3			
		22.7		6.6		4.1			
						3.9			
						4.0			
						3.7			
7-Nov-16	13	22.8		7.4		3.9			
		23.0		7.3		3.7			
						4.2			
						4.3			
						3.9			

Project Name: Bay West
Project Number: 2386-01
Sample ID: **BW16MLW-002**
GLEC ID: **11081**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (µmos)	Flow ml/min	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
8-Nov-16	14	23.1	7.82	7.0	309	4.1	132	96	1.19
		23.2	7.80	6.8	309	3.9			
						4.4			
						4.0			
						4.0			
9-Nov-16	15	22.7		7.0		3.7			
		22.6		6.9		3.4			
						3.5			
						4.1			
						3.1			
10-Nov-16	16	22.2		7.4		3.2			
		22.3		7.2		3.0			
						3.4			
						3.2			
						3.0			
11-Nov-16	17	22.6		7.6		4.4			
		22.7		7.5		4.4			
						5.2			
						4.8			
						4.4			
12-Nov-16	18	22.2		7.5		5.2			
		22.1		7.4		4.8			
						4.8			
						4.4			
						5.2			
13-Nov-16	19	22.5		7.1		5.0			
		22.4		7.0		5.0			
						4.8			
						4.6			
						5.0			
14-Nov-16	20	22.5		7.8		4.2			
		22.5		7.6		4.0			
						4.0			
						3.6			
						4.4			
15-Nov-16	21	22.4	7.95	7.6	317	3.4	132	100	0.82
		22.5	7.96	7.3	315	3.2			
						3.6			
						3.0			
						3.6			
16-Nov-16	22	22.8		7.0		4.0			
		22.9		7.0		4.4			
						5.2			
						5.0			
						5.4			
17-Nov-16	23	22.5		7.6		5.0			
		22.7		7.6		4.6			
						5.2			
						4.6			
						4.8			
18-Nov-16	24	22.5		7.2		4.3			
		22.7		7.2		3.8			
						4.4			
						4.0			
						4.6			
19-Nov-16	25	22.1		7.5		4.0			
		22.2		7.5		3.2			
						4.0			
						3.6			
						4.0			

Project Name: Bay West
Project Number: 2386-01
Sample ID: **BW16MLW-002**
GLEC ID: **11081**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	**Test Day**	**Temperature (°C)**	**pH (s.u.)**	**D.O. (mg/L)**	**Conductivity (μmos)**	**Flow ml/min**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Ammonia (mg/L)**
20-Nov-16	26	22.2		8.1		3.6			
		22.3		7.9		3.2			
						3.6			
						3.2			
						4.0			
21-Nov-16	27	22.1		8.2		3.8			
		22.1		8.0		3.2			
						3.6			
						3.2			
						4.0			
22-Nov-16	28	22.4	8.14	8.2	316	4.0	140	102	0.61
		22.6	8.12	8.2	317	3.8			
						3.6			
						3.8			
						4.0			
MEAN		**22.6**	**7.97**	**7.4**	**310**	**4.2**	**133**	**98**	**0.78**
N=		**58**	**10**	**58**	**10**	**145**	**5**	**5**	**5**
Min #		**22.1**	**7.80**	**6.6**	**299**	**3.0**	**124**	**94**	**0.20**
Max #		**23.2**	**8.19**	**8.6**	**317**	**7.0**	**140**	**102**	**1.19**

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Project Name: Bay West
Project Number: 2386-01
Sample ID: **BW16MLW-003**
GLEC ID: **11082**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (μmos)	Flow ml/min	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
25-Oct-16	0	22.4	8.22	8.6	309	4.8	140	96	0.22
		22.4	8.13	8.5	309	4.8			
						5.2			
						5.0			
						5.0			
26-Oct-16	1	22.0		7.0		4.6			
		22.0		7.0		4.8			
						4.4			
						4.6			
						4.6			
27-Oct-16	2	22.8		8.2		4.6			
		22.8		8.0		4.4			
						4.6			
						4.6			
						4.6			
28-Oct-16	3	22.7		7.7		3.8			
		22.8		7.8		3.8			
						3.6			
						3.6			
						3.8			
29-Oct-16	4	22.9		6.5		6.0			
		23.0		6.4		7.0			
						5.2			
						7.0			
						3.6			
30-Oct-16	5	22.7		7.4		7.0			
		22.7		7.5		5.2			
						5.2			
						4.0			
						4.0			
31-Oct-16	6	22.5		6.7		4.4			
		22.6		6.6		6.0			
						4.4			
						4.0			
						3.6			
1-Nov-16	7	23.1	7.85	7.1	304	4.0	128	98	1.14
		23.0	7.69	5.8	307	6.6	120	100	1.12
						4.6			
						4.0			
						3.6			
2-Nov-16	8	22.9		6.2		4.0			
		22.9		6.5		6.6			
						4.4			
						3.8			
						3.8			
3-Nov-16	9	23.2		7.8		4.1			
		23.3		6.3		6.3			
						4.4			
						3.5			
						3.3			
4-Nov-16	10	22.9		7.4		4.3			
		22.9		7.5		5.9			
						4.4			
						3.4			
						3.0			
5-Nov-16	11	22.6		7.8		4.0			
		22.8		6.7		4.7			
						4.8			
						4.0			
						4.1			
6-Nov-16	12	22.5		7.1		3.8			
		22.5		7.4		4.3			
						5.0			
						4.7			
						4.7			
7-Nov-16	13	23.2		6.8		4.0			
		23.3		6.6		6.4			
						4.7			
						3.2			
						3.5			

Project Name: Bay West
Project Number: 2386-01
Sample ID: **BW16MLW-003**
GLEC ID: **11082**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	Test Day	Temperature (°C)	pH (s.u.)	D.O. (mg/L)	Conductivity (µmos)	Flow ml/min	Hardness (mg/L)	Alkalinity (mg/L)	Ammonia (mg/L)
8-Nov-16	14	23.2	7.98	7.4	306	4.4	128	96	1.33
		23.1	8.03	7.5	306	6.4	128	98	1.32
						4.8			
						3.2			
						3.4			
9-Nov-16	15	22.5		7.1		4.0			
		22.5		6.4		4.0			
						3.9			
						4.2			
						3.8			
10-Nov-16	16	22.4		7.1		3.6			
		22.5		6.8		3.4			
						3.9			
						3.2			
						3.0			
11-Nov-16	17	22.6		7.8		4.4			
		22.7		7.4		6.8			
						5.2			
						3.8			
						3.5			
12-Nov-16	18	22.2		7.1		5.2			
		22.2		7.2		6.2			
						6.4			
						5.2			
						5.2			
13-Nov-16	19	22.3		7.4		4.4			
		22.3		7.4		5.0			
						4.4			
						4.6			
						4.6			
14-Nov-16	20	22.6		7.6		4.4			
		22.6		7.3		6.8			
						4.8			
						3.8			
						3.8			
15-Nov-16	21	22.5	8.05	7.7	314	4.0	136	102	0.81
		22.6	7.86	7.1	313	6.0	136	100	0.83
						4.0			
						3.2			
						3.0			
16-Nov-16	22	22.9		7.1		5.2			
		22.9		7.1		5.6			
						5.4			
						5.2			
						5.8			
17-Nov-16	23	22.6		7.5		5.0			
		22.7		7.1		4.4			
						4.0			
						4.4			
						4.2			
18-Nov-16	24	22.8		7.4		4.8			
		22.9		7.1		4.4			
						3.9			
						3.8			
						4.0			
19-Nov-16	25	22.2		7.8		4.0			
		22.3		7.5		3.6			
						3.2			
						3.6			
						3.2			

Project Name: Bay West
Project Number: 2386-01
Sample ID: **BW16MLW-003**
GLEC ID: **11082**

Test Dates: 10/25/16 - 11/22/16
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Lumbriculus variegatus*

Date	**Test Day**	**Temperature (°C)**	**pH (s.u.)**	**D.O. (mg/L)**	**Conductivity (µmos)**	**Flow ml/min**	**Hardness (mg/L)**	**Alkalinity (mg/L)**	**Ammonia (mg/L)**
20-Nov-16	26	22.3		8.1		3.6			
		22.4		8.1		3.2			
						3.6			
						3.2			
						3.2			
21-Nov-16	27	22.1		7.8		4.0			
		22.2		7.7		3.2			
						3.2			
						3.2			
						3.2			
22-Nov-16	28	22.4	8.12	8.1	320	3.8	132	100	0.71
		22.4	8.13	7.9	320	3.8	132	100	0.66
						3.6			
						3.8			
						3.8			
MEAN		**22.6**	**8.01**	**7.3**	**311**	**4.4**	**131**	**99**	**0.90**
N=		**58**	**10**	**58**	**10**	**145**	**9**	**9**	**9**
Min #		**22.0**	**7.69**	**5.8**	**304**	**3.0**	**120**	**96**	**0.22**
Max #		**23.3**	**8.22**	**8.6**	**320**	**7.0**	**140**	**102**	**1.33**

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L)
MDL = Minimum Detection Limit (0.02 mg/L)
U = Below MDL
J = ≥MDL and <RL

Appendix C1
Chironomus dilutus
10-Day Bench Sheets

- Survival
- Weight

2386-00
Bay West
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Page 7 of 7
QC'd by: MR
10% mw

Project Number: 2386-00	Project Name: **Bay West**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#: **CS#136**		Test Photoperiod: **16:8**	
Sample ID: **West Bearskin Lake**		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: *Chironomus dilutus*		Test Temperature: **23± 1°C**	
Date Addition of Sediment: **10/13/2016**		Test Organism Source/Age:	**ABS: 10 days**
Test Initiation Date: **10/14/2016**		Test Termination Date:	**10/24/2016**

Test Day: **Day 10**
Date: **10/24/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒ 0910 mw chemistries time/Initial

Number Daily Renewals: 1 Air: ☐ yes ☒ no
☒ 930 mw renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~TFS# (4g/L)~~ ~~☐ Feed 1.5 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	40	203	236	236	N/A	203	4	**Init:** mw
1					120	90	0.67	Larvae: 10 Pupae: 0 Midge: 0 10 /10
2					end: 13.8	end: 17.1		Larvae: 10 Pupae: 0 Midge: 0 10 /10
3					start: 10.8	start: 12.6		Larvae: 10 Pupae: 0 Midge: 0 10 /10
4					Titrant used (mL): 3.0	Titrant used (mL): 4.5		Larvae: 10 Pupae: 0 Midge: 0 10 /10
5					Sample volume (mL): 25	Sample volume (mL): 50		Larvae: 10 Pupae: 0 Midge: 0 10 /10
6								Larvae: 9 Pupae: 0 Midge: 0 9 /10
7	22.7	7.28	3.6	302				Larvae: 9 Pupae: 0 Midge: 0 9/10
8	22.7	7.32	3.5	301				Larvae: 10 Pupae: 0 Midge: 0 10 /10

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

revised: June 2012

2386-00
Bay West
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

10/QQC = mw

Page 7 of 7
QC'd by: MQ

Project Number: 2386-00	Project Name: **Bay West**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:	**N/A**	Test Photoperiod: **16:8**	
Sample ID:	Water Only	Test System: Sediment-100 mL and Overlying Water-175mL Manual Delivery	
Test Species:	*Chironomus dilutus*	Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/13/2016**	Test Organism Source/Age:	**ABS: 10 days**
Test Initiation Date:	**10/14/2016**	Test Termination Date:	**10/24/2016**

Test Day: **Day 10**
Date: **10/24/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☑ 0725 mo. chemistries time/Initial

Number Daily Renewals: 1 Air: ☐ yes ☒ no
☑ 0757 mo. renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~TFS# (4g/L)~~ ~~☐ Feed 1.5 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$) m.	Alkalinity (mg/L $CaCO_3$) m.	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	40	203	236	236	N/A	203	4	**Init:** mw
1					140	106	0.59	Larvae: 9 Pupae: 0 Midge: 0 9 /10
2					end: 31.6	end: 42.9		Larvae: 10 Pupae: 0 Midge: 0 10/10
3					start: 28.1	start: 37.6		Larvae: 10 Pupae: 0 Midge: 0 10/10
4					Titrant used (mL): 3.5	Titrant used (mL): 5.3		Larvae: 10 Pupae: 0 Midge: 0 10/10
5					Sample volume (mL): 25	Sample volume (mL): 50		Larvae: 9 Pupae: 0 Midge: 0 9 /10
6								Larvae: 10 Pupae: 0 Midge: 0 10 /10
7	22.3	7.52	4.2	323				Larvae: 10 Pupae: 0 Midge: 0 10 0
8	22.6	7.58	3.7	319				Larvae: 10 Pupae: 0 Midge: 0 10 /10

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2386-00
Bay West
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Page 7 of 7
QC'd by: MR
0% QC = mw

Project Number: **2386-00** Project Name: **Bay West**		Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:	**11080**	Test Photoperiod: **16:8**	
Sample ID:	**BW16MLW-001-0-0.15**	Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: *Chironomus dilutus*		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/13/2016**	Test Organism Source/Age:	**ABS: 10 days**
Test Initiation Date:	**10/14/2016**	Test Termination Date:	**10/24/2016**

Test Day: **Day 10**
Date: **10/24/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☑ 0725MR chemistries time/Initial

Number Daily Renewals: 1 Air: ☐ yes ☑ no
☑ 0757MR renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~TFS# (4g/L)~~ ~~☐ Feed 1.5 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$) MR	Alkalinity (mg/L $CaCO_3$) MR	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	40	203	236	236	N/A	203	4	Init: mw
1					144	102	0.58	Larvae: 10 Pupae: 0 Midge: 0 10/10
2					end: 17.5	end: 22.3		Larvae: 10 Pupae: 0 Midge: 0 10 /10
3					start: 13.9	start: 17.2		Larvae: 10 Pupae: 0 Midge: 0 10 /10
4					Titrant used (mL): 3.6	Titrant used (mL): 5.1		Larvae: 10 Pupae: 0 Midge: 0 10 /10
5					Sample volume (mL): 25	Sample volume (mL): 50		Larvae: 9 Pupae: 0 Midge: 0 9 /10
6								Larvae: 10 Pupae: 0 Midge: 0 10 /10
7	22.8	7.43	2.3	324				Larvae: 10 Pupae: 0 Midge: 0 10/10
8	22.8	7.44	2.6	320				Larvae: 9 Pupae: 0 Midge: 0 9 /10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

revised: June 2012

GLEC
Great Lakes Environmental Center

2386-00
Bay West
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Page 7 of 7
QC'd by: m.
10% QC=mw

Project Number: 2386-00	Project Name: Bay West	Test Method-Manual:	EPA 100.2-EPA/600/R-99/064
GLC#:	11081	Test Photoperiod: 16:8	
Sample ID:	BW16MLW-002-0-0.15	Test System: Sediment-100 mL and Overlying Water-175mL Manual Delivery	
Test Species: *Chironomus dilutus*		Test Temperature: 23± 1°C	
Date Addition of Sediment:	10/13/2016	Test Organism Source/Age:	ABS: 10 days
Test Initiation Date:	10/14/2016	Test Termination Date:	10/24/2016

Test Day: Day 10
Date: 10/24/2016
Overlying Water: Dechlor
Overlying Water Batch ID (GLC Number): NA
☒ 0726 m. chemistries time/Initial

Number Daily Renewals: 1 Air: ☐ yes ☒ no
☒ 0757 m. renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~TFS# (4g/L)~~ ~~☐ Feed 1.5 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$) m.	Alkalinity (mg/L $CaCO_3$) m.	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	40	203	236	236	N/A	203	4	Init: mw
1					144	98	0.43	Larvae: 9 Pupae: 0 Midge: 0 9/10
2					end: 21.1	end: 27.2		Larvae: 10 Pupae: 0 Midge: 0 10/10
3					start: 17.5	start: 22.3		Larvae: 10 Pupae: 0 Midge: 0 10/10
4					Titrant used (mL): 3.6	Titrant used (mL): 4.9		Larvae: 10 Pupae: 0 Midge: 0 10/10
5					Sample volume (mL): 25	Sample volume (mL): 50		Larvae: 10 Pupae: 0 Midge: 0 10/10
6								Larvae: 8 Pupae: 0 Midge: 0 8/10
7	22.7	7.33	2.3	314				Larvae: 10 Pupae: 0 Midge: 0 10/10
8	22.7	7.37	2.7	312				Larvae: 10 Pupae: 0 Midge: 0 10/10

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

revised: June 2012

2386-00
Bay West
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Page 7 of 7
QC'd by: M-
10% QC = mwb

Project Number: **2386-00** Project Name: **Bay West**		Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:	**11082**	Test Photoperiod: **16:8**	
Sample ID:	BW16MLW-003-0-0.15	Test System: Sediment-100 mL and Overlying Water-175mL Manual Delivery	
Test Species:	*Chironomus dilutus*	Test Temperature: **23± 1°C**	
Date Addition of Sediment:	10/13/2016	Test Organism Source/Age:	**ABS:** 10 days
Test Initiation Date:	10/14/2016	Test Termination Date:	**10/24/2016**

Test Day: **Day 10**
Date: **10/24/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
*0725 m. chemistries time/Initial

Number Daily Renewals: \ Air: ☐ yes ☒ no
☒ 0757 mn renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~TFS# (4g/L)~~ ~~☐ Feed 1.5 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	40	203	236	236	N/A	203	4	Init: Mwb
1					Dup. 140 140	Dup. 102 106	0.66	Larvae: 10 Pupae: 0 Midge: 0 10/10
2					end: 28.1 24.6	end: 376 325	dup 0.68	Larvae: 10 Pupae: 0 Midge: 0 10/10
3					start: 24.6 21.1	start: 325 272		Larvae: 9 Pupae: 0 Midge: 0 9/10
4					Titrant used (mL): 3.5 3.5	Titrant used (mL): 5.1 53		Larvae: 10 Pupae: 0 Midge: 0 10/10
5					Sample volume (mL): 25 25	Sample volume (mL): 50 50		Larvae: 10 Pupae: 0 Midge: 0 10/10
6						RPD = 2.6%		Larvae: 9 Pupae: 0 Midge: 0 9/10
7	22.7	7.42	3.3	320				Larvae: 9 Pupae: 0 Midge: 0 9/10
8	22.8	7.43	3.6	318				Larvae: 9 Pupae: 0 Midge: 0 9/10

Relative % Difference: RPD ≤15%

$$RPD = \left|\frac{(s_1 - s_2)}{(s_1 + s_2)/2}\right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

revised: June 2012

Project Name: Bay West-West Bear Skin
Project Number: 2386-00

Test Dates: 10/14/2016-10/24/2016
Test Type: 10 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Chironomus dilutus*

100% Data Entry

Date	Initials	Data Entered
12/5/2016	MWG	ALL

100% Data Quality Check

Date	Initials	Data QC'ed	Errors Found Y or N	Errors Corrected:Y or N	List Error locations
12/5/2016	NS	weight sheets	Y	Y	Control Rep 6; 10 should be 9

100% Error Corrected Quality Check

Date	Initials	Data QC'ed
12/5/2016	MWG	Control Rep 6; survival

Page 1 of 2
QC'd by: MWB

2386-00
Bay West
Chironomus dilutus WEIGHT DATA

Project Number: 2386-00
Project Name: Bay West

GLC#: CS#136
Sample ID: West Bearskin Lake

Test Species: *Chironomus dilutus*
Test Date: 10/14/2016
10/24/2016

Type/Model of Drying Oven: Blue M
Oven Temperature: 60 °C

Drying Duration (Hours): ~24 hrs
Date/Time in: 10/24/16 1245
Date/Time out: 10/25/16 1300

Dessicator: # 128
Date/Time in: 10/25/16 1200
Date/Time out: 10/31/16 1210

Dry Weigh Date / Technician's Initials: 10/31/16 MO.

Type/Model of Muffle Furnace: F6020 Thermolyne MOD.
Muffle Furnace Temperature: 550 °C

Drying Duration (Hours): 2 hrs
Date/Time in: 11/3/16 1020
Date/Time out: 11/3/16 1221

Dessicator: # 128
Date/Time in: 11/3/16 1534
Date/Time out: 11/10/16 1517

Ashed Weigh Date / Technician's Initials: 11/10/16 MO.

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	0.85806	0.84716	0.00000	10	#DIV/0!	0	0.00000
West Bearskin Lake	2	10	0.85316	0.84375	0.00000	10	#DIV/0!	0	0.00000
GLC Number:	3	10	0.86177	0.85114	0.00000	10	#DIV/0!	0	0.00000
CS#136	4	10	0.86307	0.85340	0.00000	10	#DIV/0!	0	0.00000
	5	10	0.84914	0.83972	0.00000	10	#DIV/0!	0	0.00000
	6	10	0.84648	0.83816	0.00000	9	#DIV/0!	0	0.00000
	7	10	0.85330	0.84401	0.00000	9	#DIV/0!	0	0.00000
	8	10	0.84881	0.83904	0.00000	10	#DIV/0!	0	0.00000
						AVERAGE:	#DIV/0!	—	0.00000

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	80	0.86341	0.83676	0	80	Average at Day 0 (mg)	0.33313	0

See Attached sheet for calculated weights.

Great Lakes Environmental Center

Page _2_ of _2_
QC'd by:__MWG____

2386
Bay West
Chironomus dilutus WEIGHT DATA

Project Number: **2386**
Project Name: **Bay West**

GLC#: **CS 136**
Sample ID: **West Bear Skin**
Laboratory Control

Test Species: ***Chironomus dilutus***
Test Date: **10/14/2016**
10/24/2016

Type/Model of Drying Oven: **Blue M**
Oven Temperature: **60 °C**

Drying Duration (Hours): **~ 24 hrs**
Date/Time in: 10/24/2016 12:45
Date/Time out: 10/25/2016 13:00

Dessicator: **# 128**
Date/Time in: 10/25/2016 13:00
Date/Time out: 10/31/2016 12:10

Dry Weigh Date / Technician's Initials 10/31/2016 mp

Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Muffle Furnace Temperature: **550 °C**

Drying Duration (Hours): **2 hrs**
Date/Time in: 11/3/2016 10:20
Date/Time out: 11/3/2016 12:21

Dessicator: **# 128**
Date/Time in: 11/3/2016 15:34
Date/Time out: 11/10/2016 15:17

Ashed Weigh Date / Technician's Initials: 11/10/2016 mp

	Replicate Number	**A** Number of Organisms at Test Initiation	**B** Dry Weight of Pan and Organisms (g)	**C** Ashed Weight of Pan and Organisms (g)	**B-C** Total Ash-Free Dry Weight (g)	**D** Number of Organisms Weighed	**B-C/D** Average Ash-Free Dry Weight (mg)	**E** Number of Pupae and Midges at Day 10	**(B-C) / (A-E)** *Biomass weight (mg)
Sample ID:	**1**	10	0.85806	0.84716	0.01090	10	1.09000	0	1.09000
West Bear Skin Lab Control	**2**	10	0.85316	0.84375	0.00941	10	0.94100	0	0.94100
GLC Number:	**3**	10	0.86177	0.85114	0.01063	10	1.06300	0	1.06300
CS 136	**4**	10	0.86307	0.85340	0.00967	10	0.96700	0	0.96700
	5	10	0.84914	0.83972	0.00942	10	0.94200	0	0.94200
	6	10	0.84648	0.83816	0.00832	9	0.92444	0	0.83200
	7	10	0.85330	0.84401	0.00929	9	1.03222	0	0.92900
	8	10	0.84881	0.83904	0.00977	10	0.97700	0	0.97700
						AVERAGE:	0.99208	▨	0.96762

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 10 weights	80	0.86341	0.83676	0.02665	80	Average at Day 0 (mg)		0.33313

See Attached sheet for calculated weights.

GLEC
Great Lakes Environmental Center

Page 1 of 2
QC'd by: mw

2386-00
Bay West
Chironomus dilutus WEIGHT DATA

Project Number: 2386-00
Project Name: Bay West

GLC#: N/A
Sample ID: Water Only

Test Species: *Chironomus dilutus*
Test Date: 10/14/2016
10/24/2016

Type/Model of Drying Oven: Blue M
Oven Temperature: 60 °C

Drying Duration (Hours): ~ 24 hrs
Date/Time in: 10/24/16 1245
Date/Time out: 10/25/16 1300

Dessicator: # 128
Date/Time in: 10/25/16 1300
Date/Time out: 10/31/16 1210

Dry Weigh Date / Technician's Initials: 10/31/16 mp.

Type/Model of Muffle Furnace: F6020 Thermolyne MOD.
Muffle Furnace Temperature: 550 °C

Drying Duration (Hours): 2 hrs
Date/Time in: ~~11/3/16 1020~~ 11/3/16 1020 mw 12/5/16
Date/Time out: 11/3/16 1221

Dessicator: # 128
Date/Time in: 11/3/16 1534
Date/Time out: ~~11/3/16~~ 1517 11/10/16 mw 12/5/16

Ashed Weigh Date / Technician's Initials: 11/10/16 mp.

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	0.86251	0.85311	0.00000	9	#DIV/0!	0	0.00000
Water Only	2	10	0.87173	0.86293	0.00000	10	#DIV/0!	0	0.00000
GLC Number:	3	10	0.86699	0.85745	0.00000	10	#DIV/0!	0	0.00000
N/A	4	10	0.87267	0.86279	0.00000	10	#DIV/0!	0	0.00000
	5	10	0.87262	0.86360	0.00000	9	#DIV/0!	0	0.00000
	6	10	0.85997	0.85157	0.00000	10	#DIV/0!	0	0.00000
	7	10	0.86519	0.85570	0.00000	10	#DIV/0!	0	0.00000
	8	10	0.88633	0.87698	0.00000	10	#DIV/0!	0	0.00000
						AVERAGE:	#DIV/0!	—	0.00000

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	80	0.86341	0.83676	0	80	Average at Day 0 (mg)	0.33313	0

See Attached sheet for calculated weights.

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QC'd by: _MWG_

2386
Bay West
Chironomus dilutus WEIGHT DATA

Project Number: **2386**
Project Name: **Bay West**

GLC#: **NA**
Sample ID: **Water Only Control**

Test Species: ***Chironomus dilutus***
Test Date: **10/14/2016**
10/24/2016

Type/Model of Drying Oven: **Blue M**
Oven Temperature: **60 °C**

Drying Duration (Hours): **~ 24 hrs**
Date/Time in: 10/24/2016 12:45
Date/Time out: 10/25/2016 13:00

Dessicator: **# 128**
Date/Time in: 10/25/2016 13:00
Date/Time out: 10/31/2016 12:10

Dry Weigh Date / Technician's Initials: 10/31/2016 mp

Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Muffle Furnace Temperature: **550 °C**

Drying Duration (Hours): **2 hrs**
Date/Time in: 11/3/2016 10:20
Date/Time out 11/3/2016 12:21

Dessicator: **# 128**
Date/Time in: 11/3/2016 15:34
Date/Time out 11/10/2016 15:17

Ashed Weigh Date / Technician's Initials: 11/10/2016 mp

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	**1**	10	0.86251	0.85311	0.00940	9	1.04444	0	0.94000
Water Only Control	**2**	10	0.87173	0.86293	0.00880	10	0.88000	0	0.88000
GLC Number:	**3**	10	0.86699	0.85745	0.00954	10	0.95400	0	0.95400
NA	**4**	10	0.87267	0.86279	0.00988	10	0.98800	0	0.98800
	5	10	0.87262	0.86360	0.00902	9	1.00222	0	0.90200
	6	10	0.85997	0.85157	0.00840	10	0.84000	0	0.84000
	7	10	0.86519	0.85570	0.00949	10	0.94900	0	0.94900
	8	10	0.88633	0.87698	0.00935	10	0.93500	0	0.93500
						AVERAGE:	0.94908		0.92350

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	80	0.86341	0.83676	0.02665	80	Average at Day 0 (mg)		0.33313

See Attached sheet for calculated weights.

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2386-00
Bay West
Chironomus dilutus WEIGHT DATA

Project Number: 2386-00
Project Name: Bay West

GLC#: 11080
Sample ID: BW16MLW-001-0-0.15

Test Species: *Chironomus dilutus*
Test Date: 10/14/2016
10/24/2016

Type/Model of Drying Oven: Blue M
Oven Temperature: 60 °C

Drying Duration (Hours): ~24 hrs
Date/Time in: 10/24/16 1245
Date/Time out: 10/25/16 1300

Dessicator: # 128
Date/Time in: 10/25/16 1300
Date/Time out: 10/31/16 1210

Dry Weigh Date / Technician's Initials: 10/31/16 m.

Type/Model of Muffle Furnace: F6020 Thermolyne MOD.
Muffle Furnace Temperature: 550 °C

Drying Duration (Hours): 2 hrs
Date/Time in: 11/3/16 1020
Date/Time out: 11/3/16 1221

Dessicator: # 128
Date/Time in: 11/3/16 1534
Date/Time out: 11/10/16 1517

Ashed Weigh Date / Technician's Initials: 11/10/16 m.

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	0.84523	0.83052	0.00000	10	#DIV/0!	0	0.00000
BW16MLW-001-0-0.15	2	10	0.85730	0.84620	0.00000	10	#DIV/0!	0	0.00000
GLC Number:	3	10	0.82770	0.81428	0.00000	10	#DIV/0!	0	0.00000
11080	4	10	0.86493	0.85017	0.00000	10	#DIV/0!	0	0.00000
	5	10	0.85591	0.83839	0.00000	9	#DIV/0!	0	0.00000
	6	10	0.86081	0.84835	0.00000	10	#DIV/0!	0	0.00000
	7	10	0.86650	0.84670	0.00000	10	#DIV/0!	0	0.00000
	8	10	0.85387	0.84162	0.00000	9	#DIV/0!	0	0.00000
						AVERAGE:	#DIV/0!	—	0.00000

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	80	0.86341	0.836716	0	80	Average at Day 0 (mg)	0.33313	0

See Attached sheet for calculated weights.

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2386
Bay West
Chironomus dilutus WEIGHT DATA

Project Number: **2386**
Project Name: **Bay West**

GLC#: **11080**
Sample ID: **BW16MLW-001-0-0.15**

Test Species: ***Chironomus dilutus***
Test Date: **10/14/2016**
10/24/2016

Type/Model of Drying Oven: **Blue M**
Oven Temperature: **60 °C**

Drying Duration (Hours): **~ 24 hrs**
Date/Time in: 10/24/2016 12:45
Date/Time out: 10/25/2016 13:00

Dessicator: **# 128**
Date/Time in: 10/25/2016 13:00
Date/Time out: 10/31/2016 12:10

Dry Weigh Date / Technician's Initials: 10/31/2016 mp

Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Muffle Furnace Temperature: **550 °C**

Drying Duration (Hours): **2 hrs**
Date/Time in: 11/3/2016 10:20
Date/Time out 11/3/2016 12:21

Dessicator: **# 128**
Date/Time in: 11/3/2016 15:34
Date/Time out 11/10/2016 15:17

Ashed Weigh Date / Technician's Initials: 11/10/2016 mp

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	**1**	10	0.84523	0.83052	0.01471	10	1.47100	0	1.47100
BW16MLW-001-0-0.15	**2**	10	0.85730	0.84620	0.01110	10	1.11000	0	1.11000
GLC Number:	**3**	10	0.82770	0.81428	0.01342	10	1.34200	0	1.34200
11080	**4**	10	0.86493	0.85017	0.01476	10	1.47600	0	1.47600
	5	10	0.85591	0.83839	0.01752	9	1.94667	0	1.75200
	6	10	0.86081	0.84835	0.01246	10	1.24600	0	1.24600
	7	10	0.86050	0.84670	0.01380	10	1.38000	0	1.38000
	8	10	0.85387	0.84162	0.01225	9	1.36111	0	1.22500
						AVERAGE:	1.41660	▨	1.37525

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	80	0.86341	0.83676	0.02665	80	Average at Day 0 (mg)		0.33313

See Attached sheet for calculated weights.

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2386-00
Bay West
Chironomus dilutus WEIGHT DATA

Project Number: 2386-00
Project Name: Bay West

GLC#: 11081
Sample ID: BW16MLW-002-0-0.15

Test Species: *Chironomus dilutus*
Test Date: 10/14/2016
10/24/2016

Type/Model of Drying Oven: Blue M
Oven Temperature: 60 °C

Drying Duration (Hours): ~24 hrs
Date/Time in: 10/24/16 1245
Date/Time out: 10/25/16 1200

Dessicator: # 128
Date/Time in: 10/25/16 1300
Date/Time out: 10/31/16 1210

Dry Weigh Date / Technician's Initials: 10/31/16 MP

Type/Model of Muffle Furnace: F6020 Thermolyne MOD.
Muffle Furnace Temperature: 550 °C

Drying Duration (Hours): 2 hrs
Date/Time in: 11/3/16 1020
Date/Time out: 11/3/16 1221

Dessicator: # 128
Date/Time in: 11/3/16 1534
Date/Time out: 11/10/16 1517

Ashed Weigh Date / Technician's Initials: 11/10/16 MP.

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	0.85524	0.84228	0.00000	9	#DIV/0!	0	0.00000
BW16MLW-002-0-0.15	2	10	0.84978	0.83633	0.00000	10	#DIV/0!	0	0.00000
GLC Number:	3	10	0.86181	0.84884	0.00000	10	#DIV/0!	0	0.00000
11081	4	10	0.85159	0.84027	0.00000	10	#DIV/0!	0	0.00000
	5	10	0.85746	0.84507	0.00000	10	#DIV/0!	0	0.00000
	6	10	0.85972	0.84837	0.00000	8	#DIV/0!	0	0.00000
	7	10	0.85947	0.84453	0.00000	10	#DIV/0!	0	0.00000
	8	10	0.85337	0.83983	0.00000	10	#DIV/0!	—	0.00000
						AVERAGE:	#DIV/0!		0.00000

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	80	0.86341	0.83676	0	80	Average at Day 0 (mg)	0.33313	0

See Attached sheet for calculated weights.

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2386
Bay West
Chironomus dilutus WEIGHT DATA

Project Number: **2386**
Project Name: **Bay West**

GLC#: **11081**
Sample ID: **BW16MLW-002-0.0-0.15**

Test Species: ***Chironomus dilutus***
Test Date: **10/14/2016**
10/24/2016

Type/Model of Drying Oven: **Blue M**
Oven Temperature: **60 °C**

Drying Duration (Hours): **~ 24 hrs**
Date/Time in: 10/24/2016 12:45
Date/Time out: 10/25/2016 13:00

Dessicator: **# 128**
Date/Time in: 10/25/2016 13:00
Date/Time out: 10/31/2016 12:10

Dry Weigh Date / Technician's Initials: 10/31/2016 mp

Type/Model of Muffle Furnace: **F6020 Thermolyne MOD**.
Muffle Furnace Temperature: **550 °C**

Drying Duration (Hours): **2 hrs**
Date/Time in: 11/3/2016 10:20
Date/Time out 11/3/2016 12:21

Dessicator: **# 128**
Date/Time in: 11/3/2016 15:34
Date/Time out 11/10/2016 15:17

Ashed Weigh Date / Technician's Initials: 11/10/2016 mp

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	**1**	10	0.85524	0.84228	0.01296	9	1.44000	0	1.29600
BW16MLW-002-0.0-0.15	**2**	10	0.84978	0.83633	0.01345	10	1.34500	0	1.34500
GLC Number:	**3**	10	0.86181	0.84884	0.01297	10	1.29700	0	1.29700
11081	**4**	10	0.85159	0.84027	0.01132	10	1.13200	0	1.13200
	5	10	0.85746	0.84507	0.01239	10	1.23900	0	1.23900
	6	10	0.85972	0.84837	0.01135	8	1.41875	0	1.13500
	7	10	0.85947	0.84453	0.01494	10	1.49400	0	1.49400
	8	10	0.85337	0.83983	0.01354	10	1.35400	0	1.35400
						AVERAGE:	1.33997	▨	1.28650

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	80	0.86341	0.83676	0.02665	80	Average at Day 0 (mg)		0.33313

See Attached sheet for calculated weights.

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2386-00
Bay West
Chironomus dilutus WEIGHT DATA

Project Number: 2386-00
Project Name: **Bay West**

GLC#: 11082
Sample ID: BW16MLW-003-0-0.15

Test Species: *Chironomus dilutus*
Test Date: 10/14/2016
10/24/2016

Type/Model of Drying Oven: Blue M
Oven Temperature: 60 °C

Drying Duration (Hours): ~24 hrs
Date/Time in: 10/24/16 1245
Date/Time out: 10/25/16 1300

Dessicator: # 128
Date/Time in: 10/25/16 1300
Date/Time out: 10/31/16 1210

Dry Weigh Date / Technician's Initials: 10/31/16 M.

Type/Model of Muffle Furnace: F6020 Thermolyne MOD.
Muffle Furnace Temperature: 550 °C

Drying Duration (Hours): 2 hrs
Date/Time in: 11/3/16 1020
Date/Time out: 11/3/16 1721

Dessicator: # 128
Date/Time in: 11/3/15 1534
Date/Time out: 11/3/16 1517

Ashed Weigh Date / Technician's Initials: 11/10/16 MP.

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	0.86570	0.85518	0.00000	10	#DIV/0!	0	0.00000
BW16MLW-003-0-0.15	2	10	0.85706	0.84397	0.00000	10	#DIV/0!	0	0.00000
GLC Number:	3	10	0.85802	0.84406	0.00000	9	#DIV/0!	0	0.00000
11082	4	10	0.86066	0.84879	0.00000	10	#DIV/0!	0	0.00000
	5	10	0.86616	0.85363	0.00000	10	#DIV/0!	0	0.00000
	6	10	0.85666	0.84558	0.00000	9	#DIV/0!	0	0.00000
	7	10	0.85430	0.84242	0.00000	9	#DIV/0!	0	0.00000
	8	10	0.84935	0.83854	0.00000	9	#DIV/0!	0	0.00000
						AVERAGE:	#DIV/0!	—	0.00000

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	80	0.86341	0.83676	0	80	Average at Day 0 (mg)	0.33313	0

See Attached sheet for calculated weights.

Great Lakes Environmental Center

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2386
Bay West
Chironomus dilutus WEIGHT DATA

Project Number: **2386**
Project Name: **Bay West**
GLC#: **11082**
Sample ID: **BW16MLW-003-0.0-0.15**
Test Species: ***Chironomus dilutus***
Test Date: **10/14/2016**
10/24/2016

Type/Model of Drying Oven: **Blue M**
Oven Temperature: **60 °C**
Drying Duration (Hours): **~ 24 hrs**
Date/Time in: 10/24/2016 12:45
Date/Time out: 10/25/2016 13:00
Dessicator: **# 128**
Date/Time in: 10/25/2016 13:00
Date/Time out: 10/31/2016 12:10
Dry Weigh Date / Technician's Initials: 10/31/2016 mp

Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Muffle Furnace Temperature: **550 °C**
Drying Duration (Hours): **2 hrs**
Date/Time in: 11/3/2016 10:20
Date/Time out 11/3/2016 12:21
Dessicator: **# 128**
Date/Time in: 11/3/2016 15:34
Date/Time out 11/10/2016 15:17
Ashed Weigh Date / Technician's Initials: 11/10/2016 mp

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	**1**	10	0.86570	0.85518	0.01052	10	1.05200	0	1.05200
BW16MLW-003-0.0-0.15	**2**	10	0.85706	0.84397	0.01309	10	1.30900	0	1.30900
GLC Number:	**3**	10	0.85802	0.84406	0.01396	9	1.55111	0	1.39600
11082	**4**	10	0.86066	0.84879	0.01187	10	1.18700	0	1.18700
	5	10	0.86616	0.85363	0.01253	10	1.25300	0	1.25300
	6	10	0.85666	0.84558	0.01108	9	1.23111	0	1.10800
	7	10	0.85430	0.84242	0.01188	9	1.32000	0	1.18800
	8	10	0.84935	0.83854	0.01081	9	1.20111	0	1.08100
						AVERAGE:	1.26304		1.19675

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	80	0.86341	0.83676	0.02665	80	Average at Day 0 (mg)		0.33313

See Attached sheet for calculated weights.

Appendix C2
Chironomus dilutus
10-Day Statistical Data

Test: EPA 100.2-Chironomus dilutus 10d Survival and Growth Test
Species: CDIL-Chironomus dilutus
Sample ID: MUD LAKE W
Start Date: 10/14/2016 End Date: 10/24/2016

Test ID: 2386cd16
Protocol: EPA 600/R-99/064
Sample Type: -WHOLE SEDIMENT
Lab ID: -GREAT LAKES ENVIRONMENTAL CENTER

Pos	ID	Rep	Group	Day 0	Day 4	Day 10	Day 10	Day 20	Day 20	# pupae + Mi	Alive in Sedi	Remain in Se	Emerged	Weight pan/o	Weight ashed pan/orgs aft
	1	1	CS 136 West B	10	10	10	10			0				0.85806	0.84716
	2	2	CS 136 West B	10	10	10	10			0				0.85316	0.84375
	3	3	CS 136 West B	10	10	10	10			0				0.86177	0.85114
	4	4	CS 136 West B	10	10	10	10			0				0.86307	0.8534
	5	5	CS 136 West B	10	10	10	10			0				0.84914	0.83972
	6	6	CS 136 West B	10	10	9	9			0				0.84648	0.83816
	7	7	CS 136 West B	10	10	9	9			0				0.8533	0.84401
	8	8	CS 136 West B	10	10	10	10			0				0.84881	0.83904
	9	1	Water only	10	10	9	9			0				0.86251	0.85311
	10	2	Water only	10	10	10	10			0				0.87173	0.86293
	11	3	Water only	10	10	10	10			0				0.86699	0.85745
	12	4	Water only	10	10	10	10			0				0.87267	0.86279
	13	5	Water only	10	10	9	9			0				0.87262	0.8636
	14	6	Water only	10	10	10	10			0				0.85997	0.85157
	15	7	Water only	10	10	10	10			0				0.86519	0.8557
	16	8	Water only	10	10	10	10			0				0.88633	0.87698
	17	1	BW16MLW-001	10	10	10	10			0				0.84523	0.83052
	18	2	BW16MLW-001	10	10	10	10			0				0.8573	0.8462
	19	3	BW16MLW-001	10	10	10	10			0				0.8277	0.81428
	20	4	BW16MLW-001	10	10	10	10			0				0.86493	0.85017
	21	5	BW16MLW-001	10	10	9	9			0				0.85591	0.83839
	22	6	BW16MLW-001	10	10	10	10			0				0.86081	0.84835
	23	7	BW16MLW-001	10	10	10	10			0				0.8605	0.8467
	24	8	BW16MLW-001	10	10	9	9			0				0.85387	0.84162
	25	1	BW16MLW-002	10	10	9	9			0				0.85524	0.84228
	26	2	BW16MLW-002	10	10	10	10			0				0.84978	0.83633
	27	3	BW16MLW-002	10	10	10	10			0				0.86181	0.84884
	28	4	BW16MLW-002	10	10	10	10			0				0.85159	0.84027
	29	5	BW16MLW-002	10	10	10	10			0				0.85746	0.84507
	30	6	BW16MLW-002	10	10	8	8			0				0.85972	0.84837
	31	7	BW16MLW-002	10	10	10	10			0				0.85947	0.84453
	32	8	BW16MLW-002	10	10	10	10			0				0.85337	0.83983
	33	1	BW16MLW-003	10	10	10	10			0				0.8657	0.85518
	34	2	BW16MLW-003	10	10	10	10			0				0.85706	0.84397
	35	3	BW16MLW-003	10	10	9	9			0				0.85802	0.84406
	36	4	BW16MLW-003	10	10	10	10			0				0.86066	0.84879
	37	5	BW16MLW-003	10	10	10	10			0				0.86616	0.85363
	38	6	BW16MLW-003	10	10	9	9			0				0.85666	0.84558

Reviewed by: MLV

Test: EPA 100.2-Chironomus dilutus 10d Survival and Growth Test
Species: CDIL-Chironomus dilutus
Sample ID: MUD LAKE W
Start Date: 10/14/2016 End Date: 10/24/2016

Test ID: 2386cd16
Protocol: EPA 600/R-99/064
Sample Type: -WHOLE SEDIMENT
Lab ID: -GREAT LAKES ENVIRONMENTAL CENTER

Pos	ID	Rep	Group	Day 0	Day 4	Day 1	Day 1	Day 2	Day 2	# pupae + Mi	Alive in Sedi	Remain in S	Emerged	Weight pan/	Weight ashed pan/orgs aft
	39	7	BW16MLW-00	10	10	9	9			0				0.8543	0.84242
	40	8	BW16MLW-00	10	10	9	9			0				0.84935	0.83854

Comments: Bay West Mud Lake West 10 day Cdilutus survival and growth Oct 2016

Reviewed by: MLV

Chironomus dilutus 10d Survival and Growth Test-10-day survival

Start Date:	10/14/2016	Test ID:	2386cd16	Sample ID:	Mud Lake West
End Date:	10/24/2016	Lab ID:	-GREAT LAKES ENVIRONM	Sample Type:	-WHOLE SEDIMENT
Sample Date:		Protocol:	EPA 100.4-EPA 600/R-94/02	Test Species:	CDIL-Chironomus dilutus
Comments:	Bay West Mud Lake West 10 day Cdilutus survival and growth Oct 2016				

Conc-%	1	2	3	4	5	6	7	8
CS 136 West Bear Con	1.0000	1.0000	1.0000	1.0000	1.0000	0.9000	0.9000	1.0000
Water only	0.9000	1.0000	1.0000	1.0000	0.9000	1.0000	1.0000	1.0000
BW16MLW-001 GLC #11080	1.0000	1.0000	1.0000	1.0000	0.9000	1.0000	1.0000	0.9000
BW16MLW-002 GLC #11081	0.9000	1.0000	1.0000	1.0000	1.0000	0.8000	1.0000	1.0000
BW16MLW-003 GLC #11082	1.0000	1.0000	0.9000	1.0000	1.0000	0.9000	0.9000	0.9000

			Transform: Arcsin Square Root						
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Rank Sum	1-Tailed Critical
CS 136 West Bear Con	0.9750	1.0000	1.3713	1.2490	1.4120	5.501	8	*	
Water only	0.9750	1.0000	1.3713	1.2490	1.4120	5.501	8		
BW16MLW-001 GLC #11080	0.9750	1.0000	1.3713	1.2490	1.4120	5.501	8	68.00	48.00
BW16MLW-002 GLC #11081	0.9625	0.9872	1.3535	1.1071	1.4120	8.476	8	67.00	48.00
BW16MLW-003 GLC #11082	0.9500	0.9744	1.3305	1.2490	1.4120	6.547	8	60.00	48.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.77407	0.904	-1.1908	0.51842
Bartlett's Test indicates equal variances (p = 0.64)	1.66885	7.81473		
The control means are not significantly different (p = 1.00)	0	2.14479		
Hypothesis Test (1-tail, 0.05)				
Steel's Many-One Rank Test indicates no significant differences				
Treatments vs CS 136 West Bear Con				

Reviewed by: MLV

Chironomus dilutus 10d Survival and Growth Test-10-Day Growth (AFDW)

Start Date:	10/14/2016	Test ID:	2386cd16	Sample ID:	Mud Lake West
End Date:	10/24/2016	Lab ID:	-GREAT LAKES ENVIRONM	Sample Type:	-WHOLE SEDIMENT
Sample Da		Protocol:	EPA 100.4-EPA 600/R-94/02	Test Species:	CDIL-Chironomus dilutus

Comments Bay West Mud Lake West 10 day Cdilutus survival and growth Oct 2016

Conc-%	1	2	3	4	5	6	7	8
CS 136 West Bear Con	1.0900	0.9410	1.0630	0.9670	0.9420	0.9244	1.0322	0.9770
Water only	1.0444	0.8800	0.9540	0.9880	1.0022	0.8400	0.9490	0.9350
BW16MLW-001 GLC #11080	1.4710	1.1100	1.3420	1.4760	1.9467	1.2460	1.3800	1.3611
BW16MLW-002 GLC #11081	1.4400	1.3450	1.2970	1.1320	1.2390	1.4188	1.4940	1.3540
BW16MLW-003 GLC #11082	1.0520	1.3090	1.5511	1.1870	1.2530	1.2311	1.3200	1.2011

			Transform: Untransformed					Rank	1-Tailed
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
CS 136 West Bear Con	0.9921	1.0453	0.9921	0.9244	1.0900	6.234	8	*	
Water only	0.9491	1.0000	0.9491	0.8400	1.0444	6.935	8		
BW16MLW-001 GLC #11080	1.4166	1.4926	1.4166	1.1100	1.9467	17.303	8	100.00	48.00
BW16MLW-002 GLC #11081	1.3400	1.4119	1.3400	1.1320	1.4940	8.715	8	100.00	48.00
BW16MLW-003 GLC #11082	1.2630	1.3308	1.2630	1.0520	1.5511	11.341	8	98.00	48.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.89395	0.904	1.30312	4.70951
Bartlett's Test indicates unequal variances (p = 9.74E-03)	11.4015	7.81473		
The control means are not significantly different (p = 0.20)	1.34657	2.14479		

Hypothesis Test (1-tail, 0.05)

Steel's Many-One Rank Test indicates no significant differences
Treatments vs CS 136 West Bear Con

Reviewed by: MLV

Chironomus dilutus 10d Survival and Growth Test-10-Day Biomass (AFDW)

Start Date:	10/14/2016	Test ID:	2386cd16	Sample ID:	Mud Lake West
End Date:	10/24/2016	Lab ID:	-GREAT LAKES ENVIRONMENT/	Sample Type:	-WHOLE SEDIMENT
Sample Da		Protocol:	EPA 100.4-EPA 600/R-94/025	Test Species:	CDIL-Chironomus dilutus

Comments Bay West Mud Lake West 10 day Cdilutus survival and growth Oct 2016

Conc-%	1	2	3	4	5	6	7	8
CS 136 West Bear Con	1.0900	0.9410	1.0630	0.9670	0.9420	0.8320	0.9290	0.9770
Water only	0.9400	0.8800	0.9540	0.9880	0.9020	0.8400	0.9490	0.9350
BW16MLW-001 GLC #11080	1.4710	1.1100	1.3420	1.4760	1.7520	1.2460	1.3800	1.2250
BW16MLW-002 GLC #11081	1.2960	1.3450	1.2970	1.1320	1.2390	1.1350	1.4940	1.3540
BW16MLW-003 GLC #11082	1.0520	1.3090	1.3960	1.1870	1.2530	1.1080	1.1880	1.0810

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
CS 136 West Bear Con	0.9676	1.0478	0.9676	0.8320	1.0900	8.324	8	*		
Water only	0.9235	1.0000	0.9235	0.8400	0.9880	5.091	8			
BW16MLW-001 GLC #11080	1.3753	1.4892	1.3753	1.1100	1.7520	14.334	8	-6.008	2.156	0.1463
BW16MLW-002 GLC #11081	1.2865	1.3931	1.2865	1.1320	1.4940	9.305	8	-4.700	2.156	0.1463
BW16MLW-003 GLC #11082	1.1968	1.2959	1.1968	1.0520	1.3960	9.880	8	-3.377	2.156	0.1463

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96526		0.904		0.6036	1.23454
Bartlett's Test indicates equal variances (p = 0.14)	5.43546		7.81473			
The control means are not significantly different (p = 0.20)	1.33822		2.14479			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Dunnett's Test indicates no significant differences	0.14627	0.15116	0.24542	0.01841	1.4E-05	3, 28
Treatments vs CS 136 West Bear Con						

Reviewed by: MLV

Appendix D1
Hyalella azteca
28-Day Bench sheets

- Survival
- Weight

2386-01
Bay West
Hyalella azteca 28-Day Survival and Growth Whole Sediment Toxicity Test

Page 18 of 18
QC'd by: MLV

Project Number: **2386-01** Project Name: **Bay West**
GLC#: **CS 136**
Sample ID: **West Bearskin Lake**
Test Species: ***Hyalella azteca***
Date Addition of Sediment: **10/18/2016**
Test Initiation Date: **10/19/2016**

Test Method-Manual: **EPA 100.4-EPA/600/R-99/064**
Test Photoperiod: **16:8**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **In House 7/8 day**
Test Termination Date: ~~11/23/2016~~ 11/16/16 mw 11/17/16

Test Day: **28**
Date: **11/16/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒ 0805 mw chemistries time/Initial

Number Daily Renewals: 1
☒ 0800 mw renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~YTC#~~ ~~☐ Feed 1.0 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no ü n/a

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	40	203	236	236	N/A	203	4	Init: mw
1					136	98	0.09 J	10/10
2					end: 30.8	end: 22.6		10/10
3					start: 27.4	start: 17.7		9/10
4					Titrant used (mL): 3.4	Titrant used (mL): 4.9		10/10
5	23.1	7.57	7.2	311	Sample volume (mL): 25	Sample volume (mL): 50		10/10
6	23.1	7.64	7.0	308				10/10
7								10/10
8								10/10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible

revised: June 2012

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QC'd by: MLV

2386-01
Bay West
Hyalella azteca 28-Day Survival and Growth Whole Sediment Toxicity Test

Project Number: **2386-01** Project Name: **Bay West**
GLC#: **Water Only**
Sample ID: **N/A**
Test Species: ***Hyalella azteca***
Date Addition of Sediment: **10/18/2016**
Test Initiation Date: **10/19/2016**

Test Method-Manual: **EPA 100.4-EPA/600/R-99/064**
Test Photoperiod: **16:8**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **In House 7/8 day**
Test Termination Date: ~~**11/23/2016**~~ 11/16/16 mw 11/17/16

Test Day: **28**
Date: **11/16/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒ 0752 mw chemistries time/Initial

Number Daily Renewals: 1
☒ 0800 EM renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~YTC#~~ ~~☐ Feed 1.0 ml/replicate~~
Screens Cleaned: ☐ **yes** ☒ **no** **ü n/a**

Replicate	**Temperature (23± 1°C)***	**pH**	**Dissolved Oxygen (mg/L)***	**Specific Conductance (µmhos/cm)**	**Hardness (mg/L $CaCO_3$)**	**Alkalinity (mg/L $CaCO_3$)**	**Ammonia (as N)**	**Observations/ # Surviving Organisms**
Record Meter ID	~~40~~ 236 mw 11/16/16	203	236	236	N/A	203	4	**Init:** mw
1					136	104	0.06 J	10 /10
2					end: 34.2	end: 27.8		9 /10
3					start: 30.8	start: 22.6		10 /10
4					Titrant used (mL): 3.4	Titrant used (mL): 5.2		10 /10
5	22.9	7.97	7.9	315	Sample volume (mL): 25	Sample volume (mL): 50		10 /10
6	22.8	7.94	8.0	319				10 /10
7								10 /10
8								10 /10

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible

revised: June 2012

2386-01
Bay West
Hyalella azteca 28-Day Survival and Growth Whole Sediment Toxicity Test

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QC'd by: MLV

Project Number: **2386-01** Project Name: **Bay West**
GLC#: **11080**
Sample ID: **BW16MLW-001**
Test Species: ***Hyalella azteca***
Date Addition of Sediment: **10/18/2016**
Test Initiation Date: **10/19/2016**

Test Method-Manual: **EPA 100.4-EPA/600/R-99/064**
Test Photoperiod: **16:8**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **In House 7/8 day**
Test Termination Date: ~~11/23/2016~~ 11/16/16 mw 11/17/16

Test Day: **28**
Date: **11/16/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒ 0752 m chemistries time/Initial

Number Daily Renewals: \
☒ 0800 em renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~YTC#~~ ~~☐ Feed 1.0 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no ü n/a

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	236 m ~~40~~ 11/16/16	203	236	236	N/A	203	4	Init: mw
1					136 dup 136	98 dup 98	0.06 J	10 /10
2					end: 37.6	end: 32.7	DUP=0.06J	10 /10
3					start: 34.2	start: 27.8		9 /10
4					Titrant used (mL): 3.4	Titrant used (mL): 4.9		10 /10
5	22.8	7.64	7.3	319	Sample volume (mL): 25	Sample volume (mL): 50		9 /10
6	22.8	7.79	7.0	321				10 /10
7								10/10
8								10/10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

Hard dup
end: 41.0
start: 37.6
titrant: 3.4
Sample: 25

Alk dup
end 37.6
start 32.7
titrant 4.9
Sample 50

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible

revised: June 2012

Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day Survival and Growth Whole Sediment Toxicity Test

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QC'd by: MLV

Project Number: **2386-01** Project Name: **Bay West**
GLC#: **11081**
Sample ID: **BW16MLW-002**
Test Species: ***Hyalella azteca***
Date Addition of Sediment: **10/18/2016**
Test Initiation Date: **10/19/2016**

Test Method-Manual: **EPA 100.4-EPA/600/R-99/064**
Test Photoperiod: **16:8**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **In House 7/8 day**
Test Termination Date: ~~**11/23/2016**~~ 11/16/16 Mw 11/17/16

Test Day: **28**
Date: **11/16/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒ 0752 MV chemistries time/Initial

Number Daily Renewals: 1
☒ 0808 MV renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~YTC#~~ ~~☐ Feed 1.0 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no ü n/a

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	236	203	236	236	N/A	203	4	Init: Mw
1					136	106	0.05J	10 /10
2					end: 44.4	end: 42.9		9 /10
3					start: 41.0	start: 37.6		9 /10
4					Titrant used (mL): 3.4	Titrant used (mL): 5.3		10 /10
5	22.8	7.91	7.3	325	Sample volume (mL): 25	Sample volume (mL): 50		10 /10
6	22.8	7.93	7.0	327				10 /10
7								9 /10
8								10 /10

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible

revised: June 2012

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QC'd by: MLV

2386-01
Bay West
Hyalella azteca 28-Day Survival and Growth Whole Sediment Toxicity Test

Project Number: **2386-01** Project Name: **Bay West**
GLC#: **11082**
Sample ID: **BW16MLW-003**
Test Species: ***Hyalella azteca***
Date Addition of Sediment: **10/18/2016**
Test Initiation Date: **10/19/2016**

Test Method-Manual: **EPA 100.4-EPA/600/R-99/064**
Test Photoperiod: **16:8**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **In House 7/8 day**
Test Termination Date: ~~**11/23/2016**~~ 11/16/16 MW 11/17/16

Test Day: **28**
Date: **11/16/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒0752 MC chemistries time/Initial

Number Daily Renewals: \
☒0809 MC renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~YTC#~~ ~~☐ Feed 1.0 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no ü n/a

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	236	203	236	236	N/A	203	4	**Init:** MW
1					132	98	0.05 J	10 /10
2					end: 47.7	end: 47.8		10 /10
3					start: 44.4	start: 42.9		10 /10
4					Titrant used (mL): 3.3	Titrant used (mL): 4.9		10 /10
5	23.0	7.60	6.8	317	Sample volume (mL): 25	Sample volume (mL): 50		9 /10
6	23.0	7.67	6.3	317				8 /10
7								10 /10
8								10 /10

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible

revised: June 2012

GLEC
Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day Survival and Growth Whole Sediment Toxicity Test

Page 18 of 18
QC'd by: MLV

Project Number: 2386-01 Project Name: **Bay West**
GLC#: **CS 136**
Sample ID: **West Bearskin Lake**
Test Species: ***Hyalella azteca***
Date Addition of Sediment: **10/18/2016**
Test Initiation Date: **10/19/2016**

Test Method-Manual: **EPA 100.4-EPA/600/R-99/064**
Test Photoperiod: **16:8**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **In House 7/8 day**
Test Termination Date: ~~**11/23/2016**~~ 11/16/16 mw 11/17/16

Test Day: **28**
Date: **11/16/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒ 0805 mw chemistries time/Initial

Number Daily Renewals: 1
☒ 0820 mw renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~YTC#~~ ~~☐ Feed 1.0 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no ü n/a

Replicate	**Temperature (23± 1°C)***	**pH**	**Dissolved Oxygen (mg/L)***	**Specific Conductance (µmhos/cm)**	**Hardness (mg/L $CaCO_3$)**	**Alkalinity (mg/L $CaCO_3$)**	**Ammonia (as N)**	**Observations/ # Surviving Organisms**
Record Meter ID	40	203	236	236	N/A	203	4	**Init:** mw
1					136	98	0.09 J	10/10
2					end: 30.8	end: 22.6		10/10
3					start: 27.4	start: 17.7		9/10
4					Titrant used (mL): 3.4	Titrant used (mL): 4.9		10/10
5	23.1	7.57	7.2	311	Sample volume (mL): 25	Sample volume (mL): 50		10/10
6	23.1	7.64	7.0	308				10/10
7								10/10
8								10/10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible

revised: June 2012

GLEC

2386-01
Bay West
Hyalella azteca 28-Day Survival and Growth Whole Sediment Toxicity Test

Page 18 of 18
QC'd by: MLV

Project Number: **2386-01** Project Name: **Bay West**
GLC#: **Water Only**
Sample ID: **N/A**
Test Species: ***Hyalella azteca***
Date Addition of Sediment: **10/18/2016**
Test Initiation Date: **10/19/2016**

Test Method-Manual: **EPA 100.4-EPA/600/R-99/064**
Test Photoperiod: **16:8**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **In House 7/8 day**
Test Termination Date: ~~**11/23/2016**~~ 11/16/16 mw 11/17/16

Test Day: **28**
Date: **11/16/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒ 0752 mw chemistries time/Initial

Number Daily Renewals: \
☒ 0808 EM renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~YTC#~~ ~~☐ Feed 1.0 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no ü n/a

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (μmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	~~40~~ 236 mw 11/16/16	203	236	236	N/A	203	4	Init: mw
1					136	104	0.06 J	10 /10
2					end: 34.2	end: 27.8		9 /10
3					start: 30.8	start: 22.6		10 /10
4					Titrant used (mL): 3.4	Titrant used (mL): 5.2		10 /10
5	22.9	7.97	7.9	315	Sample volume (mL): 25	Sample volume (mL): 50		10 /10
6	22.8	7.94	8.0	319				10 /10
7								10 /10
8								10 /10

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible

revised: June 2012

2386-01
Bay West
Hyalella azteca 28-Day Survival and Growth Whole Sediment Toxicity Test

Page 18 of 18
QC'd by: MLV

Project Number: **2386-01** Project Name: **Bay West**
GLC#: **11080**
Sample ID: **BW16MLW-001**
Test Species: ***Hyalella azteca***
Date Addition of Sediment: **10/18/2016**
Test Initiation Date: **10/19/2016**

Test Method-Manual: **EPA 100.4-EPA/600/R-99/064**
Test Photoperiod: **16:8**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **In House 7/8 day**
Test Termination Date: ~~**11/23/2016**~~ 11/16/16 mw 11/17/16

Test Day: **28**
Date: **11/16/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒ 0752 m. chemistries time/Initial

Number Daily Renewals: \
☑ 1000 em renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~YTC#~~ ~~☐ Feed 1.0 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no ü n/a

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	~~40~~ 236 mw	203	236	236	N/A	203	4	Init: mw
1					136 dup 136	98 dup 98	0.06 J	10 /10
2					end: 37.6	end: 32.7	DUP=0.06J	10 /10
3					start: 34.2	start: 27.8		9 /10
4					Titrant used (mL): 3.4	Titrant used (mL): 4.9		10 /10
5	22.8	7.64	7.3	319	Sample volume (mL): 25	Sample volume (mL): 50		9 /10
6	22.8	7.79	7.0	321				10 /10
7								10/10
8								10/10

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

Hard dup
end: 41.0
start: 37.6
titrant: 3.4
sample: 25

Alk dup
end 37.6
start 32.7
titrant 4.9
sample 50

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible

revised: June 2012

2386-01
Bay West
Hyalella azteca 28-Day Survival and Growth Whole Sediment Toxicity Test

Page 18 of 18
QC'd by: MLV

Project Number: **2386-01** Project Name: **Bay West**
GLC#: **11081**
Sample ID: **BW16MLW-002**
Test Species: ***Hyalella azteca***
Date Addition of Sediment: **10/18/2016**
Test Initiation Date: **10/19/2016**

Test Method-Manual: **EPA 100.4-EPA/600/R-99/064**
Test Photoperiod: **16:8**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **In House 7/8 day**
Test Termination Date: ~~11/23/2016~~ 11/16/16 MLW 11/17/16

Test Day: **28**
Date: **11/16/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☑ 0752 MD chemistries time/Initial

Number Daily Renewals: 1
☑ 0808 MD renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~YTC#~~ ~~☐ Feed 1.0 ml/replicate~~
Screens Cleaned: ☐ yes ☑ no ü n/a

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness ($mg/L CaCO_3$)	Alkalinity ($mg/L CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	236	203	236	236	N/A	203	4	Init: MLW
1					136	106	0.05J	10 /10
2					end: 44.4	end: 42.9		9 /10
3					start: 41.0	start: 37.6		9 /10
4					Titrant used (mL): 3.4	Titrant used (mL): 5.3		10 /10
5	22.8	7.91	7.3	325	Sample volume (mL): 25	Sample volume (mL): 50		10 /10
6	22.8	7.93	7.0	327				10 /10
7								9 /10
8								10 /10

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible

revised: June 2012

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QC'd by: MLV

2386-01
Bay West
Hyalella azteca 28-Day Survival and Growth Whole Sediment Toxicity Test

Project Number: **2386-01**	Project Name: **Bay West**	Test Method-Manual:	**EPA 100.4-EPA/600/R-99/064**
GLC#: **11082**		Test Photoperiod: **16:8**	
Sample ID: **BW16MLW-003**		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Hyalella azteca***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/18/2016**	Test Organism Source/Age:	**In House 7/8 day**
Test Initiation Date:	**10/19/2016**	Test Termination Date:	~~11/23/2016~~ 11/16/16 MW 11/17/16

Test Day: **28**
Date: **11/16/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☑0752 MC chemistries time/Initial

Number Daily Renewals: \
☒0809 MC renewal time/Initials ~~☐ renewal~~
~~☐ renewal time/Initials ☐ renewal~~
Food: ~~YTC#~~ ~~☐ Feed 1.0 ml/replicate~~
Screens Cleaned: ☐ yes ☒ no ü n/a

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	236	203	236	236	N/A	203	4	**Init:** MW
1					132	98	0.05 J	10 /10
2					end: 47.7	end: 47.8		10 /10
3					start: 44.4	start: 42.9		10 /10
4					Titrant used (mL): 3.3	Titrant used (mL): 4.9		10 /10
5	23.0	7.60	6.8	317	Sample volume (mL): 25	Sample volume (mL): 50		9 /10
6	23.0	7.67	6.3	317				8 /10
7								10 /10
8								10 /10

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible

revised: June 2012

Project Name: Bay West
Project Number: 2386-01

Test Dates: 10/19/2016-11/16/2016
Test Type: 28 Day Whole Sediment Toxicity Survival and Growth
Test Species: *Hyalella azteca*

100% Data Entry

Date	Initials	Data Entered
11/10/2015	MWG	ALL

100% Data Quality Check

Date	Initials	Data QC'ed	Errors Found Y or N	Errors Corrected:Y or N	List Error locations
12/5/2016	NS	Weight sheets	N	N	

GLEC
Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day WEIGHT DATA

Page 1 of 2

QC'd by: Mwt

Project Number: **2386-01**

Type/Model of Drying Oven: **Blue M**

Project Name: **Bay West**

Oven Temperature: **60 °C**

GLC#: **CS 136**

Drying Duration (Hours): **~24 hrs**

Dessicator: **# 128**

Sample ID: **West Bearskin Lake**

Date/Time in: 11/16/16 1030

Date/Time in: 11/17/16 1101

Test Species: ***Hyalella azteca***

Date/Time out: 11/17/16 1101

Date/Time out: 11/23/16 1100

Test Dates: **10/19/2016**
~~**11/23/2016**~~ 11/16/16
Mwt 11/17/16

Technician's Initials: m.

Weigh Date / Initials: 11/23/16 MN

Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Dry Weight of Pan (g)	B-C Total Dry Weight of Organisms (g)	D Number of Organisms Weighed	B-C/D Average Weight (mg)	B-C/A Biomass Weight (mg)
1	10	0.83404	0.83213		10	#DIV/0!	
2	10	0.81254	0.81078		10	#DIV/0!	
3	10	0.84190	0.84037		9	#DIV/0!	
4	10	0.83736	0.83573		10	#DIV/0!	
5	10	0.82420	0.82251		10	#DIV/0!	
6	10	0.81684	0.81512		10	#DIV/0!	
7	10	0.82620	0.82457		10	#DIV/0!	
8	10	0.84023	0.83874		10	#DIV/0!	
						AVERAGE:	

Day 0 weights	80	0.83458	0.83302	0	80	Average at Day 0 (mg)	0.01950 ~~0.00000~~

See Attached sheet for calculated weights.

Mwt
12/5/16

2386-01
Bay West
Hyalella azteca 28-Day WEIGHT DATA

Page 2 of 2

QC'd by: MWG

Project Number:	**2386-01**	Type/Model of Drying Oven: **Blue M**				
Project Name:	**Bay West**	Oven Temperature: **60 °C**				
GLC#:	**CS 136**	Drying Duration (Hours): **~ 24 hrs**		Dessicator: **# 186**		
Sample ID:	**West Bear Skin Lab Control**	Date/Time in:	11/16/2016 10:50	Date/Time in:	11/17/2016	11:01
Test Species:	***Hyalella azteca***	Date/Time out:	11/17/2016 11:01	Date/Time out:	11/23/2016	11:00
Test Dates:	**10/16/2016** **11/16/2016**	Technician's Initia	mp	Weigh Date / Initials:	11/23/2016 mp	

Replicate Number	**A** Number of Organisms at Test Initiation	**B** Dry Weight of Pan and Organisms (g)	**C** Dry Weight of Pan (g)	**B-C** Total Dry Weight of Organisms (g)	**D** Number of Organisms Weighed	**B-C/D** Average Weight (mg)	**B-C/A** Biomass Weight (mg)
1	10	0.83404	0.83213	0.00191	10	0.19100	0.19100
2	10	0.81254	0.81078	0.00176	10	0.17600	0.17600
3	10	0.84190	0.84037	0.00153	9	0.17000	0.15300
4	10	0.83736	0.83573	0.00163	10	0.16300	0.16300
5	10	0.82420	0.82251	0.00169	10	0.16900	0.16900
6	10	0.81684	0.81512	0.00172	10	0.17200	0.17200
7	10	0.82620	0.82457	0.00163	10	0.16300	0.16300
8	10	0.84023	0.83874	0.00149	10	0.14900	0.14900
						AVERAGE:	

Day 0 weights	80	0.83458	0.83302	0.00156	80	Average at Day 0 (mg)	0.0195

See Attached sheet for calculated weights.

GLEC
Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day WEIGHT DATA

Page 1 of 2

QC'd by: Mw

Project Number: **2386-01**	Type/Model of Drying Oven: **Blue M**		
Project Name: **Bay West**	Oven Temperature: **60 °C**		
GLC#: **Water Only**	Drying Duration (Hours): **~24 hrs**	Dessicator: **# 128**	
Sample ID: **N/A**	Date/Time in: 11/16/16 1050	Date/Time in: 11/17/16 1101	
Test Species: ***Hyalella azteca***	Date/Time out: 11/17/16 1101	Date/Time out: 11/23/16 1100	
Test Dates: **10/19/2016** ~~**11/23/2016**~~ 11/16/16 Mw 11/17/16	Technician's Initials: M	Weigh Date / Initials: 11/23/16 M	

Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Dry Weight of Pan (g)	B-C Total Dry Weight of Organisms (g)	D Number of Organisms Weighed	B-C/D Average Weight (mg)	B-C/A Biomass Weight (mg)
1	10	0.83179	0.82920		10	#DIV/0!	[illegible]
2	10	0.81783	0.81504		9	#DIV/0!	[illegible]
3	10	0.82753	0.82404		10	#DIV/0!	[illegible]
4	10	0.82906	0.82448		10	#DIV/0!	[illegible]
5	10	0.82400	0.82032		10	#DIV/0!	[illegible]
6	10	0.81876	081540		10	#DIV/0!	[illegible]
7	10	0.83597	0.83267		10	#DIV/0!	[illegible]
8	10	0.83290	0.82998		10	#DIV/0!	[illegible]
						AVERAGE:	

Day 0 weights	80	0.83458	0.83302	0	80	Average at Day 0 (mg)	0.01950 ~~0.00000~~

Mw 12/5/16

See Attached sheet for calculated weights.

Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day WEIGHT DATA

Page 2 of 2

QC'd by: MWG

Project Number:	**2386-01**	Type/Model of Drying Oven: **Blue M**					
Project Name:	**Bay West**	Oven Temperature: **60 °C**					
GLC#:	**N/A**	Drying Duration (Hours): **~ 24 hrs**			Dessicator: **# 186**		
Sample ID:	**Water Only Control**	Date/Time in:	11/16/2016	10:50	Date/Time in:	11/17/2016	11:01
Test Species:	***Hyalella azteca***	Date/Time out:	11/17/2016	11:01	Date/Time out:	11/23/2016	11:00
Test Dates:	**10/16/2016** **11/16/2016**	Technician's Initia	mp		Weigh Date / Initials:	11/23/2016 mp	

Replicate Number	**A** Number of Organisms at Test Initiation	**B** Dry Weight of Pan and Organisms (g)	**C** Dry Weight of Pan (g)	**B-C** Total Dry Weight of Organisms (g)	**D** Number of Organisms Weighed	**B-C/D** Average Weight (mg)	**B-C/A** Biomass Weight (mg)
1	10	0.83179	0.82920	0.00259	10	0.25900	0.25900
2	10	0.81783	0.81504	0.00279	9	0.31000	0.27900
3	10	0.82753	0.82404	0.00349	10	0.34900	0.34900
4	10	0.82906	0.82448	0.00458	10	0.45800	0.45800
5	10	0.82400	0.82032	0.00368	10	0.36800	0.36800
6	10	0.81876	0.81540	0.00336	10	0.33600	0.33600
7	10	0.83597	0.83267	0.0033	10	0.33000	0.33000
8	10	0.83290	0.82998	0.00292	10	0.29200	0.29200
						AVERAGE:	

Day 0 weights	80	0.83458	0.83302	0.00156	80	Average at Day 0 (mg)	0.0195

See Attached sheet for calculated weights.

Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day WEIGHT DATA

Page 1 of 2

QC'd by: MW

Project Number:	**2386-01**	Type/Model of Drying Oven: **Blue M**			
Project Name:	**Bay West**	Oven Temperature: **60 °C**			
GLC#:	**11080**	Drying Duration (Hours): **~24 hrs**		Dessicator: **# 128**	
Sample ID:	**BW16MLW-001**	Date/Time in: 11/16/16 1050		Date/Time in: 11/17/16 1101	
Test Species:	***Hyalella azteca***	Date/Time out: 11/17/16 1101		Date/Time out: 11/23/16 1100	
Test Dates:	**10/19/2016** ~~11/23/2016~~ 11/16/16 MW 11/17/16	Technician's Initials: m		Weigh Date / Initials: 11/23/16 m	

Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Dry Weight of Pan (g)	B-C Total Dry Weight of Organisms (g)	D Number of Organisms Weighed	B-C/D Average Weight (mg)	B-C/A Biomass Weight (mg)
1	10	0.81066	0.80881		10	#DIV/0!	
2	10	0.81033	0.80872		10	#DIV/0!	
3	10	m 11/23/16 0.817308	0.81120		9	#DIV/0!	
4	10	0.82765	0.82560		10	#DIV/0!	
5	10	0.82539	0.82364		9	#DIV/0!	
6	10	0.83790	0.83628		10	#DIV/0!	
7	10	0.84137	0.83947		10	#DIV/0!	
8	10	0.83909	0.83740		10	#DIV/0!	
						AVERAGE:	

Day 0 weights	80	0.83458	0.83302	0	80	Average at Day 0 (mg)	0.01950 MW 12/5/16 ~~0.00000~~

See Attached sheet for calculated weights.

Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day WEIGHT DATA

Page 2 of 2

QC'd by: MWG

Project Number:	**2386-01**	Type/Model of Drying Oven: **Blue M**					
Project Name:	**Bay West**	Oven Temperature: **60 °C**					
GLC#:	**11080**	Drying Duration (Hours): **~ 24 hrs**			Dessicator: **# 186**		
Sample ID:	**BW16MLW-001-0.0-0.15**	Date/Time in:	11/16/2016	10:50	Date/Time in:	11/17/2016	11:01
Test Species:	***Hyalella azteca***	Date/Time out:	11/17/2016	11:01	Date/Time out:	11/23/2016	11:00
Test Dates:	**10/16/2016** **11/16/2016**	Technician's Initia	mp		Weigh Date / Initials:	11/23/2016 mp	

Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Dry Weight of Pan (g)	B-C Total Dry Weight of Organisms (g)	D Number of Organisms Weighed	B-C/D Average Weight (mg)	B-C/A Biomass Weight (mg)
1	10	0.81066	0.80881	0.00185	10	0.18500	0.18500
2	10	0.81033	0.80872	0.00161	10	0.16100	0.16100
3	10	0.81308	0.81120	0.00188	9	0.20889	0.18800
4	10	0.82765	0.82560	0.00205	10	0.20500	0.20500
5	10	0.82539	0.82364	0.00175	9	0.19444	0.17500
6	10	0.83790	0.83628	0.00162	10	0.16200	0.16200
7	10	0.84137	0.83947	0.0019	10	0.19000	0.19000
8	10	0.83909	0.83740	0.00169	10	0.16900	0.16900
						AVERAGE:	

Day 0 weights	80	0.83458	0.83302	0.00156	80	Average at Day 0 (mg)	0.0195

See Attached sheet for calculated weights.

GLEC
Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day WEIGHT DATA

Page 1 of 2

QC'd by: MWO

Project Number: 2386-01	Type/Model of Drying Oven: **Blue M**		
Project Name: **Bay West**	Oven Temperature: **60 °C**		
GLC#: **11081**	Drying Duration (Hours): **~ 24 hrs**	Dessicator: **# 128**	
Sample ID: **BW16MLW-002**	Date/Time in: 11/16/16 1050	Date/Time in: 11/17/16 1101	
Test Species: ***Hyalella azteca***	Date/Time out: 11/17/16 1101	Date/Time out: 11/23/16 1100	
Test Dates: **10/19/2016** ~~**11/23/2016**~~ 11/16/16 MW 11/17/16	Technician's Initials: m	Weigh Date / Initials: 11/23/16 m	

Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Dry Weight of Pan (g)	B-C Total Dry Weight of Organisms (g)	D Number of Organisms Weighed	B-C/D Average Weight (mg)	B-C/A Biomass Weight (mg)
1	10	0.82494	0.82339		10	#DIV/0!	[illegible]
2	10	0.83234	0.83078		9	#DIV/0!	[illegible]
3	10	0.82713	0.82537		9	#DIV/0!	[illegible]
4	10	0.82537	0.82390		10	#DIV/0!	[illegible]
5	10	0.81757	0.81594		10	#DIV/0!	[illegible]
6	10	0.81784	0.81619		10	#DIV/0!	[illegible]
7	10	0.82836	0.82668		9	#DIV/0!	[illegible]
8	10	0.82514	0.82358		10	#DIV/0!	[illegible]
						AVERAGE:	

Day 0 weights	80	0.83458	0.83302	0	80	Average at Day 0 (mg)	0.0195 ~~0.00000~~ MW 12/5/16

See Attached sheet for calculated weights.

Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day WEIGHT DATA

Page 2 of 2

QC'd by: MWG

Project Number:	**2386-01**	Type/Model of Drying Oven: **Blue M**			
Project Name:	**Bay West**	Oven Temperature: **60 °C**			
GLC#:	**11081**	Drying Duration (Hours): **~ 24 hrs**		Dessicator: **# 186**	
Sample ID:	**BW16MLW-002-0.0-0.15**	Date/Time in: 11/16/2016	10:50	Date/Time in: 11/17/2016	11:01
Test Species:	***Hyalella azteca***	Date/Time out: 11/17/2016	11:01	Date/Time out: 11/23/2016	11:00
Test Dates:	**10/16/2016** **11/16/2016**	Technician's Initia	mp	Weigh Date / Initials: 11/23/2016 mp	

Replicate Number	**A** Number of Organisms at Test Initiation	**B** Dry Weight of Pan and Organisms (g)	**C** Dry Weight of Pan (g)	**B-C** Total Dry Weight of Organisms (g)	**D** Number of Organisms Weighed	**B-C/D** Average Weight (mg)	**B-C/A** Biomass Weight (mg)
1	10	0.82494	0.82339	0.00155	10	0.15500	0.15500
2	10	0.83234	0.83078	0.00156	9	0.17333	0.15600
3	10	0.82713	0.82537	0.00176	9	0.19556	0.17600
4	10	0.82537	0.82390	0.00147	10	0.14700	0.14700
5	10	0.81757	0.81594	0.00163	10	0.16300	0.16300
6	10	0.81784	0.81619	0.00165	10	0.16500	0.16500
7	10	0.82836	0.82668	0.00168	9	0.18667	0.16800
8	10	0.82514	0.82358	0.00156	10	0.15600	0.15600
						AVERAGE:	

Day 0 weights	80	0.83458	0.83302	0.00156	80	Average at Day 0 (mg)	0.0195

See Attached sheet for calculated weights.

GLEC
Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day WEIGHT DATA

Page 1 of 2

QC'd by: MWr

Project Number:	**2386-01**	Type/Model of Drying Oven: **Blue M**			
Project Name:	**Bay West**	Oven Temperature: **60 °C**			
GLC#:	**11082**	Drying Duration (Hours): **~24 hrs**		Dessicator: **# 128**	
Sample ID:	**BW16MLW-003**	Date/Time in: 11/16/16 1050		Date/Time in: 11/17/16 1107	
Test Species:	***Hyalella azteca***	Date/Time out: 11/17/16 1101		Date/Time out: 11/23/16 1100	
Test Dates:	**10/19/2016** ~~**11/23/2016**~~ 11/16/16 MWr 11/17/16	Technician's Initials: MO		Weigh Date / Initials: 11/23/16 MO	

Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Dry Weight of Pan (g)	B-C Total Dry Weight of Organisms (g)	D Number of Organisms Weighed	B-C/D Average Weight (mg)	B-C/A Biomass Weight (mg)
1	10	0.85272	0.85067		10	#DIV/0!	0.00000
2	10	0.83154	0.82984		10	#DIV/0!	0.00000
3	10	0.83067	0.82891		10	#DIV/0!	0.00000
4	10	0.82738	0.82592		10	#DIV/0!	0.00000
5	10	0.84242	0.84076		9	#DIV/0!	0.00000
6	10	0.82874	0.82656		8	#DIV/0!	0.00000
7	10	0.82900	0.82753		10	#DIV/0!	0.00000
8	10	0.83159	0.82983		10	#DIV/0!	0.00000
						AVERAGE:	

Day 0 weights	80	0.83458	0.83302	0	80	Average at Day 0 (mg)	0.0195 ~~0.00000~~

MWr 12/5/16

See Attached sheet for calculated weights.

GLEC
Great Lakes Environmental Center

2386-01
Bay West
Hyalella azteca 28-Day WEIGHT DATA

Page 2 of 2

QC'd by: MWG

Project Number: **2386-01**
Type/Model of Drying Oven: **Blue M**
Project Name: **Bay West**
Oven Temperature: **60 °C**
GLC#: **11082**
Drying Duration (Hours): **~ 24 hrs**
Dessicator: **# 186**
Sample ID: **BW16MLW-003-0.0-0.15**
Date/Time in: 11/16/2016 10:50
Date/Time in: 11/17/2016 11:01
Test Species: ***Hyalella azteca***
Date/Time out: 11/17/2016 11:01
Date/Time out: 11/23/2016 11:00
Test Dates: **10/16/2016**
11/16/2016
Technician's Initia mp
Weigh Date / Initials: 11/23/2016 mp

Replicate Number	**A** Number of Organisms at Test Initiation	**B** Dry Weight of Pan and Organisms (g)	**C** Dry Weight of Pan (g)	**B-C** Total Dry Weight of Organisms (g)	**D** Number of Organisms Weighed	**B-C/D** Average Weight (mg)	**B-C/A** Biomass Weight (mg)
1	10	0.85272	0.85067	0.00205	10	0.20500	0.20500
2	10	0.83154	0.82984	0.0017	10	0.17000	0.17000
3	10	0.83067	0.82891	0.00176	10	0.17600	0.17600
4	10	0.82738	0.82592	0.00146	10	0.14600	0.14600
5	10	0.84242	0.84076	0.00166	9	0.18444	0.16600
6	10	0.82874	0.82656	0.00218	8	0.27250	0.21800
7	10	0.82900	0.82753	0.00147	10	0.14700	0.14700
8	10	0.83159	0.82983	0.00176	10	0.17600	0.17600
						AVERAGE:	

Day 0 weights	80	0.83458	0.83302	0.00156	80	Average at Day 0 (mg)	0.0195

See Attached sheet for calculated weights.

Appendix D2
Hyalella azteca
28-Day Statistical Data

Test: EPA 100.1M-Hyalella azteca 28d Survival and Growth T Test ID: 2386ha16
Species: HA-Hyalella azteca Protocol: EPA 600/R-99/064
Sample ID: Mud Lake West Sample Type: -WHOLE SEDIMENT
Start Date: 10/19/2016 End Date: 11/17/2016 Lab ID: -GREAT LAKES ENVIRONMENTAL CENTER

Pos	ID	Rep	Group	Day 0-	Day 4	Day 10	Day 28	Total Weight	Pan weight	Weigh	Weight Ct 28-	Notes
	1	1	CS 136 West B	10	10		10	0.83404	0.83213		10	
	2	2	CS 136 West B	10	10		10	0.81254	0.81078		10	
	3	3	CS 136 West B	10	10		9	0.8419	0.84037		9	
	4	4	CS 136 West B	10	10		10	0.83736	0.83573		10	
	5	5	CS 136 West B	10	10		10	0.8242	0.82251		10	
	6	6	CS 136 West B	10	10		10	0.81684	0.81512		10	
	7	7	CS 136 West B	10	10		10	0.8262	0.82457		10	
	8	8	CS 136 West B	10	10		10	0.84023	0.83874		10	
	9	1	Water only	10	10		10	0.83179	0.8292		10	
	10	2	Water only	10	10		9	0.81783	0.81504		9	
	11	3	Water only	10	10		10	0.82753	0.82404		10	
	12	4	Water only	10	10		10	0.82906	0.82448		10	
	13	5	Water only	10	10		10	0.824	0.82032		10	
	14	6	Water only	10	10		10	0.81876	0.8154		10	
	15	7	Water only	10	10		10	0.83597	0.83267		10	
	16	8	Water only	10	10		10	0.8329	0.82998		10	
	17	1	BW16MLW-001	10	10		10	0.81066	0.80881		10	
	18	2	BW16MLW-001	10	10		10	0.81033	0.80872		10	
	19	3	BW16MLW-001	10	10		9	0.81308	0.8112		9	
	20	4	BW16MLW-001	10	10		10	0.82765	0.8256		10	
	21	5	BW16MLW-001	10	10		9	0.82539	0.82364		9	
	22	6	BW16MLW-001	10	10		10	0.8379	0.83628		10	
	23	7	BW16MLW-001	10	10		10	0.84137	0.83947		10	
	24	8	BW16MLW-001	10	10		10	0.83909	0.8374		10	
	25	1	BW16MLW-002	10	10		10	0.82494	0.82339		10	
	26	2	BW16MLW-002	10	10		9	0.83234	0.83078		9	
	27	3	BW16MLW-002	10	10		9	0.82713	0.82537		9	
	28	4	BW16MLW-002	10	10		10	0.82537	0.8239		10	
	29	5	BW16MLW-002	10	10		10	0.81757	0.81594		10	
	30	6	BW16MLW-002	10	10		10	0.81784	0.81619		10	
	31	7	BW16MLW-002	10	10		9	0.82836	0.82668		9	
	32	8	BW16MLW-002	10	10		10	0.82514	0.82358		10	
	33	1	BW16MLW-003	10	10		10	0.85272	0.85067		10	
	34	2	BW16MLW-003	10	10		10	0.83154	0.82984		10	
	35	3	BW16MLW-003	10	10		10	0.83067	0.82891		10	
	36	4	BW16MLW-003	10	10		10	0.82738	0.82592		10	
	37	5	BW16MLW-003	10	10		9	0.84242	0.84076		9	
	38	6	BW16MLW-003	10	10		8	0.82874	0.82656		8	
	39	7	BW16MLW-003	10	10		10	0.829	0.82753		10	
	40	8	BW16MLW-003	10	10		10	0.83159	0.82983		10	

Comments: Bay West Mud Lake West 28 day H azteca survival and growth Oct 2016

Reviewed by: MLV

Hyalella azteca 28d Survival and Growth Test-28-Day Survival

Start Date: 10/19/2016 Test ID: 2386ha16 Sample ID: Mud Lake West
End Date: 11/17/2016 Lab ID: -GREAT LAKES ENVIRONMENT/ Sample Type: -WHOLE SEDIMENT
Sample Da Protocol: EPA 600/R-99/064 Test Species: HA-Hyalella azteca
Comments Bay West Mud Lake West 28 day H azteca survival and growth Oct 2016

Conc-%	1	2	3	4	5	6	7	8
CS 136 West Bear Con	1.0000	1.0000	0.9000	1.0000	1.0000	1.0000	1.0000	1.0000
Water only	1.0000	0.9000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
BW16MLW-001 GLC #11080	1.0000	1.0000	0.9000	1.0000	0.9000	1.0000	1.0000	1.0000
BW16MLW-002 GLC #11081	1.0000	0.9000	0.9000	1.0000	1.0000	1.0000	0.9000	1.0000
BW16MLW-003 GLC #11082	1.0000	1.0000	1.0000	1.0000	0.9000	0.8000	1.0000	1.0000

			Transform: Arcsin Square Root					Rank	1-Tailed
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
CS 136 West Bear Con	0.9875	1.0000	1.3916	1.2490	1.4120	4.140	8	*	
Water only	0.9875	1.0000	1.3916	1.2490	1.4120	4.140	8		
BW16MLW-001 GLC #11080	0.9750	0.9873	1.3713	1.2490	1.4120	5.501	8	64.00	48.00
BW16MLW-002 GLC #11081	0.9625	0.9747	1.3509	1.2490	1.4120	6.244	8	60.00	48.00
BW16MLW-003 GLC #11082	0.9625	0.9747	1.3535	1.1071	1.4120	8.476	8	63.50	48.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.731867	0.904	-1.472323	1.291852
Bartlett's Test indicates equal variances (p = 0.36)	3.20586	7.814728		
The control means are not significantly different (p = 1.00)	0	2.144787		
Hypothesis Test (1-tail, 0.05)				
Steel's Many-One Rank Test indicates no significant differences				
Treatments vs CS 136 West Bear Con				

Reviewed by: MLV

Hyalella azteca 28d Survival and Growth Test-28-day Average Growth

Start Date:	10/19/2016	Test ID:	2386ha16	Sample ID:	Mud Lake West
End Date:	11/17/2016	Lab ID:	-GREAT LAKES ENVIRONMENT/	Sample Type:	-WHOLE SEDIMENT
Sample Da		Protocol:	EPA 600/R-99/064	Test Species:	HA-Hyalella azteca

Comments Bay West Mud Lake West 28 day H azteca survival and growth Oct 2016

Conc-%	1	2	3	4	5	6	7	8
CS 136 West Bear Con	0.1910	0.1760	0.1700	0.1630	0.1690	0.1720	0.1630	0.1490
Water only	0.2590	0.3100	0.3490	0.4580	0.3680	0.3360	0.3300	0.2920
BW16MLW-001 GLC #11080	0.1850	0.1610	0.2089	0.2050	0.1944	0.1620	0.1900	0.1690
BW16MLW-002 GLC #11081	0.1550	0.1733	0.1956	0.1470	0.1630	0.1650	0.1867	0.1560
BW16MLW-003 GLC #11082	0.2050	0.1700	0.1760	0.1460	0.1844	0.2725	0.1470	0.1760

			Transform: Untransformed					Rank	1-Tailed
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical
CS 136 West Bear Con	0.1691	0.5007	0.1691	0.1490	0.1910	7.119	8	*	
Water only	0.3377	1.0000	0.3377	0.2590	0.4580	17.562	8		
BW16MLW-001 GLC #11080	0.1844	0.5460	0.1844	0.1610	0.2089	10.130	8	79.00	48.00
BW16MLW-002 GLC #11081	0.1677	0.4965	0.1677	0.1470	0.1956	9.885	8	64.00	48.00
BW16MLW-003 GLC #11082	0.1846	0.5466	0.1846	0.1460	0.2725	21.866	8	75.50	48.00

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.886947	0.904	1.602484	5.58003
Bartlett's Test indicates unequal variances (p = 9.29E-03)	11.50399	7.814728		
The control means are significantly different (p = 1.63E-06)	7.879886	2.144787		

Hypothesis Test (1-tail, 0.05)

Steel's Many-One Rank Test indicates no significant differences
Treatments vs CS 136 West Bear Con

Reviewed by: MLV

Hyalella azteca 28d Survival and Growth Test-28-Day Biomass

Start Date:	10/19/2016	Test ID:	2386ha16	Sample ID:	Mud Lake West
End Date:	11/17/2016	Lab ID:	-GREAT LAKES ENVIRONMENT/	Sample Type:	-WHOLE SEDIMENT
Sample Da		Protocol:	EPA 600/R-99/064	Test Species:	HA-Hyalella azteca

Comments Bay West Mud Lake West 28 day H azteca survival and growth Oct 2016

Conc-%	1	2	3	4	5	6	7	8
CS 136 West Bear Con	0.1910	0.1760	0.1530	0.1630	0.1690	0.1720	0.1630	0.1490
Water only	0.2590	0.2790	0.3490	0.4580	0.3680	0.3360	0.3300	0.2920
BW16MLW-001 GLC #11080	0.1850	0.1610	0.1880	0.2050	0.1750	0.1620	0.1900	0.1690
BW16MLW-002 GLC #11081	0.1550	0.1560	0.1760	0.1470	0.1630	0.1650	0.1680	0.1560
BW16MLW-003 GLC #11082	0.2050	0.1700	0.1760	0.1460	0.1660	0.2180	0.1470	0.1760

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
CS 136 West Bear Con	0.1670	0.5002	0.1670	0.1490	0.1910	7.963	8	*		
Water only	0.3339	1.0000	0.3339	0.2590	0.4580	18.667	8			
BW16MLW-001 GLC #11080	0.1794	0.5373	0.1794	0.1610	0.2050	8.538	8	-1.470	2.156	0.0181
BW16MLW-002 GLC #11081	0.1608	0.4815	0.1608	0.1470	0.1760	5.641	8	0.743	2.156	0.0181
BW16MLW-003 GLC #11082	0.1755	0.5256	0.1755	0.1460	0.2180	14.415	8	-1.010	2.156	0.0181

Auxiliary Tests	Statistic		Critical		Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.967769		0.904		0.552671	0.68469
Bartlett's Test indicates equal variances (p = 0.07)	7.159739		7.814728			
The control means are significantly different (p = 3.32E-06)	7.406371		2.144787			
Hypothesis Test (1-tail, 0.05)	**MSDu**	**MSDp**	**MSB**	**MSE**	**F-Prob**	**df**
Dunnett's Test indicates no significant differences	0.018145	0.108655	0.000563	0.000283	0.139045	3, 28
Treatments vs CS 136 West Bear Con						

Reviewed by: MLV

Hyalella azteca 28d Survival and Growth Test-28-Day Biomass

Start Date:	10/19/2016	Test ID:	2386ha16	Sample ID:	Mud Lake West
End Date:	11/17/2016	Lab ID:	-GREAT LAKES ENVIRONMENT/	Sample Type:	-WHOLE SEDIMENT
Sample Da		Protocol:	EPA 600/R-99/064	Test Species:	HA-Hyalella azteca

Comments Bay West Mud Lake West 28 day H azteca survival and growth Oct 2016

Conc-%	1	2	3	4	5	6	7	8
CS 136 West Bear Con	0.1910	0.1760	0.1530	0.1630	0.1690	0.1720	0.1630	0.1490
Water only	0.2590	0.2790	0.3490	0.4580	0.3680	0.3360	0.3300	0.2920
BW16MLW-001 GLC #11080	0.1850	0.1610	0.1880	0.2050	0.1750	0.1620	0.1900	0.1690
BW16MLW-002 GLC #11081	0.1550	0.1560	0.1760	0.1470	0.1630	0.1650	0.1680	0.1560
BW16MLW-003 GLC #11082	0.2050	0.1700	0.1760	0.1460	0.1660	0.2180	0.1470	0.1760

			Transform: Untransformed						1-Tailed	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD
CS 136 West Bear Con	0.1670	0.5002	0.1670	0.1490	0.1910	7.963	8	*		
Water only	0.3339	1.0000	0.3339	0.2590	0.4580	18.667	8			
BW16MLW-001 GLC #11080	0.1794	0.5373	0.1794	0.1610	0.2050	8.538	8			
BW16MLW-002 GLC #11081	0.1608	0.4815	0.1608	0.1470	0.1760	5.641	8	1.098	1.761	0.0100
BW16MLW-003 GLC #11082	0.1755	0.5256	0.1755	0.1460	0.2180	14.415	8			

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.968909	0.887	0.40084	0.230652
F-Test indicates equal variances (p = 0.33)	2.151173	4.994909		
The control means are significantly different (p = 3.32E-06)	7.406371	2.144787		

Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates no significant differences Treatments vs CS 136 West Bear Con	0.010023	0.060018	0.000156	0.00013	0.29061	1, 14

Reviewed by: MW

Appendix E
Lumbriculus variegatus
4-Day Bench Sheets

- Survival

GLEC
Great Lakes Environmental Center

2386-00
Bay West
Lumbriculus variegatus 4-Day Screening Survival Test

Page 4 of 4
QC'd by: M.

Project Number: 2386-00	Project Name: **Bay West**	Test Method-Manual:	**EPA 100.3-EPA/600/R-99/064**
GLC#	**CS#136**	Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID:	**West Bearskin Lake**	Test System: **Sediment-100 mL and Overlying Water-175mL Manual**	
Test Species:	***Lumbriculus variegatus***	Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/13/2016**	Test Organism Source/Age:	**DBA Cali. Blackworm Co. 10/13/2016 /Adults**
Test Initiation Date:	**10/14/2016**	Test Termination Date:	**10/18/2016**

Test Day: **Day 4**
Date: **10/18/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒ 0734 M. chemistries time/Initial

Number Daily Renewals: 1
☒ 0600 M. renewal time/Initials ☐ — renewal
☐ — renewal time/Initials ☐ — renewal
Food: **None**
Screens Cleaned: ☐ **yes** ☒ **no** ☐ **n/a**

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N) M.	Observations
Record Meter ID	40	~~236~~ 203 M. 10/18/16	236	236	N/A	203	4	**Init:** MW
1	22.5	7.35	6.6	302	128	88	0.16 J.	10
2	22.6	7.46	6.6	295	end: 3.6	end: 4.9		10
3					start: 0.4	start: 0.5		10
4					Titrant used (mL): 3.2	Titrant used (mL): 4.4		10
					Sample volume (mL): 25	Sample volume (mL): 50		

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 4 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible
WC : Overlying water visibly clear

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2386-00
Bay West
Lumbriculus variegatus 4-Day Screening Survival Test

Page 4 of 4
QC'd by: M.

Project Number: **2386-00**	Project Name: **Bay West**	Test Method-Manual:	**EPA 100.3-EPA/600/R-99/064**
GLC#	**11080**	Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID:	**BW16MLW-001-0.0-0.15**	Test System: **Sediment-100 mL and Overlying Water-175mL Manual**	
Test Species:	***Lumbriculus variegatus***	Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/13/2016**	Test Organism Source/Age:	**DBA Cali. Blackworm Co. 10/13/2016 /Adults**
Test Initiation Date:	**10/14/2016**	Test Termination Date:	**10/18/2016**

Test Day: **Day 4**

Date: **10/18/2016**

Overlying Water: **Dechlor**

Overlying Water Batch ID (GLC Number): **NA**

☒ 0730 M. chemistries time/Initial

Number Daily Renewals: 1

☒ 0800 M. renewal time/Initials ☐ — renewal

☐ — renewal time/Initials ☐ — renewal

Food: **None**

Screens Cleaned: ☐ **yes** ☑ **no** ☐ **n/a**

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (μmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N) M.	Observations
Record Meter ID	40	203	236	236	N/A	203	4	**Init:** MW
1	22.8	7.62	6.2	309	136	100	0.07 J.	10
2	22.8	7.62	6.2	309	end: 7.0	end: 9.9		9
3					start: 3.6	start: 4.9		10
4					Titrant used (mL): 3.4	Titrant used (mL): 5.0		10
					Sample volume (mL): 25	Sample volume (mL): 50		

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 4 replicates.

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible
WC: Overlying water visibly clear

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2386-00
Bay West
Lumbriculus variegatus 4-Day Screening Survival Test

Page 4 of 4
QC'd by: mn

Project Number: **2386-00** Project Name: **Bay West**
GLC# **11081**
Sample ID: **BW16MLW-002-0.0-0.15**
Test Species: ***Lumbriculus variegatus***
Date Addition of Sediment: **10/13/2016**
Test Initiation Date: **10/14/2016**

Test Method-Manual: **EPA 100.3-EPA/600/R-99/064**
Test Photoperiod: **16:8** Lux: **100-1000**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **DBA Cali. Blackworm Co. 10/13/2016 /Adults**
Test Termination Date: **10/18/2016**

Test Day: **Day 4**
Date: **10/18/2016**
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
☒0734 m chemistries time/Initial

Number Daily Renewals: 1
☒1000 m renewal time/Initials ☐ — renewal
☐ — renewal time/Initials ☐ — renewal
Food: **None**
Screens Cleaned: ☐ **yes** ☑ **no** ☐ **n/a**

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N) m	Observations
Record Meter ID	40	203	236	236	N/A	203	4	**Init:** mw
1	22.3	7.66	6.0	304	136	100	0.02J	9
2	22.5	7.65	6.2	307	end: 10.4	end: 14.9		10
3					start: 7.0	start: 9.9		10
4					Titrant used (mL): 3.4	Titrant used (mL): 5.0		10
					Sample volume (mL): 25	Sample volume (mL): 50		

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 4 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible
WC : Overlying water visibly clear

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2386-00
Bay West
Lumbriculus variegatus 4-Day Screening Survival Test

Page 4 of 4
QC'd by: M

Project Number: **2386-00** Project Name: **Bay West**
GLC# **11082**
Sample ID: BW16MLW-003-0.0-0.15
Test Species: *Lumbriculus variegatus*
Date Addition of Sediment: 10/13/2016
Test Initiation Date: 10/14/2016

Test Method-Manual: **EPA 100.3-EPA/600/R-99/064**
Test Photoperiod: **16:8** Lux: **100-1000**
Test System: Sediment-100 mL and Overlying Water-175mL Manual
Test Temperature: 23± 1°C
Test Organism Source/Age: DBA Cali. Blackworm Co. 10/13/2016 /Adults
Test Termination Date: **10/18/2016**

Test Day: **Day 4**
Date: 10/18/2016
Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
K0734MW. chemistries time/Initial

Number Daily Renewals: 1
K0800M. renewal time/Initials ☐ — renewal
☐ — renewal time/Initials ☐ — renewal
Food: **None**
Screens Cleaned: ☐ **yes** ☑ **no** ☐ **n/a**

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)		Alkalinity (mg/L $CaCO_3$)		Ammonia (as N) M.	Observations
Record Meter ID	40	203	236	236	N/A		203		4	Init: MW
1	22.7	7.64	5.4	316	Dup. 144	132	Dup. 100	98	0.15 J	8
2	22.7	7.68	5.3	312	17.3 end:	13.7	24.8 end:	19.8	0.15 J.	10
3					13.7 start:	10.4	19.8 start:	14.9		10
4					Titrant 3.6 used (mL):	3.3	Titrant 5.0 used (mL):	4.9		10
					Sample 25 volume (mL):	25	Sample 50 volume (mL):	50		

Relative % Difference: RPD ≤15%

$$RPD = \left| \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \right| \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 4 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible
WC: Overlying water visibly clear

Appendix F
Lumbriculus variegatus

28-Day Depurated Wet Weight

- Weights

Bay West
2386-01
Lumbriculus variegatus 28-Day Survival Test

Page 17 of 18
QC'd by: MW

Project Number:	2386-01	Project Name:	**Bay West**
GLC#:	**CS 136**		
Sample ID:	**Control-West Bearskin Lake**		
Test Species:	*Lumbriculus variegatus*		
Date Addition of Sediment:	**10/24/2016**		
Test Initiation Date:	**10/25/2016**		

Test Method-Manual:	**EPA 100.3-EPA/600/R-99/064**
Test Photoperiod: **16:8**	Lux: **100-1000**
Test System: **Sediment-1.5 L, Overlying Water-1.5 L, Automatic Renewal**	
Test Temperature: **23± 1°C**	
Test Organism Source/Age:	**DBA Cali. Blackworm Co. 10/20/2016 Adults**
Test Termination Date:	**11/22/2016**

Test Day: **28**
Date: **11/22/2016**
X440 chemistries time/Initial
MW

Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
Food: **none**

Replicate	**Temperature** (23± 1°C)*	**pH** 11/22/16	**Dissolved Oxygen** (mg/L)*	**Specific Conductance** (µmhos/cm)	**Flow** (3-7 mL per minute)	**Hardness** (mg/L $CaCO_3$) mr. 11/21/16	**Alkalinity** (mg/L $CaCO_3$)	**Ammonia** (as N)	**Observations/ Depuration Period** Date/Time In Initials	Date/Time Out Initials
Record Meter ID	40	2043	236	236	N/A	N/A	203	4	—	—
1	22.7	8.26	8.3	315	40	128	106	0.48	MW 11/22/16 0640	MW 11/23/16 0500
2	22.7	8.21	8.0	316	4.2	end: 20.1	end: 30.7		11/22/16 0655 DS	MW 11/23/16 0500
3					4.2	start: 16.9	start: 25.4		11/22/16 0825 MLV	MW 11/23/16 0500
4					4.0	Titrant used (mL): 3.2	Titrant used (mL): 5.3		MW 11/22/16 0800	MW 11/23/16 0500
5					4.0	Sample volume (mL): 25	Sample volume (mL): 50		m. 11/22/16 0830	MW 11/23/16 0500

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 5 replicates.

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible
WC : Overlying water visibly clear

MO QC 12/5/16

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2386-01
Bay West
Lumbriculus variegatus 28-Day Survival Test

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Project Number: **2386-01** Project Name: **Bay West**

Test Method-Manual: EPA100.3 EPA/600/R-99/064

GLC#: **CS 136**

Sample ID: **Control-West Bearskin Lake**

Test Species: ***Lumbriculus variegatus***

Date Addition of Sediment: **10/24/2016**

Test Initiation Date: **10/25/2016**

Test Day: **29**

Date: **11/23/2016**

Scale Used: PJ4W

Location: **Freezer #** 169

Replicate	(A) Weight of Jar (grams)	(B) Weight of Jar and *Lumbriculus* (grams)	A-B Weight of Lumbriculus (grams)	Technician Initials	Date/Time In: Initials	Date/Time Out: Initials
1	176.47	196.19	19.72	MWB	MWB 0640 11/22/16	MWB 11/23/16 0500
2	196.09	215.09	19.00	MWB	DS 11/22/16 0655	MWB 11/23/16 0500
3	6.81	26.11	19.30	MWB	MLV 11/22/16 0825	MWB 11/23/16 0500
4	7.53	24.89	17.36	MWB	MWB 11/22/16 0800	MWB 11/23/16 0500
5	7.65	23.64	15.99	MWB	MP 11/22/16 0836	MWB 11/23/16 0500

Bay West
2386-01
Lumbriculus variegatus 28-Day Survival Test

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QC'd by: mw

Project Number: **2386-01** Project Name: **Bay West**
GLC#: **11080**
Sample ID: **BW16MLW-001**
Test Species: *Lumbriculus variegatus*
Date Addition of Sediment: **10/24/2016**
Test Initiation Date: **10/25/2016**

Test Method-Manual: **EPA 100.3-EPA/600/R-99/064**
Test Photoperiod: **16:8** Lux: **100-1000**
Test System: **Sediment-1.5 L, Overlying Water-1.5 L, Automatic Renewal**
Test Temperature: **23± 1°C**
Test Organism Source/Age: **DBA Cali. Blackworm Co. 10/20/2016 Adults**
Test Termination Date: **11/22/2016**

Test Day: **28**
Date: **11/22/2016**
~~X~~ 440 mw chemistries time/Initial

Overlying Water: **Dechlor**
Overlying Water Batch ID (GLC Number): **NA**
Food: **none**

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Flow (3-7 mL per minute)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ Depuration Period Date/Time In Initials	Observations/ Depuration Period Date/Time Out Initials
						m 11/21/16				
Record Meter ID	40	203	236	236	N/A	N/A	203	4	—	—
1	22.6	8.16	8.2	317	4.0	136	102	0.52	11/22/16 1027 NS	11/23/16 0830 mw
2	22.6	8.14	8.2	316	4.2	end: 235	end: 35.8		11/22/16 957 LS	11/23/16 0830 mw
3					3.8	start: 20.1	start: 30.7		11/22/16 1020 DS	11/23/16 0830 mw
4					3.8	Titrant used (mL): 3.4	Titrant used (mL): 5.1		mw 1030 11/22/16	11/23/16 0830 mw
5					3.8	Sample volume (mL): 25	Sample volume (mL): 50		MGM 1208 11/22/16	11/23/16 1000 mw

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 5 replicates.

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible
WC: Overlying water visibly clear

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2386-01
Bay West
Lumbriculus variegatus 28-Day Survival Test

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Project Number:	**2386-01**	Project Name:	**Bay West**
GLC#:	**11080**		
Sample ID:	**BW16MLW-001**		
Test Species:	***Lumbriculus variegatus***		
Date Addition of Sediment:	**10/24/2016**		
Test Initiation Date:	**10/25/2016**		

Test Method-Manual: EPA 100.3
EPA/600/R-99/064

Test Day:	**29**
Date:	**11/23/2016**
Scale Used:	DJ400
Location: **Freezer #**	169

Replicate	(A) Weight of Jar (grams)	(B) Weight of Jar and *Lumbriculus* (grams)	A-B Weight of Lumbriculus (grams)	Technician Initials	Date/Time In: Initials	Date/Time Out: Initials
1	6.82	24.11	17.29	MW	11/22/16 1027 NS	11/23/16 0830 MW
2	7.40	21.62	14.22	MW	11/22/16 957 KS	11/23/16 0830 MW
3	7.53	22.81	15.28	MW	11/22/16 1020 DS	11/23/16 0830 MW
4	7.45	22.54	15.09	MW	11/22/16 1030 MW	11/23/16 0830 MW
5	6.85	20.37	13.52	MW	11/22/16 1208 MGM	11/23/16 1000 MW

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Bay West
2386-01
Lumbriculus variegatus 28-Day Survival Test

Page 17 of 18
QC'd by: mw

Project Number: 2386-01	Project Name: Bay West	Test Method-Manual:	EPA 100.3-EPA/600/R-99/064
GLC#:	11081	Test Photoperiod: 16:8	Lux: 100-1000
Sample ID:	BW16MLW-002	Test System: Sediment-1.5 L, Overlying Water-1.5 L, Automatic Renewal	
Test Species:	*Lumbriculus variegatus*	Test Temperature: 23± 1°C	
Date Addition of Sediment:	10/24/2016	Test Organism Source/Age:	DBA Cali. Blackworm Co. 10/20/2016 Adults
Test Initiation Date:	10/25/2016	Test Termination Date:	11/22/2016

Test Day: 28
Date: 11/22/2016
☒ 440 mw chemistries time/Initial

Overlying Water: Dechlor
Overlying Water Batch ID (GLC Number): NA
Food: none

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Flow (3-7 mL per minute)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$) mn. 11/21/16	Ammonia (as N)	Observations/ Depuration Period	
									Date/Time In Initials	Date/Time Out Initials
Record Meter ID	40	203	236	236	N/A	N/A	203	4	—	—
1	22.4	8.14	8.2	316	4.0	140	102	0.61	① ~~11/22/16~~ 11/22/16 ~~1226 mw~~ 1315 mw	11/23/16 1030 mw
2	22.6	8.12	8.2	317	3.8	end: 27.0	end: 40.9		11/22/16 no 1234 mw 11/22/16	11/23/16 1030 mw
3					3.6	start: 23.5	start: 35.8		11/22/16 1359 KJ	11/23/16 1030 mw
4					3.8	Titrant used (mL): 3.5	Titrant used (mL): 5.1		11/22/16 NS 1333	11/23/16 1030 mw
5					4.0	Sample volume (mL): 25	Sample volume (mL): 50		11/22/16 1420 DS	11/23/16 1030 mw

① mp wrote wrong spot.
mw 11/22/16

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 5 replicates.

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. J = ≥ MDL and < RL.

KEY:
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NAV: No Animals Visible
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BHV: Bore Holes Visible
WC: Overlying water visibly clear

2386-01
Bay West
Lumbriculus variegatus 28-Day Survival Test

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Project Number:	2386-01	Project Name:	Bay West
GLC#:	11081		
Sample ID:	BW16MLW-002		
Test Species:	*Lumbriculus variegatus*		
Date Addition of Sediment:	10/24/2016		
Test Initiation Date:	10/25/2016		

Test Method-Manual: EPA 100.3
EPA/600/R-99/064

Test Day:	29
Date:	11/23/2016
Scale Used:	PJ400
Location:	Freezer # 169

Replicate	(A) Weight of Jar (grams)	(B) Weight of Jar and *Lumbriculus* (grams)	A-B Weight of Lumbriculus (grams)	Technician Initials	Date/Time In: Initials	Date/Time Out: Initials
1	6.93	22.55	15.62	mwt	11/22/16 1315 MW	11/23/16 mwt 1030
2	7.13	23.30	16.17	mwt	11/22/16 1236 MP	11/23/16 mwt 1030
3	7.28	21.58	14.30	mwt	11/22/16 KS 1359	11/23/16 1030
4	7.44	23.18	15.74	mwt	11/22/16 NS 1333	11/23/16 1030
5	7.41	23.60	16.19	mwt	11/22/16 DS 1420	11/23/16 1030

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Bay West
2386-01
Lumbriculus variegatus 28-Day Survival Test

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QC'd by: MW

Project Number: 2386-01 Project Name: Bay West
GLC#: 11082
Sample ID: BW16MLW-003
Test Species: *Lumbriculus variegatus*
Date Addition of Sediment: 10/24/2016
Test Initiation Date: 10/25/2016

Test Day: 28
Date: 11/22/2016
X 440 mw chemistries time/Initial

Test Method-Manual: EPA 100.3-EPA/600/R-99/064
Test Photoperiod: 16:8 Lux: 100-1000
Test System: Sediment-1.5 L, Overlying Water-1.5 L, Automatic Renewal
Test Temperature: 23± 1°C
Test Organism Source/Age: DBA Cali. Blackworm Co. 10/20/2016 Adults
Test Termination Date: 11/22/2016

Overlying Water: Dechlor
Overlying Water Batch ID (GLC Number): NA
Food: none

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Flow (3-7 mL per minute)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ Depuration Period Date/Time In Initials	Observations/ Depuration Period Date/Time Out Initials
						mn. 11/21/16				
Record Meter ID	40	203	236	236	N/A	N/A	203	4	—	—
1	22.4	8.12	8.1	320	3.8	132	100	0.71	MW 11/22/16 1430	11/23/16 1315 MW
2	22.4	8.13	7.9	320	3.8	end: 30.3	end: 45.9	dup: 0.66	11/22/16 1605 mn	11/23/16 1330 MW
3					3.6	start: 27.0	start: 40.9	RPD=	11/22/16 1636 MLV	11/23/16 1330 MW
4					3.8	Titrant used (mL): 3.3	Titrant used (mL): 5.0	7.3%	NS 11/22/16 1654	11/23/16 1330 MW
5					3.8	Sample volume (mL): 25	Sample volume (mL): 50	—	11/22/16 1700 DS	11/23/16 1330 MW

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 5 replicates.

Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 3/2016.
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible
WC : Overlying water visibly clear

DUPLICATES

	HARDNESS	ALKALINITY
	132	100
END.	33.6	50.0 + 1.0
START	30.3	45.9 + 0.1
USED.	3.3	4.1 + 0.9 = 5.0

revised: June 2012

MC QC 12/5/16

Great Lakes Environmental Center

2386-01
Bay West
Lumbriculus variegatus 28-Day Survival Test

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Project Number:	2386-01	Project Name:	Bay West
GLC#:	11082		
Sample ID:	BW16MLW-003		
Test Species:	*Lumbriculus variegatus*		
Date Addition of Sediment:		10/24/2016	
Test Initiation Date:		10/25/2016	

Test Method-Manual: EPA 100.3
EPA/600/R-99/064

Test Day:	29
Date:	11/23/2016
Scale Used:	P5400
Location: **Freezer #**	169

Replicate	(A) Weight of Jar (grams)	(B) Weight of Jar and *Lumbriculus* (grams)	A-B Weight of Lumbriculus (grams)	Technician Initials	Date/Time In: Initials	Date/Time Out: Initials
1	6.29	22.92	16.63	mwb	11/22/16 1430 mwb	11/23/16 mwb 1315
2	7.29	21.96	14.67	mwb	11/22/16 1604 MP	11/23/16 mwb 1330
3	7.44	22.87	15.43	mwb	11/22/16 1636 MLV	11/23/16 mwb 1330
4	7.48	22.52	15.04	mwb	11/22/16 NS 1654	11/23/16 mwb 1330
5	7.84	23.47	15.63	mwb	11/22/16 DS 1700	11/22/16 mwb 1330

Appendix G
Lumbriculus variegatus Tissue Analysis

- Analytical Results

Pace Analytical Services, LLC
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

December 12, 2016

Mailee Garton
GLEC
739 Hastings Street
Traverse City, MI 49686

RE: Project: 2386.00 BAY WEST
Pace Project No.: 40142670

Dear Mailee Garton:

Enclosed are the analytical results for sample(s) received by the laboratory on November 29, 2016. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Tod Noltemeyer

Tod Noltemeyer
tod.noltemeyer@pacelabs.com
Project Manager

Enclosures

cc: Dennis McCauley, Great Lakes Environmental Center, Inc.

CERTIFICATIONS

Project:	2386.00 BAY WEST
Pace Project No.:	40142670

Green Bay Certification IDs

1241 Bellevue Street, Green Bay, WI 54302
Florida/NELAP Certification #: E87948
Illinois Certification #: 200050
Kentucky UST Certification #: 82
Louisiana Certification #: 04168
Minnesota Certification #: 055-999-334
New York Certification #: 12064
North Dakota Certification #: R-150
Virginia VELAP ID: 460263
South Carolina Certification #: 83006001
Texas Certification #: T104704529-14-1
Wisconsin Certification #: 405132750
Wisconsin DATCP Certification #: 105-444
USDA Soil Permit #: P330-16-00157
Federal Fish & Wildlife Permit #: LE51774A-0

Pace Analytical Services, LLC
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

SAMPLE SUMMARY

Project: 2386.00 BAY WEST
Pace Project No.: 40142670

Lab ID	Sample ID	Matrix	Date Collected	Date Received
40142670001	**BACKGROUND DAY 0 10/25/16**	Tissue	11/23/16 13:30	11/29/16 10:05
40142670002	**CS 136 (CONTROL WEST BEAR SKIN**	Tissue	11/23/16 13:30	11/29/16 10:05
40142670003	**11080 (BW16MLW-001)**	Tissue	11/23/16 13:30	11/29/16 10:05
40142670004	**11081 (BW16MLW-002)**	Tissue	11/23/16 13:30	11/29/16 10:05
40142670005	**11082 (BW16MLW-003)**	Tissue	11/23/16 13:30	11/29/16 10:05

Pace Analytical Services, LLC
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

SAMPLE ANALYTE COUNT

Project: 2386.00 BAY WEST
Pace Project No.: 40142670

Lab ID	Sample ID	Method	Analysts	Analytes Reported
40142670001	**BACKGROUND DAY 0 10/25/16**	EPA 6020	DS1	2
40142670002	**CS 136 (CONTROL WEST BEAR SKIN**	EPA 6020	DS1	2
40142670003	**11080 (BW16MLW-001)**	EPA 6020	DS1	2
40142670004	**11081 (BW16MLW-002)**	EPA 6020	DS1	2
40142670005	**11082 (BW16MLW-003)**	EPA 6020	DS1	2

PROJECT NARRATIVE

Project: 2386.00 BAY WEST
Pace Project No.: 40142670

Method: **EPA 6020**
Description: 6020 MET ICPMS
Client: Great Lakes Environmental Center
Date: December 12, 2016

General Information:
5 samples were analyzed for EPA 6020. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 3050B with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

ANALYTICAL RESULTS

Project:	2386.00 BAY WEST
Pace Project No.:	40142670

Sample: BACKGROUND DAY 0 10/25/16 **Lab ID: 40142670001** Collected: 11/23/16 13:30 Received: 11/29/16 10:05 Matrix: Tissue

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020 Preparation Method: EPA 3050B								
Nickel	**1.0**	mg/kg	0.099	0.030	1	12/07/16 10:53	12/08/16 20:10	7440-02-0	
Zinc	**21.4**	mg/kg	2.0	0.64	1	12/07/16 10:53	12/08/16 20:10	7440-66-6	

ANALYTICAL RESULTS

Project: 2386.00 BAY WEST
Pace Project No.: 40142670

Sample: CS 136 (CONTROL WEST BEAR SKIN **Lab ID: 40142670002** Collected: 11/23/16 13:30 Received: 11/29/16 10:05 Matrix: Tissue

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020 Preparation Method: EPA 3050B								
Nickel	**1.1**	mg/kg	0.094	0.028	1	12/07/16 10:53	12/08/16 20:37	7440-02-0	
Zinc	**18.2**	mg/kg	1.9	0.61	1	12/07/16 10:53	12/08/16 20:37	7440-66-6	

ANALYTICAL RESULTS

Project: 2386.00 BAY WEST
Pace Project No.: 40142670

Sample: 11080 (BW16MLW-001) **Lab ID: 40142670003** Collected: 11/23/16 13:30 Received: 11/29/16 10:05 Matrix: Tissue

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020 Preparation Method: EPA 3050B								
Nickel	**0.72**	mg/kg	0.088	0.026	1	12/07/16 10:53	12/08/16 21:04	7440-02-0	
Zinc	**18.0**	mg/kg	1.8	0.56	1	12/07/16 10:53	12/08/16 21:04	7440-66-6	

ANALYTICAL RESULTS

Project: 2386.00 BAY WEST
Pace Project No.: 40142670

Sample: 11081 (BW16MLW-002) **Lab ID: 40142670004** Collected: 11/23/16 13:30 Received: 11/29/16 10:05 Matrix: Tissue

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020 Preparation Method: EPA 3050B								
Nickel	**2.1**	mg/kg	0.089	0.027	1	12/07/16 10:53	12/08/16 21:10	7440-02-0	
Zinc	**17.0**	mg/kg	1.8	0.57	1	12/07/16 10:53	12/08/16 21:10	7440-66-6	

ANALYTICAL RESULTS

Project: 2386.00 BAY WEST
Pace Project No.: 40142670

Sample: 11082 (BW16MLW-003) **Lab ID: 40142670005** Collected: 11/23/16 13:30 Received: 11/29/16 10:05 Matrix: Tissue

Results reported on a "wet-weight" basis

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS	Analytical Method: EPA 6020 Preparation Method: EPA 3050B								
Nickel	**0.46**	mg/kg	0.098	0.029	1	12/07/16 10:53	12/08/16 21:17	7440-02-0	
Zinc	**21.3**	mg/kg	2.0	0.63	1	12/07/16 10:53	12/08/16 21:17	7440-66-6	

Pace Analytical Services, LLC
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

QUALITY CONTROL DATA

Project: 2386.00 BAY WEST
Pace Project No.: 40142670

QC Batch: 243498 Analysis Method: EPA 6020
QC Batch Method: EPA 3050B Analysis Description: 6020 MET TISSUE
Associated Lab Samples: 40142670001, 40142670002, 40142670003, 40142670004, 40142670005

METHOD BLANK: 1442087 Matrix: Tissue
Associated Lab Samples: 40142670001, 40142670002, 40142670003, 40142670004, 40142670005

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Nickel	mg/kg	<0.030	0.10	0.030	12/08/16 19:36	
Zinc	mg/kg	<0.64	2.0	0.64	12/08/16 19:36	

LABORATORY CONTROL SAMPLE: 1442088

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nickel	mg/kg	20	19.6	98	80-120	
Zinc	mg/kg	20	20.5	102	80-120	

LABORATORY CONTROL SAMPLE: 1442090

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nickel	mg/kg	5.3	4.8	90	76-120	
Zinc	mg/kg	136	148	109	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1442091 1442092

Parameter	Units	40142670001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nickel	mg/kg	1.0	20	19.9	21.1	21.4	101	102	75-125	1	20	
Zinc	mg/kg	21.4	20	19.9	44.1	46.2	113	124	75-125	5	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project: 2386.00 BAY WEST
Pace Project No.: 40142670

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 2386.00 BAY WEST
Pace Project No.: 40142670

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
40142670001	**BACKGROUND DAY 0 10/25/16**	EPA 3050B	243498	EPA 6020	243560
40142670002	**CS 136 (CONTROL WEST BEAR SKIN**	EPA 3050B	243498	EPA 6020	243560
40142670003	**11080 (BW16MLW-001)**	EPA 3050B	243498	EPA 6020	243560
40142670004	**11081 (BW16MLW-002)**	EPA 3050B	243498	EPA 6020	243560
40142670005	**11082 (BW16MLW-003)**	EPA 3050B	243498	EPA 6020	243560

(Please Print Clearly)

Company Name: GLEC
Branch/Location: Traverse City MI
Project Contact: Mailee Garton
Phone: 231-941-2230
Project Number: 2386-00
Project Name: Bay West
Project State: MN
Sampled By (Print): Mailee Garton
Sampled By (Sign): Mailee W Garton
PO #:
Regulatory Program:

Pace Analytical®
www.pacelabs.com

CHAIN OF CUSTODY

UPPER MIDWEST REGION
MN: 612-607-1700 **WI:** 920-469-2436

Page 1 of 1

40142670

*Preservation Codes
A=None B=HCL C=H2SO4 D=HNO3 E=DI Water F=Methanol G=NaOH
H=Sodium Bisulfate Solution I=Sodium Thiosulfate J=Other

Quote #:	email: 9/12/16 Nickel/Zinc $50.
Mail To Contact:	Mailee Garton
Mail To Company:	GLEC
Mail To Address:	739 Hastings St. Traverse City MI 49686
Invoice To Contact:	Mailee Garton
Invoice To Company:	GLEC
Invoice To Address:	739 Hastings Street Traverse City, MI 49686
Invoice To Phone:	231-941-2230

Data Package Options (billable)
☐ EPA Level III
☐ EPA Level IV

MS/MSD
☐ On your sample (billable)
☐ NOT needed on your sample

Matrix Codes
A = Air W = Water
B = Biota DW = Drinking Water
C = Charcoal GW = Ground Water
O = Oil SW = Surface Water
S = Soil WW = Waste Water
Sl = Sludge WP = Wipe

					Analyses Requested	Zinc SW-846-6020A	Nickel SW 846-6020A	CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)	Profile #
				FILTERED? (YES/NO)	Y/N	N	N			
				PRESERVATION (CODE)*	Pick Letter	J	J			
PACE LAB #	**CLIENT FIELD ID**	**COLLECTION DATE**	**COLLECTION TIME**	**MATRIX**						
001	Background day Ø 10/25/16	11/23/16	1330	Tissue		X	X	method zinc SW-846-6020A	1-40mLv A	
002	CS136 (Control West Bear Skin	11/23/16	1330			X	X	method Nickel SW-846-6020A	1-~~4~~ 2ozcg A kf 11/29/16	
003	11080 (BW16MLW-001)	11/23/16	1330			X	X	Need results by 12/12/16 please		
004	11081 (BW16MLW-002)	11/23/16	1330			X	X			
005	11082 (BW16MLW-003)	11/23/16	1330	Tissue		X	X		kf 11/29/16	

Rush Turnaround Time Requested - Prelims
(Rush TAT subject to approval/surcharge)
Date Needed: 12/12/2016

Transmit Prelim Rush Results by (complete what you want):
Email #1: mgarton@glec.com
Email #2:
Telephone: 231-941-2230
Fax: 231-941-2240

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
Mailee W. Garton	11/28/16 14:00		
FedEx	11/29/16 1005	Katie Schram Pace	11/29/16 1005

PACE Project No. 40142670

Receipt Temp = 0.5 °C

Sample Receipt pH
OK / Adjusted

Cooler Custody Seal
[✓ Present] / Not Present
[✓ Intact] / Not Intact

C019a(27Jun2006)

Version 6.0 06/14/06

ORIGINAL

Pace Analytical™

Sample Condition Upon Receipt

Pace Analytical Services, Inc.
1241 Bellevue Street, Suite 9
Green Bay, WI 54302

Project #

WO# : 40142670

40142670

Client Name: GLEC

Courier: ☑ Fed Ex ☐ UPS ☐ Client ☐ Pace Other:

Tracking #: 980253186282

Custody Seal on Cooler/Box Present: ☑ yes ☐ no Seals intact: ☑ yes ☐ no

Custody Seal on Samples Present: ☐ yes ☑ no Seals intact: ☐ yes ☐ no

Packing Material: ☐ Bubble Wrap ☑ Bubble Bags ☐ None ☐ Other

Thermometer Used SR-53 **Type of Ice:** [✓ Wet] Blue Dry None ☑ Samples on ice, cooling process has begun

Cooler Temperature Uncorr: 0.5 /Corr: 0.5 **Biological Tissue is Frozen:** ☐ yes ☑ no

Temp Blank Present: ☑ yes ☐ no

Temp should be above freezing to 6°C for all sample except Biota.
Frozen Biota Samples should be received ≤ 0°C.

Person examining contents:
Date: 11/29/16
Initials: KF

				Comments:
Chain of Custody Present:	☑Yes	☐No	☐N/A	1.
Chain of Custody Filled Out:	☑Yes	☐No	☐N/A	2.
Chain of Custody Relinquished:	☑Yes	☐No	☐N/A	3.
Sampler Name & Signature on COC:	☑Yes	☐No	☐N/A	4.
Samples Arrived within Hold Time:	☑Yes	☐No	☐N/A	5.
- VOA Samples frozen upon receipt	☐Yes	☐No		Date/Time:
Short Hold Time Analysis (<72hr):	☐Yes	☑No	☐N/A	6.
Rush Turn Around Time Requested:	☐Yes	☑No	☐N/A	7. 12/12 KF 11/29/16
Sufficient Volume:	☑Yes	☐No	☐N/A	8.
Correct Containers Used:	☑Yes	☐No	☐N/A	9.
-Pace Containers Used:	☑Yes	☐No	☐N/A	
-Pace IR Containers Used:	☐Yes	☐No	☑N/A	
Containers Intact:	☑Yes	☐No	☐N/A	10.
Filtered volume received for Dissolved tests	☐Yes	☐No	☑N/A	11.
Sample Labels match COC:	☑Yes	☐No	☐N/A	12. matrix is worms
-Includes date/time/ID/Analysis Matrix: B				KF 11/29/16
All containers needing preservation have been checked. (Non-Compliance noted in 13.)	☐Yes	☐No	☑N/A	13. ☐ HNO3 ☐ H2SO4 ☐ NaOH ☐ NaOH +ZnAct
All containers needing preservation are found to be in compliance with EPA recommendation. (HNO3, H2SO4 ≤2; NaOH+ZnAct ≥9, NaOH ≥12)	☐Yes	☐No	☑N/A	
exceptions: VOA, coliform, TOC, TOX, TOH, O&G, WIDROW, Phenolics, OTHER:	☐Yes	☑No		Initial when completed / Lab Std #ID of preservative / Date/ Time:
Headspace in VOA Vials (>6mm):	☐Yes	☐No	☑N/A	14.
Trip Blank Present:	☐Yes	☐No	☑N/A	15.
Trip Blank Custody Seals Present	☐Yes	☐No	☑N/A	
Pace Trip Blank Lot # (if purchased):				

Client Notification/ Resolution: If checked, see attached form for additional comments ☐

Person Contacted: Date/Time:

Comments/ Resolution:

Project Manager Review: **Date:** 11-29-16

F-GB-C-031-Rev.03 (9April2015) SCUR Form

Appendix H
Sediment Sample Chemistry Analysis

- Analytical Results

Pace Analytical Services, LLC
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

December 13, 2016

Mailee Garton
GLEC
739 Hastings Street
Traverse City, MI 49686

RE: Project: 2386-00 BAY WEST
Pace Project No.: 40140160

Dear Mailee Garton:

Enclosed are the analytical results for sample(s) received by the laboratory on October 14, 2016. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

Some analyses have been subcontracted outside of the Pace Network. The subcontracted laboratory report has been attached.

TOC Analysis subcontracted to Keystone Laboratories.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Christopher Hyska

Christopher Hyska for
Tod Noltemeyer
tod.noltemeyer@pacelabs.com
Project Manager

Enclosures

cc: Dennis McCauley, Great Lakes Environmental Center, Inc.

REPORT OF LABORATORY ANALYSIS

CERTIFICATIONS

Project: 2386-00 BAY WEST
Pace Project No.: 40140160

Green Bay Certification IDs

1241 Bellevue Street, Green Bay, WI 54302
Florida/NELAP Certification #: E87948
Illinois Certification #: 200050
Kentucky UST Certification #: 82
Louisiana Certification #: 04168
Minnesota Certification #: 055-999-334
New York Certification #: 12064
North Dakota Certification #: R-150
Virginia VELAP ID: 460263
South Carolina Certification #: 83006001
Texas Certification #: T104704529-14-1
Wisconsin Certification #: 405132750
Wisconsin DATCP Certification #: 105-444
USDA Soil Permit #: P330-16-00157
Federal Fish & Wildlife Permit #: LE51774A-0

SAMPLE SUMMARY

Project: 2386-00 BAY WEST
Pace Project No.: 40140160

Lab ID	Sample ID	Matrix	Date Collected	Date Received
40140160001	**CS136 WEST BEAR SKIN**	Solid	10/13/16 10:00	10/14/16 09:05
40140160002	**BW16MLW001-0.0-0.15**	Solid	10/13/16 10:30	10/14/16 09:05
40140160003	**BW16MLW002-0.0-0.15**	Solid	10/13/16 11:00	10/14/16 09:05
40140160004	**BW16MLW003-0.0-0.15**	Solid	10/13/16 11:30	10/14/16 09:05

SAMPLE ANALYTE COUNT

Project: 2386-00 BAY WEST
Pace Project No.: 40140160

Lab ID	Sample ID	Method	Analysts	Analytes Reported
40140160001	**CS136 WEST BEAR SKIN**	ASTM D2974-87	BTH	1
40140160002	**BW16MLW001-0.0-0.15**	ASTM D2974-87	BTH	1
40140160003	**BW16MLW002-0.0-0.15**	ASTM D2974-87	BTH	1
40140160004	**BW16MLW003-0.0-0.15**	ASTM D2974-87	BTH	1

PROJECT NARRATIVE

Project:
Pace Project No.:

Method:
Description:
Client:
Date:

This data package has been reviewed for quality and completeness and is approved for release.

Pace Analytical Services, LLC
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

ANALYTICAL RESULTS

Project: 2386-00 BAY WEST
Pace Project No.: 40140160

Sample: CS136 WEST BEAR SKIN **Lab ID: 40140160001** Collected: 10/13/16 10:00 Received: 10/14/16 09:05 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**86.6**	%	0.10	0.10	1		10/14/16 18:02		

REPORT OF LABORATORY ANALYSIS

ANALYTICAL RESULTS

Project: 2386-00 BAY WEST
Pace Project No.: 40140160

Sample: BW16MLW001-0.0-0.15 **Lab ID: 40140160002** Collected: 10/13/16 10:30 Received: 10/14/16 09:05 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**84.8**	%	0.10	0.10	1		10/14/16 18:02		

REPORT OF LABORATORY ANALYSIS

ANALYTICAL RESULTS

Project: 2386-00 BAY WEST
Pace Project No.: 40140160

Sample: BW16MLW002-0.0-0.15 **Lab ID: 40140160003** Collected: 10/13/16 11:00 Received: 10/14/16 09:05 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**79.9**	%	0.10	0.10	1		10/14/16 18:02		

ANALYTICAL RESULTS

Project: 2386-00 BAY WEST
Pace Project No.: 40140160

Sample: BW16MLW003-0.0-0.15 **Lab ID: 40140160004** Collected: 10/13/16 11:30 Received: 10/14/16 09:05 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Percent Moisture	Analytical Method: ASTM D2974-87								
Percent Moisture	**87.7**	%	0.10	0.10	1		10/14/16 18:03		

REPORT OF LABORATORY ANALYSIS

QUALITY CONTROL DATA

Project: 2386-00 BAY WEST
Pace Project No.: 40140160

QC Batch: 238213
Analysis Method: ASTM D2974-87
QC Batch Method: ASTM D2974-87
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 40140160001, 40140160002, 40140160003, 40140160004

SAMPLE DUPLICATE: 1411462

Parameter	Units	40140097001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	8.7	8.7	1	10	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	2386-00 BAY WEST
Pace Project No.:	40140160

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 2386-00 BAY WEST
Pace Project No.: 40140160

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
40140160001	**CS136 WEST BEAR SKIN**	ASTM D2974-87	238213		
40140160002	**BW16MLW001-0.0-0.15**	ASTM D2974-87	238213		
40140160003	**BW16MLW002-0.0-0.15**	ASTM D2974-87	238213		
40140160004	**BW16MLW003-0.0-0.15**	ASTM D2974-87	238213		

(Please Print Clearly)

Company Name:	GLEC
Branch/Location:	Traverse City MI
Project Contact:	Mailee Garton
Phone:	231-941-2230
Project Number:	2386-00
Project Name:	Bay West
Project State:	MN
Sampled By (Print):	Mailee Garton
Sampled By (Sign):	Mailee W Garton
PO #:	
Regulatory Program:	

Pace Analytical®
www.pacelabs.com

CHAIN OF CUSTODY

UPPER MIDWEST REGION
MN: 612-607-1700 **WI:** 920-469-2436

Page 1 of 1

40140160

9/12/16

***Preservation Codes**
A=None B=HCL C=H2SO4 D=HNO3 E=DI Water F=Methanol G=NaOH
H=Sodium Bisulfate Solution I=Sodium Thiosulfate J=Other

Quote #:	e-mail $80 + 5 TAT
Mail To Contact:	Mailee Garton
Mail To Company:	GLEC
Mail To Address:	739 Hastings Street T.C. MI 49686
Invoice To Contact:	Mailee Garton
Invoice To Company:	GLEC
Invoice To Address:	739 Hastings Street Traverse City, MI 49686
Invoice To Phone:	231-941-2230

Data Package Options (billable)
☐ EPA Level III
☐ EPA Level IV

MS/MSD
☐ On your sample (billable)
☐ NOT needed on your sample

Matrix Codes

A = Air	W = Water
B = Biota	DW = Drinking Water
C = Charcoal	GW = Ground Water
O = Oil	SW = Surface Water
S = Soil	WW = Waste Water
Sl = Sludge	WP = Wipe

FILTERED? (YES/NO) — Y/N: N
PRESERVATION (CODE)* — Pick Letter: J
Analyses Requested: TOC Quad EPA 9060A

PACE LAB #	CLIENT FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX	TOC Quad EPA 9060A		CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)	Profile #
001	CS136 West Bear skin	10/13/16	10:00	S	✓		TOC analyzed	1-100mlag	
002	BW16MLW001-0.0-0.15	10/13/16	10:30	S	✓	11080 - BW16MLW001 - 0.0-0.15	in Quadurplicate		
003	BW16MLW002-0.0-0.15	10/13/16	11:00	S	✓	11081 - BW16MLW002 - 0.0-0.15	↓		
004	BW16MLW003 0.0-0.15	10/13/16	11:30	S	✓	11082 - BW16MLW003 - 0.0-0.15			
							5 day		
							TAT		
							e-mail 1.5%		

Rush Turnaround Time Requested - Prelims
(Rush TAT subject to approval/surcharge)
Date Needed:

Transmit Prelim Rush Results by (complete what you want):

Email #1:	mgarton@glec.com
Email #2:	
Telephone:	231-941-2230
Fax:	231-941-2240

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
Mailee W Garton	10/13/16 14:00		
Fed Ex	10-14-16 0905	Susan Kluglie Pace	10-14-16 0905

PACE Project No. 40140160

Receipt Temp = 5 °C

Sample Receipt pH
OK / Adjusted

Cooler Custody Seal
Present / ~~Not Present~~
Intact / Not Intact

Version 6.0 06/14/06

C019a(27Jun2006)

Pace Analytical™

Sample Condition Upon Receipt

Pace Analytical Services, Inc.
1241 Bellevue Street, Suite 9
Green Bay, WI 54302

Client Name: GLEC

Project #: **WO#: 40140160**

40140160

Courier: ☒ Fed Ex ☐ UPS ☐ Client ☐ Pace Other:

Tracking #: 980253184912

Custody Seal on Cooler/Box Present: ☒ yes ☐ no Seals intact: ☒ yes ☐ no

Custody Seal on Samples Present: ☐ yes ☒ no Seals intact: ☐ yes ☐ no

Packing Material: ☒ Bubble Wrap ☒ Bubble Bags ☐ None ☐ Other

Thermometer Used SR45 **Type of Ice:** [✓ Wet] Blue Dry None ☒ Samples on ice, cooling process has begun

Cooler Temperature Uncorr: 5 /Corr: 5 **Biological Tissue is Frozen:** ☐ yes ☐ no

Temp Blank Present: ☐ yes ☒ no

Temp should be above freezing to 6°C for all sample except Biota.
Frozen Biota Samples should be received ≤ 0°C.

Person examining contents:
Date: 10-14-16
Initials: SW

				Comments:
Chain of Custody Present:	☒Yes	☐No	☐N/A	1. Original and a copy. 10-14-16
Chain of Custody Filled Out:	☒Yes	☐No	☐N/A	2.
Chain of Custody Relinquished:	☒Yes	☐No	☐N/A	3.
Sampler Name & Signature on COC:	☒Yes	☐No	☐N/A	4.
Samples Arrived within Hold Time:	☒Yes	☐No	☐N/A	5.
- VOA Samples frozen upon receipt	☐Yes	☐No		Date/Time:
Short Hold Time Analysis (<72hr):	☐Yes	☒No	☐N/A	6.
Rush Turn Around Time Requested:	☐Yes	☒No	☐N/A	7. 5 day TAT 10-14-16
Sufficient Volume:	☒Yes	☐No	☐N/A	8.
Correct Containers Used:	☒Yes	☐No	☐N/A	9.
-Pace Containers Used:	☒Yes	☐No	☐N/A	
-Pace IR Containers Used:	☐Yes	☐No	☒N/A	
Containers Intact:	☒Yes	☐No	☐N/A	10.
Filtered volume received for Dissolved tests	☐Yes	☐No	☒N/A	11.
Sample Labels match COC:	☐Yes	☒No	☐N/A	12. 002 thru 004 have 11082 before ID. 10-14-16
-Includes date/time/ID/Analysis Matrix: S				
All containers needing preservation have been checked. (Non-Compliance noted in 13.)	☐Yes	☐No	☒N/A	13. ☐ HNO3 ☐ H2SO4 ☐ NaOH ☐ NaOH +ZnAct
All containers needing preservation are found to be in compliance with EPA recommendation. (HNO3, H2SO4 ≤2; NaOH+ZnAct ≥9, NaOH ≥12)	☐Yes	☐No	☒N/A	
exceptions: VOA, coliform, TOC, TOX, TOH, O&G, WIDROW, Phenolics, OTHER:	☐Yes	☒No		Initial when completed / Lab Std #ID of preservative / Date/ Time:
Headspace in VOA Vials (>6mm):	☐Yes	☐No	☒N/A	14.
Trip Blank Present:	☐Yes	☐No	☒N/A	15.
Trip Blank Custody Seals Present	☐Yes	☐No	☒N/A	
Pace Trip Blank Lot # (if purchased):				

Client Notification/ Resolution:

If checked, see attached form for additional comments ☐

Person Contacted: Date/Time:

Comments/ Resolution:

Project Manager Review: Amt for TN **Date:** 10/14/16

October 21 2016

Tod Noltemeyer
Pace Analytical-WI
1241 Bellevue St, Suite 9
Green Bay, WI 54302

RE: Subcontract - TN
40140160

Enclosed are the results of analyses for samples received by the laboratory on 10/18/16 13:00. If you have any questions concerning this report, please feel free to contact me at 1-800-858-5227.

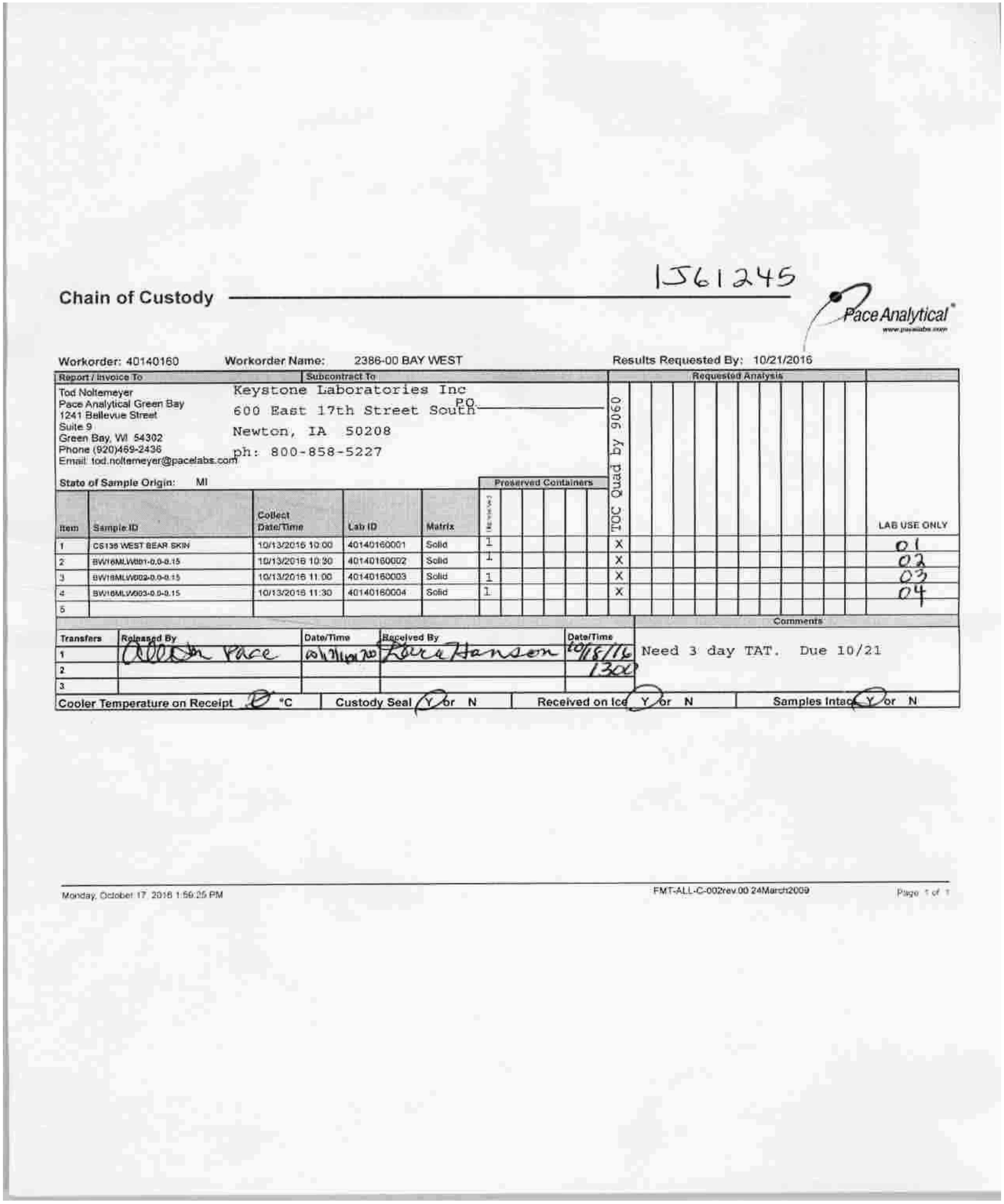
ANALYTICAL REPORT FOR SAMPLES

Client Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
CS136 West Bear Skin	1J61245-01	Soil	10/13/16 10:00	10/18/16 13:00
BW16MLW001-0.0-0.15	1J61245-02	Soil	10/13/16 10:30	10/18/16 13:00
BW16MLW002-0.0-0.15	1J61245-03	Soil	10/13/16 11:00	10/18/16 13:00
BW16MLW003-0.0-0.15	1J61245-04	Soil	10/13/16 11:30	10/18/16 13:00

Client Supplied Containers

The results in this report apply to the samples analyzed in accordance with the Chain-of-Custody record. This report must be reproduced in its entirety.

Pace Analytical-WI 1241 Bellevue St, Suite 9 Green Bay, WI 54302	Project: Subcontract - TN Project Number: 40140160 Project Manager: Tod Noltemeyer	Reported 10/21/16 16:54



Chain of Custody

1561245

Pace Analytical®
www.pacelabs.com

Workorder: 40140160 Workorder Name: 2386-00 BAY WEST Results Requested By: 10/21/2016

Report / Invoice To
Tod Noltemeyer
Pace Analytical Green Bay
1241 Bellevue Street
Suite 9
Green Bay, WI 54302
Phone (920)469-2436
Email: tod.noltemeyer@pacelabs.com

Subcontract To
Keystone Laboratories Inc
600 East 17th Street South
Newton, IA 50208
ph: 800-858-5227

P.O.

State of Sample Origin: MI

Item	Sample ID	Collect Date/Time	Lab ID	Matrix	Preserved Containers	TOC Quad by 9060	LAB USE ONLY
1	CS136 WEST BEAR SKIN	10/13/2016 10:00	40140160001	Solid	1	X	01
2	BW16MLW001-0.0-0.15	10/13/2016 10:30	40140160002	Solid	1	X	02
3	BW16MLW002-0.0-0.15	10/13/2016 11:00	40140160003	Solid	1	X	03
4	BW16MLW003-0.0-0.15	10/13/2016 11:30	40140160004	Solid	1	X	04
5							

Transfers	Released By	Date/Time	Received By	Date/Time
1	[illegible] Pace	10/17/16 700	Lara Hansen	10/18/16 1300
2				
3				

Comments: Need 3 day TAT. Due 10/21

Cooler Temperature on Receipt 0 °C | Custody Seal [✓ Y] or N | Received on Ice [✓ Y] or N | Samples Intact [✓ Y] or N

Monday, October 17, 2016 1:59:25 PM FMT-ALL-C-002rev.00 24March2009 Page 1 of 1

The results in this report apply to the samples analyzed in accordance with the Chain-of-Custody record. This report must be reproduced in its entirety.

Pace Analytical-WI 1241 Bellevue St, Suite 9 Green Bay, WI 54302	Project: Subcontract - TN Project Number: 40140160 Project Manager: Tod Noltemeyer	Reported 10/21/16 16:54

CS136 West Bear Skin

1J61245-01 (Soil)

Date Sampled:10/13/2016 10:00:00AM

Keystone Laboratories, Inc. - Newton

Determination of Conventional Chemistry Parameters

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**86.6**	0.1	%	1	1ZJ0697	10/14/16	10/14/16 18:02	SM 2540 G	A-01
Total Organic Carbon (1 of 4)	**15100**	100	mg/kg dry	"	1ZJ0888	10/21/16	10/21/16 15:47	EPA 9060	
Total Organic Carbon (2 of 4)	**15500**	100	"	"	"	"	"	"	
Total Organic Carbon (3 of 4)	**14500**	100	"	"	"	"	"	"	
Total Organic Carbon (4 of 4)	**14400**	100	"	"	"	"	"	"	
Total Organic Carbon (Mean)	**14900**	100	"	"	"	"	"	"	

Pace Analytical-WI 1241 Bellevue St, Suite 9 Green Bay, WI 54302	Project: Project Number: Project Manager:	Subcontract - TN 40140160 Tod Noltemeyer	Reported 10/21/16 16:54

BW16MLW001-0.0-0.15

1J61245-02 (Soil)

Date Sampled:10/13/2016 10:30:00AM

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Keystone Laboratories, Inc. - Newton									
Determination of Conventional Chemistry Parameters									
% Solids	**84.8**	0.1	%	1	1ZJ0697	10/14/16	10/14/16 18:02	SM 2540 G	A-01
Total Organic Carbon (1 of 4)	**24600**	100	mg/kg dry	"	1ZJ0888	10/21/16	10/21/16 15:47	EPA 9060	
Total Organic Carbon (2 of 4)	**25600**	100	"	"	"	"	"	"	
Total Organic Carbon (3 of 4)	**26300**	100	"	"	"	"	"	"	
Total Organic Carbon (4 of 4)	**27600**	100	"	"	"	"	"	"	
Total Organic Carbon (Mean)	**26100**	100	"	"	"	"	"	"	

The results in this report apply to the samples analyzed in accordance with the Chain-of-Custody record. This report must be reproduced in its entirety.

Pace Analytical-WI 1241 Bellevue St, Suite 9 Green Bay, WI 54302	Project: Subcontract - TN Project Number: 40140160 Project Manager: Tod Noltemeyer	Reported 10/21/16 16:54

BW16MLW002-0.0-0.15

1J61245-03 (Soil)

Date Sampled:10/13/2016 11:00:00AM

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Determination of Conventional Chemistry Parameters									
% Solids	**79.9**	0.1	%	1	1ZJ0697	10/14/16	10/14/16 18:02	SM 2540 G	A-01
Total Organic Carbon (1 of 4)	**24000**	100	mg/kg dry	"	1ZJ0888	10/21/16	10/21/16 15:47	EPA 9060	
Total Organic Carbon (2 of 4)	**24500**	100	"	"	"	"	"	"	
Total Organic Carbon (3 of 4)	**25000**	100	"	"	"	"	"	"	
Total Organic Carbon (4 of 4)	**24300**	100	"	"	"	"	"	"	
Total Organic Carbon (Mean)	**24500**	100	"	"	"	"	"	"	

The results in this report apply to the samples analyzed in accordance with the Chain-of-Custody record. This report must be reproduced in its entirety.

Pace Analytical-WI
1241 Bellevue St, Suite 9
Green Bay, WI 54302

Project: Subcontract - TN
Project Number: 40140160
Project Manager: Tod Noltemeyer

Reported
10/21/16 16:54

BW16MLW003-0.0-0.15

1J61245-04 (Soil)

Date Sampled:10/13/2016 11:30:00AM

Keystone Laboratories, Inc. - Newton

Determination of Conventional Chemistry Parameters

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
% Solids	**87.7**	0.1	%	1	1ZJ0697	10/14/16	10/14/16 18:03	SM 2540 G	A-01
Total Organic Carbon (1 of 4)	**27600**	100	mg/kg dry	"	1ZJ0888	10/21/16	10/21/16 15:47	EPA 9060	
Total Organic Carbon (2 of 4)	**31000**	100	"	"	"	"	"	"	
Total Organic Carbon (3 of 4)	**31400**	100	"	"	"	"	"	"	
Total Organic Carbon (4 of 4)	**30800**	100	"	"	"	"	"	"	
Total Organic Carbon (Mean)	**30200**	100	"	"	"	"	"	"	

The results in this report apply to the samples analyzed in accordance with the Chain-of-Custody record. This report must be reproduced in its entirety.

Pace Analytical-WI	Project: Subcontract - TN	Reported
1241 Bellevue St, Suite 9	Project Number: 40140160	10/21/16 16:54
Green Bay, WI 54302	Project Manager: Tod Noltemeyer	

Determination of Conventional Chemistry Parameters - Quality Control

Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1ZJ0888 - TOC/DOC										
Blank (1ZJ0888-BLK1)				Prepared & Analyzed: 10/21/16						
Total Organic Carbon (1 of 4)	ND	100	mg/kg wet							
Total Organic Carbon (2 of 4)	ND	100	"							
Total Organic Carbon (3 of 4)	ND	100	"							
Total Organic Carbon (4 of 4)	ND	100	"							
Total Organic Carbon (Mean)	ND	100	"							
LCS (1ZJ0888-BS1)				Prepared & Analyzed: 10/21/16						
Total Organic Carbon (1 of 4)	5000		mg/kg wet	3440.00		145	63-146			
LCS Dup (1ZJ0888-BSD1)				Prepared & Analyzed: 10/21/16						
Total Organic Carbon (1 of 4)	4400		mg/kg wet	3440.00		128	63-146	12.8	16	
Duplicate (1ZJ0888-DUP1)	**Source: 1J61245-04**			Prepared & Analyzed: 10/21/16						
Total Organic Carbon (1 of 4)	27820	100	mg/kg dry		27590			0.823	17	
Total Organic Carbon (2 of 4)	30330	100	"		31010			2.23	200	
Total Organic Carbon (3 of 4)	30670	100	"		31360			2.21	200	
Total Organic Carbon (4 of 4)	29760	100	"		30790			3.39	200	
Total Organic Carbon (Mean)	29650	100	"		30220			1.90	200	

Certified Analyses Included in This Report

Method/Matrix	Analyte	Certifications
SM 2540 G in Solid		
	% Solids	SIA1X

Code	Certifying Authority	Certificate Number	Expires
KS-KC	Kansas Department of Health and Environment-KC	E-10110	04/30/2017
KS-NT	Kansas Department of Health and Environment (NELAP	E-10287	10/31/2016
MO-KC	Missouri Department of Natural Resources	140	04/30/2015
SIA1X	Iowa Department of Natural Resources	95	02/01/2017

The results in this report apply to the samples analyzed in accordance with the Chain-of-Custody record. This report must be reproduced in its entirety.

Pace Analytical-WI
1241 Bellevue St, Suite 9
Green Bay, WI 54302

Project: Subcontract - TN
Project Number: 40140160
Project Manager: Tod Noltemeyer

Reported
10/21/16 16:54

Notes and Definitions

A-01	Analysis performed by Pace Analytical Inc. Green Bay Wisconsin.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

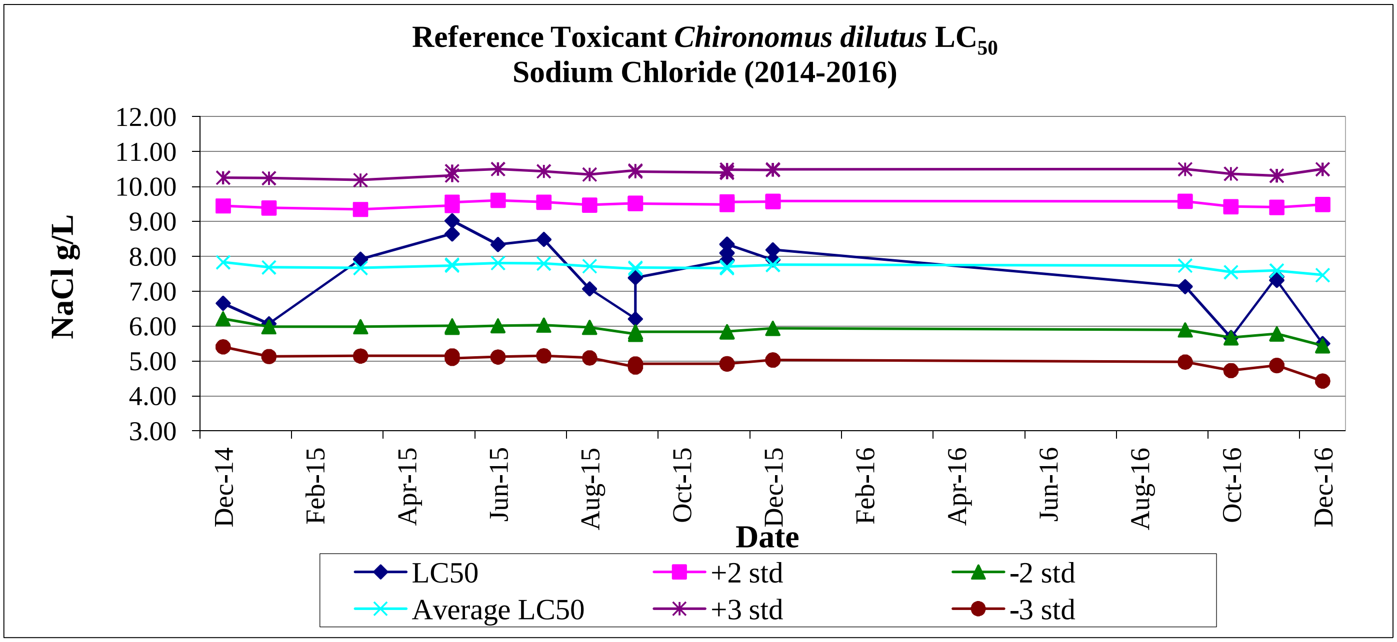
The results in this report apply to the samples analyzed in accordance with the Chain-of-Custody record. This report must be reproduced in its entirety.

Sue Thompson

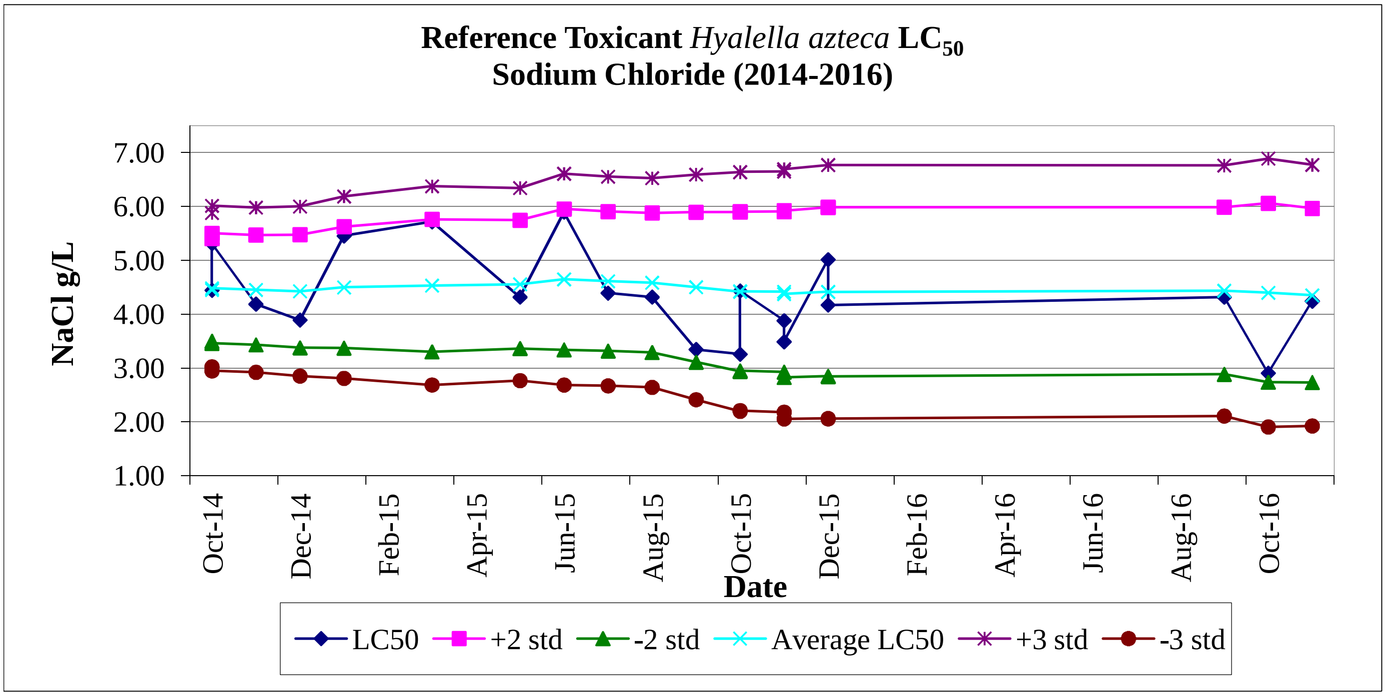
Sue Thompson

Project Manager II

Appendix I
Reference Toxicant Data



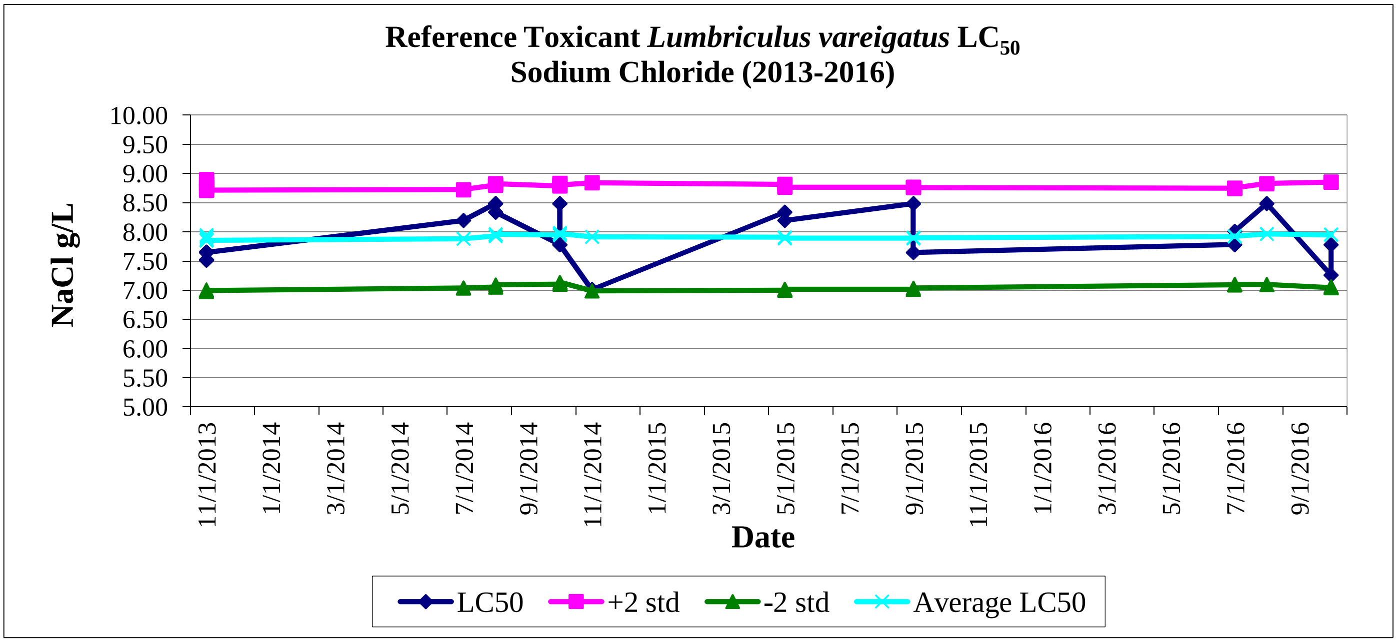
96-Hour Acute Toxicity Data for *Chironomus dilutus*					
Date	**Control Survival (%)**	**LC_{50} (g/L NaCl)**	**Average LC_{50} (g/L NaCl)**	**+2 std**	**-2 std**
September 23, 2016	100.0	7.14	7.74	9.58	5.90
October 14, 2016	100.0	5.67	7.55	9.43	5.67
November 11, 2016	95.0	7.42	7.60	9.41	5.79
November 29, 2016	92.5	7.32	7.59	9.40	5.78
December 2, 2016	95.0	5.50	7.46	9.49	5.44



Reference Toxicant *Hyalella azteca* LC_{50}
Sodium Chloride (2014-2016)

96-Hour Acute Toxicity Data for
Hyalella azteca

Date	Control Survival (%)	LC_{50} (g/L NaCl)	Average LC_{50} (g/L NaCl)	+2 std	-2 std
December 2, 2015	92.5	5.02	4.42	5.99	2.85
December 9, 2015	100.0	4.17	4.41	5.98	2.84
September 27, 2016	100.0	4.32	4.44	5.99	2.88
October 24, 2016	97.5	2.91	4.40	6.06	2.74
November 11, 2016	100.0	4.24	4.35	5.97	2.73



96-Hour Acute Toxicity Data for *Lumbriculus vareigatus*

Date	Control Survival (%)	LC_{50} (g/L NaCl)	Average LC_{50} (g/L NaCl)	+2 std	-2 std
July 8, 2016	100.0	7.781	7.92	8.75	7.09
July 14, 2016	100.0	8.0095	7.93	8.75	7.10
August 3, 2016	100.0	8.4853	7.96	8.83	7.10
October 18, 2016	100.0	7.26	7.95	8.85	7.05
October 24, 2016	100.0	7.78201	7.96	8.85	7.06

Appendix C
Disposal Documentation

VEOLIA
ENVIRONMENTAL SERVICES

WASTESTREAM INFORMATION PROFILE

☐ Recertification

Disposal Code ____

Veolia ES LOCATION ____ ADDRESS ____ CITY ____ ST ____

☐ Invoice Address

☐ Manifest from – blank if direct

Veolia ES TSDF requested ____ Technology requested ____ Generator No. ____ **Generator EPA ID No.** MND982612368

1. **Generator Name** MPCA-Duluth **Generator State No.** ____ ____

Address 525 South Lake Ave, Suite **State Wastestream No.** ____

City Duluth **State** MN **Country** USA **ZIP** 55802

NAICS (SIC) Code ____ ____ ____ **Source** ____ **Origin** ____ **Form** ____ **System Type**

2. **Waste Name** SLR Sediment **Lab or Waste Area** ____

3. **Process Generating Waste** Investigation river sediment sampling

4. **Shipping Name** Non DOT, Non RCRA Hazardous Waste

Hazard Class ____ **UN/NA No.** ____ **PG** ____ **RQ amt** ____ **lb**

RQ Desc: 1. 2.

DOT Desc: 1. 2.

5. **Waste Codes** ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

Wastewater ☐ **Non Wastewater** ☐ **Sub Category** ____

6. **Physical and chemical properties** (*check all that apply*)

pH
- a ☐ < 2
- b ☐ 2 - 5
- c ☒ 5 - 9
- d ☐ 9 - 12.5
- e ☐ > 12.5
- ____ exact

Specific Gravity
- a ☐ < .8
- b ☐ .8 - 1.0
- c ☐ 1.0
- d ☐ 1.0 - 1.2
- e ☒ > 1.2
- ____ exact

Flash Point (F)
- a ☐ < 80
- b ☐ 80 - 100
- c ☐ 101 - 140
- d ☐ 141 - 200
- e ☐ > 200
- f ☒ no flash ____ exact

Solids
- ____ % suspended
- ____ % settleable
- ____ % dissolved

Free Liquid Range 0% to 0% %

- ____ % ash
- ____ water solubility
- ____ BTU/lb

Physical State
- s ☒ solid
- m ☐ semi-solid
- l ☐ liquid
- p ☐ pumpable semi-solid
- f ☐ flowable powder
- g ☐ gas
- a ☐ aerosol
- r ☐ pressurized liquid
- d ☐ debris per 40 CFR 268.45
- h ☐ sharps

Hazardous Characteristics
- a ☐ air reactive
- w ☐ water reactive
- c ☐ cyanide reactive
- f ☐ sulfide reactive
- e ☐ explosive
- o ☐ oxidizing acid
- p ☐ peroxide former
- r ☐ radioactive or NRC regulated
- s ☐ shock sensitive
- t ☐ temp sensitive
- m ☐ polymerization/monomer
- n ☐ OSHA carcinogen
- I ☐ infectious
- h ☐ inhalation hazard Zone: NO

Odor
- a none ☒
- b mild ☐
- c strong ☐
- describe

Halogens
- Br 0 % Bromine
- Cl 0 % Chlorine
- F 0 % Fluorine
- I 0 % Iodine

Layers: a ☐ **multilayered:** b ☐ **bi-layered:** c ☒ **single phase:**

	Top Layer	Second Layer	Bottom Layer
Viscosity by Layer:	☐ high (syrup) ☐ medium (oil) ☐ low (water) ☐ solid	☐ high (syrup) ☐ medium (oil) ☐ low (water) ☐ solid	☐ high (syrup) ☐ medium (oil) ☐ low (water) ☒ solid

Color

Used oil y [✓ n] **HOC <1000 ppm** ☐ **or > 1000 ppm** ☐

WIP No.

7. **Chemical Composition** [**M** = Marine Pollutant, **S** - Severe Marine Pollutant, **O** = Ozone Depleting Substance, **U** = Underlying Hazardous Constituent, **B** = Benzene NESHAP, **T** = TRI Chemical, **C** = **OSHA** Carcinogen]

	Constituents	**Range**	**Units**		**Constituents**	**Range**	**Units**
	River sediment	100	%				

Total Composition Must Equal or Exceed 100%

Other:

8. Is the wastestream being imported into the USA? Yes ☐ No ☒
9. Does the wastestream contain PCBs regulated by 40CFR? Yes ☐ No ☒
   PCB concentration _____ppm
10. Is the wastestream subject to the Marine Pollutant Regulations? Yes ☐ No ☒
11. Is the wastestream subject to Benzene NESHAP? Yes ☐ No ☒
    If yes, is the wastestream subject to Notification and Control Requirements? Yes ☐ No ☒
    Benzene concentration _____ ppm
12. Is the wastestream subject to RCRA subpart CC controls? Yes ☐ No ☒
    Volatile organic concentration, if known _____ ppmw
    CC approved analytical method ☐ Generator Knowledge ☐
13. Is the wastestream from a CERCLA or state mandated cleanup? Yes ☐ No ☒

---

14. **Container Information** (*Identify UN container marking if known*)

Packaging: **Bulk Solid** ☐ Type/Size: _____ **Bulk Liquid** ☐ Type/Size: _____ **Drum** ☒ Type/Size: DM/55 gallon

Other

Shipping Frequency: Units 2 Per Month ☐ Quarter ☐ Year ☐ One Time ☒ Other

---

15. **Additional Information**:

Site:
St. Louis River Reservoirs (SLR)
Duluth, MN 55802

Is analytical or an MSDS available that describes the waste? Yes ☒ No ☐ If yes, please attach.

GENERATOR CERTIFICATION

I hereby certify that all information submitted in this and all attached documents contains true and accurate descriptions of this waste. Any sample submitted is representative as defined in 40 CFR 261 - Appendix I or by using an equivalent method. All relevant information regarding known or suspected hazards in the possession of the generator has been disclosed. I authorize sampling of any waste shipment for purposes of recertification.

Heidi Bauman
NAME (PRINT OR TYPE)

218-302-6607
PHONE

11/29/16
DATE

Heidi Bauman
SIGNATURE

Project Manager
TITLE

FACILITY NOTIFICATION

If approved for management, Veolia ES has all the necessary permits and licenses for the waste that has been characterized and identified by this profile.

TSDF PROCESSING USE ONLY: PPE REQUIRED No _____ Yes _____ Describe ________________

WIP No.

NON-HAZARDOUS WASTE MANIFEST

1\. Generator ID Number: MND981612368

2\. Page 1 of 1

3\. Emergency Response Phone: 3E: 800-451 8346

4\. Waste Tracking Number: BW16132

5\. Generator's Name and Mailing Address:
MPCA-Duluth
525 South Lake Ave, Suite 400
Duluth, MN 55802

Generator's Site Address (if different than mailing address):
SLR AOC
St. Louis River Reservoirs
Duluth MN 55802

Generator's Phone: 218 723 4837

6\. Transporter 1 Company Name: BAY WEST LLC

U.S. EPA ID Number: MND98[illegible]05437

7\. Transporter 2 Company Name: Veolia ES Technical Solutions-NJ

U.S. EPA ID Number: NJD080631369

8\. Designated Facility Name and Site Address:
Veolia ES Technical Solutions-TWD
W124 N9451 Boundary Road
Menomonee Falls WI 53051

Facility's Phone: 800-255-5097

U.S. EPA ID Number: WID003967148

9. Waste Shipping Name and Description	10. Containers No.	Type	11. Total Quantity	12. Unit Wt./Vol.
1. Non DOT, Non RCRA Hazardous Waste,	01 ~~[illegible]~~	DM	250 ~~[illegible]~~	P
2. NON DOT, NON RCRA Hazardous waste	01	VF	250	P
3.				
4.				

13\. Special Handling Instructions and Additional Information:
1) 068821 - SLR Sediment 2.) 068821 - SLR Sediment
Job # J160139 1
ER phone # is contracted by Bay West with 3E (contract# 5567)

14\. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: [illegible] Lundin
Signature:
Month Day Year: 12 [illegible] 16

15\. International Shipments ☐ Import to U.S. ☐ Export from U.S.
Port of entry/exit:
Transporter Signature (for exports only):
Date leaving U.S.:

16\. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: Jim Leisz
Signature:
Month Day Year: 12 13 16

Transporter 2 Printed/Typed Name:
Signature:
Month Day Year:

17\. Discrepancy
17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator)
U.S. EPA ID Number:
Facility's Phone:

17c. Signature of Alternate Facility (or Generator)
Month Day Year

18\. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name: Robert L Kann Jr
Signature:
Month Day Year: 12 28 16

169-BLS-C 6 10497 (Rev. 9/09)

COPY

Appendix D
Laboratory Analytical Reports

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

October 24, 2016

Nancy McDonald
Bay West Inc
5 Empire Drive
Saint Paul, MN 55103

RE: Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Dear Nancy McDonald:

Enclosed are the analytical results for sample(s) received by the laboratory on October 06, 2016. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Lori Castille
lori.castille@pacelabs.com
Project Manager

Enclosures

cc: Paul Raymaker, Bay West
Jeff Smith, Pace Analytical Services, Inc

CERTIFICATIONS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Minnesota Certification IDs

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
525 N 8th Street, Salina, KS 67401
Alaska Certification UST-107
A2LA Certification #: 2926.01
Alaska Certification #: UST-078
Alaska Certification #MN00064
Alabama Certification #40770
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
Colorado Certification #Pace
Connecticut Certification #: PH-0256
EPA Region 8 Certification #: 8TMS-L
Florida/NELAP Certification #: E87605
Guam Certification #:14-008r
Georgia Certification #: 959
Georgia EPD #: Pace
Idaho Certification #: MN00064
Hawaii Certification #MN00064
Illinois Certification #: 200011
Indiana Certification#C-MN-01
Iowa Certification #: 368
Kansas Certification #: E-10167
Kentucky Dept of Envi. Protection - DW #90062
Kentucky Dept of Envi. Protection - WW #:90062
Louisiana DEQ Certification #: 3086
Louisiana DHH #: LA140001
Maine Certification #: 2013011
Maryland Certification #: 322
Michigan DEPH Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT0092
Nevada Certification #: MN_00064
Nebraska Certification #: Pace
New Jersey Certification #: MN-002
New York Certification #: 11647
North Carolina Certification #: 530
North Carolina State Public Health #: 27700
North Dakota Certification #: R-036
Ohio EPA #: 4150
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Oregon Certification #: MN300001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Saipan (CNMI) #:MP0003
South Carolina #:74003001
Texas Certification #: T104704192
Tennessee Certification #: 02818
Utah Certification #: MN000642013-4
Virginia DGS Certification #: 251
Virginia/VELAP Certification #: Pace
Washington Certification #: C486
West Virginia Certification #: 382
West Virginia DHHR #:9952C
Wisconsin Certification #: 999407970

Virginia Minnesota Certification ID's

315 Chestnut Street, Virginia, MN 55792
Alaska Certification UST-107
Alaska Certification UST-107
Alaska Certification #MN01084
Arizona Department of Health Certification #AZ0785
Minnesota Dept of Health Certification #: 027-137-445
North Dakota Certification: # R-203
Wisconsin DNR Certification # : 998027470
WA Department of Ecology Lab ID# C1007
Nevada DNR #MN010842015-1
Oklahoma Department of Environmental Quality

SAMPLE SUMMARY

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10365180001	**BW16MLW-001-0.0-0.15**	Solid	10/04/16 10:08	10/06/16 20:25
10365180002	**BW16MLW-002-0.0-0.15**	Solid	10/04/16 10:48	10/06/16 20:25
10365180003	**BW16MLW-003-0.0-0.15**	Solid	10/04/16 11:07	10/06/16 20:25
10365180004	**BW16MLW-005-0.90-0.15**	Solid	10/04/16 13:09	10/06/16 20:25
10365180005	**BW16MLW-006-1.75-2.0**	Solid	10/04/16 12:58	10/06/16 20:25
10365180006	**BW16MLW-007-1.6-1.85**	Solid	10/04/16 12:42	10/06/16 20:25
10365180007	**BW16MLW-008-1.15-1.40**	Solid	10/04/16 12:26	10/06/16 20:25
10365180008	**BW16MLW-009-1.75-2.0**	Solid	10/04/16 12:03	10/06/16 20:25
10365180009	**BW16MLW-010-1.45-1.70**	Solid	10/04/16 11:38	10/06/16 20:25

SAMPLE ANALYTE COUNT

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
10365180004	**BW16MLW-005-0.90-0.15**	ASTM D2974	JDL	1	PASI-M
		EPA 9060A	KRV	5	PASI-V
10365180005	**BW16MLW-006-1.75-2.0**	ASTM D2974	JDL	1	PASI-M
		EPA 9060A	KRV	5	PASI-V
10365180006	**BW16MLW-007-1.6-1.85**	ASTM D2974	JDL	1	PASI-M
		EPA 9060A	KRV	5	PASI-V
10365180007	**BW16MLW-008-1.15-1.40**	ASTM D2974	JDL	1	PASI-M
		EPA 9060A	KRV	5	PASI-V
10365180008	**BW16MLW-009-1.75-2.0**	ASTM D2974	JDL	1	PASI-M
		EPA 9060A	KRV	5	PASI-V
10365180009	**BW16MLW-010-1.45-1.70**	ASTM D2974	JDL	1	PASI-M
		EPA 9060A	KRV	5	PASI-V

PROJECT NARRATIVE

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Method: **EPA 9060A**
Description: Total Organic Carbon Quad
Client: Bay West, Inc.
Date: October 24, 2016

General Information:
6 samples were analyzed for EPA 9060A. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: 97596

A matrix spike and/or matrix spike duplicate (MS/MSD) were performed on the following sample(s): 10365379001,10365383012

M1: Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

- MSD (Lab ID: 386209)
  - Mean Total Organic Carbon

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Sample: BW16MLW-005-0.90-0.15 **Lab ID: 10365180004** Collected: 10/04/16 13:09 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**86.9**	%	0.10	0.10	1		10/17/16 15:38		
Total Organic Carbon Quad	Analytical Method: EPA 9060A								
Total Organic Carbon	**154000**	mg/kg	8960	1430	1		10/19/16 07:19	7440-44-0	
Total Organic Carbon	**147000**	mg/kg	8700	1390	1		10/19/16 07:27	7440-44-0	
Total Organic Carbon	**69900**	mg/kg	7790	1250	1		10/19/16 07:34	7440-44-0	
Total Organic Carbon	**47100**	mg/kg	7890	1260	1		10/19/16 07:41	7440-44-0	
Mean Total Organic Carbon	**104000**	mg/kg	8330	1330	1		10/19/16 07:41	7440-44-0	

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Sample: BW16MLW-006-1.75-2.0 **Lab ID: 10365180005** Collected: 10/04/16 12:58 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**82.1**	%	0.10	0.10	1		10/17/16 15:38		
Total Organic Carbon Quad	Analytical Method: EPA 9060A								
Total Organic Carbon	**49000**	mg/kg	6940	1110	1		10/19/16 07:49	7440-44-0	
Total Organic Carbon	**197000**	mg/kg	5630	901	1		10/19/16 07:56	7440-44-0	
Total Organic Carbon	**41000**	mg/kg	6260	1000	1		10/19/16 08:03	7440-44-0	
Total Organic Carbon	**54000**	mg/kg	6100	976	1		10/19/16 08:10	7440-44-0	
Mean Total Organic Carbon	**85300**	mg/kg	6230	997	1		10/19/16 08:10	7440-44-0	

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Sample: BW16MLW-007-1.6-1.85 **Lab ID: 10365180006** Collected: 10/04/16 12:42 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**81.9**	%	0.10	0.10	1		10/17/16 15:38		
Total Organic Carbon Quad	Analytical Method: EPA 9060A								
Total Organic Carbon	**188000**	mg/kg	6580	1050	1		10/19/16 08:18	7440-44-0	
Total Organic Carbon	**195000**	mg/kg	10200	1630	1		10/19/16 08:25	7440-44-0	
Total Organic Carbon	**32900**	mg/kg	10900	1740	1		10/19/16 08:32	7440-44-0	
Total Organic Carbon	**54300**	mg/kg	11000	1760	1		10/19/16 08:40	7440-44-0	
Mean Total Organic Carbon	**117000**	mg/kg	9650	1540	1		10/19/16 08:40	7440-44-0	

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Sample: BW16MLW-008-1.15-1.40 **Lab ID: 10365180007** Collected: 10/04/16 12:26 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**82.7**	%	0.10	0.10	1		10/17/16 15:38		
Total Organic Carbon Quad	Analytical Method: EPA 9060A								
Total Organic Carbon	**26900**	mg/kg	13600	2170	1		10/19/16 08:47	7440-44-0	
Total Organic Carbon	**275000**	mg/kg	9120	1460	1		10/19/16 08:55	7440-44-0	
Total Organic Carbon	**66300**	mg/kg	9710	1550	1		10/19/16 09:02	7440-44-0	
Total Organic Carbon	**28400**	mg/kg	10300	1650	1		10/19/16 09:10	7440-44-0	
Mean Total Organic Carbon	**99200**	mg/kg	10700	1710	1		10/19/16 09:10	7440-44-0	

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Sample: BW16MLW-009-1.75-2.0 **Lab ID: 10365180008** Collected: 10/04/16 12:03 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**88.1**	%	0.10	0.10	1		10/17/16 15:39		
Total Organic Carbon Quad	Analytical Method: EPA 9060A								
Total Organic Carbon	**154000**	mg/kg	11800	1880	1		10/19/16 09:17	7440-44-0	
Total Organic Carbon	**303000**	mg/kg	12100	1940	1		10/19/16 09:25	7440-44-0	
Total Organic Carbon	**65100**	mg/kg	12000	1920	1		10/19/16 09:33	7440-44-0	
Total Organic Carbon	**85900**	mg/kg	12700	2030	1		10/19/16 09:40	7440-44-0	
Mean Total Organic Carbon	**152000**	mg/kg	12100	1940	1		10/19/16 09:40	7440-44-0	

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Sample: BW16MLW-010-1.45-1.70 **Lab ID: 10365180009** Collected: 10/04/16 11:38 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**89.1**	%	0.10	0.10	1		10/17/16 15:39		
Total Organic Carbon Quad	Analytical Method: EPA 9060A								
Total Organic Carbon	**132000**	mg/kg	11700	1880	1		10/19/16 09:47	7440-44-0	
Total Organic Carbon	**306000**	mg/kg	11400	1820	1		10/19/16 09:54	7440-44-0	
Total Organic Carbon	**79200**	mg/kg	11400	1820	1		10/19/16 10:02	7440-44-0	
Total Organic Carbon	**93600**	mg/kg	13600	2180	1		10/19/16 10:09	7440-44-0	
Mean Total Organic Carbon	**153000**	mg/kg	12000	1920	1		10/19/16 10:09	7440-44-0	

QUALITY CONTROL DATA

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

QC Batch: 441541
Analysis Method: ASTM D2974
QC Batch Method: ASTM D2974
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 10365180004, 10365180005, 10365180006, 10365180007, 10365180008, 10365180009

SAMPLE DUPLICATE: 2403248

Parameter	Units	10365048013 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	26.6	25.8	3	30	

SAMPLE DUPLICATE: 2403249

Parameter	Units	10365188006 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	37.1	35.8	4	30	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

QC Batch: 97596 Analysis Method: EPA 9060A
QC Batch Method: EPA 9060A Analysis Description: 9060 TOC Average
Associated Lab Samples: 10365180004, 10365180005, 10365180006, 10365180007, 10365180008, 10365180009

METHOD BLANK: 386204 Matrix: Solid
Associated Lab Samples: 10365180004, 10365180005, 10365180006, 10365180007, 10365180008, 10365180009

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Mean Total Organic Carbon	mg/kg	ND	301	48.2	10/19/16 20:22	

LABORATORY CONTROL SAMPLE: 386205

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mean Total Organic Carbon	mg/kg	5820	4490	77	49-151	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 386206 386207

Parameter	Units	10365379001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mean Total Organic Carbon	mg/kg	33000	44700	45700	83900	74700	114	91	70-130	12	25	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 386208 386209

Parameter	Units	10365383012 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mean Total Organic Carbon	mg/kg	42500	31600	31100	68700	60100	83	57	70-130	13	25	M1

QUALIFIERS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-M	Pace Analytical Services - Minneapolis
PASI-V	Pace Analytical Services - Virginia

ANALYTE QUALIFIERS

M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365180

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10365180004	**BW16MLW-005-0.90-0.15**	ASTM D2974	441541		
10365180005	**BW16MLW-006-1.75-2.0**	ASTM D2974	441541		
10365180006	**BW16MLW-007-1.6-1.85**	ASTM D2974	441541		
10365180007	**BW16MLW-008-1.15-1.40**	ASTM D2974	441541		
10365180008	**BW16MLW-009-1.75-2.0**	ASTM D2974	441541		
10365180009	**BW16MLW-010-1.45-1.70**	ASTM D2974	441541		
10365180004	**BW16MLW-005-0.90-0.15**	EPA 9060A	97596		
10365180004	**BW16MLW-005-0.90-0.15**	EPA 9060A	97656		
10365180005	**BW16MLW-006-1.75-2.0**	EPA 9060A	97596		
10365180005	**BW16MLW-006-1.75-2.0**	EPA 9060A	97656		
10365180006	**BW16MLW-007-1.6-1.85**	EPA 9060A	97596		
10365180006	**BW16MLW-007-1.6-1.85**	EPA 9060A	97656		
10365180007	**BW16MLW-008-1.15-1.40**	EPA 9060A	97596		
10365180007	**BW16MLW-008-1.15-1.40**	EPA 9060A	97656		
10365180008	**BW16MLW-009-1.75-2.0**	EPA 9060A	97596		
10365180008	**BW16MLW-009-1.75-2.0**	EPA 9060A	97656		
10365180009	**BW16MLW-010-1.45-1.70**	EPA 9060A	97596		
10365180009	**BW16MLW-010-1.45-1.70**	EPA 9060A	97656		

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

10365180

Section A
Required Client Information:

Company: Bay West, LLC
Address: 5 Empire Drive
St. Paul, MN 55103
Email To: nmcdonald@baywest.com
Phone: 651-291-3483
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Nancy McDonald
Copy To: Paul Raymaker
Purchase Order No.: 108002
Project Name: SLR Sediment AOCs
Project Number: J160139

Section C
Invoice Information:

Attention: Accounts Payable
Company Name: Bay West, LLC
Address: 5 Empire Drive
Lab Quote Reference: 3000017136
Lab Project Manager: Oyeyemi Odujole

Section D
EQuIS Information:

Facility_Name: St. Louis River Sediment Areas of Concern
Facility_Code: St Louis River Sed
Facility_ID: 547023
Subfacility_code:

Page 1 of 1
COC# SLR-MLW-2
Site Location STATE: MN

Section E
Required Client Information

Valid Matrix Codes

MATRIX	CODE
Drinking Water	DW
Waste Water	W
Product	WW
Soil/Solid	P
Oil	SO
Wipe	OL
Air	WP
Tissue	AR
Other	TS
	OT

					Collection			Preservatives								Requested Analysis		
ITEM #	Sample Location ID (sys_loc_code)	Sample ID (sys_sample_code)	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	DATE	Time	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Grain Size (ASTM D422 w/ hydrometer)	TOC (SW-846 9060A Quad Burn)	Comments
Ex.	*BW15MLW-005*	*BW14MLW-005-0-0.15*	*SO*	*G*	*3/12/15*	*1204*												
1	BW16MLW-001	BW16MLW-001-0.0-0.15	SO	G	10/4/16	1008	1	1								1		001
2	BW16MLW-002	BW16MLW-002-0.0-0.15	SO	G	10/4/16	1048	1	1								1		002
3	BW16MLW-003	BW16MLW-003-0.0-0.15	SO	G	10/4/16	1107	1	1								1		003
4	BW16MLW-005	BW16MLW-005-0.90-1.15	SO	G	10/4/16	1309	2	2								1	1	004
5	BW16MLW-006	BW16MLW-006-1.75-2.0	SO	G	10/4/16	1258	2	2								1	1	005
6	BW16MLW-007	BW16MLW-007-1.6-1.85	SO	G	10/4/16	1242	2	2								1	1	006
7	BW16MLW-008	BW16MLW-008-1.15-1.40	SO	G	10/4/16	1226	2	2								1	1	007
8	BW16MLW-009	BW16MLW-009-1.75-2.0	SO	G	10/4/16	1203	1	1									1	008
9	BW16MLW-010	BW16MLW-010-1.45-1.70	SO	G	10/4/16	1138	1	1									1	009
10																		
11																		
12																		

ADDITIONAL COMMENTS

Reference Subcontractor Goods and/or Services Purchase Order Form signed by Bay West on 9/19/16

RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
	10/6/16	1444		10/6/16	1445
Kristina Polson	10/6/16	1715		10/9/19	1715
	10/9/19	2025		10.6.19	20:25

SAMPLE CONDITIONS

Temp (°C)	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
0.2 4.9 0.6	Y	N	Y

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Chris Musson
SIGNATURE of SAMPLER: CJM
DATE Signed (MM/DD/YY): 10/6/16

Pace Analytical®	Document Name: **Sample Condition Upon Receipt Form**	Document Revised: 02Aug2016 Page 1 of 2
	Document No.: **F-MN-L-213-rev.17**	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Bay West LLC

Project #: **WO# : 10365180**

10365180

Courier: ☐Fed Ex ☐UPS ☐USPS ☐Client ☐Commercial ☑Pace ☐SpeeDee ☐Other:

Tracking Number:

Custody Seal on Cooler/Box Present? ☑Yes ☐No **Seals Intact?** ☑Yes ☐No

Optional: Proj. Due Date: Proj. Name:

Packing Material: ☐Bubble Wrap ☑Bubble Bags ☐None ☐Other:

Temp Blank? ☐Yes ☐No

Thermometer Used: ☑151401163 ☐151401164 ☐B88A912167504 ☐B88A0143310098

Type of Ice: ☐Wet ☐Blue ☐None ☐Samples on ice, cooling process has begun

Cooler Temp Read (°C): 00,0.6,4.7 **Cooler Temp Corrected (°C):** 0.2, 0.8, 4.9 **Biological Tissue Frozen?** ☐Yes ☐No ☒N/A

Temp should be above freezing to 6°C **Correction Factor:** +0.2 **Date and Initials of Person Examining Contents:** CLT 10.6.16

USDA Regulated Soil (☐ N/A, water sample)

Did samples originate in a quarantine zone within the United States: AL, AR, AZ, CA, FL, GA, ID, LA. MS, NC, NM, NY, OK, OR, SC, TN, TX or VA (check maps)? ☐Yes ☒No

Did samples originate from a foreign source (internationally, including Hawaii and Puerto Rico)? ☐Yes ☒No

If Yes to either question, fill out a Regulated Soil Checklist (F-MN-Q-338) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present?	☒Yes	☐No	☐N/A	1.
Chain of Custody Filled Out?	☒Yes	☐No	☐N/A	2.
Chain of Custody Relinquished?	☒Yes	☐No	☐N/A	3.
Sampler Name and/or Signature on COC?	☒Yes	☐No	☐N/A	4.
Samples Arrived within Hold Time?	☑Yes	☐No	☐N/A	5.
Short Hold Time Analysis (<72 hr)?	☐Yes	☒No	☐N/A	6.
Rush Turn Around Time Requested?	☐Yes	☑No	☐N/A	7.
Sufficient Volume?	☑Yes	☐No	☐N/A	8.
Correct Containers Used?	☒Yes	☐No	☐N/A	9.
-Pace Containers Used?	☒Yes	☑No	☐N/A	
Containers Intact?	☑Yes	☐No	☐N/A	10.
Filtered Volume Received for Dissolved Tests?	☐Yes	☐No	☒N/A	11. Note if sediment is visible in the dissolved container
Sample Labels Match COC? -Includes Date/Time/ID/Analysis Matrix: SL	☒Yes	☐No	☐N/A	12.
All containers needing acid/base preservation have been checked?	☐Yes	☐No	☒N/A	13. ☐HNO_3 ☐H_2SO_4 ☐NaOH ☐HCl Sample #
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, HCl<2; NaOH >9 Sulfide, NaOH>12 Cyanide)	☐Yes	☐No	☒N/A	
Exceptions: VOA, Coliform, TOC, Oil and Grease, DRO/8015 (water) DOC	☐Yes	☐No	☒N/A	Initial when completed: Lot # of added preservative:
Headspace in VOA Vials (>6mm)?	☐Yes	☐No	☒N/A	14.
Trip Blank Present?	☐Yes	☐No	☒N/A	15.
Trip Blank Custody Seals Present?	☐Yes	☐No	☒N/A	
Pace Trip Blank Lot # (if purchased):				

CLIENT NOTIFICATION/RESOLUTION

Field Data Required? ☐Yes ☐No

Person Contacted: Date/Time:

Comments/Resolution:

Project Manager Review: **Date:** 10/7/16

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers).

Intra-Regional Chain of Custody

Pace Analytical®
www.pacelabs.com

SCANNED

Workorder: 10365180 **Workorder Name:** J160139 SLR Sediment AOCs **Owner Received Date:** 10/6/2016 **Due Date:** 10/20/2016

Received at:
Pace Analytical Minnesota
1700 Elm Street
Suite 200
Minneapolis, MN 55414
Phone (612)607-1700

Send To Lab:
Pace Analytical Billings MT
150 N Ninth Street
Billings, MT 59101
Phone (406)254-7226

Report To:
Oyeyemi Odujole

						Preserved Containers	Requested Analysis	
Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Other	ASTM D422	LAB USE ONLY
1	BW16MLW-001-0.0-0.15	PS	10/4/2016 10:08	10365180001	Solid	1	X	
2	BW16MLW-002-0.0-0.15	PS	10/4/2016 10:48	10365180002	Solid	1	X	
3	BW16MLW-003-0.0-0.15	PS	10/4/2016 11:07	10365180003	Solid	1	X	
4	BW16MLW-005-0.90-0.15	PS	10/4/2016 13:09	10365180004	Solid	1	X	
5	BW16MLW-006-1.75-2.0	PS	10/4/2016 12:58	10365180005	Solid	1	X	
6	BW16MLW-007-1.6-1.85	PS	10/4/2016 12:42	10365180006	Solid	1	X	
7	BW16MLW-008-1.15-1.40	PS	10/4/2016 12:26	10365180007	Solid	1	X	

Transfers	Released By	Date/Time	Received By	Date/Time
1	Pace	10/7/16 1226		
2	FedEx		RWalter - Pace	10/8/16 0930
3				
4				

Comments
Admin work

Cooler Temperature on Receipt 1.7 °C **Custody Seal** [✓ Y] or N **Received on Ice** [✓ Y] or N **Samples Intact** [✓ Y] or N

****In order to maintain client confidentiality, location/name of the sampling site, sampler's name and signature may not be provided on this COC document. This chain of custody is considered complete as is since this information is available in the owner laboratory.*

Pace Analytical	Document Name: **Sample Condition Upon Receipt Form**	Document Revised: 04Aug2016 Page 1 of 1
	Document No.: **F-MT-C-184-Rev.10**	Issuing Authority: Pace Montana Quality Office

Sample Condition Upon Receipt

Client Name: Pace MN

Project #: 10365180

Courier: ☒ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace ☐ Other:

(2)

Tracking Number: 6751 5826 4964, 4995

Custody Seal on Cooler/Box Present? ☒ Yes ☐ No **Seals Intact?** ☒ Yes ☐ No

Optional: Proj. Due Date: Proj. Name:

Packing Material: ☒ Bubble Wrap ☐ Bubble Bags ☐ None ☐ Other:

Temp Blank? ☒ Yes ☐ No

Thermometer Used: ☒ 160285052 ☐ 140279186 ☐ NA

Type of Ice: ☒ Wet ☐ Blue ☐ None ☐ Samples on ice, cooling process has begun

Cooler Temp Read: 2.6, 2.2

Cooler Temp Corrected: 2.1, 1.7

Temp should be above freezing to 6°C

Date and Initials of Person Examining Contents: MRW 10/8/16

Biological Tissue Frozen? ☐ Yes ☒ No

Comments:

Chain of Custody Present?	☒ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out?	☒ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished?	☒ Yes	☐ No	☐ N/A	3.
Sampler Name and Signature on COC?	☐ Yes	☒ No	☐ N/A	4.
Samples Arrived within Hold Time?	☒ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72 hr)?	☐ Yes	☒ No	☐ N/A	6.
Rush Turn Around Time Requested?	☐ Yes	☒ No	☐ N/A	7.
Sufficient Volume?	☒ Yes	☐ No	☐ N/A	8.
Correct Containers Used?	☒ Yes	☐ No	☐ N/A	9.
-Pace Containers Used?	☐ Yes	☒ No	☐ N/A	
Containers Intact?	☒ Yes	☐ No	☐ N/A	10.
Filtered Volume Received for Dissolved Tests?	☐ Yes	☐ No	☒ N/A	11. Note if sediment is visible in the dissolved container.
Sample Labels Match COC? -Includes Date/Time/ID/Analysis Matrix: Soil	☒ Yes	☐ No	☐ N/A	12.
All containers needing acid/base preservation have been checked?	☐ Yes	☐ No	☒ N/A	13. ☐ HNO₃ ☐ H₂SO₄ ☐ NaOH ☐ HCl Sample #
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, HCl<2; NaOH >9 Sulfide, NaOH>12 Cyanide)	☐ Yes	☐ No	☒ N/A	
Exceptions: VOA, Coliform, TOC, Oil and Grease, WI-DRO (water)	☐ Yes	☒ No		Initial when completed: Lot # of added preservative:
Headspace in VOA Vials (>6mm)?	☐ Yes	☐ No	☒ N/A	14.
Trip Blank Present?	☐ Yes	☐ No	☒ N/A	15.
Trip Blank Custody Seals Present?	☐ Yes	☐ No	☒ N/A	
Pace Trip Blank Lot # (if purchased): NA				

CLIENT NOTIFICATION/RESOLUTION

Field Data Required? ☐ Yes ☐ No

Person Contacted:

Date/Time:

Comments/Resolution:

Project Manager Review:

Date: 10/14/16

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Chain of Custody

WO#:1276612
PM: CLJ Due Date: 10/20/16
CLIENT: PACE MPLS

Pace Analytical®
www.pacelabs.com

Workorder: 10365180 **Workorder Name:** J160139 SLR Sediment AOCs **Owner Received Date:** 10/6/2016 **Results Requested By:** 10/20/2016

Report To

Oyeyemi Odujole
Pace Analytical Minnesota
1700 Elm Street
Suite 200
Minneapolis, MN 55414
Phone (612)607-1700

Subcontract To

Pace Analytical Virginia MN
315 Chestnut Street
Virginia, MN 55792
Phone (218)742-1042

						Preserved Containers	Requested Analysis	
Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Unpreserved	TOC	LAB USE ONLY
1	BW16MLW-005-0.90-0.15	PS	10/4/2016 13:09	10365180004	Solid	1	X	
2	BW16MLW-006-1.75-2.0	PS	10/4/2016 12:58	10365180005	Solid	1	X	
3	BW16MLW-007-1.6-1.85	PS	10/4/2016 12:42	10365180006	Solid	1	X	
4	BW16MLW-008-1.15-1.40	PS	10/4/2016 12:26	10365180007	Solid	1	X	
5	BW16MLW-009-1.75-2.0	PS	10/4/2016 12:03	10365180008	Solid	1	X	
6	BW16MLW-010-1.45-1.70	PS	10/4/2016 11:38	10365180009	Solid	1	X	

Transfers	Released By	Date/Time	Received By	Date/Time
1	Pace	10/7/16 1240		10/7/16 1935
2		10/7/16 2330		10-8-16 1100
3				

Comments

Admin Work

Cooler Temperature on Receipt 3.4 °C **Custody Seal** [✓ Y] or N **Received on Ice** [✓ Y] or N **Samples Intact** [✓ Y] or N

****In order to maintain client confidentiality, location/name of the sampling site, sampler's name and signature may not be provided on this COC document. This chain of custody is considered complete as is since this information is available in the owner laboratory.*

Pace Analytical	Document Name: Sample Condition Upon Receipt Form	Document Revised: 23Feb2015 Page 1 of 1
	Document No.: F-VM-C-001-Rev.09	Issuing Authority: Pace Virginia, Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Pace- MIL

Project #:

WO#: 1276612

1276612

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☑ Pace ☐ Other:

Tracking Number:

Custody Seal on Cooler/Box Present? ☑ Yes ☐ No Seals Intact? ☑ Yes ☐ No

Optional: Proj. Due Date: Proj. Name:

Packing Material: ☑ Bubble Wrap ☑ Bubble Bags ☐ None ☑ Other: Haz Pac Temp Blank? ☑ Yes ☐ No

Thermometer Used: ☑ 140792808 Type of Ice: ☑ Wet ☐ Blue ☐ None ☑ Samples on ice, cooling process has begun

Cooler Temp Read °C: 3.1 Cooler Temp Corrected °C: 3.4 Biological Tissue Frozen? ☐ Yes ☐ No ☑ NA

Temp should be above freezing to 6°C Correction Factor: +0.3 Date and Initials of Person Examining Contents: JPK 10/7/16

Comments: CL 10-8-16

Chain of Custody Present?	☑ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out?	☑ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished?	☑ Yes	☐ No	☐ N/A	3.
Sampler Name and Signature on COC?	☐ Yes	☑ No	☐ N/A	4.
Samples Arrived within Hold Time?	☑ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72 hr)?	~~☑ Yes~~ JPK	☑ No	☐ N/A	6.
Rush Turn Around Time Requested?	☐ Yes	☑ No	☐ N/A	7.
Sufficient Volume?	☑ Yes	☐ No	☐ N/A	8.
Correct Containers Used?	☑ Yes	☐ No	☐ N/A	9.
-Pace Containers Used?	☑ Yes	☐ No	☐ N/A	
Containers Intact?	☑ Yes	☐ No	☐ N/A	10.
Filtered Volume Received for Dissolved Tests?	☐ Yes	☐ No	☑ N/A	11. Note if sediment is visible in the dissolved containers.
Sample Labels Match COC? -Includes Date/Time/ID/Analysis Matrix: SL	☑ Yes	☐ No	☐ N/A	12.
All containers needing acid/base preservation will be checked and documented in the pH logbook.	☐ Yes	☐ No	☑ N/A	See pH log for results and additional preservation documentation
Headspace in Methyl Mercury Container	☐ Yes	☐ No	☑ N/A	13.
Headspace in VOA Vials (>6mm)?	☐ Yes	☐ No	☑ N/A	14.
Trip Blank Present?	☐ Yes	☐ No	☑ N/A	15.
Trip Blank Custody Seals Present?	☐ Yes	☐ No	☑ N/A	
Pace Trip Blank Lot # (if purchased):				

CLIENT NOTIFICATION/RESOLUTION

Field Data Required? ☐ Yes ☐ No

Person Contacted: Date/Time:

Comments/Resolution:

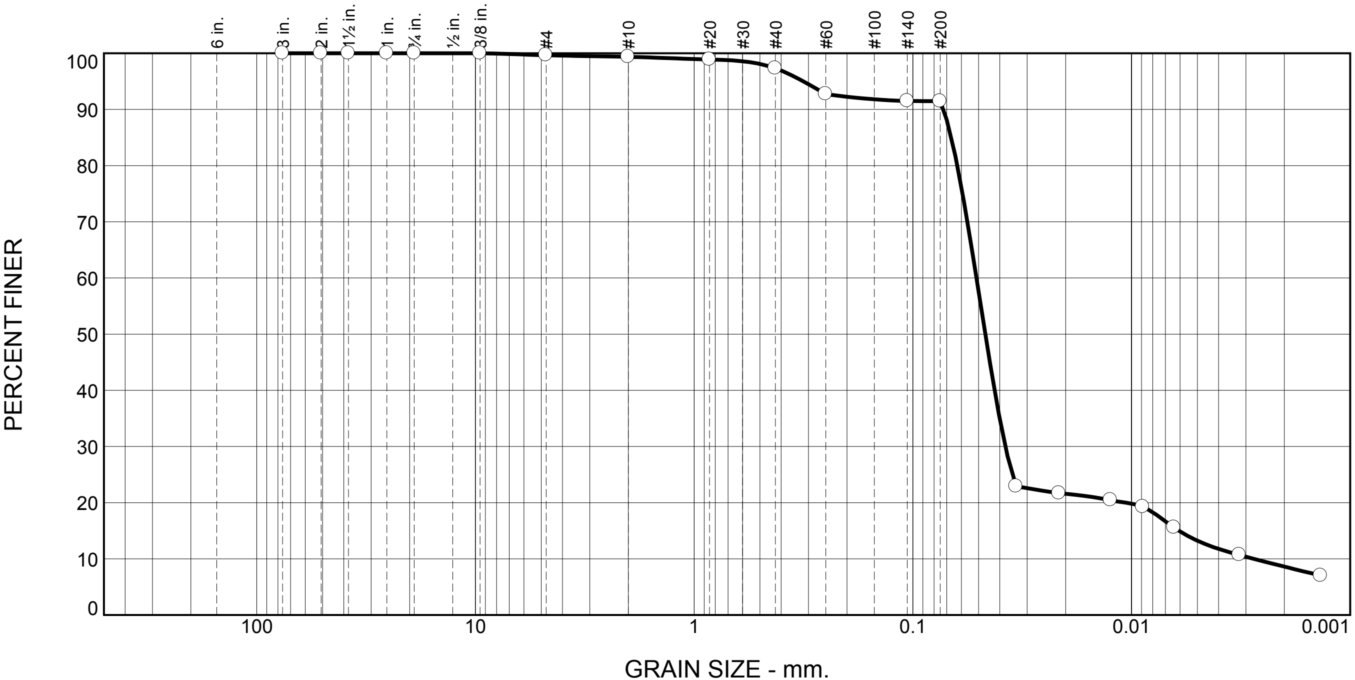
FECAL WAIVER ON FILE Y N

TEMPERATURE WAIVER ON FILE Y N

Project Manager Review: Date: 10/10/16

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	1	2	6	78	13

TEST RESULTS (ASTM D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	99		
#20	99		
#40	97		
#60	93		
#140	92		
#200	91		
0.0337 mm.	23		
0.0214 mm.	22		
0.0125 mm.	20		
0.0089 mm.	19		
0.0064 mm.	16		
0.0032 mm.	11		
0.0014 mm.	7.0		

* (no specification provided)

Material Description

silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.0725	D_{85}= 0.0667	D_{60}= 0.0512
D_{50}= 0.0466	D_{30}= 0.0377	D_{15}= 0.0061
D_{10}= 0.0028	C_u= 18.56	C_c= 10.10

Remarks

Date Received: 10/6/16 **Date Tested:** 10/18/16

Tested By: Will Thomas

Checked By: Rhonda Johnson

Title: Lab Manager

Location: BW16MLW-001-0.0-0.15

Sample Number: 10365180-1

Date Sampled: 10/4/16

Pace Analytical Services, Inc.

Billings, MT

Client: Bay West, Inc

Project: J160139 SLR Sediment AOCs

Project No:

Figure

GRAIN SIZE DISTRIBUTION TEST DATA

10/20/2016

Client: Bay West, Inc
Project: J160139 SLR Sediment AOCs
Location: BW16MLW-001-0.0-0.15
Sample Number: 10365180-1
Material Description: silt
Sample Date: 10/4/16
Date Received: 10/6/16 **PL:** NP **LL:** NV
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D422
Tested By: Will Thomas **Test Date:** 10/18/16
Checked By: Rhonda Johnson **Title:** Lab Manager

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
768.18	566.46	3	0.00	0.00	100
		2	0.00	0.00	100
		1.5	0.00	0.00	100
		1	0.00	0.00	100
		.75	0.00	0.00	100
		.375	0.00	0.00	100
		#4	0.70	0.00	100
		#10	0.59	0.00	99
81.33	0.00	#20	0.39	0.00	99
		#40	1.28	0.00	97
		#60	3.76	0.00	93
		#140	1.00	0.00	92
		#200	0.03	0.00	91

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99
Weight of hydrometer sample =81.33
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -8
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	19.0	27.0	18.8	0.0138	27.0	11.9	0.0337	22.9
5.00	19.0	26.0	17.8	0.0138	26.0	12.0	0.0214	21.7
15.00	19.0	25.0	16.8	0.0138	25.0	12.2	0.0125	20.5
30.00	19.0	24.0	15.8	0.0138	24.0	12.4	0.0089	19.2
60.00	19.0	21.0	12.8	0.0138	21.0	12.9	0.0064	15.6
250.00	19.0	17.0	8.8	0.0138	17.0	13.5	0.0032	10.7
1440.00	19.0	14.0	5.8	0.0138	14.0	14.0	0.0014	7.0

Pace Analytical Services, Inc.

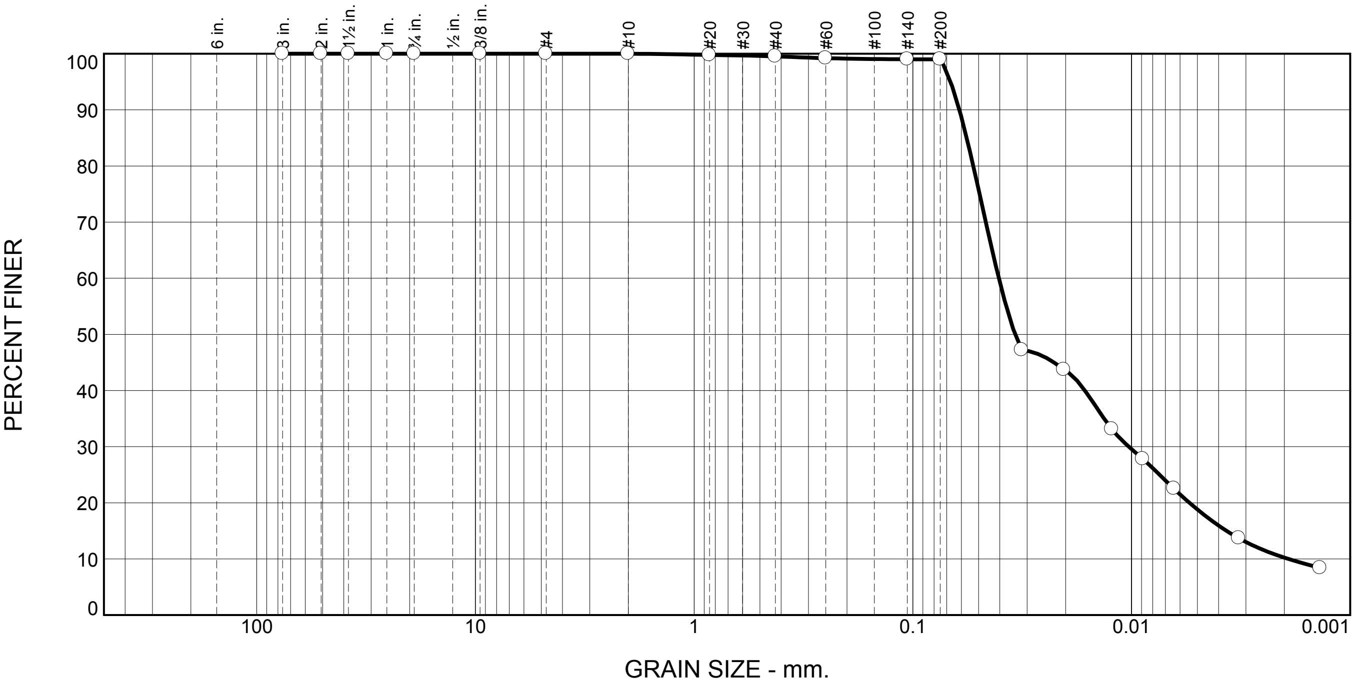
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	1	2	6	9	78	13	91

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0028	0.0061	0.0106	0.0377	0.0423	0.0466	0.0512	0.0626	0.0667	0.0725	0.3167

Fineness Modulus	C_u	C_c
0.17	18.56	10.10

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	1	80	19

TEST RESULTS (ASTM D422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	100		
#20	100		
#40	100		
#60	99		
#140	99		
#200	99		
0.0317 mm.	47		
0.0204 mm.	44		
0.0123 mm.	33		
0.0089 mm.	28		
0.0064 mm.	23		
0.0032 mm.	14		
0.0014 mm.	8.4		

* (no specification provided)

Material Description

sandy silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.0612	D_{85}= 0.0567	D_{60}= 0.0404
D_{50}= 0.0341	D_{30}= 0.0103	D_{15}= 0.0037
D_{10}= 0.0019	C_u= 21.09	C_c= 1.37

Remarks

Date Received: 10/6/16 **Date Tested:** 10/18/16

Tested By: Will Thomas

Checked By: Rhonda Johnson

Title: Lab Manager

Location: BW16MLW-002-0.0-0.15

Sample Number: 10365180-2

Date Sampled: 10/4/16

Pace Analytical Services, Inc.

Billings, MT

Client: Bay West, Inc

Project: J160139 SLR Sediment AOCs

Project No:

Figure

GRAIN SIZE DISTRIBUTION TEST DATA

10/20/2016

Client: Bay West, Inc
Project: J160139 SLR Sediment AOCs
Location: BW16MLW-002-0.0-0.15
Sample Number: 10365180-2
Material Description: sandy silt
Sample Date: 10/4/16
Date Received: 10/6/16 **PL:** NP **LL:** NV **PI:** NP
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D422
Tested By: Will Thomas **Test Date:** 10/18/16
Checked By: Rhonda Johnson **Title:** Lab Manager

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
633.82	563.56	3	0.00	0.00	100
		2	0.00	0.00	100
		1.5	0.00	0.00	100
		1	0.00	0.00	100
		.75	0.00	0.00	100
		.375	0.00	0.00	100
		#4	0.00	0.00	100
		#10	0.00	0.00	100
56.64	0.00	#20	0.13	0.00	100
		#40	0.13	0.00	100
		#60	0.19	0.00	99
		#140	0.11	0.00	99
		#200	0.00	0.00	99

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100
Weight of hydrometer sample =56.64
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -8
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	19.0	35.0	26.8	0.0138	35.0	10.6	0.0317	47.2
5.00	19.0	33.0	24.8	0.0138	33.0	10.9	0.0204	43.7
15.00	19.0	27.0	18.8	0.0138	27.0	11.9	0.0123	33.1
30.00	19.0	24.0	15.8	0.0138	24.0	12.4	0.0089	27.8
60.00	19.0	21.0	12.8	0.0138	21.0	12.9	0.0064	22.5
250.00	19.0	16.0	7.8	0.0138	16.0	13.7	0.0032	13.7
1440.00	19.0	13.0	4.8	0.0138	13.0	14.2	0.0014	8.4

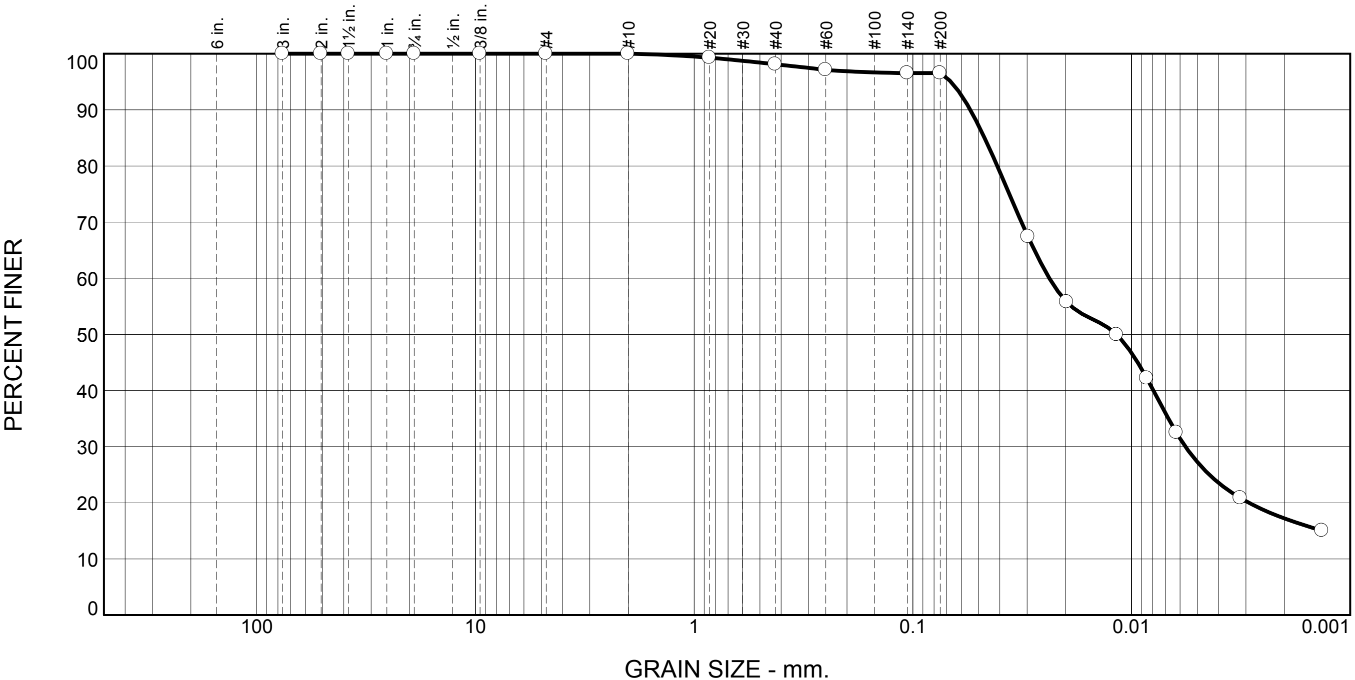
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	0	0	1	1	80	19	99

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0019	0.0037	0.0054	0.0103	0.0163	0.0341	0.0404	0.0529	0.0567	0.0612	0.0672

Fineness Modulus	C_u	C_c
0.02	21.09	1.37

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	2	1	70	27

TEST RESULTS (ASTM D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	100		
#20	99		
#40	98		
#60	97		
#140	97		
#200	97		
0.0297 mm.	67		
0.0198 mm.	56		
0.0117 mm.	50		
0.0085 mm.	42		
0.0062 mm.	32		
0.0032 mm.	21		
0.0013 mm.	15		

* (no specification provided)

Material Description

silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.0546 D_{85}= 0.0470 D_{60}= 0.0237
D_{50}= 0.0117 D_{30}= 0.0057 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 10/6/16 **Date Tested:** 10/18/16
Tested By: Will Thomas
Checked By: Rhonda Johnson
Title: Lab Manager

Location: BW16MLW-003-0.0-0.15
Sample Number: 10365180-3
Date Sampled: 104/16

Pace Analytical Services, Inc.

Billings, MT

Client: Bay West, Inc
Project: J160139 SLR Sediment AOCs
Project No:
Figure

GRAIN SIZE DISTRIBUTION TEST DATA

10/20/2016

Client: Bay West, Inc
Project: J160139 SLR Sediment AOCs
Location: BW16MLW-003-0.0-0.15
Sample Number: 10365180-3
Material Description: silt
Sample Date: 104/16
Date Received: 10/6/16 **PL:** NP **LL:** NV
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D422
Tested By: Will Thomas **Test Date:** 10/18/16
Checked By: Rhonda Johnson **Title:** Lab Manager

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
661.63	572.25	3	0.00	0.00	100
		2	0.00	0.00	100
		1.5	0.00	0.00	100
		1	0.00	0.00	100
		.75	0.00	0.00	100
		.375	0.00	0.00	100
		#4	0.00	0.00	100
		#10	0.00	0.00	100
51.57	0.00	#20	0.37	0.00	99
		#40	0.60	0.00	98
		#60	0.53	0.00	97
		#140	0.28	0.00	97
		#200	0.00	0.00	97

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100
Weight of hydrometer sample =51.57
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -8
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	19.0	43.0	34.8	0.0138	43.0	9.2	0.0297	67.4
5.00	19.0	37.0	28.8	0.0138	37.0	10.2	0.0198	55.8
15.00	19.0	34.0	25.8	0.0138	34.0	10.7	0.0117	49.9
30.00	19.0	30.0	21.8	0.0138	30.0	11.4	0.0085	42.2
60.00	19.0	25.0	16.8	0.0138	25.0	12.2	0.0062	32.5
250.00	19.0	19.0	10.8	0.0138	19.0	13.2	0.0032	20.8
1440.00	19.0	16.0	7.8	0.0138	16.0	13.7	0.0013	15.0

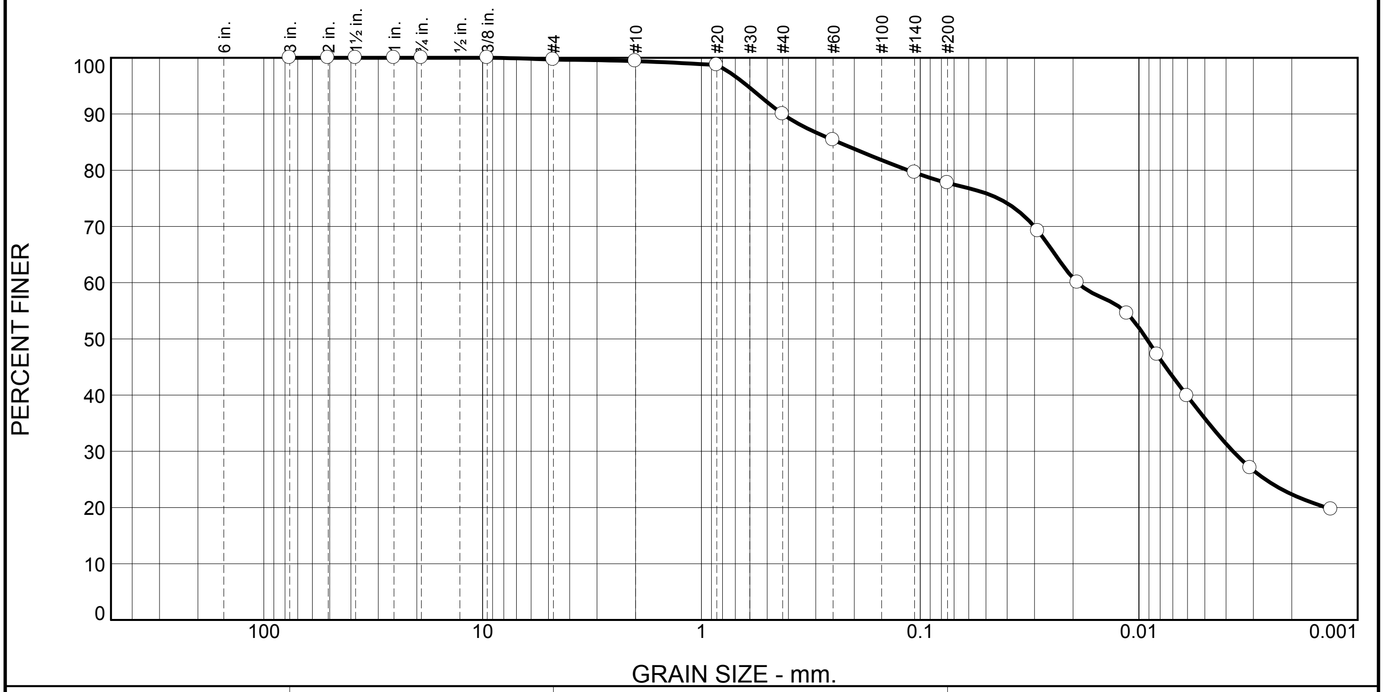
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	0	2	1	3	70	27	97

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0029	0.0057	0.0079	0.0117	0.0237	0.0411	0.0470	0.0546	0.0670

Fineness Modulus
0.07

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	1	9	12	42	36

TEST RESULTS (ASTM D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	99		
#20	99		
#40	90		
#60	85		
#140	80		
#200	78		
0.0289 mm.	69		
0.0191 mm.	60		
0.0113 mm.	55		
0.0083 mm.	47		
0.0060 mm.	40		
0.0031 mm.	27		
0.0013 mm.	20		

* (no specification provided)

Material Description

silt with sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.4248	D_{85}= 0.2368	D_{60}= 0.0191
D_{50}= 0.0092	D_{30}= 0.0037	D_{15}=
D_{10}=	C_u=	C_c=

Remarks

Date Received: 10/6/16 **Date Tested:** 10/18/16

Tested By: Will Thomas

Checked By: Rhonda Johnson

Title: Lab Manager

Location: BW16MLW-005-0.90-0.15
Sample Number: 10365180-4

Date Sampled: 10/4/16

Pace Analytical Services, Inc.

Billings, MT

Client: Bay West, Inc
Project: J160139 SLR Sediment AOCs

Project No: **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

10/20/2016

Client: Bay West, Inc
Project: J160139 SLR Sediment AOCs
Location: BW16MLW-005-0.90-0.15
Sample Number: 10365180-4
Material Description: silt with sand
Sample Date: 10/4/16
Date Received: 10/6/16 **PL:** NP **LL:** NV
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D422
Tested By: Will Thomas **Test Date:** 10/18/16
Checked By: Rhonda Johnson **Title:** Lab Manager

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
659.74	580.53	3	0.00	0.00	100
		2	0.00	0.00	100
		1.5	0.00	0.00	100
		1	0.00	0.00	100
		.75	0.00	0.00	100
		.375	0.00	0.00	100
		#4	0.27	0.00	100
		#10	0.20	0.00	99
54.24	0.00	#20	0.38	0.00	99
		#40	4.75	0.00	90
		#60	2.52	0.00	85
		#140	3.17	0.00	80
		#200	1.01	0.00	78

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99
Weight of hydrometer sample =54.24
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -8
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	19.0	46.0	37.8	0.0138	46.0	8.8	0.0289	69.2
5.00	19.0	41.0	32.8	0.0138	41.0	9.6	0.0191	60.0
15.00	19.0	38.0	29.8	0.0138	38.0	10.1	0.0113	54.5
30.00	19.0	34.0	25.8	0.0138	34.0	10.7	0.0083	47.2
60.00	19.0	30.0	21.8	0.0138	30.0	11.4	0.0060	39.9
250.00	19.0	23.0	14.8	0.0138	23.0	12.5	0.0031	27.0
1440.00	19.0	19.0	10.8	0.0138	19.0	13.2	0.0013	19.7

Pace Analytical Services, Inc.

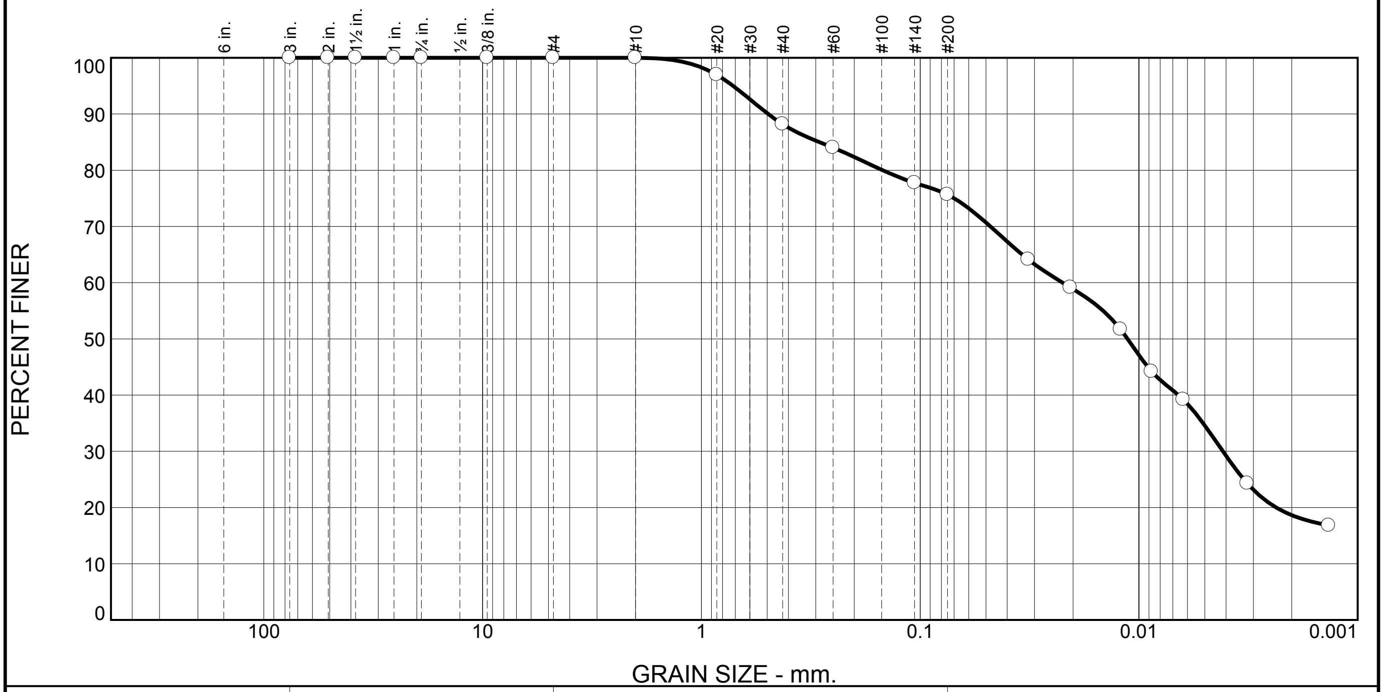
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	1	9	12	22	42	36	78

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0014	0.0037	0.0061	0.0092	0.0191	0.1136	0.2368	0.4248	0.6148

Fineness Modulus
0.39

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	12	12	41	35

TEST RESULTS (ASTM D422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	100		
#20	97		
#40	88		
#60	84		
#140	78		
#200	76		
0.0320 mm.	64		
0.0205 mm.	59		
0.0121 mm.	52		
0.0088 mm.	44		
0.0063 mm.	39		
0.0032 mm.	24		
0.0014 mm.	17		

* (no specification provided)

Material Description

silt with sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.4948 D_{85}= 0.2886 D_{60}= 0.0223

D_{50}= 0.0113 D_{30}= 0.0041 D_{15}=

D_{10}= C_u= C_c=

Remarks

Date Received: 10/6/16 **Date Tested:** 10/18/16

Tested By: Will Thomas

Checked By: Rhonda Johnson

Title: Lab Manager

Location: BW16MLW-006-1.75-2.0

Sample Number: 10365180-5

Date Sampled: 10/4/16

Pace Analytical Services, Inc.

Billings, MT

Client: Bay West, Inc

Project: J160139 SLR Sediment AOCs

Project No:

Figure

GRAIN SIZE DISTRIBUTION TEST DATA

10/20/2016

Client: Bay West, Inc
Project: J160139 SLR Sediment AOCs
Location: BW16MLW-006-1.75-2.0
Sample Number: 10365180-5
Material Description: silt with sand
Sample Date: 10/4/16
Date Received: 10/6/16 **PL:** NP **LL:** NV
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D422
Tested By: Will Thomas **Test Date:** 10/18/16
Checked By: Rhonda Johnson **Title:** Lab Manager

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
626.21	583.62	3	0.00	0.00	100
		2	0.00	0.00	100
		1.5	0.00	0.00	100
		1	0.00	0.00	100
		.75	0.00	0.00	100
		.375	0.00	0.00	100
		#4	0.00	0.00	100
		#10	0.00	0.00	100
40.17	0.00	#20	1.22	0.00	97
		#40	3.53	0.00	88
		#60	1.67	0.00	84
		#140	2.52	0.00	78
		#200	0.84	0.00	76

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100
Weight of hydrometer sample =40.17
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -8
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	19.0	34.0	25.8	0.0138	34.0	10.7	0.0320	64.1
5.00	19.0	32.0	23.8	0.0138	32.0	11.0	0.0205	59.1
15.00	19.0	29.0	20.8	0.0138	29.0	11.5	0.0121	51.7
30.00	19.0	26.0	17.8	0.0138	26.0	12.0	0.0088	44.2
60.00	19.0	24.0	15.8	0.0138	24.0	12.4	0.0063	39.2
250.00	19.0	18.0	9.8	0.0138	18.0	13.3	0.0032	24.3
1440.00	19.0	15.0	6.8	0.0138	15.0	13.8	0.0014	16.8

Pace Analytical Services, Inc.

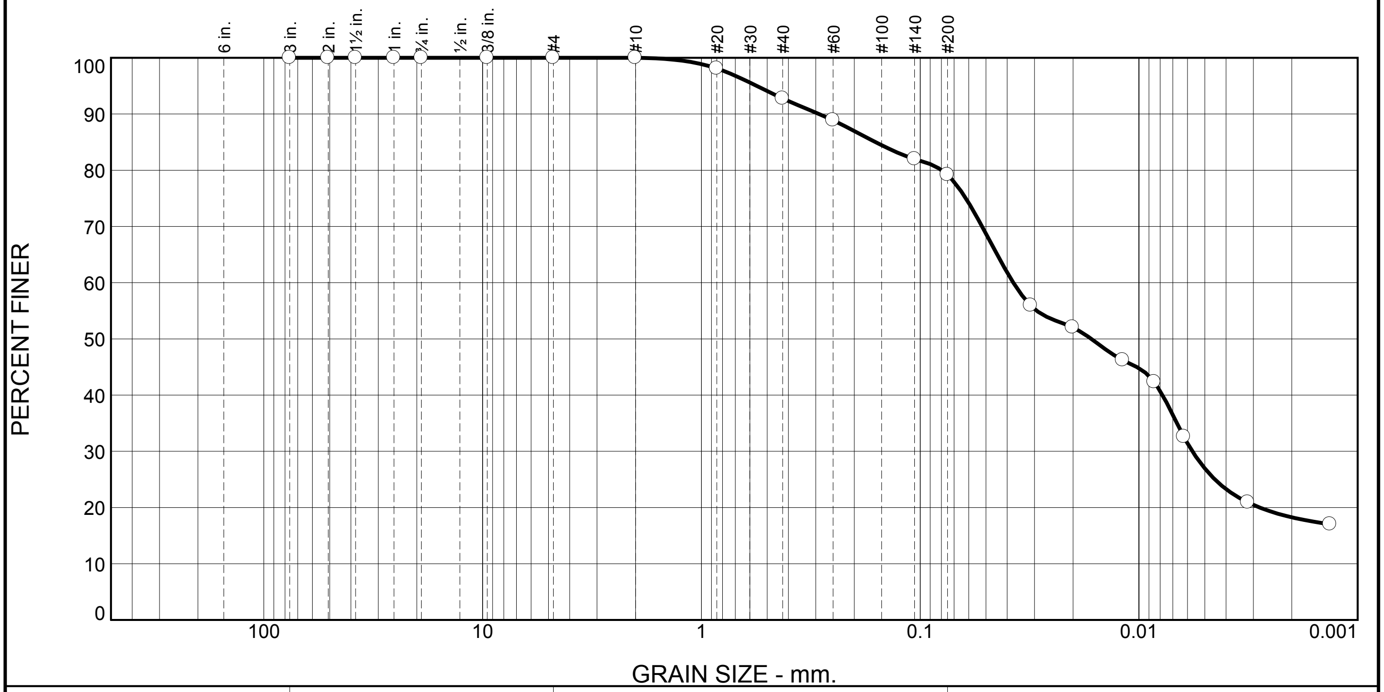
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	0	12	12	24	41	35	76

D_{5}	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0024	0.0041	0.0066	0.0113	0.0223	0.1482	0.2886	0.4948	0.7160

Fineness Modulus
0.43

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	7	14	52	27

TEST RESULTS (ASTM D422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	100		
#20	98		
#40	93		
#60	89		
#140	82		
#200	79		
0.0312 mm.	56		
0.0201 mm.	52		
0.0119 mm.	46		
0.0085 mm.	42		
0.0062 mm.	33		
0.0032 mm.	21		
0.0013 mm.	17		

* (no specification provided)

Material Description

silt with sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.2901 D_{85}= 0.1600 D_{60}= 0.0375
D_{50}= 0.0165 D_{30}= 0.0057 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 10/6/16 **Date Tested:** 10/18/16
Tested By: Will Thomas
Checked By: Rhonda Johnson
Title: Lab Manager

Location: BW16MLW-007-1.6-1.85 **Date Sampled:** 10/4/16
Sample Number: 10365180-6

Pace Analytical Services, Inc.

Billings, MT

Client: Bay West, Inc
Project: J160139 SLR Sediment AOCs
Project No: **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

10/20/2016

Client: Bay West, Inc
Project: J160139 SLR Sediment AOCs
Location: BW16MLW-007-1.6-1.85
Sample Number: 10365180-6
Material Description: silt with sand
Sample Date: 10/4/16
Date Received: 10/6/16 **PL:** NP **LL:** NV
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D422
Tested By: Will Thomas **Test Date:** 10/18/16
Checked By: Rhonda Johnson **Title:** Lab Manager

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
635.41	571.56	3	0.00	0.00	100
		2	0.00	0.00	100
		1.5	0.00	0.00	100
		1	0.00	0.00	100
		.75	0.00	0.00	100
		.375	0.00	0.00	100
		#4	0.00	0.00	100
		#10	0.00	0.00	100
51.40	0.00	#20	0.98	0.00	98
		#40	2.74	0.00	93
		#60	2.00	0.00	89
		#140	3.54	0.00	82
		#200	1.44	0.00	79

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100
Weight of hydrometer sample =51.4
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -8
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	19.0	37.0	28.8	0.0138	37.0	10.2	0.0312	55.9
5.00	19.0	35.0	26.8	0.0138	35.0	10.6	0.0201	52.0
15.00	19.0	32.0	23.8	0.0138	32.0	11.0	0.0119	46.2
30.00	19.0	30.0	21.8	0.0138	30.0	11.4	0.0085	42.3
60.00	19.0	25.0	16.8	0.0138	25.0	12.2	0.0062	32.6
250.00	19.0	19.0	10.8	0.0138	19.0	13.2	0.0032	20.9
1440.00	19.0	17.0	8.8	0.0138	17.0	13.5	0.0013	17.0

Pace Analytical Services, Inc.

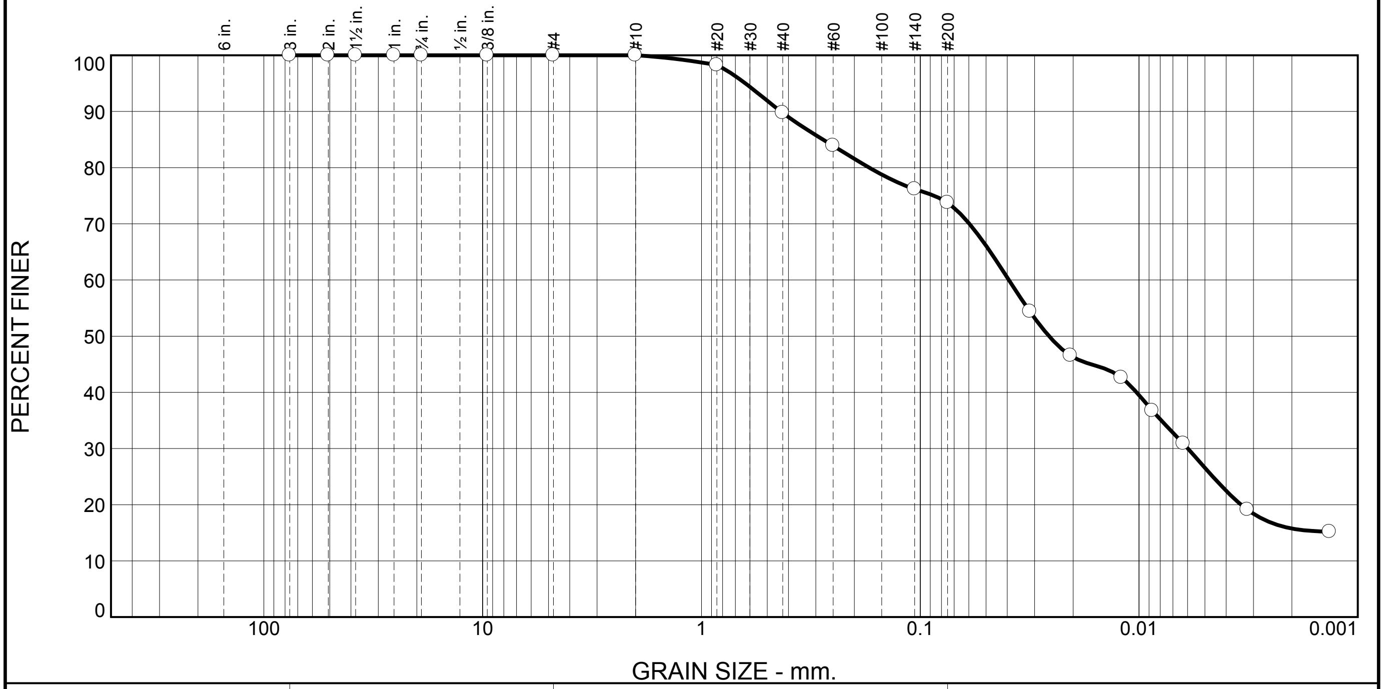
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	0	7	14	21	52	27	79

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0028	0.0057	0.0078	0.0165	0.0375	0.0796	0.1600	0.2901	0.5585

Fineness Modulus
0.30

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	10	16	47	27

TEST RESULTS (ASTM D422)			
Opening Size	**Percent Finer**	**Spec.* (Percent)**	**Pass? (X=Fail)**
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	100		
#20	98		
#40	90		
#60	84		
#140	76		
#200	74		
0.0315 mm.	54		
0.0205 mm.	47		
0.0120 mm.	43		
0.0087 mm.	37		
0.0063 mm.	31		
0.0032 mm.	19		
0.0013 mm.	15		

* (no specification provided)

Material Description

silt with sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.4334	D_{85}= 0.2782	D_{60}= 0.0393
D_{50}= 0.0258	D_{30}= 0.0060	D_{15}=
D_{10}=	C_u=	C_c=

Remarks

Date Received: 10/6/16 **Date Tested:** 10/18/16

Tested By: Will Thomas

Checked By: Rhonda Johnson

Title: Lab Manager

Location: BW16MLW-008-1.15-1.40

Sample Number: 10365180-7

Date Sampled: 10/4/16

Pace Analytical Services, Inc.

Billings, MT

Client: Bay West, Inc

Project: J160139 SLR Sediment AOCs

Project No: **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

10/20/2016

Client: Bay West, Inc
Project: J160139 SLR Sediment AOCs
Location: BW16MLW-008-1.15-1.40
Sample Number: 10365180-7
Material Description: silt with sand
Sample Date: 10/4/16
Date Received: 10/6/16 **PL:** NP **LL:** NV
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D422
Tested By: Will Thomas **Test Date:** 10/18/16
Checked By: Rhonda Johnson **Title:** Lab Manager

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
623.12	569.26	3	0.00	0.00	100
		2	0.00	0.00	100
		1.5	0.00	0.00	100
		1	0.00	0.00	100
		.75	0.00	0.00	100
		.375	0.00	0.00	100
		#4	0.00	0.00	100
		#10	0.00	0.00	100
51.03	0.00	#20	0.89	0.00	98
		#40	4.34	0.00	90
		#60	2.99	0.00	84
		#140	3.94	0.00	76
		#200	1.24	0.00	74

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100
Weight of hydrometer sample =51.03
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -8
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 - 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	19.0	36.0	27.8	0.0138	36.0	10.4	0.0315	54.4
5.00	19.0	32.0	23.8	0.0138	32.0	11.0	0.0205	46.5
15.00	19.0	30.0	21.8	0.0138	30.0	11.4	0.0120	42.6
30.00	19.0	27.0	18.8	0.0138	27.0	11.9	0.0087	36.7
60.00	19.0	24.0	15.8	0.0138	24.0	12.4	0.0063	30.9
250.00	19.0	18.0	9.8	0.0138	18.0	13.3	0.0032	19.1
1440.00	19.0	16.0	7.8	0.0138	16.0	13.7	0.0013	15.2

Pace Analytical Services, Inc.

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0	0	0	0	0	10	16	26	47	27	74

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0034	0.0060	0.0103	0.0258	0.0393	0.1709	0.2782	0.4334	0.6297

Fineness Modulus
0.42

Pace Analytical™
www.pacelabs.com

Pace Analytical Services, Inc.
1700 Elm Street
Minneapolis, MN 55414
Phone: 612.607.1700
Fax: 612.607.6444

Report Prepared for:

Nancy McDonald
Bay West, Inc.
5 Empire Drive
Saint Paul MN 55103

REPORT OF LABORATORY ANALYSIS FOR PCDD/PCDF

Report Prepared Date:

October 18, 2016

Report Information:

Pace Project #: 10365194
Sample Receipt Date: 10/06/2016
Client Project #: J160139 SLR Sediment AOCs
Client Sub PO #: 108002
State Cert #: 027-053-137

Invoicing & Reporting Options:

The report provided has been invoiced as a Level 2 PCDD/PCDF Report. If an upgrade of this report package is requested, an additional charge may be applied.

Please review the attached invoice for accuracy and forward any questions to Carolynne Trout, your Pace Project Manager.

This report has been reviewed by:

Carolynne Trout

October 18, 2016
Carolynne Trout, Project Manager
(612) 607-6351
(612) 607-6444 (fax)
Carolynne.Trout@pacelabs.com

NELAP ACCREDITED TNI LABORATORY

Report of Laboratory Analysis

DISCUSSION

This report presents the results from the analyses performed on six samples submitted by a representative of Bay West LLC. The samples were analyzed for the presence or absence of polychlorodibenzo-p-dioxins (PCDDs) and polychlorodibenzofurans (PCDFs) using a modified version of USEPA Method 8290. The reporting limits were based on signal-to-noise measurements. Estimated Maximum Possible Concentration (EMPC) values were treated as positives in the toxic equivalence calculations. The samples were received above the recommended temperature range of 0-6 degrees Celsius.

The recoveries of the isotopically-labeled PCDD/PCDF internal standards in the sample extracts ranged from 32-97%. Except for two low values, which were flagged "R" on the results tables, the labeled standard recoveries obtained for this project were within the 40-135% target range specified in Method 8290. Also, since the quantification of the native 2,3,7,8-substituted congeners was based on isotope dilution, the data were automatically corrected for variation in recovery and accurate values were obtained.

Values were flagged "I" where incorrect isotope ratios were obtained. Concentrations below the calibration range were flagged "J" and should be regarded as estimates.

A laboratory method blank was prepared and analyzed with the sample batch as part of our routine quality control procedures. The results show the blank to contain trace levels of selected congeners. These levels were below the calibration range of the method. The levels reported for the affected congeners in the field samples were higher than the corresponding blank levels by one or more orders of magnitude. These results indicate that the sample processing steps did not contribute significantly to the levels reported for the field samples.

A laboratory spike sample was also prepared with the sample batch using clean reference matrix that had been fortified with native standard materials. The results show that the spiked native compounds were recovered at 82-117%. These results were within the target range for the method. Matrix spikes were prepared with the sample batch using sample material from a separate project; results from these analyses will be provided upon request.

The response obtained for the native OCDF in calibration standard analyses U161012A_17 was outside the target range. As specified in our procedures, the average of the daily response factors for this compound was used in the calculations for the samples from this runshift. The affected values were flagged "Y" on the results tables.

Minnesota Laboratory Certifications

Authority	Certificate #	Authority	Certificate #
A2LA	2926.01	Mississippi	MN00064
Alabama	40770	Montana	92
Alaska	MN00064	Nebraska	NE-OS-18-06
Arizona	AZ0014	Nevada	MN_00064_200
Arkansas	88-0680	New Jersey (NE	MN002
California	01155CA	New York (NEL	11647
Colorado	MN00064	North Carolina	27700
Connecticut	PH-0256	North Dakota	R-036
EPA Region 8	8TMS-Q	Ohio	4150
Florida (NELAP	E87605	Oklahoma	D9922
Georgia (DNR)	959	Oregon (ELAP)	MN200001-005
Guam	959	Oregon (OREL	MN300001-001
Hawaii	SLD	Pennsylvania	68-00563
Idaho	MN00064	Puerto Rico	MN00064
Illinois	200012	Saipan	MP0003
Indiana	C-MN-01	South Carolina	74003001
Indiana	C-MN-01	Tennessee	TN02818
Iowa	368	Texas	T104704192-08
Kansas	E-10167	Utah (NELAP)	MN00064
Kentucky	90062	Virginia	00251
Louisiana	03086	Washington	C755
Maine	2007029	West Virginia #	9952C
Maryland	322	West Virginia D	382
Michigan	9909	Wisconsin	999407970
Minnesota	027-053-137	Wyoming	8TMS-Q

Appendix A

Sample Management

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

10365194

Section A
Required Client Information:

Company: Bay West, LLC
Address: 5 Empire Drive
St. Paul, MN 55103
Email To: nmcdonald@baywest.com
Phone: 651-291-3483
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Nancy McDonald
Copy To: Paul Raymaker
Purchase Order No.: 108002
Project Name: SLR Sediment AOCs
Project Number: J160139

Section C
Invoice Information:

Attention: Accounts Payable
Company Name: Bay West, LLC
Address: 5 Empire Drive
Lab Quote Reference: 3000017136
Lab Project Manager: Oyeyemi Odujole

Section D
EQuIS Information:

Facility_Name: St. Louis River Sediment Areas of Concern
Facility_Code: St Louis River Sed
Facility_ID: 547023
Subfacility_code:

Page 1 of 1
COC# SLR-MLW-1
Site Location STATE: MN

Section E Required Client Information

Valid Matrix Codes

MATRIX	CODE
Drinking Water	DW
Waste Water	W
Product	WW
Soil/Solid	P
Oil	SO
Wipe	OL
Air	WP
Tissue	AR
Other	TS
	OT

ITEM #	Sample Location ID (sys_loc_code)	Sample ID (sys_sample_code)	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	Collection DATE	Collection Time	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Requested Analysis: Nickel (6020A)	Zinc (6020A)	Dioxins/furans (8290A)	% Moisture									Comments
Ex.	BW15MLW-005	BW14MLW-005-0-0.15	SO	G	3/12/15	1204																						
1	BW16MLW-005	BW16MLW-005-0.90-1.15	SO	G	10/4/16	1309	3	3								1	1	1									001	Collect % moisture from 4 oz jar
2	BW16MLW-006	BW16MLW-006-1.75-2.0	SO	G	10/4/16	1258	3	3								1	1	1									002	Collect % moisture from 4 oz jar
3	BW16MLW-007	BW16MLW-007-1.6-1.85	SO	G	10/4/16	1242	3	3								1	1	1									003	Collect % moisture from 4 oz jar
4	BW16MLW-008	BW16MLW-008-1.15-1.40	SO	G	10/4/16	1226	3	3								1	1	1									004	Collect % moisture from 4 oz jar
5	BW16MLW-009	BW16MLW-009-1.75-2.0	SO	G	10/4/16	1203	3	3								1	1	1									005	Collect % moisture from 4 oz jar
6	BW16MLW-010	BW16MLW-010-1.45-1.70	SO	G	10/4/16	1138	3	3								1	1	1									006	Collect % moisture from 4 oz jar
7																												
8																												
9																												
10																												
11																												
12																												

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
Reference Pace Subcontractor Order Form signed by Pace on 9/16/16		10/6/16	1444	Kristina Polson	10/6/16	1445
	Kristina Polson	10/6/16	1715		10/6/16	1718
		10/6/16	2025			

SAMPLE CONDITIONS			
4.9	Y	N	Y
Temp (°C)	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Chris Musson
SIGNATURE of SAMPLER: CJM
DATE Signed (MM/DD/YY): 10/6/16

Pace Analytical	Document Name: **Sample Condition Upon Receipt Form**	Document Revised: 02Aug2016 Page 1 of 2
	Document No.: **F-MN-L-213-rev.17**	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Bay West LLC

Project #:

WO# : 10365194

10365194

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☑ Pace ☐ SpeeDee ☐ Other:

Tracking Number:

Custody Seal on Cooler/Box Present? ☑ Yes ☐ No **Seals Intact?** ☑ Yes ☐ No

Optional: Proj. Due Date: Proj. Name:

Packing Material: ☐ Bubble Wrap ☑ Bubble Bags ☐ None ☐ Other:

Temp Blank? ☐ Yes ☐ No

Thermometer Used: ☑ 151401163 ☐ 151401164 ☐ B88A912167504 ☐ B88A0143310098

Type of Ice: ☐ Wet ☐ Blue ☐ None ☐ Samples on ice, cooling process has begun

Cooler Temp Read (°C): 0.0, 0.6, 4.7 **Cooler Temp Corrected (°C):** 0.2, 0.8, 4.9 **Biological Tissue Frozen?** ☐ Yes ☐ No ☒ N/A

Temp should be above freezing to 6°C **Correction Factor:** +0.2 **Date and Initials of Person Examining Contents:** CL 10.6.16

USDA Regulated Soil (☐ N/A, water sample)

Did samples originate in a quarantine zone within the United States: AL, AR, AZ, CA, FL, GA, ID, LA, MS, NC, NM, NY, OK, OR, SC, TN, TX or VA (check maps)? ☐ Yes ☒ No

Did samples originate from a foreign source (internationally, including Hawaii and Puerto Rico)? ☐ Yes ☒ No

If Yes to either question, fill out a Regulated Soil Checklist (F-MN-Q-338) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present?	☒ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out?	☒ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished?	☒ Yes	☐ No	☐ N/A	3.
Sampler Name and/or Signature on COC?	☒ Yes	☐ No	☐ N/A	4.
Samples Arrived within Hold Time?	☑ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72 hr)?	☐ Yes	☒ No	☐ N/A	6.
Rush Turn Around Time Requested?	☐ Yes	☒ No	☐ N/A	7.
Sufficient Volume?	☒ Yes	☐ No	☐ N/A	8.
Correct Containers Used?	☒ Yes	☐ No	☐ N/A	9.
-Pace Containers Used?	☒ Yes	☑ No	☐ N/A	
Containers Intact?	☒ Yes	☐ No	☐ N/A	10.
Filtered Volume Received for Dissolved Tests?	☐ Yes	☐ No	☒ N/A	11. Note if sediment is visible in the dissolved container
Sample Labels Match COC? -Includes Date/Time/ID/Analysis Matrix: SL	☒ Yes	☐ No	☐ N/A	12.
All containers needing acid/base preservation have been checked?	☐ Yes	☐ No	☒ N/A	13. ☐ HNO_3 ☐ H_2SO_4 ☐ NaOH ☐ HCl Sample #
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, HCl<2; NaOH >9 Sulfide, NaOH>12 Cyanide)	☐ Yes	☐ No	☒ N/A	
Exceptions: VOA, Coliform, TOC, Oil and Grease, DRO/8015 (water) DOC	☐ Yes	☐ No	☒ N/A	Initial when completed: Lot # of added preservative:
Headspace in VOA Vials (>6mm)?	☐ Yes	☐ No	☒ N/A	14.
Trip Blank Present?	☐ Yes	☐ No	☒ N/A	15.
Trip Blank Custody Seals Present?	☐ Yes	☐ No	☒ N/A	
Pace Trip Blank Lot # (if purchased):				

CLIENT NOTIFICATION/RESOLUTION

Field Data Required? ☐ Yes ☐ No

Person Contacted:

Date/Time:

Comments/Resolution:

Project Manager Review: Carolynne Trout

Date: 10/101/6

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers).

Reporting Flags

A = Reporting Limit based on signal to noise

B = Less than 10x higher than method blank level

C = Result obtained from confirmation analysis

D = Result obtained from analysis of diluted sample

E = Exceeds calibration range

I = Interference present

J = Estimated value

Nn = Value obtained from additional analysis

P = PCDE Interference

R = Recovery outside target range

S = Peak saturated

U = Analyte not detected

V = Result verified by confirmation analysis

X = %D Exceeds limits

Y = Calculated using average of daily RFs

* = See Discussion

Appendix B

Sample Analysis Summary

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-005-0.90-1.15		
Lab Sample ID	10365194001		
Filename	U161012A_08		
Injected By	SMT		
Total Amount Extracted	15.3 g	Matrix	Solid
% Moisture	71.4	Dilution	NA
Dry Weight Extracted	4.38 g	Collected	10/04/2016 13:09
ICAL ID	U161011	Received	10/06/2016 20:25
CCal Filename(s)	U161012A_01 & U161012A_17	Extracted	10/10/2016 16:10
Method Blank ID	BLANK-52316	Analyzed	10/12/2016 15:27

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg		**Internal Standards**	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF	0.83	----	0.180	J	2,3,7,8-TCDF-13C	2.00	59
Total TCDF	3.70	----	0.180		2,3,7,8-TCDD-13C	2.00	78
					1,2,3,7,8-PeCDF-13C	2.00	69
2,3,7,8-TCDD	ND	----	0.180		2,3,4,7,8-PeCDF-13C	2.00	66
Total TCDD	3.60	----	0.180		1,2,3,7,8-PeCDD-13C	2.00	86
					1,2,3,4,7,8-HxCDF-13C	2.00	67
1,2,3,7,8-PeCDF	0.22	----	0.190	J	1,2,3,6,7,8-HxCDF-13C	2.00	62
2,3,4,7,8-PeCDF	0.26	----	0.087	J	2,3,4,6,7,8-HxCDF-13C	2.00	65
Total PeCDF	2.90	----	0.140	J	1,2,3,7,8,9-HxCDF-13C	2.00	54
					1,2,3,4,7,8-HxCDD-13C	2.00	74
1,2,3,7,8-PeCDD	0.24	----	0.210	J	1,2,3,6,7,8-HxCDD-13C	2.00	61
Total PeCDD	3.00	----	0.210	J	1,2,3,4,6,7,8-HpCDF-13C	2.00	61
					1,2,3,4,7,8,9-HpCDF-13C	2.00	65
1,2,3,4,7,8-HxCDF	0.40	----	0.300	J	1,2,3,4,6,7,8-HpCDD-13C	2.00	81
1,2,3,6,7,8-HxCDF	1.00	----	0.420	J	OCDD-13C	4.00	54
2,3,4,6,7,8-HxCDF	ND	----	0.140				
1,2,3,7,8,9-HxCDF	ND	----	0.150		1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	11.00	----	0.250	J	1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	ND	----	0.140		2,3,7,8-TCDD-37Cl4	0.20	72
1,2,3,6,7,8-HxCDD	0.56	----	0.180	J			
1,2,3,7,8,9-HxCDD	----	0.30	0.180	IJ			
Total HxCDD	6.10	----	0.160	J			
1,2,3,4,6,7,8-HpCDF	14.00	----	0.560				
1,2,3,4,7,8,9-HpCDF	ND	----	0.510				
Total HpCDF	25.00	----	0.540				
1,2,3,4,6,7,8-HpCDD	7.80	----	0.240	J			
Total HpCDD	16.00	----	0.240				
OCDF	6.60	----	0.810	JY			
OCDD	74.00	----	0.870				

Total 2,3,7,8-TCDD
Equivalence: 0.88 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present
Y = Calculated using average of daily RFs

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-006-1.75-2.0		
Lab Sample ID	10365194002		
Filename	U161012A_09		
Injected By	SMT		
Total Amount Extracted	13.6 g	Matrix	Solid
% Moisture	82.0	Dilution	NA
Dry Weight Extracted	2.45 g	Collected	10/04/2016 12:58
ICAL ID	U161011	Received	10/06/2016 20:25
CCal Filename(s)	U161012A_01 & U161012A_17	Extracted	10/10/2016 16:10
Method Blank ID	BLANK-52316	Analyzed	10/12/2016 16:14

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg		**Internal Standards**	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF	2.20	----	0.25	J	2,3,7,8-TCDF-13C	2.00	63
Total TCDF	9.40	----	0.25		2,3,7,8-TCDD-13C	2.00	84
					1,2,3,7,8-PeCDF-13C	2.00	71
2,3,7,8-TCDD	0.47	----	0.39	J	2,3,4,7,8-PeCDF-13C	2.00	64
Total TCDD	3.00	----	0.39	J	1,2,3,7,8-PeCDD-13C	2.00	81
					1,2,3,4,7,8-HxCDF-13C	2.00	65
1,2,3,7,8-PeCDF	----	0.52	0.36	IJ	1,2,3,6,7,8-HxCDF-13C	2.00	55
2,3,4,7,8-PeCDF	0.92	----	0.29	J	2,3,4,6,7,8-HxCDF-13C	2.00	66
Total PeCDF	15.00	----	0.32	J	1,2,3,7,8,9-HxCDF-13C	2.00	56
					1,2,3,4,7,8-HxCDD-13C	2.00	74
1,2,3,7,8-PeCDD	----	0.39	0.24	IJ	1,2,3,6,7,8-HxCDD-13C	2.00	56
Total PeCDD	4.00	----	0.24	J	1,2,3,4,6,7,8-HpCDF-13C	2.00	59
					1,2,3,4,7,8,9-HpCDF-13C	2.00	65
1,2,3,4,7,8-HxCDF	1.70	----	0.84	J	1,2,3,4,6,7,8-HpCDD-13C	2.00	77
1,2,3,6,7,8-HxCDF	8.40	----	0.87	J	OCDD-13C	4.00	47
2,3,4,6,7,8-HxCDF	2.10	----	0.32	J			
1,2,3,7,8,9-HxCDF	ND	----	0.39		1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	57.00	----	0.61		1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	ND	----	1.00		2,3,7,8-TCDD-37Cl4	0.20	77
1,2,3,6,7,8-HxCDD	3.20	----	0.60	J			
1,2,3,7,8,9-HxCDD	1.90	----	0.67	J			
Total HxCDD	21.00	----	0.76				
1,2,3,4,6,7,8-HpCDF	94.00	----	0.60				
1,2,3,4,7,8,9-HpCDF	----	1.10	1.10	IJ			
Total HpCDF	170.00	----	0.84				
1,2,3,4,6,7,8-HpCDD	39.00	----	0.47				
Total HpCDD	84.00	----	0.47				
OCDF	47.00	----	2.80	Y			
OCDD	410.00	----	4.00				

Total 2,3,7,8-TCDD
Equivalence: 4.6 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present
Y = Calculated using average of daily RFs

REPORT OF LABORATORY ANALYSIS

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-007-1.6-1.85		
Lab Sample ID	10365194003		
Filename	U161012A_10		
Injected By	SMT		
Total Amount Extracted	14.2 g	Matrix	Solid
% Moisture	81.4	Dilution	NA
Dry Weight Extracted	2.64 g	Collected	10/04/2016 12:42
ICAL ID	U161011	Received	10/06/2016 20:25
CCal Filename(s)	U161012A_01 & U161012A_17	Extracted	10/10/2016 16:10
Method Blank ID	BLANK-52316	Analyzed	10/12/2016 17:01

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg	
2,3,7,8-TCDF	2.60	----	0.34	J
Total TCDF	18.00	----	0.34	
2,3,7,8-TCDD	----	0.60	0.36	IJ
Total TCDD	4.30	----	0.36	
1,2,3,7,8-PeCDF	1.20	----	0.37	J
2,3,4,7,8-PeCDF	1.50	----	0.20	J
Total PeCDF	35.00	----	0.29	
1,2,3,7,8-PeCDD	1.00	----	0.34	J
Total PeCDD	15.00	----	0.34	J
1,2,3,4,7,8-HxCDF	3.30	----	0.72	J
1,2,3,6,7,8-HxCDF	18.00	----	0.59	J
2,3,4,6,7,8-HxCDF	3.80	----	0.58	J
1,2,3,7,8,9-HxCDF	ND	----	0.37	
Total HxCDF	150.00	----	0.56	
1,2,3,4,7,8-HxCDD	0.67	----	0.43	J
1,2,3,6,7,8-HxCDD	6.00	----	0.71	J
1,2,3,7,8,9-HxCDD	3.40	----	0.30	J
Total HxCDD	44.00	----	0.48	
1,2,3,4,6,7,8-HpCDF	230.00	----	0.52	
1,2,3,4,7,8,9-HpCDF	2.60	----	1.00	J
Total HpCDF	400.00	----	0.77	
1,2,3,4,6,7,8-HpCDD	79.00	----	0.90	
Total HpCDD	170.00	----	0.90	
OCDF	110.00	----	1.90	Y
OCDD	840.00	----	2.70	

Internal Standards	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF-13C	2.00	68
2,3,7,8-TCDD-13C	2.00	92
1,2,3,7,8-PeCDF-13C	2.00	79
2,3,4,7,8-PeCDF-13C	2.00	73
1,2,3,7,8-PeCDD-13C	2.00	96
1,2,3,4,7,8-HxCDF-13C	2.00	72
1,2,3,6,7,8-HxCDF-13C	2.00	58
2,3,4,6,7,8-HxCDF-13C	2.00	71
1,2,3,7,8,9-HxCDF-13C	2.00	65
1,2,3,4,7,8-HxCDD-13C	2.00	81
1,2,3,6,7,8-HxCDD-13C	2.00	68
1,2,3,4,6,7,8-HpCDF-13C	2.00	68
1,2,3,4,7,8,9-HpCDF-13C	2.00	74
1,2,3,4,6,7,8-HpCDD-13C	2.00	89
OCDD-13C	4.00	52
1,2,3,4-TCDD-13C	2.00	NA
1,2,3,7,8,9-HxCDD-13C	2.00	NA
2,3,7,8-TCDD-37Cl4	0.20	85

Total 2,3,7,8-TCDD
Equivalence: 9.3 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present
Y = Calculated using average of daily RFs

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-008-1.15-1.40		
Lab Sample ID	10365194004		
Filename	U161012A_11		
Injected By	SMT		
Total Amount Extracted	16.5 g	Matrix	Solid
% Moisture	85.7	Dilution	NA
Dry Weight Extracted	2.36 g	Collected	10/04/2016 12:26
ICAL ID	U161011	Received	10/06/2016 20:25
CCal Filename(s)	U161012A_01 & U161012A_17	Extracted	10/10/2016 16:10
Method Blank ID	BLANK-52316	Analyzed	10/12/2016 17:48

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg		**Internal Standards**	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF	1.70	----	0.27	J	2,3,7,8-TCDF-13C	2.00	68
Total TCDF	5.10	----	0.27		2,3,7,8-TCDD-13C	2.00	92
					1,2,3,7,8-PeCDF-13C	2.00	77
2,3,7,8-TCDD	ND	----	0.35		2,3,4,7,8-PeCDF-13C	2.00	70
Total TCDD	0.52	----	0.35	J	1,2,3,7,8-PeCDD-13C	2.00	89
					1,2,3,4,7,8-HxCDF-13C	2.00	59
1,2,3,7,8-PeCDF	ND	----	0.30		1,2,3,6,7,8-HxCDF-13C	2.00	60
2,3,4,7,8-PeCDF	----	0.34	0.18	IJ	2,3,4,6,7,8-HxCDF-13C	2.00	71
Total PeCDF	4.50	----	0.24	J	1,2,3,7,8,9-HxCDF-13C	2.00	63
					1,2,3,4,7,8-HxCDD-13C	2.00	78
1,2,3,7,8-PeCDD	ND	----	0.24		1,2,3,6,7,8-HxCDD-13C	2.00	64
Total PeCDD	3.20	----	0.24	J	1,2,3,4,6,7,8-HpCDF-13C	2.00	64
					1,2,3,4,7,8,9-HpCDF-13C	2.00	69
1,2,3,4,7,8-HxCDF	ND	----	0.87		1,2,3,4,6,7,8-HpCDD-13C	2.00	82
1,2,3,6,7,8-HxCDF	----	0.92	0.81	IJ	OCDD-13C	4.00	63
2,3,4,6,7,8-HxCDF	ND	----	0.66				
1,2,3,7,8,9-HxCDF	ND	----	0.36		1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	15.00	----	0.68	J	1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	ND	----	0.62		2,3,7,8-TCDD-37Cl4	0.20	83
1,2,3,6,7,8-HxCDD	1.10	----	0.41	J			
1,2,3,7,8,9-HxCDD	----	0.64	0.31	IJ			
Total HxCDD	9.40	----	0.45	J			
1,2,3,4,6,7,8-HpCDF	23.00	----	1.50				
1,2,3,4,7,8,9-HpCDF	ND	----	1.50				
Total HpCDF	40.00	----	1.50				
1,2,3,4,6,7,8-HpCDD	12.00	----	0.71	J			
Total HpCDD	28.00	----	0.71				
OCDF	----	11.00	1.50	IJY			
OCDD	130.00	----	2.30				

Total 2,3,7,8-TCDD
Equivalence: 0.94 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit
ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present
Y = Calculated using average of daily RFs

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-009-1.75-2.0		
Lab Sample ID	10365194005		
Filename	U161012A_12		
Injected By	SMT		
Total Amount Extracted	15.6 g	Matrix	Solid
% Moisture	91.0	Dilution	NA
Dry Weight Extracted	1.40 g	Collected	10/04/2016 12:03
ICAL ID	U161011	Received	10/06/2016 20:25
CCal Filename(s)	U161012A_01 & U161012A_17	Extracted	10/10/2016 16:10
Method Blank ID	BLANK-52316	Analyzed	10/12/2016 18:34

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg	
2,3,7,8-TCDF	2.70	----	0.63	J
Total TCDF	10.00	----	0.63	
2,3,7,8-TCDD	ND	----	0.66	
Total TCDD	1.50	----	0.66	J
1,2,3,7,8-PeCDF	ND	----	0.58	
2,3,4,7,8-PeCDF	0.86	----	0.35	J
Total PeCDF	15.00	----	0.47	J
1,2,3,7,8-PeCDD	0.61	----	0.26	J
Total PeCDD	5.00	----	0.26	J
1,2,3,4,7,8-HxCDF	1.70	----	0.95	J
1,2,3,6,7,8-HxCDF	2.80	----	1.30	J
2,3,4,6,7,8-HxCDF	1.10	----	0.94	J
1,2,3,7,8,9-HxCDF	ND	----	0.50	
Total HxCDF	50.00	----	0.91	
1,2,3,4,7,8-HxCDD	ND	----	0.74	
1,2,3,6,7,8-HxCDD	3.20	----	0.91	J
1,2,3,7,8,9-HxCDD	1.50	----	1.00	J
Total HxCDD	24.00	----	0.88	J
1,2,3,4,6,7,8-HpCDF	71.00	----	1.80	
1,2,3,4,7,8,9-HpCDF	ND	----	1.80	
Total HpCDF	120.00	----	1.80	
1,2,3,4,6,7,8-HpCDD	35.00	----	1.20	J
Total HpCDD	70.00	----	1.20	
OCDF	34.00	----	4.20	JY
OCDD	380.00	----	4.50	

Internal Standards	**ng's Added**	**Percent Recovery**	
2,3,7,8-TCDF-13C	2.00	61	
2,3,7,8-TCDD-13C	2.00	75	
1,2,3,7,8-PeCDF-13C	2.00	72	
2,3,4,7,8-PeCDF-13C	2.00	67	
1,2,3,7,8-PeCDD-13C	2.00	84	
1,2,3,4,7,8-HxCDF-13C	2.00	64	
1,2,3,6,7,8-HxCDF-13C	2.00	58	
2,3,4,6,7,8-HxCDF-13C	2.00	70	
1,2,3,7,8,9-HxCDF-13C	2.00	54	
1,2,3,4,7,8-HxCDD-13C	2.00	78	
1,2,3,6,7,8-HxCDD-13C	2.00	65	
1,2,3,4,6,7,8-HpCDF-13C	2.00	63	
1,2,3,4,7,8,9-HpCDF-13C	2.00	69	
1,2,3,4,6,7,8-HpCDD-13C	2.00	83	
OCDD-13C	4.00	32	R
1,2,3,4-TCDD-13C	2.00	NA	
1,2,3,7,8,9-HxCDD-13C	2.00	NA	
2,3,7,8-TCDD-37Cl4	0.20	68	

Total 2,3,7,8-TCDD
Equivalence: 3.3 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
R = Recovery outside target range
Y = Calculated using average of daily RFs

REPORT OF LABORATORY ANALYSIS

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Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-010-1.45-1.70		
Lab Sample ID	10365194006		
Filename	U161012A_13		
Injected By	SMT		
Total Amount Extracted	15.6 g	Matrix	Solid
% Moisture	92.2	Dilution	NA
Dry Weight Extracted	1.22 g	Collected	10/04/2016 11:38
ICAL ID	U161011	Received	10/06/2016 20:25
CCal Filename(s)	U161012A_01 & U161012A_17	Extracted	10/10/2016 16:10
Method Blank ID	BLANK-52316	Analyzed	10/12/2016 19:21

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg		**Internal Standards**	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF	2.9	—	0.42	J	2,3,7,8-TCDF-13C	2.00	70
Total TCDF	8.2	—	0.42		2,3,7,8-TCDD-13C	2.00	93
					1,2,3,7,8-PeCDF-13C	2.00	83
2,3,7,8-TCDD	ND	—	0.51		2,3,4,7,8-PeCDF-13C	2.00	76
Total TCDD	2.9	—	0.51	J	1,2,3,7,8-PeCDD-13C	2.00	97
					1,2,3,4,7,8-HxCDF-13C	2.00	67
1,2,3,7,8-PeCDF	ND	—	0.63		1,2,3,6,7,8-HxCDF-13C	2.00	54
2,3,4,7,8-PeCDF	—	0.59	0.32	IJ	2,3,4,6,7,8-HxCDF-13C	2.00	71
Total PeCDF	3.4	—	0.48	J	1,2,3,7,8,9-HxCDF-13C	2.00	66
					1,2,3,4,7,8-HxCDD-13C	2.00	80
1,2,3,7,8-PeCDD	ND	—	0.64		1,2,3,6,7,8-HxCDD-13C	2.00	68
Total PeCDD	2.5	—	0.64	J	1,2,3,4,6,7,8-HpCDF-13C	2.00	67
					1,2,3,4,7,8,9-HpCDF-13C	2.00	71
1,2,3,4,7,8-HxCDF	ND	—	1.30		1,2,3,4,6,7,8-HpCDD-13C	2.00	83
1,2,3,6,7,8-HxCDF	ND	—	1.50		OCDD-13C	4.00	36 R
2,3,4,6,7,8-HxCDF	ND	—	1.00				
1,2,3,7,8,9-HxCDF	ND	—	0.73		1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	11.0	—	1.10	J	1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	ND	—	1.70		2,3,7,8-TCDD-37Cl4	0.20	84
1,2,3,6,7,8-HxCDD	ND	—	0.85				
1,2,3,7,8,9-HxCDD	ND	—	1.30				
Total HxCDD	9.1	—	1.30	J			
1,2,3,4,6,7,8-HpCDF	19.0	—	1.40	J			
1,2,3,4,7,8,9-HpCDF	ND	—	3.00				
Total HpCDF	32.0	—	2.20	J			
1,2,3,4,6,7,8-HpCDD	11.0	—	1.10	J			
Total HpCDD	22.0	—	1.10	J			
OCDF	13.0	—	4.60	JY			
OCDD	95.0	—	3.60				

Total 2,3,7,8-TCDD
Equivalence: 0.79 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
R = Recovery outside target range
I = Interference present
Y = Calculated using average of daily RFs

REPORT OF LABORATORY ANALYSIS

Method 8290 Blank Analysis Results

Lab Sample ID	BLANK-52316	Matrix	Solid
Filename	U161012A_06	Dilution	NA
Total Amount Extracted	10.2 g	Extracted	10/10/2016 16:10
ICAL ID	U161011	Analyzed	10/12/2016 13:53
CCal Filename(s)	U161012A_01 & U161012A_17	Injected By	SMT

Native Isomers	Conc ng/Kg	EMPC ng/Kg	EDL ng/Kg	Internal Standards	ng's Added	Percent Recovery
2,3,7,8-TCDF	ND	----	0.046	2,3,7,8-TCDF-13C	2.00	64
Total TCDF	0.054	----	0.046 J	2,3,7,8-TCDD-13C	2.00	89
				1,2,3,7,8-PeCDF-13C	2.00	73
2,3,7,8-TCDD	ND	----	0.064	2,3,4,7,8-PeCDF-13C	2.00	69
Total TCDD	ND	----	0.064	1,2,3,7,8-PeCDD-13C	2.00	92
				1,2,3,4,7,8-HxCDF-13C	2.00	69
1,2,3,7,8-PeCDF	ND	----	0.059	1,2,3,6,7,8-HxCDF-13C	2.00	66
2,3,4,7,8-PeCDF	ND	----	0.040	2,3,4,6,7,8-HxCDF-13C	2.00	70
Total PeCDF	ND	----	0.049	1,2,3,7,8,9-HxCDF-13C	2.00	64
				1,2,3,4,7,8-HxCDD-13C	2.00	77
1,2,3,7,8-PeCDD	ND	----	0.044	1,2,3,6,7,8-HxCDD-13C	2.00	66
Total PeCDD	ND	----	0.044	1,2,3,4,6,7,8-HpCDF-13C	2.00	68
				1,2,3,4,7,8,9-HpCDF-13C	2.00	69
1,2,3,4,7,8-HxCDF	ND	----	0.063	1,2,3,4,6,7,8-HpCDD-13C	2.00	84
1,2,3,6,7,8-HxCDF	ND	----	0.068	OCDD-13C	4.00	58
2,3,4,6,7,8-HxCDF	ND	----	0.060			
1,2,3,7,8,9-HxCDF	ND	----	0.063	1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	ND	----	0.063	1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	ND	----	0.074	2,3,7,8-TCDD-37Cl4	0.20	77
1,2,3,6,7,8-HxCDD	ND	----	0.076			
1,2,3,7,8,9-HxCDD	ND	----	0.079			
Total HxCDD	0.270	----	0.076 J			
1,2,3,4,6,7,8-HpCDF	ND	----	0.140			
1,2,3,4,7,8,9-HpCDF	ND	----	0.180			
Total HpCDF	ND	----	0.160			
1,2,3,4,6,7,8-HpCDD	0.087	----	0.086 J			
Total HpCDD	0.087	----	0.086 J			
OCDF	ND	----	0.170			
OCDD	ND	----	0.290			

Total 2,3,7,8-TCDD
Equivalence: 0.00087 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

Results reported on a total weight basis and are valid to no more than 2 significant figures.
J = Estimated value

Method 8290 Laboratory Control Spike Results

Lab Sample ID	LCS-52317		
Filename	U161012A_04	Matrix	Solid
Total Amount Extracted	10.4 g	Dilution	NA
ICAL ID	U161011	Extracted	10/10/2016 16:10
CCal Filename(s)	U161012A_01 & U161012A_17	Analyzed	10/12/2016 12:20
Method Blank ID	BLANK-52316	Injected By	SMT

Native Isomers	**Qs** (ng)	**Qm** (ng)	% Rec.	**Internal Standards**	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF	0.20	0.21	103	2,3,7,8-TCDF-13C	2.0	67
Total TCDF				2,3,7,8-TCDD-13C	2.0	95
				1,2,3,7,8-PeCDF-13C	2.0	79
2,3,7,8-TCDD	0.20	0.16	82	2,3,4,7,8-PeCDF-13C	2.0	73
Total TCDD				1,2,3,7,8-PeCDD-13C	2.0	94
				1,2,3,4,7,8-HxCDF-13C	2.0	73
1,2,3,7,8-PeCDF	1.0	1.00	100	1,2,3,6,7,8-HxCDF-13C	2.0	69
2,3,4,7,8-PeCDF	1.0	1.1	108	2,3,4,6,7,8-HxCDF-13C	2.0	71
Total PeCDF				1,2,3,7,8,9-HxCDF-13C	2.0	64
				1,2,3,4,7,8-HxCDD-13C	2.0	83
1,2,3,7,8-PeCDD	1.0	0.93	93	1,2,3,6,7,8-HxCDD-13C	2.0	69
Total PeCDD				1,2,3,4,6,7,8-HpCDF-13C	2.0	70
				1,2,3,4,7,8,9-HpCDF-13C	2.0	72
1,2,3,4,7,8-HxCDF	1.0	1.1	112	1,2,3,4,6,7,8-HpCDD-13C	2.0	87
1,2,3,6,7,8-HxCDF	1.0	1.0	102	OCDD-13C	4.0	63
2,3,4,6,7,8-HxCDF	1.0	1.0	102			
1,2,3,7,8,9-HxCDF	1.0	1.0	100	1,2,3,4-TCDD-13C	2.0	NA
Total HxCDF				1,2,3,7,8,9-HxCDD-13C	2.0	NA
1,2,3,4,7,8-HxCDD	1.0	1.0	101	2,3,7,8-TCDD-37Cl4	0.20	84
1,2,3,6,7,8-HxCDD	1.0	1.1	112			
1,2,3,7,8,9-HxCDD	1.0	1.1	108			
Total HxCDD						
1,2,3,4,6,7,8-HpCDF	1.0	1.1	106			
1,2,3,4,7,8,9-HpCDF	1.0	0.98	98			
Total HpCDF						
1,2,3,4,6,7,8-HpCDD	1.0	1.0	101			
Total HpCDD						
OCDF	2.0	2.3	117 Y			
OCDD	2.0	2.2	108			

Qs = Quantity Spiked
Qm = Quantity Measured
Rec. = Recovery (Expressed as Percent)
R = Recovery outside of target range

Y = RF averaging used in calculations
Nn = Value obtained from additional analysis
NA = Not Applicable
* = See Discussion

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

October 19, 2016

Nancy McDonald
Bay West Inc
5 Empire Drive
Saint Paul, MN 55103

RE: Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Dear Nancy McDonald:

Enclosed are the analytical results for sample(s) received by the laboratory on October 06, 2016. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Lori Castille
lori.castille@pacelabs.com
Project Manager

Enclosures

cc: Paul Raymaker, Bay West
Jeff Smith, Pace Analytical Services, Inc

CERTIFICATIONS

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10365195

Minnesota Certification IDs

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
Alaska Certification UST-107
525 N 8th Street, Salina, KS 67401
A2LA Certification #: 2926.01
Alaska Certification #: UST-078
Alaska Certification #MN00064
Alabama Certification #40770
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
Colorado Certification #Pace
Connecticut Certification #: PH-0256
EPA Region 8 Certification #: 8TMS-L
Florida/NELAP Certification #: E87605
Guam Certification #:14-008r
Georgia Certification #: 959
Georgia EPD #: Pace
Idaho Certification #: MN00064
Hawaii Certification #MN00064
Illinois Certification #: 200011
Indiana Certification#C-MN-01
Iowa Certification #: 368
Kansas Certification #: E-10167
Kentucky Dept of Envi. Protection - DW #90062
Kentucky Dept of Envi. Protection - WW #:90062
Louisiana DEQ Certification #: 3086
Louisiana DHH #: LA140001
Maine Certification #: 2013011
Maryland Certification #: 322
Michigan DEPH Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT0092
Nevada Certification #: MN_00064
Nebraska Certification #: Pace
New Jersey Certification #: MN-002
New York Certification #: 11647
North Carolina Certification #: 530
North Carolina State Public Health #: 27700
North Dakota Certification #: R-036
Ohio EPA #: 4150
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Oregon Certification #: MN300001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Saipan (CNMI) #:MP0003
South Carolina #:74003001
Texas Certification #: T104704192
Tennessee Certification #: 02818
Utah Certification #: MN000642013-4
Virginia DGS Certification #: 251
Virginia/VELAP Certification #: Pace
Washington Certification #: C486
West Virginia Certification #: 382
West Virginia DHHR #:9952C
Wisconsin Certification #: 999407970

SAMPLE SUMMARY

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10365195001	**BW16MLW-005-0.90-1.15**	Solid	10/04/16 13:09	10/06/16 20:25
10365195002	**BW16MLW-006-1.75-2.0**	Solid	10/04/16 12:58	10/06/16 20:25
10365195003	**BW16MLW-007-1.6-1.85**	Solid	10/04/16 12:42	10/06/16 20:25
10365195004	**BW16MLW-008-1.15-1.40**	Solid	10/04/16 12:26	10/06/16 20:25
10365195005	**BW16MLW-009-1.75-2.0**	Solid	10/04/16 12:03	10/06/16 20:25
10365195006	**BW16MLW-010-1.45-1.70**	Solid	10/04/16 11:38	10/06/16 20:25

SAMPLE ANALYTE COUNT

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Lab ID	Sample ID	Method	Analysts	Analytes Reported
10365195001	**BW16MLW-005-0.90-1.15**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1
10365195002	**BW16MLW-006-1.75-2.0**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1
10365195003	**BW16MLW-007-1.6-1.85**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1
10365195004	**BW16MLW-008-1.15-1.40**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1
10365195005	**BW16MLW-009-1.75-2.0**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1
10365195006	**BW16MLW-010-1.45-1.70**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1

PROJECT NARRATIVE

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Method: **EPA 6020A**
Description: 6020A MET ICPMS
Client: Bay West, Inc.
Date: October 19, 2016

General Information:
6 samples were analyzed for EPA 6020A. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 3050 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: 439755

A matrix spike and/or matrix spike duplicate (MS/MSD) were performed on the following sample(s): 10364962001

M6: Matrix spike and Matrix spike duplicate recovery not evaluated against control limits due to sample dilution.

- MS (Lab ID: 2390875)
  - Zinc

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Sample: BW16MLW-005-0.90-1.15 **Lab ID: 10365195001** Collected: 10/04/16 13:09 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**62.0**	mg/kg	6.8	1.2	20	10/12/16 10:24	10/13/16 10:27	7440-02-0	
Zinc	**176**	mg/kg	68.4	9.1	20	10/12/16 10:24	10/13/16 10:27	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**93.2**	%	0.10	0.10	1		10/18/16 10:59		

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Sample: BW16MLW-006-1.75-2.0 **Lab ID: 10365195002** Collected: 10/04/16 12:58 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**39.0**	mg/kg	2.4	0.42	20	10/12/16 10:24	10/13/16 10:31	7440-02-0	
Zinc	**108**	mg/kg	24.2	3.2	20	10/12/16 10:24	10/13/16 10:31	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**83.4**	%	0.10	0.10	1		10/18/16 11:00		

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Sample: BW16MLW-007-1.6-1.85 **Lab ID: 10365195003** Collected: 10/04/16 12:42 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**28.4**	mg/kg	2.5	0.43	20	10/12/16 10:24	10/13/16 10:36	7440-02-0	
Zinc	**84.5**	mg/kg	25.1	3.3	20	10/12/16 10:24	10/13/16 10:36	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**84.7**	%	0.10	0.10	1		10/18/16 11:00		

REPORT OF LABORATORY ANALYSIS

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Sample: BW16MLW-008-1.15-1.40 **Lab ID: 10365195004** Collected: 10/04/16 12:26 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**38.7**	mg/kg	2.8	0.49	20	10/12/16 10:24	10/13/16 10:40	7440-02-0	
Zinc	**67.3**	mg/kg	28.0	3.7	20	10/12/16 10:24	10/13/16 10:40	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**85.5**	%	0.10	0.10	1		10/18/16 11:00		

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Sample: BW16MLW-009-1.75-2.0 **Lab ID: 10365195005** Collected: 10/04/16 12:03 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**13.5**	mg/kg	3.3	0.57	20	10/12/16 10:24	10/13/16 10:45	7440-02-0	
Zinc	**27.4J**	mg/kg	32.8	4.4	20	10/12/16 10:24	10/13/16 10:45	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**87.9**	%	0.10	0.10	1		10/18/16 11:00		

REPORT OF LABORATORY ANALYSIS

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Sample: BW16MLW-010-1.45-1.70 **Lab ID: 10365195006** Collected: 10/04/16 11:38 Received: 10/06/16 20:25 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**17.1**	mg/kg	3.4	0.59	20	10/12/16 10:24	10/13/16 10:49	7440-02-0	
Zinc	**30.9J**	mg/kg	34.2	4.5	20	10/12/16 10:24	10/13/16 10:49	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**88.3**	%	0.10	0.10	1		10/18/16 11:01		

QUALITY CONTROL DATA

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

QC Batch: 439755 Analysis Method: EPA 6020A
QC Batch Method: EPA 3050 Analysis Description: 6020A Solids UPD4
Associated Lab Samples: 10365195001, 10365195002, 10365195003, 10365195004, 10365195005, 10365195006

METHOD BLANK: 2390873 Matrix: Solid
Associated Lab Samples: 10365195001, 10365195002, 10365195003, 10365195004, 10365195005, 10365195006

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Nickel	mg/kg	ND	0.50	0.087	10/13/16 10:08	
Zinc	mg/kg	ND	5.0	0.66	10/13/16 10:08	

LABORATORY CONTROL SAMPLE: 2390874

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nickel	mg/kg	49	49.9	102	80-120	
Zinc	mg/kg	49	47.8	98	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2390875 2390876

Parameter	Units	10364962001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nickel	mg/kg	17.6	55.7	58.9	80.5	77.0	113	101	80-120	4	20	
Zinc	mg/kg	232	55.7	58.9	269	287	66	93	80-120	6	20	M6

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

QC Batch: 441644
Analysis Method: ASTM D2974
QC Batch Method: ASTM D2974
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 10365195001, 10365195002, 10365195003, 10365195004, 10365195005, 10365195006

SAMPLE DUPLICATE: 2404092

Parameter	Units	10365195006 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	88.3	88.5	0	30	

SAMPLE DUPLICATE: 2404495

Parameter	Units	10366384001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	17.9	16.5	8	30	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10365195

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

ANALYTE QUALIFIERS

M6	Matrix spike and Matrix spike duplicate recovery not evaluated against control limits due to sample dilution.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10365195

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10365195001	**BW16MLW-005-0.90-1.15**	EPA 3050	439755	EPA 6020A	440829
10365195002	**BW16MLW-006-1.75-2.0**	EPA 3050	439755	EPA 6020A	440829
10365195003	**BW16MLW-007-1.6-1.85**	EPA 3050	439755	EPA 6020A	440829
10365195004	**BW16MLW-008-1.15-1.40**	EPA 3050	439755	EPA 6020A	440829
10365195005	**BW16MLW-009-1.75-2.0**	EPA 3050	439755	EPA 6020A	440829
10365195006	**BW16MLW-010-1.45-1.70**	EPA 3050	439755	EPA 6020A	440829
10365195001	**BW16MLW-005-0.90-1.15**	ASTM D2974	441644		
10365195002	**BW16MLW-006-1.75-2.0**	ASTM D2974	441644		
10365195003	**BW16MLW-007-1.6-1.85**	ASTM D2974	441644		
10365195004	**BW16MLW-008-1.15-1.40**	ASTM D2974	441644		
10365195005	**BW16MLW-009-1.75-2.0**	ASTM D2974	441644		
10365195006	**BW16MLW-010-1.45-1.70**	ASTM D2974	441644		

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

10365195

Section A Required Client Information:	**Section B** Required Project Information:	**Section C** Invoice Information:	**Section D** EQuIS Information:	
Company: Bay West, LLC	Report To: Nancy McDonald	Attention: Accounts Payable	Facility_Name: St. Louis River Sediment Areas of Concern	Page 1 of 1
Address: 5 Empire Drive	Copy To: Paul Raymaker	Company Name: Bay West, LLC	Facility_Code: St Louis River Sed	
St. Paul, MN 55103		Address: 5 Empire Drive	Facility_ID: 547023	COC# SLR-MLW-1
Email To: nmcdonald@baywest.com	Purchase Order No.: 108002	Lab Quote Reference: 3000017136	Subfacility_code:	
Phone: 651-291-3483	Project Name: SLR Sediment AOCs	Lab Project Manager: Oyeyemi Odujole		Site Location STATE: MN
Requested Due Date/TAT: Standard	Project Number: J160139			

Section E Required Client Information

Valid Matrix Codes
MATRIX CODE
Drinking Water DW
Waste Water W
Product WW
Soil/Solid P
Oil SO
Wipe OL
Air WP
Tissue AR
Other TS
OT

ITEM #	Sample Location ID (sys_loc_code)	Sample ID (sys_sample_code)	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	Collection DATE	Collection Time	# OF CONTAINERS	Preservatives Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Requested Analysis Nickel (6020A)	Zinc (6020A)	Dioxins/furans (8290A)	% Moisture		Comments
Ex.	BW15MLW-005	BW14MLW-005-0-0.15	SO	G	3/12/15	1204															
1	BW16MLW-005	BW16MLW-005-0.90-1.15	SO	G	10/4/16	1309	3	3								1	1	1		001	Collect % moisture from 4 oz jar
2	BW16MLW-006	BW16MLW-006-1.75-2.0	SO	G	10/4/16	1258	3	3								1	1	1		002	Collect % moisture from 4 oz jar
3	BW16MLW-007	BW16MLW-007-1.6-1.85	SO	G	10/4/16	1242	3	3								1	1	1		003	Collect % moisture from 4 oz jar
4	BW16MLW-008	BW16MLW-008-1.15-1.40	SO	G	10/4/16	1226	3	3								1	1	1		004	Collect % moisture from 4 oz jar
5	BW16MLW-009	BW16MLW-009-1.75-2.0	SO	G	10/4/16	1203	3	3								1	1	1		005	Collect % moisture from 4 oz jar
6	BW16MLW-010	BW16MLW-010-1.45-1.70	SO	G	10/4/16	1138	3	3								1	1	1		006	Collect % moisture from 4 oz jar
7																					
8																					
9																					
10																					
11																					
12																					

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
Reference Pace Subcontractor Order Form signed by Pace on 9/16/16		10/6/16	1444	Kristina Polson	10/6/16	1445
	Kristina Polson	10/6/16	1715		10/6/16	1718
		10/6/16	2025			

SAMPLE CONDITIONS			
4.9	Y	N	Y
Temp (°C)	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Chris Murson

SIGNATURE of SAMPLER: CJM

DATE Signed (MM/DD/YY): 10/6/16

Pace Analytical®	Document Name: **Sample Condition Upon Receipt Form**	Document Revised: 02Aug2016 Page 1 of 2
	Document No.: **F-MN-L-213-rev.17**	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Bay West LLC

Project #: **WO# : 10365195**

10365195

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☒ Pace ☐ SpeeDee ☐ Other:

Tracking Number:

Custody Seal on Cooler/Box Present? ☒ Yes ☐ No **Seals Intact?** ☒ Yes ☐ No

Optional: Proj. Due Date: Proj. Name:

Packing Material: ☐ Bubble Wrap ☒ Bubble Bags ☐ None ☐ Other: **Temp Blank?** ☐ Yes ☐ No

Thermometer Used: ☒ 151401163 ☐ 151401164 ☐ B88A912167504 ☐ B88A0143310098 **Type of Ice:** ☐ Wet ☐ Blue ☐ None ☐ Samples on ice, cooling process has begun

Cooler Temp Read (°C): 0.0, 0.6, 4.7 **Cooler Temp Corrected (°C):** 0.2, 0.8, 4.9 **Biological Tissue Frozen?** ☐ Yes ☐ No ☒ N/A

Temp should be above freezing to 6°C **Correction Factor:** +0.2 **Date and Initials of Person Examining Contents:** CA 10.6.16

USDA Regulated Soil (☐ N/A, water sample)

Did samples originate in a quarantine zone within the United States: AL, AR, AZ, CA, FL, GA, ID, LA, MS, NC, NM, NY, OK, OR, SC, TN, TX or VA (check maps)? ☐ Yes ☒ No

Did samples originate from a foreign source (internationally, including Hawaii and Puerto Rico)? ☐ Yes ☒ No

If Yes to either question, fill out a Regulated Soil Checklist (F-MN-Q-338) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present?	☒ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out?	☒ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished?	☒ Yes	☐ No	☐ N/A	3.
Sampler Name and/or Signature on COC?	☒ Yes	☐ No	☐ N/A	4.
Samples Arrived within Hold Time?	☒ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72 hr)?	☐ Yes	☒ No	☐ N/A	6.
Rush Turn Around Time Requested?	☐ Yes	☒ No	☐ N/A	7.
Sufficient Volume?	☒ Yes	☐ No	☐ N/A	8.
Correct Containers Used?	☒ Yes	☐ No	☐ N/A	9.
-Pace Containers Used?	☒ Yes	☒ No	☐ N/A	
Containers Intact?	☒ Yes	☐ No	☐ N/A	10.
Filtered Volume Received for Dissolved Tests?	☐ Yes	☐ No	☒ N/A	11. Note if sediment is visible in the dissolved container
Sample Labels Match COC? -Includes Date/Time/ID/Analysis Matrix: SL	☒ Yes	☐ No	☐ N/A	12.
All containers needing acid/base preservation have been checked?	☐ Yes	☐ No	☒ N/A	13. ☐ HNO_3 ☐ H_2SO_4 ☐ NaOH ☐ HCl Sample #
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, HCl<2; NaOH >9 Sulfide, NaOH>12 Cyanide)	☐ Yes	☐ No	☒ N/A	
Exceptions: VOA, Coliform, TOC, Oil and Grease, DRO/8015 (water) DOC	☐ Yes	☐ No	☒ N/A	Initial when completed: Lot # of added preservative:
Headspace in VOA Vials (>6mm)?	☐ Yes	☐ No	☒ N/A	14.
Trip Blank Present?	☐ Yes	☐ No	☒ N/A	15.
Trip Blank Custody Seals Present?	☐ Yes	☐ No	☒ N/A	
Pace Trip Blank Lot # (if purchased):				

CLIENT NOTIFICATION/RESOLUTION **Field Data Required?** ☐ Yes ☐ No

Person Contacted: Date/Time:

Comments/Resolution:

Project Manager Review: **Date:** 10/7/16

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers).

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

October 27, 2016

Nancy McDonald
Bay West
5 Empire Drive
Saint Paul, MN 55103

RE: Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Dear Nancy McDonald:

Enclosed are the analytical results for sample(s) received by the laboratory on October 14, 2016. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Lori Castille
lori.castille@pacelabs.com
Project Manager

Enclosures

cc: Paul Raymaker, Bay West
Jeff Smith, Pace Analytical Services, Inc

CERTIFICATIONS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Minnesota Certification IDs

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
Alaska Certification UST-107
525 N 8th Street, Salina, KS 67401
A2LA Certification #: 2926.01
Alaska Certification #: UST-078
Alaska Certification #MN00064
Alabama Certification #40770
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
Colorado Certification #Pace
Connecticut Certification #: PH-0256
EPA Region 8 Certification #: 8TMS-L
Florida/NELAP Certification #: E87605
Guam Certification #:14-008r
Georgia Certification #: 959
Georgia EPD #: Pace
Idaho Certification #: MN00064
Hawaii Certification #MN00064
Illinois Certification #: 200011
Indiana Certification#C-MN-01
Iowa Certification #: 368
Kansas Certification #: E-10167
Kentucky Dept of Envi. Protection - DW #90062
Kentucky Dept of Envi. Protection - WW #:90062
Louisiana DEQ Certification #: 3086
Louisiana DHH #: LA140001
Maine Certification #: 2013011
Maryland Certification #: 322
Michigan DEPH Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT0092
Nevada Certification #: MN_00064
Nebraska Certification #: Pace
New Jersey Certification #: MN-002
New York Certification #: 11647
North Carolina Certification #: 530
North Carolina State Public Health #: 27700
North Dakota Certification #: R-036
Ohio EPA #: 4150
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Oregon Certification #: MN300001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Saipan (CNMI) #:MP0003
South Carolina #:74003001
Texas Certification #: T104704192
Tennessee Certification #: 02818
Utah Certification #: MN000642013-4
Virginia DGS Certification #: 251
Virginia/VELAP Certification #: Pace
Washington Certification #: C486
West Virginia Certification #: 382
West Virginia DHHR #:9952C
Wisconsin Certification #: 999407970

SAMPLE SUMMARY

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10366128001	**BW16MLW-001-0-0.15**	Solid	10/13/16 10:30	10/14/16 09:45
10366128002	**BW16MLW-002-0-0.15**	Solid	10/13/16 11:00	10/14/16 09:45
10366128003	**BW16MLW-003-0-0.15**	Solid	10/13/16 11:30	10/14/16 09:45

SAMPLE ANALYTE COUNT

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Lab ID	Sample ID	Method	Analysts	Analytes Reported
10366128001	**BW16MLW-001-0-0.15**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1
10366128002	**BW16MLW-002-0-0.15**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1
10366128003	**BW16MLW-003-0-0.15**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1

PROJECT NARRATIVE

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10366128

Method: **EPA 6020A**
Description: 6020A MET ICPMS
Client: Bay West, Inc.
Date: October 27, 2016

General Information:
3 samples were analyzed for EPA 6020A. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 3050 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

ANALYTICAL RESULTS

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10366128

Sample: BW16MLW-001-0-0.15 **Lab ID: 10366128001** Collected: 10/13/16 10:30 Received: 10/14/16 09:45 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**32.5**	mg/kg	2.8	0.49	20	10/19/16 14:18	10/20/16 10:02	7440-02-0	
Zinc	**165**	mg/kg	28.2	3.7	20	10/19/16 14:18	10/20/16 10:02	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**85.8**	%	0.10	0.10	1		10/26/16 14:11		

REPORT OF LABORATORY ANALYSIS

ANALYTICAL RESULTS

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10366128

Sample: BW16MLW-002-0-0.15 **Lab ID: 10366128002** Collected: 10/13/16 11:00 Received: 10/14/16 09:45 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**40.0**	mg/kg	3.0	0.52	20	10/19/16 14:18	10/20/16 10:07	7440-02-0	
Zinc	**185**	mg/kg	30.2	4.0	20	10/19/16 14:18	10/20/16 10:07	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**85.2**	%	0.10	0.10	1		10/26/16 14:11		

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Sample: BW16MLW-003-0-0.15 **Lab ID: 10366128003** Collected: 10/13/16 11:30 Received: 10/14/16 09:45 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**50.6**	mg/kg	2.9	0.51	20	10/19/16 14:18	10/20/16 10:11	7440-02-0	
Zinc	**328**	mg/kg	29.2	3.9	20	10/19/16 14:18	10/20/16 10:11	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**84.1**	%	0.10	0.10	1		10/26/16 14:11		

REPORT OF LABORATORY ANALYSIS

QUALITY CONTROL DATA

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

QC Batch: 441310
Analysis Method: EPA 6020A
QC Batch Method: EPA 3050
Analysis Description: 6020A Solids UPD4
Associated Lab Samples: 10366128001, 10366128002, 10366128003

METHOD BLANK: 2402404
Matrix: Solid
Associated Lab Samples: 10366128001, 10366128002, 10366128003

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Nickel	mg/kg	0.16J	0.46	0.080	10/20/16 09:36	
Zinc	mg/kg	ND	4.6	0.61	10/20/16 09:36	

LABORATORY CONTROL SAMPLE: 2402405

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nickel	mg/kg	46.3	50.2	108	80-120	
Zinc	mg/kg	46.3	48.2	104	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2402406 2402407

Parameter	Units	10366241001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nickel	mg/kg	17.1	50.8	56.6	62.4	75.6	89	103	80-120	19	20	
Zinc	mg/kg	41.5	50.8	56.6	86.8	102	89	107	80-120	16	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

QUALITY CONTROL DATA

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

QC Batch: 443355
Analysis Method: ASTM D2974
QC Batch Method: ASTM D2974
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 10366128001, 10366128002, 10366128003

SAMPLE DUPLICATE: 2416822

Parameter	Units	10367183012 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	2.1	2.1	1	30	

SAMPLE DUPLICATE: 2416823

Parameter	Units	10366203021 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	12.0	11.5	4	30	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10366128

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10366128001	**BW16MLW-001-0-0.15**	EPA 3050	441310	EPA 6020A	442244
10366128002	**BW16MLW-002-0-0.15**	EPA 3050	441310	EPA 6020A	442244
10366128003	**BW16MLW-003-0-0.15**	EPA 3050	441310	EPA 6020A	442244
10366128001	**BW16MLW-001-0-0.15**	ASTM D2974	443355		
10366128002	**BW16MLW-002-0-0.15**	ASTM D2974	443355		
10366128003	**BW16MLW-003-0-0.15**	ASTM D2974	443355		

10366128

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A
Required Client Information:

Company: Bay West, LLC
Address: 5 Empire Drive
St. Paul, MN 55103
Email To: mgarton@glec.com
Phone: 231-941-2230
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Mailee Garton - Great Lake Environmental Center
Copy To: Paul Raymaker - Bay West
Nancy McDonald - Bay West
Purchase Order No.: 108002
Project Name: SLR Sediment AOCs
Project Number: J160139

Section C
Invoice Information:

Attention: Accounts Payable
Company Name: Bay West, LLC
Address: 5 Empire Drive
Lab Quote Reference: 3000017136
Lab Project Manager: Oyeyemi Odujole

Section D
EQuIS Information:

Facility_Name: St. Louis River Sediment Areas of Concern
Facility_Code: St Louis River Sed.
Facility_ID: 547023
Subfacility_code:

Page 1 of 1
COC# SLR-ToxBio-MLW-01
Site Location STATE: MN

Section E
Required Client Information

Valid Matrix Codes

MATRIX	CODE
Drinking Water	DW
Water	W
Waste Water	WW
Product	P
Soil/Solid	SO
Oil	OL
Wipe	WP
Air	AR
Tissue	TS
Other	OT

					Collection			Preservatives								Requested Analysis				
ITEM #	Sample Location ID (sys_loc_code)	Sample ID (sys_sample_code)	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	DATE	Time	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Dioxins and furans (SW-846 8290A)	Nickel (6020A)	Zinc (6020A)	% Moisture	Comments
Ex.	*BW15MLW-005*	*BW14MLW-005-0-0.15*	*SO*	*G*	*3/12/15*	*1204*														
1	BW16MLW-001	BW16MLW-001-0.0-0.15	SO	G	10/13/16	10:30	4									X	X	X	X	001
2	BW16MLW-002	BW16MLW-002-0.0-0.15	SO	G	10/13/16	11:00	4									X	X	X	X	002
3	BW16MLW-003	BW16MLW-003-0.0-0.15	SO	G	10/13/16	11:30	4									X	X	X	X	003
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
Reference Pace Subcontractor Order Form signed by Pace on 9/16/16	Mailee W Garton / GLEC	10/13/16	14:00	PACE	10/14/16	09:45	1.1	Y	N	Y
							Temp (°C)	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Mailee W. Garton
SIGNATURE of SAMPLER: Mailee W Garton
DATE Signed (MM/DD/YY): 10/13/2016

Pace Analytical	Document Name: **Sample Condition Upon Receipt Form**	Document Revised: 02Aug2016 Page 1 of 2
	Document No.: **F-MN-L-213-rev.17**	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Bay West

Project #: WO# : 10366128

10366128

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace ☐ SpeeDee ☐ Other:

Tracking Number: 9802 5318 4934

Custody Seal on Cooler/Box Present? ☐ Yes ☑ No **Seals Intact?** ☐ Yes ☑ No

Optional: Proj. Due Date: Proj. Name:

Packing Material: ☑ Bubble Wrap ☑ Bubble Bags ☐ None ☐ Other:

Temp Blank? ☑ Yes ☐ No

Thermometer Used: ☑ 151401163 ☐ 151401164 ☐ B88A912167504 ☐ B88A0143310098

Type of Ice: ☑ Wet ☐ Blue ☐ None ☐ Samples on ice, cooling process has begun

Cooler Temp Read (°C): 0.9 **Cooler Temp Corrected (°C):** 1.1 **Biological Tissue Frozen?** ☐ Yes ☐ No ☑ N/A

Temp should be above freezing to 6°C **Correction Factor:** +0.2 **Date and Initials of Person Examining Contents:** K 10/14/16

USDA Regulated Soil (☐ N/A, water sample)

Did samples originate in a quarantine zone within the United States: AL, AR, AZ, CA, FL, GA, ID, LA, MS, NC, NM, NY, OK, OR, SC, TN, TX or VA (check maps)? ☐ Yes ☑ No

Did samples originate from a foreign source (internationally, including Hawaii and Puerto Rico)? ☐ Yes ☑ No

If Yes to either question, fill out a Regulated Soil Checklist (F-MN-Q-338) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present?	☑ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out?	☑ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished?	☑ Yes	☐ No	☐ N/A	3.
Sampler Name and/or Signature on COC?	☑ Yes	☐ No	☐ N/A	4.
Samples Arrived within Hold Time?	☑ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72 hr)?	☐ Yes	☑ No	☐ N/A	6.
Rush Turn Around Time Requested?	☐ Yes	☑ No	☐ N/A	7.
Sufficient Volume?	☑ Yes	☐ No	☐ N/A	8.
Correct Containers Used?	☑ Yes	☐ No	☐ N/A	9.
-Pace Containers Used?	☑ Yes	☐ No	☐ N/A	
Containers Intact?	☑ Yes	☐ No	☐ N/A	10.
Filtered Volume Received for Dissolved Tests?	☐ Yes	☐ No	☑ N/A	11. Note if sediment is visible in the dissolved container
Sample Labels Match COC? SL -Includes Date/Time/ID/Analysis Matrix:	☑ Yes	☐ No	☐ N/A	12.
All containers needing acid/base preservation have been checked?	☐ Yes	☐ No	☑ N/A	13. ☐ HNO$_3$ ☐ H$_2$SO$_4$ ☐ NaOH ☐ HCl
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO$_3$, H$_2$SO$_4$, HCl<2; NaOH >9 Sulfide, NaOH>12 Cyanide)	☐ Yes	☐ No	☑ N/A	Sample #
Exceptions: VOA, Coliform, TOC, Oil and Grease, DRO/8015 (water) DOC	☐ Yes	☐ No	☑ N/A	Initial when completed: Lot # of added preservative:
Headspace in VOA Vials (>6mm)?	☐ Yes	☐ No	☑ N/A	14.
Trip Blank Present?	☐ Yes	☐ No	☑ N/A	15.
Trip Blank Custody Seals Present?	☐ Yes	☐ No	☑ N/A	
Pace Trip Blank Lot # (if purchased):				

CLIENT NOTIFICATION/RESOLUTION

Field Data Required? ☐ Yes ☐ No

Person Contacted: Date/Time:

Comments/Resolution:

Project Manager Review: **Date:** 10/14/16

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers).

Pace Analytical Services, LLC
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

October 27, 2016

Nancy McDonald
Bay West
5 Empire Drive
Saint Paul, MN 55103

RE: Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Dear Nancy McDonald:

Enclosed are the analytical results for sample(s) received by the laboratory on October 14, 2016. The results relate only to the samples included in this report. Results reported herein conform to the most current, applicable TNI/NELAC standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Lori Castille
lori.castille@pacelabs.com
Project Manager

Enclosures

cc: Paul Raymaker, Bay West
Jeff Smith, Pace Analytical Services, Inc

CERTIFICATIONS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Minnesota Certification IDs

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
Alaska Certification UST-107
525 N 8th Street, Salina, KS 67401
A2LA Certification #: 2926.01
Alaska Certification #: UST-078
Alaska Certification #MN00064
Alabama Certification #40770
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
Colorado Certification #Pace
Connecticut Certification #: PH-0256
EPA Region 8 Certification #: 8TMS-L
Florida/NELAP Certification #: E87605
Guam Certification #:14-008r
Georgia Certification #: 959
Georgia EPD #: Pace
Idaho Certification #: MN00064
Hawaii Certification #MN00064
Illinois Certification #: 200011
Indiana Certification#C-MN-01
Iowa Certification #: 368
Kansas Certification #: E-10167
Kentucky Dept of Envi. Protection - DW #90062
Kentucky Dept of Envi. Protection - WW #:90062
Louisiana DEQ Certification #: 3086
Louisiana DHH #: LA140001
Maine Certification #: 2013011
Maryland Certification #: 322
Michigan DEPH Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT0092
Nevada Certification #: MN_00064
Nebraska Certification #: Pace
New Jersey Certification #: MN-002
New York Certification #: 11647
North Carolina Certification #: 530
North Carolina State Public Health #: 27700
North Dakota Certification #: R-036
Ohio EPA #: 4150
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Oregon Certification #: MN300001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Saipan (CNMI) #:MP0003
South Carolina #:74003001
Texas Certification #: T104704192
Tennessee Certification #: 02818
Utah Certification #: MN000642013-4
Virginia DGS Certification #: 251
Virginia/VELAP Certification #: Pace
Washington Certification #: C486
West Virginia Certification #: 382
West Virginia DHHR #:9952C
Wisconsin Certification #: 999407970

SAMPLE SUMMARY

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10366128

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10366128001	**BW16MLW-001-0-0.15**	Solid	10/13/16 10:30	10/14/16 09:45
10366128002	**BW16MLW-002-0-0.15**	Solid	10/13/16 11:00	10/14/16 09:45
10366128003	**BW16MLW-003-0-0.15**	Solid	10/13/16 11:30	10/14/16 09:45

SAMPLE ANALYTE COUNT

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Lab ID	Sample ID	Method	Analysts	Analytes Reported
10366128001	**BW16MLW-001-0-0.15**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1
10366128002	**BW16MLW-002-0-0.15**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1
10366128003	**BW16MLW-003-0-0.15**	EPA 6020A	RJS	2
		ASTM D2974	JDL	1

PROJECT NARRATIVE

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10366128

Method: **EPA 6020A**
Description: 6020A MET ICPMS
Client: Bay West, Inc.
Date: October 27, 2016

General Information:
3 samples were analyzed for EPA 6020A. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 3050 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Sample: BW16MLW-001-0-0.15 **Lab ID: 10366128001** Collected: 10/13/16 10:30 Received: 10/14/16 09:45 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**32.5**	mg/kg	2.8	0.49	20	10/19/16 14:18	10/20/16 10:02	7440-02-0	
Zinc	**165**	mg/kg	28.2	3.7	20	10/19/16 14:18	10/20/16 10:02	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**85.8**	%	0.10	0.10	1		10/26/16 14:11		

ANALYTICAL RESULTS

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

Sample: BW16MLW-002-0-0.15 **Lab ID: 10366128002** Collected: 10/13/16 11:00 Received: 10/14/16 09:45 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**40.0**	mg/kg	3.0	0.52	20	10/19/16 14:18	10/20/16 10:07	7440-02-0	
Zinc	**185**	mg/kg	30.2	4.0	20	10/19/16 14:18	10/20/16 10:07	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**85.2**	%	0.10	0.10	1		10/26/16 14:11		

ANALYTICAL RESULTS

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10366128

Sample: BW16MLW-003-0-0.15 **Lab ID: 10366128003** Collected: 10/13/16 11:30 Received: 10/14/16 09:45 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
6020A MET ICPMS	Analytical Method: EPA 6020A Preparation Method: EPA 3050								
Nickel	**50.6**	mg/kg	2.9	0.51	20	10/19/16 14:18	10/20/16 10:11	7440-02-0	
Zinc	**328**	mg/kg	29.2	3.9	20	10/19/16 14:18	10/20/16 10:11	7440-66-6	
Dry Weight	Analytical Method: ASTM D2974								
Percent Moisture	**84.1**	%	0.10	0.10	1		10/26/16 14:11		

REPORT OF LABORATORY ANALYSIS

QUALITY CONTROL DATA

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

QC Batch: 441310
Analysis Method: EPA 6020A
QC Batch Method: EPA 3050
Analysis Description: 6020A Solids UPD4
Associated Lab Samples: 10366128001, 10366128002, 10366128003

METHOD BLANK: 2402404
Matrix: Solid
Associated Lab Samples: 10366128001, 10366128002, 10366128003

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Nickel	mg/kg	0.16J	0.46	0.080	10/20/16 09:36	
Zinc	mg/kg	ND	4.6	0.61	10/20/16 09:36	

LABORATORY CONTROL SAMPLE: 2402405

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nickel	mg/kg	46.3	50.2	108	80-120	
Zinc	mg/kg	46.3	48.2	104	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2402406 2402407

Parameter	Units	10366241001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nickel	mg/kg	17.1	50.8	56.6	62.4	75.6	89	103	80-120	19	20	
Zinc	mg/kg	41.5	50.8	56.6	86.8	102	89	107	80-120	16	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: J160139 SLR Sediment AOCs
Pace Project No.: 10366128

QC Batch: 443355
Analysis Method: ASTM D2974
QC Batch Method: ASTM D2974
Analysis Description: Dry Weight/Percent Moisture
Associated Lab Samples: 10366128001, 10366128002, 10366128003

SAMPLE DUPLICATE: 2416822

Parameter	Units	10367183012 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	2.1	2.1	1	30	

SAMPLE DUPLICATE: 2416823

Parameter	Units	10366203021 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	12.0	11.5	4	30	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10366128

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project:	J160139 SLR Sediment AOCs
Pace Project No.:	10366128

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10366128001	**BW16MLW-001-0-0.15**	EPA 3050	441310	EPA 6020A	442244
10366128002	**BW16MLW-002-0-0.15**	EPA 3050	441310	EPA 6020A	442244
10366128003	**BW16MLW-003-0-0.15**	EPA 3050	441310	EPA 6020A	442244
10366128001	**BW16MLW-001-0-0.15**	ASTM D2974	443355		
10366128002	**BW16MLW-002-0-0.15**	ASTM D2974	443355		
10366128003	**BW16MLW-003-0-0.15**	ASTM D2974	443355		

10366128

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A
Required Client Information:
Company: Bay West, LLC
Address: 5 Empire Drive
St. Paul, MN 55103
Email To: mgarton@glec.com
Phone: 231-941-2230
Requested Due Date/TAT: Standard

Section B
Required Project Information:
Report To: Mailee Garton - Great Lake Environmental Center
Copy To: Paul Raymaker - Bay West
Nancy McDonald - Bay West
Purchase Order No.: 108002
Project Name: SLR Sediment AOCs
Project Number: J160139

Section C
Invoice Information:
Attention: Accounts Payable
Company Name: Bay West, LLC
Address: 5 Empire Drive
Lab Quote Reference: 3000017136
Lab Project Manager: Oyeyemi Odujole

Section D
EQuIS Information:
Facility_Name: St. Louis River Sediment Areas of Concern
Facility_Code: St Louis River Sed.
Facility_ID: 547023
Subfacility_code:

Page 1 of 1
COC# SLR-ToxBio-MLW-01
Site Location STATE: MN

Section E
Required Client Information

Valid Matrix Codes

MATRIX	CODE
Drinking Water	DW
Water	W
Waste Water	WW
Product	P
Soil/Solid	SO
Oil	OL
Wipe	WP
Air	AR
Tissue	TS
Other	OT

ITEM #	Sample Location ID (sys_loc_code)	Sample ID (sys_sample_code)	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	Collection DATE	Collection Time	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Dioxins and furans (SW-846 8290A)	Nickel (6020A)	Zinc (6020A)	% Moisture	Comments
Ex.	BW15MLW-005	BW14MLW-005-0-0.15	SO	G	3/12/15	1204														
1	BW16MLW-001	BW16MLW-001-0.0-0.15	SO	G	10/13/16	10:30	4									X	X	X	X	001
2	BW16MLW-002	BW16MLW-002-0.0-0.15	SO	G	10/13/16	11:00	4									X	X	X	X	002
3	BW16MLW-003	BW16MLW-003-0.0-0.15	SO	G	10/13/16	11:30	4									X	X	X	X	003
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

ADDITIONAL COMMENTS

Reference Pace Subcontractor Order Form signed by Pace on 9/16/16

RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	Temp (°C)	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
Mailee W Garton/GLEC	10/13/16	14:00	PACE	10/14/16	09:45	1.1	Y	N	Y

SAMPLE CONDITIONS

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: Mailee W. Garton
SIGNATURE of SAMPLER: Mailee W Garton
DATE Signed (MM/DD/YY): 10/13/2016

Pace Analytical	Document Name: **Sample Condition Upon Receipt Form**	Document Revised: 02Aug2016 Page 1 of 2
	Document No.: **F-MN-L-213-rev.17**	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Bay West

Project #: **WO#:10366128**

10366128

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace ☐ SpeeDee ☐ Other:

Tracking Number: 98025318 4934

Custody Seal on Cooler/Box Present? ☐ Yes ☑ No **Seals Intact?** ☐ Yes ☑ No

Optional: Proj. Due Date: Proj. Name:

Packing Material: ☑ Bubble Wrap ☑ Bubble Bags ☐ None ☐ Other:

Temp Blank? ☑ Yes ☐ No

Thermometer Used: ☑ 151401163 ☐ 151401164 ☐ B88A912167504 ☐ B88A0143310098

Type of Ice: ☑ Wet ☐ Blue ☐ None ☐ Samples on ice, cooling process has begun

Cooler Temp Read (°C): 0.9 **Cooler Temp Corrected (°C):** 1.1 **Biological Tissue Frozen?** ☐ Yes ☐ No ☑ N/A

Temp should be above freezing to 6°C **Correction Factor:** +0.2 **Date and Initials of Person Examining Contents:** KL 10/14/16

USDA Regulated Soil (☐ N/A, water sample)

Did samples originate in a quarantine zone within the United States: AL, AR, AZ, CA, FL, GA, ID, LA. MS, NC, NM, NY, OK, OR, SC, TN, TX or VA (check maps)? ☐ Yes ☑ No

Did samples originate from a foreign source (internationally, including Hawaii and Puerto Rico)? ☐ Yes ☑ No

If Yes to either question, fill out a Regulated Soil Checklist (F-MN-Q-338) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present?	☑ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out?	☑ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished?	☑ Yes	☐ No	☐ N/A	3.
Sampler Name and/or Signature on COC?	☑ Yes	☐ No	☐ N/A	4.
Samples Arrived within Hold Time?	☑ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72 hr)?	☐ Yes	☑ No	☐ N/A	6.
Rush Turn Around Time Requested?	☐ Yes	☑ No	☐ N/A	7.
Sufficient Volume?	☑ Yes	☐ No	☐ N/A	8.
Correct Containers Used?	☑ Yes	☐ No	☐ N/A	9.
-Pace Containers Used?	☑ Yes	☐ No	☐ N/A	
Containers Intact?	☑ Yes	☐ No	☐ N/A	10.
Filtered Volume Received for Dissolved Tests?	☐ Yes	☐ No	☑ N/A	11. Note if sediment is visible in the dissolved container
Sample Labels Match COC? SL -Includes Date/Time/ID/Analysis Matrix:	☑ Yes	☐ No	☐ N/A	12.
All containers needing acid/base preservation have been checked?	☐ Yes	☐ No	☑ N/A	13. ☐ HNO_3 ☐ H_2SO_4 ☐ NaOH ☐ HCl
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, HCl<2; NaOH >9 Sulfide, NaOH>12 Cyanide)	☐ Yes	☐ No	☑ N/A	Sample #
Exceptions: VOA, Coliform, TOC, Oil and Grease, DRO/8015 (water) DOC	☐ Yes	☐ No	☑ N/A	Initial when completed: Lot # of added preservative:
Headspace in VOA Vials (>6mm)?	☐ Yes	☐ No	☑ N/A	14.
Trip Blank Present?	☐ Yes	☐ No	☑ N/A	15.
Trip Blank Custody Seals Present?	☐ Yes	☐ No	☑ N/A	
Pace Trip Blank Lot # (if purchased):				

CLIENT NOTIFICATION/RESOLUTION

Field Data Required? ☐ Yes ☐ No

Person Contacted: Date/Time:

Comments/Resolution:

Project Manager Review: **Date:** 10/14/16

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers).

Pace Analytical™
www.pacelabs.com

Pace Analytical Services, Inc.
1700 Elm Street
Minneapolis, MN 55414
Phone: 612.607.1700
Fax: 612.607.6444

Report Prepared for:

Nancy McDonald
Bay West, Inc.
5 Empire Drive
Saint Paul MN 55103

REPORT OF LABORATORY ANALYSIS FOR PCDD/PCDF

Report Prepared Date:

October 28, 2016

Report Information:

Pace Project #: 10366129
Sample Receipt Date: 10/14/2016
Client Project #: J160139 SLR Sediment AOCs
Client Sub PO #: N/A
State Cert #: 027-053-137

Invoicing & Reporting Options:

The report provided has been invoiced as a Level 2 PCDD/PCDF Report. If an upgrade of this report package is requested, an additional charge may be applied.

Please review the attached invoice for accuracy and forward any questions to Carolynne Trout, your Pace Project Manager.

This report has been reviewed by:

Carolynne Trout

October 28, 2016
Carolynne Trout, Project Manager
(612) 607-6351
(612) 607-6444 (fax)
Carolynne.Trout@pacelabs.com

Report of Laboratory Analysis

DISCUSSION

This report presents the results from the analyses performed on three samples submitted by a representative of BayWest, Inc. The samples were analyzed for the presence or absence of polychlorodibenzo-p-dioxins (PCDDs) and polychlorodibenzofurans (PCDFs) using a modified version of USEPA Method 8290. The reporting limits were based on signal-to-noise measurements. Estimated Maximum Possible Concentration (EMPC) values were treated as positives in the toxic equivalence calculations.

Second column confirmation analyses of 2,3,7,8-TCDF values obtained from the primary (DB5-MS) column are performed only when specifically requested for a project and only when the values are above the concentration of the lowest calibration standard. Typical resolution for this isomer using the DB5-MS column ranges from 25-30%.

The recoveries of the isotopically-labeled PCDD/PCDF internal standards in the sample extracts ranged from 62-88%. All of the labeled standard recoveries obtained for this project were within the 40-135% target range specified in Method 8290. Also, since the quantification of the native 2,3,7,8-substituted congeners was based on isotope dilution, the data were automatically corrected for variation in recovery and accurate values were obtained.

Values were flagged "I" where incorrect isotope ratios were obtained. Concentrations below the calibration range were flagged "J" and should be regarded as estimates.

A laboratory method blank was prepared and analyzed with the sample batch as part of our routine quality control procedures. The results show the blank to contain trace levels of selected congeners. These levels were below the calibration range of the method. The levels reported for the affected congeners in the field samples were higher than the corresponding blank levels by one or more orders of magnitude. These results indicate that the sample processing steps did not contribute significantly to the levels reported for the field samples.

Laboratory and matrix spike samples were also prepared with the sample batch using clean reference matrix or sample matrix that had been fortified with native standard materials. The results show that the spiked native compounds were generally recovered at 71-122% with relative percent differences (RPDs) generally from 0.0-5.2%. The background-subtracted recovery values obtained for OCDD in the matrix spike analyses were below the 70-130% target range. This deviation may be due to the level of this congener in the sample material.

The responses obtained for selected labeled congeners in calibration standard analyses F161027B_18 were outside the target range. As specified in our procedures, the averages of the daily response factors for these compounds were used in the calculations for the samples from this runshift. The affected values were flagged "Y" on the results tables. It should be noted that the accuracy of the native congener determinations was not impacted by these deviations.

Minnesota Laboratory Certifications

Authority	Certificate #	Authority	Certificate #
A2LA	2926.01	Mississippi	MN00064
Alabama	40770	Montana	92
Alaska	MN00064	Nebraska	NE-OS-18-06
Arizona	AZ0014	Nevada	MN_00064_200
Arkansas	88-0680	New Jersey (NE	MN002
California	01155CA	New York (NEL	11647
Colorado	MN00064	North Carolina	27700
Connecticut	PH-0256	North Dakota	R-036
EPA Region 8	8TMS-Q	Ohio	4150
Florida (NELAP	E87605	Oklahoma	D9922
Georgia (DNR)	959	Oregon (ELAP)	MN200001-005
Guam	959	Oregon (OREL	MN300001-001
Hawaii	SLD	Pennsylvania	68-00563
Idaho	MN00064	Puerto Rico	MN00064
Illinois	200012	Saipan	MP0003
Indiana	C-MN-01	South Carolina	74003001
Indiana	C-MN-01	Tennessee	TN02818
Iowa	368	Texas	T104704192-08
Kansas	E-10167	Utah (NELAP)	MN00064
Kentucky	90062	Virginia	00251
Louisiana	03086	Washington	C755
Maine	2007029	West Virginia #	9952C
Maryland	322	West Virginia D	382
Michigan	9909	Wisconsin	999407970
Minnesota	027-053-137	Wyoming	8TMS-Q

Appendix A

Sample Management

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

10366129

Section A
Required Client Information:
Company: Bay West, LLC
Address: 5 Empire Drive
St. Paul, MN 55103
Email To: mgarton@glec.com
Phone: 231-941-2230
Requested Due Date/TAT: Standard

Section B
Required Project Information:
Report To: Mailee Garton - Great Lake Environmental Center
Copy To: Paul Raymaker - Bay West
Nancy McDonald - Bay West
Purchase Order No.: 108002
Project Name: SLR Sediment AOCs
Project Number: J160139

Section C
Invoice Information:
Attention: Accounts Payable
Company Name: Bay West, LLC
Address: 5 Empire Drive
Lab Quote Reference: 3000017136
Lab Project Manager: Oyeyemi Odujole

Section D
EQuIS Information:
Facility_Name: St. Louis River Sediment Areas of Concern
Facility_Code: St Louis River Sed
Facility_ID: 547023
Subfacility_code:

Page 1 of 1
COC# SLR-ToxBio-MLW-01
Site Location STATE: MN

Section E Required Client Information

Valid Matrix Codes: MATRIX / CODE
Drinking Water DW
Water W
Waste Water WW
Product P
Soil/Solid SO
Oil OL
Wipe WP
Air AR
Tissue TS
Other OT

ITEM #	Sample Location ID (sys_loc_code)	Sample ID (sys_sample_code)	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	Collection DATE	Collection Time	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Dioxins and furans (SW-846 8290A)	Nickel (6020A)	Zinc (6020A)	% Moisture	Comments
Ex.	BW15MLW-005	BW14MLW-005-0-0.15	SO	G	3/12/15	1204														
1	BW16MLW-001	BW16MLW-001-0.0-0.15	SO	G	10/13/16	10:30	4									X	X	X	X	001
2	BW16MLW-002	BW16MLW-002-0.0-0.15	SO	G	10/13/16	11:00	4									X	X	X	X	002
3	BW16MLW-003	BW16MLW-003-0.0-0.15	SO	G	10/13/16	11:30	4									X	X	X	X	003
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
Reference Pace Subcontractor Order Form signed by Pace on 9/16/16	Mailee W Garton/GLEC	10/13/16	14:00	PACE	10-14-16	09:45

SAMPLE CONDITIONS

Temp (°C)	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
1.1	Y	N	Y

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: Mailee W. Garton
SIGNATURE of SAMPLER: Mailee W Garton
DATE Signed (MM/DD/YY): 10/13/2016

Pace Analytical	Document Name: **Sample Condition Upon Receipt Form**	Document Revised: 02Aug2016 Page 1 of 2
	Document No.: **F-MN-L-213-rev.17**	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Bay West

Project #: WO# : 10366129

10366129

Courier: ☐ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace ☐ SpeeDee ☐ Other:

Tracking Number: 98025318 4934

Custody Seal on Cooler/Box Present? ☐ Yes ☒ No **Seals Intact?** ☐ Yes ☒ No

Optional: Proj. Due Date: Proj. Name:

Packing Material: ☒ Bubble Wrap ☒ Bubble Bags ☐ None ☐ Other:

Temp Blank? ☒ Yes ☐ No

Thermometer Used: ☒ 151401163 ☐ 151401164 ☐ B88A912167504 ☐ B88A0143310098

Type of Ice: ☒ Wet ☐ Blue ☐ None ☐ Samples on ice, cooling process has begun

Cooler Temp Read (°C): 0.9 **Cooler Temp Corrected (°C):** 1.1

Biological Tissue Frozen? ☐ Yes ☐ No ☒ N/A

Temp should be above freezing to 6°C **Correction Factor:** +0.2 **Date and Initials of Person Examining Contents:** KJ 10/14/16

USDA Regulated Soil (☐ N/A, water sample)

Did samples originate in a quarantine zone within the United States: AL, AR, AZ, CA, FL, GA, ID, LA. MS, NC, NM, NY, OK, OR, SC, TN, TX or VA (check maps)? ☐ Yes ☒ No

Did samples originate from a foreign source (internationally, including Hawaii and Puerto Rico)? ☐ Yes ☒ No

If Yes to either question, fill out a Regulated Soil Checklist (F-MN-Q-338) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present?	☒ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out?	☒ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished?	☒ Yes	☐ No	☐ N/A	3.
Sampler Name and/or Signature on COC?	☒ Yes	☐ No	☐ N/A	4.
Samples Arrived within Hold Time?	☒ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72 hr)?	☐ Yes	☒ No	☐ N/A	6.
Rush Turn Around Time Requested?	☐ Yes	☒ No	☐ N/A	7.
Sufficient Volume?	☒ Yes	☐ No	☐ N/A	8.
Correct Containers Used?	☒ Yes	☐ No	☐ N/A	9.
-Pace Containers Used?	☒ Yes	☐ No	☐ N/A	
Containers Intact?	☒ Yes	☐ No	☐ N/A	10.
Filtered Volume Received for Dissolved Tests?	☐ Yes	☐ No	☒ N/A	11. Note if sediment is visible in the dissolved container
Sample Labels Match COC? SL -Includes Date/Time/ID/Analysis Matrix:	☒ Yes	☐ No	☐ N/A	12.
All containers needing acid/base preservation have been checked?	☐ Yes	☐ No	☒ N/A	13. ☐ HNO₃ ☐ H₂SO₄ ☐ NaOH ☐ HCl
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO$_3$, H$_2$SO$_4$, HCl<2; NaOH >9 Sulfide, NaOH>12 Cyanide)	☐ Yes	☐ No	☒ N/A	Sample #
Exceptions: VOA, Coliform, TOC, Oil and Grease, DRO/8015 (water) DOC	☐ Yes	☐ No	☒ N/A	Initial when completed: Lot # of added preservative:
Headspace in VOA Vials (>6mm)?	☐ Yes	☐ No	☒ N/A	14.
Trip Blank Present?	☐ Yes	☐ No	☒ N/A	15.
Trip Blank Custody Seals Present?	☐ Yes	☐ No	☒ N/A	
Pace Trip Blank Lot # (if purchased):				

CLIENT NOTIFICATION/RESOLUTION **Field Data Required?** ☐ Yes ☐ No

Person Contacted: Date/Time:

Comments/Resolution:

Project Manager Review: Carolynne Trout **Date:** 10/17/16

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers).

Pace Container Order #172174

Addresses

Order By :		**Ship To :**		**Return To:**	
Company	Bay West, Inc.	Company	Great Lakes Environmental Center	Company	Pace Analytical Minnesota
Contact	Raymaker, Paul	Contact	Mailee Garton	Contact	Odujole, Oyeyemi
Email	praymaker@baywest.com	Email	mgarton@glec.com	Email	oyeyemi.odujole@pacelabs.com
Address	5 Empire Drive	Address	739 Hastings Street	Address	1700 Elm Street
Address 2		Address 2		Address 2	Suite 200
City	Saint Paul	City	Traverse City	City	Minneapolis
State	MN Zip 55103	State	MI Zip 49686	State	MN Zip 55414
Phone	NONE	Phone	(231) 941-2230	Phone	(612) 360-0714

Info

Project Name SLR

Due Date 10/10/2016

Profile 24380

Quote

Project Manager Odujole, Oyeyemi

Return

Carrier Most Economical

Location MI

Trip Blanks

☐ Include Trip Blanks

Bottle Labels

☒ Blank
☐ Pre-Printed No Sample IDs
☐ Pre-Printed With Sample IDs

Bottles

☐ Boxed Cases
☐ Individually Wrapped
☐ Grouped By Sample

Return Shipping Labels

☐ No Shipper Number
☐ With Shipper Number

COC Options

☒ Number of Blanks 1
☐ Pre-Printed

Misc

☐ Sampling Instructions
☒ Custody Seal
☒ Temp. Blanks
☒ Coolers
☐ Syringes
☐ Extra Bubble Wrap
☐ Short Hold/Rush Stickers
☐ DI Water Liter(s)
☐ USDA Regulated Soils

# of Samples	Matrix	Test	Container	Total	# of QC	Lot #	Notes
9 ⊛	SL	Dioxin High Res 8290	9oz. Amber Wide Mouth Jar unpres	9	0	082916-1LH	
3 ⊛	SL	Metals - 6020A Nickel	4oz Soil Jar	3	0	080816-1KM	
6	SL	Mercury - Mercury	4oz Soil Jar	6	0	080816-1KM	
3 ⊛	SL	Metals - 6020A Zinc	4oz Soil Jar	3	0	080816-1KM	
6	SL	TOC - 9060A Quad run	4oz. Amber Wide Mouth Jar unpres	6	0	080816-1KM	
9 ⊛	SL	Moisture/ Dry weight	4oz. Plastic	9	0	080116-5	
9	SL	Moisture/ Dry weight	None	0	0		

⊛ only sent in 3 samples. 10/13/16
will ship remaining samples later. - Mailee Garton
231-941-2230

Return w/ Samples

Hazard Shipping Placard In Place : NO

*Sample receiving hours are Mon-Fri 7:30am-7:00pm and Sat 9:00am-1:00pm unless special arrangements are made with your project manager.

*Pace Analytical reserves the right to return hazardous, toxic, or radioactive samples to you.
*Pace Analytical reserves the right to charge for unused bottles, as well as cost associated with sample storage and disposal.
*Payment term are net 30 days.
*Please include the proposal number on the chain of custody to insure proper billing.

Sample Notes

Ship Date : 10/06/2016
Prepared By: KG
Verified By:

Reporting Flags

A = Reporting Limit based on signal to noise

B = Less than 10x higher than method blank level

C = Result obtained from confirmation analysis

D = Result obtained from analysis of diluted sample

E = Exceeds calibration range

I = Interference present

J = Estimated value

Nn = Value obtained from additional analysis

P = PCDE Interference

R = Recovery outside target range

S = Peak saturated

U = Analyte not detected

V = Result verified by confirmation analysis

X = %D Exceeds limits

Y = Calculated using average of daily RFs

* = See Discussion

Appendix B

Sample Analysis Summary

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-001-0.0-0.15		
Lab Sample ID	10366129001		
Filename	F161027B_10		
Injected By	SMT		
Total Amount Extracted	19.7 g	Matrix	Solid
% Moisture	86.7	Dilution	NA
Dry Weight Extracted	2.62 g	Collected	10/13/2016 10:30
ICAL ID	F161011	Received	10/14/2016 09:45
CCal Filename(s)	F161027B_03 & F161027B_18	Extracted	10/24/2016 17:35
Method Blank ID	BLANK-52487	Analyzed	10/27/2016 23:24

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg	**Internal Standards**	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF	6.9	----	0.33	2,3,7,8-TCDF-13C	2.00	67
Total TCDF	68.0	----	0.33	2,3,7,8-TCDD-13C	2.00	74
				1,2,3,7,8-PeCDF-13C	2.00	80
2,3,7,8-TCDD	1.6	----	0.11 J	2,3,4,7,8-PeCDF-13C	2.00	81
Total TCDD	15.0	----	0.11	1,2,3,7,8-PeCDD-13C	2.00	87
				1,2,3,4,7,8-HxCDF-13C	2.00	66 Y
1,2,3,7,8-PeCDF	2.8	----	0.29 J	1,2,3,6,7,8-HxCDF-13C	2.00	76
2,3,4,7,8-PeCDF	6.2	----	0.18 J	2,3,4,6,7,8-HxCDF-13C	2.00	68 Y
Total PeCDF	130.0	----	0.23	1,2,3,7,8,9-HxCDF-13C	2.00	67
				1,2,3,4,7,8-HxCDD-13C	2.00	76
1,2,3,7,8-PeCDD	3.6	----	0.49 J	1,2,3,6,7,8-HxCDD-13C	2.00	63
Total PeCDD	43.0	----	0.49	1,2,3,4,6,7,8-HpCDF-13C	2.00	62
				1,2,3,4,7,8,9-HpCDF-13C	2.00	71
1,2,3,4,7,8-HxCDF	9.5	----	0.36 J	1,2,3,4,6,7,8-HpCDD-13C	2.00	83
1,2,3,6,7,8-HxCDF	28.0	----	0.40	OCDD-13C	4.00	69
2,3,4,6,7,8-HxCDF	10.0	----	0.30 J			
1,2,3,7,8,9-HxCDF	3.0	----	0.40 J	1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	400.0	----	0.36	1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	3.4	----	0.52 J	2,3,7,8-TCDD-37Cl4	0.20	66
1,2,3,6,7,8-HxCDD	21.0	----	1.10			
1,2,3,7,8,9-HxCDD	10.0	----	1.00 J			
Total HxCDD	190.0	----	0.88			
1,2,3,4,6,7,8-HpCDF	580.0	----	0.63			
1,2,3,4,7,8,9-HpCDF	5.5	----	0.58 J			
Total HpCDF	1000.0	----	0.60			
1,2,3,4,6,7,8-HpCDD	350.0	----	1.20			
Total HpCDD	770.0	----	1.20			
OCDF	250.0	----	0.40			
OCDD	3900.0	----	0.44			

Total 2,3,7,8-TCDD
Equivalence: 27 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
Y = Calculated using average of daily RFs

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-002-0.0-0.15		
Lab Sample ID	10366129002		
Filename	F161027B_11		
Injected By	SMT		
Total Amount Extracted	19.1 g	Matrix	Solid
% Moisture	85.5	Dilution	NA
Dry Weight Extracted	2.77 g	Collected	10/13/2016 11:00
ICAL ID	F161011	Received	10/14/2016 09:45
CCal Filename(s)	F161027B_03 & F161027B_18	Extracted	10/24/2016 17:35
Method Blank ID	BLANK-52487	Analyzed	10/28/2016 00:13

Native Isomers	Conc ng/Kg	EMPC ng/Kg	EDL ng/Kg	
2,3,7,8-TCDF	5.8	----	0.41	
Total TCDF	64.0	----	0.41	
2,3,7,8-TCDD	----	1.3	0.43	IJ
Total TCDD	13.0	----	0.43	
1,2,3,7,8-PeCDF	2.9	----	0.42	J
2,3,4,7,8-PeCDF	5.9	----	0.26	J
Total PeCDF	120.0	----	0.34	
1,2,3,7,8-PeCDD	2.9	----	0.33	J
Total PeCDD	45.0	----	0.33	
1,2,3,4,7,8-HxCDF	9.1	----	0.38	J
1,2,3,6,7,8-HxCDF	28.0	----	0.54	
2,3,4,6,7,8-HxCDF	9.8	----	0.49	J
1,2,3,7,8,9-HxCDF	3.3	----	0.35	J
Total HxCDF	370.0	----	0.44	
1,2,3,4,7,8-HxCDD	3.1	----	0.33	J
1,2,3,6,7,8-HxCDD	20.0	----	0.27	
1,2,3,7,8,9-HxCDD	9.6	----	0.42	J
Total HxCDD	180.0	----	0.34	
1,2,3,4,6,7,8-HpCDF	560.0	----	0.22	
1,2,3,4,7,8,9-HpCDF	5.5	----	0.53	J
Total HpCDF	970.0	----	0.38	
1,2,3,4,6,7,8-HpCDD	250.0	----	1.10	
Total HpCDD	530.0	----	1.10	
OCDF	270.0	----	0.36	
OCDD	2800.0	----	0.36	

Internal Standards	ng's Added	Percent Recovery
2,3,7,8-TCDF-13C	2.00	68
2,3,7,8-TCDD-13C	2.00	74
1,2,3,7,8-PeCDF-13C	2.00	79
2,3,4,7,8-PeCDF-13C	2.00	80
1,2,3,7,8-PeCDD-13C	2.00	88
1,2,3,4,7,8-HxCDF-13C	2.00	69 Y
1,2,3,6,7,8-HxCDF-13C	2.00	79
2,3,4,6,7,8-HxCDF-13C	2.00	70 Y
1,2,3,7,8,9-HxCDF-13C	2.00	68
1,2,3,4,7,8-HxCDD-13C	2.00	80
1,2,3,6,7,8-HxCDD-13C	2.00	64
1,2,3,4,6,7,8-HpCDF-13C	2.00	64
1,2,3,4,7,8,9-HpCDF-13C	2.00	74
1,2,3,4,6,7,8-HpCDD-13C	2.00	82
OCDD-13C	4.00	73
1,2,3,4-TCDD-13C	2.00	NA
1,2,3,7,8,9-HxCDD-13C	2.00	NA
2,3,7,8-TCDD-37Cl4	0.20	66

Total 2,3,7,8-TCDD
Equivalence: 24 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present
Y = Calculated using average of daily RFs

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-003-0.0-0.15		
Lab Sample ID	10366129003		
Filename	F161027B_12		
Injected By	SMT		
Total Amount Extracted	19.4 g	Matrix	Solid
% Moisture	81.2	Dilution	NA
Dry Weight Extracted	3.65 g	Collected	10/13/2016 11:30
ICAL ID	F161011	Received	10/14/2016 09:45
CCal Filename(s)	F161027B_03 & F161027B_18	Extracted	10/24/2016 17:35
Method Blank ID	BLANK-52487	Analyzed	10/28/2016 01:01

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg		**Internal Standards**	**ng's Added**	**Percent Recovery**	
2,3,7,8-TCDF	11.0	----	0.37		2,3,7,8-TCDF-13C	2.00	69	
Total TCDF	110.0	----	0.37		2,3,7,8-TCDD-13C	2.00	74	
					1,2,3,7,8-PeCDF-13C	2.00	77	
2,3,7,8-TCDD	2.6	----	0.23	J	2,3,4,7,8-PeCDF-13C	2.00	78	
Total TCDD	34.0	----	0.23		1,2,3,7,8-PeCDD-13C	2.00	85	
					1,2,3,4,7,8-HxCDF-13C	2.00	72	Y
1,2,3,7,8-PeCDF	8.3	----	0.19	J	1,2,3,6,7,8-HxCDF-13C	2.00	78	
2,3,4,7,8-PeCDF	10.0	----	0.39	J	2,3,4,6,7,8-HxCDF-13C	2.00	72	Y
Total PeCDF	230.0	----	0.29		1,2,3,7,8,9-HxCDF-13C	2.00	74	
					1,2,3,4,7,8-HxCDD-13C	2.00	83	
1,2,3,7,8-PeCDD	5.5	----	0.44	J	1,2,3,6,7,8-HxCDD-13C	2.00	68	
Total PeCDD	76.0	----	0.44		1,2,3,4,6,7,8-HpCDF-13C	2.00	65	
					1,2,3,4,7,8,9-HpCDF-13C	2.00	75	
1,2,3,4,7,8-HxCDF	19.0	----	0.46		1,2,3,4,6,7,8-HpCDD-13C	2.00	86	
1,2,3,6,7,8-HxCDF	84.0	----	0.41		OCDD-13C	4.00	74	
2,3,4,6,7,8-HxCDF	20.0	----	0.45					
1,2,3,7,8,9-HxCDF	5.7	----	0.42	J	1,2,3,4-TCDD-13C	2.00	NA	
Total HxCDF	810.0	----	0.43		1,2,3,7,8,9-HxCDD-13C	2.00	NA	
1,2,3,4,7,8-HxCDD	5.4	----	0.96	J	2,3,7,8-TCDD-37Cl4	0.20	67	
1,2,3,6,7,8-HxCDD	39.0	----	0.80					
1,2,3,7,8,9-HxCDD	18.0	----	0.41					
Total HxCDD	330.0	----	0.73					
1,2,3,4,6,7,8-HpCDF	1300.0	----	0.23					
1,2,3,4,7,8,9-HpCDF	11.0	----	2.10	J				
Total HpCDF	2200.0	----	1.20					
1,2,3,4,6,7,8-HpCDD	460.0	----	1.10					
Total HpCDD	990.0	----	1.10					
OCDF	570.0	----	0.31					
OCDD	5400.0	----	0.47					

Total 2,3,7,8-TCDD
Equivalence: 51 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
Y = Calculated using average of daily RFs

Method 8290 Blank Analysis Results

Lab Sample ID	BLANK-52487	Matrix	Solid
Filename	U161026B_10	Dilution	NA
Total Amount Extracted	20.2 g	Extracted	10/24/2016 17:35
ICAL ID	U161025	Analyzed	10/26/2016 23:46
CCal Filename(s)	U161026B_01 & U161026B_18	Injected By	SMT

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg	
2,3,7,8-TCDF	ND	----	0.029	
Total TCDF	0.040	----	0.029	J
2,3,7,8-TCDD	ND	----	0.043	
Total TCDD	ND	----	0.043	
1,2,3,7,8-PeCDF	ND	----	0.031	
2,3,4,7,8-PeCDF	ND	----	0.023	
Total PeCDF	ND	----	0.027	
1,2,3,7,8-PeCDD	ND	----	0.038	
Total PeCDD	ND	----	0.038	
1,2,3,4,7,8-HxCDF	ND	----	0.023	
1,2,3,6,7,8-HxCDF	ND	----	0.022	
2,3,4,6,7,8-HxCDF	ND	----	0.016	
1,2,3,7,8,9-HxCDF	ND	----	0.018	
Total HxCDF	ND	----	0.020	
1,2,3,4,7,8-HxCDD	ND	----	0.030	
1,2,3,6,7,8-HxCDD	ND	----	0.027	
1,2,3,7,8,9-HxCDD	ND	----	0.030	
Total HxCDD	0.042	----	0.029	J
1,2,3,4,6,7,8-HpCDF	ND	----	0.027	
1,2,3,4,7,8,9-HpCDF	ND	----	0.031	
Total HpCDF	ND	----	0.029	
1,2,3,4,6,7,8-HpCDD	ND	----	0.027	
Total HpCDD	0.083	----	0.027	J
OCDF	ND	----	0.047	
OCDD	0.140	----	0.062	J

Internal Standards	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF-13C	2.00	80
2,3,7,8-TCDD-13C	2.00	89
1,2,3,7,8-PeCDF-13C	2.00	81
2,3,4,7,8-PeCDF-13C	2.00	81
1,2,3,7,8-PeCDD-13C	2.00	87
1,2,3,4,7,8-HxCDF-13C	2.00	73
1,2,3,6,7,8-HxCDF-13C	2.00	75
2,3,4,6,7,8-HxCDF-13C	2.00	79
1,2,3,7,8,9-HxCDF-13C	2.00	85
1,2,3,4,7,8-HxCDD-13C	2.00	73
1,2,3,6,7,8-HxCDD-13C	2.00	67
1,2,3,4,6,7,8-HpCDF-13C	2.00	65
1,2,3,4,7,8,9-HpCDF-13C	2.00	73
1,2,3,4,6,7,8-HpCDD-13C	2.00	75
OCDD-13C	4.00	64
1,2,3,4-TCDD-13C	2.00	NA
1,2,3,7,8,9-HxCDD-13C	2.00	NA
2,3,7,8-TCDD-37Cl4	0.20	86

Total 2,3,7,8-TCDD
Equivalence: 0.000043 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

Results reported on a total weight basis and are valid to no more than 2 significant figures.
J = Estimated value

Method 8290 Laboratory Control Spike Results

Lab Sample ID	LCS-52488		
Filename	U161026B_06	Matrix	Solid
Total Amount Extracted	20.7 g	Dilution	NA
ICAL ID	U161025	Extracted	10/24/2016 17:35
CCal Filename(s)	U161026B_01 & U161026B_18	Analyzed	10/26/2016 20:38
Method Blank ID	BLANK-52487	Injected By	SMT

Native Isomers	**Qs** (ng)	**Qm** (ng)	% Rec.
2,3,7,8-TCDF	0.20	0.22	110
Total TCDF			
2,3,7,8-TCDD	0.20	0.19	95
Total TCDD			
1,2,3,7,8-PeCDF	1.0	1.1	111
2,3,4,7,8-PeCDF	1.0	1.2	117
Total PeCDF			
1,2,3,7,8-PeCDD	1.0	1.0	104
Total PeCDD			
1,2,3,4,7,8-HxCDF	1.0	1.1	113
1,2,3,6,7,8-HxCDF	1.0	1.2	116
2,3,4,6,7,8-HxCDF	1.0	1.1	108
1,2,3,7,8,9-HxCDF	1.0	1.1	109
Total HxCDF			
1,2,3,4,7,8-HxCDD	1.0	1.2	115
1,2,3,6,7,8-HxCDD	1.0	1.2	121
1,2,3,7,8,9-HxCDD	1.0	1.2	121
Total HxCDD			
1,2,3,4,6,7,8-HpCDF	1.0	1.1	114
1,2,3,4,7,8,9-HpCDF	1.0	1.0	104
Total HpCDF			
1,2,3,4,6,7,8-HpCDD	1.0	1.0	104
Total HpCDD			
OCDF	2.0	2.3	115
OCDD	2.0	2.4	121

Internal Standards	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF-13C	2.0	83
2,3,7,8-TCDD-13C	2.0	95
1,2,3,7,8-PeCDF-13C	2.0	79
2,3,4,7,8-PeCDF-13C	2.0	79
1,2,3,7,8-PeCDD-13C	2.0	86
1,2,3,4,7,8-HxCDF-13C	2.0	73
1,2,3,6,7,8-HxCDF-13C	2.0	72
2,3,4,6,7,8-HxCDF-13C	2.0	78
1,2,3,7,8,9-HxCDF-13C	2.0	84
1,2,3,4,7,8-HxCDD-13C	2.0	75
1,2,3,6,7,8-HxCDD-13C	2.0	68
1,2,3,4,6,7,8-HpCDF-13C	2.0	70
1,2,3,4,7,8,9-HpCDF-13C	2.0	76
1,2,3,4,6,7,8-HpCDD-13C	2.0	77
OCDD-13C	4.0	68
1,2,3,4-TCDD-13C	2.0	NA
1,2,3,7,8,9-HxCDD-13C	2.0	NA
2,3,7,8-TCDD-37Cl4	0.20	98

Qs = Quantity Spiked
Qm = Quantity Measured
Rec. = Recovery (Expressed as Percent)
R = Recovery outside of target range

Y = RF averaging used in calculations
Nn = Value obtained from additional analysis
NA = Not Applicable
* = See Discussion

Method 8290 Spiked Sample Report

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-001-0.0-0.15-MS		
Lab Sample ID	10366129001-MS		
Filename	F161027B_06	Matrix	Solid
Total Amount Extracted	19.8 g	Dilution	NA
ICAL ID	F161011	Extracted	10/24/2016 17:35
CCal Filename(s)	F161027B_03 & F161027B_18	Analyzed	10/27/2016 20:09
Method Blank ID	BLANK-52487	Injected By	SMT

Native Isomers	**Qs** (ng)	**Qm** (ng)	% Rec.
2,3,7,8-TCDF	0.20	0.24	119
2,3,7,8-TCDD	0.20	0.17	83
1,2,3,7,8-PeCDF	1.00	1.15	115
2,3,4,7,8-PeCDF	1.00	1.21	121
1,2,3,7,8-PeCDD	1.00	1.00	100
1,2,3,4,7,8-HxCDF	1.00	1.22	122
1,2,3,6,7,8-HxCDF	1.00	1.21	121
2,3,4,6,7,8-HxCDF	1.00	1.08	108
1,2,3,7,8,9-HxCDF	1.00	1.10	110
1,2,3,4,7,8-HxCDD	1.00	1.21	121
1,2,3,6,7,8-HxCDD	1.00	1.23	123
1,2,3,7,8,9-HxCDD	1.00	1.09	109
1,2,3,4,6,7,8-HpCDF	1.00	2.64	264
1,2,3,4,7,8,9-HpCDF	1.00	0.98	98
1,2,3,4,6,7,8-HpCDD	1.00	1.62	162
OCDF	2.00	2.99	150
OCDD	2.00	10.02	501

Internal Standards	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF-13C	2.00	66
2,3,7,8-TCDD-13C	2.00	73
1,2,3,7,8-PeCDF-13C	2.00	78
2,3,4,7,8-PeCDF-13C	2.00	81
1,2,3,7,8-PeCDD-13C	2.00	89
1,2,3,4,7,8-HxCDF-13C	2.00	65 Y
1,2,3,6,7,8-HxCDF-13C	2.00	82
2,3,4,6,7,8-HxCDF-13C	2.00	69 Y
1,2,3,7,8,9-HxCDF-13C	2.00	68
1,2,3,4,7,8-HxCDD-13C	2.00	77
1,2,3,6,7,8-HxCDD-13C	2.00	71
1,2,3,4,6,7,8-HpCDF-13C	2.00	65
1,2,3,4,7,8,9-HpCDF-13C	2.00	75
1,2,3,4,6,7,8-HpCDD-13C	2.00	85
OCDD-13C	4.00	75
1,2,3,4-TCDD-13C	2.00	NA
1,2,3,7,8,9-HxCDD-13C	2.00	NA
2,3,7,8-TCDD-37Cl4	0.20	68

Qs = Quantity Spiked

Qm = Quantity Measured

Rec. = Recovery (Expressed as Percent)

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
Y = Calculated using average of daily RFs

Method 8290 Spiked Sample Report

Client - Bay West, Inc.

Client's Sample ID	BW16MLW-001-0.0-0.15-MSD		
Lab Sample ID	10366129001-MSD		
Filename	F161027B_07	Matrix	Solid
Total Amount Extracted	19.7 g	Dilution	NA
ICAL ID	F161011	Extracted	10/24/2016 17:35
CCal Filename(s)	F161027B_03 & F161027B_18	Analyzed	10/27/2016 20:58
Method Blank ID	BLANK-52487	Injected By	SMT

Native Isomers	Qs (ng)	Qm (ng)	% Rec.
2,3,7,8-TCDF	0.20	0.24	119
2,3,7,8-TCDD	0.20	0.17	86
1,2,3,7,8-PeCDF	1.00	1.13	113
2,3,4,7,8-PeCDF	1.00	1.24	124
1,2,3,7,8-PeCDD	1.00	1.03	103
1,2,3,4,7,8-HxCDF	1.00	1.21	121
1,2,3,6,7,8-HxCDF	1.00	1.18	118
2,3,4,6,7,8-HxCDF	1.00	1.10	110
1,2,3,7,8,9-HxCDF	1.00	1.05	105
1,2,3,4,7,8-HxCDD	1.00	1.18	118
1,2,3,6,7,8-HxCDD	1.00	1.23	123
1,2,3,7,8,9-HxCDD	1.00	1.08	108
1,2,3,4,6,7,8-HpCDF	1.00	2.61	261
1,2,3,4,7,8,9-HpCDF	1.00	0.99	99
1,2,3,4,6,7,8-HpCDD	1.00	1.68	168
OCDF	2.00	3.04	152
OCDD	2.00	10.21	511

Internal Standards	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF-13C	2.00	69
2,3,7,8-TCDD-13C	2.00	74
1,2,3,7,8-PeCDF-13C	2.00	79
2,3,4,7,8-PeCDF-13C	2.00	82
1,2,3,7,8-PeCDD-13C	2.00	89
1,2,3,4,7,8-HxCDF-13C	2.00	68 Y
1,2,3,6,7,8-HxCDF-13C	2.00	81
2,3,4,6,7,8-HxCDF-13C	2.00	71 Y
1,2,3,7,8,9-HxCDF-13C	2.00	69
1,2,3,4,7,8-HxCDD-13C	2.00	81
1,2,3,6,7,8-HxCDD-13C	2.00	69
1,2,3,4,6,7,8-HpCDF-13C	2.00	65
1,2,3,4,7,8,9-HpCDF-13C	2.00	75
1,2,3,4,6,7,8-HpCDD-13C	2.00	84
OCDD-13C	4.00	73
1,2,3,4-TCDD-13C	2.00	NA
1,2,3,7,8,9-HxCDD-13C	2.00	NA
2,3,7,8-TCDD-37Cl4	0.20	65

Qs = Quantity Spiked   Qm = Quantity Measured   Rec. = Recovery (Expressed as Percent)

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
Y = Calculated using average of daily RFs

Method 8290 Spike Sample Results

Client - Bay West, Inc.

Client Sample ID	BW16MLW-001-0.0-0.15			Dry Weights	
Lab Sample ID	10366129001	Sample Filename	F161027B_10	Sample Amount	2.62 g
MS ID	10366129001-MS	MS Filename	F161027B_06	MS Amount	2.6 g
MSD ID	10366129001-MSD	MSD Filename	F161027B_07	MSD Amount	2.6 g

Analyte	Sample Conc. ng/Kg	MS/MSD Qs (ng)	MS Qm (ng)	MSD Qm (ng)	RPD	Background Subtracted MS % Rec.	Background Subtracted MSD % Rec.	Background Subtracted RPD
2,3,7,8-TCDF	6.872	0.20	0.24	0.24	0.3	110	110	0.3
2,3,7,8-TCDD	1.631	0.20	0.17	0.17	3.5	81	84	3.6
1,2,3,7,8-PeCDF	2.813	1.00	1.15	1.13	1.5	114	112	1.5
2,3,4,7,8-PeCDF	6.165	1.00	1.21	1.24	2.3	119	122	2.3
1,2,3,7,8-PeCDD	3.609	1.00	1.00	1.03	3.4	99	102	3.5
1,2,3,4,7,8-HxCDF	9.501	1.00	1.22	1.21	1.1	120	119	1.1
1,2,3,6,7,8-HxCDF	28.272	1.00	1.21	1.18	2.9	114	110	3.0
2,3,4,6,7,8-HxCDF	10.388	1.00	1.08	1.10	1.5	105	107	1.5
1,2,3,7,8,9-HxCDF	3.005	1.00	1.10	1.05	5.2	110	104	5.3
1,2,3,4,7,8-HxCDD	3.370	1.00	1.21	1.18	2.9	120	117	2.9
1,2,3,6,7,8-HxCDD	20.507	1.00	1.23	1.23	0.0	117	117	0.0
1,2,3,7,8,9-HxCDD	10.058	1.00	1.09	1.08	0.8	106	105	0.8
1,2,3,4,6,7,8-HpCDF	582.118	1.00	2.64	2.61	1.1	110	108	2.0
1,2,3,4,7,8,9-HpCDF	5.462	1.00	0.98	0.99	0.7	97	98	0.7
1,2,3,4,6,7,8-HpCDD	345.145	1.00	1.62	1.68	3.9	71	78	9.3
OCDF	251.261	2.00	2.99	3.04	1.5	117	119	2.1
OCDD	3881.063	2.00	10.02	10.21	1.9	0	2	200.0

Definitions

MS = Matrix Spike
MSD = Matrix Spike Duplicate
Qm = Quantity Measured
Qs = Quantity Spiked
% Rec. = Percent Recovery
RPD = Relative Percent Difference
NA = Not Applicable
NC = Not Calculated

CDD = Chlorinated dibenzo-p-dioxin
CDF = Chlorinated dibenzo-p-furan
T = Tetra
Pe = Penta
Hx = Hexa
Hp = Hepta
O = Octa

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DIOXIN/FURAN ANALYSIS

TISSUE SAMPLES

PROJECT NAME: SLR AOC DATA GAP INVESTIGATION

WORK ORDER #: 3000017136

Contract: 4819
Data Package Identification: DPWG57987

Analysis WG57620

20 January 2017

BAY WEST INC.
TISSUE SAMPLES

DIOXIN/FURAN ANALYSIS
AXYS METHODS: MLA-017
4819: L26338-1 to -5

Project: SLR AOC Data Gap Investigation
Work Order #: 3000017136

19 January 2017

NARRATIVE

This narrative describes the analysis of five tissue samples for the determination of polychlorinated dibenzodioxins and dibenzofurans using high-resolution gas chromatography / high-resolution mass spectrometry (HRGC/HRMS).

SAMPLE RECEIPT, STORAGE AND DESCRIPTION

The samples were received on the 29th of November 2016. Details of sample conditions upon receipt are provided on the Sample Receiving Record form included in the sample documentation section of this data package. Prior to sample preparation and analysis, the samples were stored at -20°C.

It was noted that '#' on the original sample IDs have been removed for programming reasons. Sample ID discrepancies between the Chain of Custody (COC) and the sample container labelling for L26338-1 was noted by the receiving chemist, the sample ID was logged in based on COC.

SAMPLE ANALYSIS

The samples and QC samples (a procedural blank and two Ongoing Precision and Recovery (OPR) samples) were analyzed in one batch named WG57620. The composition of the analysis batch is shown on the Correlation Table included in this data package.

Extraction and analysis procedures were in accordance with AXYS Method MLA-017: ***Analytical Method for the Determination of Polychlorinated Dibenzodioxins and Dibenzofurans by EPA Method 1613B, EPA Method 8290/8290A OR EPA Method DLM02.2***. The method summary, MSU-017, is included following this narrative.

The samples were accurately weighed, spiked with isotopically-labeled quantification standards and Soxhlet extracted with 1:1 DCM:Hexane. The resulting extract was spiked with ^{13}C-labeled cleanup standards, sub-sampled for lipid analysis, and cleaned up using acid/base Silica, Florisil, Alumina and Carbon Celite chromatographic columns. Following cleanup, the extracts were reduced in volume and spiked with ^{13}C-labeled recovery (internal) standards prior to instrumental analysis. The final extract volume was 20µL. 1µL was injected for the DB5 column analysis; 2µL were injected for the DB225 column analysis.

REPORTING CONVENTIONS

The AXYS contract number assigned for internal tracking was 4819. The samples were assigned a unique laboratory identifier of the form L26338-X, where X = numeral. All data reports reference this unique AXYS ID plus the client's sample identifier. To assist with locating data, a table correlating AXYS ID with the client sample number is included in this data package. The report forms were generated using Laboratory Information Management Software (LIMS).

The following laboratory qualifier flags are used in this data package:

U = identifies a compound that was not detected

J = indicates an estimated value where the concentration of the analyte is less than the LMCL but greater than the SDL

K = identifies a target that could not be confirmed by virtue of not satisfying all method required criteria, the reported value may be interpreted as an estimated maximum analyte concentration.

Results are reported in concentration units of picograms per gram (pg/g) on a wet weight basis. Concentration and detection limits are provided to three significant figures. Analysis results for each sample are provided on Analysis Report form 1A/2.

QA/QC NOTES

Samples and QC samples analyzed in one analysis batch were carried intact through the entire analytical process. The sample data were reviewed and evaluated in relation to the batch QC samples.

- Sample analyte concentrations are not blank corrected. Sample data should be evaluated with consideration of the procedural blank results.
- By virtue of the isotope dilution/internal standard quantification procedures, data are recovery corrected for possible losses during extraction and cleanup.
- All linearity, CAL/VER, OPRs, duplicate and labeled compound recovery specifications were met with following exception.

Data are not blank corrected. 1,2,3,4,6,7,8-HPCDD and OCDD were detected above the method control limit for the lab blank (AXYS ID WG57620-101), sample data should be reviewed with consideration of the blank levels.

ANALYTICAL DISCUSSION

No analytical difficulties were encountered.

DATA PACKAGE

This data package is assigned a unique identifier, DPWG57987, shown on the title page of the data package. Included in the data package after this narrative are the following documents:

- Method summaries
- Sample 'Correlation Table'
- Sample receiving documentation
- Sample data reports
- Laboratory QC data reports
- Instrumental QC data reports (organized by analysis date)
- Accreditation Scope

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, except for the conditions detailed above. In addition, I certify, that to the best of my knowledge and belief, the data as reported are true and accurate. The following signature, on behalf of AXYS Analytical Services Ltd, authorizes the release of the data contained in this data package.

Huang

Signed: Henry Huang, Ph.D., Data Validation Chemist

19 Jan. 2017

Date Signed

AXYS Analytical Services Ltd.

SUMMARY OF AXYS METHOD MLA-017 REV. 20 VER. 09:

ANALYTICAL METHOD FOR THE DETERMINATION OF POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS BY EPA METHOD 1613B, 8290/8290A OR DLM02.2

AXYS Method MLA-017 describes the analysis of polychlorinated (tetra-octa) dibenzodioxins and dibenzofurans in solids (sediment, soil, biosolid, pulp), tissues (including blood, serum, plasma and milk), aqueous samples, XAD-2 columns, air samples, particulate filters and solvent extracts.

Target Analytes

Dioxins (PCDD)	Furans (PCDF)
2,3,7,8 Tetrachlorodibenzodioxin (TCDD)	2,3,7,8 Tetrachlorodibenzofuran (TCDF)
Total TCDD	Total TCDF
1,2,3,7,8 Pentachlorodibenzodioxin (PeCDD)	1,2,3,7,8 Pentachlorodibenzofuran (PeCDF)
Total PeCDD	2,3,4,7,8 PeCDF
	Total PeCDF
1,2,3,4,7,8 Hexachlorodibenzodioxin (HxCDD)	1,2,3,4,7,8 Hexachlorodibenzofuran (HxCDF)
1,2,3,6,7,8 HxCDD	1,2,3,6,7,8 HxCDF
1,2,3,7,8,9 HxCDD	1,2,3,7,8,9 HxCDF
Total HxCDD	2,3,4,6,7,8 HxCDF
	Total HxCDF
1,2,3,4,6,7,8 Heptachlorodibenzodioxin (HpCDD)	1,2,3,4,6,7,8 Heptachlorodibenzofuran (HpCDF)
Total HpCDD	1,2,3,4,7,8,9 HpCDF
	Total HpCDF
Octachlorodibenzodioxin (OCDD)	Octachlorodibenzofuran (OCDF)

1.0 EXTRACTION AND CLEANUP PROCEDURES

All samples are spiked with ^{13}C-labelled surrogate standards prior to extraction and extracted as per the table below. Optional extraction procedures are shown within parentheses.

Sample Extraction

Matrix	Extraction
Aqueous samples	Liquid-liquid extraction with dichloromethane. (If visible particulates are present the sample is filtered prior to extraction and the particulate fraction separately extracted by Soxhlet extraction or Dean-Stark Soxhlet extraction. The two extracts are then combined.)
Solid (sediment, soil, sludge, particles on filter paper)	Soxhlet extraction with toluene:acetone 80:20. (optional: Dean-Stark Soxhlet extraction with toluene)
Solid (pulp, black liquor)	Soxhlet extraction with toluene:acetone 80:20.
Solid (ash, slag)	Sonication with hydrochloric acid and filtering. Liquid-liquid extraction of filtrate using dichloromethane, Soxhlet extraction of particulate using toluene:acetone 80:20. The two extracts are combined.
Tissue	Soxhlet extraction with dichloromethane:hexane 1:1 (optional: Base digestion and liquid-liquid extraction with hexane)
Whole blood/serum	Liquid-liquid extraction with ethanol:hexane:saturated ammonium sulfate.
Milk	Liquid-liquid extraction with acetone and hexane.
XAD-2 column and filter	XAD-2 adsorbent is dried and Soxhlet extracted (with toluene:acetone 80:20) or Dean-Stark Soxhlet extracted (with toluene). The filter is extracted by Dean-Stark Soxhlet extraction using toluene.
Ambient air (PUF and filter)	The PUF and filter(s) are Soxhlet extracted together using toluene:acetone 80:20.
Stationary Source Air Samples (Stack Gas sample trains)	The filter is sonicated with dilute hydrochloride acid and filtered. Equipment rinsates are collected, filtered, dried and/or extracted depending on sampling conditions.

The extracts are then routinely cleaned up according to the following table:

Water Soil Sediment XAD-2 adsorbent Air samples Sludge High organic soil	(Base/acid wash →) DX $AgNO_3$ 30g 44% → (DX Florisil →) Copper → Alumina/carbon/Celite combination column
Tissue Blood/serum/ plasma Milk	(Biobead →) DX 20g 44% → DX Florisil → (Copper →) Alumina/carbon/Celite combination column

Note: Items in brackets are optional procedures that may be used if needed or if required by Project Managers.

An optional Biobead clean-up may be carried out for biosolid sample extracts.

2.0 INSTRUMENTATION

Instrumental analysis is performed on a DB-5 capillary chromatography column coupled to a high-resolution mass spectrometer (HRMS). The HRMS is operated at a static (10000) mass resolution in the voltage selected ion-recording mode (V-SIR) using selected PFK ions as a reference for mass lock. Two masses from the molecular ion cluster are used to monitor each of the target analytes and ^{13}C-labelled surrogate standards. A second column, DB-225, is used for confirmation of 2,3,7,8-TCDF identification. Five additional ions are monitored to check for interference from chlorinated diphenylethers.

Upon client request, the concentrations of PCDD/F may be determined using bracketing calibration procedures and a smaller suite of surrogate standards.

3.0 CALIBRATION

Initial calibration (default procedure) is performed using a five point calibration series of solutions that encompass the working concentration range. Initial calibration solutions contain the suite of labelled surrogate and recovery standards and authentic target PCDDs/PCDFs. Calibration is verified at least once every 12 hours by analysis of a mid-level calibration solution. Calibration procedures use the mean RRFs determined from the initial calibration to calculate analyte concentrations.

Alternately clients may request initial calibration be performed using a six point calibration series of solutions if lower detection limits are required.

Concentration of PCDD/PCDF Calibration Solutions

	Concentration (ng/mL)						Authentic Standard Amount added to sample (pg)
	CS0.2	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**	
Native Compound							
2,3,7,8-TCDD	0.1	0.5	2	10	40	200	200
2,3,7,8-TCDF	0.1	0.5	2	10	40	200	200
1,2,3,7,8-PeCDD	0.5	2.5	10	50	200	1000	1000
1,2,3,7,8-PeCDF	0.5	2.5	10	50	200	1000	1000
2,3,4,7,8-PeCDF	0.5	2.5	10	50	200	1000	1000
1,2,3,4,7,8-HxCDD	0.5	2.5	10	50	200	1000	1000
1,2,3,6,7,8-HxCDD	0.5	2.5	10	50	200	1000	1000
1,2,3,7,8,9-HXCDD	0.5	2.5	10	50	200	1000	1000
1,2,3,4,7,8-HxCDF	0.5	2.5	10	50	200	1000	1000
1,2,3,6,7,8-HxCDF	0.5	2.5	10	50	200	1000	1000
1,2,3,7,8,9-HxCDF	0.5	2.5	10	50	200	1000	1000
2,3,4,6,7,8-HxCDF	0.5	2.5	10	50	200	1000	1000
1,2,3,4,6,7,8-HpCDD	0.5	2.5	10	50	200	1000	1000
1,2,3,4,6,7,8-HpCDF	0.5	2.5	10	50	200	1000	1000
1,2,3,4,7,8,9-HpCDF	0.5	2.5	10	50	200	1000	1000
OCDD	1.0	5.0	20	100	400	2000	2000
OCDF	1.0	5.0	20	100	400	2000	2000
Surrogate Standards							**Surrogate Standard Amount added to sample (pg)**
$^{13}C_{12}$-2,3,7,8-TCDD	100	100	100	100	100	100	2000
$^{13}C_{12}$-2,3,7,8-TCDF	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,7,8-PeCDD	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,7,8-PeCDF	100	100	100	100	100	100	2000
$^{13}C_{12}$-2,3,4,7,8-PeCDF	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	100	100	100	100	100	100	2000
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	100	100	100	100	100	100	2000
$^{13}C_{12}$-OCDD	200	200	200	200	200	200	4000
Cleanup Standard							
$^{37}Cl_4$-2,3,7,8-TCDD	0.1	0.5	2	10	40	200	200

Recovery Standard							
$^{13}C_{12}$-1,2,3,4-TCDD	100	100	100	100	100	100	2000
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	100	100	100	100	100	100	2000

4.0 QUANTIFICATION PROCEDURES

The response for any component is taken as the sum of the integrated peak areas for the two characteristic masses for that compound. Quantification is by the isotope dilution method. Target concentrations are determined with respect to labelled surrogate standards. Mean relative response factors (RRF), determined from the multi-level initial calibration series are used to convert raw peak areas in sample chromatograms to final concentrations as follows:

$$\text{Concentration of Target} = \left(\frac{\text{area of Target}}{\text{area of Qt Std}}\right) \times \left(\frac{\text{weight of Qt Std}}{\text{RRF}}\right) \times \left(\frac{1}{\text{weight of sample}}\right)$$

$$\textit{where}\quad \text{RRF} = \left(\frac{\text{area of Target}}{\text{area of Qt Std}}\right) \times \left(\frac{\text{weight of Qt Std}}{\text{weight of Target}}\right)$$

and the Qt Std is either the surrogate or the internal standard

Those compounds quantified against a labelled standard added at the beginning of the analysis procedure are recovery corrected by the method of quantification. Surrogate recoveries are determined similarly against the recovery (internal) standard and are used as general indicators of overall analytical quality.

4.1 Reporting Limits

Concentrations and detection limits for the 2,3,7,8-polychlorinated dioxins and furans (tetra-octa) are reported. Typical reporting units for all data are pg/g, pg/L or pg/sample. Concentrations for solids are reported on a dry weight basis. Concentrations in tissues (including blood and milk) are reported on a wet weight basis and/or on a lipid weight basis when requested. Concentrations in aqueous samples are reported on a volume basis. Concentrations in XAD-2 resin, filters and stack gas samples are reported on a per sample basis or a per volume basis. Concentrations in particulate filters are reported on a per sample basis.

The following are commonly requested reporting limits:

Sample Specific Detection Limit or Sample Detection Limit (SDL) – determined individually for every sample analysis run by converting the area equivalent of 3.0 times (2.5 times for EPA 1600 series methods) the estimated chromatographic noise height to a concentration in the same manner that target peak responses are converted to final concentrations. The SDL accounts for any effect of matrix on the detection system and for recovery achieved through the analytical work-up. Equivalent term(s): Estimated Detection Limit (EDL) from EPA method 8290.

Method Detection Limit (MDL) - determined as specified by EPA Fed. Reg. 40 CFR Part 136 Appendix B (no iteration option). The 99% confidence level MDL is determined based on analysis of a minimum of 7 replicate matrix spikes fortified at 1-10 times the estimated detection limit. MDL is determined as required based on accreditation, contract and workload requirements.

Lower Method Calibration Limit (LMCL) - determined by prorating the concentration of the lowest calibration limit for sample size and extract volume. The following equation is used. ((lowest level cal conc.) x (extract volume))/sample size. Typical extract volume for PCDDs/PCDFs is 20 µL.

For the analysis of PCDDs/PCDFs AXYS standard is to report sample concentrations using the SDL with a minimum reporting limit of 0.5 pg absolute.

Analyte Ions Monitored, Surrogates Used and RRF Determination for Dioxins/Furans

Analytes	Quantification Ion (m/z)	Confirmation Ion (m/z)	Surrogate	RRF Determined From
2,3,7,8-TCDD	319.8965	321.8936	$^{13}C_{12}$-2,3,7,8-TCDD	2,3,7,8-TCDD
1,3,6,8-TCDD *	319.8965	321.8936	$^{13}C_{12}$-2,3,7,8-TCDD	2,3,7,8-TCDD
1,3,7,9-TCDD *	319.8965	321.8936	$^{13}C_{12}$-2,3,7,8-TCDD	2,3,7,8-TCDD
1,2,3,7,8-PeCDD	353.8576	355.8546	$^{13}C_{12}$-1,2,3,7,8-PeCDD	1,2,3,7,8-PeCDD
1,2,3,4,7,8-HxCDD	389.8156	391.8127	$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-HxCDD
1,2,3,6,7,8-HxCDD	389.8156	391.8127	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD	389.8156	391.8127	Mean of $^{13}C_{12}$-1,2,3,6,7,8/1,2,3,4,7,8-HxCDD	1,2,3,7,8,9-HxCDD
1,2,3,4,6,7,8-HpCDD	423.7767	425.7737	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-HpCDD
OCDD	457.7377	459.7348	$^{13}C_{12}$-OCDD	OCDD
2,3,7,8-TCDF	303.9016	305.8987	$^{13}C_{12}$-2,3,7,8 -TCDF	2,3,7,8-TCDF
1,2,7,8-TCDF *	303.9016	305.8987	$^{13}C_{12}$-2,3,7,8 -TCDF	2,3,7,8-TCDF
1,2,3,7,8-PeCDF	339.8597	341.8568	$^{13}C_{12}$-1,2,3,7,8-PeCDF	1,2,3,7,8-PeCDF
2,3,4,7,8-PeCDF	339.8597	341.8568	$^{13}C_{12}$-2,3,4,7,8-PeCDF	2,3,4,7,8-PeCDF
1,2,3,4,7,8-HxCDF	373.8207	375.8178	$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	1,2,3,4,7,8-HxCDF
1,2,3,6,7,8-HxCDF	373.8207	375.8178	$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	1,2,3,6,7,8-HxCDF
2,3,4,6,7,8-HxCDF	373.8207	375.8178	$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	2,3,4,6,7,8-HxCDF
1,2,3,7,8,9-HxCDF	373.8207	375.8178	$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	1,2,3,7,8,9-HxCDF
1,2,3,4,6,7,8-HpCDF	407.7818	409.7788	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-HpCDF	407.7818	409.7788	$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8,9-HpCDF
OCDF	441.7428	443.7398	$^{13}C_{12}$-OCDD	OCDF
Cleanup Standard				
$^{37}Cl_4$-2,3,7,8-TCDD	327.8847	-	$^{13}C_{12}$-1,2,3,4-TCDD	
Field Standard				
$^{13}C_6$-1,2,3,4-TCDD	325.9166	327.9137	$^{13}C_{12}$-1,2,3,4-TCDD	$^{13}C_{12}$-1,2,3,4-TCDD

Labelled Surrogates	**Quantification Ion (m/z)**	**Confirmation Ion (m/z)**	**Recovery Calculated Using**
$^{13}C_{12}$-2,3,7,8-TCDD	331.9368	333.9339	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,7,8-PeCDD	365.8978	367.8949	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	401.8559	403.8530	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	401.8559	403.8530	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	435.8169	437.8140	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-OCDD	469.7780	471.7750	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-2,3,7,8 -TCDF	315.9419	317.9389	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,7,8-PeCDF	351.9000	353.8970	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-2,3,4,7,8-PeCDF	351.9000	353.8970	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	383.8639	385.8610	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	383.8639	385.8610	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	383.8639	385.8610	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	383.8639	385.8610	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	417.8250	419.8220	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	417.8250	419.8220	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
Recovery Standards			
$^{13}C_{12}$-1,2,3,4-TCDD	331.9368	333.9339	
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	401.8559	403.8530	
Cl-DPE Monitoring Ions			
Descriptor	**Exact M/Z**	**M/Z Type**	**Substance**
3	375.8364	M+2	HxCDPE
4	409.7974	M+2	HpCDPE
5	445.7555	M+4	OCDPE
6	479.7165	M+4	NCDPE
7	513.6775	M+4	DCDPE

*Optional isomers which may be reported upon client request.

5.0 QUALITY ACCEPTANCE CRITERIA

Samples are analyzed in batches consisting of a maximum of twenty samples, one procedural blank and one spiked matrix (OPR) sample. A duplicate is analyzed, provided there is sufficient sample, with batches containing 7-20 samples. Matrix spike/matrix spike duplicate (MS/MSD) pairs may be analyzed on an individual contract basis. The batch is carried through the complete analytical process as a unit. For sample data to be reportable, the batch QC data must meet the established acceptance criteria presented on the analysis reports.

AXYS Analytical Services Ltd.

QC Specification Table: Authentic and Surrogate Standard Recoveries, CAL/VER, IPR, OPR and Samples

	Test Conc. (ng/mL)	IPR		OPR (%)	I-CAL (%)	CAL/VER (%)	Labelled Compound (% rec. in sample)	
		SD (%) *	$\bar{X}$ (%)				Warning Limits	Control Limits
Native Compound								
2,3,7,8-TCDD	10	28	83-129	70-130	20	78-125	-	-
2,3,7,8-TCDF	10	20	87-137	75-130	20	84-120	-	-
1,2,3,7,8-PeCDD	50	15	76-132	70-130	20	78-125	-	-
1,2,3,7,8-PeCDF	50	15	86-124	80-130	20	82-120	-	-
2,3,4,7,8-PeCDF	50	17.2	72-150	70-130	20	82-122	-	-
1,2,3,4,7,8-HxCDD	50	18.8	78-152	70-130	20	78-125	-	-
1,2,3,6,7,8-HxCDD	50	15.4	84-124	76-130	20	78-125	-	-
1,2,3,7,8,9-HXCDD	50	22.2	74-142	70-130	35	82-122	-	-
1,2,3,4,7,8-HxCDF	50	17.4	82-118	72-130	20	90-112	-	-
1,2,3,6,7,8-HxCDF	50	13.4	92-120	84-130	20	88-114	-	-
1,2,3,7,8,9-HxCDF	50	12.8	84-122	78-130	20	90-112	-	-
2,3,4,6,7,8-HxCDF	50	14.8	74-148	70-130	20	88-114	-	-
1,2,3,4,6,7,8-HpCDD	50	15.4	76-130	70-130	20	86-116	-	-
1,2,3,4,6,7,8-HpCDF	50	12.6	90-112	82-122	20	90-110	-	-
1,2,3,4,7,8,9-HpCDF	50	16.2	86-126	78-130	20	86-116	-	-
OCDD	100	19	89-127	78-130	20	79-125	-	-
OCDF	100	27	74-146	70-130	35	75-125	-	-
Surrogate Standards								
$^{13}C_{12}$-2,3,7,8-TCDD	100	37	28-134	25-130	35	82-121	40-120	25-130
$^{13}C_{12}$-2,3,7,8-TCDF	100	35	31-113	25-130	35	71-130	40-120	24-130
$^{13}C_{12}$-1,2,3,7,8-PeCDD	100	39	27-184	25-150	35	70-130	40-120	25-130
$^{13}C_{12}$-1,2,3,7,8-PeCDF	100	34	27-156	25-130	35	76-130	40-120	24-130
$^{13}C_{12}$-2,3,4,7,8-PeCDF	100	38	16-279	25-130	35	77-130	40-120	21-130
$^{13}C_{12}$-1,2,3,4,7,8-HxCDD	100	41	29-147	25-130	35	85-117	40-120	32-130
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	100	38	34-122	25-130	35	85-118	40-120	28-130
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	100	43	27-152	25-130	35	76-130	40-120	26-130
$^{13}C_{12}$-1,2,3,6,7,8-HxCDF	100	35	30-122	25-130	35	70-130	40-120	26-123
$^{13}C_{12}$-1,2,3,7,8,9-HxCDF	100	40	24-157	25-130	35	74-130	40-120	29-130
$^{13}C_{12}$-2,3,4,6,7,8-HxCDF	100	37	29-136	25-130	35	73-130	40-120	28-130
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	100	35	34-129	26-130	35	72-130	40-120	23-130
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	100	41	32-110	25-130	35	78-129	40-120	28-130
$^{13}C_{12}$-1,2,3,4,7,8,9-HpCDF	100	40	28-141	25-130	35	77-129	40-120	26-130
$^{13}C_{12}$-OCDD	200	47.5	20.5-138	25-130	35	70-130	25-120	17-130
Cleanup Standard								
$^{37}Cl_4$-2,3,7,8-TCDD	10	36	39-154	31-130	35	79-127	40-120	35-130

* For comparability with EPA 1613B the precision specification for IPR is stated as %SD (=standard deviation relative to the fortification level,)

QC Specification Table: QC Samples, Instrumental Analysis, and Analyte Quantification

QC Parameter	Specification
Analysis Duplicate	Must agree to within ±20% of the mean (applicable to concentrations >10 times the DL)[1]
Procedural Blank	**Blood/serum/plasma and milk:** TCDD/F <0.2 pg/sample, PeCDD/F <0.5 pg/sample, HxCDD/F and HpCDD/F <1.0 pg/ sample, OCDD/F<5 pg/sample. **Other matrices:** TCDD/F <0.5 pg/sample, PeCDD/F, HxCDD/F, HpCDD/F <1.0 pg/sample, OCDD/F <5 pg/sample. Higher levels acceptable where all sample concentrations are > 10X the blank concentrations.
Detection Limit	SDL Requirements (where target concentrations are detectable or sample extracts display atypical interference, SDL values may be higher): **Blood/serum/plasma and milk:** Tetra-penta-CDD/F 0.2 pg/sample, Hexa-octa-CDD/F 0.5 pg/sample **Other matrices**: 0.5 pg/sample
Instrument Carry over and Background: **Toluene Blank**	A. 1st toluene blank following Cal Ver must have <0.6 pg TCDD and <25 pg OCDD[2]. B. 2nd toluene blank following Cal Ver must have <0.2 pg TCDD/F, <0.8 pg Pe-HpCDD/F, and <5.0 pg OCDD[2]. Blood/serum/plasma and milk extract analysis: As many toluene blanks as necessary are run to achieve an instrument blank level of <0.1 pg TCDD/F, <0.3 pg PeCDD/F, <0.5 pg HxCDD/F, <0.5 pg HpCDD/F and <3.5 pg OCDD.
Samples	<10% contribution from preceding sample (based on observed instrument carryover rate).
Analyte Peak Response	Response must be below the upper calibrated range of the instrument. Data may be taken from more than one chromatogram to get the responses in the calibrated range.
Ion Ratios	Must be within ±15% of theoretical. For 1613B applications only (as per section 16.3 of 1613B) an alternate acceptance criteria of within ±10% of the ratio in the midpoint calibration (CS3) or calibration verification (Cal Ver), whichever is most recent., may be applied. Exception for blood/serum/plasma samples: Ion ratios for sample responses below the lowest calibration level equivalent must be within ±35% of theoretical.
Sensitivity	S:N ≥10:1 for all compounds in CS-0.2 for 1.0 µL injected, plus for blood/serum/plasma and milk S:N ≥3:1 for 0.05 pg injected 2,3,7,8-TCDD.

[1] Duplicate criterion is a guideline; final assessment depends upon sample characteristics, overall batch QC and on-going lab performance.

[2] Instrument background specifications are calculated from spiking labelled standard into the toluene blank and expressed as pg in a 20 µL extract.

Modifications to EPA Method 1613B

The following sections of EPA Method 1613B have been modified as described below.

Section 2.1.2

Aqueous liquid from multiphase samples is liquid/liquid extracted with DCM. The extract from the aqueous phase is then combined with the extract from the solid phase portion of the sample.

Section 7.2.1

Anhydrous sodium sulfate (Na_2SO_4) is baked overnight prior to use. There is no solvent rinse with dichloromethane.

Section 7.10

The concentration of the labelled compound solution is 100 ng/mL (except for labeled OCDD which is 200 ng/mL) and is prepared in toluene; 20 µL of the labelled compound solution is spiked to solids and tissue samples to yield the method specified concentrations in the final extracts.

Section 7.11

The concentration of the cleanup standard spiking solution is 10 ng/mL in toluene and the sample spiking volume is 20 µL. The resulting concentration in the final extracts is ¼ of the concentration specified in the method.

Sections 7.13, 14.0, 15.0

A modified EPA 1613B/8290 procedure is offered that includes an additional lower level calibration solution, 0.2 times the concentration of CS1 in the initial calibration series so that initial calibration is based on a six-point series. The calibration solutions are prepared in nonane. A modified EPA 1613B/8290 procedure using calibration solutions prepared in toluene is also available.

Section 7.14

The concentration of the PAR spiking solutions is 0.2/1.0/2.0 ng/mL for tetra/penta, hexa, hepta, hexa/octas respectively and the spiking volume is 1 mL. The resulting final concentration in the extracts are as specified in the method.

Section 9.3.3

Table 7 (EPA 1613B) specifications for the percent recovery of surrogate standards in samples that are higher than 130% have been lowered to 130%, as presented in table "QC Specification Table: Authentic and Surrogate Standard Recoveries, CAL/VER, IPR, OPR and Samples" of this document.

Section 11.5

Multiphase, predominately aqueous, samples containing >1% suspended solids may be prepared and extracted using the same procedure as samples containing ≤1% suspended solids with client approval. This involves separating the solids and aqueous phases by filtration, extracting the solids by Soxhlet extraction, extracting the filtrate by liquid/liquid extraction, and combining the extract from the two phases. Alternatively, with client approval, multiphase, predominately particulate, samples containing >1%

suspended solids may be processed as solids samples using Soxhlet or Soxhlet Dean-Stark extraction.

Section 12.3

For solids samples with suitable moisture content, an option is offered for drying the sample with anhydrous sodium sulfate followed by Soxhlet extraction with 80:20 toluene:acetone. Alternatively Soxhlet Dean-Stark extraction using toluene is available

Section 12.3.1 – 12.3.5

Silica or quartz sand is not pre-extracted in the Dean Stark apparatus. Silica is baked the lab. Quartz sand is proofed prior to use. Sand is mixed with the sample in a beaker and then loaded into the soxhlet thimble.

Section 12.3.9.1.1

Sample extracts are reduced to approximately 1 mL after extraction, not 5 mL.

Section 12.4

The equilibration time for the sodium sulfate drying step is sufficient to produce a dry, free-flowing powder (minimum 30 minutes). This may be less than the 12-hour minimum specified in EPA 1613B.

Section 12.5.3

Ultra-pure water is used to rinse the extract between base and acid washes, not NaCl solution.

Section 12.6.1.1

Rotary evaporator baths are maintained at 35°C. Trends in QC blanks are monitored and diagnostic proofing is conducted if indicated instead of collecting proofs each day and archiving. Historical proofing tests have demonstrated that routine cleaning practices between samples are sufficient to ensure rotary evaporator cleanliness; as an additional safeguard the laboratory segregates processing of samples on the basis of predicted target concentration levels.

Section 12.7.3

Water baths are not used with the nitrogen blowdown apparatus.

Section 12.7.4

Solvent exchange is dependent on the type of solvent present: if toluene is present the extract is reduced to 50 µL and topped up to 1 mL with hexane; if dichloromethane is present the extract is reduced to 300 µL and topped up to 1 mL with hexane.

Section 12.7.7

Sample extracts are concentrated in a microvial using nitrogen to near dryness before adding the recovery standard.

Section 13.7

Gravimetric lipid analysis is carried out on two subsamples of the extract, representing 2/15ths of the extract. A correction factor is applied to the surrogate recovery standards.

Sections 14.0, 15.0, 16.0, Table 8, Table 9

M/Z channels 354/356 and 366/368 are used to confirm and quantify the native and surrogate penta-substituted dioxins, respectively; this change from the method's specification is made in the instrument method in order to avoid a persistent interference in the 356/358 and 368/370 M/Z channels. The theoretical ratio for the P5CDD M/M+2 ions is 0.61; therefore, the acceptance range is 0.52 - 0.70.

Section 14.2

The EPA 1613B/8290 procedure uses nonane to dilute extracts. Alternatively a modified EPA 1613B/8290 procedure using toluene to dilute extracts may be performed.

Section 15.3.5

Table 6 (EPA 1613B) specifications for CAL-VER solution concentrations outside the 70-130% range have been revised to be 70-130%, as presented in table "QC Specification Table: Authentic and Surrogate Standard Recoveries, CAL/VER, IPR, OPR and Samples" on page 7 of this document.

Section 15.4.2.2

Figure 7 (EPA 1613B) is incorrectly titled as 'on DB-5 column', should be 'on DB-225 column'. The peak annotation in figure 7 is also incorrect; the centre peak is 2,3,7,8-TCDF, not 2,3,4,8-TCDF as indicated.

Section 15.5.3

Table 6 (EPA 1613B) specifications for OPR concentrations outside the 70-130% range have been revised to be 70-130%, as presented in table "QC Specification Table: Authentic and Surrogate Standard Recoveries, CAL/VER, IPR, OPR and Samples" on page 7 of this document.

Section 17.0

Conci - the concentrations of target analytes, and the labelled compound concentrations and recoveries, are calculated using the equations below. These procedures are equivalent to those described in the method but are more direct.

$$Conc = \frac{A_i}{A_{si}} \times \frac{M_{si}}{RRF_{i,si}} \times \frac{1}{M_x}$$

where Ai = summed areas of the primary and secondary m/z's for the analyte peak of interest (compound i)

Asi = summed areas of the primary and secondary m/z's for the labelled surrogate peak used to quantify i)

Mx = mass of sample taken for analysis

Msi = mass of labelled surrogate (compound si) added to sample as calculated by the concentration of standard spiked (pg/mL) multiplied by the volume spiked (mL)

$RRFi, si$ = mean relative response factor of i to si from the five-point calibration range and defined individually as:

$$\frac{A_i}{A_{si}} \; x \; \frac{M_{si}}{M_i}$$

Calculation of Surrogate Standard Concentrations and Percent Recoveries:

Concentrations of surrogate standards are calculated using the following equation:

$$Conc_{si} = \frac{A_{si}}{A_{rs}} \; x \; \frac{M_{rs}}{RRF_{si,rs}}$$

and, the percent recoveries of the surrogate standards are calculated using the following equation:

$$\%Recovery = \frac{A_{si}}{A_{rs}} \; x \; \frac{M_{rs}}{RRF_{si,rs}} \; x \; \frac{1}{M_{si}} \; x \; 100$$

where A_{rs} and A_{si} are the summed peak areas (from the primary and secondary m/z channels) of recovery standard and labelled surrogate added to the sample;
M_{rs} and M_{si} are the masses of recovery standard and labelled surrogate added to the sample, and;
$RRF_{si,rs}$ is the mean relative response factor of the labelled surrogate to the recovery standard as determined by the five-point calibration range and defined individually as:

$$\frac{A_{si}}{A_{rs}} \; x \; \frac{M_{rs}}{M_{si}}$$

Section 17.5

Where acceptable to the client, extracts may be diluted with solvent and re-analyzed by GC/MS to bring the instrumental response to within the linear range of the instrument. Typically, no additional recovery (internal) standard is added. For very high-level samples where a smaller sample aliquot may not be representative, extracts may be diluted and respiked with labelled quantification standards and re-analyzed by GC/MS to bring the instrumental response analytes within range. Final results are recovery corrected using the mean recovery of labelled quantification standards.

AXYS Analytical Services Ltd.

Modifications to EPA Method 8290

The AXYS implementation of EPA Methods 8290 and 8290A includes the following:

1. A sample hold time of 30 days from time of sample collection is recommended.
2. Extract hold time, stored at <-10°C, is 45 days.
3. The same surrogate, recovery, authentic spike and calibration solutions that are used for EPA method 1613B are used to perform EPA Methods 8290 and 8290A.
4. A matrix spike/matrix spike duplicate (MS/MSD) sample may be analysed with every analysis batch, as negotiated with the client and provided sufficient sample is available. This requirement may be waived by contract.
5. The typical final extract volume is 20 µL but may vary between 10 µL and 50 µL.
6. HRGC/MS analysis is performed according to EPA 1613B protocols with the following requirements:
   - An instrumental blank is analyzed at the beginning of every 12-hour analysis sequence, injected following the CAL/VER solution.
   - Should the CAL/VER analysis fail at the end of a 12 hour period by no more than 25% RPD for the native analytes and 35% for the labelled standards, the mean RRF from the two CAL/VER analyses may be used to calculate the analyte concentrations.
7. Quantification of target analytes is performed using an expanded suite of surrogate standards and quantification references (listed in table "Analyte Ions Monitored, Surrogates Used and RRF Determination for Dioxins/Furans" on pages 5-6 of this document) as per method 8290A section 5.8 allowances (alternative quantification using the smaller suite of surrogate standards listed in method 8290A and in table "Analyte Ions Monitored, Surrogates Used and RRF Determination for Dioxins/Furans by EPA 8290/8290A" on page 14 of this document may be negotiated by individual customers).
8. The QC specifications in table "QC Criteria for PCDD/F Analysis by EPA 8290/8290A" below are used for evaluating data.

The following modifications have been made to EPA Methods 8290 and 8290A:

1. Procedures described in section "Modifications to EPA Method 1613B" of this document are applicable.
2. The concentrations of the initial calibration solutions, surrogate standard solution and recovery standard solution are modified to be those described in table "Concentration of PCDD/PCDF Calibration Solutions" found on pages 3-4 of this document.
3. The amount of surrogate standard and recovery standard added to each sample are modified to be as described in table "Concentration of PCDD/PCDF Calibration Solutions" found on pages 3-4 of this document.

4. Sample Specific Estimated Detection Limits (EDL) are reported as Sample Specific Detection Limits (SDL), calculated as described in sections "4. Quantification Procedures" and "4.1 Reporting Limits" of this document.

QC Criteria for PCDD/F Analysis by EPA 8290/8290A

Initial Calibration	Native analytes: ±20% RSD for mean RRF Labelled Compounds: ±30% RSD for mean RRF
CAL-VER	Native Analytes: RRF must be ±20% of mean RRF from ICAL Labelled Compounds: RRF must be ±30% of mean RRF from ICAL
Sample Surrogate Recovery	40-135% (lower or higher recoveries for the procedural blank may be accepted based on analyst professional judgement.)
Spiked Reference Sample	In house specification: 70%-130% of the expected value for all targets except 1,2,3,7,8,9-HxCDF, which is 60%-140%. Professional judgement may be applied in consideration of overall QC data, including MS/MSD to determine acceptability.
Analysis Duplicate	Must agree to within 25% RPD
MS/MSD	Must agree to within 20% RPD

Analyte Ions Monitored, Surrogates Used and RRF Determination for Dioxins/Furans by EPA 8290/8290A

Analytes	Quantification Ion (m/z)	Confirmation Ion (m/z)	Surrogate	RRF Determined From
2,3,7,8-TCDD	319.8965	321.8936	$^{13}C_{12}$-2,3,7,8-TCDD	2,3,7,8-TCDD
1,2,3,7,8-PeCDD	353.8576	355.8546	$^{13}C_{12}$-1,2,3,7,8-PeCDD	1,2,3,7,8-PeCDD
1,2,3,4,7,8-HxCDD	389.8156	391.8127	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	1,2,3,4,7,8-HxCDD
1,2,3,6,7,8-HxCDD	389.8156	391.8127	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD	389.8156	391.8127	$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	1,2,3,7,8,9-HxCDD
1,2,3,4,6,7,8-HpCDD	423.7767	425.7737	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-HpCDD
OCDD	457.7377	459.7348	$^{13}C_{12}$-OCDD	OCDD
2,3,7,8-TCDF	303.9016	305.8987	$^{13}C_{12}$-2,3,7,8-TCDF	2,3,7,8-TCDF
1,2,3,7,8-PeCDF	339.8597	341.8568	$^{13}C_{12}$-1,2,3,7,8-PeCDF	1,2,3,7,8-PeCDF
2,3,4,7,8-PeCDF	339.8597	341.8568	$^{13}C_{12}$-1,2,3,7,8-PeCDF	2,3,4,7,8-PeCDF
1,2,3,4,7,8-HxCDF	373.8207	375.8178	$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	1,2,3,4,7,8-HxCDF
1,2,3,6,7,8-HxCDF	373.8207	375.8178	$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDF
2,3,4,6,7,8-HxCDF	373.8207	375.8178	$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	2,3,4,6,7,8-HxCDF
1,2,3,7,8,9-HxCDF	373.8207	375.8178	$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	1,2,3,7,8,9-HxCDF
1,2,3,4,6,7,8-HpCDF	407.7818	409.7788	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-HpCDF	407.7818	409.7788	$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8,9-HpCDF
OCDF	441.7428	443.7398	$^{13}C_{12}$-OCDD	OCDF

Labelled Surrogate Stds	**Quantification Ion (m/z)**	**Confirmation Ion (m/z)**	**Recovery Calculated Using**
$^{13}C_{12}$-2,3,7,8-TCDF	315.9419	317.9389	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-2,3,7,8-TCDD	331.9368	333.9339	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,7,8-PeCDF	351.9000	353.8970	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,7,8-PeCDD	365.8978	367.8949	$^{13}C_{12}$-1,2,3,4-TCDD
$^{13}C_{12}$-1,2,3,4,7,8-HxCDF	383.8639	385.8610	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-1,2,3,6,7,8-HxCDD	401.8559	403.8530	$^{13}C_{12}$-1,2,3,7, 8,9-HxCDD
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF	417.8250	419.8220	$^{13}C_{12}$-1,2,3,7,8,9 -HxCDD
$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD	435.8169	437.8140	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
$^{13}C_{12}$-OCDD	469.7780	471.7750	$^{13}C_{12}$-1,2,3,7,8,9-HxCDD
Labelled Recovery Stds			
$^{13}C_{12}$-1,2,3,4-TCDD	331.9368	333.9339	
$^{13}C_{12}$-1,2,3,7,8,9-HxCDD	401.8559	403.8530	

Bay West Inc.

CORRELATION TABLE

DIOXIN/FURAN ANALYSIS

Lab Name: AXYS Analytical Services Ltd.	**Project Manager: Andrew Porat**
Project Name: SLR AOC Data Gap Investigation	**Contract No: 4819**
Work Order #: 3000017136	**AXYS Method: MLA-017**
Data Package Identification: DPWG57987	**Program: Tissue Samples**
Client Sample No.	**Lab Sample ID**
LAB BLANK	WG57620-101
OPR	WG57620-102
Control-CS136 West Bear	L26338-1
BW16MLW-001 (GLC 11080)	L26338-2
BW16MLW-002 (GLC 11081)	L26338-3
BW16MLW-003 (GLC 11082)	L26338-4
Background day 0 10/25/16	L26338-5

AXYS | Axys Analytical Services Ltd

CHAIN OF CUSTODY

2045 Mills Road West TEL: (250) 655-5800
Sidney, British Columbia, Canada V8L 5X2 FAX: (250) 655-5811

AXYS CLIENT #: 4819

REPORT TO:

Company: BayWest LLC
Address: 5 Empire Drive
St. Paul, MN 55103
Contact: Paul Raymaker / Nancy McDonald
Phone: 651-291-3411 / 651-291-3483
~~FAX~~ praymaker@baywest.com
E-mail: nmcdonald@baywest.com

INVOICE TO:

Company: BayWest, LLC : Accounts Payable
Address: 5 Empire Drive
St. Paul, MN 55103
Contact: Paul Raymaker / Nancy McDonald
Phone / FAX / E-mail: see report to section:

Project Name/Number: BayWest

Sampler's Name: Mailee W. Garter
Signature: Mailee W Garter

ANALYSIS REQUESTED

Client Sample Identification	Matrix	Sampling Date	Sampling Time	Container Type/No.	Preservative Y / N	AXYS Lab ID Lab use only	Dioxins	Furans	Lipids		
Control - CS136 West Bear	Tissue	11/23/16	1330	250 ml amber	N	L26338 -1	✓	✓	✓		
BW16MLW-001 (GLC# 11080)	Tissue	11/23/16	1330	250 ml amber	N	-2	✓	✓	✓		
BW16MLW-002 (GLC# 11081)	Tissue	11/23/16	1330	250 ml amber	N	-3	✓	✓	✓		
BW16MLW-003 (GLC# 11082)	Tissue	11/23/16	1330	250 ml amber	N	-4	✓	✓	✓		
Background day 10/25/16	Tissue	11/23/16	1330	250 ml amber	N	-5	✓	✓	✓		

Relinquished by (Signature): Mailee W Garter Date: 11/28/16 Time: 1330
Received by (Signature):
Date: 29-NOV-2016 Time: 11:25

Relinquished by (Signature): Date: Time:
Received by (Signature):
Date: Time:

Remarks / Type Of Preservative: Frozen

Courier:
Waybill No.:

Sample Receipt

	Cooler
Temp °C	
Custody Seal #	
Seal Intact Y / N	
Sample Tags Y / N	

FedEx Express

Expanded Service International Air Waybill

Origin Copy

FedEx Tracking Number 8077 9467 8323 4819 Form ID No. 0426

Not all services and options are available to all destinations.

1 From

Date 11/28/16 Sender's FedEx Account Number

Sender's Name Mailee Garton Phone 231-941-2230

Company Great Lakes Environmental Center

Address 739 Hastings Street Dept./Floor

Address

City Traverse City Province MI, USA CANADA Postal Code 49686

2 Your Internal Reference

3

28 ☐ Residential Delivery

ipient's ne SAMPLE RECEIVING Phone 2506355800

ompany AXYS ANALYTICAL/COAST ACCOUNT

Address Dept./Floor

Address 2045 MILLS RD

City SIDNEY State Province BC

Country CA ZIP Postal Code V8L5X2

Recipient's Tax ID Number Required for Customs Purposes
e.g. GST/RFC/VAT/IN/EIN/ABN, or as locally required.

8077 9467 8323

4 Shipment Information

Total Packages Shipper's Load and Count/SLAC 1 Total Weight 25 ☒ lbs. ☐ kg DIM / / ☐ in. ☐ cm

Commodity Description	Harmonized Code	Country of Manufacture	Value for Customs
250 ml amber Glass bottles Containing Fish Tissue Sample for Scientific Testing Purposes Only.	3822.00	USA	25.00

Canada Export Declaration / B13A: ☐ No B13A required.

☐ Manual B13A attached. ☐ B13A filed electronically. ☐ B13A Summary Reporting.

Auth. ID / Form ID#

Total Declared Value for Carriage 25.00

Total Declared Value for Customs (Specify Currency) 25.00 USD

Origin Station ID	Country Code/Destination Station ID	URSA Routing
TVCA	CA/Y4JA	

Handling Units

Total Volume

Received At: 1 ☒ Reg. Stop 2 ☐ On-Call Stop 3 ☐ Drop Box 4 ☐ World Service Center 5 ☐ Station Forms Attached: ☒ CI ☐ CO

FedEx Emp. # Audit Emp. # Date Time Del. Courier Emp. # Date Time

Freight Fret Other Autre Total

Non-Negotiable International Air Waybill • ©1994–2010 FedEx

5a Express Package Service

Packages up to 150 lbs. (68 kg)

01 ☒ FedEx International Priority 06 ☐ FedEx International First Available to select locations.

☐ 03 ☐ FedEx International Economy FedEx Envelope and FedEx Pak rate not available.

5b Express Freight Service

Packages over 150 lbs. (68 kg)

70 ☐ FedEx International Priority Freight 86 ☐ FedEx International Economy Freight

Booking Number
Please call your local FedEx office to book shipments.

6 Packaging

*These unique brown boxes with special pricing are provided by FedEx for FedEx Intl. Priority only.

06 ☐ FedEx Envelope 02 ☐ FedEx Pak 03 ☐ FedEx Box 04 ☐ FedEx Tube

01 ☒ Other Cooler 15 ☐ FedEx 10kg Box* 25 ☐ FedEx 25kg Box*

7 Special Handling

01 ☐ HOLD at FedEx Location May not be in the same city. 03 ☐ SATURDAY Delivery Available to select locations for FedEx International Priority and FedEx International Priority Freight only.

☐

Does this shipment contain dangerous goods?
One box must be checked.

☒ No 04 ☐ Yes As per attached Shipper's Declaration. 08 ☐ Yes Shipper's Declaration not required. 06 ☐ Dry Ice 9, UN 1845 ___ x ___ kg

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging or placed in a FedEx Express Drop Box.

CA ☐ Cargo Aircraft Only

8 Broker Selection *Optional*

Not available with FedEx International First.

40 ☐ International Broker Select To specify a broker other than FedEx.

Broker's Name

City/State/Country

ZIP/Postal Code Phone

9 Payment

Complete payment options for both transportation charges and duties and taxes.

Bill transportation charges to:

Enter FedEx Acct. No. or Credit Card No. below.

1 ☐ Sender Acct. No. in Section 1 will be billed. 2 ☒ Recipient 3 ☐ Third Party 4 ☐ Credit Card 5 ☐ Cash / Cheque

FedEx Acct. No. 6262-5186-2

Credit Card Exp. Date Credit Card Auth.

Bill Customs charges to:

ALL shipments may be subject to Customs charges, which FedEx does not estimate prior to clearance

Enter FedEx Acct. No. below.

1 ☐ Sender Acct. No. in Section 1 will be billed. 2 ☒ Recipient 3 ☐ Third Party 5 ☐ Cash / Cheque

FedEx Acct. No. 232384450

10 Required Signature

Use of this Air Waybill constitutes your agreement to the Conditions of Contract on the back of this Air Waybill. Certain international treaties, including the Warsaw Convention, may apply to this shipment and limit our liability for damage, loss, or delay, as described in the Conditions of Contract.

Sender's Signature Mailee Garton

This is not authorization to deliver this shipment without a recipient signature.

Received above shipment in good order and condition. We agree to pay all charges, including Customs duties and taxes as applicable, and we agree to the Conditions of Contract as stated on the reverse side of the Recipient's Copy.

Recipient's Signature 29-NOV-2016 11:25

FedEx Tracking Number 8077 9467 8323 0426 Form ID No.

01/15

628 PART 157683 Rev. Date 12/10 PRINTED IN U.S.A. RRDA /0169/0300/0012229286/4

AXYS Analytical Services Ltd
SAMPLE RECEIVING RECORD

Waybill : [✓ Yes] /No
Date Shipped: 28-NOV-16
Waybill #: 807794678323
Date /Time Received: 29-NOV-16 11:25

AXYS Client & Contract # **4819-Bay West LLC**

Project Number:
Receipt No: WB21266
Login Number:

Received By: **IHARDER**
Log in by: I. HARDER
Signature:

Axys Sample ID's: L26338-1 to -5
Matrix Type: **Tissue**
Condition of Shipping Container: Intact
Temperature upon Receipt: **1 Celcius** **Ice packs frozen, temperature blank present**
Thermometer ID: **5534**
Corrected Temperature: **1 Celcius**

Custody Seals: Shipping Containers Yes [✓ No] Intact Yes /No Seal Numbers Yes /No
Samples Yes [✓ No] Intact Yes /No Seal Numbers Yes /No

Chain of Custody or Documents: [✓ Yes] /No
Sample ID's [✓ Yes] /No
Collection Location Yes [✓ No]
Date & Time Collection [✓ Yes] /No
Collector's Name [✓ Yes] /No

Tracking Report /Packing List: Yes [✓ No]
Sample Tag Numbers Yes [✓ No]
Sample Type [✓ Yes] /No
Preservative Added Yes [✓ No]
Preservation Requested Yes [✓ No]

Sample Tags Yes [✓ No]
Sample Labels [✓ Yes] /No
Sample Labels Cross Referenced to COC [✓ Yes] /No — Information Agrees [✓ Yes] /[✓ No]
Sample Tags Cross Referenced to Sample Labels Yes /No — Information Agrees Yes /No
Sample Tags Cross Referenced to COC Yes /No — Information Agrees Yes /No

Comments: "#" symbols removed from sample IDs for programming reasons

Sample ID discrepancy:
-1 on COC = 'Control - CS136 West bear' + on label = 'Control West Bear Skin-CS136',
logged in as per client COC

Action Taken:

AXYS Analytical Services Ltd.

Login Chain of Custody Report (In01)

Dec. 06, 2016
08:39 AM

Login Number: L26338
Account: 4819 Bay West LLC
Project: SLR DATA GAP INVSTGN

Page: 1 of 2

Axys ID versus Client Sample Identification | **Received** | **Due** | **PR**

L26338-1 29-NOV-16
Storage: WIF-4, 5A
Control-CS136 West Bear
23-NOV-16 13:30 Project #: SLR DATA GAP INVSTGN

Tissue	7:LIPIDS		:	USD
Tissue	7:MOISTURE		:	USD
Tissue	DX017.1613		:	USD
Tissue	DX017.1613-2		:	USD
Tissue	HOMOGENIZATION		:	USD
EDataDeliv	DX017 EDD		:	USD
Data Package	DX017 MINI		:	USD
ANY	SAMPLE RECEIPT	1	: 250 mL glass AMB	USD

L26338-2 29-NOV-16
Storage: WIF-4, 5A
BW16MLW-001 (GLC 11080)
23-NOV-16 13:30 Project #: SLR DATA GAP INVSTGN

Tissue	7:LIPIDS		:	USD
Tissue	7:MOISTURE		:	USD
Tissue	DX017.1613		:	USD
Tissue	DX017.1613-2		:	USD
Tissue	HOMOGENIZATION		:	USD
EDataDeliv	DX017 EDD		:	USD
Data Package	DX017 MINI		:	USD
ANY	SAMPLE RECEIPT	1	: 250 mL glass AMB	USD

L26338-3 29-NOV-16
Storage: WIF-4, 5A
BW16MLW-002 (GLC 11081)
23-NOV-16 13:30 Project #: SLR DATA GAP INVSTGN

Tissue	7:LIPIDS		:	USD
Tissue	7:MOISTURE		:	USD
Tissue	DX017.1613		:	USD
Tissue	DX017.1613-2		:	USD
Tissue	HOMOGENIZATION		:	USD
EDataDeliv	DX017 EDD		:	USD
Data Package	DX017 MINI		:	USD
ANY	SAMPLE RECEIPT	1	: 250 mL glass AMB	USD

KP
6 Dec 2016
for Scanning

AXYS Analytical Services Ltd.

Login Chain of Custody Report (In01)

Dec. 06, 2016
08:39 AM

Login Number: L26338
Account: 4819 Bay West LLC
Project: SLR DATA GAP INVSTGN

Page: 2 of 2

Axys ID versus Client Sample Identification			**Received**	**Due**	**PR**
L26338-4		Storage: WIF-4, 5A	29-NOV-16		
BW16MLW-003 (GLC 11082) 23-NOV-16 13:30		Project #: SLR DATA GAP INVSTGN			
Tissue	7:LIPIDS		:		USD
Tissue	7:MOISTURE		:		USD
Tissue	DX017.1613		:		USD
Tissue	DX017.1613-2		:		USD
Tissue	HOMOGENIZATION		:		USD
EDataDeliv	DX017 EDD		:		USD
Data Package	DX017 MINI		:		USD
ANY	SAMPLE RECEIPT		1 : 250 mL glass AMB		USD
L26338-5		Storage: WIF-4, 5A	29-NOV-16		
Background day 0 10/25/16 23-NOV-16 13:30		Project #: SLR DATA GAP INVSTGN			
Tissue	7:LIPIDS		:		USD
Tissue	7:MOISTURE		:		USD
Tissue	DX017.1613		:		USD
Tissue	DX017.1613-2		:		USD
Tissue	HOMOGENIZATION		:		USD
EDataDeliv	DX017 EDD		:		USD
Data Package	DX017 MINI		:		USD
ANY	SAMPLE RECEIPT		1 : 250 mL glass AMB		USD

AXYS METHOD MLA-017 Rev 20

Form 1A
PCDD/PCDF ANALYSIS REPORT

CLIENT SAMPLE NO.
Control-CS136 West Bear
Sample Collection:
23-Nov-2016 13:30

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-1
Matrix:	TISSUE	**Sample Size:**	10.0 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 03:35:33	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 20**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg/g (wet weight basis)	**% Lipid:**	1.01

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	LAB FLAG [1]	CONCENTRATION FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO [3]	RRT [3]
2,3,7,8-TCDD	U		0.0575 (Q)		
1,2,3,7,8-PECDD [4]	U		0.0575 (Q)		
1,2,3,4,7,8-HXCDD	U		0.0575 (Q)		
1,2,3,6,7,8-HXCDD	U		0.0575 (Q)		
1,2,3,7,8,9-HXCDD	U		0.0575 (Q)		
1,2,3,4,6,7,8-HPCDD	K J	0.147	0.0575 (Q)	1.45	1.001
OCDD	J	0.716	0.0575 (Q)	0.97	1.000
2,3,7,8-TCDF	U		0.0575 (Q)		
1,2,3,7,8-PECDF	U		0.0575 (Q)		
2,3,4,7,8-PECDF	U		0.0575 (Q)		
1,2,3,4,7,8-HXCDF	U		0.0575 (Q)		
1,2,3,6,7,8-HXCDF	U		0.0575 (Q)		
1,2,3,7,8,9-HXCDF	U		0.0575 (Q)		
2,3,4,6,7,8-HXCDF	U		0.0575 (Q)		
1,2,3,4,6,7,8-HPCDF	U		0.0575 (Q)		
1,2,3,4,7,8,9-HPCDF	U		0.0575 (Q)		
OCDF	J	0.0677	0.0575 (Q)	0.93	1.002
TOTAL TETRA-DIOXINS		0.138	0.0575 (Q)		
TOTAL PENTA-DIOXINS	U		0.0575 (Q)		
TOTAL HEXA-DIOXINS	U		0.0575 (Q)		
TOTAL HEPTA-DIOXINS	U		0.0575 (Q)		
TOTAL TETRA-FURANS	U		0.0575 (Q)		
TOTAL PENTA-FURANS	U		0.0575 (Q)		
TOTAL HEXA-FURANS	U		0.0575 (Q)		
TOTAL HEPTA-FURANS	U		0.0575 (Q)		

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL; K = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration; J = concentration less than lowest calibration equivalent.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = contract defined limit.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: ________Henry Huang________

For Axys Internal Use Only [XSL Template: Form1A.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB5_L26338-1_Form1A_DX7M_002S20_SJ2147945.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
Control-CS136 West Bear
Sample Collection:
23-Nov-2016 13:30

Form 2

PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-1
Matrix:	TISSUE	**Sample Size:**	10.0 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 03:35:33	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 20**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg absolute	**% Lipid:**	1.01

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	**LAB FLAG [1]**	**SPIKE CONC.**	**CONC. FOUND**	**R(%) [2]**	**ION ABUND. RATIO [3]**	**RRT [3]**
13C-2,3,7,8-TCDD		2000	1440	72.1	0.78	1.012
13C-1,2,3,7,8-PECDD [4]		2000	1970	98.3	0.65	1.381
13C-1,2,3,4,7,8-HXCDD		2000	1460	72.9	1.27	0.986
13C-1,2,3,6,7,8-HXCDD		2000	1450	72.7	1.24	0.990
13C-1,2,3,4,6,7,8-HPCDD		2000	1750	87.4	1.07	1.096
13C-OCDD		4000	3600	89.9	0.90	1.181
13C-2,3,7,8-TCDF		2000	1340	66.9	0.78	0.966
13C-1,2,3,7,8-PECDF		2000	1550	77.3	1.56	1.281
13C-2,3,4,7,8-PECDF		2000	1500	75.2	1.55	1.349
13C-1,2,3,4,7,8-HXCDF		2000	1410	70.5	0.52	0.953
13C-1,2,3,6,7,8-HXCDF		2000	1430	71.4	0.52	0.957
13C-1,2,3,7,8,9-HXCDF		2000	1410	70.6	0.52	1.005
13C-2,3,4,6,7,8-HXCDF		2000	1410	70.3	0.53	0.980
13C-1,2,3,4,6,7,8-HPCDF		2000	1600	80.1	0.44	1.063
13C-1,2,3,4,7,8,9-HPCDF		2000	1720	86.2	0.46	1.105
CLEANUP STANDARD						
37CL-2,3,7,8-TCDD		200	151	75.6		1.001

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for percent recovery (R) are specified in Section 9.3.3, Method 1613.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613. NOTE: There is no ion abundance ratio for 37Cl4-2,3,7,8-TCDD
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Henry Huang________

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Report Filename: 1613_DIOXINS_1613DB5_L26338-1_Form2_DX7M_002S20_SJ2147945.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

PCDD/PCDF ANALYSIS TEQ DATA REPORT

CLIENT SAMPLE NO.
Control-CS136 West Bear

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Sample Collection:	23-Nov-2016 13:30
Contract No.:	4819	**Project No.**	SLR AOC DATA GAP INVESTIGATION
Matrix:	TISSUE	**Lab Sample I.D.:**	L26338-1
Sample Size:	10.0 g (wet)	**GC Column ID:**	DB5
Concentration Units:	pg/g (wet weight basis)	**Sample Data Filename:**	**DX7M_002 S: 20**

COMPOUND	LAB FLAG 1	CONC. FOUND	REPORTING LIMIT (RL)	WHO 2005 TEF	TEQ ND=0	TEQ ND=1/2 RL	TEQ ND=RL
2,3,7,8-TCDD	U		0.0575	1	0.00e+00	2.88e-02	
1,2,3,7,8-PECDD	U		0.0575	1	0.00e+00	2.88e-02	
1,2,3,4,7,8-HXCDD	U		0.0575	0.1	0.00e+00	2.88e-03	
1,2,3,6,7,8-HXCDD	U		0.0575	0.1	0.00e+00	2.88e-03	
1,2,3,7,8,9-HXCDD	U		0.0575	0.1	0.00e+00	2.88e-03	
1,2,3,4,6,7,8-HPCDD	U		0.0575	0.01	0.00e+00	2.88e-04	
OCDD		0.716	0.0575	0.0003	2.15e-04	2.15e-04	
2,3,7,8-TCDF	U		0.0575	0.1	0.00e+00	2.88e-03	
1,2,3,7,8-PECDF	U		0.0575	0.03	0.00e+00	8.63e-04	
2,3,4,7,8-PECDF	U		0.0575	0.3	0.00e+00	8.63e-03	
1,2,3,4,7,8-HXCDF	U		0.0575	0.1	0.00e+00	2.88e-03	
1,2,3,6,7,8-HXCDF	U		0.0575	0.1	0.00e+00	2.88e-03	
1,2,3,7,8,9-HXCDF	U		0.0575	0.1	0.00e+00	2.88e-03	
2,3,4,6,7,8-HXCDF	U		0.0575	0.1	0.00e+00	2.88e-03	
1,2,3,4,6,7,8-HPCDF	U		0.0575	0.01	0.00e+00	2.88e-04	
1,2,3,4,7,8,9-HPCDF	U		0.0575	0.01	0.00e+00	2.88e-04	
OCDF		0.0677	0.0575	0.0003	2.03e-05	2.03e-05	
			TOTAL TEQ		0.000235	0.0911	

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL.
(2) Concentrations that do not meet quantification criteria are not included in the TEQ calculations.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: __________Henry Huang_________

These pages are part of a larger report that may contain information necessary for full data evaluation. Results reported relate only to the sample tested.

For Axys Internal Use Only [XSL Template: TEQ.xsl; Created: 12-Jan-2017 15:30:42; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613-TEQ_L26338-1_TEQ_SJ2147945.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
BW16MLW-001 (GLC 11080)
Sample Collection:
23-Nov-2016 13:30

Form 1A
PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-2
Matrix:	TISSUE	**Sample Size:**	9.98 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 04:30:48	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 21**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg/g (wet weight basis)	**% Lipid:**	1.03

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	LAB FLAG [1]	CONCENTRATION FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO [3]	RRT [3]
2,3,7,8-TCDD	K J	0.200	0.0584 (S)	0.54	1.002
1,2,3,7,8-PECDD [4]	J	0.216	0.0635 (S)	0.65	1.002
1,2,3,4,7,8-HXCDD	J	0.0867	0.0576 (Q)	1.18	1.000
1,2,3,6,7,8-HXCDD	K J	0.415	0.0576 (Q)	1.02	1.000
1,2,3,7,8,9-HXCDD	K J	0.162	0.0576 (Q)	1.88	1.011
1,2,3,4,6,7,8-HPCDD	J	1.70	0.0576 (Q)	0.98	1.000
OCDD	J	9.14	0.0897 (S)	0.91	1.000
2,3,7,8-TCDF	J	0.657	0.0576 (Q)	0.78	1.002
1,2,3,7,8-PECDF	K J	0.206	0.0576 (Q)	1.07	1.001
2,3,4,7,8-PECDF	K J	0.270	0.0576 (Q)	1.84	1.002
1,2,3,4,7,8-HXCDF	K J	0.219	0.0576 (Q)	1.69	1.001
1,2,3,6,7,8-HXCDF	J	0.450	0.0576 (Q)	1.18	1.000
1,2,3,7,8,9-HXCDF	U		0.0576 (Q)		
2,3,4,6,7,8-HXCDF	K J	0.0867	0.0576 (Q)	1.84	1.000
1,2,3,4,6,7,8-HPCDF	J	3.67	0.0576 (Q)	1.00	1.000
1,2,3,4,7,8,9-HPCDF	U		0.0576 (Q)		
OCDF	J	1.02	0.0576 (Q)	0.79	1.002
TOTAL TETRA-DIOXINS		1.24	0.0584 (S)		
TOTAL PENTA-DIOXINS		0.774	0.0635 (S)		
TOTAL HEXA-DIOXINS		1.09	0.0576 (Q)		
TOTAL HEPTA-DIOXINS		3.71	0.0576 (Q)		
TOTAL TETRA-FURANS		6.10	0.0576 (Q)		
TOTAL PENTA-FURANS		5.59	0.0576 (Q)		
TOTAL HEXA-FURANS		5.36	0.0576 (Q)		
TOTAL HEPTA-FURANS		7.24	0.0576 (Q)		

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL; K = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration; J = concentration less than lowest calibration equivalent.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = contract defined limit.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________Henry Huang_________

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Report Filename: 1613_DIOXINS_1613DB5_L26338-2_Form1A_DX7M_002S21_SJ2147946.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
BW16MLW-001 (GLC 11080)
Sample Collection:
23-Nov-2016 13:30

Form 2
PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Project No. SLR AOC DATA GAP INVESTIGATION

Contract No.: 4819

Lab Sample I.D.: L26338-2

Matrix: TISSUE

Sample Size: 9.98 g (wet)

Sample Receipt Date: 29-Nov-2016

Initial Calibration Date: 27-Sep-2016

Extraction Date: 20-Dec-2016

Instrument ID: HR GC/MS

Analysis Date: 10-Jan-2017 **Time:** 04:30:48

GC Column ID: DB5

Extract Volume (uL): 20

Sample Data Filename: **DX7M_002 S: 21**

Injection Volume (uL): 1.0

Blank Data Filename: DX7M_002 S: 17

Dilution Factor: N/A

Cal. Ver. Data Filename: DX7M_002 S: 13

Concentration Units: pg absolute

% Lipid: 1.03

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Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	LAB FLAG [1]	SPIKE CONC.	CONC. FOUND	R(%) [2]	ION ABUND. RATIO [3]	RRT [3]
13C-2,3,7,8-TCDD		2000	1580	78.9	0.81	1.013
13C-1,2,3,7,8-PECDD [4]		2000	2090	104	0.64	1.381
13C-1,2,3,4,7,8-HXCDD		2000	1560	77.8	1.25	0.987
13C-1,2,3,6,7,8-HXCDD		2000	1540	77.0	1.28	0.990
13C-1,2,3,4,6,7,8-HPCDD		2000	1800	90.0	1.05	1.096
13C-OCDD		4000	3660	91.6	0.90	1.181
13C-2,3,7,8-TCDF		2000	1460	72.9	0.78	0.966
13C-1,2,3,7,8-PECDF		2000	1670	83.5	1.59	1.282
13C-2,3,4,7,8-PECDF		2000	1650	82.3	1.59	1.350
13C-1,2,3,4,7,8-HXCDF		2000	1500	75.0	0.52	0.953
13C-1,2,3,6,7,8-HXCDF		2000	1460	72.9	0.52	0.958
13C-1,2,3,7,8,9-HXCDF		2000	1540	76.8	0.53	1.005
13C-2,3,4,6,7,8-HXCDF		2000	1520	76.1	0.51	0.980
13C-1,2,3,4,6,7,8-HPCDF		2000	1750	87.6	0.45	1.063
13C-1,2,3,4,7,8,9-HPCDF		2000	1770	88.3	0.45	1.105
CLEANUP STANDARD						
37CL-2,3,7,8-TCDD		200	157	78.6		1.001

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for percent recovery (R) are specified in Section 9.3.3, Method 1613.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613. NOTE: There is no ion abundance ratio for 37Cl4-2,3,7,8-TCDD
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________Henry Huang________

For Axys Internal Use Only [XSL Template: Form2.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB5_L26338-2_Form2_DX7M_002S21_SJ2147946.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 1A
PCDD/PCDF ANALYSIS REPORT

CLIENT SAMPLE NO.
BW16MLW-001 (GLC 11080)
Sample Collection:
23-Nov-2016 13:30

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-2 i
Matrix:	TISSUE	**Sample Size:**	9.98 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	04-Jan-2017
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 17:11:18	**GC Column ID:**	DB225
Extract Volume (uL):	20	**Sample Data Filename:**	**DB7T_010C S: 1**
Injection Volume (uL):	2.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DB7T_010B S: 2
Concentration Units:	pg/g (wet weight basis)	**% Lipid:**	1.03

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	LAB FLAG [1]	CONCENTRATION FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO [3]	RRT [3]
2,3,7,8-TCDF	J	0.492	0.0576 (Q)	0.89	1.001

(1) Where applicable, custom lab flags have been used on this report; J = concentration less than lowest calibration equivalent.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = contract defined limit.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________Henry Huang________

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Report Filename: 1613_DIOXINS_1613DB225_L26338-2_Form1A_DB7T_010CS1_SJ2148504.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

PCDD/PCDF ANALYSIS TEQ DATA REPORT

CLIENT SAMPLE NO.
BW16MLW-001 (GLC 11080)

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Contract No.:	4819	**Sample Collection:**	23-Nov-2016 13:30
		Project No.	SLR AOC DATA GAP INVESTIGATION
Matrix:	TISSUE	**Lab Sample I.D.:**	L26338-2
Sample Size:	9.98 g (wet)	**GC Column ID(s):**	DB225 DB5
Concentration Units:	pg/g (wet weight basis)	**Sample Data Filenames:**	**DB7T_010C S: 1** **DX7M_002 S: 21**

COMPOUND	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)	WHO 2005 TEF	TEQ ND=0	TEQ ND=1/2 RL	TEQ ND=RL
2,3,7,8-TCDD	U		0.0584	1	0.00e+00	2.92e-02	
1,2,3,7,8-PECDD		0.216	0.0635	1	2.16e-01	2.16e-01	
1,2,3,4,7,8-HXCDD		0.0867	0.0576	0.1	8.67e-03	8.67e-03	
1,2,3,6,7,8-HXCDD	U		0.0576	0.1	0.00e+00	2.88e-03	
1,2,3,7,8,9-HXCDD	U		0.0576	0.1	0.00e+00	2.88e-03	
1,2,3,4,6,7,8-HPCDD		1.70	0.0576	0.01	1.70e-02	1.70e-02	
OCDD		9.14	0.0897	0.0003	2.74e-03	2.74e-03	
2,3,7,8-TCDF		0.492	0.0576	0.1	4.92e-02	4.92e-02	
1,2,3,7,8-PECDF	U		0.0576	0.03	0.00e+00	8.64e-04	
2,3,4,7,8-PECDF	U		0.0576	0.3	0.00e+00	8.64e-03	
1,2,3,4,7,8-HXCDF	U		0.0576	0.1	0.00e+00	2.88e-03	
1,2,3,6,7,8-HXCDF		0.450	0.0576	0.1	4.50e-02	4.50e-02	
1,2,3,7,8,9-HXCDF	U		0.0576	0.1	0.00e+00	2.88e-03	
2,3,4,6,7,8-HXCDF	U		0.0576	0.1	0.00e+00	2.88e-03	
1,2,3,4,6,7,8-HPCDF		3.67	0.0576	0.01	3.67e-02	3.67e-02	
1,2,3,4,7,8,9-HPCDF	U		0.0576	0.01	0.00e+00	2.88e-04	
OCDF		1.02	0.0576	0.0003	3.06e-04	3.06e-04	
			TOTAL TEQ		0.376	0.429	

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL.
(2) Concentrations that do not meet quantification criteria are not included in the TEQ calculations.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: __________Henry Huang_________

These pages are part of a larger report that may contain information necessary for full data evaluation. Results reported relate only to the sample tested.

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Report Filename: 1613_DIOXINS_1613-TEQ_L26338-2_TEQ_SJ2147946.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
BW16MLW-002 (GLC 11081)
Sample Collection:
23-Nov-2016 13:30

Form 1A
PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-3
Matrix:	TISSUE	**Sample Size:**	9.99 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 05:26:02	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 22**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg/g (wet weight basis)	**% Lipid:**	1.03

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	LAB FLAG [1]	CONCENTRATION FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO [3]	RRT [3]
2,3,7,8-TCDD	J	0.350	0.0581 (Q)	0.72	1.001
1,2,3,7,8-PECDD [4]	J	0.155	0.0581 (Q)	0.54	1.001
1,2,3,4,7,8-HXCDD	J	0.102	0.0581 (Q)	1.40	1.000
1,2,3,6,7,8-HXCDD	J	0.521	0.0581 (Q)	1.25	1.000
1,2,3,7,8,9-HXCDD	J	0.205	0.0581 (Q)	1.25	1.010
1,2,3,4,6,7,8-HPCDD	J	1.88	0.0581 (Q)	1.05	1.000
OCDD	J	9.28	0.0581 (Q)	0.84	1.000
2,3,7,8-TCDF	J	0.726	0.0581 (Q)	0.85	1.001
1,2,3,7,8-PECDF	J	0.212	0.0783 (S)	1.54	1.000
2,3,4,7,8-PECDF	J	0.230	0.0783 (S)	1.67	1.001
1,2,3,4,7,8-HXCDF	K J	0.206	0.0581 (Q)	1.01	1.001
1,2,3,6,7,8-HXCDF	J	0.535	0.0581 (Q)	1.20	1.000
1,2,3,7,8,9-HXCDF	U		0.0581 (Q)		
2,3,4,6,7,8-HXCDF	K J	0.101	0.0581 (Q)	1.49	1.000
1,2,3,4,6,7,8-HPCDF	J	3.65	0.0581 (Q)	1.20	1.000
1,2,3,4,7,8,9-HPCDF	U		0.0581 (Q)		
OCDF	J	0.999	0.0581 (Q)	0.88	1.002
TOTAL TETRA-DIOXINS		2.11	0.0581 (Q)		
TOTAL PENTA-DIOXINS		1.29	0.0581 (Q)		
TOTAL HEXA-DIOXINS		2.57	0.0581 (Q)		
TOTAL HEPTA-DIOXINS		3.90	0.0581 (Q)		
TOTAL TETRA-FURANS		5.35	0.0581 (Q)		
TOTAL PENTA-FURANS		5.99	0.0783 (S)		
TOTAL HEXA-FURANS		5.95	0.0581 (Q)		
TOTAL HEPTA-FURANS		7.42	0.0581 (Q)		

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL; K = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration; J = concentration less than lowest calibration equivalent.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = contract defined limit.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________Henry Huang________

For Axys Internal Use Only [XSL Template: Form1A.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB5_L26338-3_Form1A_DX7M_002S22_SJ2147947.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 2

PCDD/PCDF ANALYSIS REPORT

CLIENT SAMPLE NO.
BW16MLW-002 (GLC 11081)
Sample Collection:
23-Nov-2016 13:30

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-3
Matrix:	TISSUE	**Sample Size:**	9.99 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 05:26:02	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 22**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg absolute	**% Lipid:**	1.03

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	**LAB FLAG [1]**	**SPIKE CONC.**	**CONC. FOUND**	**R(%) [2]**	**ION ABUND. RATIO [3]**	**RRT [3]**
13C-2,3,7,8-TCDD		2000	1440	71.8	0.77	1.013
13C-1,2,3,7,8-PECDD [4]		2000	1880	94.1	0.65	1.381
13C-1,2,3,4,7,8-HXCDD		2000	1450	72.6	1.30	0.987
13C-1,2,3,6,7,8-HXCDD		2000	1400	70.1	1.28	0.990
13C-1,2,3,4,6,7,8-HPCDD		2000	1670	83.4	1.04	1.096
13C-OCDD		4000	3470	86.7	0.90	1.181
13C-2,3,7,8-TCDF		2000	1340	67.1	0.79	0.967
13C-1,2,3,7,8-PECDF		2000	1520	75.9	1.57	1.282
13C-2,3,4,7,8-PECDF		2000	1460	73.2	1.56	1.350
13C-1,2,3,4,7,8-HXCDF		2000	1420	71.0	0.53	0.953
13C-1,2,3,6,7,8-HXCDF		2000	1370	68.6	0.53	0.958
13C-1,2,3,7,8,9-HXCDF		2000	1400	70.2	0.52	1.005
13C-2,3,4,6,7,8-HXCDF		2000	1400	70.1	0.52	0.980
13C-1,2,3,4,6,7,8-HPCDF		2000	1550	77.6	0.45	1.063
13C-1,2,3,4,7,8,9-HPCDF		2000	1630	81.7	0.45	1.105
CLEANUP STANDARD						
37CL-2,3,7,8-TCDD		200	155	77.3		1.001

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for percent recovery (R) are specified in Section 9.3.3, Method 1613.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613. NOTE: There is no ion abundance ratio for 37Cl4-2,3,7,8-TCDD
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Henry Huang________

For Axys Internal Use Only [XSL Template: Form2.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB5_L26338-3_Form2_DX7M_002S22_SJ2147947.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 1A

PCDD/PCDF ANALYSIS REPORT

CLIENT SAMPLE NO.
BW16MLW-002 (GLC 11081)
Sample Collection:
23-Nov-2016 13:30

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-3
Matrix:	TISSUE	**Sample Size:**	9.99 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	04-Jan-2017
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 15:39:30	**GC Column ID:**	DB225
Extract Volume (uL):	20	**Sample Data Filename:**	**DB7T_010B S: 10**
Injection Volume (uL):	2.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DB7T_010B S: 2
Concentration Units:	pg/g (wet weight basis)	**% Lipid:**	1.03

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Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	LAB FLAG [1]	CONCENTRATION FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO [3]	RRT [3]
2,3,7,8-TCDF	J	0.436	0.0581 (Q)	0.79	1.002

(1) Where applicable, custom lab flags have been used on this report; J = concentration less than lowest calibration equivalent.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = contract defined limit.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Henry Huang________

For Axys Internal Use Only [XSL Template: Form1A.xsl; Created: 12-Jan-2017 15:30:06; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB225_L26338-3_Form1A_DB7T_010BS10_SJ2148502.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

PCDD/PCDF ANALYSIS TEQ DATA REPORT

CLIENT SAMPLE NO.
BW16MLW-002 (GLC 11081)

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Sample Collection: 23-Nov-2016 13:30

Contract No.: 4819

Project No. SLR AOC DATA GAP INVESTIGATION

Matrix: TISSUE

Lab Sample I.D.: L26338-3

Sample Size: 9.99 g (wet)

GC Column ID(s): DB225
DB5

Concentration Units: pg/g (wet weight basis)

Sample Data Filenames: **DB7T_010B S: 10**
DX7M_002 S: 22

COMPOUND	LAB FLAG 1	CONC. FOUND	REPORTING LIMIT (RL)	WHO 2005 TEF	TEQ ND=0	TEQ ND=1/2 RL	TEQ ND=RL
2,3,7,8-TCDD		0.350	0.0581	1	3.50e-01	3.50e-01	
1,2,3,7,8-PECDD		0.155	0.0581	1	1.55e-01	1.55e-01	
1,2,3,4,7,8-HXCDD		0.102	0.0581	0.1	1.02e-02	1.02e-02	
1,2,3,6,7,8-HXCDD		0.521	0.0581	0.1	5.21e-02	5.21e-02	
1,2,3,7,8,9-HXCDD		0.205	0.0581	0.1	2.05e-02	2.05e-02	
1,2,3,4,6,7,8-HPCDD		1.88	0.0581	0.01	1.88e-02	1.88e-02	
OCDD		9.28	0.0581	0.0003	2.78e-03	2.78e-03	
2,3,7,8-TCDF		0.436	0.0581	0.1	4.36e-02	4.36e-02	
1,2,3,7,8-PECDF		0.212	0.0783	0.03	6.36e-03	6.36e-03	
2,3,4,7,8-PECDF		0.230	0.0783	0.3	6.90e-02	6.90e-02	
1,2,3,4,7,8-HXCDF	U		0.0581	0.1	0.00e+00	2.91e-03	
1,2,3,6,7,8-HXCDF		0.535	0.0581	0.1	5.35e-02	5.35e-02	
1,2,3,7,8,9-HXCDF	U		0.0581	0.1	0.00e+00	2.91e-03	
2,3,4,6,7,8-HXCDF	U		0.0581	0.1	0.00e+00	2.91e-03	
1,2,3,4,6,7,8-HPCDF		3.65	0.0581	0.01	3.65e-02	3.65e-02	
1,2,3,4,7,8,9-HPCDF	U		0.0581	0.01	0.00e+00	2.91e-04	
OCDF		0.999	0.0581	0.0003	3.00e-04	3.00e-04	
			TOTAL TEQ		0.819	0.828	

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL.
(2) Concentrations that do not meet quantification criteria are not included in the TEQ calculations.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: __________Henry Huang_________

These pages are part of a larger report that may contain information necessary for full data evaluation. Results reported relate only to the sample tested.

For Axys Internal Use Only [XSL Template: TEQ.xsl; Created: 12-Jan-2017 15:30:42; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613-TEQ_L26338-3_TEQ_SJ2147947.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20			**CLIENT SAMPLE NO.** **BW16MLW-003 (GLC 11082)** **Sample Collection:** **23-Nov-2016 13:30**

Form 1A
PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-4
Matrix:	TISSUE	**Sample Size:**	10.0 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 06:21:14	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 23**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg/g (wet weight basis)	**% Lipid:**	1.27

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	LAB FLAG [1]	CONCENTRATION FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO [3]	RRT [3]
2,3,7,8-TCDD	K J	0.305	0.0578 (Q)	0.62	1.001
1,2,3,7,8-PECDD [4]	J	0.333	0.0578 (Q)	0.62	1.002
1,2,3,4,7,8-HXCDD	J	0.155	0.0625 (S)	1.12	1.001
1,2,3,6,7,8-HXCDD	J	0.797	0.0625 (S)	1.14	1.000
1,2,3,7,8,9-HXCDD	J	0.287	0.0625 (S)	1.16	1.010
1,2,3,4,6,7,8-HPCDD	J	3.45	0.0578 (Q)	0.93	1.000
OCDD		22.7	0.0578 (Q)	0.89	1.000
2,3,7,8-TCDF	J	0.921	0.0578 (Q)	0.72	1.001
1,2,3,7,8-PECDF	K J	0.427	0.0578 (Q)	1.83	1.001
2,3,4,7,8-PECDF	J	0.372	0.0578 (Q)	1.73	1.001
1,2,3,4,7,8-HXCDF	K J	0.322	0.0578 (Q)	1.60	1.001
1,2,3,6,7,8-HXCDF	J	1.23	0.0578 (Q)	1.16	1.000
1,2,3,7,8,9-HXCDF	U		0.0578 (Q)		
2,3,4,6,7,8-HXCDF	J	0.158	0.0578 (Q)	1.10	1.000
1,2,3,4,6,7,8-HPCDF		8.72	0.0578 (Q)	1.06	1.000
1,2,3,4,7,8,9-HPCDF	J	0.0893	0.0578 (Q)	1.17	1.000
OCDF	J	2.26	0.0578 (Q)	0.87	1.002
TOTAL TETRA-DIOXINS		1.93	0.0578 (Q)		
TOTAL PENTA-DIOXINS		2.00	0.0578 (Q)		
TOTAL HEXA-DIOXINS		3.84	0.0625 (S)		
TOTAL HEPTA-DIOXINS		7.40	0.0578 (Q)		
TOTAL TETRA-FURANS		8.16	0.0578 (Q)		
TOTAL PENTA-FURANS		8.03	0.0578 (Q)		
TOTAL HEXA-FURANS		10.3	0.0578 (Q)		
TOTAL HEPTA-FURANS		16.1	0.0578 (Q)		

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL; K = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration; J = concentration less than lowest calibration equivalent.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = contract defined limit.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Henry Huang_________

For Axys Internal Use Only [XSL Template: Form1A.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB5_L26338-4_Form1A_DX7M_002S23_SJ2147948.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
BW16MLW-003 (GLC 11082)
Sample Collection:
23-Nov-2016 13:30

Form 2
PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-4
Matrix:	TISSUE	**Sample Size:**	10.0 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 06:21:14	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 23**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg absolute	**% Lipid:**	1.27

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	LAB FLAG [1]	SPIKE CONC.	CONC. FOUND	R(%) [2]	ION ABUND. RATIO [3]	RRT [3]
13C-2,3,7,8-TCDD		2000	1550	77.5	0.78	1.013
13C-1,2,3,7,8-PECDD [4]		2000	2030	101	0.64	1.381
13C-1,2,3,4,7,8-HXCDD		2000	1570	78.5	1.27	0.987
13C-1,2,3,6,7,8-HXCDD		2000	1530	76.5	1.27	0.990
13C-1,2,3,4,6,7,8-HPCDD		2000	1810	90.6	1.05	1.096
13C-OCDD		4000	3690	92.3	0.90	1.181
13C-2,3,7,8-TCDF		2000	1470	73.3	0.80	0.966
13C-1,2,3,7,8-PECDF		2000	1640	82.1	1.58	1.282
13C-2,3,4,7,8-PECDF		2000	1610	80.5	1.57	1.350
13C-1,2,3,4,7,8-HXCDF		2000	1510	75.7	0.52	0.953
13C-1,2,3,6,7,8-HXCDF		2000	1520	76.1	0.52	0.958
13C-1,2,3,7,8,9-HXCDF		2000	1540	76.8	0.53	1.005
13C-2,3,4,6,7,8-HXCDF		2000	1510	75.7	0.52	0.980
13C-1,2,3,4,6,7,8-HPCDF		2000	1720	86.2	0.45	1.063
13C-1,2,3,4,7,8,9-HPCDF		2000	1770	88.6	0.45	1.105
CLEANUP STANDARD						
37CL-2,3,7,8-TCDD		200	151	75.5		1.001

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for percent recovery (R) are specified in Section 9.3.3, Method 1613.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613. NOTE: There is no ion abundance ratio for 37Cl4-2,3,7,8-TCDD
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Henry Huang________

For Axys Internal Use Only [XSL Template: Form2.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB5_L26338-4_Form2_DX7M_002S23_SJ2147948.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
BW16MLW-003 (GLC 11082)
Sample Collection:
23-Nov-2016 13:30

Form 1A

PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-4
Matrix:	TISSUE	**Sample Size:**	10.0 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	04-Jan-2017
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 17:47:43	**GC Column ID:**	DB225
Extract Volume (uL):	20	**Sample Data Filename:**	**DB7T_010C S: 2**
Injection Volume (uL):	2.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DB7T_010B S: 2
Concentration Units:	pg/g (wet weight basis)	**% Lipid:**	1.27

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	LAB FLAG [1]	CONCENTRATION FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO [3]	RRT [3]
2,3,7,8-TCDF	J	0.624	0.0578 (Q)	0.75	1.002

(1) Where applicable, custom lab flags have been used on this report; J = concentration less than lowest calibration equivalent.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = contract defined limit.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________Henry Huang________

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Report Filename: 1613_DIOXINS_1613DB225_L26338-4_Form1A_DB7T_010CS2_SJ2148505.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

PCDD/PCDF ANALYSIS TEQ DATA REPORT

CLIENT SAMPLE NO.
BW16MLW-003 (GLC 11082)

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Sample Collection:	23-Nov-2016 13:30
Contract No.:	4819	**Project No.**	SLR AOC DATA GAP INVESTIGATION
Matrix:	TISSUE	**Lab Sample I.D.:**	L26338-4
Sample Size:	10.0 g (wet)	**GC Column ID(s):**	DB225 DB5
Concentration Units:	pg/g (wet weight basis)	**Sample Data Filenames:**	**DB7T_010C S: 2** **DX7M_002 S: 23**

COMPOUND	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)	WHO 2005 TEF	TEQ ND=0	TEQ ND=1/2 RL	TEQ ND=RL
2,3,7,8-TCDD	U		0.0578	1	0.00e+00	2.89e-02	
1,2,3,7,8-PECDD		0.333	0.0578	1	3.33e-01	3.33e-01	
1,2,3,4,7,8-HXCDD		0.155	0.0625	0.1	1.55e-02	1.55e-02	
1,2,3,6,7,8-HXCDD		0.797	0.0625	0.1	7.97e-02	7.97e-02	
1,2,3,7,8,9-HXCDD		0.287	0.0625	0.1	2.87e-02	2.87e-02	
1,2,3,4,6,7,8-HPCDD		3.45	0.0578	0.01	3.45e-02	3.45e-02	
OCDD		22.7	0.0578	0.0003	6.81e-03	6.81e-03	
2,3,7,8-TCDF		0.624	0.0578	0.1	6.24e-02	6.24e-02	
1,2,3,7,8-PECDF	U		0.0578	0.03	0.00e+00	8.67e-04	
2,3,4,7,8-PECDF		0.372	0.0578	0.3	1.12e-01	1.12e-01	
1,2,3,4,7,8-HXCDF	U		0.0578	0.1	0.00e+00	2.89e-03	
1,2,3,6,7,8-HXCDF		1.23	0.0578	0.1	1.23e-01	1.23e-01	
1,2,3,7,8,9-HXCDF	U		0.0578	0.1	0.00e+00	2.89e-03	
2,3,4,6,7,8-HXCDF		0.158	0.0578	0.1	1.58e-02	1.58e-02	
1,2,3,4,6,7,8-HPCDF		8.72	0.0578	0.01	8.72e-02	8.72e-02	
1,2,3,4,7,8,9-HPCDF		0.0893	0.0578	0.01	8.93e-04	8.93e-04	
OCDF		2.26	0.0578	0.0003	6.78e-04	6.78e-04	
			TOTAL TEQ		0.900	0.935	

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL.
(2) Concentrations that do not meet quantification criteria are not included in the TEQ calculations.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: __________Henry Huang_________

These pages are part of a larger report that may contain information necessary for full data evaluation. Results reported relate only to the sample tested.

For Axys Internal Use Only [XSL Template: TEQ.xsl; Created: 12-Jan-2017 15:30:42; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613-TEQ_L26338-4_TEQ_SJ2147948.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
Background day 0 10/25/16
Sample Collection:
23-Nov-2016 13:30

Form 1A
PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-5
Matrix:	TISSUE	**Sample Size:**	10.1 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 07:16:27	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 24**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg/g (wet weight basis)	**% Lipid:**	2.00

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	LAB FLAG [1]	CONCENTRATION FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO [3]	RRT [3]
2,3,7,8-TCDD	K J	0.0685	0.0572 (Q)	0.51	1.000
1,2,3,7,8-PECDD [4]	K J	0.0575	0.0572 (Q)	0.50	1.002
1,2,3,4,7,8-HXCDD	U		0.0572 (Q)		
1,2,3,6,7,8-HXCDD	K J	0.0610	0.0572 (Q)	1.79	1.000
1,2,3,7,8,9-HXCDD	U		0.0572 (Q)		
1,2,3,4,6,7,8-HPCDD	J	0.173	0.0572 (Q)	1.16	1.000
OCDD	K J	0.256	0.0572 (Q)	1.11	1.000
2,3,7,8-TCDF	K J	0.192	0.0572 (Q)	0.64	1.001
1,2,3,7,8-PECDF	U		0.0572 (Q)		
2,3,4,7,8-PECDF	U		0.0572 (Q)		
1,2,3,4,7,8-HXCDF	U		0.0572 (Q)		
1,2,3,6,7,8-HXCDF	U		0.0572 (Q)		
1,2,3,7,8,9-HXCDF	U		0.0572 (Q)		
2,3,4,6,7,8-HXCDF	U		0.0572 (Q)		
1,2,3,4,6,7,8-HPCDF	U		0.0572 (Q)		
1,2,3,4,7,8,9-HPCDF	U		0.0572 (Q)		
OCDF	U		0.0572 (Q)		
TOTAL TETRA-DIOXINS	U		0.0572 (Q)		
TOTAL PENTA-DIOXINS	U		0.0572 (Q)		
TOTAL HEXA-DIOXINS	U		0.0572 (Q)		
TOTAL HEPTA-DIOXINS		0.276	0.0572 (Q)		
TOTAL TETRA-FURANS		0.0713	0.0572 (Q)		
TOTAL PENTA-FURANS	U		0.0572 (Q)		
TOTAL HEXA-FURANS	U		0.0572 (Q)		
TOTAL HEPTA-FURANS	U		0.0572 (Q)		

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL; K = peak detected but did not meet quantification criteria, result reported represents the estimated maximum possible concentration; J = concentration less than lowest calibration equivalent.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = contract defined limit.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Henry Huang_________

For Axys Internal Use Only [XSL Template: Form1A.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB5_L26338-5_Form1A_DX7M_002S24_SJ2147949.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
Background day 0 10/25/16
Sample Collection:
23-Nov-2016 13:30

Form 2
PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-5
Matrix:	TISSUE	**Sample Size:**	10.1 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 07:16:27	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 24**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg absolute	**% Lipid:**	2.00

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	LAB FLAG [1]	SPIKE CONC.	CONC. FOUND	R(%) [2]	ION ABUND. RATIO [3]	RRT [3]
13C-2,3,7,8-TCDD		2000	1330	66.4	0.77	1.013
13C-1,2,3,7,8-PECDD [4]		2000	1800	89.8	0.64	1.382
13C-1,2,3,4,7,8-HXCDD		2000	1310	65.4	1.30	0.987
13C-1,2,3,6,7,8-HXCDD		2000	1280	64.1	1.25	0.990
13C-1,2,3,4,6,7,8-HPCDD		2000	1460	73.2	1.07	1.096
13C-OCDD		4000	2670	66.9	0.89	1.181
13C-2,3,7,8-TCDF		2000	1290	64.4	0.79	0.967
13C-1,2,3,7,8-PECDF		2000	1400	70.2	1.61	1.282
13C-2,3,4,7,8-PECDF		2000	1400	69.9	1.58	1.351
13C-1,2,3,4,7,8-HXCDF		2000	1270	63.6	0.52	0.953
13C-1,2,3,6,7,8-HXCDF		2000	1260	62.9	0.53	0.957
13C-1,2,3,7,8,9-HXCDF		2000	1320	66.1	0.53	1.005
13C-2,3,4,6,7,8-HXCDF		2000	1280	63.9	0.52	0.980
13C-1,2,3,4,6,7,8-HPCDF		2000	1460	72.8	0.45	1.063
13C-1,2,3,4,7,8,9-HPCDF		2000	1440	71.9	0.43	1.105
CLEANUP STANDARD						
37CL-2,3,7,8-TCDD		200	153	76.7		1.001

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for percent recovery (R) are specified in Section 9.3.3, Method 1613.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613. NOTE: There is no ion abundance ratio for 37Cl4-2,3,7,8-TCDD
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Henry Huang________

For Axys Internal Use Only [XSL Template: Form2.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB5_L26338-5_Form2_DX7M_002S24_SJ2147949.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
Background day 0 10/25/16
Sample Collection:
23-Nov-2016 13:30

Form 1A
PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	SLR AOC DATA GAP INVESTIGATION
Contract No.:	4819	**Lab Sample I.D.:**	L26338-5
Matrix:	TISSUE	**Sample Size:**	10.1 g (wet)
Sample Receipt Date:	29-Nov-2016	**Initial Calibration Date:**	04-Jan-2017
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 15:02:59	**GC Column ID:**	DB225
Extract Volume (uL):	20	**Sample Data Filename:**	**DB7T_010B S: 9**
Injection Volume (uL):	2.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DB7T_010B S: 2
Concentration Units:	pg/g (wet weight basis)	**% Lipid:**	2.00

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	LAB FLAG [1]	CONCENTRATION FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO [3]	RRT [3]
2,3,7,8-TCDF	J	0.141	0.0572 (Q)	0.83	1.002

(1) Where applicable, custom lab flags have been used on this report; J = concentration less than lowest calibration equivalent.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = contract defined limit.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________Henry Huang________

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Report Filename: 1613_DIOXINS_1613DB225_L26338-5_Form1A_DB7T_010BS9_SJ2148501.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

PCDD/PCDF ANALYSIS TEQ DATA REPORT

CLIENT SAMPLE NO.
Background day 0 10/25/16

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Sample Collection:	23-Nov-2016 13:30
Contract No.:	4819	**Project No.**	SLR AOC DATA GAP INVESTIGATION
Matrix:	TISSUE	**Lab Sample I.D.:**	L26338-5
Sample Size:	10.1 g (wet)	**GC Column ID(s):**	DB225 DB5
Concentration Units:	pg/g (wet weight basis)	**Sample Data Filenames:**	**DB7T_010B S: 9** **DX7M_002 S: 24**

COMPOUND	LAB FLAG 1	CONC. FOUND	REPORTING LIMIT (RL)	WHO 2005 TEF	TEQ ND=0	TEQ ND=1/2 RL	TEQ ND=RL
2,3,7,8-TCDD	U		0.0572	1	0.00e+00	2.86e-02	
1,2,3,7,8-PECDD	U		0.0572	1	0.00e+00	2.86e-02	
1,2,3,4,7,8-HXCDD	U		0.0572	0.1	0.00e+00	2.86e-03	
1,2,3,6,7,8-HXCDD	U		0.0572	0.1	0.00e+00	2.86e-03	
1,2,3,7,8,9-HXCDD	U		0.0572	0.1	0.00e+00	2.86e-03	
1,2,3,4,6,7,8-HPCDD		0.173	0.0572	0.01	1.73e-03	1.73e-03	
OCDD	U		0.0572	0.0003	0.00e+00	8.58e-06	
2,3,7,8-TCDF		0.141	0.0572	0.1	1.41e-02	1.41e-02	
1,2,3,7,8-PECDF	U		0.0572	0.03	0.00e+00	8.58e-04	
2,3,4,7,8-PECDF	U		0.0572	0.3	0.00e+00	8.58e-03	
1,2,3,4,7,8-HXCDF	U		0.0572	0.1	0.00e+00	2.86e-03	
1,2,3,6,7,8-HXCDF	U		0.0572	0.1	0.00e+00	2.86e-03	
1,2,3,7,8,9-HXCDF	U		0.0572	0.1	0.00e+00	2.86e-03	
2,3,4,6,7,8-HXCDF	U		0.0572	0.1	0.00e+00	2.86e-03	
1,2,3,4,6,7,8-HPCDF	U		0.0572	0.01	0.00e+00	2.86e-04	
1,2,3,4,7,8,9-HPCDF	U		0.0572	0.01	0.00e+00	2.86e-04	
OCDF	U		0.0572	0.0003	0.00e+00	8.58e-06	
			TOTAL TEQ		0.0158	0.103	

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL.
(2) Concentrations that do not meet quantification criteria are not included in the TEQ calculations.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: __________Henry Huang_________

These pages are part of a larger report that may contain information necessary for full data evaluation. Results reported relate only to the sample tested.

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Report Filename: 1613_DIOXINS_1613-TEQ_L26338-5_TEQ_SJ2147949.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
Lab Blank
Sample Collection:
N/A

Form 1A
PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	N/A
Contract No.:	4819	**Lab Sample I.D.:**	WG57620-101
Matrix:	TISSUE	**Sample Size:**	10.0 g
Sample Receipt Date:	N/A	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 00:49:55	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 17**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg/g		

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Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

COMPOUND	LAB FLAG [1]	CONCENTRATION FOUND	REPORTING LIMIT (RL)[2]	ION ABUND. RATIO [3]	RRT [3]
2,3,7,8-TCDD	U		0.0615 (Q)		
1,2,3,7,8-PECDD [4]	U		0.0615 (Q)		
1,2,3,4,7,8-HXCDD	U		0.0615 (Q)		
1,2,3,6,7,8-HXCDD	U		0.0615 (Q)		
1,2,3,7,8,9-HXCDD	J	0.0793	0.0615 (Q)	1.12	1.010
1,2,3,4,6,7,8-HPCDD	J	0.262	0.0615 (Q)	1.07	1.000
OCDD	J	0.596	0.0615 (Q)	0.87	1.000
2,3,7,8-TCDF	U		0.0615 (Q)		
1,2,3,7,8-PECDF	U		0.0615 (Q)		
2,3,4,7,8-PECDF	U		0.0615 (Q)		
1,2,3,4,7,8-HXCDF	U		0.0615 (Q)		
1,2,3,6,7,8-HXCDF	U		0.0615 (Q)		
1,2,3,7,8,9-HXCDF	U		0.0615 (Q)		
2,3,4,6,7,8-HXCDF	U		0.0615 (Q)		
1,2,3,4,6,7,8-HPCDF	U		0.0615 (Q)		
1,2,3,4,7,8,9-HPCDF	U		0.0615 (Q)		
OCDF	U		0.0615 (Q)		
TOTAL TETRA-DIOXINS	U		0.0615 (Q)		
TOTAL PENTA-DIOXINS	U		0.0615 (Q)		
TOTAL HEXA-DIOXINS		0.178	0.0615 (Q)		
TOTAL HEPTA-DIOXINS		0.937	0.0615 (Q)		
TOTAL TETRA-FURANS	U		0.0615 (Q)		
TOTAL PENTA-FURANS	U		0.0615 (Q)		
TOTAL HEXA-FURANS	U		0.0615 (Q)		
TOTAL HEPTA-FURANS	U		0.0615 (Q)		

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL; J = concentration less than lowest calibration equivalent.
(2) Reporting Limit (Code): S = sample detection limit; M = method detection limit; L = lowest calibration level equivalent; Q = contract defined limit.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613.
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Henry Huang________

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Report Filename: 1613_DIOXINS_1613DB5_WG57620-101_Form1A_DX7M_002S17_SJ2147941.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
Lab Blank
Sample Collection:
N/A

Form 2
PCDD/PCDF ANALYSIS REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Project No.	N/A
Contract No.:	4819	**Lab Sample I.D.:**	WG57620-101
Matrix:	TISSUE	**Sample Size:**	10.0 g
Sample Receipt Date:	N/A	**Initial Calibration Date:**	27-Sep-2016
Extraction Date:	20-Dec-2016	**Instrument ID:**	HR GC/MS
Analysis Date:	10-Jan-2017 **Time:** 00:49:55	**GC Column ID:**	DB5
Extract Volume (uL):	20	**Sample Data Filename:**	**DX7M_002 S: 17**
Injection Volume (uL):	1.0	**Blank Data Filename:**	DX7M_002 S: 17
Dilution Factor:	N/A	**Cal. Ver. Data Filename:**	DX7M_002 S: 13
Concentration Units:	pg absolute		

This page is part of a total report that contains information necessary for accreditation compliance.
Results are compliant with NELAP accreditation described in the total report. Sample results relate only to the sample tested.

LABELED COMPOUND	LAB FLAG [1]	SPIKE CONC.	CONC. FOUND	R(%) [2]	ION ABUND. RATIO [3]	RRT [3]
13C-2,3,7,8-TCDD		2000	1610	80.3	0.75	1.012
13C-1,2,3,7,8-PECDD [4]		2000	2160	108	0.65	1.381
13C-1,2,3,4,7,8-HXCDD		2000	1650	82.6	1.25	0.986
13C-1,2,3,6,7,8-HXCDD		2000	1680	83.8	1.25	0.990
13C-1,2,3,4,6,7,8-HPCDD		2000	1970	98.4	1.05	1.096
13C-OCDD		4000	4210	105	0.91	1.180
13C-2,3,7,8-TCDF		2000	1520	75.8	0.80	0.966
13C-1,2,3,7,8-PECDF		2000	1770	88.6	1.57	1.281
13C-2,3,4,7,8-PECDF		2000	1720	86.2	1.56	1.349
13C-1,2,3,4,7,8-HXCDF		2000	1630	81.6	0.51	0.954
13C-1,2,3,6,7,8-HXCDF		2000	1620	81.1	0.51	0.957
13C-1,2,3,7,8,9-HXCDF		2000	1640	81.9	0.53	1.004
13C-2,3,4,6,7,8-HXCDF		2000	1600	79.9	0.53	0.980
13C-1,2,3,4,6,7,8-HPCDF		2000	1810	90.7	0.47	1.063
13C-1,2,3,4,7,8,9-HPCDF		2000	1940	97.2	0.46	1.105
CLEANUP STANDARD						
37CL-2,3,7,8-TCDD		200	152	76.1		1.001

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for percent recovery (R) are specified in Section 9.3.3, Method 1613.
(3) Contract-required limits for RRTs and ion abundance ratios are specified in Tables 2 and 9, respectively, Method 1613. NOTE: There is no ion abundance ratio for 37Cl4-2,3,7,8-TCDD
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Henry Huang________

For Axys Internal Use Only [XSL Template: Form2.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB5_WG57620-101_Form2_DX7M_002S17_SJ2147941.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

CLIENT SAMPLE NO.
Lab Blank

PCDD/PCDF ANALYSIS TEQ DATA REPORT

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

		Sample Collection:	N/A
Contract No.:	4819	**Project No.**	N/A
Matrix:	TISSUE	**Lab Sample I.D.:**	WG57620-101
Sample Size:	10.0 g	**GC Column ID:**	DB5
Concentration Units:	pg/g	**Sample Data Filename:**	**DX7M_002 S: 17**

COMPOUND	LAB FLAG [1]	CONC. FOUND	REPORTING LIMIT (RL)	WHO 2005 TEF	TEQ ND=0	TEQ ND=1/2 RL	TEQ ND=RL
2,3,7,8-TCDD	U		0.0615	1	0.00e+00	3.08e-02	
1,2,3,7,8-PECDD	U		0.0615	1	0.00e+00	3.08e-02	
1,2,3,4,7,8-HXCDD	U		0.0615	0.1	0.00e+00	3.08e-03	
1,2,3,6,7,8-HXCDD	U		0.0615	0.1	0.00e+00	3.08e-03	
1,2,3,7,8,9-HXCDD		0.0793	0.0615	0.1	7.93e-03	7.93e-03	
1,2,3,4,6,7,8-HPCDD		0.262	0.0615	0.01	2.62e-03	2.62e-03	
OCDD		0.596	0.0615	0.0003	1.79e-04	1.79e-04	
2,3,7,8-TCDF	U		0.0615	0.1	0.00e+00	3.08e-03	
1,2,3,7,8-PECDF	U		0.0615	0.03	0.00e+00	9.23e-04	
2,3,4,7,8-PECDF	U		0.0615	0.3	0.00e+00	9.23e-03	
1,2,3,4,7,8-HXCDF	U		0.0615	0.1	0.00e+00	3.08e-03	
1,2,3,6,7,8-HXCDF	U		0.0615	0.1	0.00e+00	3.08e-03	
1,2,3,7,8,9-HXCDF	U		0.0615	0.1	0.00e+00	3.08e-03	
2,3,4,6,7,8-HXCDF	U		0.0615	0.1	0.00e+00	3.08e-03	
1,2,3,4,6,7,8-HPCDF	U		0.0615	0.01	0.00e+00	3.08e-04	
1,2,3,4,7,8,9-HPCDF	U		0.0615	0.01	0.00e+00	3.08e-04	
OCDF	U		0.0615	0.0003	0.00e+00	9.23e-06	
			TOTAL TEQ		0.0107	0.105	

(1) Where applicable, custom lab flags have been used on this report; U = not detected at RL.
(2) Concentrations that do not meet quantification criteria are not included in the TEQ calculations.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: __________Henry Huang_________

These pages are part of a larger report that may contain information necessary for full data evaluation. Results reported relate only to the sample tested.

For Axys Internal Use Only [XSL Template: TEQ.xsl; Created: 12-Jan-2017 15:30:42; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613-TEQ_WG57620-101_TEQ_SJ2147941.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 8A
PCDD/PCDF ONGOING PRECISION AND RECOVERY (OPR)

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Contract No.:	4819	**OPR Data Filename:**	**DX7M_002 S: 14**
Matrix:	TISSUE	**Lab Sample I.D.:**	WG57620-102
Extraction Date:	20-Dec-2016	**Analysis Date:**	09-Jan-2017 **Time:** 22:06:59

ALL CONCENTRATIONS REPORTED ON THIS FORM ARE CONCENTRATIONS IN EXTRACT, BASED ON A 20 uL EXTRACT VOLUME.

COMPOUND	LAB FLAG [1]	ION ABUND. RATIO [2]	SPIKE CONC. (ng/mL)	CONC. FOUND (ng/mL)	OPR CONC. LIMITS [3] (ng/mL)	% RECOVERY
2,3,7,8-TCDD		0.77	10.0	9.79	6.70 - 15.8	97.9
1,2,3,7,8-PECDD [4]		0.62	50.0	51.5	35.0 - 71.0	103
1,2,3,4,7,8-HXCDD		1.23	50.0	48.3	35.0 - 82.0	96.6
1,2,3,6,7,8-HXCDD		1.21	50.0	48.9	38.0 - 67.0	97.7
1,2,3,7,8,9-HXCDD		1.22	50.0	51.5	32.0 - 81.0	103
1,2,3,4,6,7,8-HPCDD		1.04	50.0	46.3	35.0 - 70.0	92.6
OCDD		0.89	100	93.4	78.0 - 144	93.4
2,3,7,8-TCDF		0.77	10.0	9.78	7.50 - 15.8	97.8
1,2,3,7,8-PECDF		1.55	50.0	49.6	40.0 - 67.0	99.3
2,3,4,7,8-PECDF		1.53	50.0	49.7	34.0 - 80.0	99.5
1,2,3,4,7,8-HXCDF		1.24	50.0	49.2	36.0 - 67.0	98.3
1,2,3,6,7,8-HXCDF		1.24	50.0	50.6	42.0 - 65.0	101
1,2,3,7,8,9-HXCDF		1.25	50.0	49.8	39.0 - 65.0	99.6
2,3,4,6,7,8-HXCDF		1.22	50.0	50.5	35.0 - 78.0	101
1,2,3,4,6,7,8-HPCDF		1.02	50.0	50.9	41.0 - 61.0	102
1,2,3,4,7,8,9-HPCDF		1.04	50.0	50.1	39.0 - 69.0	100
OCDF		0.91	100	91.4	63.0 - 170	91.4

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required Ion Abundance Ratios are specified in Table 9, Method 1613.
(3) Contract-required concentration range as determined from the percent of the test concentration in Table 6, Method 1613, under OPR.
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: __________Henry Huang_________

These pages are part of a larger report that may contain information necessary for full data evaluation. Results reported relate only to the sample tested.

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Report Filename: 1613_DIOXINS_1613DB5_WG57620-102_Form8A_SJ2147937.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 8B
PCDD/PCDF ONGOING PRECISION AND RECOVERY (OPR)

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Contract No.:	4819	**OPR Data Filename:**	**DX7M_002 S: 14**
Matrix:	TISSUE	**Lab Sample I.D.:**	WG57620-102
Extraction Date:	20-Dec-2016	**Analysis Date:**	09-Jan-2017 **Time:** 22:06:59

ALL CONCENTRATIONS REPORTED ON THIS FORM ARE CONCENTRATIONS IN EXTRACT, BASED ON A 20 uL EXTRACT VOLUME.

LABELED COMPOUND	LAB FLAG ^{1}	ION ABUND. RATIO ^{2}	SPIKE CONC. (ng/mL)	CONC. FOUND (ng/mL)	OPR CONC. LIMITS ^{3} (ng/mL)	% RECOVERY
13C-2,3,7,8-TCDD		0.77	100	75.7	20.0-175	75.7
13C-1,2,3,7,8-PECDD ^{4}		0.66	100	104	21.0-227	104
13C-1,2,3,4,7,8-HXCDD		1.26	100	76.7	21.0-193	76.7
13C-1,2,3,6,7,8-HXCDD		1.28	100	76.0	25.0-163	76.0
13C-1,2,3,4,6,7,8-HPCDD		1.03	100	89.5	26.0-166	89.5
13C-OCDD		0.88	200	189	26.0-397	94.5
13C-2,3,7,8-TCDF		0.78	100	71.6	22.0-152	71.6
13C-1,2,3,7,8-PECDF		1.56	100	85.2	21.0-192	85.2
13C-2,3,4,7,8-PECDF		1.59	100	82.7	13.0-328	82.7
13C-1,2,3,4,7,8-HXCDF		0.52	100	74.2	19.0-202	74.2
13C-1,2,3,6,7,8-HXCDF		0.53	100	73.5	21.0-159	73.5
13C-1,2,3,7,8,9-HXCDF		0.51	100	73.3	17.0-205	73.3
13C-2,3,4,6,7,8-HXCDF		0.53	100	74.1	22.0-176	74.1
13C-1,2,3,4,6,7,8-HPCDF		0.45	100	82.3	21.0-158	82.3
13C-1,2,3,4,7,8,9-HPCDF		0.44	100	86.4	20.0-186	86.4
CLEANUP STANDARD						
37CL-2,3,7,8-TCDD			10.0	7.73	3.10-19.1	77.3

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required Ion Abundance Ratios are specified in Table 9, Method 1613.
(3) Contract-required concentration limits for OPR as specified in Table 6, Method 1613. Labeled compound concentrations limits are based on required percent recovery (Section 15.5, Method 1613).
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Henry Huang________

These pages are part of a larger report that may contain information necessary for full data evaluation. Results reported relate only to the sample tested.

For Axys Internal Use Only [XSL Template: Form8B.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_1613DB5_WG57620-102_Form8B_SJ2147937.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 3A
PCDD/PCDF INITIAL CALIBRATION RELATIVE RESPONSES

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date: 27-Sep-2016

Instrument ID: HR GC/MS

GC Column ID: DB5

CS0 Data Filename: N/A

CS1 Data Filename: DX6M_125 S: 5

CS2 Data Filename: DX6M_125 S: 6

CS3 Data Filename: DX6M_125 S: 4

CS4 Data Filename: DX6M_125 S: 7

CS5 Data Filename: DX6M_125 S: 8

CS6 Data Filename: N/A

		RELATIVE RESPONSE (RR)								
COMPOUND	**LAB FLAG [1]**	**CS0**	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**	**CS6**	**MEAN RR**	**CV (%RSD)[2]**
2,3,7,8-TCDD			0.96	0.96	0.99	1.00	1.00		0.98	2.00
1,2,3,7,8-PECDD [3]			1.08	0.98	1.04	1.08	1.06		1.05	3.77
1,2,3,4,7,8-HXCDD			1.07	0.95	1.02	1.04	1.03		1.02	4.32
1,2,3,6,7,8-HXCDD			0.93	0.88	0.91	0.96	0.93		0.92	2.98
1,2,3,7,8,9-HXCDD [4]			0.99	0.88	0.94	0.95	0.94		0.94	4.16
1,2,3,4,6,7,8-HPCDD			1.04	0.95	0.99	1.02	1.01		1.00	3.36
OCDD			1.11	1.02	1.06	1.10	1.07		1.07	3.24
2,3,7,8-TCDF			0.96	0.88	0.92	0.93	0.91		0.92	3.28
1,2,3,7,8-PECDF			0.87	0.83	0.90	0.92	0.93		0.89	4.60
2,3,4,7,8-PECDF			0.95	0.86	0.92	0.97	0.96		0.93	4.52
1,2,3,4,7,8-HXCDF			1.06	1.02	1.11	1.12	1.08		1.08	3.84
1,2,3,6,7,8-HXCDF			1.04	0.99	1.02	1.11	1.04		1.04	4.05
1,2,3,7,8,9-HXCDF			1.06	0.95	0.96	1.06	1.01		1.01	5.16
2,3,4,6,7,8-HXCDF			1.07	0.99	1.05	1.09	1.06		1.05	3.46
1,2,3,4,6,7,8-HPCDF			1.30	1.15	1.27	1.28	1.22		1.25	4.76
1,2,3,4,7,8,9-HPCDF			1.18	1.13	1.20	1.20	1.16		1.17	2.54
OCDF [5]			1.24	1.19	1.21	1.35	1.34		1.27	5.86

(1) Where applicable, custom lab flags have been used on this report.
(2) For contract CV specifications, see Section 10.5.4, Method 1613.
(3) Alternate confirmation and quantitation ions used for native and labeled PECDD.
(4) Response ratios are calculated relative to the labeled analogs of the other two HXCDDs (Section 17.1.2, Method 1613).
(5) Response ratios are calculated relative to the labeled analog of OCDD (Section 17.1.1, Method 1613).

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Robert Tones________

For Axys Internal Use Only [XSL Template: Form3A.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_27-Sep-2016_DX6M__Form3A_GS67950.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 3B
PCDD/PCDF INITIAL CALIBRATION RELATIVE RESPONSES

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date: 27-Sep-2016

Instrument ID: HR GC/MS

GC Column ID: DB5

CS0 Data Filename: N/A

CS1 Data Filename: DX6M_125 S: 5

CS2 Data Filename: DX6M_125 S: 6

CS3 Data Filename: DX6M_125 S: 4

CS4 Data Filename: DX6M_125 S: 7

CS5 Data Filename: DX6M_125 S: 8

CS6 Data Filename: N/A

		RELATIVE RESPONSE (RR)								
LABELED COMPOUND	**LAB FLAG [1]**	**CS0**	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**	**CS6**	**MEAN RR**	**CV (%RSD)[2]**
13C-2,3,7,8-TCDD			0.98	0.98	1.02	0.99	1.03		1.00	2.53
13C-1,2,3,7,8-PECDD [3]			0.56	0.58	0.59	0.61	0.68		0.60	7.48
13C-1,2,3,4,7,8-HXCDD			0.93	0.96	0.93	0.95	0.96		0.94	1.64
13C-1,2,3,6,7,8-HXCDD			1.03	1.07	1.06	1.05	1.09		1.06	2.07
13C-1,2,3,4,6,7,8-HPCDD			0.72	0.73	0.69	0.72	0.73		0.72	2.71
13C-OCDD			0.58	0.56	0.57	0.60	0.68		0.60	7.94
13C-2,3,7,8-TCDF			1.50	1.51	1.52	1.47	1.58		1.51	2.54
13C-1,2,3,7,8-PECDF			1.01	1.04	1.05	1.06	1.17		1.07	5.93
13C-2,3,4,7,8-PECDF			0.99	1.03	1.01	1.03	1.14		1.04	5.94
13C-1,2,3,4,7,8-HXCDF			1.22	1.23	1.20	1.20	1.20		1.21	1.20
13C-1,2,3,6,7,8-HXCDF			1.34	1.41	1.37	1.34	1.43		1.38	2.91
13C-1,2,3,7,8,9-HXCDF			1.08	1.10	1.08	1.10	1.15		1.10	2.57
13C-2,3,4,6,7,8-HXCDF			1.27	1.30	1.23	1.23	1.28		1.26	2.60
13C-1,2,3,4,6,7,8-HPCDF			0.87	0.89	0.86	0.87	0.91		0.88	2.40
13C-1,2,3,4,7,8,9-HPCDF			0.72	0.72	0.68	0.72	0.75		0.72	3.47
CLEANUP STANDARD										
37CL-2,3,7,8-TCDD			1.13	1.04	1.08	1.03	1.08		1.07	3.68

(1) Where applicable, custom lab flags have been used on this report.
(2) For contract CV specifications, see Section 10.5.4, Method 1613.
(3) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Robert Tones________

For Axys Internal Use Only [XSL Template: Form3B.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_27-Sep-2016_DX6M__Form3B_GS67950.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 3C
PCDD/PCDF INITIAL CALIBRATION ION ABUNDANCE RATIOS

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date: 27-Sep-2016
Instrument ID: HR GC/MS
GC Column ID: DB5

CS0 Data Filename: N/A
CS1 Data Filename: DX6M_125 S: 5
CS2 Data Filename: DX6M_125 S: 6
CS3 Data Filename: DX6M_125 S: 4
CS4 Data Filename: DX6M_125 S: 7
CS5 Data Filename: DX6M_125 S: 8
CS6 Data Filename: N/A

COMPOUND	LAB FLAG [1]	M/Z's FORMING RATIO [2]	ION ABUNDANCE RATIO							QC LIMITS[3]
			CS0	CS1	CS2	CS3	CS4	CS5	CS6	
2,3,7,8-TCDD		**M/M+2**		0.70	0.77	0.79	0.78	0.78		0.65-0.89
1,2,3,7,8-PECDD [4]		**M/M+2**		0.58	0.60	0.62	0.62	0.62		0.52-0.70
1,2,3,4,7,8-HXCDD		**M+2/M+4**		1.26	1.25	1.27	1.25	1.24		1.05-1.43
1,2,3,6,7,8-HXCDD		**M+2/M+4**		1.25	1.23	1.22	1.24	1.25		1.05-1.43
1,2,3,7,8,9-HXCDD		**M+2/M+4**		1.28	1.28	1.23	1.24	1.23		1.05-1.43
1,2,3,4,6,7,8-HPCDD		**M+2/M+4**		1.01	1.01	1.04	1.04	1.03		0.88-1.20
OCDD		**M+2/M+4**		0.81	0.88	0.88	0.88	0.88		0.76-1.02
2,3,7,8-TCDF		**M/M+2**		0.74	0.78	0.76	0.76	0.77		0.65-0.89
1,2,3,7,8-PECDF		**M+2/M+4**		1.42	1.49	1.54	1.52	1.50		1.32-1.78
2,3,4,7,8-PECDF		**M+2/M+4**		1.56	1.50	1.50	1.51	1.47		1.32-1.78
1,2,3,4,7,8-HXCDF		**M+2/M+4**		1.29	1.18	1.21	1.19	1.21		1.05-1.43
1,2,3,6,7,8-HXCDF		**M+2/M+4**		1.23	1.25	1.18	1.22	1.22		1.05-1.43
1,2,3,7,8,9-HXCDF		**M+2/M+4**		1.24	1.25	1.20	1.22	1.23		1.05-1.43
2,3,4,6,7,8-HXCDF		**M+2/M+4**		1.17	1.19	1.19	1.21	1.19		1.05-1.43
1,2,3,4,6,7,8-HPCDF		**M+2/M+4**		1.00	1.01	1.00	1.02	1.00		0.88-1.20
1,2,3,4,7,8,9-HPCDF		**M+2/M+4**		1.11	1.02	1.03	1.04	1.04		0.88-1.20
OCDF		**M+2/M+4**		0.86	0.89	0.86	0.86	0.86		0.76-1.02

(1) Where applicable, custom lab flags have been used on this report.
(2) See Table 8, Method 1613, for m/z specifications.
(3) Ion Abundance Ratio Control Limits from Table 9, Method 1613.
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________Robert Tones________

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Report Filename: 1613_DIOXINS_27-Sep-2016_DX6M__Form3C_GS67950.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 3D
PCDD/PCDF INITIAL CALIBRATION ION ABUNDANCE RATIOS

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date: 27-Sep-2016

Instrument ID: HR GC/MS

GC Column ID: DB5

CS0 Data Filename: N/A

CS1 Data Filename: DX6M_125 S: 5

CS2 Data Filename: DX6M_125 S: 6

CS3 Data Filename: DX6M_125 S: 4

CS4 Data Filename: DX6M_125 S: 7

CS5 Data Filename: DX6M_125 S: 8

CS6 Data Filename: N/A

			ION ABUNDANCE RATIO							
LABELED COMPOUND	**LAB FLAG[1]**	**M/Z's FORMING RATIO [2]**	**CS0**	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**	**CS6**	**QC LIMITS[3]**
13C-2,3,7,8-TCDD		**M/M+2**		0.77	0.78	0.76	0.78	0.78		0.65-0.89
13C-1,2,3,7,8-PECDD [4]		**M/M+2**		0.65	0.65	0.64	0.65	0.65		0.52-0.70
13C-1,2,3,4,7,8-HXCDD		**M+2/M+4**		1.26	1.26	1.29	1.28	1.26		1.05-1.43
13C-1,2,3,6,7,8-HXCDD		**M+2/M+4**		1.25	1.25	1.25	1.27	1.26		1.05-1.43
13C-1,2,3,4,6,7,8-HPCDD		**M+2/M+4**		1.07	1.06	1.05	1.05	1.04		0.88-1.20
13C-OCDD		**M+2/M+4**		0.89	0.88	0.92	0.90	0.87		0.76-1.02
13C-2,3,7,8-TCDF		**M/M+2**		0.77	0.79	0.79	0.79	0.78		0.65-0.89
13C-1,2,3,7,8-PECDF		**M+2/M+4**		1.53	1.55	1.59	1.56	1.59		1.32-1.78
13C-2,3,4,7,8-PECDF		**M+2/M+4**		1.58	1.53	1.57	1.55	1.58		1.32-1.78
13C-1,2,3,4,7,8-HXCDF		**M/M+2**		0.52	0.52	0.51	0.51	0.51		0.43-0.59
13C-1,2,3,6,7,8-HXCDF		**M/M+2**		0.51	0.51	0.51	0.53	0.52		0.43-0.59
13C-1,2,3,7,8,9-HXCDF		**M/M+2**		0.52	0.51	0.51	0.52	0.51		0.43-0.59
13C-2,3,4,6,7,8-HXCDF		**M/M+2**		0.52	0.52	0.52	0.52	0.51		0.43-0.59
13C-1,2,3,4,6,7,8-HPCDF		**M/M+2**		0.45	0.45	0.46	0.44	0.44		0.37-0.51
13C-1,2,3,4,7,8,9-HPCDF		**M/M+2**		0.44	0.45	0.44	0.44	0.45		0.37-0.51

(1) Where applicable, custom lab flags have been used on this report.
(2) See Table 8, Method 1613, for m/z specifications.
(3) Ion Abundance Ratio Control Limits from Table 9, Method 1613.
(4) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Robert Tones________

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Report Filename: 1613_DIOXINS_27-Sep-2016_DX6M__Form3D_GS67950.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 5
PCDD/PCDF RT WINDOW AND ISOMER SPECIFICITY STANDARDS

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Instrument ID:	HR GC/MS	**Initial Calibration Date:**		27-Sep-2016
RT Window Data Filename:	DX6M_125 S: 1	**Analysis Date:**	27-Sep-2016	**Time:** 09:17:52
DB-5 IS Data Filename:	DX6M_125 S: 1	**Analysis Date:**	27-Sep-2016	**Time:** 09:17:52
DB-225 IS Data Filename:		**Analysis Date:**		**Time:**

DB5 RT WINDOW DEFINING STANDARDS RESULT

ISOMERS	ABSOLUTE RT	ISOMERS	ABSOLUTE RT
1,3,6,8-TCDD (F)	22:59	**1,3,6,8-TCDF (F)**	21:28
1,2,8,9-TCDD (L)	28:19	**1,2,8,9-TCDF (L)**	28:10
1,2,4,7,9-PECDD (F)	32:02	**1,3,4,6,8-PECDF (F)**	28:53
1,2,3,8,9-PECDD (L)	37:01	**1,2,3,8,9-PECDF (L)**	37:05
1,2,4,6,7,9-HXCDD (F)	40:01	**1,2,3,4,6,8-HXCDF (F)**	38:58
1,2,3,4,6,7-HXCDD (L)	42:40	**1,2,3,4,8,9-HXCDF (L)**	43:00
1,2,3,4,6,7,9-HPCDD (F)	45:46	**1,2,3,4,6,7,8-HPCDF (F)**	45:19
1,2,3,4,6,7,8-HPCDD (L)	46:42	**1,2,3,4,7,8,9-HPCDF (L)**	47:07

(F) = First eluting isomer (DB-5); (L) = Last eluting isomer (DB-5)

ISOMER SPECIFICITY (IS) TEST STANDARDS RESULT

Isomers	% Valley Height Between Compared Peaks	Isomers	% Valley Height Between Compared Peaks
1,2,3,4-TCDD **1,2,7,8-TCDD**	0	**1,2,3,8-TCDD** **2,3,7,8-TCDD**	10
1,2,7,8-TCDD **1,4,7,8-TCDD**	0	**2,3,4,7-TCDF** **2,3,7,8-TCDF**	N/A
1,4,7,8-TCDD **1,2,3,7-TCDD**	0	**2,3,7,8-TCDF** **1,2,3,9-TCDF**	N/A
1,2,3,7-TCDD **1,2,3,8-TCDD**	DB-5 column; co-elute as per Figure 6 in Method		

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Robert Tones________

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Report Filename: 1613_DIOXINS__DX6M_125S1_Form5_SJ2101493.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 3A
PCDD/PCDF INITIAL CALIBRATION RELATIVE RESPONSES

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	04-Jan-2017	**CS0 Data Filename:**	N/A
Instrument ID:	HR GC/MS	**CS1 Data Filename:**	DB7T_003A S: 4
GC Column ID:	DB225	**CS2 Data Filename:**	DB7T_003A S: 5
		CS3 Data Filename:	DB7T_003A S: 3
		CS4 Data Filename:	DB7T_003A S: 6
		CS5 Data Filename:	DB7T_003A S: 7
		CS6 Data Filename:	N/A

		RELATIVE RESPONSE (RR)								
COMPOUND	**LAB FLAG** [1]	**CS0**	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**	**CS6**	**MEAN RR**	**CV (%RSD)** [2]
2,3,7,8-TCDF			0.92	0.85	0.93	0.93	0.92		0.91	3.71

(1) Where applicable, custom lab flags have been used on this report.
(2) For contract CV specifications, see Section 10.5.4, Method 1613.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________David Nelson________

For Axys Internal Use Only [XSL Template: Form3A.xsl; Created: 12-Jan-2017 15:30:06; Application: XMLTransformer-1.15.33; Report Filename: 1613_DIOXINS_04-Jan-2017_DB7T__Form3A_GS67977.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 3C
PCDD/PCDF INITIAL CALIBRATION ION ABUNDANCE RATIOS

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	04-Jan-2017
Instrument ID:	HR GC/MS
GC Column ID:	DB225

CS0 Data Filename:	N/A
CS1 Data Filename:	DB7T_003A S: 4
CS2 Data Filename:	DB7T_003A S: 5
CS3 Data Filename:	DB7T_003A S: 3
CS4 Data Filename:	DB7T_003A S: 6
CS5 Data Filename:	DB7T_003A S: 7
CS6 Data Filename:	N/A

			ION ABUNDANCE RATIO							
COMPOUND	**LAB FLAG [1]**	**M/Z's FORMING RATIO [2]**	**CS0**	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**	**CS6**	**QC LIMITS[3]**
2,3,7,8-TCDF		**M/M+2**		0.70	0.80	0.76	0.77	0.77		0.65-0.89

(1) Where applicable, custom lab flags have been used on this report.
(2) See Table 8, Method 1613, for m/z specifications.
(3) Ion Abundance Ratio Control Limits from Table 9, Method 1613.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________David Nelson________

For Axys Internal Use Only [XSL Template: Form3C.xsl; Created: 12-Jan-2017 15:30:06; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_04-Jan-2017_DB7T__Form3C_GS67977.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 5
PCDD/PCDF RT WINDOW AND ISOMER SPECIFICITY STANDARDS

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Instrument ID:	HR GC/MS	**Initial Calibration Date:**		04-Jan-2017
RT Window Data Filename:		**Analysis Date:**		**Time:**
DB-5 IS Data Filename:		**Analysis Date:**		**Time:**
DB-225 IS Data Filename:	DB7T_003 S: 1	**Analysis Date:**	04-Jan-2017	**Time:** 11:01:45

DB225 RT WINDOW DEFINING STANDARDS RESULT

ISOMERS	ABSOLUTE RT	ISOMERS	ABSOLUTE RT
1,3,6,8-TCDD (F)	N/A	**1,3,6,8-TCDF (F)**	N/A
1,2,8,9-TCDD (L)	N/A	**1,2,8,9-TCDF (L)**	N/A
1,2,4,7,9-PECDD (F)	N/A	**1,3,4,6,8-PECDF (F)**	N/A
1,2,3,8,9-PECDD (L)	N/A	**1,2,3,8,9-PECDF (L)**	N/A
1,2,4,6,7,9-HXCDD (F)	N/A	**1,2,3,4,6,8-HXCDF (F)**	N/A
1,2,3,4,6,7-HXCDD (L)	N/A	**1,2,3,4,8,9-HXCDF (L)**	N/A
1,2,3,4,6,7,9-HPCDD (F)	N/A	**1,2,3,4,6,7,8-HPCDF (F)**	N/A
1,2,3,4,6,7,8-HPCDD (L)	N/A	**1,2,3,4,7,8,9-HPCDF (L)**	N/A

(F) = First eluting isomer (DB-5); (L) = Last eluting isomer (DB-5)

ISOMER SPECIFICITY (IS) TEST STANDARDS RESULT

Isomers	% Valley Height Between Compared Peaks	Isomers	% Valley Height Between Compared Peaks
1,2,3,4-TCDD **1,2,7,8-TCDD**	N/A	**1,2,3,8-TCDD** **2,3,7,8-TCDD**	N/A
1,2,7,8-TCDD **1,4,7,8-TCDD**	N/A	**2,3,4,7-TCDF** **2,3,7,8-TCDF**	2
1,4,7,8-TCDD **1,2,3,7-TCDD**	N/A	**2,3,7,8-TCDF** **1,2,3,9-TCDF**	3
1,2,3,7-TCDD **1,2,3,8-TCDD**	N/A		

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________Robert Tones________

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Report Filename: 1613_DIOXINS__DB7T_003S1_Form5_SJ2145827.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 4A
PCDD/PCDF CALIBRATION VERIFICATION

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date: 27-Sep-2016

VER Data Filename: DX7M_002 S: 13

Instrument ID: HR GC/MS

Analysis Date: 09-Jan-2017

GC Column ID: DB5

Analysis Time: 20:56:43

COMPOUND	LAB FLAG [1]	MZ's FORMING RATIO [2]	ION ABUND. RATIO	QC LIMITS [3]	CONC. FOUND (ng/mL)	CONC. RANGE (ng/mL) [4]
2,3,7,8-TCDD		**M/M+2**	0.77	0.65-0.89	10.2	7.8 - 12.9
1,2,3,7,8-PECDD [5]		**M/M+2**	0.62	0.52-0.70	50.4	39 - 65
1,2,3,4,7,8-HXCDD		**M+2/M+4**	1.24	1.05-1.43	50.2	39 - 64
1,2,3,6,7,8-HXCDD		**M+2/M+4**	1.22	1.05-1.43	51.3	39 - 64
1,2,3,7,8,9-HXCDD		**M+2/M+4**	1.23	1.05-1.43	51.8	41 - 61
1,2,3,4,6,7,8-HPCDD		**M+2/M+4**	1.01	0.88-1.20	49.8	43 - 58
OCDD		**M+2/M+4**	0.88	0.76-1.02	98.3	79 - 126
2,3,7,8-TCDF		**M/M+2**	0.76	0.65-0.89	10.3	8.4 - 12
1,2,3,7,8-PECDF		**M+2/M+4**	1.55	1.32-1.78	52.5	41 - 60
2,3,4,7,8-PECDF		**M+2/M+4**	1.55	1.32-1.78	51.5	41 - 61
1,2,3,4,7,8-HXCDF		**M+2/M+4**	1.24	1.05-1.43	52.3	45 - 56
1,2,3,6,7,8-HXCDF		**M+2/M+4**	1.22	1.05-1.43	51.3	44 - 57
1,2,3,7,8,9-HXCDF		**M+2/M+4**	1.23	1.05-1.43	50.7	45 - 56
2,3,4,6,7,8-HXCDF		**M+2/M+4**	1.22	1.05-1.43	52.2	44 - 57
1,2,3,4,6,7,8-HPCDF		**M+2/M+4**	1.04	0.88-1.20	52.2	45 - 55
1,2,3,4,7,8,9-HPCDF		**M+2/M+4**	1.03	0.88-1.20	52.1	43 - 58
OCDF		**M+2/M+4**	0.89	0.76-1.02	99.2	63 - 159

(1) Where applicable, custom lab flags have been used on this report.
(2) See Table 8, Method 1613, for m/z specifications.
(3) Ion Abundance Ratio Control Limits as specified in Table 9, Method 1613.
(4) Contract-required concentration range as determined from the percent of the test concentration in Table 6, Method 1613, under VER.
(5) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: Form4A.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_DX7M_002S13__Form4A_SJ2147936.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 4B
PCDD/PCDF CALIBRATION VERIFICATION

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	27-Sep-2016	**VER Data Filename:**	DX7M_002 S: 13
Instrument ID:	HR GC/MS	**Analysis Date:**	09-Jan-2017
GC Column ID:	DB5	**Analysis Time:**	20:56:43

	LAB FLAG [1]	MZ's FORMING RATIO [2]	ION ABUND. RATIO	QC LIMITS [3]	CONC. FOUND (ng/mL)	CONC. RANGE (ng/mL) [4]
LABELED COMPOUND						
13C-2,3,7,8-TCDD		**M/M+2**	0.78	0.65-0.89	100	82 - 121
13C-1,2,3,7,8-PECDD [5]		**M/M+2**	0.64	0.52-0.70	108	62 - 160
13C-1,2,3,4,7,8-HXCDD		**M+2/M+4**	1.25	1.05-1.43	98.2	85 - 117
13C-1,2,3,6,7,8-HXCDD		**M+2/M+4**	1.26	1.05-1.43	98.8	85 - 118
13C-1,2,3,4,6,7,8-HPCDD		**M+2/M+4**	1.07	0.88-1.20	122	72 - 138
13C-OCDD		**M+2/M+4**	0.91	0.76-1.02	284	96 - 415
13C-2,3,7,8-TCDF		**M/M+2**	0.78	0.65-0.89	96.1	71 - 140
13C-1,2,3,7,8-PECDF		**M+2/M+4**	1.59	1.32-1.78	104	76 - 130
13C-2,3,4,7,8-PECDF		**M+2/M+4**	1.54	1.32-1.78	103	77 - 130
13C-1,2,3,4,7,8-HXCDF		**M/M+2**	0.51	0.43-0.59	95.4	76 - 131
13C-1,2,3,6,7,8-HXCDF		**M/M+2**	0.52	0.43-0.59	95.2	70 - 143
13C-1,2,3,7,8,9-HXCDF		**M/M+2**	0.52	0.43-0.59	101	74 - 135
13C-2,3,4,6,7,8-HXCDF		**M/M+2**	0.52	0.43-0.59	96.5	73 - 137
13C-1,2,3,4,6,7,8-HPCDF		**M/M+2**	0.45	0.37-0.51	113	78 - 129
13C-1,2,3,4,7,8,9-HPCDF		**M/M+2**	0.46	0.37-0.51	125	77 - 129
CLEANUP STANDARD						
37CL-2,3,7,8-TCDD [6]					9.87	7.9 - 12.7

(1) Where applicable, custom lab flags have been used on this report.
(2) See Table 8, Method 1613, for m/z specifications.
(3) Ion Abundance Ratio Control Limits as specified in Table 9, Method 1613.
(4) Contract-required concentration range as determined from the percent of the test concentration in Table 6, Method 1613, under VER.
(5) Alternate confirmation and quantitation ions used for native and labeled PECDD.
(6) No ion abundance ratio for 37Cl4-2,3,7,8-TCDD; concentration reported.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: Form4B.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_DX7M_002S13__Form4B_SJ2147936.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 6A
PCDD/PCDF RELATIVE RETENTION TIMES

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date: 27-Sep-2016

VER Data Filename: DX7M_002 S: 13

Instrument ID: HR GC/MS

Analysis Date: 09-Jan-2017

GC Column ID: DB5

Analysis Time: 20:56:43

COMPOUND	LAB FLAG [1]	RETENTION TIME REFERENCE	RRT	RRT QC LIMITS [2]
2,3,7,8-TCDD		13C-2,3,7,8-TCDD	1.001	0.999-1.002
1,2,3,7,8-PECDD [3]		13C-1,2,3,7,8-PECDD	1.001	0.999-1.002
1,2,3,4,7,8-HXCDD		13C-1,2,3,4,7,8-HXCDD	1.000	0.999-1.001
1,2,3,6,7,8-HXCDD		13C-1,2,3,6,7,8-HXCDD	1.000	0.998-1.004
1,2,3,7,8,9-HXCDD		13C-1,2,3,6,7,8-HXCDD	1.011	1.000-1.019
1,2,3,4,6,7,8-HPCDD		13C-1,2,3,4,6,7,8-HPCDD	1.000	0.999-1.001
OCDD		13C-OCDD	1.000	0.999-1.001
2,3,7,8-TCDF		13C-2,3,7,8-TCDF	1.001	0.999-1.003
1,2,3,7,8-PECDF		13C-1,2,3,7,8-PECDF	1.001	0.999-1.002
2,3,4,7,8-PECDF		13C-2,3,4,7,8-PECDF	1.001	0.999-1.002
1,2,3,4,7,8-HXCDF		13C-1,2,3,4,7,8-HXCDF	1.000	0.999-1.001
1,2,3,6,7,8-HXCDF		13C-1,2,3,6,7,8-HXCDF	1.000	0.997-1.005
1,2,3,7,8,9-HXCDF		13C-1,2,3,7,8,9-HXCDF	1.000	0.999-1.001
2,3,4,6,7,8-HXCDF		13C-2,3,4,6,7,8-HXCDF	1.001	0.999-1.001
1,2,3,4,6,7,8-HPCDF		13C-1,2,3,4,6,7,8-HPCDF	1.000	0.999-1.001
1,2,3,4,7,8,9-HPCDF		13C-1,2,3,4,7,8,9-HPCDF	1.000	0.999-1.001
OCDF		13C-OCDD	1.002	0.999-1.008

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for Relative Retention Times (RRT) as specified in Table 2, Method 1613.
(3) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: Form6A.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_DX7M_002S13__Form6A_SJ2147936.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 6B
PCDD/PCDF RELATIVE RETENTION TIMES

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date: 27-Sep-2016

VER Data Filename: DX7M_002 S: 13

Instrument ID: HR GC/MS

Analysis Date: 09-Jan-2017

GC Column ID: DB5

Analysis Time: 20:56:43

	LAB FLAG [1]	RETENTION TIME REFERENCE	RRT	RRT QC LIMITS [2]
LABELED COMPOUND				
13C-2,3,7,8-TCDD		13C-1,2,3,4-TCDD	1.013	0.976-1.043
13C-1,2,3,7,8-PECDD		13C-1,2,3,4-TCDD	1.382	1.000-1.567
13C-1,2,3,4,7,8-HXCDD		13C-1,2,3,7,8,9-HXCDD	0.987	0.977-1.000
13C-1,2,3,6,7,8-HXCDD		13C-1,2,3,7,8,9-HXCDD	0.990	0.981-1.003
13C-1,2,3,4,6,7,8-HPCDD		13C-1,2,3,7,8,9-HXCDD	1.096	1.086-1.110
13C-OCDD		13C-1,2,3,7,8,9-HXCDD	1.181	1.032-1.311
13C-2,3,7,8-TCDF		13C-1,2,3,4-TCDD	0.966	0.923-1.103
13C-1,2,3,7,8-PECDF		13C-1,2,3,4-TCDD	1.282	1.000-1.425
13C-2,3,4,7,8-PECDF		13C-1,2,3,4-TCDD	1.350	1.011-1.526
13C-1,2,3,4,7,8-HXCDF		13C-1,2,3,7,8,9-HXCDD	0.953	0.944-0.970
13C-1,2,3,6,7,8-HXCDF		13C-1,2,3,7,8,9-HXCDD	0.957	0.949-0.975
13C-1,2,3,7,8,9-HXCDF		13C-1,2,3,7,8,9-HXCDD	1.004	0.977-1.047
13C-2,3,4,6,7,8-HXCDF		13C-1,2,3,7,8,9-HXCDD	0.980	0.959-1.021
13C-1,2,3,4,6,7,8-HPCDF		13C-1,2,3,7,8,9-HXCDD	1.063	1.043-1.085
13C-1,2,3,4,7,8,9-HPCDF		13C-1,2,3,7,8,9-HXCDD	1.105	1.057-1.151
CLEANUP STANDARD				
37CL-2,3,7,8-TCDD		13C-1,2,3,4-TCDD	1.001	0.989-1.052

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for Relative Retention Times (RRT) as specified in Table 2, Method 1613.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

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Report Filename: 1613_DIOXINS_DX7M_002S13__Form6B_SJ2147936.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 4A
PCDD/PCDF CALIBRATION VERIFICATION

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date: 27-Sep-2016
VER Data Filename: DX7M_002 S: 25
Instrument ID: HR GC/MS
Analysis Date: 10-Jan-2017
GC Column ID: DB5
Analysis Time: 08:11:42

COMPOUND	LAB FLAG [1]	MZ's FORMING RATIO [2]	ION ABUND. RATIO	QC LIMITS [3]	CONC. FOUND (ng/mL)	CONC. RANGE (ng/mL) [4]
2,3,7,8-TCDD		**M/M+2**	0.79	0.65-0.89	10.5	7.8 - 12.9
1,2,3,7,8-PECDD [5]		**M/M+2**	0.63	0.52-0.70	50.7	39 - 65
1,2,3,4,7,8-HXCDD		**M+2/M+4**	1.24	1.05-1.43	49.8	39 - 64
1,2,3,6,7,8-HXCDD		**M+2/M+4**	1.24	1.05-1.43	51.7	39 - 64
1,2,3,7,8,9-HXCDD		**M+2/M+4**	1.22	1.05-1.43	53.5	41 - 61
1,2,3,4,6,7,8-HPCDD		**M+2/M+4**	1.04	0.88-1.20	48.6	43 - 58
OCDD		**M+2/M+4**	0.90	0.76-1.02	97.6	79 - 126
2,3,7,8-TCDF		**M/M+2**	0.79	0.65-0.89	10.1	8.4 - 12
1,2,3,7,8-PECDF		**M+2/M+4**	1.57	1.32-1.78	53.0	41 - 60
2,3,4,7,8-PECDF		**M+2/M+4**	1.57	1.32-1.78	51.3	41 - 61
1,2,3,4,7,8-HXCDF		**M+2/M+4**	1.26	1.05-1.43	53.0	45 - 56
1,2,3,6,7,8-HXCDF		**M+2/M+4**	1.22	1.05-1.43	51.3	44 - 57
1,2,3,7,8,9-HXCDF		**M+2/M+4**	1.23	1.05-1.43	49.2	45 - 56
2,3,4,6,7,8-HXCDF		**M+2/M+4**	1.24	1.05-1.43	51.4	44 - 57
1,2,3,4,6,7,8-HPCDF		**M+2/M+4**	1.04	0.88-1.20	52.5	45 - 55
1,2,3,4,7,8,9-HPCDF		**M+2/M+4**	1.05	0.88-1.20	51.4	43 - 58
OCDF		**M+2/M+4**	0.89	0.76-1.02	97.9	63 - 159

(1) Where applicable, custom lab flags have been used on this report.
(2) See Table 8, Method 1613, for m/z specifications.
(3) Ion Abundance Ratio Control Limits as specified in Table 9, Method 1613.
(4) Contract-required concentration range as determined from the percent of the test concentration in Table 6, Method 1613, under VER.
(5) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: __________Shelley Honkanen_________

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Report Filename: 1613_DIOXINS_DX7M_002S25__Form4A_SJ2147950.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 4B
PCDD/PCDF CALIBRATION VERIFICATION

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	27-Sep-2016	**VER Data Filename:**	DX7M_002 S: 25
Instrument ID:	HR GC/MS	**Analysis Date:**	10-Jan-2017
GC Column ID:	DB5	**Analysis Time:**	08:11:42

	LAB FLAG [1]	MZ's FORMING RATIO [2]	ION ABUND. RATIO	QC LIMITS [3]	CONC. FOUND (ng/mL)	CONC. RANGE (ng/mL) [4]
LABELED COMPOUND						
13C-2,3,7,8-TCDD		**M/M+2**	0.77	0.65-0.89	98.1	82 - 121
13C-1,2,3,7,8-PECDD [5]		**M/M+2**	0.63	0.52-0.70	108	62 - 160
13C-1,2,3,4,7,8-HXCDD		**M+2/M+4**	1.28	1.05-1.43	99.8	85 - 117
13C-1,2,3,6,7,8-HXCDD		**M+2/M+4**	1.27	1.05-1.43	95.9	85 - 118
13C-1,2,3,4,6,7,8-HPCDD		**M+2/M+4**	1.09	0.88-1.20	119	72 - 138
13C-OCDD		**M+2/M+4**	0.89	0.76-1.02	270	96 - 415
13C-2,3,7,8-TCDF		**M/M+2**	0.78	0.65-0.89	97.3	71 - 140
13C-1,2,3,7,8-PECDF		**M+2/M+4**	1.58	1.32-1.78	104	76 - 130
13C-2,3,4,7,8-PECDF		**M+2/M+4**	1.57	1.32-1.78	105	77 - 130
13C-1,2,3,4,7,8-HXCDF		**M/M+2**	0.52	0.43-0.59	94.6	76 - 131
13C-1,2,3,6,7,8-HXCDF		**M/M+2**	0.53	0.43-0.59	96.2	70 - 143
13C-1,2,3,7,8,9-HXCDF		**M/M+2**	0.51	0.43-0.59	104	74 - 135
13C-2,3,4,6,7,8-HXCDF		**M/M+2**	0.51	0.43-0.59	98.8	73 - 137
13C-1,2,3,4,6,7,8-HPCDF		**M/M+2**	0.45	0.37-0.51	110	78 - 129
13C-1,2,3,4,7,8,9-HPCDF		**M/M+2**	0.45	0.37-0.51	119	77 - 129
CLEANUP STANDARD						
37CL-2,3,7,8-TCDD [6]					9.55	7.9 - 12.7

(1) Where applicable, custom lab flags have been used on this report.
(2) See Table 8, Method 1613, for m/z specifications.
(3) Ion Abundance Ratio Control Limits as specified in Table 9, Method 1613.
(4) Contract-required concentration range as determined from the percent of the test concentration in Table 6, Method 1613, under VER.
(5) Alternate confirmation and quantitation ions used for native and labeled PECDD.
(6) No ion abundance ratio for 37Cl4-2,3,7,8-TCDD; concentration reported.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: Form4B.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_DX7M_002S25__Form4B_SJ2147950.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 6A
PCDD/PCDF RELATIVE RETENTION TIMES

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	27-Sep-2016	**VER Data Filename:**	DX7M_002 S: 25
Instrument ID:	HR GC/MS	**Analysis Date:**	10-Jan-2017
GC Column ID:	DB5	**Analysis Time:**	08:11:42

COMPOUND	**LAB FLAG [1]**	**RETENTION TIME REFERENCE**	**RRT**	**RRT QC LIMITS [2]**
2,3,7,8-TCDD		13C-2,3,7,8-TCDD	1.001	0.999-1.002
1,2,3,7,8-PECDD [3]		13C-1,2,3,7,8-PECDD	1.001	0.999-1.002
1,2,3,4,7,8-HXCDD		13C-1,2,3,4,7,8-HXCDD	1.001	0.999-1.001
1,2,3,6,7,8-HXCDD		13C-1,2,3,6,7,8-HXCDD	1.000	0.998-1.004
1,2,3,7,8,9-HXCDD		13C-1,2,3,6,7,8-HXCDD	1.010	1.000-1.019
1,2,3,4,6,7,8-HPCDD		13C-1,2,3,4,6,7,8-HPCDD	1.000	0.999-1.001
OCDD		13C-OCDD	1.000	0.999-1.001
2,3,7,8-TCDF		13C-2,3,7,8-TCDF	1.001	0.999-1.003
1,2,3,7,8-PECDF		13C-1,2,3,7,8-PECDF	1.001	0.999-1.002
2,3,4,7,8-PECDF		13C-2,3,4,7,8-PECDF	1.001	0.999-1.002
1,2,3,4,7,8-HXCDF		13C-1,2,3,4,7,8-HXCDF	1.000	0.999-1.001
1,2,3,6,7,8-HXCDF		13C-1,2,3,6,7,8-HXCDF	1.000	0.997-1.005
1,2,3,7,8,9-HXCDF		13C-1,2,3,7,8,9-HXCDF	1.000	0.999-1.001
2,3,4,6,7,8-HXCDF		13C-2,3,4,6,7,8-HXCDF	1.000	0.999-1.001
1,2,3,4,6,7,8-HPCDF		13C-1,2,3,4,6,7,8-HPCDF	1.001	0.999-1.001
1,2,3,4,7,8,9-HPCDF		13C-1,2,3,4,7,8,9-HPCDF	1.000	0.999-1.001
OCDF		13C-OCDD	1.002	0.999-1.008

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for Relative Retention Times (RRT) as specified in Table 2, Method 1613.
(3) Alternate confirmation and quantitation ions used for native and labeled PECDD.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: Form6A.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_DX7M_002S25__Form6A_SJ2147950.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 6B
PCDD/PCDF RELATIVE RETENTION TIMES

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	27-Sep-2016	**VER Data Filename:**	DX7M_002 S: 25
Instrument ID:	HR GC/MS	**Analysis Date:**	10-Jan-2017
GC Column ID:	DB5	**Analysis Time:**	08:11:42

	LAB FLAG [1]	RETENTION TIME REFERENCE	RRT	RRT QC LIMITS [2]
LABELED COMPOUND				
13C-2,3,7,8-TCDD		13C-1,2,3,4-TCDD	1.012	0.976-1.043
13C-1,2,3,7,8-PECDD		13C-1,2,3,4-TCDD	1.380	1.000-1.567
13C-1,2,3,4,7,8-HXCDD		13C-1,2,3,7,8,9-HXCDD	0.987	0.977-1.000
13C-1,2,3,6,7,8-HXCDD		13C-1,2,3,7,8,9-HXCDD	0.990	0.981-1.003
13C-1,2,3,4,6,7,8-HPCDD		13C-1,2,3,7,8,9-HXCDD	1.096	1.086-1.110
13C-OCDD		13C-1,2,3,7,8,9-HXCDD	1.180	1.032-1.311
13C-2,3,7,8-TCDF		13C-1,2,3,4-TCDD	0.966	0.923-1.103
13C-1,2,3,7,8-PECDF		13C-1,2,3,4-TCDD	1.281	1.000-1.425
13C-2,3,4,7,8-PECDF		13C-1,2,3,4-TCDD	1.348	1.011-1.526
13C-1,2,3,4,7,8-HXCDF		13C-1,2,3,7,8,9-HXCDD	0.953	0.944-0.970
13C-1,2,3,6,7,8-HXCDF		13C-1,2,3,7,8,9-HXCDD	0.958	0.949-0.975
13C-1,2,3,7,8,9-HXCDF		13C-1,2,3,7,8,9-HXCDD	1.005	0.977-1.047
13C-2,3,4,6,7,8-HXCDF		13C-1,2,3,7,8,9-HXCDD	0.980	0.959-1.021
13C-1,2,3,4,6,7,8-HPCDF		13C-1,2,3,7,8,9-HXCDD	1.063	1.043-1.085
13C-1,2,3,4,7,8,9-HPCDF		13C-1,2,3,7,8,9-HXCDD	1.105	1.057-1.151
CLEANUP STANDARD				
37CL-2,3,7,8-TCDD		13C-1,2,3,4-TCDD	1.001	0.989-1.052

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for Relative Retention Times (RRT) as specified in Table 2, Method 1613.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: Form6B.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_DX7M_002S25__Form6B_SJ2147950.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 5
PCDD/PCDF RT WINDOW AND ISOMER SPECIFICITY STANDARDS

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Instrument ID:	HR GC/MS	**Initial Calibration Date:**		27-Sep-2016
RT Window Data Filename:	DX7M_002 S: 13	**Analysis Date:**	09-Jan-2017	**Time:** 20:56:43
DB-5 IS Data Filename:	DX7M_002 S: 13	**Analysis Date:**	09-Jan-2017	**Time:** 20:56:43
DB-225 IS Data Filename:		**Analysis Date:**		**Time:**

DB5 RT WINDOW DEFINING STANDARDS RESULT

ISOMERS	ABSOLUTE RT	ISOMERS	ABSOLUTE RT
1,3,6,8-TCDD (F)	22:57	**1,3,6,8-TCDF (F)**	21:25
1,2,8,9-TCDD (L)	28:13	**1,2,8,9-TCDF (L)**	28:04
1,2,4,7,9-PECDD (F)	31:54	**1,3,4,6,8-PECDF (F)**	28:46
1,2,3,8,9-PECDD (L)	36:56	**1,2,3,8,9-PECDF (L)**	37:00
1,2,4,6,7,9-HXCDD (F)	39:57	**1,2,3,4,6,8-HXCDF (F)**	38:54
1,2,3,4,6,7-HXCDD (L)	42:38	**1,2,3,4,8,9-HXCDF (L)**	42:58
1,2,3,4,6,7,9-HPCDD (F)	45:46	**1,2,3,4,6,7,8-HPCDF (F)**	45:18
1,2,3,4,6,7,8-HPCDD (L)	46:42	**1,2,3,4,7,8,9-HPCDF (L)**	47:06

(F) = First eluting isomer (DB-5); (L) = Last eluting isomer (DB-5)

ISOMER SPECIFICITY (IS) TEST STANDARDS RESULT

Isomers	% Valley Height Between Compared Peaks	Isomers	% Valley Height Between Compared Peaks
1,2,3,4-TCDD **1,2,7,8-TCDD**	0	**1,2,3,8-TCDD** **2,3,7,8-TCDD**	14
1,2,7,8-TCDD **1,4,7,8-TCDD**	0	**2,3,4,7-TCDF** **2,3,7,8-TCDF**	N/A
1,4,7,8-TCDD **1,2,3,7-TCDD**	0	**2,3,7,8-TCDF** **1,2,3,9-TCDF**	N/A
1,2,3,7-TCDD **1,2,3,8-TCDD**	DB-5 column; co-elute as per Figure 6 in Method		

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: DXForm5.xsl; Created: 12-Jan-2017 15:22:02; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS__DX7M_002S13_Form5_SJ2148278.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 4A
PCDD/PCDF CALIBRATION VERIFICATION

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	04-Jan-2017	**VER Data Filename:**	DB7T_010B S: 2
Instrument ID:	HR GC/MS	**Analysis Date:**	10-Jan-2017
GC Column ID:	DB225	**Analysis Time:**	10:47:37

COMPOUND	**LAB FLAG** [1]	**MZ's FORMING RATIO** [2]	**ION ABUND. RATIO**	**QC LIMITS** [3]	**CONC. FOUND (ng/mL)**	**CONC. RANGE (ng/mL)** [4]
2,3,7,8-TCDF		**M/M+2**	0.77	0.65-0.89	9.97	8.4 - 12

(1) Where applicable, custom lab flags have been used on this report.
(2) See Table 8, Method 1613, for m/z specifications.
(3) Ion Abundance Ratio Control Limits as specified in Table 9, Method 1613.
(4) Contract-required concentration range as determined from the percent of the test concentration in Table 6, Method 1613, under VER.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: Form4A.xsl; Created: 12-Jan-2017 15:30:06; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_DB7T_010BS2__Form4A_SJ2148493.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 6A
PCDD/PCDF RELATIVE RETENTION TIMES

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	04-Jan-2017	**VER Data Filename:**	DB7T_010B S: 2
Instrument ID:	HR GC/MS	**Analysis Date:**	10-Jan-2017
GC Column ID:	DB225	**Analysis Time:**	10:47:37

COMPOUND	LAB FLAG [1]	RETENTION TIME REFERENCE	RRT	RRT QC LIMITS [2]
2,3,7,8-TCDF		13C-2,3,7,8-TCDF	1.002	0.999-1.003

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for Relative Retention Times (RRT) as specified in Table 2, Method 1613.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: Form6A.xsl; Created: 12-Jan-2017 15:30:06; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_DB7T_010BS2__Form6A_SJ2148493.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 4A
PCDD/PCDF CALIBRATION VERIFICATION

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date:	04-Jan-2017	**VER Data Filename:**	DB7T_010C S: 7
Instrument ID:	HR GC/MS	**Analysis Date:**	10-Jan-2017
GC Column ID:	DB225	**Analysis Time:**	20:50:00

COMPOUND	**LAB FLAG** [1]	**MZ's FORMING RATIO** [2]	**ION ABUND. RATIO**	**QC LIMITS** [3]	**CONC. FOUND (ng/mL)**	**CONC. RANGE (ng/mL)** [4]
2,3,7,8-TCDF		**M/M+2**	0.75	0.65-0.89	10.1	8.4 - 12

(1) Where applicable, custom lab flags have been used on this report.
(2) See Table 8, Method 1613, for m/z specifications.
(3) Ion Abundance Ratio Control Limits as specified in Table 9, Method 1613.
(4) Contract-required concentration range as determined from the percent of the test concentration in Table 6, Method 1613, under VER.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: Form4A.xsl; Created: 12-Jan-2017 15:30:06; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_DB7T_010CS7__Form4A_SJ2148506.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 6A
PCDD/PCDF RELATIVE RETENTION TIMES

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Initial Calibration Date: 04-Jan-2017

VER Data Filename: DB7T_010C S: 7

Instrument ID: HR GC/MS

Analysis Date: 10-Jan-2017

GC Column ID: DB225

Analysis Time: 20:50:00

COMPOUND	LAB FLAG [1]	RETENTION TIME REFERENCE	RRT	RRT QC LIMITS [2]
2,3,7,8-TCDF		13C-2,3,7,8-TCDF	1.001	0.999-1.003

(1) Where applicable, custom lab flags have been used on this report.
(2) Contract-required limits for Relative Retention Times (RRT) as specified in Table 2, Method 1613.

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.

Signed: _________Shelley Honkanen________

For Axys Internal Use Only [XSL Template: Form6A.xsl; Created: 12-Jan-2017 15:30:06; Application: XMLTransformer-1.15.33;
Report Filename: 1613_DIOXINS_DB7T_010CS7__Form6A_SJ2148506.html; Workgroup: WG57620; Design ID: 3006]

AXYS METHOD MLA-017 Rev 20

Form 5
PCDD/PCDF RT WINDOW AND ISOMER SPECIFICITY STANDARDS

AXYS ANALYTICAL SERVICES
2045 MILLS RD., SIDNEY, B.C., CANADA
V8L 5X2 TEL (250) 655-5800 FAX (250) 655-5811

Instrument ID:	HR GC/MS	**Initial Calibration Date:**		04-Jan-2017
RT Window Data Filename:		**Analysis Date:**		**Time:**
DB-5 IS Data Filename:		**Analysis Date:**		**Time:**
DB-225 IS Data Filename:	DB7T_010B S: 1	**Analysis Date:**	10-Jan-2017	**Time:** 10:11:11

DB225 RT WINDOW DEFINING STANDARDS RESULT

ISOMERS	ABSOLUTE RT	ISOMERS	ABSOLUTE RT
1,3,6,8-TCDD (F)	N/A	**1,3,6,8-TCDF (F)**	N/A
1,2,8,9-TCDD (L)	N/A	**1,2,8,9-TCDF (L)**	N/A
1,2,4,7,9-PECDD (F)	N/A	**1,3,4,6,8-PECDF (F)**	N/A
1,2,3,8,9-PECDD (L)	N/A	**1,2,3,8,9-PECDF (L)**	N/A
1,2,4,6,7,9-HXCDD (F)	N/A	**1,2,3,4,6,8-HXCDF (F)**	N/A
1,2,3,4,6,7-HXCDD (L)	N/A	**1,2,3,4,8,9-HXCDF (L)**	N/A
1,2,3,4,6,7,9-HPCDD (F)	N/A	**1,2,3,4,6,7,8-HPCDF (F)**	N/A
1,2,3,4,6,7,8-HPCDD (L)	N/A	**1,2,3,4,7,8,9-HPCDF (L)**	N/A

(F) = First eluting isomer (DB-5); (L) = Last eluting isomer (DB-5)

ISOMER SPECIFICITY (IS) TEST STANDARDS RESULT

Isomers	% Valley Height Between Compared Peaks	Isomers	% Valley Height Between Compared Peaks
1,2,3,4-TCDD **1,2,7,8-TCDD**	N/A	**1,2,3,8-TCDD** **2,3,7,8-TCDD**	N/A
1,2,7,8-TCDD **1,4,7,8-TCDD**	N/A	**2,3,4,7-TCDF** **2,3,7,8-TCDF**	3.4
1,4,7,8-TCDD **1,2,3,7-TCDD**	N/A	**2,3,7,8-TCDF** **1,2,3,9-TCDF**	4.1
1,2,3,7-TCDD **1,2,3,8-TCDD**	N/A		

These data are validated and reported as accurate and in accord with AXYS Analytical Services Ltd. ISO17025 compliant quality assurance processes.
Signed: _________Shelley Honkanen________

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Report Filename: 1613_DIOXINS__DB7T_010BS1_Form5_SJ2148507.html; Workgroup: WG57620; Design ID: 3006]

Accreditation Scope

AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 30

				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
BFR	BTBPE	AXYS MLA-033	MLA-033			Y										Y							Y										
	DBDPE	AXYS MLA-033	MLA-033			Y										Y							Y										
	HBB	AXYS MLA-033	MLA-033			Y										Y							Y										
	PBEB	AXYS MLA-033	MLA-033			Y										Y							Y										
BPA and MPE	4,4'-dihydroxy-2,2-diphenylpropane (Bisphenol A) (BPA)	AXYS MLA-059	MLA-059																			Y											
	Mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP)	AXYS MLA-059	MLA-059																			Y											
	Mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP)	AXYS MLA-059	MLA-059																			Y											
	Mono-(3-carboxypropyl) phthalate (MCPP)	AXYS MLA-059	MLA-059																			Y											
	Mono-2-ethylhexyl phthalate (MEHP)	AXYS MLA-059	MLA-059																			Y											
	Mono-benzyl phthalate (MBzP)	AXYS MLA-059	MLA-059																			Y											
	Mono-butyl phthalate (MBP) (n + iso)	AXYS MLA-059	MLA-059																			Y											
	Mono-cyclohexyl phthalate (MCHP)	AXYS MLA-059	MLA-059																			Y											
	Mono-ethyl phthalate (MEP)	AXYS MLA-059	MLA-059																			Y											
	Mono-iso-nonyl phthalate (MiNP)	AXYS MLA-059	MLA-059																			Y											
	Mono-methyl phthalate (MMP)	AXYS MLA-059	MLA-059																			Y											
FTS	4:2 fluorotelomer sulfonate (4:2 FTS)	AXYS MLA-081	MLA-081																													YD	
		AXYS MLA-089	MLA-089												YD																		
	6:2 fluorotelomer sulfonate (6:2 FTS)	AXYS MLA-081	MLA-081																													YD	
		AXYS MLA-089	MLA-089												YD																		
	8:2 fluorotelomer sulfonate (8:2 FTS)	AXYS MLA-081	MLA-081																													YD	
		AXYS MLA-089	MLA-089												YD																		
HBCDD	alpha-hexabromocyclododecane (a-HBCDD)	AXYS MLA-070	MLA-070		Y																												
	beta-hexabromocyclododecane (b-HBCDD)	AXYS MLA-070	MLA-070		Y																												
	gamma-hexabromocyclododecane (g-HBCDD)	AXYS MLA-070	MLA-070		Y																												
OC Pesticides	2,4'-DDD	AXYS MLA-007	MLA-007		Y	Y		Y								Y							Y		Y								
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																						Y								
		EPA 8270	MLA-007					Y					Y																				
		EPA 1699	MLA-028					Y							Y										Y							Y	
	2,4'-DDE	AXYS MLA-007	MLA-007		Y	Y		Y								Y							Y		Y								
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																						Y								
		EPA 8270	MLA-007					Y					Y																				
		EPA 1699	MLA-028					Y							Y										Y							Y	
	2,4'-DDT	AXYS MLA-007	MLA-007		Y	Y		Y								Y							Y		Y								
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																						Y								
		EPA 8270	MLA-007					Y					Y																				
		EPA 1699	MLA-028					Y							Y										Y							Y	
	4,4'-DDD	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	4,4'-DDE	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	4,4'-DDT	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	

Accreditation Scope

AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 30

				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Aldrin	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Alpha-HCH	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Beta-HCH	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Chlordane, technical	AXYS MLA-007	MLA-007					Y							Y										Y							Y	
		EPA 625	MLA-007																					Y							Y		
		EPA 8270	MLA-007				Y	Y			Y	Y		Y	Y										Y			Y	Y		Y	Y	
		EPA 1699	MLA-028												Y																	Y	
	cis-Chlordane (alpha-Chlordane)	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 8270	MLA-007					Y			Y		Y	Y	Y										Y			Y			Y	Y	
		EPA 1699	MLA-028					Y							Y										Y							Y	
	cis-Nonachlor	AXYS MLA-007	MLA-007		Y	Y		Y								Y							Y		Y								
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 8270	MLA-007					Y					Y												Y								
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Delta-HCH	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 608	MLA-007																						Y			Y	Y		Y	Y	
		EPA 8081	MLA-007					Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Dieldrin	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 608	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8081	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Endosulphan I	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 608	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8081	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Endosulphan II	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 608	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8081	MLA-007				Y	Y			Y	Y	Y	Y	Y																		

Accreditation Scope

AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 30

				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Endosulphan sulphate	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 608	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8081	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Endrin	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 608	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8081	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Endrin aldehyde	AXYS MLA-007	MLA-007			Y		Y							Y								Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 608	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8081	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Endrin ketone	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y			
		EPA 8081	MLA-007					Y			Y		Y		Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Gamma-HCH (Lindane)	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Heptachlor	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Heptachlor epoxide	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 608	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8081	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Hexachlorobenzene	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 1625	MLA-007																					Y	Y			Y				Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Methoxychlor	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 608	MLA-007																						Y			Y	Y			Y	
		EPA 8081	MLA-007				Y	Y			Y	Y	Y	Y	Y																		
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Mirex	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 8270	MLA-007					Y			Y		Y		Y										Y			Y	Y		Y	Y	
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Oxychlordane	AXYS MLA-007	MLA-007		Y	Y		Y								Y							Y		Y								

Accreditation Scope

AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 30

				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 8270	MLA-007					Y					Y												Y								
		EPA 1699	MLA-028					Y							Y										Y							Y	
	Toxaphene	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	trans-Chlordane (gamma-Chlordane)	AXYS MLA-007	MLA-007		Y	Y		Y							Y	Y							Y		Y							Y	
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 8270	MLA-007					Y			Y		Y	Y	Y										Y			Y			Y	Y	
		EPA 1699	MLA-028					Y							Y										Y							Y	
	trans-Nonachlor	AXYS MLA-007	MLA-007		Y	Y		Y								Y									Y								
		AXYS MLA-028	MLA-028		Y	Y		Y					Y		Y	Y							Y		Y					Y		Y	
		EPA 8270	MLA-007					Y					Y												Y								
		EPA 1699	MLA-028					Y							Y										Y							Y	
PAH	1,2,6-Trimethylphenanthrene	AXYS MLA-021	MLA-021			Y																	Y										
	1,2-Dimethylnaphthalene	AXYS MLA-021	MLA-021			Y																	Y										
	1,4,6,7-Tetramethylnaphthalene	AXYS MLA-021	MLA-021			Y																	Y										
	1,7-Dimethylfluorene	AXYS MLA-021	MLA-021			Y																	Y										
	1,7-Dimethylphenanthrene	AXYS MLA-021	MLA-021			Y																	Y										
	1,8-Dimethylphenanthrene	AXYS MLA-021	MLA-021			Y																	Y										
	1-Methylchrysene	AXYS MLA-021	MLA-021			Y																	Y										
	1-Methylnaphthalene	AXYS MLA-021	MLA-021			Y																	Y										
	1-Methylphenanthrene	AXYS MLA-021	MLA-021			Y																	Y										
	2,3,5-Trimethylnaphthalene	AXYS MLA-021	MLA-021			Y																	Y										
	2,3,6-Trimethylnaphthalene	AXYS MLA-021	MLA-021			Y																	Y										
	2,4-Dimethyldibenzothiophene	AXYS MLA-021	MLA-021			Y																	Y										
	2,6-Dimethylnaphthalene	AXYS MLA-021	MLA-021			Y																	Y										
	2,6-Dimethylphenanthrene	AXYS MLA-021	MLA-021			Y																	Y										
	2/3-Methyldibenzothiophenes	AXYS MLA-021	MLA-021			Y																	Y										
	2-Methylanthracene	AXYS MLA-021	MLA-021			Y																	Y										
	2-Methylfluorene	AXYS MLA-021	MLA-021			Y																	Y										
	2-methylnaphthalene	AXYS MLA-021	MLA-021			Y		Y							Y								Y									Y	
		EPA 1625	MLA-021																													Y	
		EPA 8270	MLA-021					Y			Y				Y										Y								
	2-Methylphenanthrene	AXYS MLA-021	MLA-021			Y																	Y										
	3,6-Dimethylphenanthrene	AXYS MLA-021	MLA-021			Y																	Y										
	3-Methylfluoranthene/ Benzo(a)fluorene	AXYS MLA-021	MLA-021			Y																	Y										
	3-Methylphenanthrene	AXYS MLA-021	MLA-021			Y																	Y										
	5,9-Dimethylchrysene	AXYS MLA-021	MLA-021			Y																	Y										
	5/6-Methylchrysenes	AXYS MLA-021	MLA-021			Y																	Y										
	7-Methylbenzo(a)pyrene	AXYS MLA-021	MLA-021			Y																	Y										
	9/4-Methylphenanthrenes	AXYS MLA-021	MLA-021			Y																	Y										
	Acenaphthene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Acenaphthylene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Anthracene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Benz[a]anthracene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Benzo[a]pyrene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Benzo[b]fluoranthene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Benzo[e]pyrene	AXYS MLA-021	MLA-021			Y										Y							Y										
	Benzo[ghi]perylene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Benzo[j/k]fluoranthenes	AXYS MLA-021	MLA-021																				Y										
	Benzo[k]fluoranthene	AXYS MLA-021	MLA-021					Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-021					Y			Y			Y	Y																		
	Biphenyl	AXYS MLA-021	MLA-021			Y																	Y										
	C1-Acenaphthenes	AXYS MLA-021	MLA-021			Y																	Y										
	C1-Benz(a)anthracenes/chrysenes	AXYS MLA-021	MLA-021			Y																	Y										
	C1-Benzofluoranthenes/ Benzopyrenes	AXYS MLA-021	MLA-021			Y																	Y										
	C1-Biphenyls	AXYS MLA-021	MLA-021			Y																	Y										
	C1-Dibenzothiophene	AXYS MLA-021	MLA-021			Y																	Y										
	C1-Fluoranthenes/Pyrenes	AXYS MLA-021	MLA-021			Y																	Y										
	C1-Fluorenes	AXYS MLA-021	MLA-021			Y																	Y										
	C1-Naphthalenes	AXYS MLA-021	MLA-021			Y																	Y										
	C1-Phenanthrenes/Anthracenes	AXYS MLA-021	MLA-021			Y																	Y										
	C2-Benz(a)anthracenes/Chrysenes	AXYS MLA-021	MLA-021			Y																	Y										
	C2-Benzofluoranthenes/ Benzopyrenes	AXYS MLA-021	MLA-021			Y																	Y										
	C2-Biphenyls	AXYS MLA-021	MLA-021			Y																	Y										
	C2-Dibenzothiophene	AXYS MLA-021	MLA-021			Y																	Y										
	C2-Fluoranthenes/Pyrenes	AXYS MLA-021	MLA-021			Y																	Y										
	C2-Fluorenes	AXYS MLA-021	MLA-021			Y																	Y										
	C2-Naphthalenes	AXYS MLA-021	MLA-021			Y																	Y										
	C2-Phenanthrenes/Anthracenes	AXYS MLA-021	MLA-021			Y																	Y										
	C3-Benz(a)anthracenes/Chrysenes	AXYS MLA-021	MLA-021			Y																	Y										
	C3-Dibenzothiophene	AXYS MLA-021	MLA-021			Y																	Y										
	C3-Fluoranthenes/Pyrenes	AXYS MLA-021	MLA-021			Y																	Y										
	C3-Fluorenes	AXYS MLA-021	MLA-021			Y																	Y										
	C3-Naphthalenes	AXYS MLA-021	MLA-021			Y																	Y										
	C3-Phenanthrenes/Anthracenes	AXYS MLA-021	MLA-021			Y																	Y										
	C4-Benz(a)anthracenes/Chrysenes	AXYS MLA-021	MLA-021			Y																	Y										
	C4-Dibenzothiophene	AXYS MLA-021	MLA-021			Y																	Y										
	C4-Fluoranthenes/Pyrenes	AXYS MLA-021	MLA-021			Y																	Y										
	C4-Naphthalenes	AXYS MLA-021	MLA-021			Y																	Y										
	C4-Phenanthrenes/Anthracenes	AXYS MLA-021	MLA-021			Y																	Y										
	Chrysene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Dibenz[ah]anthracene	AXYS MLA-021	MLA-021			Y										Y							Y										

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Dibenzo[ah]anthracene	AXYS MLA-021	MLA-021					Y							Y										Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Dibenzothiophene	AXYS MLA-021	MLA-021			Y																	Y										
	Fluoranthene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Fluorene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Indeno[1,2,3-cd]pyrene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Naphthalene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Perylene	AXYS MLA-021	MLA-021			Y										Y							Y										
	Phenanthrene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Pyrene	AXYS MLA-021	MLA-021			Y		Y							Y	Y							Y		Y							Y	
		EPA 1625	MLA-021																					Y	Y			Y	Y			Y	
		EPA 8270	MLA-021				Y	Y			Y	Y		Y	Y																		
	Retene	AXYS MLA-021	MLA-021			Y																	Y										
PBDPE	BDE 10 2,6-dibromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 100 2,2',4,4',6-pentabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 105 2,3,3',4,4'-pentabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 11 3,3'-dibromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 116 2,3,4,5,6-pentabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 119 2,3',4,4',6-pentabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 12 3,4-dibromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 126 3,3',4,4',5-pentabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 13 3,4'-dibromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 140 2,2',3,4,4',6'-hexabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 15 4,4'-dibromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 153 2,2',4,4',5,5'-hexabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 154 2,2',4,4',5',6-hexabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	BDE 155 2,2’,4,4’,6,6’-hexabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 166 2,3,4,4’,5,6-hexabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 17 2,2’,4-tribromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 181 2,2’,3,4,4’,5,6-heptabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 190 2,3,3’,4,4’,5,6-heptabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 206 2,2’,3,3’,4,4’,5,5’,6-nonabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 207 2,2’,3,3’,4,4’,5,6,6’-nonabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 208 2,2’,3,3’,4,5,5’,6,6’-nonabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 209 Decabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 25 2,3’,4-tribromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 28 2,4,4’-tribromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 30 2,4,6-tribromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 35 3,3’,4-tribromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 37 3,4,4’-tribromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 47 2,2’,4,4’-tetrabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 49 2,2’,4,5’-tetrabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 66 2,3’,4,4’-tetrabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 7 2,4-dibromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 75 2,4,4’,6-tetrabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 77 3,3’,4,4’-tetrabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 8 2,4’-dibromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 85 2,2’,3,4,4’-pentabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE 99 2,2’,4,4’,5-pentabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE-183 2,2’,3,4,4’,5’,6-heptabromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										
	BDE-33 2’,3,4-tribromodiphenylether	EPA 1614	MLA-033										Y																	Y			
		AXYS MLA-033	MLA-033		Y	Y										Y							Y										

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
PCB Aroclors	PCB Aroclor 1016	AXYS MLA-007	MLA-007			Y		Y							Y	Y							Y		Y							Y	
		EPA 1668	MLA-010					Y			Y			Y	Y										Y			Y			Y	Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y			Y																		
		AXYS MLA-010	MLA-010					Y							Y										Y							Y	
	PCB Aroclor 1016/1242	EPA 8270	MLA-007										Y																				
	PCB Aroclor 1221	AXYS MLA-007	MLA-007			Y		Y							Y	Y							Y		Y							Y	
		EPA 1668	MLA-010					Y			Y			Y	Y										Y			Y			Y	Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y		Y																		
		AXYS MLA-010	MLA-010					Y							Y										Y							Y	
	PCB Aroclor 1232	AXYS MLA-007	MLA-007			Y		Y							Y	Y							Y		Y							Y	
		EPA 1668	MLA-010					Y			Y			Y	Y										Y			Y			Y	Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y		Y																		
		AXYS MLA-010	MLA-010					Y							Y										Y							Y	
	PCB Aroclor 1242	AXYS MLA-007	MLA-007			Y		Y							Y	Y							Y		Y							Y	
		EPA 1668	MLA-010					Y			Y			Y	Y										Y			Y			Y	Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y			Y																		
		AXYS MLA-010	MLA-010					Y							Y										Y							Y	
	PCB Aroclor 1248	AXYS MLA-007	MLA-007			Y		Y							Y	Y							Y		Y							Y	
		EPA 1668	MLA-010					Y			Y			Y	Y										Y			Y			Y	Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y		Y																		
		AXYS MLA-010	MLA-010					Y							Y										Y							Y	
	PCB Aroclor 1254	AXYS MLA-007	MLA-007			Y		Y							Y	Y							Y		Y							Y	
		EPA 1668	MLA-010					Y			Y			Y	Y										Y			Y			Y	Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y		Y																		
		AXYS MLA-010	MLA-010					Y							Y										Y							Y	
	PCB Aroclor 1260	AXYS MLA-007	MLA-007			Y		Y							Y	Y							Y		Y							Y	
		EPA 1668	MLA-010					Y			Y			Y	Y										Y			Y			Y	Y	
		EPA 625	MLA-007																					Y	Y			Y	Y		Y	Y	
		EPA 8270	MLA-007				Y	Y			Y	Y	Y		Y																		
		AXYS MLA-010	MLA-010					Y							Y										Y							Y	
	PCB Aroclor 1268	AXYS MLA-007	MLA-007			Y										Y							Y										
PCB congeners	PCB 1 2-Chlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 10 2,6-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 100 2,2',4,4',6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 101 2,2',4,5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 101/90/89	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 102 2,2',4,5,6'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y

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				Pulp	Serum	Solids									Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 103 2,2',4,5',6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 104 2,2',4,6,6'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 105 2,3,3',4,4'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 105/127	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 106 2,3,3',4,5-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 107 2,3,3',4',5-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 107/109	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 108 2,3,3',4,5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 109 2,3,3',4,6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 11 3,3'-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 110 2,3,3',4',6-Pentachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 111 2,3,3',5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 111/117	EPA 8270	MLA-007										Y																				
	PCB 112 2,3,3',5,6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 113 2,3,3',5',6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 114 2,3,4,4',5-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 115 2,3,4,4',6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 116 2,3,4,5,6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 117 2,3,4',5,6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 118 2,3',4,4',5-Pentachlorobiphenyl	AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 118/106	AXYS MLA-007	MLA-007			Y										Y							Y										

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		EPA 8270	MLA-007										Y																				
	PCB 119 2,3',4,4',6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 12 3,4-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 12/13	EPA 8270	MLA-007										Y																				
	PCB 120 2,3',4,5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 121 2,3',4,5',6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 122 2,3,3',4',5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 123 2,3',4,4',5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 124 2,3',4',5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 125 2,3',4',5',6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 126 3,3',4,4',5-Pentachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 127 3,3',4,5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 128 2,2',3,3',4,4'-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 129 2,2',3,3',4,5-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 13 3,4'-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 130 2,2',3,3',4,5'-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 131 2,2',3,3',4,6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 131/142	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 132 2,2',3,3',4,6'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 132/168	EPA 8270	MLA-007										Y																				

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	PCB 133 2,2',3,3',5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 134 2,2',3,3',5,6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 134/143	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 135 2,2',3,3',5,6'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 136 2,2',3,3',6,6'-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 137 2,2',3,4,4',5-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 138 2,2',3,4,4',5'-Hexachlorobiphenyl	AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 138/163/164	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 139 2,2',3,4,4',6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 14 3,5-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 140 2,2',3,4,4',6'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 141 2,2',3,4,5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 142 2,2',3,4,5,6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 143 2,2',3,4,5,6'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 144 2,2',3,4,5',6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 144/135	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 145 2,2',3,4,6,6'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 146 2,2',3,4',5,5'-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 147 2,2',3,4',5,6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 148 2,2',3,4',5,6'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 149 2,2',3,4',5',6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 149/139	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 15 4,4'-Dichlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 150 2,2',3,4',6,6'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 151 2,2',3,5,5',6-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 152 2,2',3,5,6,6'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 153 2,2',4,4',5,5'-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 154 2,2',4,4',5,6'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 155 2,2',4,4',6,6'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 156 2,3,3',4,4',5-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 157 2,3,3',4,4',5'-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 158 2,3,3',4,4',6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 158/160	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 159 2,3,3',4,5,5'-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 16 2,2',3-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 16/32	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 160 2,3,3',4,5,6-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 161 2,3,3',4,5',6-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 162 2,3,3',4',5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 163 2,3,3',4',5,6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 164 2,3,3',4',5',6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 165 2,3,3',5,5',6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 166 2,3,4,4',5,6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 167 2,3',4,4',5,5'-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 168 2,3',4,4',5',6-Hexachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 169 3,3',4,4',5,5'-Hexachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 17 2,2',4-Trichlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 170 2,2',3,3',4,4',5-Heptachlorobiphenyl	AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 170/190	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 171 2,2',3,3',4,4',6-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 172 2,2',3,3',4,5,5'-Heptachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 172/192	AXYS MLA-007	MLA-007			Y										Y							Y										

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		EPA 8270	MLA-007										Y																				
	PCB 173 2,2',3,3',4,5,6-Heptachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 174 2,2',3,3',4,5,6'-Heptachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 174/181	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 175 2,2',3,3',4,5',6-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 176 2,2',3,3',4,6,6'-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 177 2,2',3,3',4,5',6'-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 178 2,2',3,3',5,5',6-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 179 2,2',3,3',5,6,6'-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 18 2,2',5-Trichlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 180 2,2',3,4,4',5,5'-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 181 2,2',3,4,4',5,6-Heptachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 182 2,2',3,4,4',5,6'-Heptachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 183 2,2',3,4,4',5',6-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 184 2,2',3,4,4',6,6'-Heptachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 185 2,2',3,4,5,5',6-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 186 2,2',3,4,5,6,6'-Heptachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 187 2,2',3,4',5,5',6-Heptachlorobiphenyl	AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 187/182	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 188 2,2',3,4',5,6,6'-Heptachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 189 2,3,3',4,4',5,5'-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 19 2,2',6-Trichlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 190 2,3,3',4,4',5,6-Heptachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 191 2,3,3',4,4',5',6-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 192 2,3,3',4,5,5',6-Heptachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 193 2,3,3',4',5,5',6-Heptachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 194 2,2',3,3',4,4',5,5'-Octachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 195 2,2',3,3',4,4',5,6-Octachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 196 2,2',3,3',4,4',5,6'-Octachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 196/203	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 197 2,2',3,3',4,4',6,6'-Octachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	

Accreditation Scope

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	PCB 198 2,2',3,3',4,5,5',6-Octachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 199 2,2',3,3',4,5,5',6'-Octachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 2 3-Chlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 20 2,3,3'-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 200 2,2',3,3',4,5,6,6'-Octachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 201 2,2',3,3',4,5',6,6'-Octachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 202 2,2',3,3',5,5',6,6'-Octachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 203 2,2',3,4,4',5,5',6-Octachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 204 2,2',3,4,4',5,6,6'-Octachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 205 2,3,3',4,4',5,5',6-Octachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 206 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 207 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 208 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 209 Decachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 21 2,3,4-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	

Accreditation Scope

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file ref.: ACC-101 Rev. 30

				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	PCB 22 2,3,4'-Trichlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 23 2,3,5-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 23/34	EPA 8270	MLA-007										Y																				
	PCB 24 2,3,6-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 24/27	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 25 2,3',4-Trichlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 26 2,3',5-Trichlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 27 2,3',6-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 28 2,4,4'-Trichlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 29 2,4,5-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 3 4-Chlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 30 2,4,6-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 31 2,4',5-Trichlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 32 2,4',6-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 33 2,3',4'-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 33/20/21	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 34 2,3',5'-Trichlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 35 3,3',4-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 36 3,3',5-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				

Accreditation Scope

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 37 3,4,4'-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 38 3,4,5-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 39 3,4',5-Trichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 4 2,2'-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 4/10	EPA 8270	MLA-007										Y																				
	PCB 40 2,2',3,3'-Tetrachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 41 2,2',3,4-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 41/71/64/68	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 42 2,2',3,4'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 42/59	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 43 2,2',3,5-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 44 2,2',3,5'-Tetrachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 45 2,2',3,6-Tetrachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 46 2,2',3,6'-Tetrachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 47 2,2',4,4'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 47/48/75	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 48 2,2',4,5-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 49 2,2',4,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 49/43	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 5 2,3-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 50 2,2',4,6-Tetrachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 51 2,2',4,6'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 52 2,2',5,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 52/73	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 53 2,2',5,6'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 54 2,2',6,6'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 55 2,3,3',4-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 56 2,3,3',4'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 56/60	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 57 2,3,3',5-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 58 2,3,3',5'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 59 2,3,3',6-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 6 2,3'-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 60 2,3,4,4'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 61 2,3,4,5-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 62 2,3,4,6-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 62/65	EPA 8270	MLA-007										Y																				
	PCB 63 2,3,4',5-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 64 2,3,4',6-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 65 2,3,5,6-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	

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				Pulp	Serum	Solids									Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	PCB 66 2,3',4,4'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 66/80	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 67 2,3',4,5-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 68 2,3',4,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 69 2,3',4,6-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 7 2,4-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 7/9	EPA 8270	MLA-007										Y																				
	PCB 70 2,3',4',5-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 70/76	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 71 2,3',4',6-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 72 2,3',5,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 73 2,3',5',6-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 74 2,4,4',5-Tetrachlorobiphenyl	AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 74/61	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 75 2,4,4',6-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 76 2,3',4',5'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 77 3,3',4,4'-Tetrachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 78 3,3',4,5-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 79 3,3',4,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 8 2,4'-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 8/5	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 80 3,3',5,5'-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 81 3,4,4',5-Tetrachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 82 2,2',3,3',4-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 83 2,2',3,3',5-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 83/108	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 84 2,2',3,3',6-Pentachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 85 2,2',3,4,4'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 85/120	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 86 2,2',3,4,5-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 87 2,2',3,4,5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 87/115/116	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 88 2,2',3,4,6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 88/121	EPA 8270	MLA-007										Y																				
	PCB 89 2,2',3,4,6'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 9 2,5-Dichlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y		YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 90 2,2',3,4',5-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 91 2,2',3,4',6-Pentachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 92 2,2',3,5,5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 93 2,2',3,5,6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 94 2,2',3,5,6'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 95 2,2',3,5',6-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 95/93	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	PCB 96 2,2',3,6,6'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 97 2,2',3,4',5'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 97/86	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 8270	MLA-007										Y																				
	PCB 98 2,2',3,4',6'-Pentachlorobiphenyl	EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB 98/102	EPA 8270	MLA-007										Y																				
	PCB 99 2,2',4,4',5-Pentachlorobiphenyl	AXYS MLA-007	MLA-007			Y										Y							Y										
		AXYS MLA-901	MLA-901		Y																												
		EPA 1668	MLA-010					Y		Y	Y	Y	Y	Y	YD						YD				Y		Y	Y	Y	Y		YD	Y
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y		Y							YD	Y					YD		Y		Y							YD	
	PCB congeners, total	EPA 1668	MLA-010								Y																	Y					
	Sum - Dichlorobiphenyls (BZ-12-+ BZ-13)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Heptachlorobiphenyls (BZ-171 + BZ-173)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Heptachlorobiphenyls (BZ-180 + BZ-193)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Heptachlorobiphenyls (BZ-183 + BZ-185)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Hexachlorobiphenyls (BZ-128 + BZ-166)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Hexachlorobiphenyls (BZ-129 + BZ-138 + BZ-160 + BZ-163)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Hexachlorobiphenyls (BZ-134 + BZ-143)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Hexachlorobiphenyls (BZ-135 + BZ-151 + BZ-154)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Hexachlorobiphenyls (BZ-139 + BZ-140)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Hexachlorobiphenyls (BZ-147 + BZ-149)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Hexachlorobiphenyls (BZ-153 + BZ-168)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Hexachlorobiphenyls (BZ-156 + BZ-157)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Pentachlorobiphenyls (BZ-107 + BZ-124)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Pentachlorobiphenyls (BZ-108 + BZ-124)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Pentachlorobiphenyls (BZ-110 + BZ-115)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Pentachlorobiphenyls (BZ-83 + BZ-99)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Pentachlorobiphenyls (BZ-85 + BZ-116 + BZ-117)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Sum - Pentachlorobiphenyls (BZ-86 + BZ-87 + BZ 97 + BZ-109 + BZ-119 + BZ-125)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Pentachlorobiphenyls (BZ-86 + BZ-87 + BZ-97 + BZ-108 + BZ-119 +BZ-125)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Pentachlorobiphenyls (BZ-88 + BZ-91)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Pentachlorobiphenyls (BZ-90 + BZ-101 + BZ-113)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Pentachlorobiphenyls (BZ-93 + BZ-95 + BZ-98 + BZ-100 + BZ-102)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Tetrachlorobiphenyls (BZ-40 + BZ-41 + BZ-71)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Tetrachlorobiphenyls (BZ-44 + BZ-47 + BZ-65)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Tetrachlorobiphenyls (BZ-45 + BZ-51)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Tetrachlorobiphenyls (BZ-49 + BZ-69)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Tetrachlorobiphenyls (BZ-50 + BZ-53)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Tetrachlorobiphenyls (BZ-59 + BZ-62 + BZ-75)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Tetrachlorobiphenyls (BZ-61 + BZ-70 + BZ-74 + BZ-76)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Trichlorobiphenyls (BZ-18 + BZ-30)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Trichlorobiphenyls (BZ-20 + BZ-28)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Trichlorobiphenyls (BZ-21 + BZ-33)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Sum - Trichlorobiphenyls (BZ-26 + BZ-29)	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Total Dichlorobiphenyls	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010												YD						YD											YD	
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y									YD	Y					YD		Y									YD	
	Total Heptachlorobiphenyls	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010												YD						YD											YD	
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y									YD	Y					YD		Y									YD	
	Total Hexachlorobiphenyls	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010												YD						YD											YD	
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y									YD	Y					YD		Y									YD	
	Total Monochlorobiphenyls	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010		Y	Y									YD	Y					YD		Y									YD	
	Total Nonachlorobiphenyls	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010												YD						YD											YD	
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y									YD	Y					YD		Y									YD	

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Total Octachlorobiphenyls	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010												YD						YD											YD	
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y									YD	Y					YD		Y									YD	
	Total PCBs	EPA 1668	MLA-010												YD						YD											YD	
		AXYS MLA-010	MLA-010												YD						YD											YD	
	Total Pentachlorobiphenyls	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010												YD						YD											YD	
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y									YD	Y					YD		Y									YD	
	Total Polychlorinated biphenyls	AXYS MLA-007	MLA-007			Y										Y							Y										
	Total Tetrachlorobiphenyls	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010												YD						YD											YD	
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y									YD	Y					YD		Y									YD	
	Total Trichlorobiphenyls	AXYS MLA-007	MLA-007			Y										Y							Y										
		EPA 1668	MLA-010												YD						YD											YD	
		EPA 8270	MLA-007										Y																				
		AXYS MLA-010	MLA-010		Y	Y									YD	Y					YD		Y									YD	
PCDDF	1,2,3,4,6,7,8-HpCDD	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	1,2,3,4,6,7,8-HpCDF	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	1,2,3,4,7,8,9-HpCDF	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	1,2,3,4,7,8-HxCDD	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	1,2,3,4,7,8-HxCDF	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	1,2,3,6,7,8-HxCDD	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	1,2,3,6,7,8-HxCDF	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	1,2,3,7,8,9-HxCDD	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	1,2,3,7,8,9-HxCDF	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	1,2,3,7,8-PeCDD	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	1,2,3,7,8-PeCDF	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	2,3,4,6,7,8-HxCDF	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	2,3,4,7,8-PeCDF	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	2,3,7,8-TCDD	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	2,3,7,8-TCDF	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	OCDD	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	OCDF	EPA 1613	MLA-017										Y		YD						YD			Y	Y		Y	Y	Y	Y	Y	YD	
		EPA 8290	MLA-017				Y	Y		Y	Y	Y		Y	YD		Y		Y	Y	YD				Y			Y	Y			YD	
		AXYS MLA-017	MLA-017	Y	Y	Y		Y							YD	Y	Y				YD		Y		Y							YD	
	Total HpCDD	EPA 1613	MLA-017												YD						YD			Y	Y						Y	YD	
		EPA 8290	MLA-017					Y		Y		Y		Y	YD		Y		Y	Y	YD				Y				Y			YD	
		AXYS MLA-017	MLA-017					Y							YD		Y				YD				Y							YD	
	Total HpCDF	EPA 1613	MLA-017												YD						YD			Y	Y						Y	YD	
		EPA 8290	MLA-017					Y		Y		Y		Y	YD		Y		Y	Y	YD				Y				Y			YD	
		AXYS MLA-017	MLA-017					Y							YD		Y				YD				Y							YD	
	Total HxCDD	EPA 1613	MLA-017												YD						YD			Y	Y						Y	YD	
		EPA 8290	MLA-017					Y		Y		Y		Y	YD		Y		Y	Y	YD				Y				Y			YD	
		AXYS MLA-017	MLA-017					Y							YD		Y				YD				Y							YD	
	Total HxCDF	EPA 1613	MLA-017												YD						YD			Y	Y						Y	YD	
		EPA 8290	MLA-017					Y		Y		Y		Y	YD		Y		Y	Y	YD				Y				Y			YD	
		AXYS MLA-017	MLA-017					Y							YD		Y				YD				Y							YD	
	Total PCDD	EPA 1613	MLA-017												YD						YD											YD	
		EPA 8290	MLA-017												YD						YD											YD	
		AXYS MLA-017	MLA-017												YD						YD											YD	
	Total PCDD+PCDF	EPA 1613	MLA-017												YD						YD											YD	
		EPA 8290	MLA-017												YD						YD											YD	
		AXYS MLA-017	MLA-017												YD						YD											YD	
	Total PCDF	EPA 1613	MLA-017												YD						YD											YD	
		EPA 8290	MLA-017												YD						YD											YD	
		AXYS MLA-017	MLA-017												YD						YD											YD	
	Total PeCDD	EPA 1613	MLA-017												YD						YD			Y	Y						Y	YD	
		EPA 8290	MLA-017					Y		Y		Y		Y	YD		Y		Y	Y	YD				Y				Y			YD	
		AXYS MLA-017	MLA-017					Y							YD		Y				YD				Y							YD	
	Total PeCDF	EPA 1613	MLA-017												YD						YD			Y	Y						Y	YD	
		EPA 8290	MLA-017					Y		Y		Y		Y	YD		Y		Y	Y	YD				Y				Y			YD	
		AXYS MLA-017	MLA-017					Y							YD		Y				YD				Y							YD	
	Total TCDD	EPA 1613	MLA-017												YD						YD			Y	Y						Y	YD	
		EPA 8290	MLA-017					Y		Y		Y		Y	YD		Y		Y	Y	YD				Y				Y			YD	
		AXYS MLA-017	MLA-017					Y							YD		Y				YD				Y							YD	

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Total TCDF	EPA 1613	MLA-017												YD						YD			Y	Y						Y	YD	
		EPA 8290	MLA-017					Y		Y		Y		Y	YD		Y		Y	Y	YD				Y				Y			YD	
		AXYS MLA-017	MLA-017					Y							YD		Y				YD				Y							YD	
PFC	Perfluorobutanesulfonate (PFBS)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluorobutanoate (PFBA)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluorodecanoate (PFDA)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluorododecanoate (PFDoA)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluoroheptanoate (PFHpA)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluorohexanesulfonate (PFHxS)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluorohexanoate (PFHxA)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluorononanoate (PFNA)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluorooctane sulfonamide (PFOSA)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluorooctanesulfonate (PFOS)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluorooctanoate (PFOA)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluoropentanoate (PFPeA)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
	Perfluoroundecanoate (PFUnA)	AXYS MLA-041	MLA-041			Y		Y	Y	Y					YD																		
		AXYS MLA-042	MLA-042		Y																												
		AXYS MLA-043	MLA-043													Y	Y	Y	Y		YD												
		AXYS MLA-060	MLA-060																				Y		Y	Y	Y					YD	
		EPA 537 modified	MLA-041												YD																		
			MLA-043																		YD												
			MLA-060																													YD	
PPCP	1,7-Dimethylxanthine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	10-hydroxy-amitriptyline	AXYS MLA-075	MLA-075			Y																	Y										
	2-hydroxy-ibuprofen	AXYS MLA-075	MLA-075			Y																	Y										
	4-Epianhydrochlortetracycline (EACTC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	4-Epianhydrotetracycline (EATC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	4-Epichlortetracycline (ECTC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	4-Epioxytetracycline (EOTC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	4-Epitetracycline (ETC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Acetaminophen	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Albuterol	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Alprazolam	AXYS MLA-075	MLA-075			Y																	Y										
	Amitriptyline	AXYS MLA-075	MLA-075			Y																	Y										
	Amlodipine	AXYS MLA-075	MLA-075			Y																	Y										
	Amphetamine	AXYS MLA-075	MLA-075			Y																	Y										
	Anhydrochlortetracycline (ACTC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Anhydrotetracycline (ATC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Atenolol	AXYS MLA-075	MLA-075			Y																	Y										
	Atorvastatin	AXYS MLA-075	MLA-075			Y																	Y										
	Azithromycin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Benzoylecgonine	AXYS MLA-075	MLA-075			Y																	Y										
	Benztropine	AXYS MLA-075	MLA-075			Y																	Y										
	Betamethasone	AXYS MLA-075	MLA-075			Y																	Y										
	Bisphenol A	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Caffeine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Carbadox	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Carbamazepine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Cefotaxime	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Chlortetracycline (CTC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Cimetidine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Ciprofloxacin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Clarithromycin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Clinafloxacin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Clonidine	AXYS MLA-075	MLA-075			Y																	Y										
	Cloxacillin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Cocaine	AXYS MLA-075	MLA-075			Y																	Y										
	Codeine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Cotinine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	DEET (N,N-diethyl-m-toluamide)	AXYS MLA-075	MLA-075			Y																	Y										
	Dehydronifedipine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Demeclocycline	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Desmethyldiltiazem	AXYS MLA-075	MLA-075			Y																	Y										
	Diazepam	AXYS MLA-075	MLA-075			Y																	Y										
	Digoxigenin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Digoxin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Diltiazem	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Diphenhydramine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Doxycycline	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Enalapril	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Enrofloxacin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Erythromycin	AXYS MLA-075	MLA-075			Y																	Y										
	Erythromycin anydrate	EPA 1694	MLA-075											Y																	Y		
	Flumequine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Fluocinonide	AXYS MLA-075	MLA-075			Y																	Y										
	Fluoxetine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Fluticasone propionate	AXYS MLA-075	MLA-075			Y																	Y										
	Furosemide	AXYS MLA-075	MLA-075			Y																	Y										
	Gemfibrozil	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Glipizide	AXYS MLA-075	MLA-075			Y																	Y										
	Glyburide	AXYS MLA-075	MLA-075			Y																	Y										
	Hydrochlorothiazide	AXYS MLA-075	MLA-075			Y																	Y										
	Hydrocodone	AXYS MLA-075	MLA-075			Y																	Y										
	Hydrocortisone	AXYS MLA-075	MLA-075			Y																	Y										
	Ibuprofen	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Isochlortetracycline (ICTC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Lincomycin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Lomefloxacin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										

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Compound Class	Compound	Accredited Method ID	AXYS Method ID	Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
				CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Meprobamate	AXYS MLA-075	MLA-075			Y																	Y										
	Metformin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Methylprednisolone	AXYS MLA-075	MLA-075			Y																	Y										
	Metoprolol	AXYS MLA-075	MLA-075			Y																	Y										
	Miconazole	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Minocycline	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Naproxen	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Norfloxacin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Norfluoxetine	AXYS MLA-075	MLA-075			Y																	Y										
	Norgestimate	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Norverapamil	AXYS MLA-075	MLA-075			Y																	Y										
	Ofloxacin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Ormetoprim	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Oxacillin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Oxolinic acid	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Oxycodone	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Oxytetracycline (OTC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Paroxetine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Penicillin G	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Penicillin V	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Prednisolone	AXYS MLA-075	MLA-075			Y																	Y										
	Prednisone	AXYS MLA-075	MLA-075			Y																	Y										
	Promethazine	AXYS MLA-075	MLA-075			Y																	Y										
	Propoxyphene	AXYS MLA-075	MLA-075			Y																	Y										
	Propranolol	AXYS MLA-075	MLA-075			Y																	Y										
	Ranitidine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Roxithromycin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Sarafloxacin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Sertraline	AXYS MLA-075	MLA-075			Y																	Y										
	Simvastatin	AXYS MLA-075	MLA-075			Y																	Y										
	Sulfachloropyridazine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Sulfadiazine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Sulfadimethoxine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Sulfamerazine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										

Accreditation Scope

AXYS Analytical Services Ltd.
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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Sulfamethazine	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Sulfamethizole	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Sulfamethoxazole	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Sulfanilamide	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Sulfathiazole	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Tetracycline (TC)	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Theophylline	AXYS MLA-075	MLA-075			Y																	Y										
	Thiabendazole	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Trenbolone	AXYS MLA-075	MLA-075			Y																	Y										
	Trenbolone acetate	AXYS MLA-075	MLA-075			Y																	Y										
	Triamterene	AXYS MLA-075	MLA-075			Y																	Y										
	Triclocarban	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Triclosan	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Trimethoprim	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Tylosin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Valsartan	AXYS MLA-075	MLA-075			Y																	Y										
	Verapamil	AXYS MLA-075	MLA-075			Y																	Y										
	Virginiamycin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
	Warfarin	EPA 1694	MLA-075											Y																	Y		
		AXYS MLA-075	MLA-075			Y																	Y										
Targeted Metabolites	11, 14, 17-eicosatrienoic acid (eicosatrienoic acid)	AXYS MLM-001	MLM-001													Y																	
	11, 14-eicosadienoic acid	AXYS MLM-001	MLM-001													Y																	
	3-hydroxytyrosine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Acetylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Acetylornithine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Alanine	AXYS MLM-001	MLM-001		Y											Y						Y											
	alpha-Aminoadipic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	Arginine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Asparagine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Aspartate	AXYS MLM-001	MLM-001		Y											Y						Y											
	Asymmetric dimethylarginine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Butenylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Butyrylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	C22:5 ISOMER 1 (tentatively all-cis-4, 8, 12, 15, 19-docosapentaenoic acid)	AXYS MLM-001	MLM-001													Y																	
	C22:5 ISOMER 2 (all-cis-7,10,13,16,19-docosapentaenoic acid (DPA)	AXYS MLM-001	MLM-001													Y																	
	C22:5 ISOMER 3 (tentatively all-cis-4, 7, 10, 13, 16-docosapentaenoic acid)	AXYS MLM-001	MLM-001													Y																	
	Carnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Carnosine	AXYS MLM-001	MLM-001		Y											Y						Y											
	chenodeoxycholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	cholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	Citrulline	AXYS MLM-001	MLM-001		Y											Y						Y											
	Creatinine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Decadienylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	decanoic acid (capric acid)	AXYS MLM-001	MLM-001													Y																	
	Decanoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Decenoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	deoxycholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	docosahexaenoic acid (DHA)	AXYS MLM-001	MLM-001													Y																	
	docosatetraenoic acid (adrenic acid)	AXYS MLM-001	MLM-001													Y																	
	Dodecanedioylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Dodecanoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Dodecenoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Dopamine	AXYS MLM-001	MLM-001		Y											Y						Y											
	eicosapentaenoic acid (EPA)	AXYS MLM-001	MLM-001													Y																	
	Eicosatetraenoic acid (arachidonic acid)	AXYS MLM-001	MLM-001													Y																	
	eicosatrienoic acid (dihomo-γ-linolenic acid)	AXYS MLM-001	MLM-001													Y																	
	Glutaconylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Glutamate	AXYS MLM-001	MLM-001		Y											Y						Y											
	Glutamine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Glutarylcarnitine (Hydroxyhexanoylcarnitine)	AXYS MLM-001	MLM-001		Y											Y						Y											
	Glycine	AXYS MLM-001	MLM-001		Y											Y						Y											
	glycochenodeoxycholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	glycocholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	glycodeoxycholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hexadecadienylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	hexadecanoic acid (palmitic acid)	AXYS MLM-001	MLM-001													Y																	
	Hexadecanoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	hexadecenoic acid (palmitoleic acid)	AXYS MLM-001	MLM-001													Y																	
	Hexadecenoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hexanoylcarnitine (Fumarylcarnitine)	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hexenoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hexose (sum isomers)	AXYS MLM-001	MLM-001		Y											Y						Y											
	Histamine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Histidine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxyhexadecadienylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxyhexadecanoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxyhexadecenoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxylbutyrylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxyoctadecenoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxyproline	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxypropionylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxysphingomyeline C14:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxysphingomyeline C16:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxysphingomyeline C22:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxysphingomyeline C22:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxysphingomyeline C24:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxytetradecadienylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxytetradecenoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Hydroxyvalerylcarnitine (Methylmalonylcarnitine)	AXYS MLM-001	MLM-001		Y											Y						Y											
	Isoleucine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Kynurenine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Leucine	AXYS MLM-001	MLM-001		Y											Y						Y											
	lithocholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	Lysine	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C14:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C16:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C16:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C17:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C18:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C18:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C18:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C20:3	AXYS MLM-001	MLM-001		Y											Y						Y											

Accreditation Scope

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				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	lysoPhosphatidylcholine acyl C20:4	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C24:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C26:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C28:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	lysoPhosphatidylcholine acyl C28:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Methionine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Methioninesulfoxide	AXYS MLM-001	MLM-001		Y											Y						Y											
	Methylglutarylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Nitrotyrosine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Nonaylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	octadecadienoic acid (linoleic acid)	AXYS MLM-001	MLM-001													Y																	
	Octadecadienylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	octadecanoic acid (stearic acid)	AXYS MLM-001	MLM-001													Y																	
	Octadecanoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	octadecatrienoic acid (γ-linolenic acid)	AXYS MLM-001	MLM-001													Y																	
	Octadecenoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Octanoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Ornithine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phenylalanine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phenylethylamine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C30:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C30:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C30:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C32:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C32:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C34:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C34:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C34:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C34:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C36:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C36:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C36:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C36:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C36:4	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C36:5	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C38:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C38:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C38:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C38:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C38:5	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C38:6	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C40:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C40:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C40:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C40:4	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C40:5	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C40:6	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C42:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C42:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C42:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C42:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C42:4	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C42:5	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C44:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C44:4	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C44:5	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine acyl-alkyl C44:6	AXYS MLM-001	MLM-001		Y											Y						Y											

Accreditation Scope

AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 30

				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Phosphatidylcholine diacyl C24:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C26:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C28:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C30:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C30:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C32:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C32:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C32:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C32:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C34:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C34:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C34:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C34:4	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C36:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C36:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C36:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C36:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C36:4	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C36:5	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C36:6	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C38:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C38:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C38:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C38:4	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C38:5	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C38:6	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C40:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C40:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C40:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C40:4	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C40:5	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C40:6	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C42:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C42:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C42:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C42:4	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C42:5	AXYS MLM-001	MLM-001		Y											Y						Y											
	Phosphatidylcholine diacyl C42:6	AXYS MLM-001	MLM-001		Y											Y						Y											
	Pimelylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Proline	AXYS MLM-001	MLM-001		Y											Y						Y											
	Propenoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Propionylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Putrescine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Sarcosine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Serine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Serotonin	AXYS MLM-001	MLM-001		Y											Y						Y											
	Spermidine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Spermine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Sphingomyeline C16:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Sphingomyeline C16:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Sphingomyeline C18:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Sphingomyeline C18:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Sphingomyeline C20:2	AXYS MLM-001	MLM-001		Y											Y						Y											
	Sphingomyeline C22:3	AXYS MLM-001	MLM-001		Y											Y						Y											
	Sphingomyeline C24:0	AXYS MLM-001	MLM-001		Y											Y						Y											
	Sphingomyeline C24:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Sphingomyeline C26:0	AXYS MLM-001	MLM-001		Y											Y						Y											

Accreditation Scope

AXYS Analytical Services Ltd.
file ref.: ACC-101 Rev. 30

				Pulp	Serum	Solids										Tissue						Urine	Water	Water, Non-Potable									
Compound Class	Compound	Accredited Method ID	AXYS Method ID	CALA	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE	Maine DOH	ANAB	CALA	Florida DOH	Minnesota DOH	New Jersey DEP	Virginia DGS	ANAB	CALA	CALA	California DPH	Florida DOH	Minnesota DOH	New Jersey DEP	New York DOH	Virginia DGS	Washington DE *	Maine DOH	ANAB	Pennsylvania DEP
	Sphingomyeline C26:1	AXYS MLM-001	MLM-001		Y											Y						Y											
	Symmetric dimethylarginine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Taurine	AXYS MLM-001	MLM-001		Y											Y						Y											
	taurochenodeoxycholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	taurocholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	taurodeoxycholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	taurolithocholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	tauroursodexoycholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	Tetradecadienylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	tetradecanoic acid (myristic acid)	AXYS MLM-001	MLM-001													Y																	
	Tetradecanoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Tetradecenoylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Threonine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Tiglylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Total dimethylarginine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Tryptophan	AXYS MLM-001	MLM-001		Y											Y						Y											
	Tyrosine	AXYS MLM-001	MLM-001		Y											Y						Y											
	ursodexoycholic acid	AXYS MLM-001	MLM-001		Y											Y						Y											
	Valerylcarnitine	AXYS MLM-001	MLM-001		Y											Y						Y											
	Valine	AXYS MLM-001	MLM-001		Y											Y						Y											
TBBPA	Tetrabromobisphenol A	AXYS MLA-079	MLA-079		Y																												

Note*
Analysis of pesticides and PCBs in non-potable water samples by AXYS method MLA-007, with the exception of NPDES or State permitted discharges and Stormwater applications, may fall within the scope of Washington State Department of Ecology solids matrix accreditation, subject to approval of the Ecology Project Manager.

Legend

Y	Accreditation scope
YD	Accreditation scope, including US DOD scope
BFR	Brominated flame retardants (non-PBDPE)
BPA and mPE	Bisphenol A and mono-Phthalate Esters
FTS	Fluorotelomer sulfonates
HBCDD	Hexabromocyclododecane
OC Pesticides	Organochlorine Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PBDPE	Polybrominated diphenylethers
PCB	Polychlorinated Biphenyls
PCDDF	Polychlorinated dibenzodioxins/furans
PFC	Perfluorinated Compounds
PPCP	Pharmaceutical and Personal Care Products
TBBPA	Tetrabromobisphenol A
California DPH	California Department of Public Health, Lab ID 2911 (target analytes shown are those approved 2014)
Florida DOH	Florida Department of Health, Lab ID E871007, (NELAC Standard)
Pennsylvania DEP	Pennsylvania Departmnent of Environmental Protection
Minnesota DOH	Minnesota Department of Health, Lab ID 232-999-430, (NELAC Standard)
New Jersey DEP	New Jersey Department of Environmental Protection, Lab ID CANA005, (NELAC Standard)
New York DOH	New York Department of Health, Lab ID 11674, (NELAC Standard)
Washington DE	Washington Department of Ecology, Lab ID C404
Virginia DGS	Virginia Department of General Services, Division of Consolidated Laboratory Services, Lab ID 460224, (NELAC Standard)
Maine DOH	Maine Center for Disease Control and Prevention, Department of Health and Human Services, Lab ID CN00003
CALA	Canadian Association for Laboratory Accreditation Inc., Lab ID A2637, (ISO/IEC 17025:2005 Standard)
ANAB	ANSI-ASQ National Accreditation Board, certificate ADE-1861, (ISO/IEC 17025:2005 and US DOD Standards)

www.pacelabs.com

Pace Analytical Services, Inc.
1700 Elm Street
Minneapolis, MN 55414
Phone: 612.607.1700
Fax: 612.607.6444

Report Prepared for:

Nancy McDonald
Bay West, Inc.
5 Empire Drive
Saint Paul MN 55103

REPORT OF LABORATORY ANALYSIS FOR PCDD/PCDF

Report Prepared Date:

November 29, 2016

Report Information:

Pace Project #: 10367136
Sample Receipt Date: 10/21/2016
Client Project #: J160139 SLR Sediment AOCs
Client Sub PO #: 108002
State Cert #: 027-053-137

Invoicing & Reporting Options:

The report provided has been invoiced as a Level 2 PCDD/PCDF Report. If an upgrade of this report package is requested, an additional charge may be applied.

Please review the attached invoice for accuracy and forward any questions to Carolynne Trout, your Pace Project Manager.

This report has been reviewed by:

Carolynne Trout

November 29, 2016
Carolynne Trout, Project Manager
(612) 607-6351
(612) 607-6444 (fax)
Carolynne.Trout@pacelabs.com

Report of Laboratory Analysis

DISCUSSION

This report presents the results from the analyses performed on seven samples submitted by a representative of BayWest, Inc. The samples were analyzed for the presence or absence of polychlorodibenzo-p-dioxins (PCDDs) and polychlorodibenzofurans (PCDFs) using a modified version of USEPA Method 8290. The reporting limits were based on signal-to-noise measurements. Estimated Maximum Possible Concentration (EMPC) values were treated as positives in the toxic equivalence calculations. This report was revised to exclude results from a second analysis of sample BW16TR-008-0.0-0.15.

Second column confirmation analyses of 2,3,7,8-TCDF values obtained from the primary (DB5-MS) column are performed only when specifically requested for a project and only when the values are above the concentration of the lowest calibration standard. Typical resolution for this isomer using the DB5-MS column ranges from 25-30%.

The recoveries of the isotopically-labeled PCDD/PCDF internal standards in the sample extracts ranged from 53-99%. All of the labeled standard recoveries obtained for this project were within the 40-135% target range specified in Method 8290. Also, since the quantification of the native 2,3,7,8-substituted congeners was based on isotope dilution, the data were automatically corrected for variation in recovery and accurate values were obtained.

Values were flagged "I" where incorrect isotope ratios were obtained and "P" where diphenylethers were present at the elution times of PCDFs. Concentrations below the calibration range were flagged "J" and should be regarded as estimates. Levels above the calibration range were flagged "E" and should be regarded as estimated concentrations.

A laboratory method blank was prepared and analyzed with the sample batch as part of our routine quality control procedures. The results show the blank to contain trace levels of selected congeners. These levels were below the calibration range of the method. The levels reported for the affected congeners in the field samples were higher than the corresponding blank levels by one or more orders of magnitude. These results indicate that the sample processing steps did not contribute significantly to the levels reported for the field samples.

A laboratory spike sample was also prepared with the sample batch using clean reference matrix that had been fortified with native standard materials. The results show that the spiked native compounds were recovered at 85-114%. These values were within the target range for this method. Matrix spikes were prepared using sample material from a separate project. Results are available upon request.

Minnesota Laboratory Certifications

Authority	Certificate #	Authority	Certificate #
A2LA	2926.01	Mississippi	MN00064
Alabama	40770	Montana	92
Alaska	MN00064	Nebraska	NE-OS-18-06
Arizona	AZ0014	Nevada	MN_00064_200
Arkansas	88-0680	New Jersey (NE	MN002
California	01155CA	New York (NEL	11647
Colorado	MN00064	North Carolina	27700
Connecticut	PH-0256	North Dakota	R-036
EPA Region 8	8TMS-Q	Ohio	4150
Florida (NELAP	E87605	Oklahoma	D9922
Georgia (DNR)	959	Oregon (ELAP)	MN200001-005
Guam	959	Oregon (OREL	MN300001-001
Hawaii	SLD	Pennsylvania	68-00563
Idaho	MN00064	Puerto Rico	MN00064
Illinois	200012	Saipan	MP0003
Indiana	C-MN-01	South Carolina	74003001
Indiana	C-MN-01	Tennessee	TN02818
Iowa	368	Texas	T104704192-08
Kansas	E-10167	Utah (NELAP)	MN00064
Kentucky	90062	Virginia	00251
Louisiana	03086	Washington	C755
Maine	2007029	West Virginia #	9952C
Maryland	322	West Virginia D	382
Michigan	9909	Wisconsin	999407970
Minnesota	027-053-137	Wyoming	8TMS-Q

Appendix A

Sample Management

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Section A
Required Client Information:

Company: Bay West, LLC
Address: 5 Empire Drive
St. Paul, MN 55103
Email To: mgarton@glec.com
Phone: 231-941-2230
Requested Due Date/TAT: Standard

Section B
Required Project Information:

Report To: Mailee Garton - Great Lake Environmental Center
Copy To: Paul Raymaker - Bay West
Nancy McDonald - Bay West
Purchase Order No.: 108002
Project Name: SLR Sediment AOCs
Project Number: J160139

Section C
Invoice Information:

Attention: Accounts Payable
Company Name: Bay West, LLC
Address: 5 Empire Drive
Lab Quote Reference: 3000017136
Lab Project Manager: Oyeyemi Odujole

Section D
EQuIS Information:

Facility_Name: St. Louis River Sediment Areas of Concern
Facility_Code: St Louis River Sed
Facility_ID: 547023
Subfacility_code:

Page 1 of 1
COC# SLR-ToxBio-02
Site Location STATE: MN

Section E
Required Client Information

Valid Matrix Codes

MATRIX	CODE
Drinking Water	DW
Water	W
Waste Water	WW
Product	P
Soil/Solid	SO
Oil	OL
Wipe	WP
Air	AR
Tissue	TS
Other	OT

Requested Analysis

ITEM #	Sample Location ID (sys_loc_code)	Sample ID (sys_sample_code)	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	Collection DATE	Collection Time	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Dioxins and furans (SW-846 8290A)	Mercury (7471B)	% Moisture	TOC (SW-846 9060A Quad Burn)	Comments
Ex	BW15MLW-005	BW14MLW-005-0-0.15	SO	G		1204														
1	BW16SR-004	BW16SR-004-0.0-0.15	SO	G	10/20/16	10:00	4									x	x	x	x	001
2	BW16SR-016	BW16SR-016-0.15-0.60	SO	G	10/20/16	10:00	4									x	x	x	x	002
3	BW16TR-008	BW16TR-008-0.0-0.15	SO	G	10/20/16	10:00	4									x	x	x	x	003
4	BW16TR-013	BW16TR-013-0.0-0.15	SO	G	10/20/16	10:00	4									x	x	x	x	004
5	BW16TR-017	BW16TR-017-0.0-0.15	SO	G	10/20/16	10:00	4									x	x	x	x	005
6	BW16TR-018	BW16TR-018-0.0-0.15	SO	G	10/20/16	10:00	4									x	x	x	x	006
7	BW16BLR-001	BW16BLR-001-0.0-0.15	SO	G	10/20/16	10:00	~~4~~ 5 mw 10/20/16									x	x	x	x	— Separate Cooler 007
8																				
9																				
10																				
11																				
12																				

Ref: pace.tox lab
Dep:
Date: 20Oct16
Wgt: 5.00 LBS
DV: 0.00
SHIPPING: 6.13
SPECIAL: 0.00
HANDLING: 0.00
TOTAL: 6.13
Svcs: PRIORITY OVERNIGHT
TRCK: 9802 5316 5172

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	Temp (°C)	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
Reference Pace Subcontractor Order Form signed by Pace on 9/16/16	Mailee Garton/GLEC	10/20/16	14:00	PACE	10/21/16	9:45	0.7 0.6	Y	N	Y

SAMPLE CONDITIONS

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: Mailee Garton
SIGNATURE of SAMPLER: Mailee Garton
DATE Signed (MM/DD/YY): 10/20/16

Pace Analytical	Document Name: **Sample Condition Upon Receipt Form**	Document Revised: 02Aug2016 Page 1 of 2
	Document No.: **F-MN-L-213-rev.17**	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Bay West LLC

Project #: WO#:10367136 10367136

Courier: ☑ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace ☐ SpeeDee ☐ Other:________

Tracking Number: 9802 5318 5161, 9802 5318 5172

Optional: Proj. Due Date: Proj. Name:

Custody Seal on Cooler/Box Present? ☑ Yes ☐ No **Seals Intact?** ☑ Yes ☐ No

Packing Material: ☐ Bubble Wrap ☑ Bubble Bags ☐ None ☐ Other:________ **Temp Blank?** ☑ Yes ☐ No

Thermometer Used: ☑ 151401163 ☐ 151401164 ☐ B88A912167504 ☐ B88A0143310098 **Type of Ice:** ☑ Wet ☐ Blue ☐ None ☐ Samples on ice, cooling process has begun

Cooler Temp Read (°C): 0.6,0.7 **Cooler Temp Corrected (°C):** 0.8,0.9 **Biological Tissue Frozen?** ☐ Yes ☐ No ☑ N/A

Temp should be above freezing to 6°C **Correction Factor:** +0.2 **Date and Initials of Person Examining Contents:** BC 10/21/16

USDA Regulated Soil (☐ N/A, water sample)

Did samples originate in a quarantine zone within the United States: AL, AR, AZ, CA, FL, GA, ID, LA, MS, NC, NM, NY, OK, OR, SC, TN, TX or VA (check maps)? ☐ Yes ☑ No

Did samples originate from a foreign source (internationally, including Hawaii and Puerto Rico)? ☐ Yes ☑ No

If Yes to either question, fill out a Regulated Soil Checklist (F-MN-Q-338) and include with SCUR/COC paperwork.

				COMMENTS:
Chain of Custody Present?	☑ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out?	☑ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished?	☑ Yes	☐ No	☐ N/A	3.
Sampler Name and/or Signature on COC?	☑ Yes	☐ No	☐ N/A	4.
Samples Arrived within Hold Time?	☑ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72 hr)?	☐ Yes	☑ No	☐ N/A	6.
Rush Turn Around Time Requested?	☐ Yes	☑ No	☐ N/A	7.
Sufficient Volume?	☑ Yes	☐ No	☐ N/A	8.
Correct Containers Used?	☑ Yes	☐ No	☐ N/A	9.
-Pace Containers Used?	☑ Yes	☐ No	☐ N/A	
Containers Intact?	☑ Yes	☐ No	☐ N/A	10.
Filtered Volume Received for Dissolved Tests?	☐ Yes	☐ No	☑ N/A	11. Note if sediment is visible in the dissolved container
Sample Labels Match COC? -Includes Date/Time/ID/Analysis Matrix: SL	☑ Yes	☐ No	☐ N/A	12.
All containers needing acid/base preservation have been checked?	☐ Yes	☐ No	☑ N/A	13. ☐ HNO_3 ☐ H_2SO_4 ☐ NaOH ☐ HCl Sample #
All containers needing preservation are found to be in compliance with EPA recommendation? (HNO_3, H_2SO_4, HCl<2; NaOH >9 Sulfide, NaOH>12 Cyanide)	☐ Yes	☐ No	☑ N/A	
Exceptions: VOA, Coliform, TOC, Oil and Grease, DRO/8015 (water) DOC	☐ Yes	☐ No	☑ N/A	Initial when completed:_____ Lot # of added preservative:_____
Headspace in VOA Vials (>6mm)?	☐ Yes	☐ No	☑ N/A	14.
Trip Blank Present?	☐ Yes	☐ No	☑ N/A	15.
Trip Blank Custody Seals Present?	☐ Yes	☐ No	☑ N/A	
Pace Trip Blank Lot # (if purchased):_____				

CLIENT NOTIFICATION/RESOLUTION **Field Data Required?** ☐ Yes ☐ No

Person Contacted:________ Date/Time:________

Comments/Resolution:________

Project Manager Review: Carolynne Trout **Date:** 10/24/16

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers).

Reporting Flags

A = Reporting Limit based on signal to noise

B = Less than 10x higher than method blank level

C = Result obtained from confirmation analysis

D = Result obtained from analysis of diluted sample

E = Exceeds calibration range

I = Interference present

J = Estimated value

Nn = Value obtained from additional analysis

P = PCDE Interference

R = Recovery outside target range

S = Peak saturated

U = Analyte not detected

V = Result verified by confirmation analysis

X = %D Exceeds limits

Y = Calculated using average of daily RFs

* = See Discussion

Appendix B

Sample Analysis Summary

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16SR-004-0.0-0.15		
Lab Sample ID	10367136001		
Filename	F161101B_11		
Injected By	SMT		
Total Amount Extracted	18.6 g	Matrix	Solid
% Moisture	58.7	Dilution	NA
Dry Weight Extracted	7.68 g	Collected	10/20/2016 10:00
ICAL ID	F161011	Received	10/21/2016 09:45
CCal Filename(s)	F161101B_03 & F161101B_19	Extracted	10/27/2016 16:25
Method Blank ID	BLANK-52558	Analyzed	11/01/2016 21:43

Native Isomers	Conc ng/Kg	EMPC ng/Kg	EDL ng/Kg		Internal Standards	ng's Added	Percent Recovery
2,3,7,8-TCDF	15.0	----	0.29		2,3,7,8-TCDF-13C	2.00	80
Total TCDF	43.0	----	0.29		2,3,7,8-TCDD-13C	2.00	89
					1,2,3,7,8-PeCDF-13C	2.00	80
2,3,7,8-TCDD	3.5	----	0.21		2,3,4,7,8-PeCDF-13C	2.00	73
Total TCDD	22.0	----	0.21		1,2,3,7,8-PeCDD-13C	2.00	79
					1,2,3,4,7,8-HxCDF-13C	2.00	93
1,2,3,7,8-PeCDF	----	1.2	0.13	IJ	1,2,3,6,7,8-HxCDF-13C	2.00	77
2,3,4,7,8-PeCDF	3.6	----	0.21	J	2,3,4,6,7,8-HxCDF-13C	2.00	86
Total PeCDF	58.0	----	0.17		1,2,3,7,8,9-HxCDF-13C	2.00	81
					1,2,3,4,7,8-HxCDD-13C	2.00	80
1,2,3,7,8-PeCDD	4.2	----	0.22	J	1,2,3,6,7,8-HxCDD-13C	2.00	66
Total PeCDD	51.0	----	0.22		1,2,3,4,6,7,8-HpCDF-13C	2.00	60
					1,2,3,4,7,8,9-HpCDF-13C	2.00	61
1,2,3,4,7,8-HxCDF	----	15.0	4.70	P	1,2,3,4,6,7,8-HpCDD-13C	2.00	72
1,2,3,6,7,8-HxCDF	19.0	----	0.82		OCDD-13C	4.00	67
2,3,4,6,7,8-HxCDF	7.9	----	0.29				
1,2,3,7,8,9-HxCDF	3.8	----	0.37	J	1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	560.0	----	1.60		1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	7.4	----	0.37		2,3,7,8-TCDD-37Cl4	0.20	87
1,2,3,6,7,8-HxCDD	55.0	----	0.72				
1,2,3,7,8,9-HxCDD	16.0	----	0.44				
Total HxCDD	350.0	----	0.51				
1,2,3,4,6,7,8-HpCDF	870.0	----	0.74				
1,2,3,4,7,8,9-HpCDF	15.0	----	0.84				
Total HpCDF	1900.0	----	0.79				
1,2,3,4,6,7,8-HpCDD	990.0	----	2.40				
Total HpCDD	2000.0	----	2.40				
OCDF	860.0	----	0.56				
OCDD	11000.0	----	0.39	E			

Total 2,3,7,8-TCDD
Equivalence: 45 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
P = PCDE Interference
E = Exceeds calibration range
I = Interference present

REPORT OF LABORATORY ANALYSIS

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16SR-016-0.15-0.60		
Lab Sample ID	10367136002		
Filename	F161101B_12		
Injected By	SMT		
Total Amount Extracted	17.5 g	Matrix	Solid
% Moisture	44.5	Dilution	NA
Dry Weight Extracted	9.71 g	Collected	10/20/2016 10:00
ICAL ID	F161011	Received	10/21/2016 09:45
CCal Filename(s)	F161101B_03 & F161101B_19	Extracted	10/27/2016 16:25
Method Blank ID	BLANK-52558	Analyzed	11/01/2016 22:31

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg		**Internal Standards**	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF	12.0	—	0.70		2,3,7,8-TCDF-13C	2.00	79
Total TCDF	68.0	—	0.70		2,3,7,8-TCDD-13C	2.00	86
					1,2,3,7,8-PeCDF-13C	2.00	74
2,3,7,8-TCDD	6.1	—	0.34		2,3,4,7,8-PeCDF-13C	2.00	63
Total TCDD	53.0	—	0.34		1,2,3,7,8-PeCDD-13C	2.00	70
					1,2,3,4,7,8-HxCDF-13C	2.00	83
1,2,3,7,8-PeCDF	—	7.2	0.24	P	1,2,3,6,7,8-HxCDF-13C	2.00	78
2,3,4,7,8-PeCDF	17.0	—	0.40		2,3,4,6,7,8-HxCDF-13C	2.00	85
Total PeCDF	240.0	—	0.32		1,2,3,7,8,9-HxCDF-13C	2.00	82
					1,2,3,4,7,8-HxCDD-13C	2.00	81
1,2,3,7,8-PeCDD	23.0	—	0.13		1,2,3,6,7,8-HxCDD-13C	2.00	61
Total PeCDD	190.0	—	0.13		1,2,3,4,6,7,8-HpCDF-13C	2.00	62
					1,2,3,4,7,8,9-HpCDF-13C	2.00	59
1,2,3,4,7,8-HxCDF	72.0	—	0.58		1,2,3,4,6,7,8-HpCDD-13C	2.00	74
1,2,3,6,7,8-HxCDF	110.0	—	0.80		OCDD-13C	4.00	61
2,3,4,6,7,8-HxCDF	19.0	—	0.53				
1,2,3,7,8,9-HxCDF	11.0	—	0.66		1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	2500.0	—	0.64		1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	17.0	—	0.82		2,3,7,8-TCDD-37Cl4	0.20	82
1,2,3,6,7,8-HxCDD	100.0	—	0.84				
1,2,3,7,8,9-HxCDD	67.0	—	0.71				
Total HxCDD	900.0	—	0.79				
1,2,3,4,6,7,8-HpCDF	4300.0	—	0.37	E			
1,2,3,4,7,8,9-HpCDF	34.0	—	2.90				
Total HpCDF	8300.0	—	1.70	E			
1,2,3,4,6,7,8-HpCDD	850.0	—	1.40				
Total HpCDD	1700.0	—	1.40				
OCDF	2000.0	—	0.48				
OCDD	6700.0	—	0.28				

Total 2,3,7,8-TCDD
Equivalence: 130 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
P = PCDE Interference
E = Exceeds calibration range

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16TR-008-0.0-0.15		
Lab Sample ID	10367136003		
Filename	F161101B_13		
Injected By	SMT		
Total Amount Extracted	18.2 g	Matrix	Solid
% Moisture	42.4	Dilution	NA
Dry Weight Extracted	10.5 g	Collected	10/20/2016 10:00
ICAL ID	F161011	Received	10/21/2016 09:45
CCal Filename(s)	F161101B_03 & F161101B_19	Extracted	10/27/2016 16:25
Method Blank ID	BLANK-52558	Analyzed	11/01/2016 23:19

Native Isomers	Conc ng/Kg	EMPC ng/Kg	EDL ng/Kg	
2,3,7,8-TCDF	0.74	——	0.49	J
Total TCDF	2.50	——	0.49	
2,3,7,8-TCDD	ND	——	0.54	
Total TCDD	2.20	——	0.54	
1,2,3,7,8-PeCDF	ND	——	0.44	
2,3,4,7,8-PeCDF	0.97	——	0.35	J
Total PeCDF	9.40	——	0.40	
1,2,3,7,8-PeCDD	0.35	——	0.31	J
Total PeCDD	26.00	——	0.31	
1,2,3,4,7,8-HxCDF	3.30	——	0.51	J
1,2,3,6,7,8-HxCDF	3.30	——	0.26	J
2,3,4,6,7,8-HxCDF	2.20	——	0.28	J
1,2,3,7,8,9-HxCDF	——	0.82	0.25	IJ
Total HxCDF	150.00	——	0.32	
1,2,3,4,7,8-HxCDD	ND	——	0.50	
1,2,3,6,7,8-HxCDD	75.00	——	0.60	
1,2,3,7,8,9-HxCDD	26.00	——	0.37	
Total HxCDD	520.00	——	0.49	
1,2,3,4,6,7,8-HpCDF	260.00	——	0.33	
1,2,3,4,7,8,9-HpCDF	2.00	——	0.31	J
Total HpCDF	470.00	——	0.32	
1,2,3,4,6,7,8-HpCDD	91.00	——	0.39	
Total HpCDD	190.00	——	0.39	
OCDF	87.00	——	0.20	
OCDD	320.00	——	0.21	

Internal Standards	ng's Added	Percent Recovery
2,3,7,8-TCDF-13C	2.00	74
2,3,7,8-TCDD-13C	2.00	82
1,2,3,7,8-PeCDF-13C	2.00	78
2,3,4,7,8-PeCDF-13C	2.00	71
1,2,3,7,8-PeCDD-13C	2.00	74
1,2,3,4,7,8-HxCDF-13C	2.00	84
1,2,3,6,7,8-HxCDF-13C	2.00	76
2,3,4,6,7,8-HxCDF-13C	2.00	83
1,2,3,7,8,9-HxCDF-13C	2.00	77
1,2,3,4,7,8-HxCDD-13C	2.00	79
1,2,3,6,7,8-HxCDD-13C	2.00	59
1,2,3,4,6,7,8-HpCDF-13C	2.00	58
1,2,3,4,7,8,9-HpCDF-13C	2.00	59
1,2,3,4,6,7,8-HpCDD-13C	2.00	66
OCDD-13C	4.00	55
1,2,3,4-TCDD-13C	2.00	NA
1,2,3,7,8,9-HxCDD-13C	2.00	NA
2,3,7,8-TCDD-37Cl4	0.20	78

Total 2,3,7,8-TCDD
Equivalence: 16 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16TR-013-0.0-0.15		
Lab Sample ID	10367136004		
Filename	F161101B_14		
Injected By	SMT		
Total Amount Extracted	18.9 g	Matrix	Solid
% Moisture	53.5	Dilution	NA
Dry Weight Extracted	8.79 g	Collected	10/20/2016 10:00
ICAL ID	F161011	Received	10/21/2016 09:45
CCal Filename(s)	F161101B_03 & F161101B_19	Extracted	10/27/2016 16:25
Method Blank ID	BLANK-52558	Analyzed	11/02/2016 00:07

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg		**Internal Standards**	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF	1.40	—	0.42		2,3,7,8-TCDF-13C	2.00	75
Total TCDF	5.60	—	0.42		2,3,7,8-TCDD-13C	2.00	83
					1,2,3,7,8-PeCDF-13C	2.00	79
2,3,7,8-TCDD	ND	—	0.31		2,3,4,7,8-PeCDF-13C	2.00	74
Total TCDD	6.40	—	0.31		1,2,3,7,8-PeCDD-13C	2.00	74
					1,2,3,4,7,8-HxCDF-13C	2.00	83
1,2,3,7,8-PeCDF	0.78	—	0.32	J	1,2,3,6,7,8-HxCDF-13C	2.00	79
2,3,4,7,8-PeCDF	1.20	—	0.39	J	2,3,4,6,7,8-HxCDF-13C	2.00	85
Total PeCDF	16.00	—	0.35		1,2,3,7,8,9-HxCDF-13C	2.00	78
					1,2,3,4,7,8-HxCDD-13C	2.00	75
1,2,3,7,8-PeCDD	—	0.80	0.53	IJ	1,2,3,6,7,8-HxCDD-13C	2.00	62
Total PeCDD	9.70	—	0.53		1,2,3,4,6,7,8-HpCDF-13C	2.00	58
					1,2,3,4,7,8,9-HpCDF-13C	2.00	59
1,2,3,4,7,8-HxCDF	4.00	—	0.98	J	1,2,3,4,6,7,8-HpCDD-13C	2.00	66
1,2,3,6,7,8-HxCDF	8.90	—	0.36		OCDD-13C	4.00	57
2,3,4,6,7,8-HxCDF	2.80	—	0.36	J			
1,2,3,7,8,9-HxCDF	—	0.86	0.65	IJ	1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	190.00	—	0.59		1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	0.73	—	0.29	J	2,3,7,8-TCDD-37Cl4	0.20	77
1,2,3,6,7,8-HxCDD	6.10	—	0.26				
1,2,3,7,8,9-HxCDD	2.30	—	0.34	J			
Total HxCDD	55.00	—	0.30				
1,2,3,4,6,7,8-HpCDF	320.00	—	0.53		Total 2,3,7,8-TCDD		
1,2,3,4,7,8,9-HpCDF	2.30	—	0.50	J	Equivalence: 8.4 ng/Kg		
Total HpCDF	600.00	—	0.51		(Using 2005 WHO Factors)		
1,2,3,4,6,7,8-HpCDD	85.00	—	0.83				
Total HpCDD	190.00	—	0.83				
OCDF	160.00	—	0.19				
OCDD	1100.00	—	0.28				

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16TR-017-0.0-0.15		
Lab Sample ID	10367136005		
Filename	F161101B_15		
Injected By	SMT		
Total Amount Extracted	18.8 g	Matrix	Solid
% Moisture	58.9	Dilution	NA
Dry Weight Extracted	7.73 g	Collected	10/20/2016 10:00
ICAL ID	F161011	Received	10/21/2016 09:45
CCal Filename(s)	F161101B_03 & F161101B_19	Extracted	10/27/2016 16:25
Method Blank ID	BLANK-52558	Analyzed	11/02/2016 00:56

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg		**Internal Standards**	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF	2.10	----	0.30		2,3,7,8-TCDF-13C	2.00	79
Total TCDF	9.70	----	0.30		2,3,7,8-TCDD-13C	2.00	89
					1,2,3,7,8-PeCDF-13C	2.00	85
2,3,7,8-TCDD	----	0.35	0.20	IJ	2,3,4,7,8-PeCDF-13C	2.00	81
Total TCDD	5.10	----	0.20		1,2,3,7,8-PeCDD-13C	2.00	83
					1,2,3,4,7,8-HxCDF-13C	2.00	89
1,2,3,7,8-PeCDF	0.57	----	0.30	J	1,2,3,6,7,8-HxCDF-13C	2.00	85
2,3,4,7,8-PeCDF	0.84	----	0.22	J	2,3,4,6,7,8-HxCDF-13C	2.00	91
Total PeCDF	14.00	----	0.26		1,2,3,7,8,9-HxCDF-13C	2.00	85
					1,2,3,4,7,8-HxCDD-13C	2.00	81
1,2,3,7,8-PeCDD	0.65	----	0.37	J	1,2,3,6,7,8-HxCDD-13C	2.00	65
Total PeCDD	12.00	----	0.37		1,2,3,4,6,7,8-HpCDF-13C	2.00	60
					1,2,3,4,7,8,9-HpCDF-13C	2.00	62
1,2,3,4,7,8-HxCDF	2.80	----	0.41	J	1,2,3,4,6,7,8-HpCDD-13C	2.00	69
1,2,3,6,7,8-HxCDF	4.40	----	0.35	J	OCDD-13C	4.00	59
2,3,4,6,7,8-HxCDF	1.80	----	0.50	J			
1,2,3,7,8,9-HxCDF	0.88	----	0.39	J	1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	90.00	----	0.41		1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	0.67	----	0.33	J	2,3,7,8-TCDD-37Cl4	0.20	82
1,2,3,6,7,8-HxCDD	5.20	----	0.30	J			
1,2,3,7,8,9-HxCDD	2.30	----	0.26	J			
Total HxCDD	47.00	----	0.30				
1,2,3,4,6,7,8-HpCDF	140.00	----	0.48				
1,2,3,4,7,8,9-HpCDF	1.80	----	0.33	J			
Total HpCDF	280.00	----	0.40				
1,2,3,4,6,7,8-HpCDD	95.00	----	0.66				
Total HpCDD	220.00	----	0.66				
OCDF	100.00	----	0.50				
OCDD	1300.00	----	0.30				

Total 2,3,7,8-TCDD
Equivalence: 6.1 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16TR-018-0.0-0.15		
Lab Sample ID	10367136006		
Filename	F161101B_16		
Injected By	SMT		
Total Amount Extracted	18.6 g	Matrix	Solid
% Moisture	49.9	Dilution	NA
Dry Weight Extracted	9.32 g	Collected	10/20/2016 10:00
ICAL ID	F161011	Received	10/21/2016 09:45
CCal Filename(s)	F161101B_03 & F161101B_19	Extracted	10/27/2016 16:25
Method Blank ID	BLANK-52558	Analyzed	11/02/2016 01:44

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg	
2,3,7,8-TCDF	1.20	----	0.26	
Total TCDF	5.00	----	0.26	
2,3,7,8-TCDD	----	0.30	0.27	IJ
Total TCDD	5.60	----	0.27	
1,2,3,7,8-PeCDF	0.49	----	0.29	J
2,3,4,7,8-PeCDF	0.91	----	0.25	J
Total PeCDF	12.00	----	0.27	
1,2,3,7,8-PeCDD	----	0.62	0.26	IJ
Total PeCDD	8.70	----	0.26	
1,2,3,4,7,8-HxCDF	2.60	----	0.42	J
1,2,3,6,7,8-HxCDF	5.60	----	0.60	
2,3,4,6,7,8-HxCDF	1.70	----	0.50	J
1,2,3,7,8,9-HxCDF	----	0.62	0.35	IJ
Total HxCDF	140.00	----	0.47	
1,2,3,4,7,8-HxCDD	0.53	----	0.26	J
1,2,3,6,7,8-HxCDD	5.30	----	0.27	J
1,2,3,7,8,9-HxCDD	2.20	----	0.30	J
Total HxCDD	44.00	----	0.28	
1,2,3,4,6,7,8-HpCDF	230.00	----	0.32	
1,2,3,4,7,8,9-HpCDF	1.60	----	0.40	J
Total HpCDF	440.00	----	0.36	
1,2,3,4,6,7,8-HpCDD	74.00	----	0.40	
Total HpCDD	160.00	----	0.40	
OCDF	130.00	----	0.51	
OCDD	910.00	----	0.38	

Internal Standards	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF-13C	2.00	75
2,3,7,8-TCDD-13C	2.00	83
1,2,3,7,8-PeCDF-13C	2.00	78
2,3,4,7,8-PeCDF-13C	2.00	71
1,2,3,7,8-PeCDD-13C	2.00	76
1,2,3,4,7,8-HxCDF-13C	2.00	85
1,2,3,6,7,8-HxCDF-13C	2.00	74
2,3,4,6,7,8-HxCDF-13C	2.00	83
1,2,3,7,8,9-HxCDF-13C	2.00	78
1,2,3,4,7,8-HxCDD-13C	2.00	72
1,2,3,6,7,8-HxCDD-13C	2.00	61
1,2,3,4,6,7,8-HpCDF-13C	2.00	55
1,2,3,4,7,8,9-HpCDF-13C	2.00	55
1,2,3,4,6,7,8-HpCDD-13C	2.00	64
OCDD-13C	4.00	53
1,2,3,4-TCDD-13C	2.00	NA
1,2,3,7,8,9-HxCDD-13C	2.00	NA
2,3,7,8-TCDD-37Cl4	0.20	76

Total 2,3,7,8-TCDD
Equivalence: 6.5 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present

Method 8290 Sample Analysis Results

Client - Bay West, Inc.

Client's Sample ID	BW16BLR-001-0.0-0.15		
Lab Sample ID	10367136007		
Filename	F161101B_17		
Injected By	SMT		
Total Amount Extracted	21.4 g	Matrix	Solid
% Moisture	82.6	Dilution	NA
Dry Weight Extracted	3.72 g	Collected	10/20/2016 10:00
ICAL ID	F161011	Received	10/21/2016 09:45
CCal Filename(s)	F161101B_03 & F161101B_19	Extracted	10/27/2016 16:25
Method Blank ID	BLANK-52558	Analyzed	11/02/2016 02:32

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg		**Internal Standards**	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF	1.70	----	0.59	J	2,3,7,8-TCDF-13C	2.00	87
Total TCDF	14.00	----	0.59		2,3,7,8-TCDD-13C	2.00	94
					1,2,3,7,8-PeCDF-13C	2.00	91
2,3,7,8-TCDD	ND	----	0.47		2,3,4,7,8-PeCDF-13C	2.00	84
Total TCDD	0.82	----	0.47	J	1,2,3,7,8-PeCDD-13C	2.00	89
					1,2,3,4,7,8-HxCDF-13C	2.00	95
1,2,3,7,8-PeCDF	0.75	----	0.49	J	1,2,3,6,7,8-HxCDF-13C	2.00	93
2,3,4,7,8-PeCDF	----	0.97	0.34	IJ	2,3,4,6,7,8-HxCDF-13C	2.00	99
Total PeCDF	9.00	----	0.41	J	1,2,3,7,8,9-HxCDF-13C	2.00	92
					1,2,3,4,7,8-HxCDD-13C	2.00	85
1,2,3,7,8-PeCDD	0.47	----	0.43	J	1,2,3,6,7,8-HxCDD-13C	2.00	74
Total PeCDD	1.80	----	0.43	J	1,2,3,4,6,7,8-HpCDF-13C	2.00	65
					1,2,3,4,7,8,9-HpCDF-13C	2.00	68
1,2,3,4,7,8-HxCDF	----	0.69	0.41	IJ	1,2,3,4,6,7,8-HpCDD-13C	2.00	75
1,2,3,6,7,8-HxCDF	0.83	----	0.42	J	OCDD-13C	4.00	59
2,3,4,6,7,8-HxCDF	----	0.68	0.41	IJ			
1,2,3,7,8,9-HxCDF	ND	----	0.70		1,2,3,4-TCDD-13C	2.00	NA
Total HxCDF	6.60	----	0.48	J	1,2,3,7,8,9-HxCDD-13C	2.00	NA
1,2,3,4,7,8-HxCDD	----	0.46	0.45	IJ	2,3,7,8-TCDD-37Cl4	0.20	87
1,2,3,6,7,8-HxCDD	----	1.00	0.50	IJ			
1,2,3,7,8,9-HxCDD	1.10	----	0.42	J			
Total HxCDD	12.00	----	0.46	J			
1,2,3,4,6,7,8-HpCDF	3.50	----	0.50	J			
1,2,3,4,7,8,9-HpCDF	ND	----	0.64				
Total HpCDF	5.50	----	0.57	J			
1,2,3,4,6,7,8-HpCDD	14.00	----	0.37				
Total HpCDD	28.00	----	0.37				
OCDF	5.40	----	0.71	J			
OCDD	89.00	----	0.74				

Total 2,3,7,8-TCDD
Equivalence: 1.6 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

ND = Not Detected
NA = Not Applicable
NC = Not Calculated

Results reported on a dry weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present

Method 8290 Blank Analysis Results

Lab Sample ID	BLANK-52558	Matrix	Solid
Filename	U161101B_15	Dilution	NA
Total Amount Extracted	20.4 g	Extracted	10/27/2016 16:25
ICAL ID	U161025	Analyzed	11/02/2016 01:42
CCal Filename(s)	U161101B_03 & U161101B_19	Injected By	SMT

Native Isomers	**Conc** ng/Kg	**EMPC** ng/Kg	**EDL** ng/Kg	
2,3,7,8-TCDF	ND	-----	0.031	
Total TCDF	ND	-----	0.031	
2,3,7,8-TCDD	ND	-----	0.033	
Total TCDD	0.042	-----	0.033	J
1,2,3,7,8-PeCDF	ND	-----	0.039	
2,3,4,7,8-PeCDF	ND	-----	0.023	
Total PeCDF	ND	-----	0.031	
1,2,3,7,8-PeCDD	ND	-----	0.029	
Total PeCDD	ND	-----	0.029	
1,2,3,4,7,8-HxCDF	ND	-----	0.027	
1,2,3,6,7,8-HxCDF	ND	-----	0.023	
2,3,4,6,7,8-HxCDF	ND	-----	0.021	
1,2,3,7,8,9-HxCDF	ND	-----	0.026	
Total HxCDF	ND	-----	0.024	
1,2,3,4,7,8-HxCDD	ND	-----	0.036	
1,2,3,6,7,8-HxCDD	ND	-----	0.035	
1,2,3,7,8,9-HxCDD	ND	-----	0.037	
Total HxCDD	ND	-----	0.036	
1,2,3,4,6,7,8-HpCDF	ND	-----	0.036	
1,2,3,4,7,8,9-HpCDF	ND	-----	0.038	
Total HpCDF	ND	-----	0.037	
1,2,3,4,6,7,8-HpCDD	-----	0.046	0.028	IJ
Total HpCDD	0.076	-----	0.028	J
OCDF	ND	-----	0.055	
OCDD	-----	0.170	0.061	IJ

Internal Standards	**ng's Added**	**Percent Recovery**
2,3,7,8-TCDF-13C	2.00	75
2,3,7,8-TCDD-13C	2.00	92
1,2,3,7,8-PeCDF-13C	2.00	85
2,3,4,7,8-PeCDF-13C	2.00	80
1,2,3,7,8-PeCDD-13C	2.00	99
1,2,3,4,7,8-HxCDF-13C	2.00	76
1,2,3,6,7,8-HxCDF-13C	2.00	74
2,3,4,6,7,8-HxCDF-13C	2.00	78
1,2,3,7,8,9-HxCDF-13C	2.00	78
1,2,3,4,7,8-HxCDD-13C	2.00	84
1,2,3,6,7,8-HxCDD-13C	2.00	70
1,2,3,4,6,7,8-HpCDF-13C	2.00	75
1,2,3,4,7,8,9-HpCDF-13C	2.00	79
1,2,3,4,6,7,8-HpCDD-13C	2.00	90
OCDD-13C	4.00	75
1,2,3,4-TCDD-13C	2.00	NA
1,2,3,7,8,9-HxCDD-13C	2.00	NA
2,3,7,8-TCDD-37Cl4	0.20	84

Total 2,3,7,8-TCDD
Equivalence: 0.00051 ng/Kg
(Using 2005 WHO Factors)

Conc = Concentration (Totals include 2,3,7,8-substituted isomers).
EMPC = Estimated Maximum Possible Concentration
EDL = Estimated Detection Limit

Results reported on a total weight basis and are valid to no more than 2 significant figures.
J = Estimated value
I = Interference present

Method 8290 Laboratory Control Spike Results

Lab Sample ID	LCS-52559		
Filename	U161101B_18	Matrix	Solid
Total Amount Extracted	20.1 g	Dilution	NA
ICAL ID	U161025	Extracted	10/27/2016 16:25
CCal Filename(s)	U161101B_03 & U161101B_19	Analyzed	11/02/2016 04:01
Method Blank ID	BLANK-52558	Injected By	SMT

Native Isomers	Qs (ng)	Qm (ng)	% Rec.
2,3,7,8-TCDF	0.20	0.19	96
Total TCDF			
2,3,7,8-TCDD	0.20	0.17	85
Total TCDD			
1,2,3,7,8-PeCDF	1.0	0.97	97
2,3,4,7,8-PeCDF	1.0	1.0	104
Total PeCDF			
1,2,3,7,8-PeCDD	1.0	0.95	95
Total PeCDD			
1,2,3,4,7,8-HxCDF	1.0	1.1	107
1,2,3,6,7,8-HxCDF	1.0	1.0	103
2,3,4,6,7,8-HxCDF	1.0	0.97	97
1,2,3,7,8,9-HxCDF	1.0	1.0	101
Total HxCDF			
1,2,3,4,7,8-HxCDD	1.0	1.1	109
1,2,3,6,7,8-HxCDD	1.0	1.1	114
1,2,3,7,8,9-HxCDD	1.0	1.1	112
Total HxCDD			
1,2,3,4,6,7,8-HpCDF	1.0	1.1	107
1,2,3,4,7,8,9-HpCDF	1.0	1.00	100
Total HpCDF			
1,2,3,4,6,7,8-HpCDD	1.0	0.97	97
Total HpCDD			
OCDF	2.0	1.9	95
OCDD	2.0	2.1	106

Internal Standards	ng's Added	Percent Recovery
2,3,7,8-TCDF-13C	2.0	67
2,3,7,8-TCDD-13C	2.0	83
1,2,3,7,8-PeCDF-13C	2.0	77
2,3,4,7,8-PeCDF-13C	2.0	73
1,2,3,7,8-PeCDD-13C	2.0	90
1,2,3,4,7,8-HxCDF-13C	2.0	70
1,2,3,6,7,8-HxCDF-13C	2.0	67
2,3,4,6,7,8-HxCDF-13C	2.0	75
1,2,3,7,8,9-HxCDF-13C	2.0	76
1,2,3,4,7,8-HxCDD-13C	2.0	80
1,2,3,6,7,8-HxCDD-13C	2.0	63
1,2,3,4,6,7,8-HpCDF-13C	2.0	75
1,2,3,4,7,8,9-HpCDF-13C	2.0	81
1,2,3,4,6,7,8-HpCDD-13C	2.0	91
OCDD-13C	4.0	78
1,2,3,4-TCDD-13C	2.0	NA
1,2,3,7,8,9-HxCDD-13C	2.0	NA
2,3,7,8-TCDD-37Cl4	0.20	81

Qs = Quantity Spiked
Qm = Quantity Measured
Rec. = Recovery (Expressed as Percent)
R = Recovery outside of target range

Y = RF averaging used in calculations
Nn = Value obtained from additional analysis
NA = Not Applicable
* = See Discussion

Minnesota Pollution
Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Laboratory Data Review Checklist

Doc Type: Data Review

Instructions: The following is the Minnesota Pollution Control Agency's (MPCA) informal checklist that may be used to review data. The information follows the general format of the National Functional Guidelines which is the primary data review tool used in the U.S. Environmental Protection Agency's Contract Laboratory Program for Superfund analytical work. This checklist should be used in conjunction with the *Laboratory Data Checklist Guidance* (p-eao-11a): http://www.pca.state.mn.us/index.php/view-document.html?gid=16113. Also see the MPCA Laboratory Quality Control (QC) and Data Policy: http://www.pca.state.mn.us/index.php/view-document.html?gid=16288.

Project Information

Project name: SLR Sediments AOCs – Scanlon Reservoir

Laboratory: Pace - 10367136

Work order number: 3000017136

Report date (mm/dd/yyyy): 11/04/2016

1. Preservation

For help with this section on holding times, containers and preservatives, refer to the Minnesota Department of Health's website at: http://www.health.state.mn.us/divs/phl/environmental/handbook/internet/envhandbook.html.

Questions			Yes	No	N/A	Comments
a.	Is there a chain of custody (COC) with the report?		☒	☐	☐	COC includes samples for Scanlon Reservoir, Thomson Reservoir and Boulder Lake. This data review checklist only applies to the Bolder Lake reference sample.
b.	Is there a sample condition form with the report?		☒	☐	☐	
c.	Were there samples requiring preservation?		☒	☐	☐	
	i.	If so, were they properly preserved?	☒	☐	☐	
	ii.	Were they received on ice?	☒	☐	☐	
d.	Were samples received in the correct containers?		☒	☐	☐	
	i.	Was there enough sample volume/weight to complete all requested analyses?	☒	☐	☐	
	ii.	Was there enough extra sample collected to complete method required batch QC?	☒	☐	☐	
e.	Were samples received with adequate holding time for sample prep for all requested analyses?		☒	☐	☐	
f.	Are there notes about sample condition or holding time issues on the COC? Explain impact.		☐	☒	☐	
g.	Is there narration or data qualifiers within the report about sample condition or holding time issues? Explain impact.		☐	☒	☐	

2. Calibration

Question		Yes	No	N/A	Comments
a.	Do the report narrative or data qualifiers indicate	☒	☐	☐	

		calibration problems for any analyses? If yes, explain the data impact.				

3. Blanks

Question			Yes	No	N/A	Comments
a.	Do any of the analyses contain samples for field or trip blanks?		☐	☒	☐	
	i.	If yes, are there target analytes present above the reporting limit?	☐	☐	☒	
	ii.	If yes, are the same compounds also present in the samples? Explain possible impact.	☐	☐	☒	
b.	Do method blanks for any analyses contain target analytes above the reporting limit?		☐	☒	☐	Low-level concentrations of Total TCDD, 1,2,3,4,6,7,8-HpCDD, Total HpCDD, and OCDD were detected in the method blank 52558.
	i.	If yes, are the same compounds present in the samples?	☐	☐	☒	
	ii.	Is the amount of target analyte in the blank more than 1/10th of that in the sample(s)? Explain the possible impact on sample results.	☐	☒	☐	All sample results were > 10x the blank concentrations.

4. Surrogates

Question			Yes	No	N/A	Comments
a.	Are there organic analyses that contain surrogate compounds?		☒	☐	☐	Dioxins/furans have internal standards instead of surrogates.
b.	Are the lab recovery limits specified on the report?		☒	☐	☐	
	i.	Do the lab limits seem reasonable when compared with the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
c.	Are there surrogates outside lab limits? (These should have a data qualifier)		☐	☒	☐	
	i.	If yes, are the surrogates above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	
	iii.	Explain what this could mean for the affected samples.	☐	☐	☒	

5. Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

Question			Yes	No	N/A	Comments
a.	Are there LCS/LCSD samples present for the reported analyses? (An LCS alone is acceptable if there is a Matrix Spike/Matrix Spike Duplicate [MS/MSD] or sample/sample dup for precision.)		☒	☐	☐	
	i.	If so, do the lab limits seem reasonable compared to the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
b.	Are there LCS/LCSD compounds outside lab limits? (These should have a data qualifier.)		☐	☒	☐	
	i.	If yes, are the analytes above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	

iii.	Are all samples in the preparation batch also flagged for the same analyte(s)?	☐	☐	☒	
iv.	Explain what this could mean for the affected samples.	☐	☐	☒	

6. Matrix Spike/Matrix Spike Duplicate/Sample Duplicate (MS/MSD/Dup)

Question		Yes	No	N/A	Comments
a.	Do the analytical methods used require an MS and/or MSD? If no, skip to 6.b.	☐	☒	☐	
i.	Have the required matrix spikes been prepared and reported?	☐	☐	☒	
ii.	If no, is there and explanation in the report as to why?	☐	☐	☒	
iii.	Did the lab process an alternate spiked sample (such as LCSD) instead?	☐	☐	☒	
iv.	Are the lab limits specified on the report?	☐	☐	☒	
v.	Do the limits seem reasonable when compared to the suggested guidelines in the MPCA QC Policy?	☐	☐	☒	
vi.	Are there compounds outside the lab limits?	☐	☐	☒	
1.	If yes, are the analytes above the lab limits?	☐	☐	☒	
2.	Below the lab limits?	☐	☐	☒	
3.	Is the source sample also flagged for compounds outside lab limits?	☐	☐	☒	
b.	Is a sample duplicate reported for the analytical method(s)? If no, skip to 6.c.	☐	☐	☒	
i.	Is the RPD for the duplicate pair within the lab limits?	☐	☐	☒	
ii.	If no, has the associated source sample been flagged?	☐	☐	☒	
c.	What is the impact of failed QC on this project?	☐	☐	☒	

7. Method Detection Limits/Report Limits

Question		Yes	No	N/A	Comments
a.	Are reporting and/or method detection limits clearly listed on the report for all analyses? (may also be called quantitation limits)	☒	☐	☐	

Additional comments on report:

(1) Interfering substances impacted the determinations of PCDF congeners; the affected values were flagged "I" where incorrect isotope ratios were obtained. All results flagged “I” were qualified “J” as estimated by the reviewer. Concentrations below the calibration range were flagged “J” as estimated by the laboratory.

(2) Level II reports were reviewed, so calibrations and raw data were not reviewed.

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Laboratory Data Review Checklist

Doc Type: Data Review

Instructions: The following is the Minnesota Pollution Control Agency's (MPCA) informal checklist that may be used to review data. The information follows the general format of the National Functional Guidelines which is the primary data review tool used in the U.S. Environmental Protection Agency's Contract Laboratory Program for Superfund analytical work. This checklist should be used in conjunction with the *Laboratory Data Checklist Guidance* (p-eao-11a): http://www.pca.state.mn.us/index.php/view-document.html?gid=16113. Also see the MPCA Laboratory Quality Control (QC) and Data Policy: http://www.pca.state.mn.us/index.php/view-document.html?gid=16288.

Project Information

Project name: SLR Sediments AOCs – Mud Lake West

Laboratory: Pace - 10366129

Work order number: 3000017136

Report date (mm/dd/yyyy): 10/28/2016

1. Preservation

For help with this section on holding times, containers and preservatives, refer to the Minnesota Department of Health's website at: http://www.health.state.mn.us/divs/phl/environmental/handbook/internet/envhandbook.html.

Questions			**Yes**	**No**	**N/A**	**Comments**
a.	Is there a chain of custody (COC) with the report?		☒	☐	☐	
b.	Is there a sample condition form with the report?		☒	☐	☐	
c.	Were there samples requiring preservation?		☐	☒	☐	
	i.	If so, were they properly preserved?	☐	☐	☒	
	ii.	Were they received on ice?	☒	☐	☐	
d.	Were samples received in the correct containers?		☒	☐	☐	
	i.	Was there enough sample volume/weight to complete all requested analyses?	☒	☐	☐	
	ii.	Was there enough extra sample collected to complete method required batch QC?	☒	☐	☐	
e.	Were samples received with adequate holding time for sample prep for all requested analyses?		☒	☐	☐	
f.	Are there notes about sample condition or holding time issues on the COC? Explain impact.		☐	☒	☐	
g.	Is there narration or data qualifiers within the report about sample condition or holding time issues? Explain impact.		☐	☒	☐	

2. Calibration

Question		**Yes**	**No**	**N/A**	**Comments**
a.	Do the report narrative or data qualifiers indicate calibration problems for any analyses? If yes, explain the data impact.	☒	☐	☐	The responses obtained for selected labeled congeners in the calibration standard analyses F161027B_18 was outside the target range. As specified in the Pace procedures, the

					average of the daily response factors for this compound was used in the calculations for the samples from this analytical run. The affected values were flagged "Y" on the results tables. No data were qualified.

3. Blanks

Question		Yes	No	N/A	Comments
a.	Do any of the analyses contain samples for field or trip blanks?	☐	☒	☐	
	i. If yes, are there target analytes present above the reporting limit?	☐	☐	☒	
	ii. If yes, are the same compounds also present in the samples? Explain possible impact.	☐	☐	☒	
b.	Do method blanks for any analyses contain target analytes above the reporting limit?	☐	☒	☐	Low-level concentrations of Total TCDF, Total HxCDD, Total HpCDD, and OCDD were detected in the method blank.
	i. If yes, are the same compounds present in the samples?	☒	☐	☐	
	ii. Is the amount of target analyte in the blank more than 1/10th of that in the sample(s)? Explain the possible impact on sample results.	☐	☒	☐	All sample results were > 10x method blank concentrations.

4. Surrogates

Question		Yes	No	N/A	Comments
a.	Are there organic analyses that contain surrogate compounds?	☒	☐	☐	Dioxins/furans have internal standards instead of surrogates.
b.	Are the lab recovery limits specified on the report?	☒	☐	☐	
	i. Do the lab limits seem reasonable when compared with the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
c.	Are there surrogates outside lab limits? (These should have a data qualifier)	☐	☒	☐	
	i. If yes, are the surrogates above the lab limits?	☐	☐	☒	
	ii. Below the lab limits?	☐	☐	☒	
	iii. Explain what this could mean for the affected samples.	☐	☐	☒	

5. Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

Question		Yes	No	N/A	Comments
a.	Are there LCS/LCSD samples present for the reported analyses? (An LCS alone is acceptable if there is an Matrix Spike/Matrix Spike Duplicate [MS/MSD] or sample/sample dup for precision.)	☒	☐	☐	
	i. If so, do the lab limits seem reasonable compared to the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
b.	Are there LCS/LCSD compounds outside lab limits? (These should have a data qualifier.)	☐	☒	☐	

	i.	If yes, are the analytes above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	
	iii.	Are all samples in the preparation batch also flagged for the same analyte(s)?	☐	☐	☒	
	iv.	Explain what this could mean for the affected samples.	☐	☐	☒	

6. Matrix Spike/Matrix Spike Duplicate/Sample Duplicate (MS/MSD/Dup)

Question				Yes	No	N/A	Comments
a.	Do the analytical methods used require an MS and/or MSD? If no, skip to 6.b.			☒	☐	☐	MS/MSDs are not required for dioxins/furans.
	i.	Have the required matrix spikes been prepared and reported?		☒	☐	☐	
	ii.	If no, is there and explanation in the report as to why?		☐	☐	☒	
	iii.	Did the lab process an alternate spiked sample (such as LCSD) instead?		☐	☐	☒	
	iv.	Are the lab limits specified on the report?		☐	☐	☒	
	v.	Do the limits seem reasonable when compared to the suggested guidelines in the MPCA QC Policy?		☐	☐	☒	
	vi.	Are there compounds outside the lab limits?		☒	☐	☐	
		1.	If yes, are the analytes above the lab limits?	☒	☐	☐	
		2.	Below the lab limits?	☐	☒	☐	Background-subtracted recoveries for OCDD recoveries were biased low and outside QC limits.
		3.	Is the source sample also flagged for compounds outside lab limits?	☐	☐	☒	
b.	Is a sample duplicate reported for the analytical method(s)? If no, skip to 6.c.			☐	☒	☐	
	i.	Is the RPD for the duplicate pair within the lab limits?		☐	☒	☐	The RPD for OCDD exceeded the acceptance criterion.
	ii.	If no, has the associated source sample been flagged?		☐	☒	☐	
c.	What is the impact of failed QC on this project?			☒	☐	☐	The OCDD result in parent sample BW16MLW-001-0.0-0.15 was qualified “J” as estimated.

7. Method Detection Limits/Report Limits

Question		Yes	No	N/A	Comments
a.	Are reporting and/or method detection limits clearly listed on the report for all analyses? (may also be called quantitation limits)	☒	☐	☐	

Additional comments on report:

(1) No field duplicates were included in this SDG.

(2) The affected results were flagged "I" when incorrect isotope ratios were observed. These results were flagged "J" as estimated. Results < the calibration range were qualified “J” as estimated by the reviewer.

(3) Level II reports were reviewed, so calibrations and raw data were not reviewed.

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Laboratory Data Review Checklist

Doc Type: Data Review

Instructions: The following is the Minnesota Pollution Control Agency's (MPCA) informal checklist that may be used to review data. The information follows the general format of the National Functional Guidelines which is the primary data review tool used in the U.S. Environmental Protection Agency's Contract Laboratory Program for Superfund analytical work. This checklist should be used in conjunction with the *Laboratory Data Checklist Guidance* (p-eao-11a): http://www.pca.state.mn.us/index.php/view-document.html?gid=16113. Also see the MPCA Laboratory Quality Control (QC) and Data Policy: http://www.pca.state.mn.us/index.php/view-document.html?gid=16288.

Project Information

Project name: SLR Sediments AOCs – Mud Lake West

Laboratory: Pace - 10365180

Work order number: 3000017136

Report date (mm/dd/yyyy): 10/24/2016

1. Preservation

For help with this section on holding times, containers and preservatives, refer to the Minnesota Department of Health's website at: http://www.health.state.mn.us/divs/phl/environmental/handbook/internet/envhandbook.html.

Questions			Yes	No	N/A	Comments
a.	Is there a chain of custody (COC) with the report?		☒	☐	☐	
b.	Is there a sample condition form with the report?		☒	☐	☐	
c.	Were there samples requiring preservation?		☐	☒	☐	
	i.	If so, were they properly preserved?	☐	☐	☒	
	ii.	Were they received on ice?	☒	☐	☐	
d.	Were samples received in the correct containers?		☒	☐	☐	
	i.	Was there enough sample volume/weight to complete all requested analyses?	☒	☐	☐	
	ii.	Was there enough extra sample collected to complete method required batch QC?	☒	☐	☐	
e.	Were samples received with adequate holding time for sample prep for all requested analyses?		☒	☐	☐	
f.	Are there notes about sample condition or holding time issues on the COC? Explain impact.		☐	☒	☐	
g.	Is there narration or data qualifiers within the report about sample condition or holding time issues? Explain impact.		☐	☒	☐	

2. Calibration

Question		Yes	No	N/A	Comments
a.	Do the report narrative or data qualifiers indicate calibration problems for any analyses? If yes, explain the data impact.	☐	☒	☐	

3. Blanks

Question			Yes	No	N/A	Comments
a.	Do any of the analyses contain samples for field or trip blanks?		☐	☒	☐	
	i.	If yes, are there target analytes present above the reporting limit?	☐	☐	☒	
	ii.	If yes, are the same compounds also present in the samples? Explain possible impact.	☐	☐	☒	
b.	Do method blanks for any analyses contain target analytes above the reporting limit?		☐	☒	☐	
	i.	If yes, are the same compounds present in the samples?	☐	☐	☒	
	ii.	Is the amount of target analyte in the blank more than 1/10th of that in the sample(s)? Explain the possible impact on sample results.	☐	☐	☒	

4. Surrogates

Question			Yes	No	N/A	Comments
a.	Are there organic analyses that contain surrogate compounds?		☐	☒	☐	
b.	Are the lab recovery limits specified on the report?		☐	☐	☒	
	i.	Do the lab limits seem reasonable when compared with the suggested guidelines in the MPCA QC Policy?	☐	☐	☒	
c.	Are there surrogates outside lab limits? (These should have a data qualifier)		☐	☐	☒	
	i.	If yes, are the surrogates above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	
	iii.	Explain what this could mean for the affected samples.	☐	☐	☒	

5. Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

Question			Yes	No	N/A	Comments
a.	Are there LCS/LCSD samples present for the reported analyses? (An LCS alone is acceptable if there is an Matrix Spike/Matrix Spike Duplicate [MS/MSD] or sample/sample dup for precision.)		☒	☐	☐	
	i.	If so, do the lab limits seem reasonable compared to the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
b.	Are there LCS/LCSD compounds outside lab limits? (These should have a data qualifier.)		☐	☒	☐	
	i.	If yes, are the analytes above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	
	iii.	Are all samples in the preparation batch also flagged for the same analyte(s)?	☐	☐	☒	

	iv.	Explain what this could mean for the affected samples.	☐	☐	☒	

6. Matrix Spike/Matrix Spike Duplicate/Sample Duplicate (MS/MSD/Dup)

Question				Yes	No	N/A	Comments
a.	Do the analytical methods used require an MS and/or MSD? If no, skip to 6.b.			☐	☒	☐	
	i.	Have the required matrix spikes been prepared and reported?		☐	☐	☒	
	ii.	If no, is there and explanation in the report as to why?		☐	☐	☒	
	iii.	Did the lab process an alternate spiked sample (such as LCSD) instead?		☐	☒	☐	Batch MS/MSDs were performed.
	iv.	Are the lab limits specified on the report?		☒	☐	☐	
	v.	Do the limits seem reasonable when compared to the suggested guidelines in the MPCA QC Policy?		☒	☐	☐	
	vi.	Are there compounds outside the lab limits?		☒	☐	☐	
		1.	If yes, are the analytes above the lab limits?	☐	☒	☐	
		2.	Below the lab limits?	☒	☐	☐	The MSD %R for TOC was biased low and outside QC limits in the batch QC for SDG 10365383.
		3.	Is the source sample also flagged for compounds outside lab limits?	☐	☐	☒	The source sample was not included in this SDG.
b.	Is a sample duplicate reported for the analytical method(s)? If no, skip to 6.c.			☐	☒	☐	RPDs discussed apply to MS/MSDs.
	i.	Is the RPD for the duplicate pair within the lab limits?		☐	☒	☐	The RPD for TOC was high in the MS/MSD performed on the sample from SDG 10365383.
	ii.	If no, has the associated source sample been flagged?		☐	☐	☒	The source sample was not included in this SDG.
c.	What is the impact of failed QC on this project?			☒	☐	☐	No qualifiers were applied based on batch QC.

7. Method Detection Limits/Report Limits

Question		Yes	No	N/A	Comments
a.	Are reporting and/or method detection limits clearly listed on the report for all analyses? (may also be called quantitation limits)	☒	☐	☐	

Additional comments on report:

(1) No blind field duplicates were collected with the TOC samples in this SDG.

(2) Level II reports were reviewed, so calibrations and raw data were not reviewed.

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Laboratory Data Review Checklist

Doc Type: Data Review

Instructions: The following is the Minnesota Pollution Control Agency's (MPCA) informal checklist that may be used to review data. The information follows the general format of the National Functional Guidelines which is the primary data review tool used in the U.S. Environmental Protection Agency's Contract Laboratory Program for Superfund analytical work. This checklist should be used in conjunction with the *Laboratory Data Checklist Guidance* (p-eao-11a): http://www.pca.state.mn.us/index.php/view-document.html?gid=16113. Also see the MPCA Laboratory Quality Control (QC) and Data Policy: http://www.pca.state.mn.us/index.php/view-document.html?gid=16288.

Project Information

Project name: SLR Sediments AOCs – Mud Lake West
Laboratory: Pace - 10365194
Work order number: 3000017136
Report date (mm/dd/yyyy): 10/18/2016

1. Preservation

For help with this section on holding times, containers and preservatives, refer to the Minnesota Department of Health's website at: http://www.health.state.mn.us/divs/phl/environmental/handbook/internet/envhandbook.html.

Questions			Yes	No	N/A	Comments
a.	Is there a chain of custody (COC) with the report?		☒	☐	☐	
b.	Is there a sample condition form with the report?		☒	☐	☐	
c.	Were there samples requiring preservation?		☐	☒	☐	
	i.	If so, were they properly preserved?	☐	☐	☒	
	ii.	Were they received on ice?	☒	☐	☐	
d.	Were samples received in the correct containers?		☒	☐	☐	
	i.	Was there enough sample volume/weight to complete all requested analyses?	☒	☐	☐	
	ii.	Was there enough extra sample collected to complete method required batch QC?	☒	☐	☐	
e.	Were samples received with adequate holding time for sample prep for all requested analyses?		☒	☐	☐	
f.	Are there notes about sample condition or holding time issues on the COC? Explain impact.		☐	☒	☐	
g.	Is there narration or data qualifiers within the report about sample condition or holding time issues? Explain impact.		☐	☒	☐	

2. Calibration

Question		Yes	No	N/A	Comments
a.	Do the report narrative or data qualifiers indicate calibration problems for any analyses? If yes, explain the data impact.	☒	☐	☐	The response obtained for the native OCDF in the calibration standard analyses U161012A_17 was outside the target range. As specified in the Pace procedures, the

					average of the daily response factors for this compound was used in the calculations for the samples from this analytical run. The affected values were flagged “Y” on the results tables. No data were qualified.

3. Blanks

Question		Yes	No	N/A	Comments
a.	Do any of the analyses contain samples for field or trip blanks?	☐	☒	☐	
	i. If yes, are there target analytes present above the reporting limit?	☐	☐	☒	
	ii. If yes, are the same compounds also present in the samples? Explain possible impact.	☐	☐	☒	
b.	Do method blanks for any analyses contain target analytes above the reporting limit?	☐	☒	☐	Low-level concentrations of Total TCDF, Total HxCDD, 1,2,3,4,6,7,8-HpCDD, and Total HpCDD were detected in the method blank.
	i. If yes, are the same compounds present in the samples?	☒	☐	☐	
	ii. Is the amount of target analyte in the blank more than 1/10th of that in the sample(s)? Explain the possible impact on sample results.	☐	☒	☐	All sample results were > 10x the blank concentrations.

4. Surrogates

Question		Yes	No	N/A	Comments
a.	Are there organic analyses that contain surrogate compounds?	☒	☐	☐	Dioxins/furans have internal standards instead of surrogates.
b.	Are the lab recovery limits specified on the report?	☒	☐	☐	
	i. Do the lab limits seem reasonable when compared with the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
c.	Are there surrogates outside lab limits? (These should have a data qualifier)	☒	☐	☐	
	i. If yes, are the surrogates above the lab limits?	☒	☐	☐	
	ii. Below the lab limits?	☒	☐	☐	The recoveries of the isotopically-labeled PCDD/PCDF internal standards in the sample extracts ranged from 32-97%. Except for two low values, which were flagged "R" on the results tables, the labeled standard recoveries obtained for this project were within the 40-135% target range specified in Method 8290.
	iii. Explain what this could mean for the affected samples.	☒	☐	☐	Since the quantification of the native 2,3,7,8-substituted congeners was based on isotope dilution, the data were automatically corrected for variation in recovery and accurate values were obtained. No data were qualified.

5. Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

Question	Yes	No	N/A	Comments

a.	Are there LCS/LCSD samples present for the reported analyses? (An LCS alone is acceptable if there is an Matrix Spike/Matrix Spike Duplicate [MS/MSD] or sample/sample dup for precision.)		☒	☐	☐	
	i.	If so, do the lab limits seem reasonable compared to the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
b.	Are there LCS/LCSD compounds outside lab limits? (These should have a data qualifier.)		☐	☒	☐	
	i.	If yes, are the analytes above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	
	iii.	Are all samples in the preparation batch also flagged for the same analyte(s)?	☐	☐	☒	
	iv.	Explain what this could mean for the affected samples.	☐	☐	☒	

6. Matrix Spike/Matrix Spike Duplicate/Sample Duplicate (MS/MSD/Dup)

Question				Yes	No	N/A	Comments
a.	Do the analytical methods used require an MS and/or MSD? If no, skip to 6.b.			☐	☒	☐	MS/MSDs are not required for dioxins/furans.
	i.	Have the required matrix spikes been prepared and reported?		☐	☐	☒	
	ii.	If no, is there and explanation in the report as to why?		☐	☐	☒	
	iii.	Did the lab process an alternate spiked sample (such as LCSD) instead?		☒	☐	☐	
	iv.	Are the lab limits specified on the report?		☐	☐	☒	
	v.	Do the limits seem reasonable when compared to the suggested guidelines in the MPCA QC Policy?		☐	☐	☒	
	vi.	Are there compounds outside the lab limits?		☐	☐	☒	
		1.	If yes, are the analytes above the lab limits?	☐	☐	☒	
		2.	Below the lab limits?	☐	☐	☒	
		3.	Is the source sample also flagged for compounds outside lab limits?	☐	☐	☒	
b.	Is a sample duplicate reported for the analytical method(s)? If no, skip to 6.c.			☐	☐	☒	
	i.	Is the RPD for the duplicate pair within the lab limits?		☐	☐	☒	
	ii.	If no, has the associated source sample been flagged?		☐	☐	☒	
c.	What is the impact of failed QC on this project?			☐	☐	☒	

7. Method Detection Limits/Report Limits

Question		Yes	No	N/A	Comments
a.	Are reporting and/or method detection limits clearly listed on the report for all analyses? (may also be called quantitation limits)	☒	☐	☐	

Additional comments on report:

(1) No field duplicates were included in this SDG.

(2) Values were flagged "I" when incorrect isotope ratios were observed or concentrations were below the calibration range. . These results were flagged "J" as estimated.

(3) Level II reports were reviewed, so calibrations and raw data were not reviewed.

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Laboratory Data Review Checklist

Doc Type: Data Review

Instructions: The following is the Minnesota Pollution Control Agency's (MPCA) informal checklist that may be used to review data. The information follows the general format of the National Functional Guidelines which is the primary data review tool used in the U.S. Environmental Protection Agency's Contract Laboratory Program for Superfund analytical work. This checklist should be used in conjunction with the *Laboratory Data Checklist Guidance* (p-eao-11a): http://www.pca.state.mn.us/index.php/view-document.html?gid=16113. Also see the MPCA Laboratory Quality Control (QC) and Data Policy: http://www.pca.state.mn.us/index.php/view-document.html?gid=16288.

Project Information

Project name: SLR Sediments AOCs – Mud Lake West

Laboratory: Pace - 10365195

Work order number: 3000017136

Report date (mm/dd/yyyy): 10/19/2016

1. Preservation

For help with this section on holding times, containers and preservatives, refer to the Minnesota Department of Health's website at: http://www.health.state.mn.us/divs/phl/environmental/handbook/internet/envhandbook.html.

Questions		Yes	No	N/A	Comments
a.	Is there a chain of custody (COC) with the report?	☒	☐	☐	
b.	Is there a sample condition form with the report?	☒	☐	☐	
c.	Were there samples requiring preservation?	☐	☒	☐	
	i. If so, were they properly preserved?	☐	☐	☒	
	ii. Were they received on ice?	☒	☐	☐	
d.	Were samples received in the correct containers?	☒	☐	☐	
	i. Was there enough sample volume/weight to complete all requested analyses?	☒	☐	☐	
	ii. Was there enough extra sample collected to complete method required batch QC?	☒	☐	☐	
e.	Were samples received with adequate holding time for sample prep for all requested analyses?	☒	☐	☐	
f.	Are there notes about sample condition or holding time issues on the COC? Explain impact.	☐	☒	☐	
g.	Is there narration or data qualifiers within the report about sample condition or holding time issues? Explain impact.	☐	☒	☐	

2. Calibration

Question		Yes	No	N/A	Comments
a.	Do the report narrative or data qualifiers indicate calibration problems for any analyses? If yes, explain the data impact.	☐	☒	☐	

3. Blanks

Question			Yes	No	N/A	Comments
a.	Do any of the analyses contain samples for field or trip blanks?		☐	☒	☐	
	i.	If yes, are there target analytes present above the reporting limit?	☐	☐	☒	
	ii.	If yes, are the same compounds also present in the samples? Explain possible impact.	☐	☐	☒	
b.	Do method blanks for any analyses contain target analytes above the reporting limit?		☐	☒	☐	
	i.	If yes, are the same compounds present in the samples?	☐	☐	☒	
	ii.	Is the amount of target analyte in the blank more than 1/10th of that in the sample(s)? Explain the possible impact on sample results.	☐	☐	☒	

4. Surrogates

Question			Yes	No	N/A	Comments
a.	Are there organic analyses that contain surrogate compounds?		☐	☒	☐	
b.	Are the lab recovery limits specified on the report?		☐	☐	☒	
	i.	Do the lab limits seem reasonable when compared with the suggested guidelines in the MPCA QC Policy?	☐	☐	☒	
c.	Are there surrogates outside lab limits? (These should have a data qualifier)		☐	☐	☒	
	i.	If yes, are the surrogates above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	
	iii.	Explain what this could mean for the affected samples.	☐	☐	☒	

5. Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

Question			Yes	No	N/A	Comments
a.	Are there LCS/LCSD samples present for the reported analyses? (An LCS alone is acceptable if there is an Matrix Spike/Matrix Spike Duplicate [MS/MSD] or sample/sample dup for precision.)		☒	☐	☐	
	i.	If so, do the lab limits seem reasonable compared to the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
b.	Are there LCS/LCSD compounds outside lab limits? (These should have a data qualifier.)		☐	☒	☐	
	i.	If yes, are the analytes above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	
	iii.	Are all samples in the preparation batch also flagged for the same analyte(s)?	☐	☐	☒	

	iv.	Explain what this could mean for the affected samples.	☐	☐	☒	

6. Matrix Spike/Matrix Spike Duplicate/Sample Duplicate (MS/MSD/Dup)

Question				Yes	No	N/A	Comments
a.	Do the analytical methods used require an MS and/or MSD? If no, skip to 6.b.			☐	☒	☐	
	i.	Have the required matrix spikes been prepared and reported?		☐	☐	☒	
	ii.	If no, is there and explanation in the report as to why?		☐	☐	☒	
	iii.	Did the lab process an alternate spiked sample (such as LCSD) instead?		☐	☒	☐	Batch MS/MSDs were performed on a sample from SDG 10364962.
	iv.	Are the lab limits specified on the report?		☒	☐	☐	
	v.	Do the limits seem reasonable when compared to the suggested guidelines in the MPCA QC Policy?		☒	☐	☐	
	vi.	Are there compounds outside the lab limits?		☒	☐	☐	
		1.	If yes, are the analytes above the lab limits?	☐	☒	☐	
		2.	Below the lab limits?	☒	☐	☐	The MS/MSD recoveries for Zinc were not evaluated against QC limits in the batch QC due to required dilutions for SDG 10364962. No qualifiers were applied based on batch QC.
		3.	Is the source sample also flagged for compounds outside lab limits?	☐	☒	☐	The source sample was not included in this SDG.
b.	Is a sample duplicate reported for the analytical method(s)? If no, skip to 6.c.			☐	☒	☐	RPDs discussed apply to MS/MSDs.
	i.	Is the RPD for the duplicate pair within the lab limits?		☒	☐	☐	
	ii.	If no, has the associated source sample been flagged?		☐	☐	☒	
c.	What is the impact of failed QC on this project?			☒	☐	☐	No qualifiers were applied based on batch QC.

7. Method Detection Limits/Report Limits

Question		Yes	No	N/A	Comments
a.	Are reporting and/or method detection limits clearly listed on the report for all analyses? (may also be called quantitation limits)	☒	☐	☐	

Additional comments on report:

(1) No blind field duplicates were collected with the metals samples in this SDG.

(2) Level II reports were reviewed, so calibrations and raw data were not reviewed.

Minnesota Pollution
Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Laboratory Data Review Checklist

Doc Type: Data Review

Instructions: The following is the Minnesota Pollution Control Agency's (MPCA) informal checklist that may be used to review data. The information follows the general format of the National Functional Guidelines which is the primary data review tool used in the U.S. Environmental Protection Agency's Contract Laboratory Program for Superfund analytical work. This checklist should be used in conjunction with the *Laboratory Data Checklist Guidance* (p-eao-11a): http://www.pca.state.mn.us/index.php/view-document.html?gid=16113. Also see the MPCA Laboratory Quality Control (QC) and Data Policy: http://www.pca.state.mn.us/index.php/view-document.html?gid=16288.

Project Information

Project name: SLR Sediments AOCs – Mud Lake West
Laboratory: Pace - 10366128
Work order number: 3000017136
Report date (mm/dd/yyyy): 10/27/2016

1. Preservation

For help with this section on holding times, containers and preservatives, refer to the Minnesota Department of Health's website at: http://www.health.state.mn.us/divs/phl/environmental/handbook/internet/envhandbook.html.

Questions			**Yes**	**No**	**N/A**	**Comments**
a.	Is there a chain of custody (COC) with the report?		☒	☐	☐	
b.	Is there a sample condition form with the report?		☒	☐	☐	
c.	Were there samples requiring preservation?		☐	☒	☒	
	i.	If so, were they properly preserved?	☐	☐	☐	
	ii.	Were they received on ice?	☒	☐	☐	
d.	Were samples received in the correct containers?		☒	☐	☐	
	i.	Was there enough sample volume/weight to complete all requested analyses?	☒	☐	☐	
	ii.	Was there enough extra sample collected to complete method required batch QC?	☒	☐	☐	
e.	Were samples received with adequate holding time for sample prep for all requested analyses?		☒	☐	☐	
f.	Are there notes about sample condition or holding time issues on the COC? Explain impact.		☐	☒	☐	
g.	Is there narration or data qualifiers within the report about sample condition or holding time issues? Explain impact.		☐	☒	☐	

2. Calibration

Question		**Yes**	**No**	**N/A**	**Comments**
a.	Do the report narrative or data qualifiers indicate calibration problems for any analyses? If yes, explain the data impact.	☐	☒	☐	

3. Blanks

Question			Yes	No	N/A	Comments
a.	Do any of the analyses contain samples for field or trip blanks?		☐	☒	☐	
	i.	If yes, are there target analytes present above the reporting limit?	☐	☐	☒	
	ii.	If yes, are the same compounds also present in the samples? Explain possible impact.	☐	☐	☒	
b.	Do method blanks for any analyses contain target analytes above the reporting limit?		☐	☒	☐	A low-level concentration of Nickel (0.16 mg/kg) was detected in Method blank 2402404
	i.	If yes, are the same compounds present in the samples?	☒	☐	☐	
	ii.	Is the amount of target analyte in the blank more than 1/10th of that in the sample(s)? Explain the possible impact on sample results.	☐	☒	☐	No action was warranted, because the sample results were > 10x the spike concentration.

4. Surrogates

Question			Yes	No	N/A	Comments
a.	Are there organic analyses that contain surrogate compounds?		☐	☒	☐	
b.	Are the lab recovery limits specified on the report?		☐	☐	☒	
	i.	Do the lab limits seem reasonable when compared with the suggested guidelines in the MPCA QC Policy?	☐	☐	☒	
c.	Are there surrogates outside lab limits? (These should have a data qualifier)		☐	☐	☒	
	i.	If yes, are the surrogates above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☐	
	iii.	Explain what this could mean for the affected samples.	☐	☐	☒	

5. Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

Question			Yes	No	N/A	Comments
a.	Are there LCS/LCSD samples present for the reported analyses? (An LCS alone is acceptable if there is an Matrix Spike/Matrix Spike Duplicate [MS/MSD] or sample/sample dup for precision.)		☒	☐	☐	
	i.	If so, do the lab limits seem reasonable compared to the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
b.	Are there LCS/LCSD compounds outside lab limits? (These should have a data qualifier.)		☐	☒	☐	
	i.	If yes, are the analytes above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	
	iii.	Are all samples in the preparation batch also flagged for the same analyte(s)?	☐	☐	☒	
	iv.	Explain what this could mean for the	☐	☐	☒	

		affected samples.				

6. Matrix Spike/Matrix Spike Duplicate/Sample Duplicate (MS/MSD/Dup)

Question				Yes	No	N/A	Comments
a.	Do the analytical methods used require an MS and/or MSD? If no, skip to 6.b.			☒	☐	☐	.
	i.	Have the required matrix spikes been prepared and reported?		☒	☐	☐	
	ii.	If no, is there and explanation in the report as to why?		☐	☐	☒	
	iii.	Did the lab process an alternate spiked sample (such as LCSD) instead?		☐	☐	☒	
	iv.	Are the lab limits specified on the report?		☒	☐	☐	
	v.	Do the limits seem reasonable when compared to the suggested guidelines in the MPCA QC Policy?		☒	☐	☐	
	vi.	Are there compounds outside the lab limits?		☐	☒	☐	
		1.	If yes, are the analytes above the lab limits?	☐	☐	☒	
		2.	Below the lab limits?	☐	☐	☒	
		3.	Is the source sample also flagged for compounds outside lab limits?	☐	☐	☒	
b.	Is a sample duplicate reported for the analytical method(s)? If no, skip to 6.c.			☒	☐	☐	RPDs are from the MS/MSD.
	i.	Is the RPD for the duplicate pair within the lab limits?		☒	☐	☐	
	ii.	If no, has the associated source sample been flagged?		☐	☐	☒	
c.	What is the impact of failed QC on this project?			☐	☐	☒	

7. Method Detection Limits/Report Limits

Question		Yes	No	N/A	Comments
a.	Are reporting and/or method detection limits clearly listed on the report for all analyses? (may also be called quantitation limits)	☒	☐	☐	

Additional comments on report:

(1) No field duplicates were included in this SDG. (3)

(2) Level II reports were reviewed, so calibrations and raw data were not reviewed.

Minnesota Pollution
Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Laboratory Data Review Checklist

Doc Type: Data Review

Instructions: The following is the Minnesota Pollution Control Agency's (MPCA) informal checklist that may be used to review data. The information follows the general format of the National Functional Guidelines which is the primary data review tool used in the U.S. Environmental Protection Agency's Contract Laboratory Program for Superfund analytical work. This checklist should be used in conjunction with the *Laboratory Data Checklist Guidance* (p-eao-11a): http://www.pca.state.mn.us/index.php/view-document.html?gid=16113. Also see the MPCA Laboratory Quality Control (QC) and Data Policy: http://www.pca.state.mn.us/index.php/view-document.html?gid=16288.

Project Information

Project name: SLR Sediments AOCs – Mud Lake West
Laboratory: AXYS - DPWG57987 (Tissue Samples)
Work order number: 3000017136
Report date (mm/dd/yyyy): 01/20/2017

1. Preservation

For help with this section on holding times, containers and preservatives, refer to the Minnesota Department of Health's website at: http://www.health.state.mn.us/divs/phl/environmental/handbook/internet/envhandbook.html.

Questions			Yes	No	N/A	Comments
a.	Is there a chain of custody (COC) with the report?		☒	☐	☐	
b.	Is there a sample condition form with the report?		☒	☐	☐	
c.	Were there samples requiring preservation?		☐	☒	☐	
	i.	If so, were they properly preserved?	☐	☐	☒	
	ii.	Were they received on ice?	☒	☐	☐	
d.	Were samples received in the correct containers?		☒	☐	☐	
	i.	Was there enough sample volume/weight to complete all requested analyses?	☒	☐	☐	
	ii.	Was there enough extra sample collected to complete method required batch QC?	☒	☐	☐	
e.	Were samples received with adequate holding time for sample prep for all requested analyses?		☒	☐	☐	
f.	Are there notes about sample condition or holding time issues on the COC? Explain impact.		☐	☒	☐	"#" Symbol was removed from sample IDs for programming reasons. Sample ID discrepancy: Sample ID on CoC was 'Control-CS136 West Bear' and sample label was 'Control West Bear Skin-CS136'
g.	Is there narration or data qualifiers within the report about sample condition or holding time issues? Explain impact.		☒	☐	☐	Sample above. was logged in per the CoC.

2. Calibration

Question	Yes	No	N/A	Comments

a.		Do the report narrative or data qualifiers indicate calibration problems for any analyses? If yes, explain the data impact.	☐	☒	☐	

3. Blanks

Question			Yes	No	N/A	Comments
a.		Do any of the analyses contain samples for field or trip blanks?	☐	☒	☐	
	i.	If yes, are there target analytes present above the reporting limit?	☐	☐	☒	
	ii.	If yes, are the same compounds also present in the samples? Explain possible impact.	☐	☐	☒	
b.		Do method blanks for any analyses contain target analytes above the reporting limit?	☒	☐	☐	Data are not blank corrected. 1,2,3,4,6,7,8-HpCDD (0.262J pg/g), OCDD (0.596J pg/g), 1,2,3,7,8,9-HXCDD (0.0793 pg/g), Total Hexa-Dioxins (0.178 pg/g), and Total Hepta-Dioxins (0.937 pg/g) were detected in the lab blank (AXYS ID WG57620-101).
	i.	If yes, are the same compounds present in the samples?	☒	☐	☐	1,2,3,4,6,7,8-HpCDD, OCDD, Total Hexa-Dioxins, 1,2,3,7,8,9-HXCDD, Total Hepta-Dioxins, and/or Total Hepta-Dioxins were detected in the field samples.
	ii.	Is the amount of target analyte in the blank more than 1/10th of that in the sample(s)? Explain the possible impact on sample results.	☐	☒	☐	Results for 1,2,3,4,6,7,8-HPCDD in sample 'Control-CS136 West Bear'; 1,2,3,4,6,7,8-HpCDD, 1,2,3,7,8,9-HXCDD, Total Hexa-Dioxins, and Total Hepta-Dioxins in sample 'BW16MLW-001'; 1,2,3,4,6,7,8-HPCDD, 1,2,3,7,8,9-HXCDD in sample 'BW16MLW-002'; Total Hepta-Dioxins in sample 'BW16MLW-003'; 1,2,3,4,6,7,8-HpCDD, OCDD, and Total Hepta-Dioxins in sample 'Background day 0 10/25/16'

4. Surrogates

Question			Yes	No	N/A	Comments
a.		Are there organic analyses that contain surrogate compounds?	☒	☐	☐	Dioxins/furans have internal standards instead of surrogates.
b.		Are the lab recovery limits specified on the report?	☒	☐	☐	
	i.	Do the lab limits seem reasonable when compared with the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
c.		Are there surrogates outside lab limits? (These should have a data qualifier)	☐	☒	☐	
	i.	If yes, are the surrogates above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	
	iii.	Explain what this could mean for the affected samples.	☐	☐	☒	

5. Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

Question			Yes	No	N/A	Comments

a.		Are there LCS/LCSD samples present for the reported analyses? (An LCS alone is acceptable if there is an Matrix Spike/Matrix Spike Duplicate [MS/MSD] or sample/sample dup for precision.)	☒	☐	☐	
	i.	If so, do the lab limits seem reasonable compared to the suggested guidelines in the MPCA QC Policy?	☒	☐	☐	
b.		Are there LCS/LCSD compounds outside lab limits? (These should have a data qualifier.)	☐	☒	☐	
	i.	If yes, are the analytes above the lab limits?	☐	☐	☒	
	ii.	Below the lab limits?	☐	☐	☒	
	iii.	Are all samples in the preparation batch also flagged for the same analyte(s)?	☐	☐	☒	
	iv.	Explain what this could mean for the affected samples.	☐	☐	☒	

6. Matrix Spike/Matrix Spike Duplicate/Sample Duplicate (MS/MSD/Dup)

Question				Yes	No	N/A	Comments
a.			Do the analytical methods used require an MS and/or MSD? If no, skip to 6.b.	☐	☒	☐	MS/MSDs are not required for dioxins/furans analysis for tissue samples.
	i.		Have the required matrix spikes been prepared and reported?	☐	☐	☒	
	ii.		If no, is there and explanation in the report as to why?	☐	☐	☒	
	iii.		Did the lab process an alternate spiked sample (such as LCSD) instead?	☐	☐	☒	
	iv.		Are the lab limits specified on the report?	☐	☐	☒	
	v.		Do the limits seem reasonable when compared to the suggested guidelines in the MPCA QC Policy?	☐	☐	☒	
	vi.		Are there compounds outside the lab limits?	☒	☐	☐	
		1.	If yes, are the analytes above the lab limits?	☒	☐	☐	
		2.	Below the lab limits?	☐	☒	☐	
		3.	Is the source sample also flagged for compounds outside lab limits?	☐	☐	☒	
b.			Is a sample duplicate reported for the analytical method(s)? If no, skip to 6.c.	☐	☒	☐	
	i.		Is the RPD for the duplicate pair within the lab limits?	☐	☐	☒	
	ii.		If no, has the associated source sample been flagged?	☐	☐	☒	
c.			What is the impact of failed QC on this project?	☐	☐	☒	

7. Method Detection Limits/Report Limits

Question		Yes	No	N/A	Comments
a.	Are reporting and/or method detection limits clearly listed on the report for all analyses? (may also be called quantitation limits)	☒	☐	☐	

Additional comments on report:

(1) No field duplicates were included in this SDG.

(2) All tissue results were reported on a wet weight basis.

(3) Level II reports were reviewed, so raw data were not reviewed.

Appendix B

Technical Analysis

Appendix B – Technical Analysis
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Four remedial alternatives involving construction activities and one alternative involving a no action approach were developed and evaluated as part of the Mud Lake West (MLW) Focused Feasibility Study (FFS) and include the following:

Alternative 2 – Enhanced Monitored Natural Recovery with Broadcasted Amendment

Alternative 3 – Enhanced Monitored Natural Recovery with Thin-Layer Amended Cover

Alternative 4 – Dredging with Wetland Restoration

Alternative 5 – Dredge Open Water Areas/Enhanced Monitored Natural Recovery with Thin-Layer Amended Cover in Wetland Areas

Class 4 rough order of magnitude cost analyses (+50/-30) were developed for each of these alternatives and are summarized within **Section 3** of the FFS document. This Technical Analysis serves to provide the calculations and outline the assumptions used to compile each of the alternative cost analyses.

Cost estimates were compiled using a variety of sources. These sources include construction cost data from RSMeans estimating software for open shop pricing in Duluth, Minnesota; current Bay West LLC (Bay West) and state contract rates for labor, equipment, and sample analysis; personal communication with vendors; historic cost data from projects similar in size and scope; other FFS documents, presentations, or technical papers that provided estimated or real construction cost data; and available online vendor pricing of materials.

The selection of construction equipment, production rates, remedial volumes, remedial action areas, and other “design-type” elements used as a starting point to develop alternative costs are based on a current understanding of Site conditions at this early feasibility study-level stage.

This document is divided into the following sections:

Section 1: Remedial Areas and Volumes
Section 2: Construction Equipment and Production Rates
Section 3: Sediment Dewatering/Staging Areas
Section 4: Construction Implementation Assumptions
Section 5: Environmental Controls and Construction Monitoring
Section 6: Material Transport between Site and Staging Area
Section 7: Sediment Dewatering and Dredge Contact Water Treatment
Section 8: Transportation and Disposal
Section 9: Cover/Cap Materials
Section 10: References

The following tables were used to calculate values incorporated into each alternative cost analysis and are included within this Technical Analysis:

Appendix B Table 1: Volume, Rate, and Time Frame Calculations
Appendix B Table 2: Unit Rate Calculations
Appendix B Table 3: Lump Sum Costs
Appendix B Table 4: Monitoring and Evaluation Costs
Appendix B Table 5: Present Value Calculations

Many of the assumptions used to compile the cost analyses for the alternatives are included within the tables. Those aspects of alternative development not readily apparent within the tables and the MLW FFS text are described in the following sections.

Section 1: Remedial Areas and Volumes

Areas targeted for remedial action (remedial areas) include those with nickel or zinc concentrations exceeding the Midpoint Sediment Quality Target (SQT), also referred to as the preliminary cleanup level (CUL). Remedial areas are presented in **Figures 5** through **10** of the MLW FFS document. Remedial areas were developed based on sample results obtained during the 2015 RI, krigging of the 2015 data, bathymetric data, and professional judgement. Remedial areas total 40.1 acres in size. It is anticipated that these areas would be further defined during the design phase.

The total volume of contaminated sediment at the Site was calculated by multiplying the total remedial area by the average maximum depth in which contamination was observed. Two important factors should be noted regarding the total volume of contaminated sediment calculation:

1. Overburden sediments (i.e., sediments with nickel or zinc concentrations less than the preliminary CUL but located above [vertically] sediments exceeding the preliminary CUL) were included within the calculation. Overburden sediments were included because overburden sediments would require removal in order to reach contaminated sediments below.
2. The remedial area was assumed to have a maximum depth of contamination of 1.0 meter (3.3 feet) across its entire area because approximately half the locations sampled contained nickel or zinc in concentrations exceeding the CUL up to 1.0 meter bss. Only two locations were sampled at intervals deeper than 1.0 meter bss; these locations did not contain nickel or zinc concentrations greater than the CUL in intervals deeper than 1.0 meter. It is unknown if nickel or zinc concentrations exceed the CUL in other areas at depths greater than 1.0 meter, and further sampling should be conducted during the design phase to ensure Site COCs have been fully delineated.

Additionally, a 0.30-meter (1-foot) over-dredge was assumed over all consolidation/dredge areas.

A differentiation between “wetland” and “open water” areas of the Site was made to facilitate costing of specialized equipment required to place materials within wetland areas, and to facilitate costing of Alternative 5, which proposes different remedial actions based on area type. Determinations of wetland and open water areas were made based on aerial imagery alone and not on official classifications of wetland systems.

Section 2: Construction Equipment and Production Rates

Unit rate costs were developed for all amendment placement, sand cover construction, and dredging elements by summing labor and equipment costs and dividing by an assumed production rate; therefore, the production rate has a substantial impact on the unit rate cost of these activities and the overall project cost. The production rates used to develop cost estimates for the proposed alternatives are assumed to be conservative. A conservative number was selected due to the inherent difficulties in conducting construction activities at the Site. The following factors were assumed to limit production rates at the Site:

1. Site Accessibility

   The Site is surrounded by wetlands to north, west, and south. In addition, steep gradients are present to the north and west immediately beyond the wetland areas. Land-based access to the Site would require construction of roadways several hundred meters in length through wetland areas or dredging of wetland areas to create draft for dredge and material transport barges to reach the upland shoreline.

   The Site is cut off from Mud Lake East (MLE) and the Saint Louis River (SLR) by a railroad embankment to the east. Barge access to the Site is limited by the railroad embankment; therefore, barges importing materials to the Site from elsewhere along the SLR must moor along the railroad embankment and materials must be offloaded over the railroad tracks and into smaller transport barges located on the other side.

2. Size Limitations

   There are no upland areas on-site and, therefore, staging and dewatering areas must be located off-site. There is minimal space between the wetland areas and active railroad tracks to the west and south of the Site. Beyond the railroad tracks to the west is developed land not suitable to construct a staging or dewatering area. Beyond the railroad tracks and State Highway 39 the south is more wetland areas and the SLR. The nearest upland location suitable for construction of a staging or dewatering area is north of the Site and on U.S. Steel property.

3. Wetland Areas

   A vast majority of the Site and a portion of the remedial area consist of established wetlands. Implementation of alternatives that limit disruption to established wetland areas, such as amendment placement and thin-layer sand cover construction, would likely require use of specialized equipment as described below. This specialized equipment is assumed to have a much lower production rate than more conventional methods of material placement. In addition, the railroad embankment limits accessibility to the Site for material supply barges arriving from Hallett Dock #7. This increases the travel distance for specialized equipment travelling to and from the wetland areas and a material loading area established at the railroad embankment.

Amendment/Sand Cover Construction Equipment

Alternatives involving distribution of sand and/or amendment materials assume that different methods of placement would be utilized in wetland areas as compared to open water areas. Open water areas were assumed to utilize a conventional barge-mounted excavator with environmental clamshell bucket for placing materials as there are no draft limitations in the open water areas.

Wetland areas would not be capable of floating a material placement barge and thus would require a different method of placement. The use of crane mats or equivalent technology was not considered because wetland areas were observed to have water depths exceeding 3 feet during the 2015 RI field sampling event, and bog-type wetland areas were also observed at the Site's southern end. The proposed method used for cost analysis is an amphibious vehicle such as a Marsh Buggy or equivalent outfitted with a 12-cubic yard bucket and stone slinger attachment. Such a vehicle is capable of navigating open waters and traversing upland areas. Production rates for this equipment was estimated based on round trip travel times, capacity of each vehicle, and the use of two vehicles at a time. Each vehicle was assumed to have an application time of 1.2 hours per load, a travel time to and from the vehicle loading location (i.e., material transport barge mooring location along the railroad embankment) of 10 minutes, and a load time of 5 minutes. A placement time frame of 11 hours per day equates to a total daily production for two vehicles of 168 cubic yards.

Photo Showing MBI Marsh Buggy with dump box; Photo from http://marshbuggies.com

Photo showing stone slinger equipment; Photo from http://bcginvestments.net/Stone_Slinger.html

Cover materials would be placed in open water areas using a conventional barge-mounted excavator. Materials would be delivered to the excavator by two material transport hopper barges, each with a 25-cubic yard capacity. The production rate for open water material placement was estimated using a bucket size of 2 cubic yards, a 70 percent (%) fill rate, and 2 minutes per cycle. The bucket size and fill percentage was reduced (as compared to the dredging production rate estimate) to allow for ease of placement within the small 25 cubic yard hopper barges. A placement time frame of 10 hours per day equates to a total daily production for a single excavator of 420 cubic yards.

Dredging Equipment

Alternatives involving dredging of sediments assume that sediments would be slurried with water and pumped as low solids content slurry (e.g., less than 5% solids) to a nearby dewatering area. This assumption was made to avoid passing of contaminated sediments over the railroad embankment into a transport barge and subsequent barging of sediments to Hallett Dock #7 for dewatering. Equipment was assumed to consist of a barge-mounted mechanical excavator with environmental clamshell bucket and slurry tank (i.e., hopper) or hydraulic dredge; costs for this equipment were assumed to be similar enough for FFS-level cost analyses.

The dredging production rate was estimated partially based on U.S. Environmental Protection Agency (USEPA) sediment remediation guidance (USEPA, 2005), which provides production rates for various sizes of mechanical buckets based on an 80% fill and cycle time of 2 minutes. These rates range from 63 cubic yards per hour for smaller buckets to 252 cubic yards per hour for larger buckets. Another source used to determine the dredge production rate was the St. Louis River/Interlake/Duluth Tar (SLRIDT) Data Gap Report (Service, 2002), in which a review of previous projects and discussions with interested parties resulted in a recommended dredge production rate of 50 cubic yards per hour. Based on these two sources the dredge production rate for the Site was conservatively estimated at 72 cubic yards per hour. This rate assumes a 3-cubic yard bucket filled 80%, a 2-minute cycle time, and an active dredging time frame of 10 hours per day. Dredging downtime is estimated at 2 hours per day to account for morning meetings/safety briefings, startup times, shutdown times, and periods of down time throughout the day. These factors equate to a daily production rate of 720 cubic yards per day.

Section 3: Sediment Dewatering/Staging Areas

Sediment Dewatering Area

Dredged sediments would require dewatering prior to transport and disposal at an off-site landfill. The only location identified as a possible sediment dewatering area for the purposes of this FFS is the U.S. Steel property located north of the Site. As stated previously, land-based access to the Site and access between the Site and U.S. Steel property is limited due to wetland areas and steep gradients present at the Site's perimeter. These limitations require that sediments are slurried and pumped to the conceptual dewatering area located at the U.S. Steel site. Slurrying of sediments would result in a large volume of slurry requiring dewatering and a large volume of dredge contact water requiring treatment.

It should be noted that the U.S. Steel site is currently serving as a dewatering area for sediments dredged from Radio Tower Bay. Based on aerial imagery it appears that sediments are being slurried and pumped to U.S. Steel property and exit into a large in-ground dewatering pond. It was assumed that a new above-ground dewatering pad would be constructed for implementation of dredging alternatives for the purposes of this FFS. The dewatering pad would be lined and paved to contain dredge contact water and would be sufficiently sized to contain geotextile tubes stacked three layers high, a large sump, and space for a water treatment plant.

Another scenario for handling of dredged sediments involves mechanically dredging sediments and transferring sediments over the railroad embankment into a large transport barge. At the end of each day, the transport barge would return to an off-site dewatering area such as Hallett Dock #7, where sediments would be dewatered and subsequently transported to an off-site landfill for disposal. This scenario was not included in this FFS due to the perceived complexities of transferring contaminated sediments over the railroad embankment. Additionally, transfer of sediments over the railroad embankment would require additional handling of sediments and could increase project costs due to increased labor and equipment demands, and decrease productivity rates.

Material Staging Area

The U.S. Steel site is not suitable for staging materials such as sand and amendments as there would be no efficient way of transferring materials from the property to barges located within the Site due to wetlands and steep gradients. It was therefore assumed that materials would be barged to the Site from an off-site location along the SLR. Hallett Dock #7 has been identified as a potential staging area through conversations between Bay West, the Minnesota Pollution Control Agency (MPCA), and Duluth Seaway Port Authority. Satellite imagery indicates the presence of a large paved area at the end of Hallett Dock #7, which is appropriately sized for stockpiling materials. The dock end is nearly 500 feet in length and was assumed to be useable for barge mooring and material onloading/offloading in its current condition. Staging area upgrades would likely include installation of site fencing to protect construction equipment and prevent unauthorized personnel from entering the staging area while the remedy is being implemented.

Section 4: Construction Implementation Assumptions

Open Water Placement of Sand and/or Amendment Materials

A general order of operations was assumed in order to facilitate costing of alternatives involving placement of sand and/or amendment materials in open water portions of the Site. This order of operations was used to assist in selecting construction equipment, labor, production rates, time frames, etc.

The general order of placement is described as follows:

- Clean washed sand meeting project specifications would be purchased from a local upland borrow source and imported to the staging area at Hallett Dock #7 via on-road dump trucks. Amendment materials would be purchased from a supplier, shipped to the staging area, and stockpiled.
- An empty transport barge would arrive at the staging area at Hallett Dock #7 after Site work was completed for the day. The barge would be loaded with amendment and/or sand during the overnight hours via end loader, hopper, and conveyor. The barge would remain moored at the staging area overnight once loaded. The following morning the barge would travel upriver to the Site in time for commencement of daily work activities.
- The transport barge would moor to dolphin pilings located along the railroad embankment separating the Site from MLE. A barge-mounted excavator or crane with clamshell bucket located at this “loading area” would remove capping material from the transport barge and load two smaller hopper barges located within the Site and on the other side of the railroad embankment.
- The hopper barges would be used to transfer amendment and/or sand materials between the loading area and a barge-mounted excavator (i.e., material placement excavator) located within the Site. The use of two hopper barges allows for filling of one hopper barge while the other is being emptied by the material placement excavator.
- Once the material transport barge was emptied, cover construction would cease for the day. The material transport barge would return to the staging area at Hallett Dock #7 where it would again be loaded during overnight hours.

Wetland Placement of Sand and/or Amendment Materials

The same general order of operations was assumed for material placement in wetland areas as for material placement within open water areas of the Site as noted above, except two amphibious dump trucks outfitted with stone slinger or conveyor apparatuses would be used in place of the two conveyor barges and material placement excavator. Amphibious dump trucks would consist of Marsh Buggy type equipment such as those manufactured by MBI and conceptually outfitted with a standard 12-cubic yard box and stone slinger or conveyor attachments for application of amendment material and/or sand.

No costs were incorporated for mowing, burning, knocking down, or otherwise preparing the wetland areas for cap placement.

Dredge Alternative

A general order of operations was assumed in order to facilitate costing of alternatives involving dredging. This order of operations was used to assist in selecting construction equipment, labor, production rates, time frames, etc. The general order of operations for the dredging alternative is described below.

- Contaminated sediments would be removed using a barge-mounted mechanical dredge with environmental clamshell bucket. A Real Time Kinematic (RTK) Global Positioning System (GPS) system would be used to track the position/cut of the bucket and the dredge’s progress.
- Dredged sediment would be immediately placed into a hopper and slurried with water from the Site. A large pump located onboard the barge would pump the sediment/water slurry to the adjacent U.S. Steel site and dewatering area located on shore.
- Polymer would be added to the incoming slurry to aid in settling and geotextile bags would be used to dewater sediments over a period of several months.
- Dredge contact water and precipitation falling on the lined pad would be treated and discharge back into the Site in compliance with discharge permits.
- Dewatered sediment would be excavated from the geotextile bags the next construction season and direct loaded onto trucks. Sediment would be hauled to a landfill and disposed of as non-hazardous waste.

Section 5: Environmental Controls and Construction Monitoring

Environmental controls and construction monitoring are important elements in mitigating environmental impacts occurring as a direct result from construction activities and also in ensuring remedial/construction goals are achieved. Environmental controls can include surface water control structures (e.g., silt curtains, sheet piling, and absorbent boom), lined sediment dewatering pads, tire washes, stormwater controls, and site fencing (for protection of human health). Construction monitoring can include turbidity monitoring during dredging activities, air monitoring during intrusive site activities, treated dredge contact water sampling, post-dredge verification sampling, cap thickness verification coring, bathymetric surveys, imported materials sampling, dewatered sediment sampling, and collection of pre- and post-construction upland soil samples within the staging area footprint. Alternatives involving amendment application or thin-layer cover construction as a remedy would likely require less controls and monitoring than alternatives incorporating dredging.

For the purposes of this FFS, it was assumed that alternatives consisting of amendment placement or cover construction would incorporate the following control and monitoring elements:

- Fencing at the Hallett Dock #7 staging area;
- Chemical and physical sampling of imported cover materials to ensure that they are suitable for use; and
- Cover thickness verification coring to ensure that project specifications are achieved.

Alternatives consisting of dredging sediments would require controls and monitoring as listed above for cover/cap placement and in addition:

- Hallett Dock #7 staging area fencing and U.S. Steel dewatering area fencing;
- Lined and bermed dewatering pad at the U.S. Steel dewatering area;
- Surface water controls;
- Real-time turbidity monitoring;
- Post-dredge verification sampling;
- Dewatered sediment sampling; and
- Treated dredge contact water sampling.

Surface water controls and turbidity monitoring will be particularly important for preventing suspension and off-site migration of contaminated sediments during dredging activities. Surface water control structures evaluated for this FFS include the use of two sets of non-structural barriers consisting of a “full height” turbidity/silt curtain anchored to the lake bed with a permeable fabric at the top 5 feet to accommodate the flow of water across the curtain while isolating suspended sediment. One of the turbidity barriers would be maintained within approximately 15 feet of the dredge. The second turbidity barrier would be placed near the railroad trestle separating the Site from MLE.

Turbidity monitoring would be conducted using real-time cellular monitoring buoys to ensure that potentially contaminated sediments are not being excessively suspended into the water column and transported downgradient during dredging. An allowable concentration of total suspended solids (TSS) above background would be determined during the design phase. A site-specific TSS: turbidity correlation would then be conducted so that a turbidity monitoring value could be established.

Section 6: Material Transport Between Site and Staging Area

In order to limit the frequency and travel time between the Site and material staging area (i.e., Hallett Dock #7), the use of a large transport barge was assumed and would be sufficiently sized to hold an entire days’ worth of cover materials. Use of a large transport barge would limit movement of the barge and materials between Hallett Dock #7 and the Site to two times per day.

Section 7: Sediment Dewatering and Dredge Contact Water Treatment

Dredged sediments will require dewatering prior to transportation and disposal at an off-site landfill. It was assumed for the purposes of this FFS that large geotextile tubes and addition of polymer to the dredge slurry would be used as the method of dewatering sediments. Sediments would be allowed to dewater until the next construction, when they would be excavated, loaded into trucks, and hauled to an off-site landfill for disposal.

A unit rate cost for sediment dewatering and treatment of dredge contact water was estimated based on professional experience of Bay West staff at $50 per cubic yard of sediment removed. This cost is considered an “all-in” value consisting of mobilization/demobilization, materials procurement (e.g., geotextile bags, treatment media), material disposal, labor, and treatment equipment costs. The extent and final cost of treatment will be dependent upon the effluent discharge location—Western Lake Superior Sanitary District (WLSSD) or SLR—and discharge permit requirements. It should be noted that sediment dewatering and water treatment costs are the single largest cost for the dredging alternatives and comprises approximately 25% of total project costs at the assumed unit rate cost of $50 per cubic yard of sediment removed.

Section 8: Transportation and Disposal

Transportation costs for sediment disposal were estimated on a per ton basis using truck rental and operator rate data obtained from RSMeans cost estimating software. It was assumed that each truck would carry 12 tons or 16 cubic yards (1.4 tons per cubic yard) and would complete two round trips per hour to the nearby Waste Management landfill. Correspondence with local landfill and sand and gravel companies indicate that transportation costs could be less than the $6.90 per cubic yard or $4.93 per ton estimated rate, but the estimated rate was retained within the cost estimates to provide a conservative scenario.

Disposal costs were obtained for the Vonco V Waste Management Campus (obtained during compilation of the Minnesota Slip Feasibility Study) located at 1100 West Gary Street in Duluth, Minnesota (approximately 2 miles northwest of the Site) and Shamrock Environmental Landfill located at 761 Highway 45 in Cloquet, Minnesota (approximately 13 miles west of the Site). Costs for these two disposal facilities were comparable for the purposes of this FFS, at $12 per ton and $16 per ton (not including environmental fees and taxes) respectively. The Vonco V landfill was used for the cost analysis due to its closer proximity to the Site.

Section 9: Cover/Cap Materials

Potential sources of cover/cap materials include materials from an upland borrow location (e.g., sand and gravel pit), sediments previously dredged for navigational purposes, and common earth upland soil. Natural materials such as dredged sediments and common earth upland soils often contain fine-grained components that make placement more difficult (Interstate Technology and Regulatory Council [ITRC], 2014). It was assumed for the purposes of the cost analyses that upland borrow materials would be used as no apparent source of dredged materials is readily available near the Site. Upland borrow material consisting of clean, washed sand was assumed for alternatives incorporating construction of a sand cover. The exact grain size specifications would be developed during the design phase but would likely consist of medium to coarse grain sands that would withstand mild erosive forces.

Section 11: References

USEPA, 2005. “Contaminated Sediment Remediation Guidance for Hazardous Waste Sites.”

Interstate Technology and Regulatory Council (ITRC) Contaminated Sediments Team, 2014. “Contaminated Sediments Remediation – Remedy Selection for Contaminated Sediments,” August.

Service Engineering Group (Service), 2002. *Data Gap Report, St. Louis River/Interlake/Duluth Tar Site*. November. Retrieved from https://www.barr.com/slridt/documents/DataGapReport/html%20files/datagap/report/dgr.htm, March, 2016.

Appendix B: Table 1
Volume, Rate, and Timeframe Calculations
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Remedial Areas

Total Remedial Area

Total wetland areas for remediation (acres)	8.2	
Total open water areas for remediation (acres)	31.9	
Total remedial area (acres)	40.1	

Contaminated Sediment/Dredge Volumes

Volume of Contaminated Sediment in Wetland Areas

Wetland areas (acres)	8.2	
Estimated depth of contamination (feet)	0.5	0.15 (meter)
Volume of contamination (cubic yards)	6647	

Volume of Contaminated Sediment in Open Water Areas

Open water area (acres)	31.9	
Estimated depth of contamination (feet)	1.64	0.5 (meter)
Volume of contamination (cubic yards)	84324	

Total Volume of Contaminated Sediment

Wetland areas (cubic yards)	6647	
Open water areas (cubic yards)	84324	
Total volume of contaminated sediment (cubic yards)	90971	

Dredge Volume - Alternative 4: Dredging with Wetland Restoration

Dredge volume (cubic yards)	90971	
Over-dredge depth (feet)	1.00	0.30 (meter)
Over-dredge volume (cubic yards)	64711	
Total dredge volume (cubic yards)	155682	

Dredge Volume - Alternative 5: Dredge Open Water Areas/Enhanced MNR with Thin-Layer Cover in Wetland Areas

Total open water area (acres)	31.9	
Dredge depth (feet)	1.64	0.5 (meter)
Over-dredge depth (feet)	1.00	
Dredge volume (cubic yards)	135741	

Appendix B: Table 1
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Amendment/Cover Volumes

Alternative 2: EMNR with Broadcasted Amendment			
Wetland areas (acres)	8.2		
Amendment thickness required per acre (inches)	0.3842975		(meter)
Amendment required (cubic yards)	426		
Wetland areas (acres)	8.2		
Amendment tons per acre	31		(metric tons)
Amendment required (tons)	255.44		
Open water areas (acres)	31.9		
Amendment thickness (inches)	0.3842975	0.010	(meter)
Amendment required (cubic yards)	1647		
Open water areas (acres)	31.9		
Amendment tons per acre	31		(metric tons)
Amendment required (tons)	987.97		
Total volume of amendment required for Alternative 2 (cubic yards)	2073		
Total mass of amendment required for Alternative 2 (metric tons)	1243.41		
Sedimite product bulk density (tons/CY)	0.57		Per manufacturer spec
Amendment application rate (tons/acre)	31		Per manufacturer spec
Amendment application rate (CY/acre)	54.4		
Amendment application rate (ft^3/acre)	1468.42		
Amendment layer thickness (cm)	1.03		
Total remedial area (acres)	40.1		
Total volume of amendment required (cubic yards)	2181.4		
Total mass of amendment required (metridc tons)	1243.4		
Alternative 3: Thin-Layer Amended Cover (Amendment Requirement)			
Amendment ratio (percent carbon by weight in upper 0.15 meter)	5		
Volume of sediment in upper 0.15 meter (cubic yards per acre)	794		
Assumed density of in-situ sediment (tons per cubic yard)	1.4		
Assumed weight of sediment in upper 0.15 meter (tons per acre)	1112		
Amount of activated carbon to be added (tons per acre)	56		
Assumed density of activated carbon (tons per cubic yard)	1.72		
Volume of activated carbon to be added (cubic yards per acre)	32		
Amendment layer thickness (cm)	0.610		
Total remedial area (acres)	40.1		
Total amendment volume (cubic yards)	1295.1		
Total amendment amount (tons)	2229.2		
Wetland area (acres)	8.2		
Total amendment volume for wetland areas (cubic yards)	266.1		
Total amendment amount for wetland areas (tons)	458.0		
Open water areas (acres)	31.9		
Total amendment volume for open water areas (cubic yards)	1029.1		
Total amendment amount for open water areas (tons)	1771.3		
Amount of activated carbon to be placed (cubic yards per acre)	0.0200138		
Thickness of amendment (centimeter)	0.6100218		
Conservative factor	1		
Assumed amount of activated carbon to be purchased (tons per acre)	56		Used to determine shipping costs
Ammendment required for wetland areas (tons)	461		
Ammendment required for open water areas (tons)	1785		
Ammendment Required for Site (tons)	2246		
Ammendment Required for Site (cubic yards)	1295		
Ammendment required for wetland areas (cubic yards)	266		
Ammendment required for open water areas (cubic yards)	1029		
Alternative 3: Thin-Layer Amended Cover (Sand Requirement)			
Cover thickness (inches)	6.0	0.15	(meter)
Sand and amendment required (cubic yards per acre)	806.66667		
Subtract out amendment (cubic yards per acre)	32		
Sand required, less amendment (cubic yards per acre)	774		
Sand required for Site (cubic yards)	31060		
Sand required for wetland areas (cubic yards)	6381		
Sand required for open water areas (cubic yards)	24679		
Total volume of materials required for Site (cubic yards)	32355		
Volume of materials required in Wetland Areas (cubic yards)	6647		
Volume of materials required in Open Water Areas (cubic yards)	25708		

Appendix B: Table 1
Volume, Rate, and Timeframe Calculations
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Alternative 4: Total Dredge with Wetland Restoration

Wetland areas (acres)	8.2			
Dredge depth/sand replacement thickness (feet)	1.50		1.3	(meter)
Sand required (cubic yards)	19941			
Open water areas (acres)	31.87			
Sand layer thickness (inches)	6		0.15	(meter)
Sand required (cubic yards)	25708			
Total amount of sand required for Alternative 4	45649			

Alternative 5: Dredge Open Water Areas, EMNR with Thin-Layer Amended Cover in Wetland Areas

Wetland areas (acres)	8.2	From Alternative #3
Cover thickness (inches)	6	From Alternative #3
Sand required (cubic yards)	6381	From Alternative #3
Amendment required (cubic yards)	266	From Alternative #3
Total materials required (cubic yards)	6647	From Alternative #3
Total materials required (tons)	11179	From Alternative #3
Open water areas (acres)	31.87	From Alternative #4
Sand layer thickness (inches)	6	From Alternative #4
Sand required (cubic yards)	25708	From Alternative #4

Production Rates

Stone Slinger Barge Production Rate (Broadcasted Amendment in Open Water Areas - Alternative #2

Cycle Time			
Hopper capacity (cubic yards)	12		
Application time per cubic yard placed (minutes)	6		
Application time per load (minutes)	72	1.2	hours
Load time (minutes)	5	0.083	hours
Add in time for travel (minutes)	10	0.17	hours
Total cycle time (hours)	1.45		
Production Rate			
Active placement time per day (hours)	11		
Number of cycles per day per barge	7		
Number of barges	2		
Total volume of amendment applied per day (cubic yards)	168		

Sand and/or Amendment Placement Rate (Placed by Excavator in Open Water Areas - Alternatives #3, 4, and 5)

Bucket size (cubic yards)	2	
Percent fill	70	
Material per bucket (cubic yards)	1.4	
Minutes per cycle	2	
Active placement duration per day (hours)	10	
Daily production (cubic yards)	420	Rate will require two material supply barges per day

Amphibious Dump Truck Production Rate (Amendment Placement in Wetland Areas - Alternatives #2, 3, and 5)

Cycle Time			
Average round trip travel distance (miles)	0.42		
Average water speed (miles per hour)	1.5		
Travel time (hours)	0.28		
Truck capacity (cubic yards)	12		
Application time per cubic yard placed (minutes)	6	0.10	hours
Application time per load (minutes)	72	1.20	hours
Load time (minutes)	5	0.08	hours
Total cycle time (hours)	1.56		
Production Rate			
Active placement time per day (hours)	11		
Number of cycles per day per truck	7		
Number of trucks	2		
Total production per day (cubic yards)	168		

Dredge Production Rate

Bucket size (cubic yards)	3.0
Percent fill	80
Sediment per bucket (cubic yards)	2.4
Minutes per cycle	2.0
Active dredging duration per day (hours)	10.0
Daily production (cubic yards)	720

Appendix B: Table 1
Volume, Rate, and Timeframe Calculations
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Geotextile Bag Requirements

Total dredge volume (cubic yards)	155682			
Length of geotextile bag required (feet)	38920	Assume 4 cubic yards per 1 foot of bag length		
Area requirement for bags (square feet)	622726	Assume 13 feet diameter bags, 16 feet wide settled width		
Area requirement for bags stacked three high (square feet)	207575			
Add in 20 percent of area for sump, treatment plant, and working space	41515			
Total area required for dewatering pad (square feet)	249090		5.7	(acres)

Construction Timeframe

Alternative 2: Enhanced MNR with Broadcasted Amendment				
Construct staging area and mobilize/setup equipment (days)	5			
Place amendment in wetland areas (days)	3			
Place amendment in open water areas (days)	10			
Breakdown equipment/demobilize and site restoration (days)	5			
Total time on-site (days)	23		5	weeks
Alternative 3: Enhanced MNR with Thin-Layer Amended Cover				
Construct staging area and mobilize/setup equipment (days)	5			
Place amendment in wetland areas (days)	40			
Place amendment in open water areas (days)	62			
Breakdown equipment/demobilize and site restoration (days)	5			
Total time on-site (days)	112		22	weeks
Alternative 4: Dredging with Wetland Restoration				
Construction Season #1				
Construct staging area and mobilize/setup equipment (days)	15			
Dredge sediments (days)	108.5	Assumes 24 hours per day, 5 days per week		
	123.5		25	weeks
Construction Season #2				
Place sand cover (days)	109			
Dewatered sediment excavation (days)	104	Sand cover and sediment excavation conducted concurrently		
Plant wetlands; breakdown equipment/demob and site restoration (days)	10			
	119		24	weeks
Alternative 5: Dredge Open Water Areas/Enhanced MNR in Wetland Areas with Thin-Layer Amended Cover				
Construction Season #1				
Construct staging area and mobilize/setup equipment (days)	15			
Dredge sediments in open water areas (days)	95	Assumes 24 hours per day, 5 days per week; Conducted concurrently with wetland work		
Place amended cover in wetland areas (days)	40	Conducted concurrently with dredging		
Place sand cover in open water areas (days)	61			
Breakdown equipment/demob and site restoration (days)	10			
	182		37	weeks
Construction Season #2				
Dewatered sediment excavation (days)	91		19	weeks

Appendix B: Table 2
Unit Rate Calculations
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Surface Broadcast Amendment Material in Open Water Areas (Alt. #2)

Description	Unit	Unit Cost	Quantity	Extended	Comments
Equipment					
Skid steer	Day	366.00	1	$366.00	Consolidate materials on material supply barge
Barge-mounted Derrick crane	Day	466.00	1	$466.00	Load transport hopper barges
Derrick crane barge platform	Day	684.00	1	$684.00	Moored to dolphin pilings driven along railroad tracks
Stone slinger and hopper	Day	508.00	2	$1,016.00	12 cubic yard capacity hopper
Placement barge	Day	129.00	2	$258.00	Carries hopper and stone slinger
Push boat	Day	373.00	2	$746.00	
Pickup trucks	Day	97.00	3	$291.00	Site supervisor, foreman, mechanic
			SUBTOTAL	$3,827.00	
Labor					
On-site project management	Day	1200.00	1	$1,200.00	
Foreman	Day	854.00	1	$854.00	
Mechanic	Day	980.00	1	$980.00	
Derrick crane/skid steer operator	Day	1106.00	1	$1,106.00	
Stone slinger operators	Day	1036.00	2	$2,072.00	
Push boat operators	Day	1036.00	2	$2,072.00	
Lodging and Per-Diem	Day	146.00	8	$1,168.00	
			SUBTOTAL	$9,452.00	
			TOTAL	$13,279.00	
			DAILY PRODUCTION (CY)	168.00	
			UNIT RATE (CY)	$79.04	

Place Materials in Open Water Areas

Description	Unit	Unit Cost	Quantity	Extended	Comments
Equipment					
Skid steer	Day	$366.00	1	$366.00	Consolidate materials on material supply barge
Barge-mounted Derrick crane	Day	$466.00	1	$466.00	Load transport hopper barges
Derrick crane barge platform	Day	$684.00	1	$684.00	Moored to dolphin pilings driven along railroad tracks
Transport hopper barges	Day	$129.00	2	$258.00	25 cubic yard capacity hopper barges
Transport tug	Day	$373.00	1	$373.00	Small tug to transport hopper barges
Barge-mounted excavator	Day	$1,265.00	1	$1,265.00	Place amendment
Clamshell bucket	Day	$70.00	1	$70.00	
RTK DGPS for dredge	Day	$190.00	1	$190.00	
Excavator barge	Day	$355.00	1	$355.00	With spuds and winches
Pickup trucks	Day	$97.00	3	$291.00	Site supervisor, foreman, mechanic
			SUBTOTAL	$4,318.00	
Labor					
On-site project management	Day	$1,200.00	1	$1,200.00	
Foreman	Day	$854.00	1	$854.00	
Mechanic	Day	$980.00	1	$980.00	
Derrick crane	Day	$1,106.00	1	$1,106.00	
Skid steer operator/bargehand	Day	$1,036.00	1	$1,036.00	
Tug operator	Day	$1,036.00	1	$1,036.00	
Excavator operator	Day	$1,106.00	1	$1,106.00	
Laborer	Day	$812.00	1	$812.00	
Lodging and Per-Diem	Day	$146.00	7	$1,022.00	
			SUBTOTAL	$9,152.00	
			TOTAL	$13,470.00	
			DAILY PRODUCTION (CY)	420	Rate requires two material supply barges per day to Site
			UNIT RATE (CY)	$32.07	

Place Materials in Wetland Areas

Description	Unit	Unit Cost	Quantity	Extended	Comments
Equipment					
Skid steer	Day	$366.00	1	$366.00	Consolidate materials on material supply barge
Barge-mounted Derrick crane	Day	$466.00	1	$466.00	Load amphibious dump trucks
Derrick crane barge platform	Day	$684.00	1	$684.00	Moored to dolphin pilings driven along railroad tracks
Amphibious dump truck (swamp buggy)	Day	$2,764.00	2	$5,528.00	With stone slinger or conveyor attachment
Dump and conveyor attachment	Day	$508.00	2	$1,016.00	
			SUBTOTAL	$8,060.00	
Labor					
On-site project management	Day	$1,200.00	1	$1,200.00	
Foreman	Day	$854.00	1	$854.00	
Mechanic	Day	$980.00	1	$980.00	
Derrick crane operator	Day	$1,106.00	1	$1,106.00	
Amphibious dump truck operators	Day	$1,106.00	2	$2,212.00	
Lodging and per-diem	Day	$146.00	6	$876.00	
			SUBTOTAL	$7,228.00	
			TOTAL	$15,288.00	
			DAILY PRODUCTION (CY)	168	
			UNIT RATE (CY)	$91.00	

Appendix B: Table 2
Unit Rate Calculations
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Dredge Sediments

Description	Unit	Unit Cost	Quantity	Extended	Comments
Equipment					
Long-reach excavator	Day	$2,656.44	1	$2,656	Large 3 cubic yard excavator
Clamshell bucket	Day	$70.00	1	$70	3 cubic yard clamshell bucket
RTK DGPS for dredge	Day	$190.00	1	$190	
Dredge barge	Day	$355.00	1	$355	With spuds, winches, power
On-board hopper	Day	$254.00	1	$254	
On-board booster pump	Day	$1,208.00	1	$1,208	
Dredge barge tug	Day	$373.00	1	$373	150 hp large work boat
Butt fusion machine	Day	$76.00	1	$76	
12" HDPE Pipeline (Per 1000')	Day	$200.00	2.5	$500	2,500 feet (far end to top of hill)
Pickup Trucks	Day	$97.00	3	$291	Site supervisor, foreman, mechanic
			SUBTOTAL	$5,973	
Labor					Assumes 12 hour day with overtime
On-site project management	Day	$1,200.00	1	$1,200	
Foreman	Day	$854.00	1	$854	
Mechanic	Day	$980.00	1	$980	
Dredge operator	Day	$1,106.00	1	$1,106	
Dredgehand/laborer	Day	$812.00	1	$812	
Tug operator/dredgehand	Day	$1,036.00	1	$1,036	
Lodging and Per-Diem	Day	$146.00	6	$876	
			SUBTOTAL	$6,864	
			TOTAL	$12,837	
			DAILY PRODUCTION (CY)	720	
			UNIT RATE (CY)	$17.83	

Dewatered Sediment Excavation

Excavate Bag Field (12-hour day)					
2 CY Excavator (x2)	Day	$1,265.00	2	$2,530.00	Load 7.8 trucks per hour per each excavator; load every 7.7 minutes
Water Truck	Day	$861.00	1	$861.00	
Operator (x2)	Day	$1,106.00	2	$2,212.00	
Laborer (x2)	Day	$812.00	2	$1,624.00	
Add in lodging and per-diem for 4 man crew	Day	$146.00	4	$584.00	
Full-time on-site project management and foreman	Day	$2,540.00	1	$2,540.00	
			TOTAL	$10,351.00	
			DAILY PRODUCTION (CY)	1500	Limited by load time
			UNIT RATE (CY)	$6.90	

Sediment Hauling and Landfill Disposal

Transport sediments to landfill	Ton	$4.93	1	$4.93	
Dispose of sediments at landfill					Vonco V Landfill in Duluth
Disposal	Ton	$12.00	1	$12.00	
Environmental Fee	Ton	$0.27	1	$0.27	
Industrial Solid Waste Tax	Ton	$0.46	1	$0.46	
			UNIT RATE (TON)	$17.66	

Purchase and Import Amendment

Purchase amendment material (Sedimite)	Ton	$4,000.00	1	$4,000.00	
Import amendment material to staging area	Ton	$0.00	1	$0.00	Cost included for delievery to site
			UNIT RATE (TON)	$4,000.00	
			UNIT RATE (CY)	$6,349.00	Assume 0.61 tons per CY
Purchase amendment material (Acitivated Carbon)	Ton	$3,000.00	1	$3,000.00	
Import amendment material to staging area	Ton	$0.00	1	$0.00	Cost included for delievery to site
			UNIT RATE (TON)	$3,000.00	
			UNIT RATE (CY)	$1,765.00	Assume 1.7 tons per CY

Purchase and Import Sand

Purchase sand from upland borrow source	CY	$6.90	1	$6.90	
Import sand to staging area	CY	$13.90	1	$13.90	40 mile cycle; 15 minute wait
			UNIT RATE (CY)	$20.80	

Load Material Transport Barge and Barge Materials to Site

Description	Unit	Unit Cost	Quantity	Extended	Comments
Equipment					
Material supply barge	Day	684.00	1	$684.00	30'x90'; 400 ton; operate between Site and Hallett Dock #7
Telehandler	Day	567.00	1	$567.00	Unload supersacks, load into hopper
Hopper/conveyor	Day	508.00	1	$508.00	Load material supply barge
Large tug	Day	2388.24	1	$2,388.24	
Labor					
Operator	Day	1036.00	1	$1,036.00	12-hr shift w/ overtime
Laborer	Day	812.00	1	$812.00	12-hr shift w/ overtime
Tug Captain	Day	632.00	1	$632.00	8-hr shift
Bargehand	Day	464.00	1	$464.00	8-hr shift
			TOTAL	$7,091	
			BARGE CAPACITY (TONS)	200	Assume 50% of capacity due to draft in Mud Lake East
			BARGE CAPACITY (CY)	143	1.4 tons per CY
			UNIT RATE (CY)	$50.00	Rounded

Appendix B: Table 2
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Construction Quality Assurance and Oversight					
Description	Unit	Unit Cost	Quantity	Extended	Comments
QA/QC and federal oversight personnel	Week	$10,200.00	1	$10,200	Two staff
Lodging and per-diem	Week	$1,460.00	1	$1,460	Two staff
Truck and mileage	Week	$1,142.00	1	$1,142	Includes mileage
			UNIT RATE (WEEK)	$12,802	

Monthly Operating Expenses and Site Security					
Description	Unit	Unit Cost	Quantity	Extended	Comments
Field Offices					
Office trailers and storage boxes (3)	Month	$942.00	1	$3,888.00	Includes utilities, equipment, and supplies for three units
Security Guard	Month	$17,280.00	1	$17,280.00	$40 per hour; 108 hours per week
			UNIT RATE (MONTH)	$21,000	Rounded

Appendix B: Table 3
Lump Sum Costs
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Lump Sum Costs - Alternative 1: No Action

No lump sum costs associated with Alternative 1.

Lump Sum Costs - Alternative 2: Enhanced MNR with Broadcasted Amendment

Description	Unit	Unit Cost	Quantity	Extended	Comments
Mobilization/Demobilization					
Office trailers (3) and connex boxes to staging area	Mile	12.26	240	$2,942.40	To staging area; within 20 miles of site
Skid steer	Each	$1,578.00	1	$1,578.00	To staging area
Telehandler	Each	$1,914.00	1	$1,914.00	To staging area
Hopper/conveyor	Each	$1,914.00	1	$1,914.00	To staging area
Pickup trucks (3)	Mile	$0.56	1500	$840.00	To staging area; 250 miles each way
Push boats (2)	Each	$1,914.00	1	$1,914.00	To staging area; 1 load
Derrick crane	Each	$2,796.00	1	$2,796.00	To staging area
Derrick crane barge platform	Hour	$1,634.00	4	$6,536.00	To staging area; sourced from Duluth Harbor
Stone slinger and hoppers (2)	Each	$1,914.00	1	$1,914.00	To staging area; 1 load
Placement barges (2)	Each	$1,914.00	2	$3,828.00	To staging area; 2 loads
Amphibious dump trucks (2)	Each	$11,184.00	2	$22,368.00	To staging area; assumed double cost for wide load and chase vehicles
Material supply barge	Hour	$1,634.00	4	$6,536.00	To staging area; sourced from Duluth Harbor
Large tug	Hour	$1,634.00	4	$6,536.00	To staging area; sourced from Duluth Harbor
Additional mileage for non-local equipment	Mile	$2.52	2500	$6,300.00	Assume 5 loads non-local; 250 miles away
Additional mileage for amphibious dump trucks	Mile	$5.04	2000	$10,080.00	Assume double cost; sourced from 1,000 miles away
Install staging area fencing	LF	$5.39	1500	$8,085.00	Install fencing around staging area perimeter
Assemble and launch equipment	Day	$10,000.00	1	$10,000.00	Half day each mob/demob
Mobilize equipment from Hallett Dock #7 to Site	Day	$10,000.00	1	$10,000.00	Half day each mob/demob
Staging area setup/breakdown	Day	$10,000.00	4	$40,000.00	Setup/breakdown staging area; 2 days each
Equipment setup and breakdown	Day	$10,000.00	6	$60,000.00	Setup/breakdown equipment; 3 days each
				$206,000.00	Rounded
Install and Remove Dolphin Pilings					
Equipment and Labor					
Work barge	Day	$855.00	1	$855.00	Monthly rate times 1.25
Tug	Day	$2,985.30	1	$2,985.30	Monthly rate times 1.25
Crane	Day	$2,150.10	1	$2,150.10	Monthly rate times 1.25
Hammer	Day	$143.48	1	$143.48	Monthly rate times 1.25
Tug captain/crane operator	Day	$1,106.00	1	$1,106.00	12-hour workday with overtime
Laborers	Day	$812.00	2	$1,624.00	12-hour workday with overtime
			TOTAL DAILY COST	$8,863.88	
Installation Work Activities					
Prep/"de-prep" equipment	Day	$8,863.88	1	$8,863.88	
Travel to/from Duluth; launch/pull equipment	Day	$8,863.88	3	$26,591.63	
Travel to/from Site; drive pilings	Day	$8,863.88	1	$8,863.88	
Removal Work Activities	Lump Sum	$44,319.38	1	$44,319.38	Same costs as installation
Materials	Lump Sum	$6,000.00	1	$6,000.00	
			TOTAL PROJECT COST	$95,000.00	Rounded

Appendix B: Table 3
Lump Sum Costs
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Lump Sum Costs - Alternative 3: Enhanced MNR with Thin-Layer Amended Cover

Description	Unit	Unit Cost	Quantity	Extended	Comments
Mobilization/Demobilization					
Office trailers (3) and connex boxes to staging area	Mile	$12.26	240	$2,942.40	To staging area; within 20 miles of site
Skid steer	Each	$1,578.00	1	$1,578.00	To staging area; within 20 miles of site
Telehandler	Each	$1,914.00	1	$1,914.00	To staging area; within 20 miles of site
Hopper/conveyor	Each	$1,914.00	1	$1,914.00	To staging area; within 20 miles of site
Pickup trucks (3)	Mile	$0.56	1500	$840.00	To staging area; 250 miles each way
Derrick crane	Each	$5,592.00	1	$5,592.00	To staging area; within 20 miles of site
Derrick crane barge platform	Hour	$1,634.00	4	$6,536.00	To staging area; sourced from Duluth Harbor
Transport hopper barges (2)	Each	$1,914.00	2	$3,828.00	To staging area; 2 loads
Transport tug	Each	$1,914.00	1	$1,914.00	To staging area
Excavator	Each	$1,914.00	1	$1,914.00	To staging area; within 20 miles of site
Excavator barge	Each	$1,914.00	1	$1,914.00	To staging area
Amphibious dump trucks (2)	Each	$11,184.00	2	$22,368.00	To staging area; assumed double cost for wide load and chase vehicles
Stone slinger and hoppers (2)	Each	$1,914.00	1	$1,914.00	To staging area; 1 load
Material supply barge	Hour	$1,634.00	4	$6,536.00	To staging area; sourced from Duluth Harbor
Large tug	Hour	$1,634.00	4	$6,536.00	To staging area; sourced from Duluth Harbor
Additional mileage for non-local equipment	Mile	$2.52	2500	$6,300.00	Assume 5 loads non-local; 250 miles away
Additional mileage for amphibious dump trucks	Mile	$5.04	2000	$10,080.00	Assume double cost; sourced from 1,000 miles away
Install staging area fencing	LF	$5.39	1500	$8,085.00	Install fencing around staging area perimeter
Assemble and launch equipment	Day	$10,000.00	1	$10,000.00	Half day each mob/demob
Mobilize equipment from Hallett Dock #7 to Site	Day	$10,000.00	1	$10,000.00	Half day each mob/demob
Staging area setup/breakdown	Day	$10,000.00	4	$40,000.00	Setup/breakdown staging area; 2 days each
Equipment setup and breakdown	Day	$10,000.00	6	$60,000.00	Setup/breakdown equipment; 3 days each
				$213,000	Rounded
Install Dolphin Pilings	Lump Sum	$95,000.00	1	$95,000	Same cost as shown for Alternative 2

Appendix B: Table 3
Lump Sum Costs
Focused Feasibility Study
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Lump Sum Costs - Alternative 4: Dredging with Wetland Restoration

Description	Unit	Unit Cost	Quantity	Extended	Comments
Mobilization/Demobilization					
Office trailers (3) and connex boxes to staging area	Mile	$12.26	240	$2,942	To staging area; within 20 miles of site
Skid steer	Each	$1,578.00	1	$1,578	To staging area; within 20 miles of site
Telehandler	Each	$1,914.00	1	$1,914	To staging area; within 20 miles of site
Hopper/conveyor	Each	$1,914.00	1	$1,914	To staging area; within 20 miles of site
Pickup trucks (3)	Mile	$0.56	1500	$840	To staging area; 250 miles each way
Derrick crane	Each	$5,592.00	1	$5,592	To staging area; within 20 miles of site
Derrick crane barge platform	Hour	$1,634.00	4	$6,536	To staging area; sourced from Duluth Harbor
Transport hopper barges (2)	Each	$1,914.00	2	$3,828	To staging area; 2 loads
Transport tug	Each	$1,914.00	1	$1,914	To staging area
Excavator	Each	$1,914.00	1	$1,914	To staging area; within 20 miles of site
Excavator barge	Each	$1,914.00	1	$1,914	To staging area
Hopper, booster pump, bucket, fusion machine	Each	$1,914.00	1	$1,914	To staging area
Dredge barge tug	Each	$1,914.00	1	$1,914	To staging area
HDPE pipe	Each	$1,914.00	1	$1,914	To staging area
Material supply barge	Hour	$1,634.00	4	$6,536	To staging area; sourced from Duluth Harbor
Large tug	Hour	$1,634.00	4	$6,536	To staging area; sourced from Duluth Harbor
Additional mileage for non-local equipment	Mile	2.52	4000	$10,080	Assume 8 loads non-local; 250 miles away
Additional mileage for amphibious dump trucks	Mile	5.04	2000	$10,080	Assume double cost; sourced from 1,000 miles away
Launch/remove equipment	Day	$10,000.00	1	$10,000	Half day each mob/demob
Mobilize equipment from Hallett Dock #7 to Site	Day	$10,000.00	1	$10,000	Half day each mob/demob
Equipment setup and breakdown	Day	$10,000.00	10	$100,000	Setup/breakdown equipment; 5 days each
				$190,000	Rounded
Site Work					
Clear and grub staging area	Acre	$10,489	6	$62,934	4-acre pad, 2-acre laydown area
Construct haul roads	SY	$13.10	6667	$87,338	8-inch crushed concrete; assume 3,000 feet of road at 20 feet wide
Construct laydown areas	SY	$11.20	9680	$108,416	4-inch crushed concrete; assume 2 acres
Construct site fencing	LF	$5.39	2500	$13,475	Surrounding 6-7 acre area
Construct dewatering pad	SF	$2.00	249090	$498,181	Assumes hydraulic pumping and dewatering of sediments
Site supervision during site work	Day	$2,540.00	10	$25,400	Assume 10 days during haul road and pad construction
			TOTAL	$796,000	Rounded
Install Dolphin Pilings	Lump Sum	$95,000.00	1	$95,000	Same cost as shown for Alternative 2
Turbidity Controls	SF	$7.60	4012	$30,000	50' radius around dredge, 8' deep; 150' curtain at trestle, 10' deep
Wetland Restoration	Acre	$16,880.00	8	$139,000	
Construction Monitoring and Sample Analysis					
Air Monitoring	Week	$600.00	21	$12,600.00	Three monitors and software; Dewatered sediment excavation
Turbidity Monitoring	Week	$750.00	22	$16,500.00	Three buoys and software; dredging duration
Pre- and Post-Construction Soil Sampling					
Dioxins/Furans (EPA 8290A)	Per Sample	$595.00	48	$28,560.00	One composite sample per 1/4 acre, 4 grabs/composite
Select Metals* (EPA 6020A/7471B)	Per Sample	$32.00	48	$1,536.00	One composite sample per 1/4 acre, 4 grabs/composite
Treated Discharge Water Sampling					
TSS (SM 2540 D)	Per Sample	$14.00	22	$308.00	1 sample per week
Dioxins/Furans (EPA 8290A)	Per Sample	$595.00	22	$13,090.00	1 sample per week
Select Metals* (EPA 6020A/7471B)	Per Sample	$32.00	22	$704.00	1 sample per week
Low-level Mercury	Per Sample	$85.00	22	$1,870.00	1 sample per week
Surface Water Sampling					
TSS (SM 2540 D)	Per Sample	$14.00	22	$308.00	One sample per week
Turbidity (EPA 180.1)	Per Sample	$10.00	22	$220.00	One sample per week
Dioxins/Furans (EPA 8290A)	Per Sample	$595.00	22	$13,090.00	One sample per week
Select Metals* (EPA 6020A/7471B)	Per Sample	$32.00	22	$704.00	One sample per week
Post-Dredge Verification Sampling					
Select Metals* (EPA 6020A/7471B)	Per Sample	$32.00	160	$5,120.00	One sample per 1/4 acre
Dewatered Sediment Sampling					
TCLP Metals* (EPA 6020A/7471B)	Per Sample	$110.00	31	$3,410.00	One sample per 5,000 CY
Flash Point	Per Sample	$10.00	31	$310.00	One sample per 5,000 CY
pH (EPA 9045)	Per Sample	$10.00	31	$310.00	One sample per 5,000 CY
Paint Filter	Per Sample	$0.00	31	$0.00	One sample per 5,000 CY
			TOTAL	$99,000.00	Rounded

Appendix B: Table 3
Lump Sum Costs
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Lump Sum Costs - Alternative 5: Dredge Open Water Areas/Enhanced MNR with Thin-Layer Cover in Wetland Areas

Description	Unit	Unit Cost	Quantity	Extended	Comments
Mobilization/Demobilization					
Office trailers (3) and connex boxes to staging area	Mile	12.26	240	$2,942.00	To staging area; within 20 miles of site
Skid steer	Each	$1,578.00	1	$1,578.00	To staging area; within 20 miles of site
Telehandler	Each	$1,914.00	1	$1,914.00	To staging area; within 20 miles of site
Hopper/conveyor	Each	$1,914.00	1	$1,914.00	To staging area; within 20 miles of site
Pickup trucks (3)	Mile	$0.56	1500	$840.00	To staging area; 250 miles each way
Derrick crane	Each	$1,914.00	1	$5,592.00	To staging area; within 20 miles of site
Derrick crane barge platform	Hour	$2,796.00	4	$6,536.00	To staging area; sourced from Duluth Harbor
Transport hopper barges (2)	Each	$1,634.00	2	$3,828.00	To staging area; 2 loads
Transport tug	Each	$1,914.00	1	$1,914.00	To staging area
Excavator	Each	$1,914.00	1	$1,914.00	To staging area; within 20 miles of site
Excavator barge	Each	$11,184.00	1	$1,914.00	To staging area
Hopper, booster pump, bucket, fusion machine	Each	$1,634.00	1	$1,914.00	To staging area
Dredge barge tug	Each	$1,634.00	1	$1,914.00	To staging area
HDPE pipe	Each	$2.52	1	$1,914.00	To staging area
Material supply barge	Hour	$5.04	4	$6,536.00	To staging area; sourced from Duluth Harbor
Large tug	Hour	$5.39	4	$6,536.00	To staging area; sourced from Duluth Harbor
Amphibious dump trucks (2)	Each	$11,184.00	2	$22,368.00	To staging area; assumed double cost for wide load and chase vehicles
Stone slinger and hoppers (2)	Each	$1,914.00	1	$1,914.00	To staging area; 1 load
Additional mileage for non-local equipment	Mile	$2.52	4000	$10,080.00	Assume 8 loads non-local; 250 miles away
Additional mileage for amphibious dump trucks	Mile	$5.04	2000	$10,080.00	Assume double cost; sourced from 1,000 miles away
Launch/remove equipment	Day	$10,000.00	1	$10,000.00	Half day each mob/demob
Mobilize equipment from Hallett Dock #7 to Site	Day	$10,000.00	1	$10,000.00	Half day each mob/demob
Equipment setup and breakdown	Day	$10,000.00	10	$100,000.00	Setup/breakdown equipment; 5 days each
			TOTAL	$214,000.00	Rounded
Site Work	Lump Sum	$796,000	1	$796,000	Approximately same costs as Alternative 4
Install Dolphin Pilings	Lump Sum	$95,000	1	$95,000	Same costs as Alternative 4
Turbidity Controls	Lump Sum	$30,000	1	$30,000	Same costs as Alternative 4
Construction Monitoring and Sample Analysis	Lump Sum	$99,000.00	1	$99,000	Approximately same costs as Alternative 4

Appendix B: Table 4
Monitoring Elements
Focused Feasibility Study
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Monitoring and Evaluation Costs - Alternative 1: No Action

No monitoring and evaluation costs associated with Alternative 1.

Monitoring and Evaluation Costs - Alternative 2: Enhanced MNR with Broadcasted Amendment

Monitoring Elements	Unit	Cost	Extended	Total	Comment
Monitoring and Evaluation Report	Each	$4,000.00	6	$24,000	Every 5 years for 30 years
Field Sampling	Event	$34,000.00	6	$204,000	Every 5 years for 30 years
Sample Analysis	Event	$55,520.00	6	$333,120	Every 5 years for 30 years
Dioxins (EPA 8290)	*Sample*	*$595.00*	*10*	*$5,950.00*	*10 locations*
Grain Size (ASTM D422 w/ Hydrometer)	*Sample*	*$375.00*	*5*	*$1,875.00*	*Needed for tox/bio; 5 locations*
TOC Quad Burn (EPA 9060A)	*Sample*	*$105.00*	*5*	*$525.00*	*Needed for tox/bio; 5 locations*
10-d toxicity C. tentans	*Sample*	*$1,638.00*	*5*	*$8,190.00*	*5 locations*
28-d toxicity H. azteca	*Sample*	*$2,013.00*	*5*	*$10,065.00*	*5 locations*
28-d bioaccumulation	*Sample*	*$2,013.00*	*5*	*$10,065.00*	*5 locations*
Dioxins (Benthic Tissue)	*Sample*	*$595.00*	*25*	*$14,875.00*	*Individual replicate analysis*
Lipids content (Pace SOP)	*Sample*	*$100.00*	*10*	*$1,000.00*	*One composite per sample; benthics and fish*
Dioxins (Fish Tissue)	*Sample*	*$595.00*	*5*	*$2,975.00*	*Five composite samples from five species*
				$55,520.00	*Rounded*
				$561,000	Rounded

Monitoring and Evaluation Costs - Alternative 3: Enhanced MNR with Thin-Layer Amended Cover

Monitoring Elements	Unit	Cost	Extended	Total	Comment
Monitoring and Evaluation Report	Each	$4,000.00	6	$24,000	Every 5 years for 30 years
Field Sampling	Event	$34,000.00	6	$204,000	Every 5 years for 30 years
Sample Analysis	Event	$61,470.00	6	$368,820	Every 5 years for 30 years
Dioxins (EPA 8290)	*Sample*	*$595.00*	*20*	*$11,900.00*	*10 cover samples; 10 from below cover*
Grain Size (ASTM D422 w/ Hydrometer)	*Sample*	*$375.00*	*5*	*$1,875.00*	*Needed for tox/bio; 5 locations*
TOC Quad Burn (EPA 9060A)	*Sample*	*$105.00*	*5*	*$525.00*	*Needed for tox/bio; 5 locations*
10-d toxicity C. tentans	*Sample*	*$1,638.00*	*5*	*$8,190.00*	*5 locations*
28-d toxicity H. azteca	*Sample*	*$2,013.00*	*5*	*$10,065.00*	*5 locations*
28-d bioaccumulation	*Sample*	*$2,013.00*	*5*	*$10,065.00*	*5 locations*
Dioxins (Benthic Tissue)	*Sample*	*$595.00*	*25*	*$14,875.00*	*Individual replicate analysis*
Lipids content (Pace SOP)	*Sample*	*$100.00*	*10*	*$1,000.00*	*One composite per sample; benthics and fish*
Dioxins (Fish Tissue)	*Sample*	*$595.00*	*5*	*$2,975.00*	*Five composite samples from five species*
				$61,470.00	
				$597,000	Rounded

Monitoring and Evaluation Costs - Alternative 4:Dredging with Wetland Restoration

No monitoring and evaluation costs associated with Alternative 4.

Appendix B: Table 4
Monitoring Elements
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Minnesota Pollution Control Agency

Monitoring and Evaluation Costs - Alternative 5: Dredge Open Water Areas/Enhanced MNR in Wetland Areas with Thin-Layer Amended Cover

Monitoring Elements	Unit	Cost	Extended	Total	Comment
Monitoring and Evaluation Report	Each	$4,000.00	6	$24,000	Every 5 years for 30 years
Field Sampling	Event	$34,000.00	6	$204,000	Every 5 years for 30 years
Sample Analysis	Event	$37,082.00	6	$222,492	Every 5 years for 30 years
Dioxins (EPA 8290)	*Sample*	*$595.00*	*10*	*$5,950.00*	*5 cover samples; 5 from below cover; wetland areas only*
Grain Size (ASTM D422 w/ Hydrometer)	*Sample*	*$375.00*	*3*	*$1,125.00*	*Needed for tox/bio; 3 locations in wetland areas*
TOC Quad Burn (EPA 9060A)	*Sample*	*$105.00*	*3*	*$315.00*	*Needed for tox/bio; 3 locations in wetland areas*
10-d toxicity C. tentans	*Sample*	*$1,638.00*	*3*	*$4,914.00*	*3 locations in wetland areas*
28-d toxicity H. azteca	*Sample*	*$2,013.00*	*3*	*$6,039.00*	*3 locations in wetland areas*
28-d bioaccumulation	*Sample*	*$2,013.00*	*3*	*$6,039.00*	*3 locations in wetland areas*
Dioxins (Benthic Tissue)	*Sample*	*$595.00*	*15*	*$8,925.00*	*Individual replicate analysis*
Lipids content (Pace SOP)	*Sample*	*$100.00*	*8*	*$800.00*	*One composite per sample; benthics and fish*
Dioxins (Fish Tissue)	*Sample*	*$595.00*	*5*	*$2,975.00*	*Five composite samples from five species*
				$37,082.00	
				$450,492	Rounded

Field Sampling Event

Description	Unit	Cost	Extended	Total	Comment
Project Management	Hour	$115.00	30	$3,450.00	Project coordination
Scientist II	Hour	$84.00	10	$840.00	Field event planning and coordination
QA/QC	Hour	$94.00	20	$1,880.00	Chemical, tox/bio, tissue results
Field Sampling					
Field Labor	Person	$4,452.00	4	$17,808.00	5 hours meetings; 40 sampling; 8 mob/demob
Truck	Day	$75.00	10	$750.00	2 trucks; boat and office trailer
Mileage	Mile	$0.57	750	$423.75	
Pontoon	Day	$200.00	5	$1,000.00	
Vibracore rental	Lump Sum	$2,500.00	1	$2,500.00	Includes freight
Disposables	Lump Sum	$1,500.00	1	$1,500.00	Vibracore tubing
Office trailer	Day	$75.00	5	$375.00	
GPS	Day	$75.00	5	$375.00	
Generator	Day	$45.00	5	$225.00	
Drum	Each	$105.00	2	$210.00	
Sediment bundle	Day	$65.00	5	$325.00	
Fuel	Lump Sum	$50.00	1	$50.00	
IDW Disposal	Lump Sum	$250.00	1	$250.00	
Lodging	Night	$100.00	16	$1,600.00	
Per-Diem	Day	$35.00	20	$700.00	
			TOTAL	$34,000.00	Rounded

Appendix B: Table 4
Monitoring Elements
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Bathymetric Survey Break-Down					
Parameter	Unit	Cost	Extended	Total Cost	
Daily labor cost					
Scientist III	Hour	$109	16	$1,744	Prep equipment; mob/demob; perform survey
Field Tech II	Hour	$64	16	$1,024	Prep equipment; mob/demob; perform survey
Lodging	Night	$100	2	$200	1 night each
Per-diem	Day	$36	4	$144	2 days each
Daily equipment cost					
Boat	Day	$200	2	$400	
Fuel	Day	$25	1	$25	
Multi-beam survey equipment	Day	$1,500	2	$3,000	
GPS	Day	$75	2	$150	
Truck	Day	$75	2	$150	
Mileage	Mile	$0.56	350	$196	
Data reduction/mapping	Hour	$109	20	$2,180	
GIS	Hour	$64	10	$640	
			TOTAL	$10,000	Rounded

Appendix B: Table 5
Present Value Calculations
Focused Feasibility Study
Mud Lake West
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Discount rate used for present worth calculations:	7.00%
Present worth calculation is: [(2016 Cost)/(1.07^Event Year 1)]+[(2016 Cost)/(1.07^Event Year 2)]+…	
Year 0 is 2016.	

Alternative 1: No Action	**2016 Costs**	**Years**							**Total Present Worth**	**Note**
No Costs Associated with this Alternative										

Alternative 2: Enhanced MNR with Broadcasted Amendment	**2016 Costs**	**Years**							**Total Present Worth**	**Note**
Construction Costs										
Mobilization/Demobilization	$206,000	1							$192,523	
Rent Hallett Dock #7 for Staging Area	$30,000	1							$28,037	
Install and Remove Dolphin Pilings	$95,000	1							$88,785	
Purchase Amendment Materials and Stockpile at Staging Area	$4,973,640	1							$4,648,262	
Load and Barge Materials Between Staging Area and Site	$103,650	1							$96,869	
Broadcast Amendment in Wetland Areas	$38,766	1							$36,230	
Broadcast Amendment in Open Water Areas	$130,182	1							$121,665	
Construction Monitoring/CQA and Oversight	$64,010	1							$59,822	
Monthly Operating Expenses and Site Security	$63,000	1							$58,879	
Implement Institutional Controls	$5,000	1							$4,673	
Long-Term Monitoring										
Monitoring and Evaluation Report	$4,000	5	10	15	20	25	30		$8,631	
Field Sampling	$34,000	5	10	15	20	25	30		$73,366	
Sample Analysis	$55,520	5	10	15	20	25	30		$119,802	
Professional and Technical Services										
Remedial Design (6%)	$470,000	0							$470,000	
Project Management and Permitting (5%)	$392,000	1							$366,355	
Construction Management (6%)	$470,000	1							$439,252	

Appendix B: Table 5
Present Value Calculations
Focused Feasibility Study
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Alternative 3: Enhanced MNR with Thin-Layer Amended Cover	**2016 Costs**	**Years**							**Total Present Worth**	**Note**
Construction Costs										
Mobilization/Demobilization	$213,000	1							$199,065	
Rent Hallett Dock #7 for Staging Area	$50,000	1							$46,729	
Install and Remove Dolphin Pilings	$95,000	1							$88,785	
Purchase Amendment Materials and Stockpile at Staging Area	$6,738,480	1							$6,297,645	
Purchase Sand and Stockpile at Staging Area	$646,054	1							$603,789	
Load and Barge Materials Between Staging Area and Site	$1,617,770	1							$1,511,935	
Construct Cover in Wetland Areas	$604,871	1							$565,300	
Construct Cover in Open Water Areas	$824,507	1							$770,568	
Construction Monitoring/CQA and Oversight	$281,644	1							$263,219	
Monthly Operating Expenses and Site Security	$105,000	1							$98,131	
Implement Institutional Controls	$5,000	1							$4,673	
Long-Term Monitoring										
Monitoring and Evaluation Report	$4,000	5	10	15	20	25	30		$8,631	
Field Sampling	$34,000	5	10	15	20	25	30		$73,366	
Sample Analysis	$61,470	5	10	15	20	25	30		$132,641	
Professional and Technical Services										
Remedial Design (6%)	$883,000	0							$883,000	
Project Management and Permitting (5%)	$736,000	1							$687,850	
Construction Management (6%)	$883,000	1							$825,234	

Alternative 4: Dredging with Wetland Restoration	**2016 Costs**	**Years**							**Total Present Worth**	**Note**
Construction Costs										
Mobilization/Demobilization	$190,000	1							$177,570	
Site Work	$796,000	1							$743,925	
Rent Hallett Dock #7 for Staging Area	$90,000	1							$84,112	
Install and Remove Dolphin Pilings	$95,000	1							$88,785	
Mechanically Dredge Sediments and Pump to Staging Area	$2,775,671	1							$2,594,085	
Turbidity Controls	$30,000	1							$28,037	
Treat Dredge Contact Water (per CY sediment removed)	$6,227,260	1							$5,819,869	
Purchase Sand and Stockpile at Staging Area	$949,495	1							$887,379	
Load and Barge Materials Between Staging Area and Site	$2,282,440	1							$2,133,121	
Construct Cover in Wetland Areas	$639,530	1							$597,692	
Construct Cover in Open Water Areas	$824,492	1							$770,554	
Wetland Restoration	$139,000	1							$129,907	
Excavate and Load Dewatered Sediments	$1,074,306	1							$1,004,024	
Transportation and Disposal of Dewatered Sediments	$3,848,030	1							$3,596,289	
Construction Monitoring/CQA and Oversight (Labor/Equipment)	$908,942	1							$849,479	
Construction Monitoring and Sample Analysis	$99,000	1							$92,523	
Monthly Operating Expenses and Site Security	$357,000	1							$333,645	
Professional and Technical Services										
Remedial Design (6%)	$1,600,000	0							$1,600,000	
Project Management and Permitting (5%)	$1,330,000	1							$1,242,991	
Construction Management (6%)	$1,600,000	1							$1,495,327	

Appendix B: Table 5
Present Value Calculations
Focused Feasibility Study
Mud Lake West
Minnesota Pollution Control Agency

Alternative 5: Dredge Open Water Areas of Site/Enhanced MNR in Wetland Areas with Thin-Layer Cover	**2016 Costs**	**Years**							**Total Present Worth**	**Note**
Construction Costs										
Mobilization/Demobilization	$214,000	1							$200,000	
Site Work	$796,000	1							$743,925	
Rent Hallett Dock #7 for Staging Area	$100,000	1							$93,458	
Install and Remove Dolphin Pilings	$95,000	1							$88,785	
Mechanically Dredge Sediments and Pump to Staging Area	$2,420,149	1							$2,261,821	
Turbidity Controls	$30,000	1							$28,037	
Treat Dredge Contact Water (per CY sediment removed)	$6,787,050	1							$6,343,037	
Purchase Sand and Stockpile at Staging Area	$667,449	1							$623,784	
Purchase Amendment Materials and Stockpile at Staging Area	$1,384,320	1							$1,293,757	
Load and Barge Materials Between Staging Area and Site	$1,627,516	1							$1,521,043	
Construct Cover in Wetland Areas	$604,871	1							$565,300	
Construct Cover in Open Water Areas	$824,507	1							$770,568	
Excavate and Load Dewatered Sediments	$936,703	1							$875,424	
Transportation and Disposal of Dewatered Sediments	$3,355,156	1							$3,135,659	
Construction Monitoring/CQA and Oversight (Labor/Equipment)	$473,674	1							$442,686	
Construction Monitoring and Sample Analysis	$99,000	1							$92,523	
Monthly Operating Expenses and Site Security	$210,000	1							$196,262	
Implement Institutional Controls	$5,000	1							$4,673	
Long-Term Monitoring										
Monitoring and Evaluation Report	$4,000	5	10	15	20	25	30		$8,631	
Field Sampling	$34,000	5	10	15	20	25	30		$73,366	
Sample Analysis	$37,082	5	10	15	20	25	30		$80,016	
Professional and Technical Services										
Remedial Design (6%)	$ 1,581,000	0							$1,581,000	
Project Management and Permitting (5%)	$ 1,318,000	1							$1,231,776	
Construction Management (6%)	$ 1,581,000	1							$1,477,570	