

From: [Lofton, Dendy](#)
To: [Schoen, Jill M - DNR](#); [Von Holdt, Crystal L - DNR](#); [Koch, Benjamin I - DNR](#)
Cc: [Jeff Lavers](#); [Hammond, Jennifer](#); [Greimann, Blair](#)
Subject: Lake Mallalieu Drawdown Request Package
Date: Thursday, April 30, 2026 3:04:06 PM
Attachments: [image001.png](#)
[image002.png](#)
[image003.png](#)
[image004.png](#)
[2026.04.30 Lake Mallalieu Drawdown Application Package.pdf](#)

CAUTION: This email originated from outside the organization.
Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello all,

On behalf of the Lake Mallalieu Association, we are submitting an application for a drawdown on Lake Mallalieu to begin in Sept 2026. The attached application package contains a technical memo to describe intent and package contents, along with the following appended attachments:

The following attachments are appended to this technical memo:

1. Dam Owner Approval Request Form for Temporary Drawdown (Attachment 1)
2. Sediment Transport Modeling Report (Attachment 2)
3. Sediment Chemistry
 - a. Memo to WDNR (Attachment 3)
 - b. WDNR's response memo (Attachment 4)
4. Natural Resources Impact Summary (Attachment 5)
5. Potential Phosphorus Loading from Lake Mallalieu Drawdown Letter (Attachment 6)
6. Lake Mallalieu Lake Response Model and Phosphorus Budget Memo (Attachment 7)

We have submitted drawdown approval forms to the four dam owners, which we will provide asap with signatures. Note that no new additional sediment transport modeling has been done since you last reviewed our report, however, we did remove discussion of the 11.5 ft drawdown depth and retained the information related to the 7.5 ft drawdown depth, which we are proposing based on lengthy discussions with WDNR last year. Attachments 6 and 7 are the only new pieces of information compared to last year's submittal, which are intended to address concerns over phosphorus loading that was expressed during the public comment period.

I'll follow up in the coming days with a meeting poll to help schedule a time to discuss our submittal and next steps. We appreciate the ongoing collaboration with WDNR on this topic and look forward to discussing with you in more detail soon.

Thanks,
Dendy

Dendy Lofton, PhD, CLM
Senior Associate, Senior Project Manager
she, her, hers

Direct: (612) 712-2072
dendy.lofton@stantec.com



With every community, we redefine what's possible.

The content of this email is the confidential property of Stantec and should not be copied, modified, retransmitted, or used for any purpose except with Stantec's written authorization. If you are not the intended recipient, please delete all copies and notify us immediately. For a list of Stantec's operating entities with associated license and registration information, please visit stantec.com.



Memo

To: Jill Schoen, WDNR
Crystal Von Holdt, WDNR
Benjamin Koch, WDNR

From: Dendy Lofton, PhD (Minneapolis, MN)
Blair Greimann, PhD, PE (Denver, CO)
Jennifer Hammond (South Burlington, VT)

Project/File: 227706430

Date: April 30, 2026

Reference: Lake Mallalieu Drawdown Application

Stantec Consulting Services Inc (Stantec) has been supporting the Lake Mallalieu Association (LMA) with a dredging feasibility study for removal of the soft sediment that was deposited in the upper reaches of Lake Mallalieu (Lake) by a series of breaches in the Willow River Dam (Little Falls Lake) from 2015 through 2019¹. Stantec was contracted by LMA to collect data to support the analyses, agency coordination, permitting and conceptual design for a dredging plan and the permit application.

Over the course of our field assessments, data collection and analyses, we determined that while dredging these areas may be feasible, the distribution of soft sediments should be mobilized with a lake drawdown, which would be less impactful to the area than dredging from an ecological perspective. Reservoir drawdowns are commonly used in management of sediment, aquatic vegetation control, flood control, and dam repairs. Lake Mallalieu drawdowns have occurred in the past for various reasons with no known reported impacts to natural resources or downstream communities. A drawdown was proposed in 2025, but was not approved in 2025 in part due to concerns by the City of Hudson related to sediment transport into Lake St. Croix and exacerbation of water quality problems in the North Bay, which is just downstream of the secondary dam on the Hudson Lower Power Dam. Since then, Stantec, LMA and the City of Hudson have met to discuss the results of our sediment transport modeling and potential for phosphorus loading to Lake St. Croix in more detail.

Stantec and LMA are resubmitting the drawdown application for a 7.5 ft drawdown on Lake Mallalieu to begin in September 2026. The purpose of this technical memorandum is to provide Wisconsin Department of Natural Resources (WDNR) with the required and requested elements as part of formal request for a temporary lowering of the dam gates at the confluence of Lake Mallalieu with the St Croix River (i.e., Hudson Lower Power Dam). Several attachments are provided in this application package which are detailed below to help guide the review process. Since our 2025 application, we have revised some of the figures in the Sediment Transport Modeling report to more clearly convey the anticipated sediment load due to the drawdown. We have also developed a lake phosphorus budget for Lake Mallalieu that characterizes

¹ Lake Mallalieu Desktop Analysis. Technical Memo. October 11, 2022. Prepared by Stantec for the Lake Mallalieu Association.

Reference: Lake Mallalieu Drawdown Application

the relative proportions of phosphorus loads from various sources. Lastly, we have included a letter that provides a response to the phosphorus loading concerns submitted by Wild Rivers Conservancy during the public comment period in 2025. This response letter includes a correction to the bulk density value applied in Wild Rivers Conservancy calculations, which was derived from a handbook on modeling radioactive soils. That factor is not representative of regional lacustrine sediments. In the corrected analysis, we instead applied a bulk density value reported for sediments in nearby Lake Pepin, which provides a more scientifically defensible regional analog for Lake Mallalieu conditions.

The purpose of this technical memorandum is to provide Wisconsin Department of Natural Resources (WDNR) with the required and requested elements as part of formal request for a temporary lowering of the dam gates at the confluence of Lake Mallalieu with the St Croix River (i.e., Hudson Lower Power Dam).

We proposed that a lake drawdown would begin in September 2026 with refilling to occur naturally through May 1, 2027. The high flows entering the headwaters of the Lake in spring 2027 will naturally flush soft sediments and disperse downstream to deeper areas. The extended duration of the drawdown period will also allow for compaction of soft sediments in the exposed areas of Lake Mallalieu. The drawdown would begin on September 1, 2026 at a rate of 5 inches/day to reach an elevation of 681.5 ft (USGS elevation = plan datum + 591.4 ft datum). In this scenario, the dam elevation will be maintained at the 681.5 ft elevation until May 1, 2027.

The following attachments are included with this technical memo along with a brief description below of each attachment:

1. Dam Owner Approval Request Form for Temporary Drawdown (Attachment 1)
2. Sediment Transport Modeling Report (Attachment 2)
3. Sediment Chemistry
 - a. Memo to DNR (Attachment 3)
 - b. DNR's response memo (Attachment 4)
4. Natural Resources Impact Summary (Attachment 5)
5. Potential Phosphorus Loading from Lake Mallalieu Drawdown Letter (Attachment 6)
6. Lake Mallalieu Lake Response Model and Phosphorus Budget Memo (Attachment 7)

1. Dam Owner Approval Request Form for Temporary Drawdown (Attachment 1)

Drawdown approval request forms were provided to each of the four owners of the Lake Mallalieu dam, which is known as the Hudson Lower Power Dam. The four dam owners are the City of Hudson, Town of Hudson, Village of North Hudson and St. Croix County.

Stantec will provide signed copies of the request forms once available.

2. Sediment Transport Modeling Results (Attachment 2)

A 1D sediment transport model (HEC-RAS) was created to estimate the potential for erosion in the delta of Lake Mallalieu and evaluate transport downstream of the project extent. Three hydraulic scenarios were run over two time periods using three bed grain size sensitivities. A drawdown rate of 5 inches per day was

Reference: Lake Mallalieu Drawdown Application

used which allows the drawdown to be completed within the month of September (Scenario 1). At low pool the water surface of the lake varies from 681.5 ft at the Lower Dam to 690 ft near the top of the delta.

We simulated a 1-month, 3-month and an extended drawdown period (i.e. Sept through May). Stantec recommends leaving the pool low for the longer extended period to May 1, 2027 to capture higher flows and allow for increases in erosion in the delta area. This extended duration will also allow time for expose sediments to compact, which will contribute to increased water depths in those areas. In-depth modeling details and results can be found in Attachment 2: *Lake Mallalieu Drawdown Sediment Transport Model Report (revised April 29, 2026)*.

3. Sediment Chemistry (Attachments 3 and 4)

Stantec conducted bathymetric and soft sediment depth surveys, followed by the collection of sediment cores for analysis of potential chemical contaminants. Kurt Rasmussen with the WDNR provided recommended sampling strategy for determining the presence of sediment contaminants. Sediments from various locations and vertical depth intervals were analyzed for heavy metals, polycyclic aromatic hydrocarbons, nutrients, total organic carbon and grain size. No elevated levels of concern were identified. Overall, the analysis indicated a low risk of contaminant mobilization, supporting the recommendation for a lake drawdown in fall 2025 to naturally redistribute sediments. Additional sediment chemistry details can be found in Attachment 3: *Lake Mallalieu Dredging Feasibility Study* including a bathymetry figure, soft sediment depth figure, and laboratory analytical results. Wisconsin DNR reviewed these findings on April 5, 2025 and determined the quality of sediments would not impede drawdown activities from occurring on Lake Mallalieu, which was documented in a memo from WDNR (Attachment 4).

4. Natural Resources (Attachment 5)

The Lake Mallalieu drawdown will simulate natural water fluctuations that are currently uncommon due to the operation of the dam. The timing of the drawdown was carefully selected to minimize negative impacts on natural resources while promoting beneficial effects on aquatic vegetation. Additional details regarding natural resources impacts can be found in Attachment 5: *Lake Mallalieu Drawdown Natural Resource Impacts*.

5. Potential Phosphorus Loading from Lake Mallalieu Drawdown (Attachment 6)

During the public comment period in 2025 from the previous drawdown request, someone from Wild River Conservancy expressed concerns over the potential phosphorus load to Lake St. Croix due to mobilization of sediments in Lake Mallalieu from the drawdown period. While we agree that some phosphorus will likely be mobilized from Lake Mallalieu sediments during the proposed drawdown, we would like to clarify a significant error in the load calculations previously submitted to the Wisconsin Department of Natural Resources. Correcting this error substantially lowers the estimated total phosphorus (TP) load associated with the drawdown and indicates that the resulting load would remain well within the existing range of TP inputs to Lake Mallalieu from the upstream Willow River watershed. The corrected calculation and the potential phosphorus load from Lake Mallalieu sediments are described in Attachment 6: *Potential Phosphorus Loading from Lake Mallalieu Drawdown*.

Reference: Lake Mallalieu Drawdown Application

6. Lake Mallalieu Lake Response Model and Phosphorus Budget (Attachment 7)

To illustrate the magnitude of phosphorus loading entering Lake Mallalieu from upstream in the Willow River subwatershed compared to the release of phosphorus from the sediments, we developed a simple lake response model that shows the proportion of phosphorus from various sources like a pie chart. The lake response model shows that internal sediment phosphorus release in Lake Mallalieu is less than 1% of the total phosphorus load to the lake with the external phosphorus load comprising over 92% of the total load. Consequently, the potential phosphorus load from Lake Mallalieu sediments is significantly overshadowed by upstream loads from the Willow River subwatershed.

Conclusion

Dendy Lofton is the Project Manager and serves as the main point of contact for this project. Thank you for your time and consideration of this Drawdown Approval Request Package. Please let me know if you have any questions. We look forward to hearing from you.

Sincerely,

Stantec Consulting Services Inc.



Dendy Lofton PhD, CLM
Senior Associate, Senior Project Manager
Phone: (612) 712-2072
dendy.lofton@stantec.com

Attachments:

- Attachment 1. Proposed Drawdown Plan and Approval Form for Dam Owners
- Attachment 2. Sediment Transport Modeling Report (revised April 29, 2026)
- Attachment 3. Sediment Chemistry Memo
- Attachment 4. DNR Memo Response on Lake Mallalieu Sediment Sampling
- Attachment 5. Lake Mallalieu Drawdown Natural Resource Impacts
- Attachment 6. Potential Phosphorus Loading from Lake Mallalieu Drawdown Letter
- Attachment 7. Lake Mallalieu Lake Response Model and Phosphorus Budget Memo



Attachment 1: Drawdown Approval Form for Dam Owners – will be provided once signed.

Attachment 2

Lake Mallalieu Drawdown

Sediment Transport Model



Prepared for: Lake Mallalieu Association &
Wisconsin Department of Natural Resources

April 29, 2026

Prepared by:
Stantec

Project/File:
227706430

Table of Contents

1	Introduction.....	1
2	Methods.....	1
2.1	Model Inputs	1
2.1.1	Geometry.....	1
2.1.2	Hydrology/Inflow Boundary Conditions	4
2.1.3	Outflow/Downstream Boundary Condition	5
2.1.4	Hydraulic Roughness/Bed Material.....	6
2.1.5	Sediment Inputs.....	7
3	Assumptions.....	12
4	Results.....	14
4.1	Invert erosion/deposition	15
4.2	Cross section bed erosion/deposition	17
4.3	Sediment Erosion and Deposition.....	17
4.4	Low Pool and Stormwater Inflow Potential Drop	20
4.5	Suspended Sediment Concentration Changes due to Drawdown	32
5	Summary and Recommendations	39

List of Tables

Table 1. Sediment Core Samples as Percent Finer Than in Inches and Millimeters	10
Table 2. Sediment Core Samples as Percent Finer Than in Millimeters formatted for HECRAS size class input.	11
Table 3. Matrix of model runs with color coding of results.....	15
Table 4. Summary of sediment volume eroded from the upper and middle portions of Lake Mallalieu over different durations	18
Table 5. Estimated distance between low pool and stormwater inflow locations.....	20
Table 6. Comparison of baseline St. Croix TSS (1976-2014) and modeled scenarios including the combined TSS (St. Croix baseline + modeled monthly average)	34

List of Figures

Figure 1. Merged terrain surface from LiDAR, 2024 bathymetry, and contours from 1970 mapping.....	2
Figure 2. Cross sections representing the Lake Mallalieu 1D model area.	3
Figure 3. Cross section representing the Hudson Lower Power Dam (primary dam) of the Lake Mallalieu 1D model...4	
Figure 4. Three flow scenarios used for inputs to the model (wet, normal and dry).	5
Figure 5. Downstream boundary representing drawdown rate of 5 inches per day with drawdown completion by the end of September.....	6
Figure 6. Total suspended sediment concentration used as input for sediment transport model. Data represent non-breach periods.	7
Figure 7. Bed mixing options for the Active Layer sorting method.	8
Figure 8. Core sediment sample locations in the delta of Lake Mallalieu.	9
Figure 9. Bed grain size comparison using HEC-RAS size class. The median, 25th percentile and 75th percentile distributions are included.....	12
Figure 10. Default HEC-RAS grain class sizes and sediment properties used.	14
Figure 11. Channel invert change over 1 month duration with a 7.5 ft drawdown.	16
Figure 12. Channel invert change over extended simulation model runs with a 7.5 ft drawdown	16



Lake Mallalieu Drawdown

Figure 13. Channel invert change over 3-month model runs with a 7.5 ft drawdown.	17
Figure 14. Example of erosion of the bed with widening during the extended drawdown simulation for a cross section near the head of the delta under the median bed grain size distribution.	21
Figure 15. Example of erosion of the bed with widening during the extended drawdown simulation for a cross section near the bottom of the delta under the median bed grain size distribution.	22
Figure 16. Example of deposition during the extended drawdown simulation for a cross section in the lower pool under the median bed grain size distribution.	23
Figure 17. Changes in bed volume (top) and mass (bottom) for segments through the Lake Mallalieu impoundment during the drawdown period of September to October for the 7.5 ft drawdown.	24
Figure 18. Changes in bed volume (top) and mass (bottom) for segments through the Lake Mallalieu impoundment during the extended drawdown period of September to July for the 7.5 ft drawdown.	25
Figure 19. Changes in bed volume (top) and mass (bottom) for segments through the Lake Mallalieu impoundment during the three-month drawdown period of September to December for the 7.5 ft drawdown.	26
Figure 20. Comparison of volume of sediment into the reach and out of the reach (top) and mass into the reach and out of the reach (bottom) during the drawdown period of September to October and the 7.5 ft drawdown.	27
Figure 21. Comparison of volume of sediment into the reach and out of the reach (top) and mass into the reach and out of the reach (bottom) during the extended drawdown period of September to July for the 7.5 ft drawdown.	28
Figure 22. Comparison of volume of sediment into the reach and out of the reach (top) and mass into the reach and out of the reach (bottom) during the three-month drawdown period of September to December for the 7.5 ft drawdown.	29
Figure 23. Overview of low pool water surface elevation and stormwater inflow locations. The dark blue shows the 7.5 ft drawdown level.	30
Figure 24. View of low pool and stormwater inflow locations for the upper reservoir. Dark blue shows the 7.5 ft drawdown level.	31
Figure 25. View of low pool and stormwater inflow locations for the lower reservoir. Dark blue shows the 7.5 ft drawdown level.	32
Figure 26. Comparison of Total Suspended Sediment Concentration (mg/L) entering Lake Mallalieu (top), leaving Lake Mallalieu (middle) and added to the St. Croix River (bottom) under the extended duration simulation with the 7.5 ft drawdown.	36



1 Introduction

Stantec Consulting Services Inc (Stantec) has been supporting the Lake Mallalieu Association (LMA) with a feasibility study for removal of the soft sediment that was deposited in the upper reaches of Lake Mallalieu (Lake) by a series of breaches in the Willow River Dam (Little Falls Lake) from 2015 through 2019. Stantec was contracted by LMA to evaluate dredging lake sediments and collect data to support the analyses, agency coordination, permitting and conceptual design. In 2024, Stantec conducted a bathymetric survey and soft sediment depth survey of the upper reach of the Lake where sediments are known to have accumulated. The soft sediment depth survey demonstrated high variability across the project extent with respect to soft sediment depths and accumulation. While dredging these areas may be feasible, the distribution of soft sediments should be mobilized with a lake drawdown, which would be less impactful to the area from an ecological perspective. A lake drawdown would begin in fall 2026 with refilling to occur naturally with spring runoff and precipitation. The high flows entering the headwaters of the Lake in spring would naturally flush soft sediments further downstream to deeper areas. Stantec developed a sediment transport model to develop a drawdown plan to achieve the objective of mobilizing accumulated sediments.

A 1D HEC-RAS sedimentation model was completed to test the possibility of using a drawdown to mobilize sediments and move it out of the delta area. The following sections describe the model setup, scenarios, assumptions, results and recommendations. This modeling report was prepared and included as part of the Drawdown Proposal Application Package to the Wisconsin Department of Natural Resources (WDNR).

2 Methods

2.1 Model Inputs

2.1.1 Geometry

Geometry data was created using a merged surface from 2023 LiDAR, bathymetry collected in the delta area in 2024, and historical bathymetric contours from 1970.¹ The merged surface was used to create a terrain in HEC-RAS (Figure 1). Once the terrain was completed cross-sections were added (Figure 2) starting at the inflow to Lake Mallalieu through the impoundment to the outflow to the St. Croix River. A gated structure was added to the model at the cross section representing the lower dam. The structure consists of 3 radial Tainter gates, 12 feet high by 22 feet wide (Figure 3). The elevation of the bottom of the gates was set at 677.4 ft. The location of each of the gates was set based on aerial images. Note, the

¹ Lake Mallalieu – St. Croix County, Wisconsin DNR Lake Map. May 1970. Accessed on May 28, 2025: <https://apps.dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2607100&page=facts>.



Lake Mallalieu Drawdown

structure at the secondary dam was not included in the model, assuming all flow released through lower dam gates.

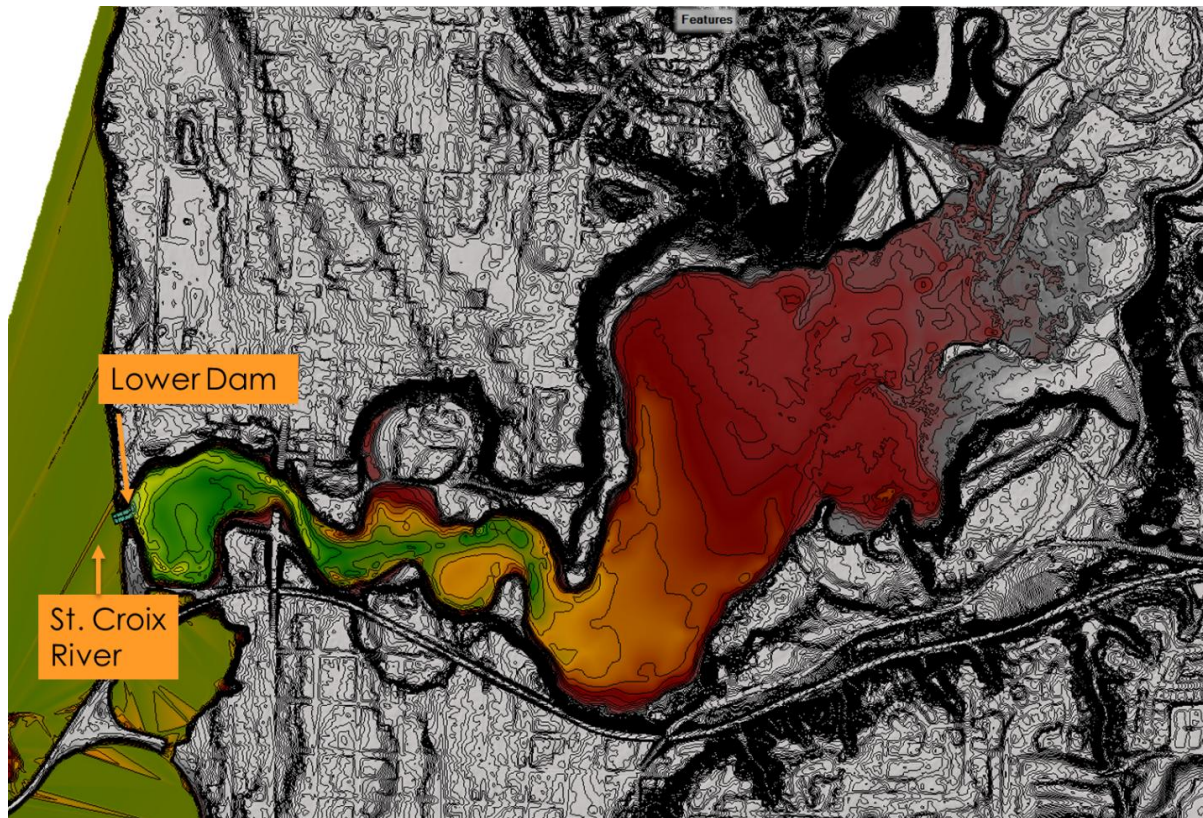


Figure 1. Merged terrain surface from LiDAR, 2024 bathymetry, and contours from 1970 mapping.



Lake Mallalieu Drawdown

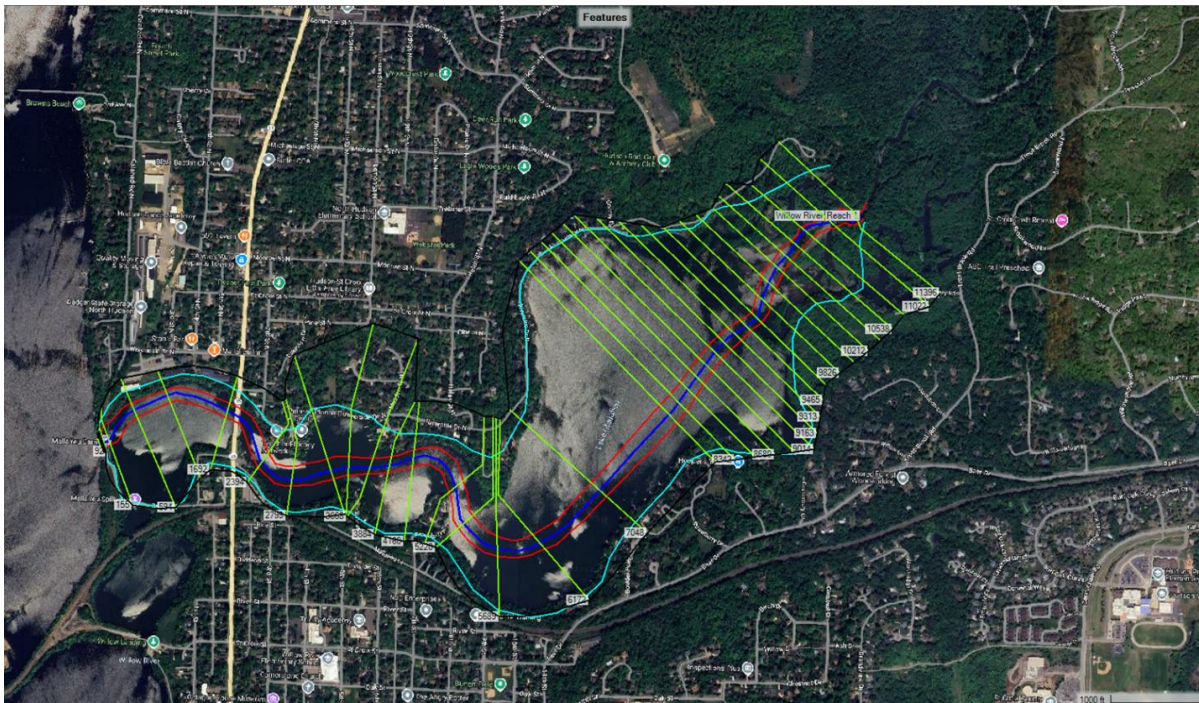


Figure 2. Cross sections representing the Lake Mallalieu 1D model area.



Lake Mallalieu Drawdown

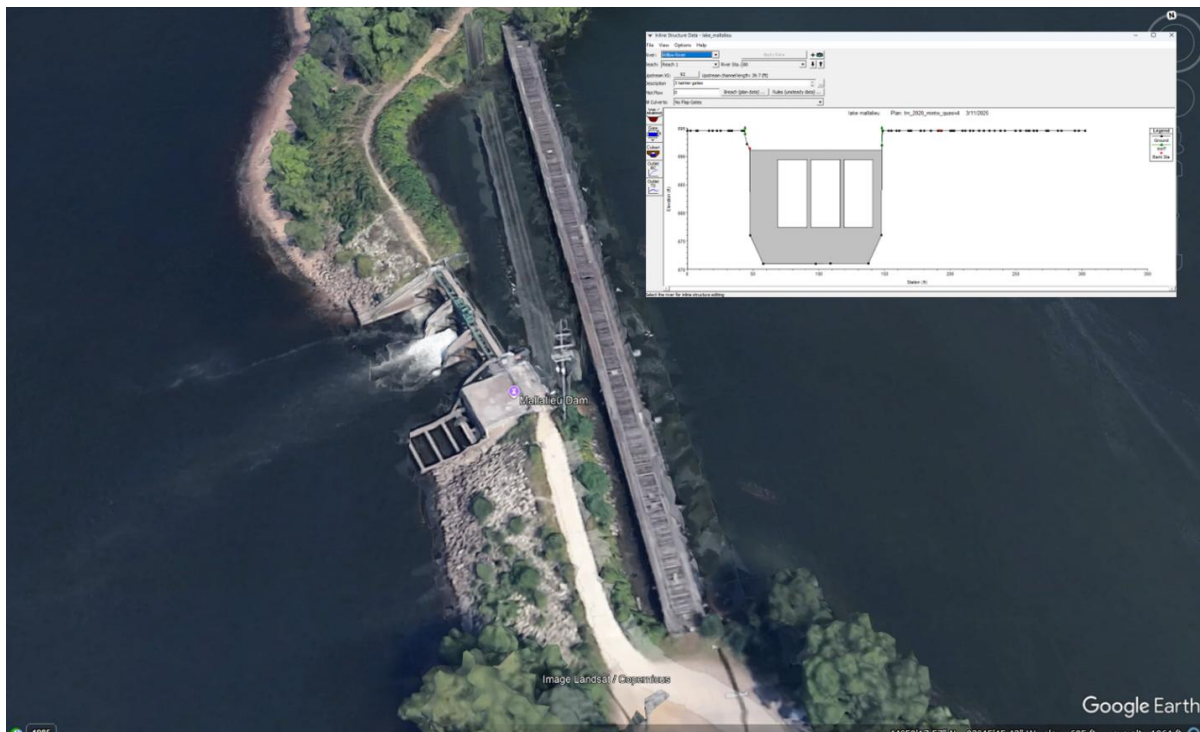


Figure 3. Cross section representing the Hudson Lower Power Dam (primary dam) of the Lake Mallalieu 1D model.

2.1.2 Hydrology/Inflow Boundary Conditions

Flow hydrographs from the USGS 05341752 gage were used to model the 3 hydraulic scenarios. Using the Period of Record (POR) from 2012-2023, three water years were selected to represent dry conditions (2022), normal conditions (2015) and a wet water year condition (2014). Model simulations were run for a short hydrograph that represents only the drawdown period of September 1 to October 1. This shortened period reflects the potential erosion during the active 1-month drawdown period. A longer hydrograph was run to represent the drawdown period and an extended period in the low pool before the spring filling of the reservoir (September 1 to June 30). While this longer drawdown period ran through the month of June the reservoir was allowed to start filling on May 1st. An additional duration drawdown scenario was run since the original submittal of this report in response to questions received from WDNR. This additional duration represents three months (September, October, and November) with the refill occurring before ice formation on the lake.

During the refilling period, Stantec will work with operations to maintain the existing low flow requirement (Wisconsin Statue Ch 31.34(1) passing a minimum of 25% of natural low flow). The refill period is the only time that this will need to be managed. During the low pool period all flows into the lake will be released through the primary dam to the St. Croix.



Lake Mallalieu Drawdown

Figure 4 shows the hydrograph used for the three water year types (i.e. dry, normal, and wet years). The erosion potential is due to peak flow magnitude, duration of a flow event, and occurrence of multiple high flow events over a given period. Often the duration of a flow event, and multiple high flow events will result in more erosion potential than a single large event with peak flows.

For the extended duration model runs, the wet conditions had the highest peak during the September to October drawdown period but resulted in lower peaks in late winter than in the normal and dry conditions. flows. The normal water year has multiple higher flows during the September to October drawdown and some of the highest peaks during the extended run at low pool. The dry scenario had the lowest flows during the drawdown period but had many higher peaks in late winter and spring under the extended flow period.

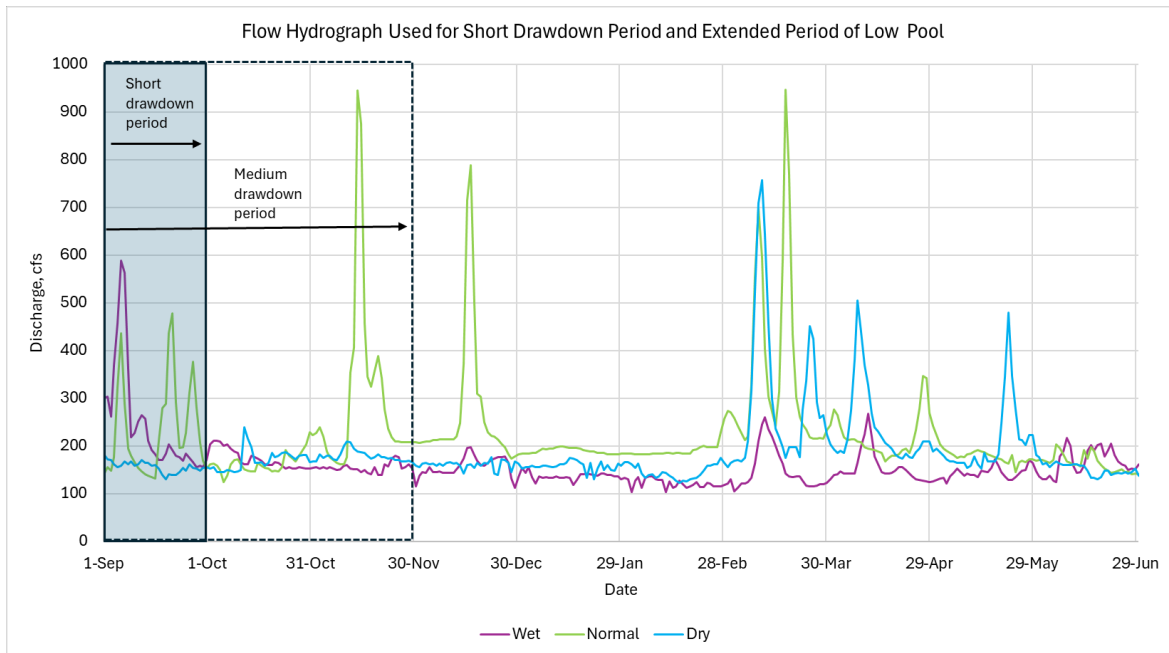


Figure 4. Three flow scenarios used for inputs to the model (wet, normal and dry).

2.1.3 Outflow/Downstream Boundary Condition

The downstream boundary condition was set at the St. Croix River as a stage hydrograph. This boundary condition was used to control the drawdown in Lake Mallalieu rather than a complicated rule set for the gating operation. Note, when the drawdown is implemented, operations will use the gates to control the downramp rate. In the model, gates were installed in the cross section representing the lower dam. Gates were set to open, allowing the downstream boundary condition to control the drawdown rate and lake water surface elevation. Figure 5 shows the water surface drawdown at the lower dam for the 7.5 ft drawdown. The conditions of the downramp were not to exceed 4" - 6" per day (based on the ability of mussels to relocate and stay wetted) and completion of the downramp within the month of September. The 4" per day



Lake Mallalieu Drawdown

rate did not allow for the drawdown to complete within the month of September therefore the 5" per day was used. This is more conservative than the 6" per day. The downstream boundary was set to start at the normal pool elevation of 688.95 ft decreasing to 675.8 ft (minimum tailwater is the water surface of the St. Croix River).

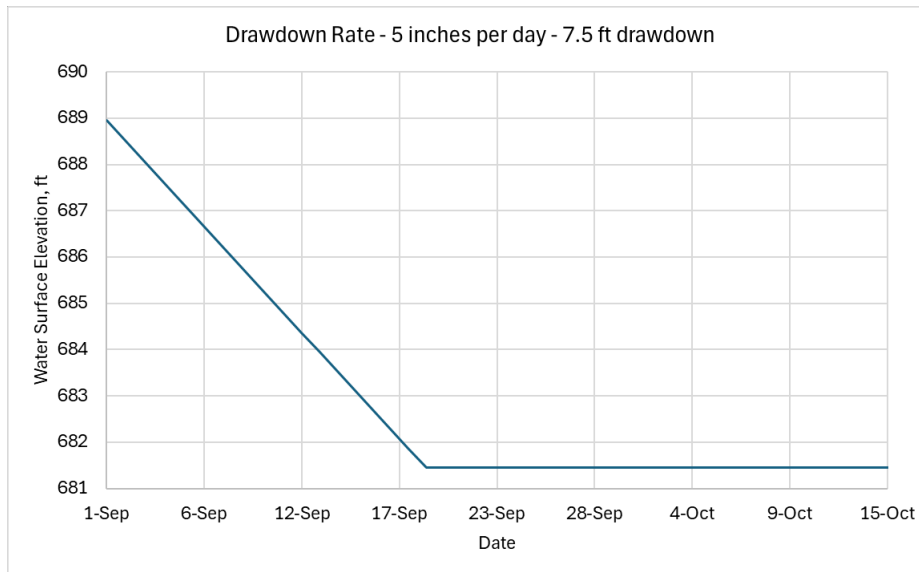


Figure 5. Downstream boundary representing drawdown rate of 5 inches per day with drawdown completion by the end of September.

2.1.4 Hydraulic Roughness/Bed Material

Bed materials are used for both the hydrodynamic model (as hydraulic roughness – Manning's n) and the sediment transport modeling. In the sediment transport model, it is used by grain size distribution for erosion and deposition (discussed below). Based on the sampling the bed material is primarily made up of sand and silt². The Manning's n used for the portion of the cross-section within the lakebed was 0.02 while the overbank/vegetated areas were assigned a Manning's n of 0.15.

² Stantec Technical Memo. Sediment Chemistry Results as part of the Lake Mallalieu Dredging Feasibility Study. Prepared for the Wisconsin Department of Natural Resources. March 11, 2025.



2.1.5 Sediment Inputs

The sediment transport model requires many inputs and decisions to be made. The following outlines the data used for each input, decisions made on equations to use, and assumptions.

2.1.5.1 Inflow Boundary Condition

The sediment transport model needs an inflow boundary condition that reflects the concentration or load coming into the reach. For the Lake Mallalieu model, a rating curve of the total suspended sediment concentration versus flow was used. The flow dependent total suspended sediment was developed using the USGS 05341752 gage data for the period(s) representative of the non-breach period of the upstream dam. The upstream dam breaches occurred during 2 time periods, September 1, 2015 through September 1, 2018 and March 24, 2019 through April 8, 2019. All other dates are considered a non-breach period and used in the rating curve development. Figure 6 shows the rating curve used. The grain size distribution data was not available for the inflow suspended sediment, therefore the median bed material size was used.

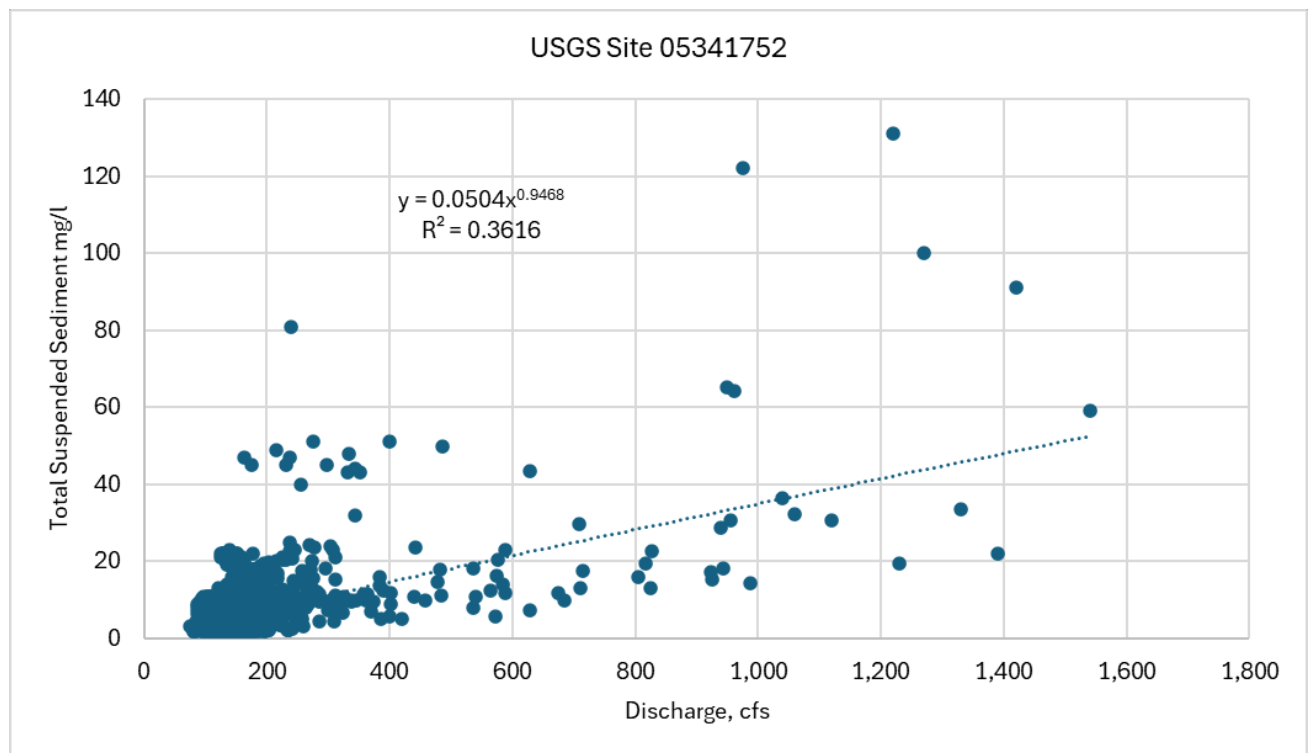


Figure 6. Total suspended sediment concentration used as input for sediment transport model. Data represent non-breach periods.



2.1.5.2 Transport equation

There are multiple transport function equations available within HEC-RAS. Using the results from the hydrodynamic model (i.e. velocity, shear stress, friction, slope etc.) the transport equation computes a transport capacity at each cross section. For this project the Engelund-Hanse equation was used. The equation is a total load transport equation suitable for sand bed systems.

2.1.5.3 Sorting method

While the transport functions compute transport capacity, they do not account for sediment availability. A bed sorting method is used to track the bed gradation and transport capacities for the different grain-class. For this model the sorting method used was the Active Layer method.

2.1.5.3.1 Active Layer

The two-layer active layer method is a simplified approach that is capable of forming a coarse or fine active layer. The active layer option requires parameters to be selected in the bed mixing options, Figure 7 shows the values used for each of the options.

Bed Mixing Options

Capacity Partitioning (1D Only)

Capacity Partitioning Method: **Bed Gradation Only** % Inflow Gradation: **10**

Hiding and Exposure Functions

Hiding Function: **None** Hiding Exponent: **0.8** Shape Factor: **0.6**

Active Layer Options

Active Layer Thickness: **X d90** Multiplier: **10** Min Thickness: **0.25** ft

Exchange Increment (1D Only): % Bedload: **70** % Active Layer: **30**

Cover/Active Layer Gradations (1D Only)

☐ Specify Seperate Cover/Active Layer Gradations

☐ Copeland Method Option (test) (1D Only) OK Cancel Defaults ...

Figure 7. Bed mixing options for the Active Layer sorting method.



2.1.5.4 Bed material

Core samples were taken at four locations in the upper lakebed/delta area. Two depths were sampled at each location resulting in 8 grain size distributions. Figure 8 shows the locations of these samples.

Table 1 shows the grain size distribution for each of the samples. The size classes were adjusted to fit the standard HEC-RAS inputs. The smallest size class measured was 0.074 mm. As seen in Table 1 there is a significant portion of the bed material that is smaller than the 0.074 mm size class. HEC-RAS allows for grain sizes distribution smaller than the sand size classes. Since we do not know what the actual distribution is below the 0.074 mm size class, the remaining % was distributed evenly across the remaining HEC-RAS sizes. Table 2 and Figure 9 show the expanded distribution.

Three bed material scenarios were run in the model to represent the best estimate of the grain size distribution. Along with a median distribution, a 25th percentile (coarse estimate) and a 75th percentile (fine estimate) were simulated (see Table 2 and Figure 9).

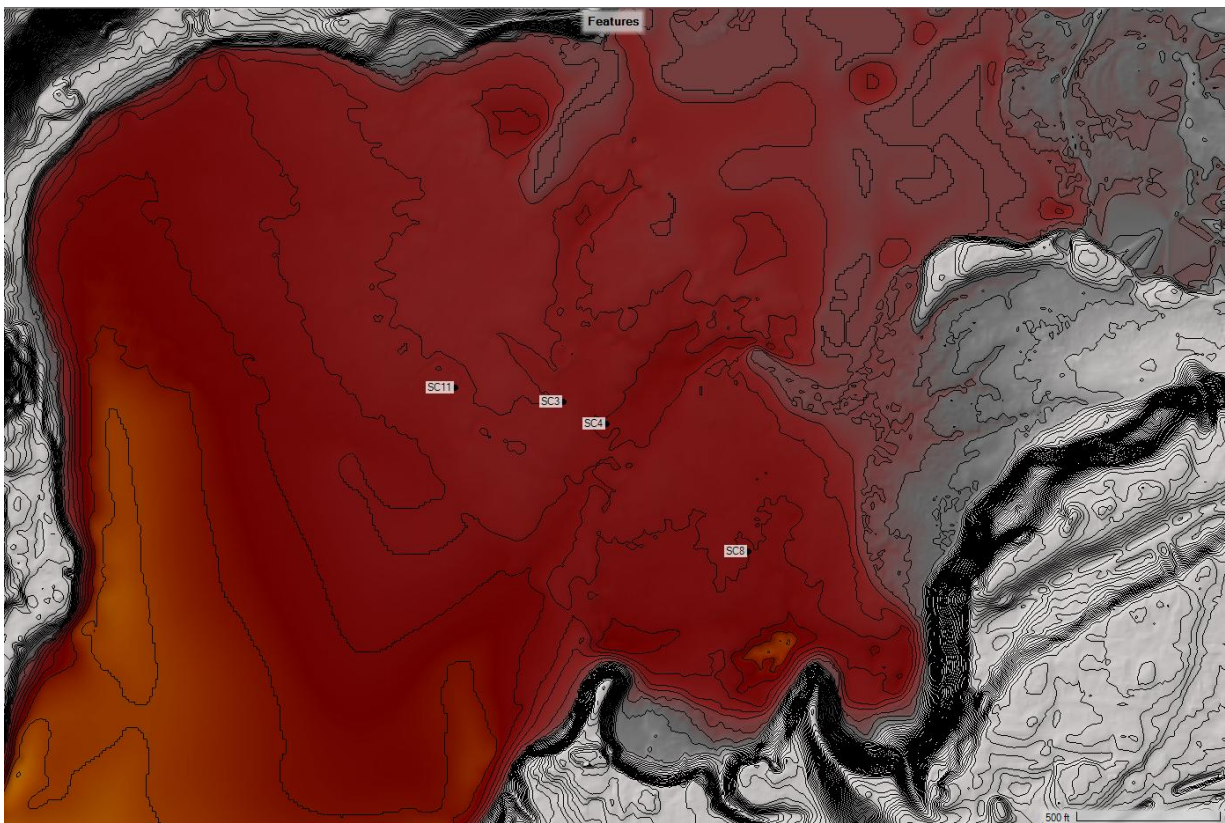


Figure 8. Core sediment sample locations in the delta of Lake Mallalieu.



Lake Mallalieu Drawdown

Table 1. Sediment Core Samples as Percent Finer Than in Inches and Millimeters

Percent Finer Than (%)									
Size Class (in)	Size Class (mm)	Sed Cr 11 Sec 1	Sed Cr 11 Sec 2	Sed Cr 3 Sec 1	Sed Cr 3 Sec 2	Sed Cr 4 Sec 1	Sed Cr 4 Sec 2	Sed Cr 8 Sec 1	Sed Cr 8 Sec 2
0.0029	0.074	35	58.9	69.8	10.5	81.5	17.2	37	23
0.0041	0.104	42	64	72.5	12	88.1	21.2	40	25.7
0.0059	0.150	66	72.1	76.1	14.8	93.3	31.8	43	34.4
0.0098	0.25	87	81.8	91	32	96.7	56.2	69	77
0.0165	0.42	95	90.1	97.2	65.3	98.4	76.3	90	94.7
0.0331	0.84	99	97.3	99.3	89.1	99.5	91.6	96	98.7
0.0787	2.00	100	99.2	100	95.1	100	95.6	97	99.9
0.187	4.75	100	99.9	100	97.6	100	97.4	97	100
0.375	9.53	100	100	100	99.5	100	98.3	100	100
0.75	19.05	100	100	100	100	100	100	100	100
1	25.40	100	100	100	100	100	100	100	100
1.5	38.10	100	100	100	100	100	100	100	100
2	50.80	100	100	100	100	100	100	100	100
3	76.20	100	100	100	100	100	100	100	100



Lake Mallalieu Drawdown

Table 2. Sediment Core Samples as Percent Finer Than in Millimeters formatted for HECRAS size class input.

Percent Finer Than (%)											
Size Class (mm)	Sed Cr 11 Sec 1	Sed Cr 11 Sec 2	Sed Cr 3 Sec 1	Sed Cr 3 Sec 2	Sed Cr 4 Sec 1	Sed Cr 4 Sec 2	Sed Cr 8 Sec 1	Sed Cr 8 Sec 2	Median	25th Perc "Coarse"	75th Perc "Fine"
0.004	8.8	11.3	12.4	2.2	15.1	4.3	6.9	4.9	7.9	4.8	11.6
0.008	17.7	22.6	24.7	4.4	30.2	8.7	13.8	9.9	15.7	9.6	23.1
0.016	26.5	33.8	37.1	6.6	45.2	13.0	20.7	14.8	23.6	14.4	34.7
0.032	35.3	45.1	49.4	8.9	60.3	17.4	27.6	19.8	31.4	19.2	46.2
0.0625	44.1	56.4	61.8	11.1	75.4	21.7	34.5	24.7	39.3	24.0	57.8
0.125	53.0	67.7	74.1	13.3	90.5	26.0	41.4	29.7	47.2	28.8	69.3
0.25	87.1	81.9	91.0	32.2	96.7	56.3	69.1	77.1	79.5	65.9	88.0
0.5	95.8	91.5	97.6	69.9	98.6	79.2	91.2	95.5	93.5	88.2	96.2
1	99.1	97.6	99.4	89.9	99.6	92.2	96.1	98.9	98.2	95.1	99.2
2	100	99.2	100	95.1	100	95.6	97.0	99.9	99.6	96.7	100
4	100	99.7	100	96.9	100	96.9	97.0	99.97	99.8	97.0	100
8	100	100	100	98.9	100	98.0	99.0	100	99.98	99.0	100
16	100	100	100	99.8	100	99.5	100	100	100	100	100
32	100	100	100	100	100	100	100	100	100	100	100
64	100	100	100	100	100	100	100	100	100	100	100
128	100	100	100	100	100	100	100	100	100	100	100
256	100	100	100	100	100	100	100	100	100	100	100
512	100	100	100	100	100	100	100	100	100	100	100



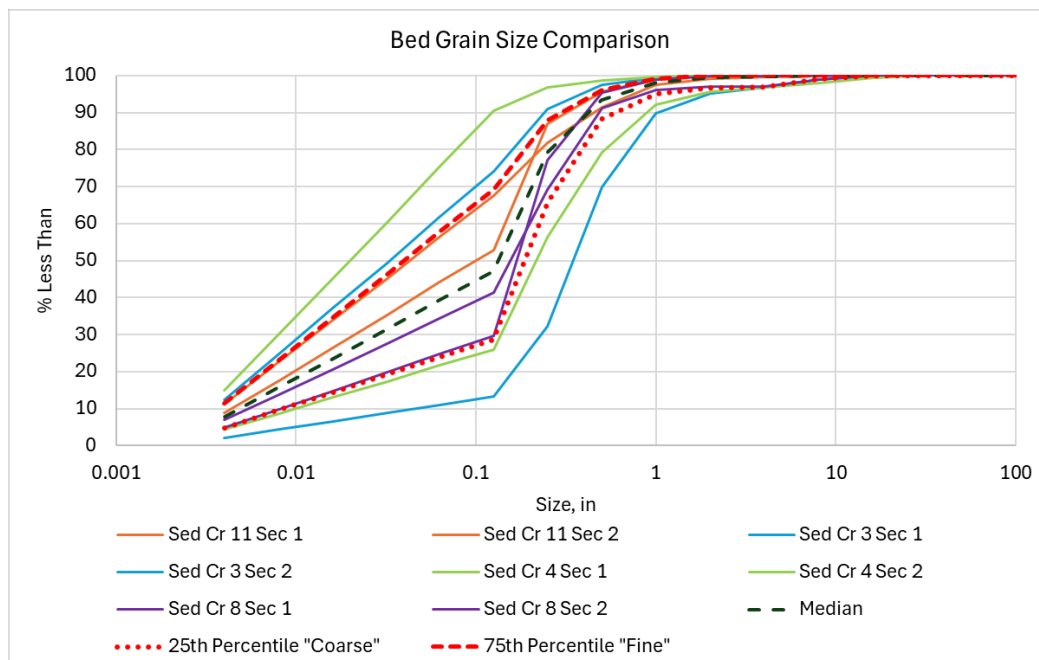


Figure 9. Bed grain size comparison using HEC-RAS size class. The median, 25th percentile and 75th percentile distributions are included.

3 Assumptions

As often is the case with sediment transport modeling, some assumptions need to be made about missing information or data. Sensitivity runs are often performed to address the uncertainties with the input data. For this project, the following assumptions were made due to lack of information:

- Bed material depth
 - During the model runs that represented only the short 1-month drawdown period, the bed material thickness was set to a maximum of 20 feet. This assumption allowed the channel incision/erosion to not be limited to bed material thickness resulting in the full potential erosion capacity of the channel. No transects eroded to that maximum point.
 - During the model runs that represented the extended run (September to July) the bed material thickness was set to a maximum of 5 feet. For this run, the bed change options were used which allowed for the channel to widen (banks to erode) when the 5-foot depth erosion limit was reached. The starting channel width was set to 100 feet.
 - During the additional model runs that represented the three-month duration (September to December) the bed material thickness was set to a maximum of 5 feet. For this run the bed



Lake Mallalieu Drawdown

change options were used which allowed for the channel to widen (banks to erode) when the 5-foot depth erosion limit was reached. The starting channel width was set to 100 feet.

- Grain size distribution
 - Upstream boundary total suspended sediment - because there was no grain size distribution with the total suspended sediment data, the median bed material distribution was used and not varied with flow.
 - Grain size distribution smaller than sand - we do not know what the actual distribution is below the 0.074 mm size class, therefore, the remaining % was distributed evenly across the remaining HEC-RAS sizes
- Default HEC-RAS sediment properties – The specific gravity, porosity and unit weights were set to the HEC-RAS defaults. The default specific gravity of 2.65 was used. HEC-RAS uses the sediment unit weights to convert the masses of the eroded/deposited sediment into volumes. Figure 10 shows the default parameters used.



Lake Mallalieu Drawdown

Define Grain Classes and Sediment Properties

Sediment Diameters (mm)									
Class	Label	Min	Max	Mean	SG	n	UW	Coh?	De
1	Clay	0.002	0.004	0.003	2.65	0.82	30	1	1
2	VFM	0.004	0.008	0.006	2.65	0.61	65	1	1
3	FM	0.008	0.016	0.011	2.65	0.61	65	1	1
4	MM	0.016	0.032	0.023	2.65	0.61	65	1	1
5	CM	0.032	0.0625	0.045	2.65	0.61	65	1	1
6	VFS	0.0625	0.125	0.088	2.65	0.3	93	0	1
7	FS	0.125	0.25	0.177	2.65	0.3	93	0	0.4
8	MS	0.25	0.5	0.354	2.65	0.3	93	0	0.09
9	CS	0.5	1	0.707	2.65	0.3	93	0	0.09
10	VCS	1	2	1.41	2.65	0.3	93	0	0.09
11	VFG	2	4	2.83	2.65	0.3	93	0	0.09
12	FG	4	8	5.66	2.65	0.3	93	0	0.09
13	MG	8	16	11.3	2.65	0.3	93	0	0.09
14	CG	16	32	22.6	2.65	0.3	93	0	0.09
15	VCG	32	64	45.3	2.65	0.3	93	0	0.09
16	SC	64	128	90.5	2.65	0.3	93	0	0.09
17	LC	128	256	181	2.65	0.3	93	0	0.09
18	SB	256	512	362	2.65	0.3	93	0	0.09
19	MB	512	1024	724	2.65	0.3	93	0	0.09
20	LB	1024	2048	1448	2.65	0.3	93	0	0.09

Currently Default

Density Method: Unit Weight (All Classes)

☐ Enforce Adjacent-Non-Overlapping Grain Classes and Geometric Mean

OK Cancel Defaults

Figure 10. Default HEC-RAS grain class sizes and sediment properties used.

4 Results

HEC-RAS offers many options for viewing the results of the sediment transport model. The following figures were chosen to best represent the results of the modeling. As mentioned previously, three (3) hydraulic scenarios over three time periods (initial 1 month drawdown, short three-month period and extended-period) and three bed grain size sensitivities (coarse, median, fine) were simulated. Table 3 summarizes the scenarios with color coding to assist with viewing the following figures in the following sections.



Lake Mallalieu Drawdown

Table 3. Matrix of model runs with color coding of results.

	Bed grain size distribution		
Hydrograph	Coarse	Median	Fine
Wet			
Normal			
Dry			

4.1 Invert erosion/deposition

Figure 11, Figure 12 and Figure 13 show the longitudinal change of the invert of the channel from the starting bed elevation to the ending of the simulation. As mentioned previously, the short duration simulation allowed for the bed to erode 20 feet but as seen in Figure 11, the channel does not erode to that point. The normal water year hydrograph resulted in greater channel erosion due to the multiple events that occurred during the month. Figure 12 shows the longer simulation that spans the initial 1-month drawdown period as well as the extended duration at low pool. The channel in the upper reservoir eroded to the 5-foot limit and as seen in Figure 12 and Figure 13, the channel begins to widen once that 5-foot limit is reached. Note, the deposition that occurs in the lower reservoir over the extended simulations (Figure 12). Figure 13 shows the additional duration run of three months with the 7.5 ft drawdown. While there is clearly not as much channel erosion as the extended duration run, there is 2-4 feet of invert erosion occurring in the delta area with visibly less deposition in the lower pool.



Lake Mallalieu Drawdown

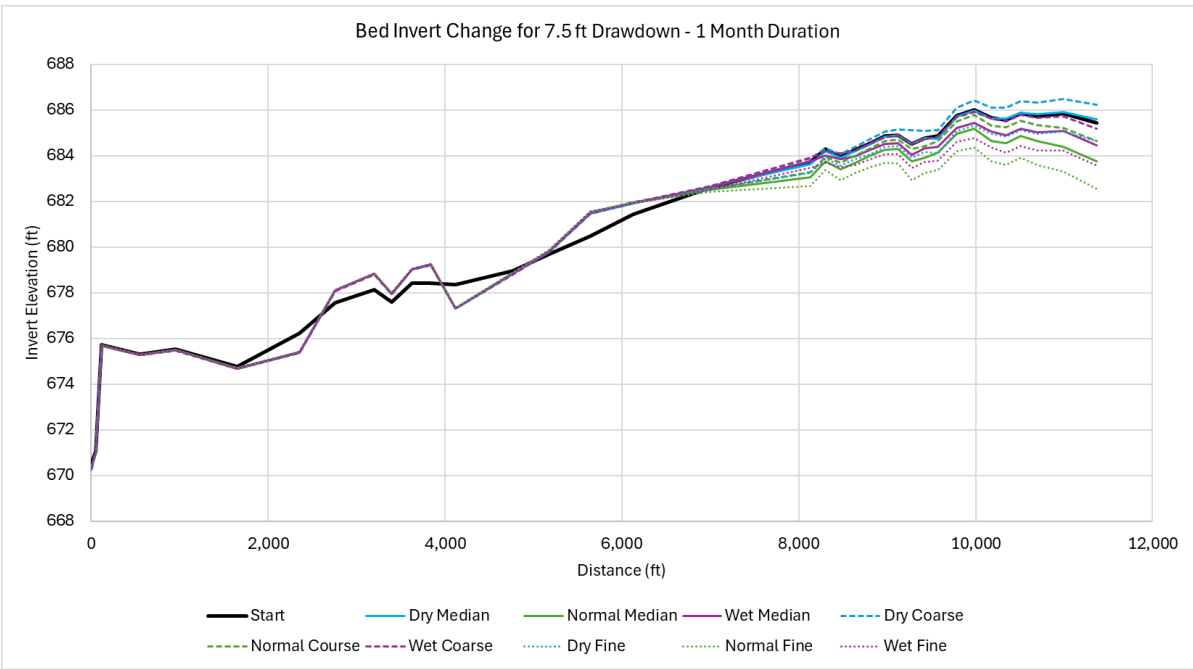


Figure 11. Channel invert change over 1 month duration with a 7.5 ft drawdown.

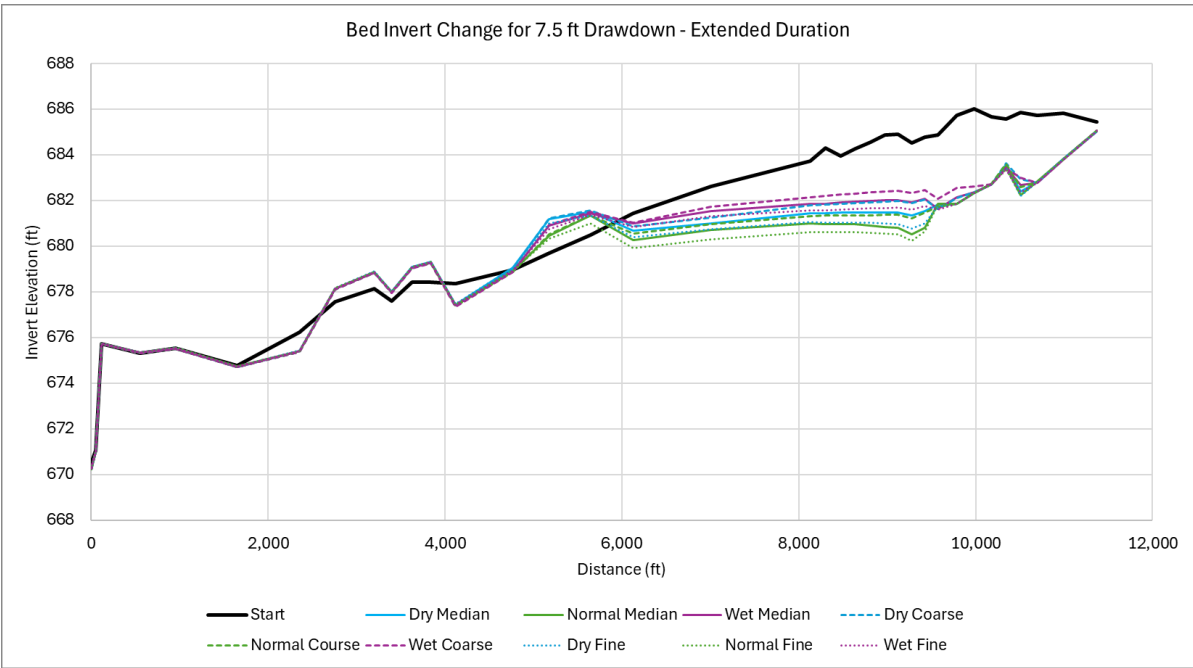


Figure 12. Channel invert change over extended simulation model runs with a 7.5 ft drawdown



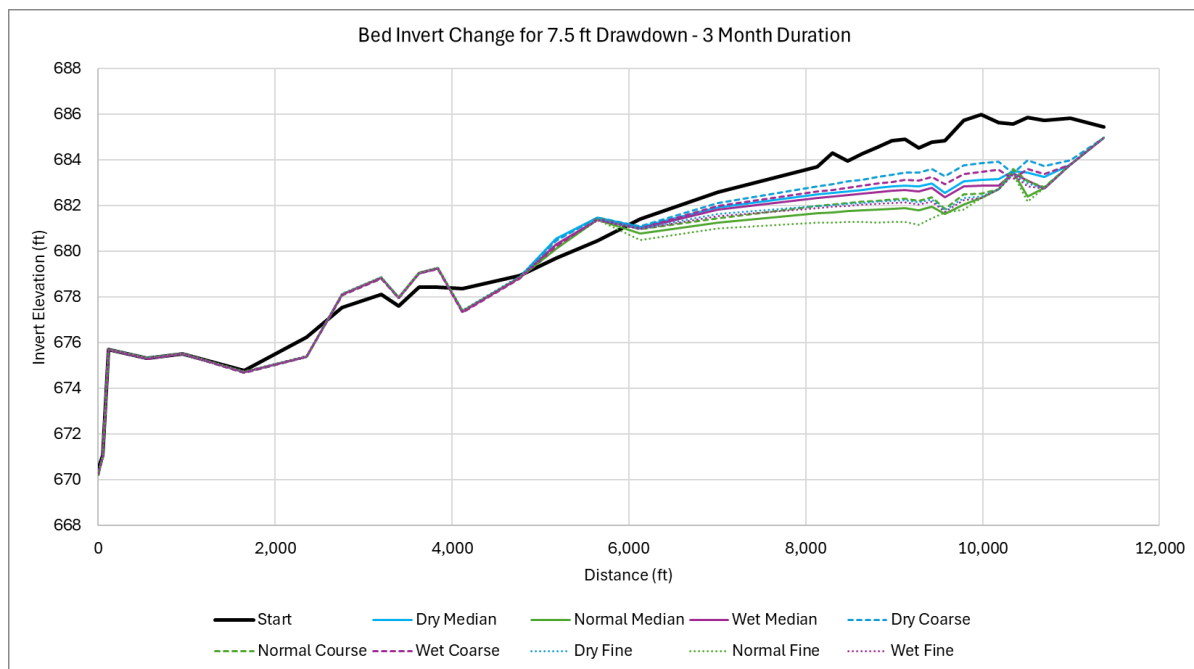


Figure 13. Channel invert change over 3-month model runs with a 7.5 ft drawdown.

4.2 Cross section bed erosion/deposition

Figure 14 and Figure 15 show examples of erosion/deposition of the bed with widening during the extended drawdown simulation for a cross section near the head of the delta and the bottom of the delta. In Figure 14, it is all erosive near the top of the delta (about 4.5 feet of channel erosion) with some channel widening while in Figure 15, we see small amounts of deposition on the edges of the transect and 6 to 7 feet of channel erosion.

Cross sections showing the deposition in the lower pool are shown in Figure 16. The 1D model is limited in that it assumes that the deposit will be uniform across the cross section. The deposition thickness may be slightly more in the middle of the lake and gradually become less on the margins of the lake. The deposition pattern will be similar to the pattern found in the upper reservoir. The deposition will be below the water surface at the time of the drawdown.

4.3 Sediment Erosion and Deposition

Bed mass and volume were summarized into segments of the impoundment (delta, middle, and lower). Figure 17 shows the changes in bed volume (top) and mass (bottom) during the drawdown period of September to October under 7.5 ft drawdown. It is clear that the multiple higher flow events during the normal water year run produce more erosion in the delta and middle segments while also resulting in



Lake Mallalieu Drawdown

slightly more deposition in the lower segment. As would be expected, the finer grain distribution results in more erosion under both simulation time periods. Figure 18 shows the changes in bed volume (top) and mass (bottom) during the extended drawdown period of September to July under the 7.5 ft drawdown. The results show that over the longer simulation, the delta segment shows similar amounts of erosion across all simulations. The middle segment of the impoundment shows more erosion under the normal and dry runs, which is due to the lower peaks in late winter under the wet scenario than the other two extended flows. As mentioned above, the normal water year has multiple higher flows during the September to October drawdown and some of the highest peaks during the extended run at low pool. The dry scenario had the lowest flows during the drawdown period but had many higher peaks in late winter and spring under the extended flow period. The changes in bed volume and bed mass in the three-month duration and 7.5 ft drawdown are shown in Figure 19. The resulting erosion in the delta is similar to the extended duration simulations with less erosion in the middle reach and less deposition in the lower pool reach.

Figure 20 shows the comparison of volume of sediment into the reach and out of the reach (top) and mass into the reach and out of the reach (bottom) during the drawdown period of September to October under the 7.5 ft drawdown. Figure 21 shows the comparison of volume of sediment into the reach and out of the reach (top) and mass into the reach and out of the reach (bottom) during extended duration under the 7.5 ft drawdown. Figure 22 shows the new run representing the three-month duration and lower 7.5 ft drawdown. From these figures, it is clear that most of the sediment moving is from the reservoir bed material, and one can see this from the very small contribution of volume and mass into the model reach versus what is coming out of the reach under each of the scenarios.

Table 4 shows a summary of the total volume eroded from the Middle and Upper portions over different drawdown depths and durations. The total volume eroded from the Middle and Upper portions for the 1-month simulations was between 6,700 and 27,700 cubic yards under the smaller 7.5 ft drawdown, whereas the total volume eroded from the Middle and Upper portions for the extended simulations was between 14,000 and 32,700 cubic yards under the smaller 7.5 ft drawdown, and between 10,000 and 28,700 cubic yards for the three-month duration simulation with the 7.5 ft drawdown.

Table 4. Summary of sediment volume eroded from the upper and middle portions of Lake Mallalieu over different durations

Drawdown Duration	Drawdown Depth (ft)	Approximate Volume of Sediment Eroded from Upper and Middle Portions of Lake Mallalieu yds ³
Sept – Oct	7.5	6,700-27,700
Sept – June	7.5	14,000-32,700
Sept – Dec	7.5	10,000-28,700



Lake Mallalieu Drawdown

The shorter 1-month duration drawdown resulted in approximately 70% of the total volume eroded from the Middle and Upper portions being delivered to the St. Croix. The smaller drawdown of 7.5 ft resulted in about 70% of total volume eroded from the Middle and Upper portions being delivered to the St. Croix while the longer extended duration simulations deliver 50 - 60% of the total volume eroded to the St. Croix. The silt and clay were primarily delivered to the St. Croix and the sand was primarily redeposited in the lower lake.

Sediment consolidation is expected to occur during drawdown in the lake sediment that is currently below the lake elevations, but that will be exposed during drawdown. There is no bulk density data on the sediment which would help to quantify the potential amount of consolidation. The lake sediment could consolidate up to as much as 60%, which was observed by in the reservoir sediment behind the PacificCorp Dams on the Klamath River³, and approximately 50% in sediment at Big Muskego Lake, Wisconsin⁴.

Stantec did not explicitly model the St. Croix River, but the expected depositional behavior can be estimated by comparing the hydraulic conditions in the St. Croix River to the hydraulic conditions in the lower pool. The average velocities in the lower pool of Lake Mallalieu ranged from 0.03 ft/s to 0.1 ft/s. The typical baseflow in the St Croix during the drawdown will be near 4,000 cfs with velocities expected to be greater than 0.3 ft/s and approximately 10 times greater than the low velocities in Lake Mallalieu. Therefore, if the sediment is transported through the Lake Mallalieu, the bulk of the sediment (clay and silt) will most likely be transported through the St. Croix River and not deposited. In areas of low velocity in the St. Croix River, there is existing evidence of deposition of sandy material. In these areas the sand fraction of the release would be the most likely deposit. The maximum sand percent of the total concentration released into Lake St. Croix was 2% and evenly distributing this volume of sand over the depositional area results in approximately 0.05 inches of deposition, which is considered insignificant as it is approximately 1 grain diameter of coarse sand. The volume of fine material (silt and clay) leaving Lake Mallalieu ranged from 7,700 yd³ to 22,000 yd³ depending on the duration and simulation drawdown (Figures 20-21) and this material is expected to remain in suspension and be carried through the St Croix River and eventually into the Mississippi River.

³ Reclamation (2012). "Hydrology, Hydraulics and Sediment Transport Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration," Technical Report No. SRH-2011-02. Prepared for Mid-Pacific Region, US Bureau of Reclamation, Technical Service Center, Denver, CO.

⁴ James, W.F., H. L. Eakin and J.W. Barko. 2001. Rehabilitation of a Shallow Lake (Big Muskego Lake, Wisconsin) Via Drawdown: Sediment Response. Aquatic Plant Control Technical Note EA-04, November 2001. Accessed on April 29, 2026 at <https://apps.dtic.mil/sti/tr/pdf/ADA398287.pdf>.



4.4 Low Pool and Stormwater Inflow Potential Drop

Consideration was given to the potential for scour due to plunge flows from the elevation differential between the stormwater inflow infrastructure and the low pool elevation from the drawdown. Figures 23 through Figure 25 show the Lake Mallalieu impoundment with the low pool elevation and the locations of the stormwater inflows. Figure 23 shows an overview of all of the inflow points whereas Figure 24 and Figure 25 show zoomed in areas of the inflows impacted by the drawdown in the upper and lower reach, respectively. Table 5 summarizes the elevation difference between the stormwater pipe and the low pool elevation. Each of these locations could cause additional scour as flows run down the impoundment bank to the low pool. If this is of concern rock slope protection could be used at the outflow from the stormwater pipe. Under the smaller drawdown (7.5 ft) there could be less scour along the outflows to the lower pool due to less distance.

Table 5. Estimated distance between low pool and stormwater inflow locations.

Stormwater Inflow Point	Estimated Distance to Low Pool (ft) 7.5 ft drawdown
0	11.7
1	7.6
2	10.5
4	5.4
5	0
6	11.2
7	13.7
8	41.6
9	25.7



Lake Mallalieu Drawdown

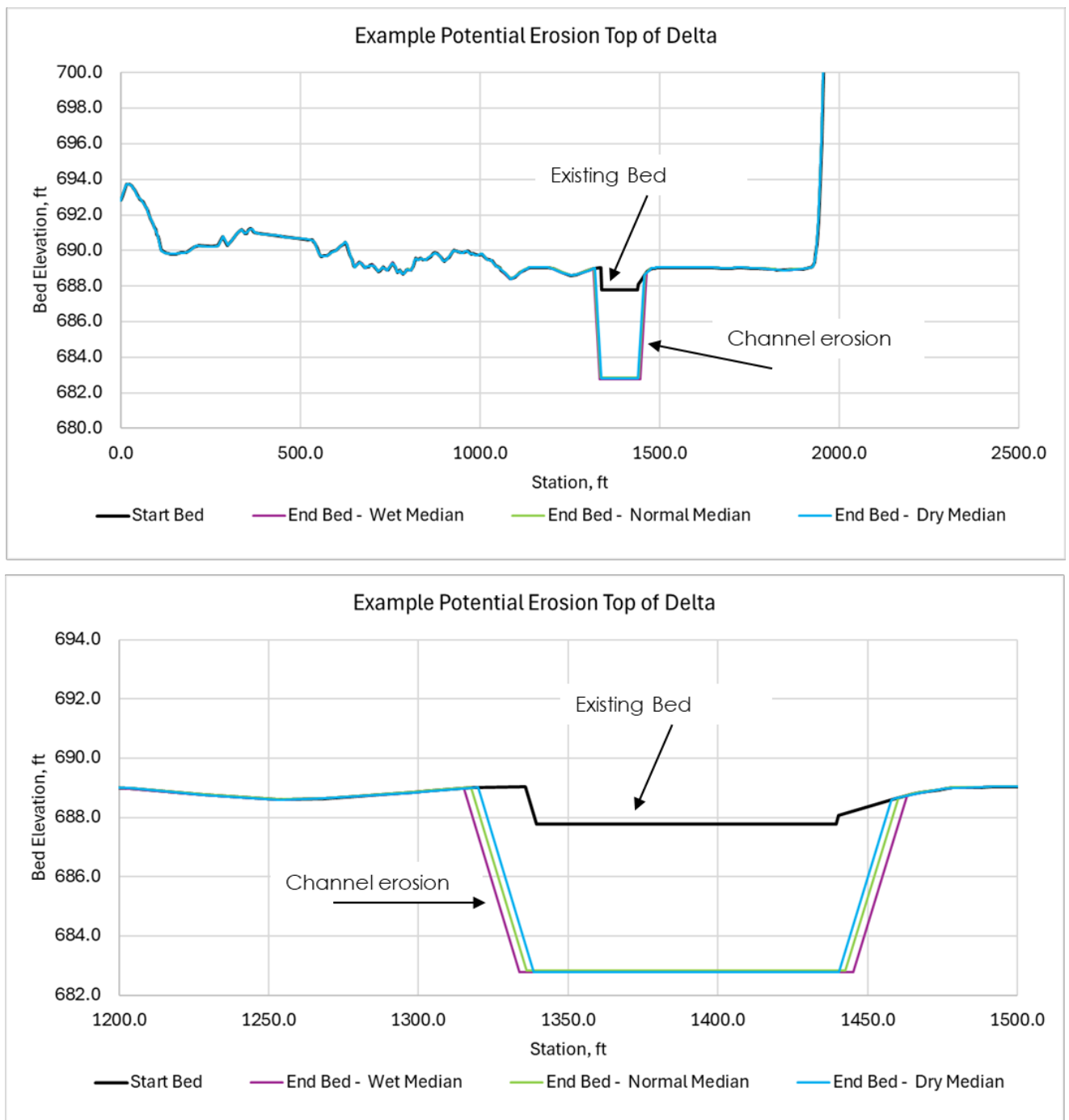


Figure 14. Example of erosion of the bed with widening during the extended drawdown simulation for a cross section near the head of the delta under the median bed grain size distribution.



Lake Mallalieu Drawdown

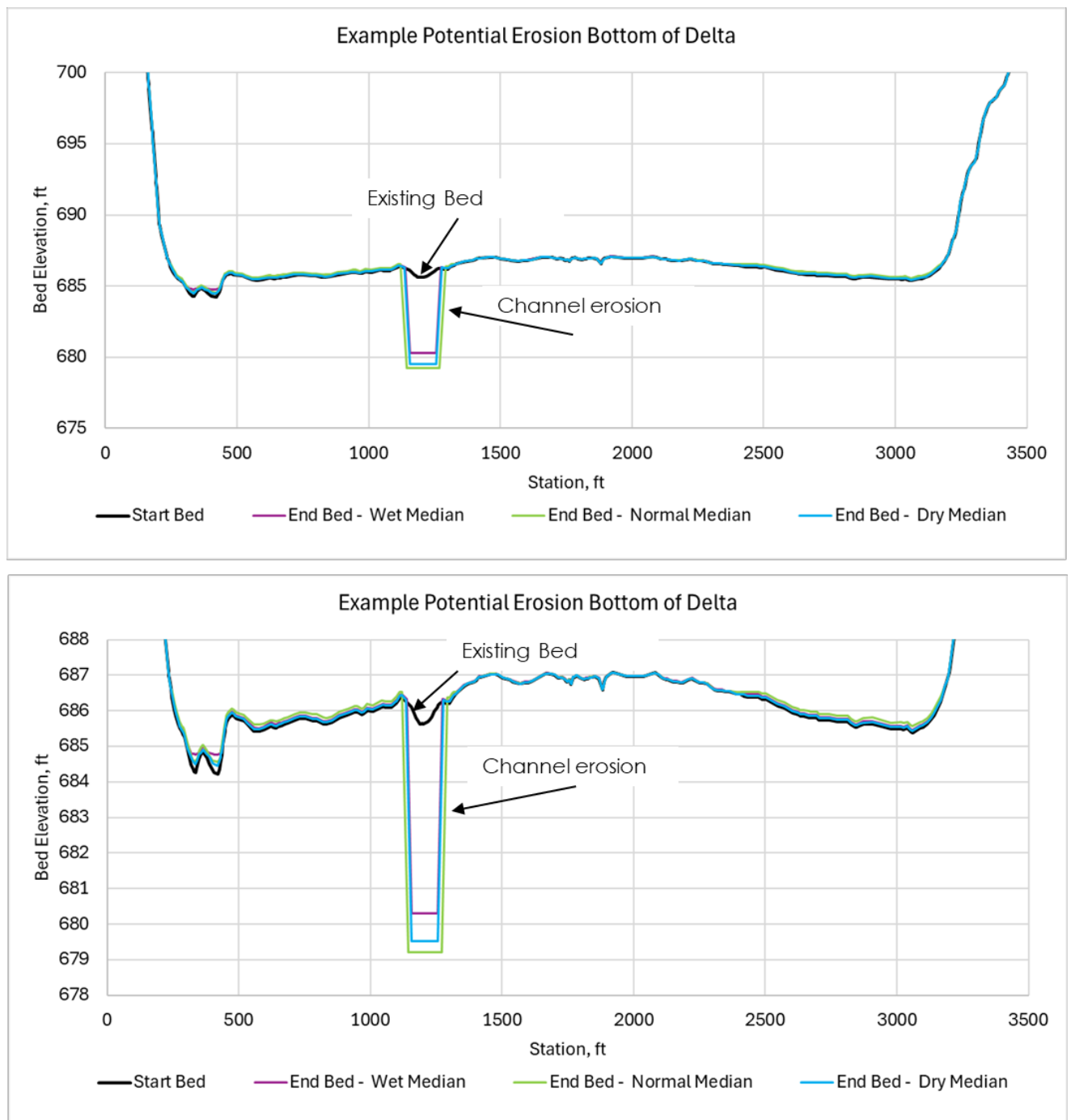


Figure 15. Example of erosion of the bed with widening during the extended drawdown simulation for a cross section near the bottom of the delta under the median bed grain size distribution.



Lake Mallalieu Drawdown

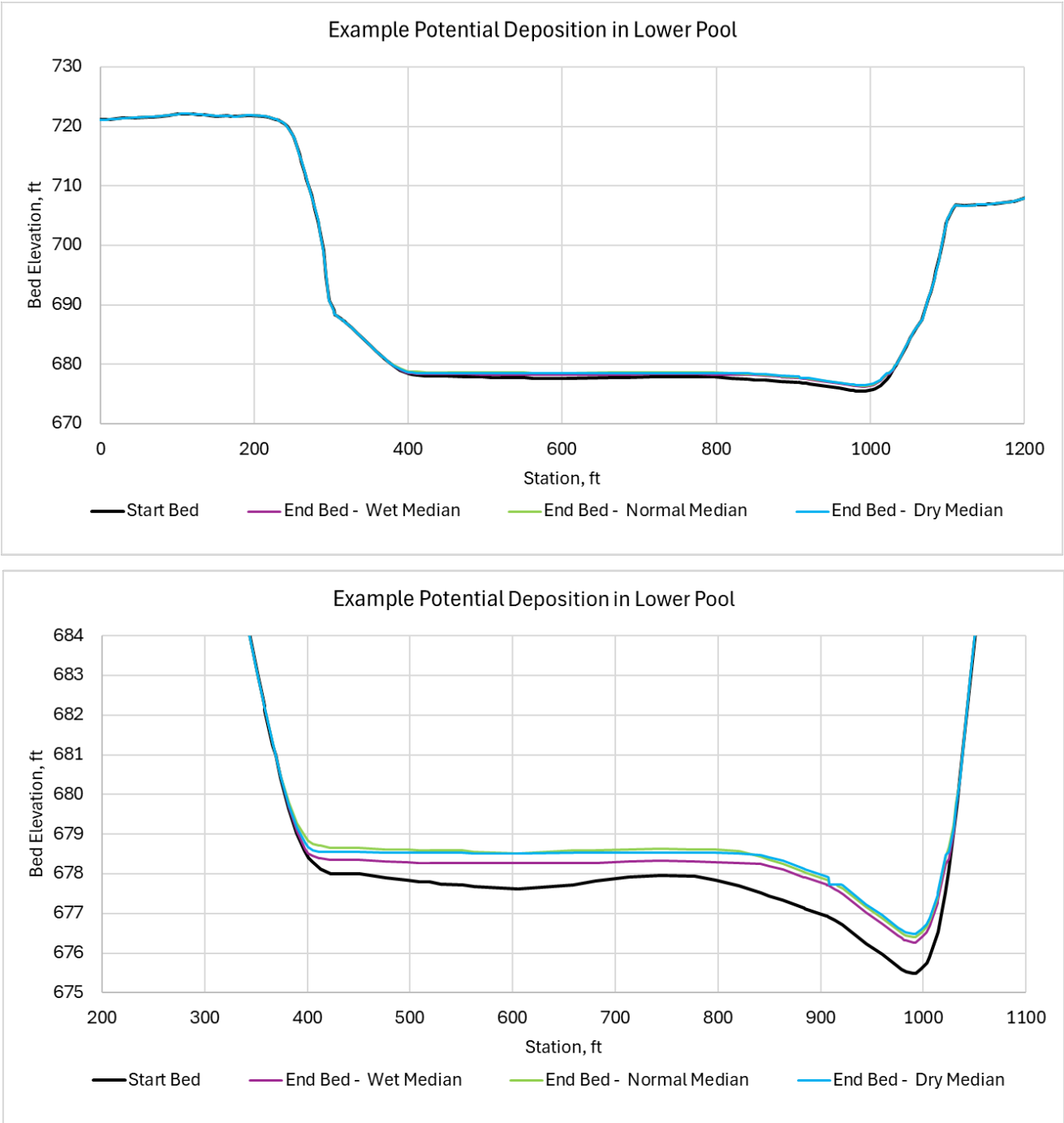


Figure 16. Example of deposition during the extended drawdown simulation for a cross section in the lower pool under the median bed grain size distribution.



Lake Mallalieu Drawdown



Figure 17. Changes in bed volume (top) and mass (bottom) for segments through the Lake Mallalieu impoundment during the drawdown period of September to October for the 7.5 drawdown.



Lake Mallalieu Drawdown



Figure 18. Changes in bed volume (top) and mass (bottom) for segments through the Lake Mallalieu impoundment during the extended drawdown period of September to July for the 7.5 ft drawdown.



Lake Mallalieu Drawdown

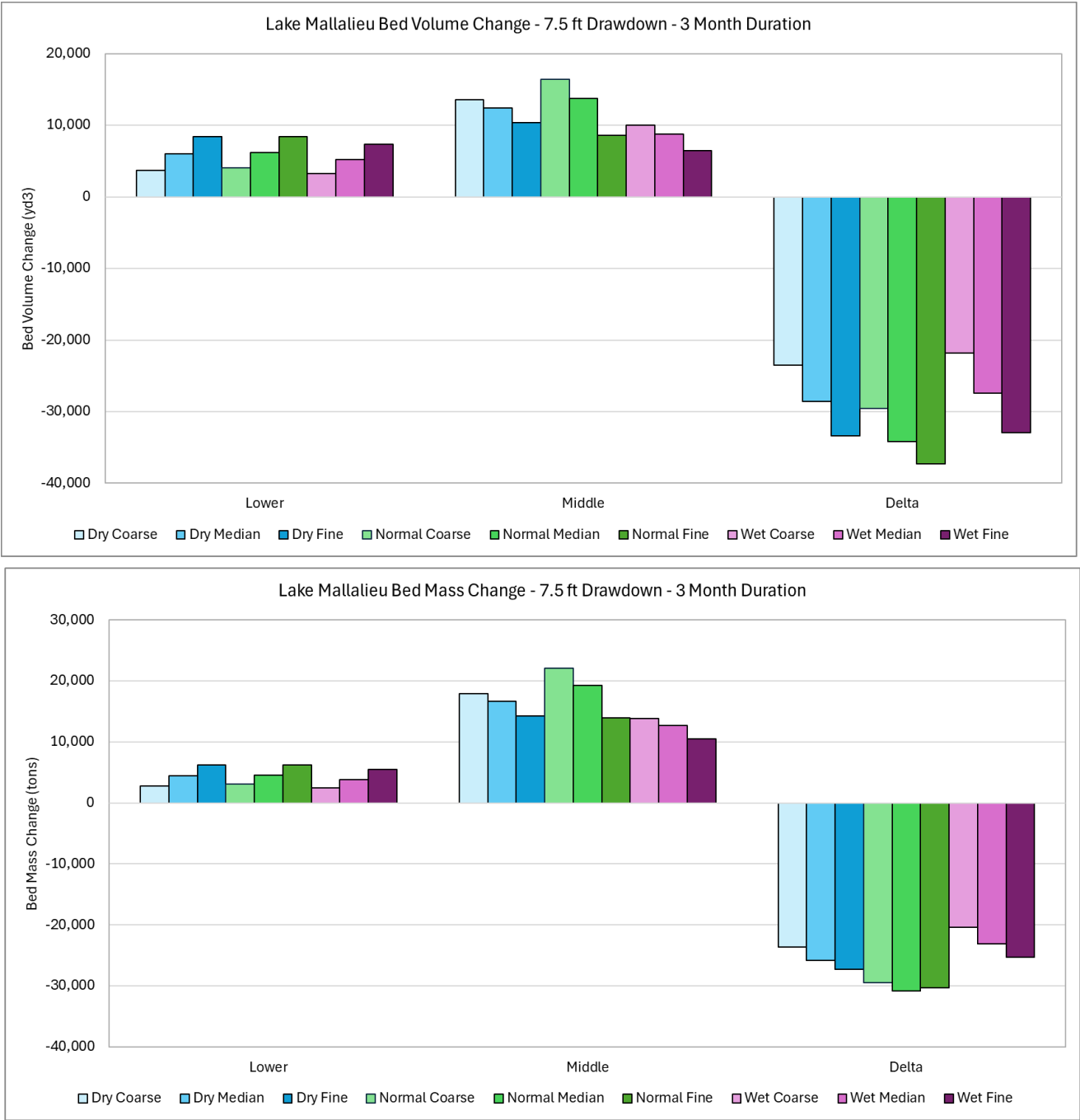


Figure 19. Changes in bed volume (top) and mass (bottom) for segments through the Lake Mallalieu impoundment during the three-month drawdown period of September to December for the 7.5 ft drawdown.



Lake Mallalieu Drawdown

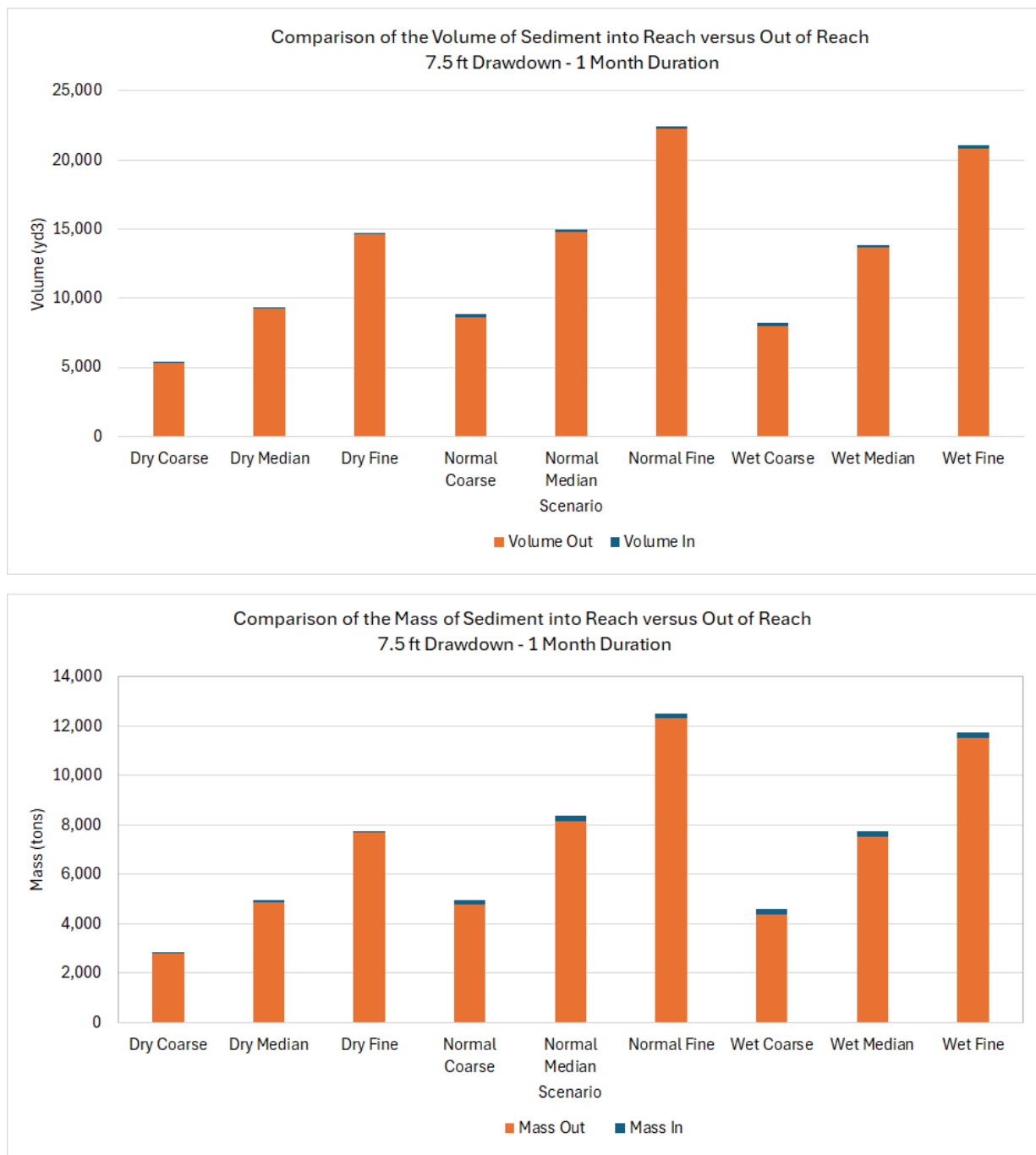


Figure 20. Comparison of volume of sediment into the reach and out of the reach (top) and mass into the reach and out of the reach (bottom) during the drawdown period of September to October and the 7.5 ft drawdown.



Lake Mallalieu Drawdown

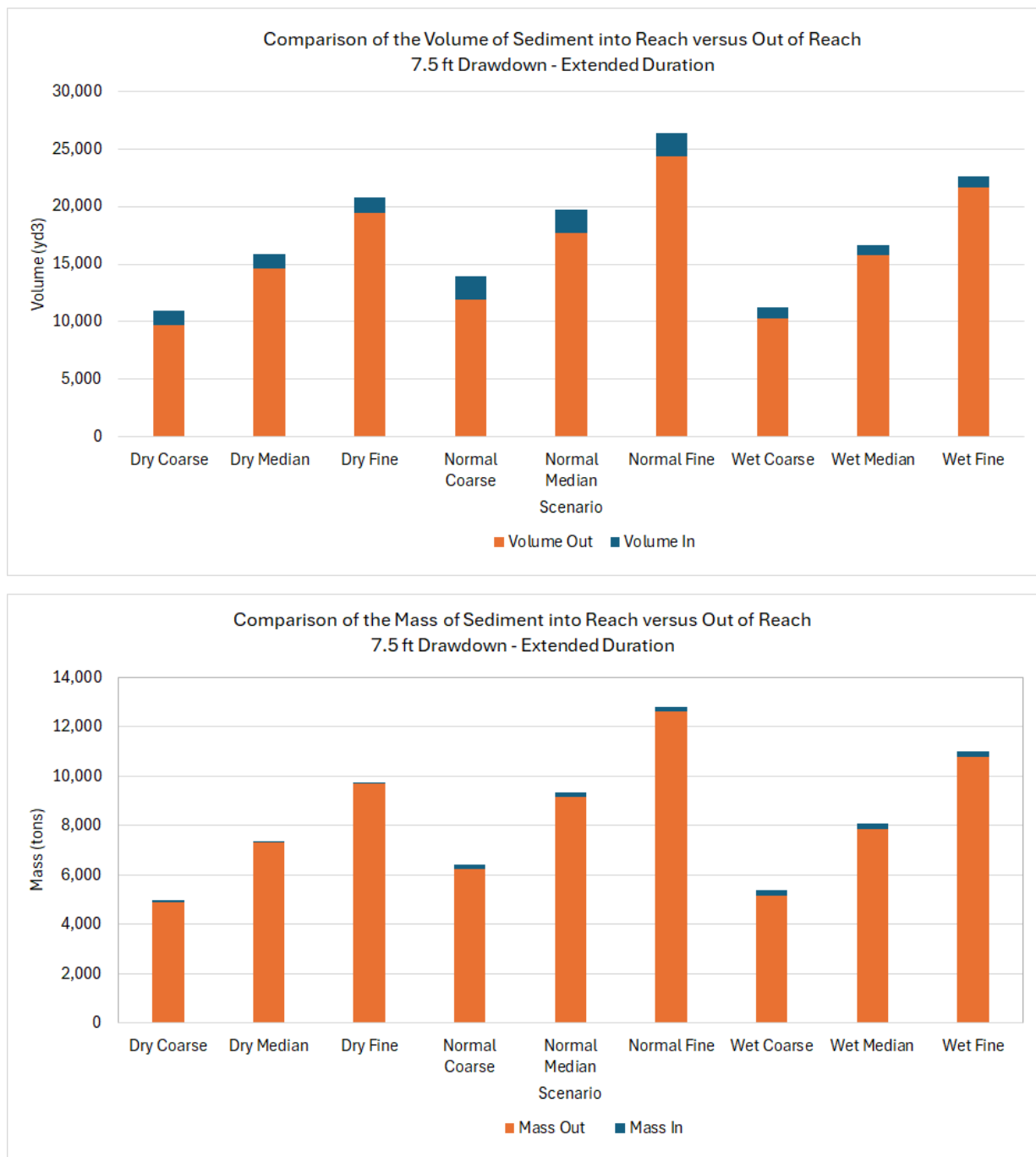


Figure 21. Comparison of volume of sediment into the reach and out of the reach (top) and mass into the reach and out of the reach (bottom) during the extended drawdown period of September to July for the 7.5 ft drawdown.



Lake Mallalieu Drawdown

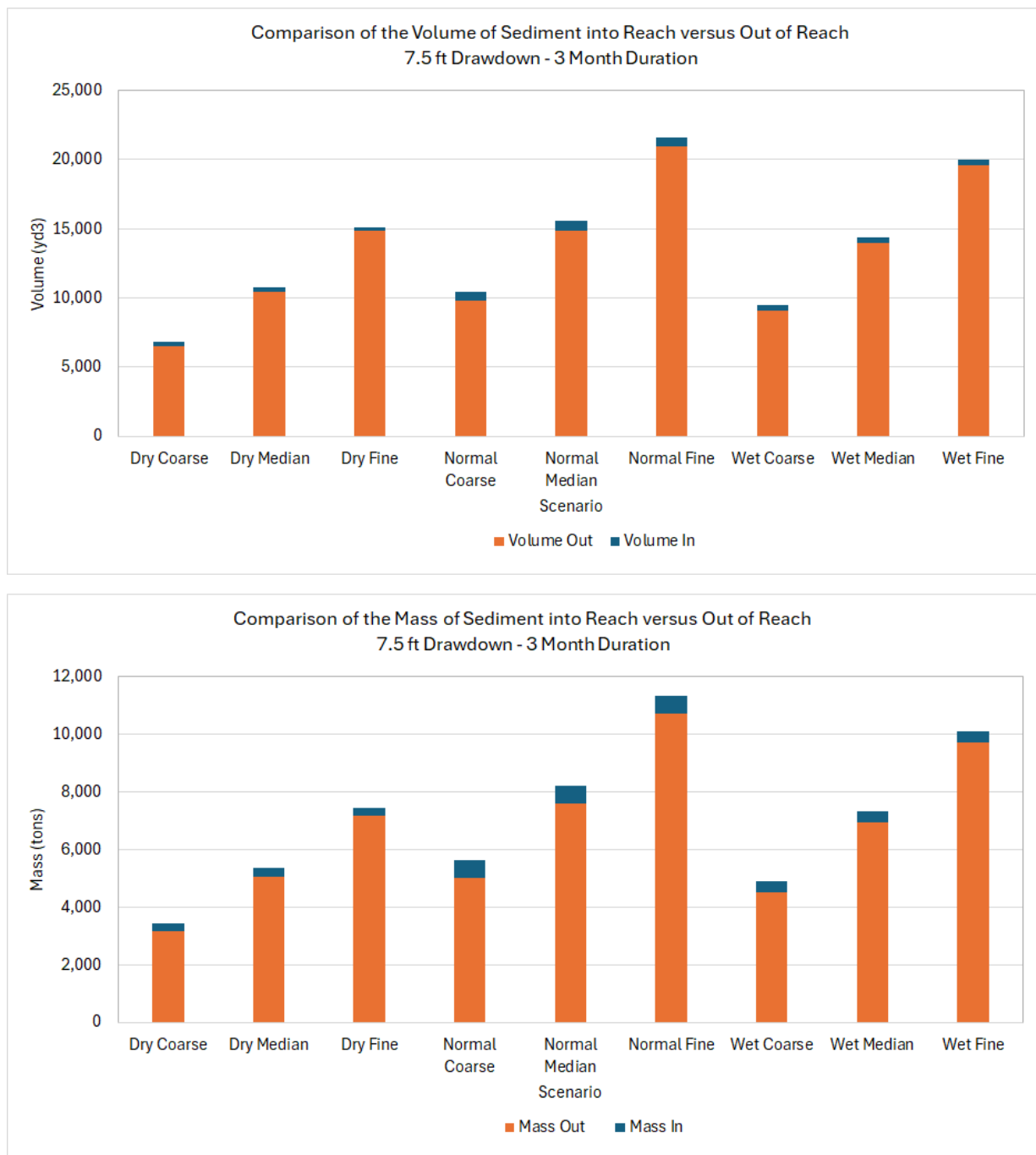


Figure 22. Comparison of volume of sediment into the reach and out of the reach (top) and mass into the reach and out of the reach (bottom) during the three-month drawdown period of September to December for the 7.5 ft drawdown.



Lake Mallalieu Drawdown

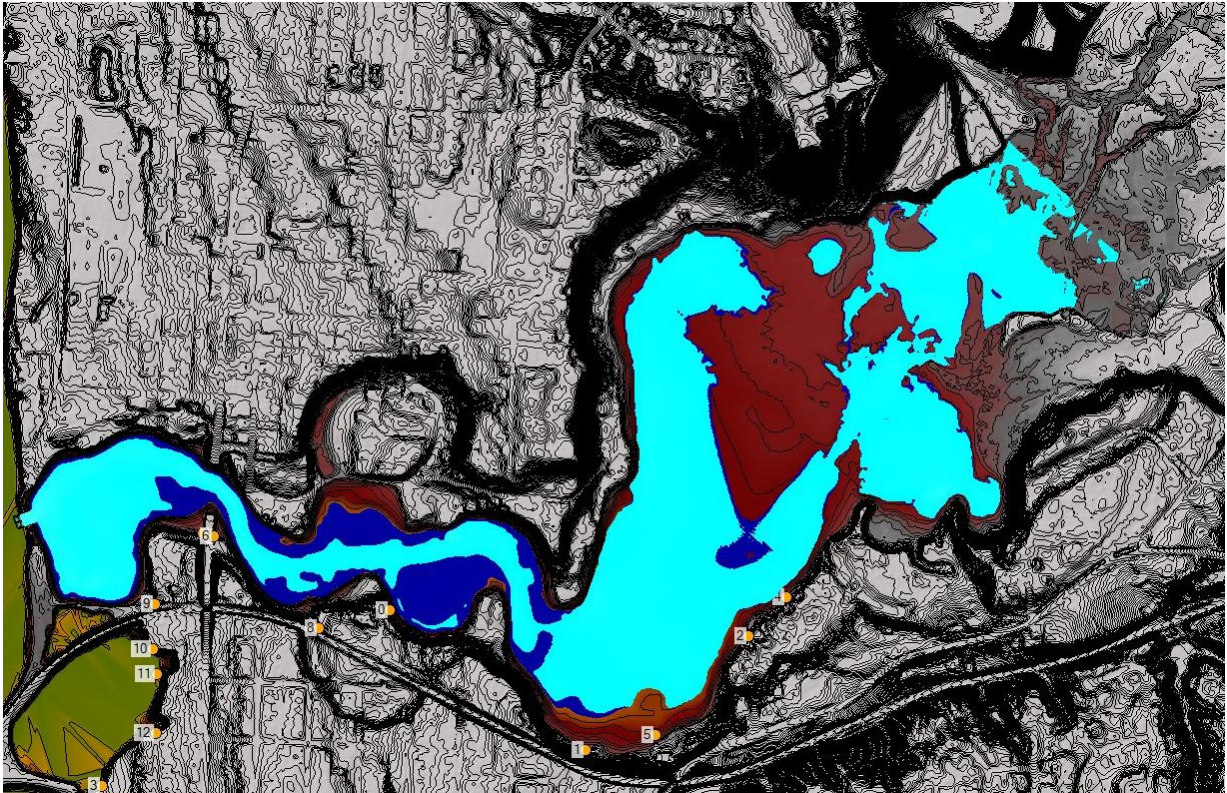


Figure 23. Overview of low pool water surface elevation and stormwater inflow locations. The dark blue shows the 7.5 ft drawdown level.



Lake Mallalieu Drawdown

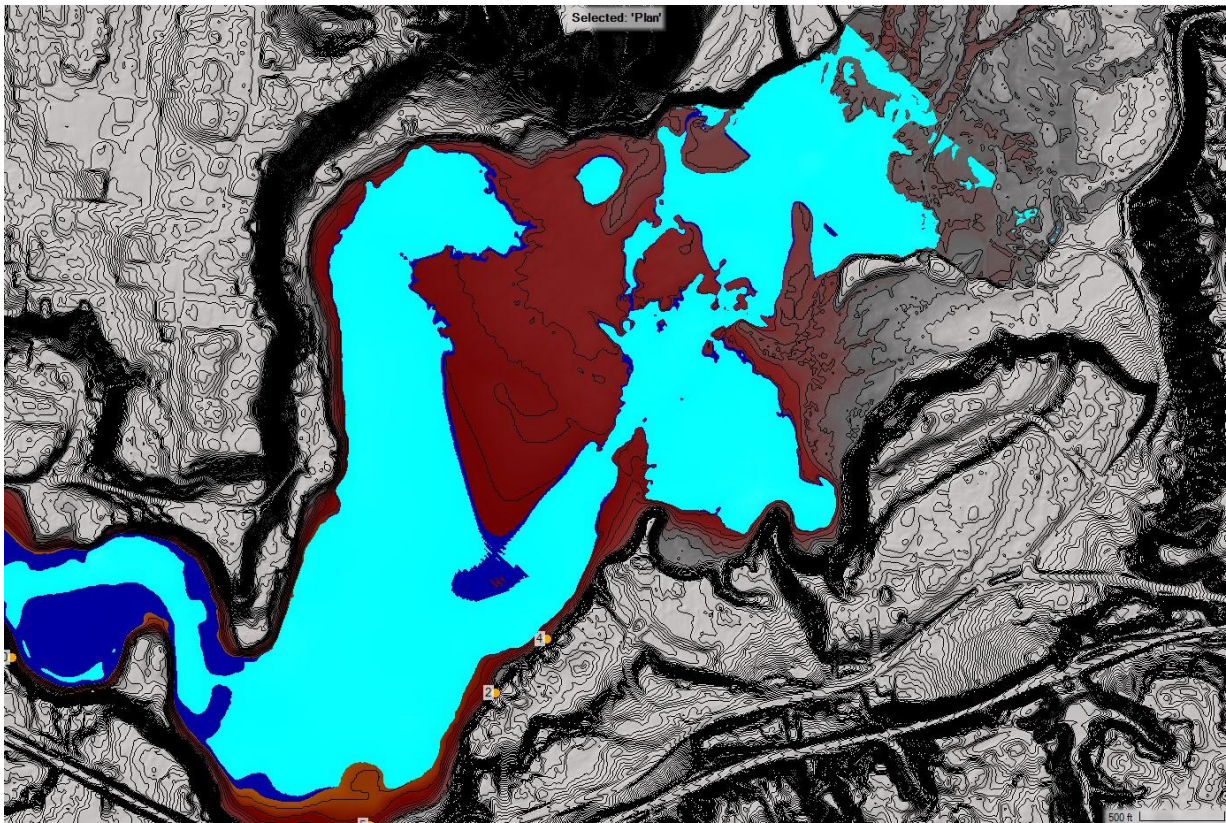


Figure 24. View of low pool and stormwater inflow locations for the upper reservoir. Dark blue shows the 7.5 ft drawdown level.



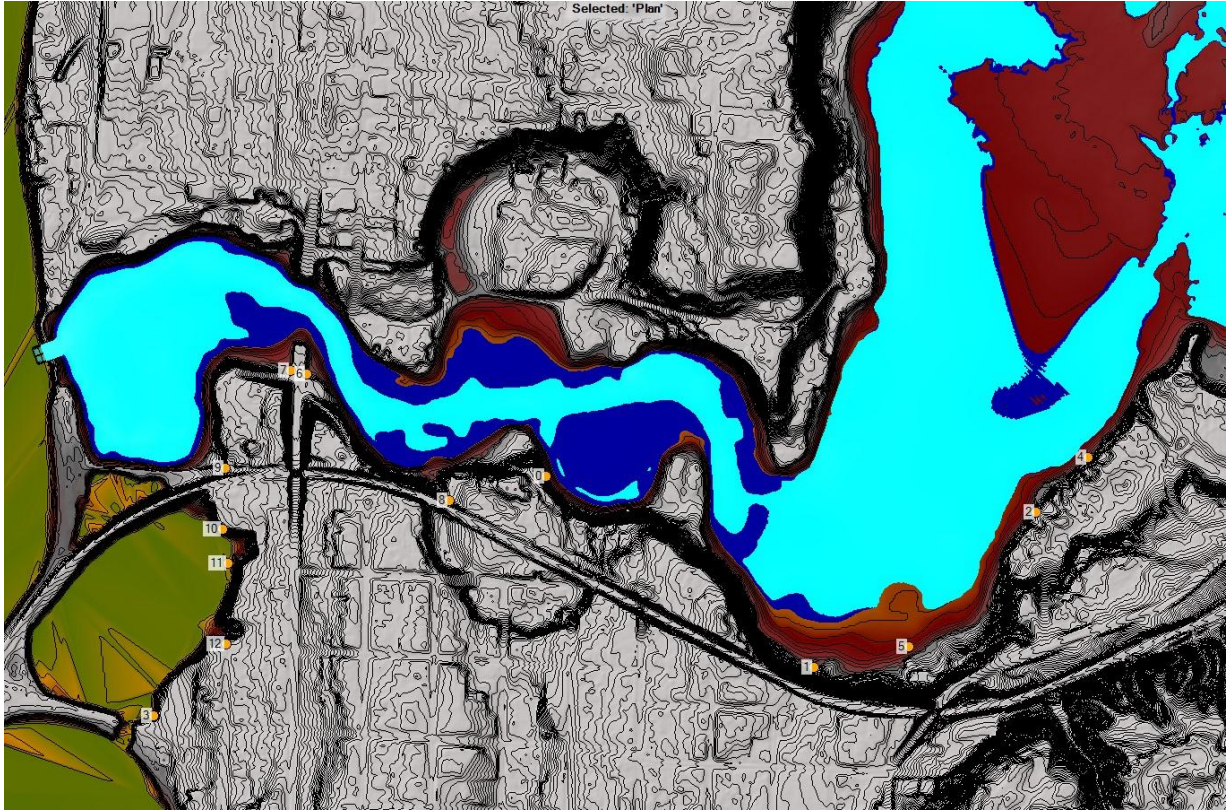


Figure 25. View of low pool and stormwater inflow locations for the lower reservoir. Dark blue shows the 7.5 ft drawdown level.

4.5 Suspended Sediment Concentration Changes due to Drawdown

Another concern is the potential for high concentrations of sediment leaving Lake Mallalieu and entering the St. Croix River. The following series of figures show the concentration of total suspended solids (TSS) into and leaving Lake Mallalieu and the potential increase in TSS concentration in the St. Croix River. To estimate the increase to the St. Croix River, the TSS concentration leaving Lake Mallalieu was diluted in proportion to low average flow for the St. Croix River (5,000 cfs).

Figure 26 summarizes the mean monthly TSS concentrations entering Lake Mallalieu (top), leaving Lake Mallalieu (middle), and the added increase in concentration to the St. Croix River (bottom) for the extended duration. Included in the bottom plot is the mean monthly concentration in the St. Croix (measured at Stillwater) during low flows and high flows⁶ and mean monthly maximum and means for the St. Croix River



Lake Mallalieu Drawdown

between Taylor Falls and Prescott, WI⁵. The active drawdown period is highlighted for the month of September, the remainder of the simulation is during a low pool run of river period.

The modeled sediment concentrations are highest during the drawdown period, ranging from 150-250 mg/L at the downstream end of Willow River. The incremental increase in sediment concentration in the St Croix during the drawdown is 10 to 20 mg/L.

Putting these results into a context based on previously reported mean monthly concentrations in Lake St. Croix (2 to 12 mg/L)⁶, the mean monthly concentrations for the model results could incrementally increase the concentration of suspended sediments in the St. Croix by 0.05 mg/L to 6 mg/L. Sediment deposition is unlikely to occur as most of the suspended sediments are silts and clays, the majority of sands drop out in the lower pool of Lake Mallalieu.

Table 6 shows a summary comparison of the mean monthly concentrations in the St. Croix and the modeled scenario (7.5 ft drawdown). The TSS standard set by the MPCA is 15 mg/L. The modeled scenario does not release more than 6 mg/L into the St. Croix. Including the St. Croix baseline load, the addition of the release from the drawdown could increase the St. Croix TSS to just under 15 mg/L. This could occur during the September/October and March/April months.

⁵ Received data from Ben Koch with DNR WME with the following note : TSS data courtesy of MN PCA. Data primarily from EQuIS Station S000-020.

⁶ Magdalene, Suzanne, et al. (2018). Report on the State of the Lake Assessing Lake St. Croix in 2018 On the Way to the 2020 TMDL Goals. Science Museum of Minnesota.



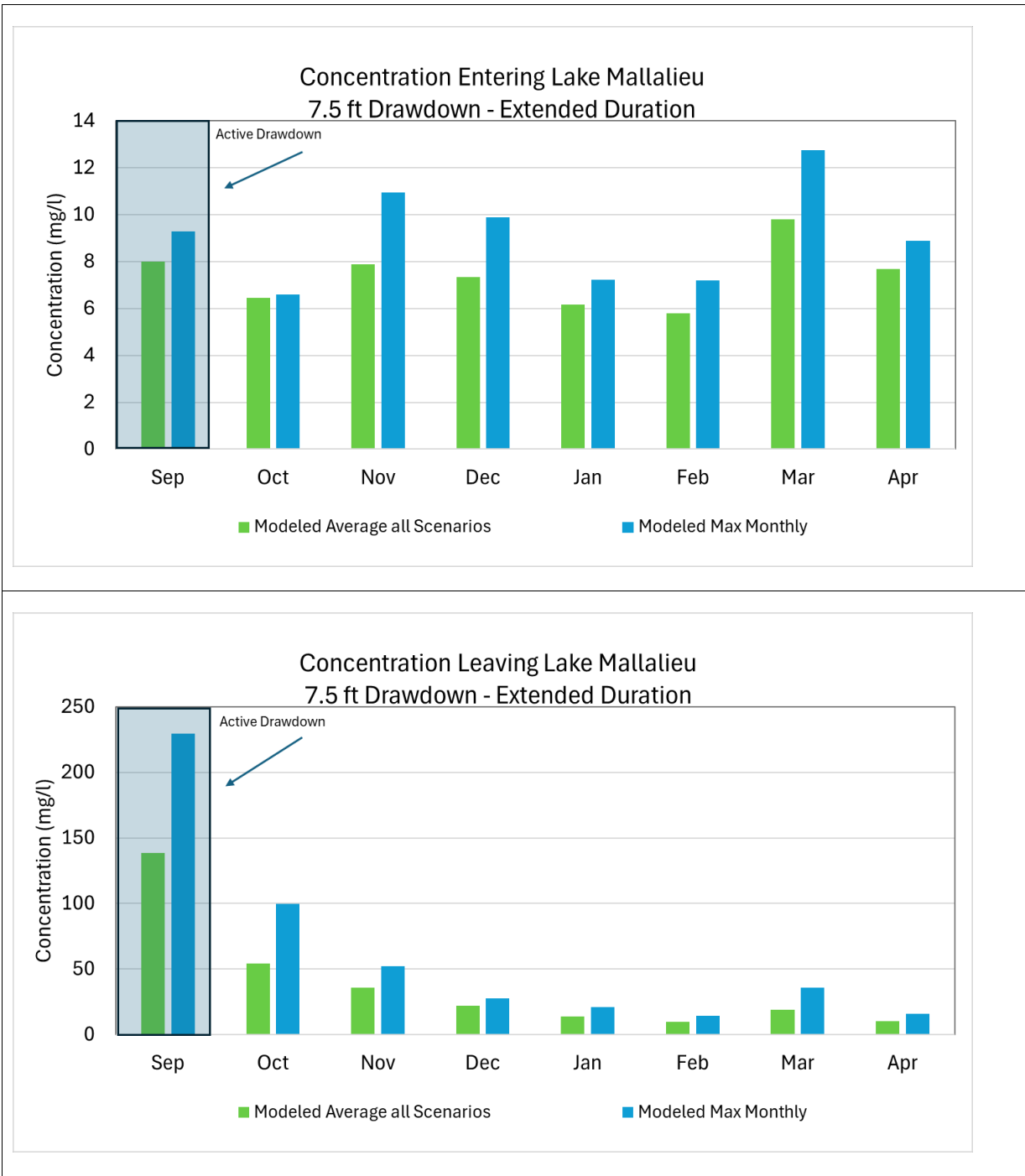
Lake Mallalieu Drawdown

Table 6. Comparison of baseline St. Croix TSS (1976-2014) and modeled scenarios including the combined TSS (St. Croix baseline + modeled monthly average)

Month	Taylors Falls to Prescott, WI Mean	TSS (mg/L)	
		Modeled Average all Scenarios, 7.5 ft drawdown	St. Croix Baseline + Modeled Average – 7.5 ft drawdown
Sep	8.1	6.2	14.3
Oct	11	1.8	12.8
Nov	5	1.8	6.8
Dec	4	0.9	4.9
Jan	1.7	0.4	2.1
Feb	4.9	0.3	5.2
Mar	11.7	1.4	13.1
Apr	14	0.5	14.5
May	12.5	0	12.5
Jun	14.2	0	14.2
Jul	13.6		
Aug	8.5		



Lake Mallalieu Drawdown



Lake Mallalieu Drawdown

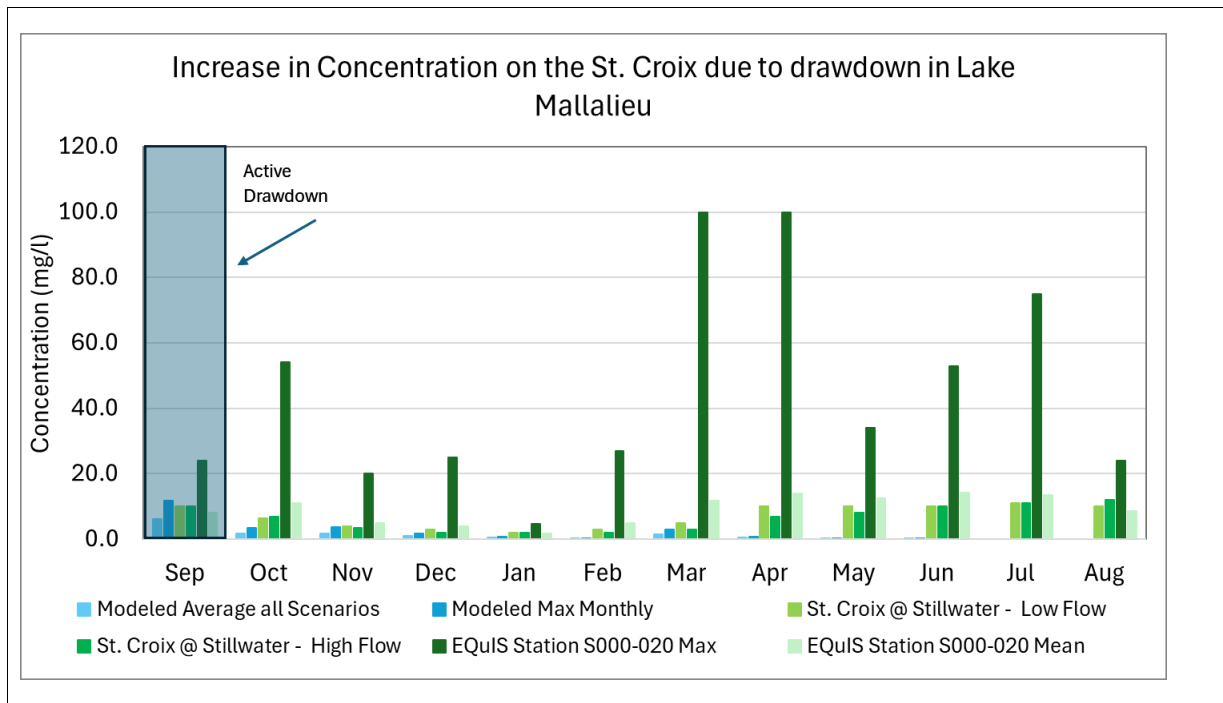


Figure 26. Comparison of Total Suspended Sediment Concentration (mg/L) entering Lake Mallalieu (top), leaving Lake Mallalieu (middle) and added to the St. Croix River (bottom) under the extended duration simulation with the 7.5 ft drawdown.



Lake Mallalieu Drawdown

Figure 27 shows a map of the existing contours for Lake Mallalieu. The shaded/hatched area represents the potential area of deposition in the lower pool. The area of potential deposition is 36.4 acres. Using the total volume of bed change for the transects that represent the lower impoundment (depositional area), the average depth of sediment deposited would range from 0.1 – 0.2 ft for the three-month 7.5 ft drawdown simulation. As mentioned previously, the 1D model is limited in that it assumes that the deposit will be uniform across the cross section. The deposition thickness may be slightly more in the middle of the lake and gradually become less on the margins of the lake.





Figure 27. Existing bed elevation contours for Lake Mallaieu with estimated depositional area in the lower impoundment.



5 Summary and Recommendations

A 1D sediment transport model was created to estimate the potential for erosion in the delta of Lake Mallalieu. Three hydraulic scenarios were run over two time periods using three bed grain size sensitivities.

A downramp rate of 5 inches per day was used. This satisfied the conditions of not to exceed 6 inches per day (based on the ability of mussels to relocate and stay wetted). Using a rate of 5 inches per day allows the drawdown to be completed within the month of September.

At low pool the water surface of the lake varies from 678 ft at the Lower Dam to 690 ft near the top of the delta.

While a 1-month drawdown period results in a total volume eroded from the Middle and Upper portions of 6,700 to 28,000 cubic yards the extended drawdown period of September to the beginning of June results in 14,000 to 33,000 cubic yards eroded. It is recommended to leave the pool low for the longer extended period at least through the spring months to capture higher flows and allow for increases erosion in the delta area.



With every community, we redefine what's possible.

Stantec is a global leader in sustainable engineering, architecture, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what's previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what's possible.

Stantec Consulting Services Inc.

stantec.com



Attachment 3

To:	Kurt A. Rasmussen Water Resources Manager Wisconsin Department of Natural Resources	From:	Dendy Lofton, PhD, CLM Anna Varian Lucas Clapp Katie Hembre Plymouth, MN
Project/File:	227706430	Date:	March 11, 2025

Reference: Lake Mallalieu Dredging Feasibility Study

Introduction

Stantec Consulting Services Inc (Stantec) has been supporting the Lake Mallalieu Association (LMA) with a feasibility study for removal of the soft sediment that was deposited in the upper reaches of Lake Mallalieu (Lake) by a series of breaches in the Willow River Dam (Little Falls Lake) from 2015 through 2019¹. Stantec was contracted by LMA to evaluate dredging lake sediments and collect data to support the analyses, agency coordination, permitting and conceptual design. In 2024, Stantec conducted a bathymetric survey (**Attachment 1**) and soft sediment depth survey of the upper reach of the Lake where sediments are known to have accumulated. **Attachment 2** shows the number of sampling points where a steel rod was inserted into the sediments until the depth of refusal, which allowed for spatial determination of the soft sediment depth across the project extent. The soft sediment depths in between surveyed points were interpolated in ArcGIS to create a density map showing the spatial distribution soft sediment accumulation within the project extent (**Attachment 3**).

The soft sediment depth survey demonstrated high variability across the project extent with respect to soft sediment depths and accumulation. While dredging these areas may be feasible, the distribution of soft sediments should be mobilized with a lake drawdown, which would be less impactful to the area from an ecological perspective. A lake drawdown would begin in fall 2025 with refilling to occur naturally with spring runoff and precipitation. The high flows entering the headwaters of the Lake in spring would naturally flush soft sediments further downstream to deeper areas. Stantec is currently working on a drawdown plan and developing a sediment transport model to simulate effects to downstream areas.

As part of the permitting process for dredging and/or drawdown, sediment samples were collected to quantify any potential sediment contamination that could negatively impact water quality. This technical

¹ Lake Mallalieu Desktop Analysis. Technical Memo. October 11, 2022. Prepared by Stantec for the Lake Mallalieu Association.

Reference: Lake Mallalieu Dredging Feasibility Study

memorandum (memo) summarizes the methods and results of recent sediment contamination sampling and analyses.

Sediment Collection & Analysis

Field Methods

On November 11, 2024, a two water resources staff from Stantec and two scientists from the Continental Scientific Drilling (CSD) Facility from the University of Minnesota used a motorboat and hand core sediment sampler to collect sediment cores on Lake Mallalieu, Hudson, WI. CSD was contracted because of their equipment capabilities to extract core samples up to 4-ft deep. The Wisconsin Department of Natural Resources (WDNR) requested the following sampling approach per email from Kurt Rasmussen on October 3, 2024.

“Samples should be collected from a total of four sediment cores:

- 2 sediment cores that extend down to 4-feet from the sediment surface in the areas of potential head cutting/mechanically dredged.
- 2 sediment cores extending down to 2-feet from the sediment surface in the soft sediment areas.

Samples shall be analyzed from each distinct layer observed in the material to be dredged. If no strata formation exists, core samples shall be divided into 2-foot segments, and each segment shall be analyzed for the required chemicals and characteristics (**Table 1**). For example, the core samples that extend down to 4 feet will have two composite samples. The first composite sample should be collected from 0-2 feet of depth in the core. The second composite sample should be collected from 2-4 feet in the core. Note - Might be able to condense the number of samples to be sent for analysis if the material is homogeneous (all sand). The soft sediment cores will have one composite sample collected from 0-2 feet. Each composite sample should then be split into 2 portions.”

Attachment 4 shows the sediment coring locations overlaying the map of soft sediment depths. The sediment core sampling sites were selected to represent a range of soft sediment depths targeting areas where sediment was deposited from the dam breaches.

Reference: Lake Mallalieu Dredging Feasibility Study

Table 1. Sediment sampling parameters required for analysis of dredging project as identified in Chapter NR 347.

Parameter	Suggested Analytical Method (Suggested Detection Level) (mg/kg, dry weight unless noted)
Inorganics – Metals	
Arsenic	SW-846 3050B/6010B/C/D (1.0)
Cadmium	SW-846 3050B/6010B/C/D (0.1)
Chromium (total)	SW-846 3050B/6010B/C/D (0.5)
Copper	SW-846 3050B/6010B/C/D (0.5)
Lead	SW-846 3050B/6010B/C/D (1.0)
Manganese	SW-846 3050B/6010B/C/D (0.5)
Mercury	SW-846 7471/A/B (0.015)
Nickel	SW-846 3050B/6010B/C/D (0.5)
Zinc	SW-846 3050B/6010B/C/D (0.5)
Inorganics – Nutrients	
Total Phosphorus	USGS I-6600 (9.9)
Nitrate + Nitrite	EPA 300.0 (0.25)
Ammonia-Nitrogen	USGS I-6522 (0.16)
Total Kjeldahl Nitrogen	USGS I-5553, SM 4500Norg B/C, EPA 351.2
Organics	
Polycyclic Aromatic Hydrocarbons (PAHs)	SW-846 8310, SW-846 8270/A/B/C/D/E-SIM
	All PAH are ng/g
Naphthalene	3.1
Phenanthrene	4.27
Pyrene	5.78
Fluorene	4.91
2-Methylnaphthelene	3.39
Acenaphthene	3.8
Acenaphthylene	3.28
Anthracene	4.55
Benzo (a) anthracene	7.9
Benzo (a) pyrene	3.4
Benzo (e) pyrene	9.93
Benzo (b) fluoranthene	5.74
Benzo (g,h,i) perylene	7.35
Benzo (k) fluoranthene	6.29
Chrysene	6.34
Dibenzo(a,h)anthracene	7.46
Fluoranthene	5.37
Indeno (1,2,3-cd) pyrene	4.51
Total PAHs	
Total Organic Carbon	SW846 9060A 44 ug/g
Physical Tests	
Particle Size Analysis – Sieve and Hydrometer Analysis	ASTM D-422 (%)

Reference: Lake Mallalieu Dredging Feasibility Study

At each site where sediment core samples were collected, the boat position was fixed with one anchor, allowed to drift with the wind and then a second anchor was deployed to stabilize the boat in position. A sediment core tube was prepared, two individuals manually depressed the sediment corer into the sediment as far as possible while a third person applied the stopper to create a seal. After pulling the sediment core up, if the sediment core depth was determined to not be sufficient the core tube was emptied and rinsed. If the core was determined to be sufficient the core tube was cut to the sediment depth, a cap was fixed to both ends and the location coordinates were recorded.

Four cores were retained from the locations shown in **Attachment 4**. Sediment layers were visually estimated by all field personnel. The boundary between the top layer and the remaining layers was identified, and each core was cut at that location. The top layer was labeled "Sec 1," and the remaining layers were labeled "Sec 2." The two samples from each core were capped and labeled for transport. Staff collected photos of each section and labeled images which are shown in **Attachment 5**.

Sediment cores were transported from the Lake on ice and processed at Stantec's field lab in Plymouth, MN. Each core section was homogenized using clean nitrile gloves, a stainless-steel bowl and spoon. Supplies were cleaned in between samples to prevent cross contamination. Field staff loaded the homogenized material into lab-provided containers, then labeled each sample with the respective core number and section. Containers were placed in labeled gallon bags and put back on ice, which were delivered to Pace Analytical lab in Minneapolis, MN the next day.

Lab Methods

Pace Analytical Services performed all analyses. Full descriptions of the testing and quality control procedures, analytical methods, detection limits, quantification limits and certifications can be viewed in the attached Pace Report (**Attachment 5**). The raw data is also summarized in **Attachment 6**.

Results

We compared the data results to the threshold values in the Consensus-Based Sediment Quality Guidelines (CBSQG) to establish the level of concern for each measured analyte². Comparison of the metals data to CBSQG thresholds are shown in **Attachment 7**. Comparison of the PAH data to CBSQG thresholds are shown in **Attachment 8**. Almost all metals were determined to be less than the threshold effects concentration (Level One Concern), except for manganese which was found to be a level 2 concern

² Consensus-Based Sediment Quality Guidelines. Recommendations for Use & Application. Interim Guidance. Developed by the Contaminated Sediment Standing Team. WDNR. December 2003. https://projects.itrcweb.org/contseds-bioavailability/References/cbsqg_interim_final.pdf. Accessed on March 10, 2025.

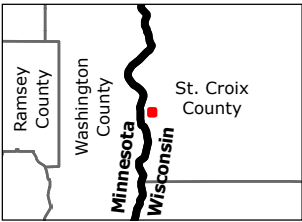
Reference: Lake Mallalieu Dredging Feasibility Study

in samples Sed Cr 3 Sec 1 and Sed Cr 4 Sec 1. Most of the values for PAHs were below the detection limit. PAH values that were detected were found to be level 1 concerns across all samples. The results of the nutrients, total organic carbon and grain size analyses are shown in **Attachment 9**.

Discussion

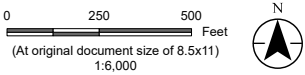
Except for one manganese results, all results were lower than the Threshold Effects Concentration (Level 1 Concern) indicated no sediment contamination in the sampled area. One sample for manganese exceeded the Threshold Effects Concentration but was than the Midpoint Effects Concentrations, which represents a Level Two Concern per the CBSQG. We assume the elevated manganese values are due to natural background concentrations given that all other contaminants were below the threshold effects concentration (Level 1 concern). Consequently, the risk of mobilizing or exposing contaminants of concern through sediment movement in the project extent, or to downstream areas, is quite low. Consequently, Stantec recommends a drawdown on the Lake in fall 2025 to mitigate the sediment accumulation from the series of dam breaches at the Willow River Dam from 2015-2019. The results of the sediment analysis presented in this memo represent one component of the data collection and sediment transport analyses being conducted in support of a drawdown plan for Lake Mallalieu.

Please let us know if there are additional questions on this data or interpretation.



Notes
1. Coordinate System: NAD 1983 HARN WISCRS St Croix County Feet
2. Data Sources: USDA, Stantec
3. Background: USDA NAIP 2021 Imagery

Legend
Survey Extent
Lake Mallalieu Bathymetry (1ft)



Stantec

Project Location Hudson, St. Croix Co., WI Prepared by ARH on 2024-04-24

Client/Project Lake Mallalieu Association, Inc. 227706430
Lake Mallalieu Dredging Feasibility

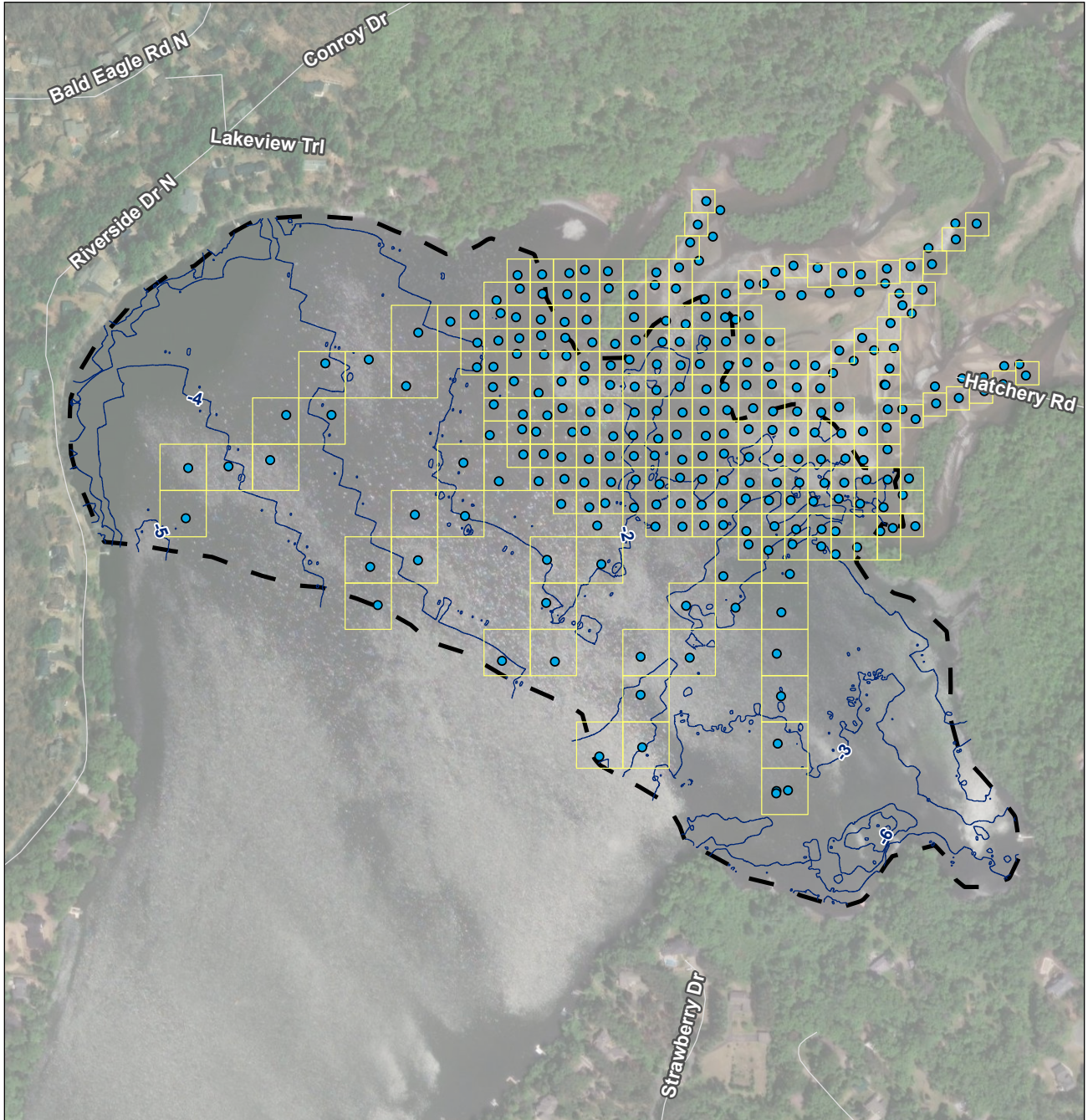
Figure No. 1

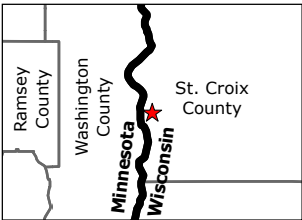
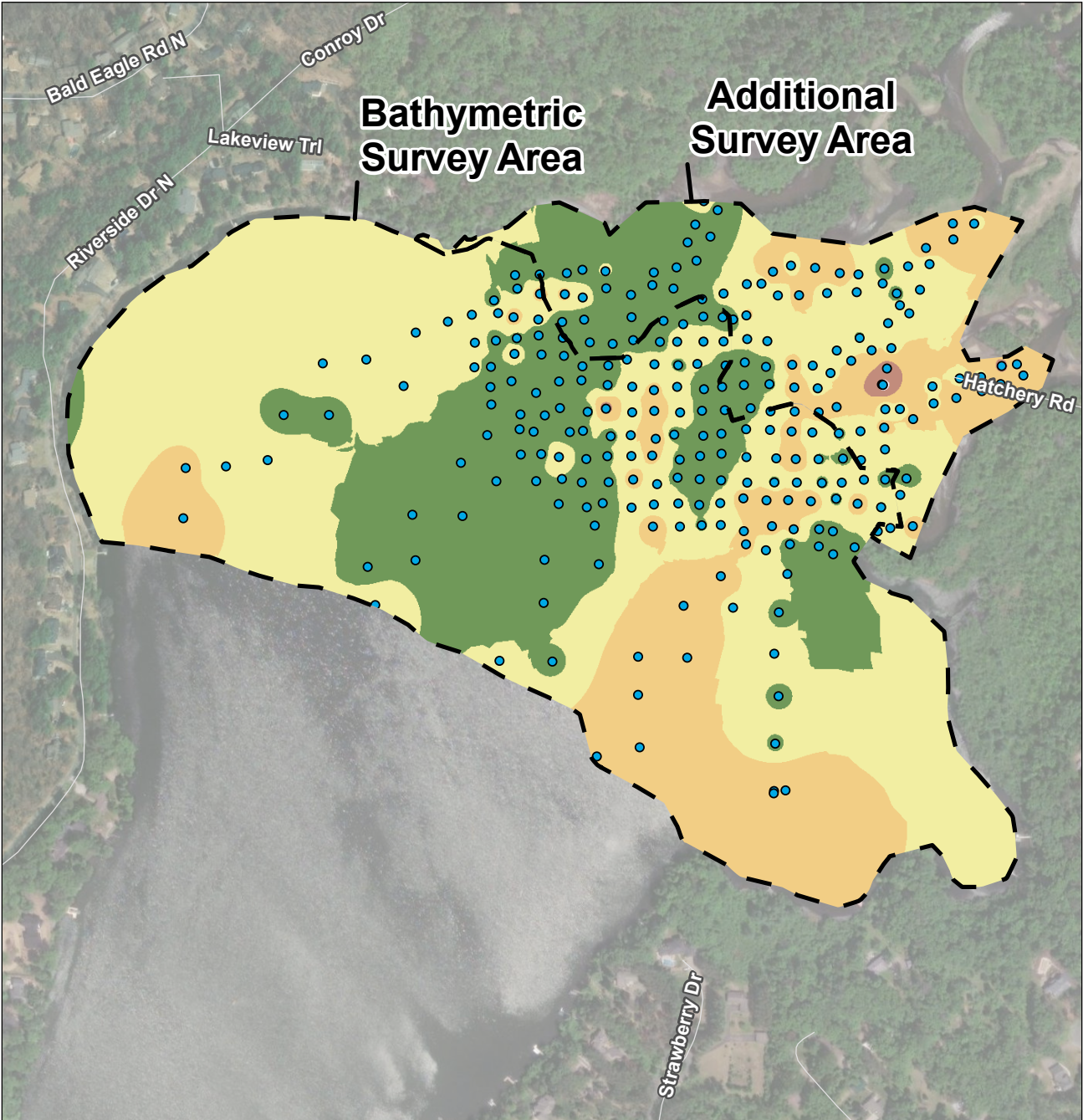
Title
Lake Mallalieu Bathymetry

V:\227706430\227706430\03_data\gis_cad\gis\lake_mallalieu_dredging_feasibility.aprx Revised: 2024-04-24 By: ahyams

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

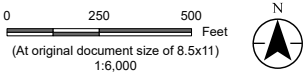
Attachment 2





Notes
1. Coordinate System: NAD 1983 HARN WISCRS St Croix County Feet
2. Data Sources: ESRI, Stantec
3. Background: ESRI World Imagery

- Legend**
- Analysis Boundary
 - Survey Points
 - Sediment Depth (ft)**
 - 0.1 - 0.5
 - > 0.5 - 1.0
 - > 1.0 - 2.0
 - > 2.0 - 3.0
 - > 3.0 - 4.0



Project Location Hudson, St. Croix Co., WI Prepared by ARH on 2024-06-26

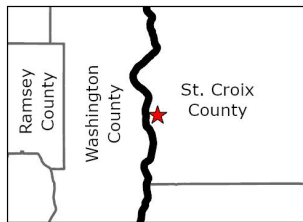
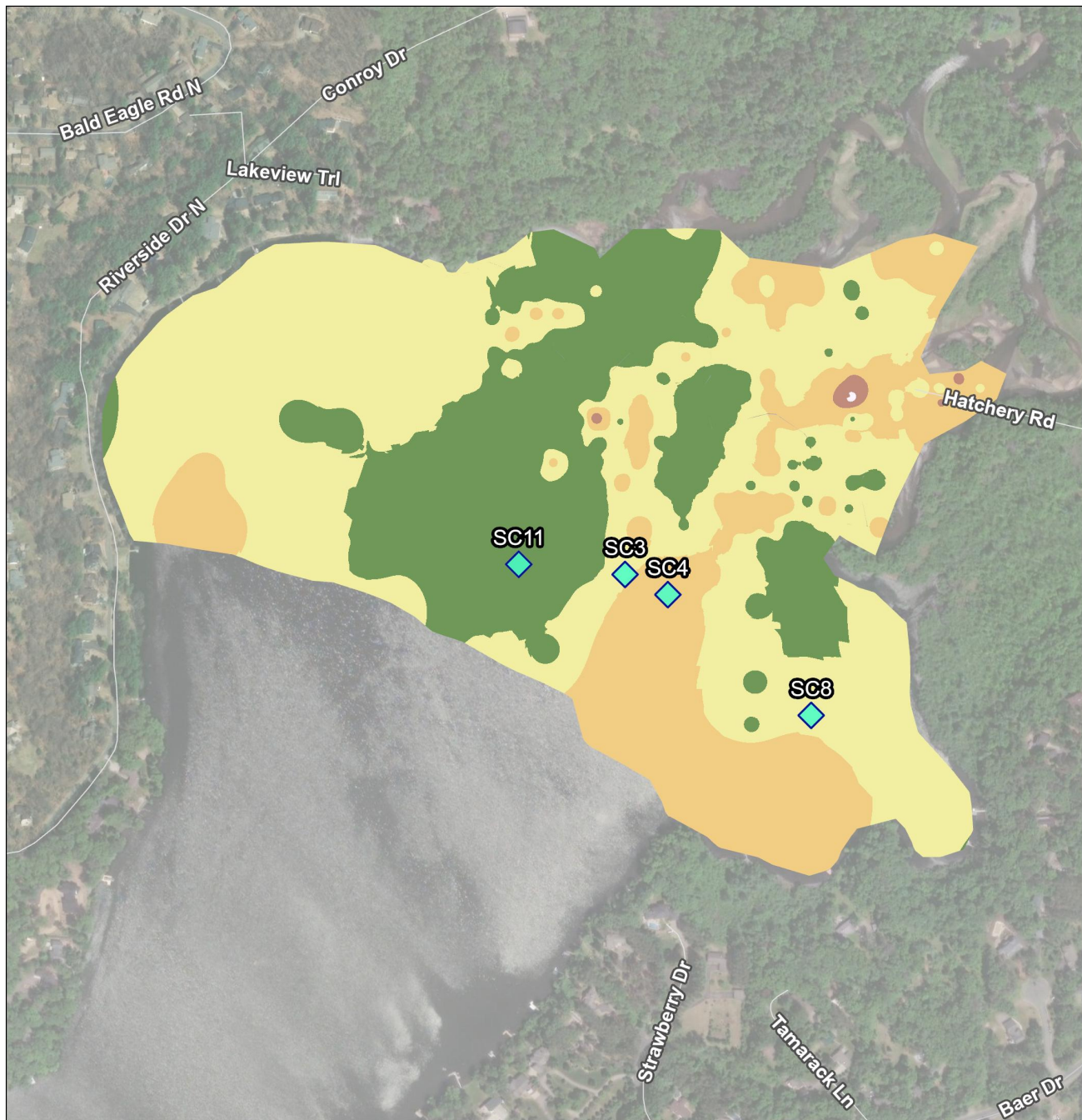
Client/Project Lake Mallalieu Association, Inc. 227706430
Lake Mallalieu Dredging Feasibility

Figure No. 3

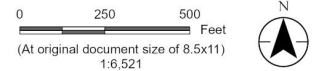
Title Lake Mallalieu Soft Sediment Depth

V:\2277\active\227706430\03_data\gis_cad\gis\lake_mallalieu_dredging_feasibility.aprx Revised: 2024-06-26 By: ahyams

Attachment 4



- Legend**
- Sediment Core
 - Sediment Depth (ft)**
 - 0.1 - 0.5
 - > 0.5 - 1.0
 - > 1.0 - 2.0
 - > 2.0 - 3.0
 - > 3.0 - 4.0



Project Location Hudson, St. Croix Co., WI Prepared by ARH on 2025-02-13

Client/Project Lake Mallalieu Association, Inc. 227706430
Lake Mallalieu Dredging Feasibility

Figure No. 3

Sediment Chemistry Coring Locations

V:\2277\active\227706430\03_data\gis\cad\gis\profilelake_mallalieu_dredging_feasibility\lake_mallalieu_dredging_feasibility.aprx Revised: 2025-02-13 By: ahyams

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.



January 16, 2025

Katie Hembre
Stantec
One Carlson Parkway
Suite 100
Plymouth, MN 55447

RE: Project: 227706430
Pace Project No.: 10716716

Dear Katie Hembre:

Enclosed are the analytical results for sample(s) received by the laboratory on November 22, 2024. The results relate only to the samples included in this report. Results reported herein conform to the applicable TNI/NELAC Standards and the laboratory's Quality Manual, where applicable, unless otherwise noted in the body of the report.

The test results provided in this final report were generated by each of the following laboratories within the Pace Network:

- Pace Analytical Services - Duluth, MN
- Pace Analytical Services - Green Bay
- Pace Analytical Services - Minneapolis

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Annika Asp'.

Annika Asp
annika.asp@pacelabs.com
(612)607-1700
Project Manager

Enclosures



REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



CERTIFICATIONS

Project: 227706430

Pace Project No.: 10716716

Pace Analytical Services, LLC - Minneapolis MN

1700 Elm Street SE, Minneapolis, MN 55414

Alabama Certification #: 40770

Alaska Contaminated Sites Certification #: 17-009

Alaska DW Certification #: MN00064

Arizona Certification #: AZ0014

Arkansas DW Certification #: MN00064

Arkansas WW Certification #: 88-0680

California Certification #: 2929

Colorado Certification #: MN00064

Connecticut Certification #: PH-0256

DoD Certification via A2LA #: 2926.01

EPA Region 8 Tribal Water Systems+Wyoming DW
Certification #: via MN 027-053-137

Florida Certification #: E87605

Georgia Certification #: 959

GMP+ Certification #: GMP050884

Hawaii Certification #: MN00064

Idaho Certification #: MN00064

Illinois Certification #: 200011

Indiana Certification #: C-MN-01

Iowa Certification #: 368

ISO/IEC 17025 Certification via A2LA #: 2926.01

Kansas Certification #: E-10167

Kentucky DW Certification #: 90062

Kentucky WW Certification #: 90062

Louisiana DEQ Certification #: AI-03086

Louisiana DW Certification #: MN00064

Maine Certification #: MN00064

Maryland Certification #: 322

Michigan Certification #: 9909

Minnesota Certification #: 027-053-137

Minnesota Dept of Ag Approval: via MN 027-053-137

Minnesota Petrofund Registration #: 1240

Mississippi Certification #: MN00064

Missouri Certification #: 10100

Montana Certification #: CERT0092

Nebraska Certification #: NE-OS-18-06

Nevada Certification #: MN00064

New Hampshire Certification #: 2081

New Jersey Certification #: MN002

New York Certification #: 11647

North Carolina DW Certification #: 27700

North Carolina WW Certification #: 530

North Dakota Certification (A2LA) #: R-036

North Dakota Certification (MN) #: R-036

Ohio DW Certification #: 41244

Ohio VAP Certification (1700) #: CL101

Oklahoma Certification #: 9507

Oregon Primary Certification #: MN300001

Oregon Secondary Certification #: MN200001

Pennsylvania Certification #: 68-00563

Puerto Rico Certification #: MN00064

South Carolina Certification #: 74003001

Tennessee Certification #: TN02818

Texas Certification #: T104704192

Utah Certification #: MN00064

Vermont Certification #: VT-027053137

Virginia Certification #: 460163

Washington Certification #: C486

West Virginia DEP Certification #: 382

West Virginia DW Certification #: 9952 C

Wisconsin Certification #: 999407970

Wyoming UST Certification via A2LA #: 2926.01

USDA Permit #: P330-19-00208

Pace Analytical Services Green Bay

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

South Carolina Certification #: 83006001

Texas Certification #: T104704529-21-8

Virginia VELAP Certification ID: 11873

Wisconsin Certification #: 405132750

Wisconsin DATCP Certification #: 105-444

USDA Soil Permit #: P330-21-00008

Federal Fish & Wildlife Permit #: 51774A

Pace Analytical Services, LLC - Duluth MN

4730 Oneota Street, Duluth, MN 55807

Minnesota Certification #: 027-137-152

Minnesota Dept of Ag Approval: via Minnesota 027-137-
152

Minnesota Petrofund Registration #: 1240

North Dakota Certification #: R-105

Wisconsin Certification #: 999446800

Wisconsin Dept of Ag Certification #: 480341

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



SAMPLE SUMMARY

Project: 227706430
Pace Project No.: 10716716

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10716716001	Sed Cr 3 Sec 1	Solid	11/20/24 15:00	11/22/24 08:53
10716716002	Sed Cr 3 Sec 2	Solid	11/20/24 15:00	11/22/24 08:53
10716716003	Sed Cr 4 Sec 1	Solid	11/20/24 15:00	11/22/24 08:53
10716716004	Sed Cr 4 Sec 2	Solid	11/20/24 15:00	11/22/24 08:53
10716716005	Sed Cr 8 Sec 1	Solid	11/20/24 15:00	11/22/24 08:53
10716716006	Sed Cr 8 Sec 2	Solid	11/20/24 15:00	11/22/24 08:53
10716716007	Sed Cr 11 Sec 1	Solid	11/20/24 15:00	11/22/24 08:53
10716716008	Sed Cr 11 Sec 2	Solid	11/20/24 15:00	11/22/24 08:53

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



SAMPLE ANALYTE COUNT

Project: 227706430

Pace Project No.: 10716716

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
10716716001	Sed Cr 3 Sec 1	EPA 350.1	DS3	1	PASI-DU
		EPA 351.2	GMH	1	PASI-DU
		EPA 365.1	DS3	1	PASI-DU
		EPA 9060A	DW3	4	PASI-DU
		EPA 6010D	DM	8	PASI-M
		EPA 7471B	LMW	1	PASI-M
		ASTM D2974	JDL	1	PASI-M
		EPA 8270E by SIM	GY1	18	PASI-M
		ASTM D6913/D7928	AXH	22	PASI-G
10716716002	Sed Cr 3 Sec 2	EPA 350.1	DS3	1	PASI-DU
		EPA 351.2	GMH	1	PASI-DU
		EPA 365.1	DS3	1	PASI-DU
		EPA 9060A	DW3	4	PASI-DU
		EPA 6010D	DM	8	PASI-M
		EPA 7471B	LMW	1	PASI-M
		ASTM D2974	JDL	1	PASI-M
		EPA 8270E by SIM	GY1	18	PASI-M
		ASTM D6913/D7928	AXH	22	PASI-G
10716716003	Sed Cr 4 Sec 1	EPA 350.1	DS3	1	PASI-DU
		EPA 351.2	GMH	1	PASI-DU
		EPA 365.1	DS3	1	PASI-DU
		EPA 9060A	DW3	4	PASI-DU
		EPA 6010D	DM	8	PASI-M
		EPA 7471B	LMW	1	PASI-M
		ASTM D2974	JDL	1	PASI-M
		EPA 8270E by SIM	GY1	18	PASI-M
		ASTM D6913/D7928	AXH	22	PASI-G
10716716004	Sed Cr 4 Sec 2	EPA 350.1	DS3	1	PASI-DU
		EPA 351.2	GMH	1	PASI-DU
		EPA 365.1	DS3	1	PASI-DU
		EPA 9060A	DW3	4	PASI-DU
		EPA 6010D	DM	8	PASI-M
		EPA 7471B	LMW	1	PASI-M
		ASTM D2974	JDL	1	PASI-M
		EPA 8270E by SIM	GY1	18	PASI-M
		ASTM D6913/D7928	AXH	22	PASI-G
10716716005	Sed Cr 8 Sec 1	EPA 350.1	DS3	1	PASI-DU

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



SAMPLE ANALYTE COUNT

Project: 227706430

Pace Project No.: 10716716

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
10716716006	Sed Cr 8 Sec 2	EPA 351.2	GMH	1	PASI-DU
		EPA 365.1	DS3	1	PASI-DU
		EPA 9060A	DW3	4	PASI-DU
		EPA 6010D	DM	8	PASI-M
		EPA 7471B	LMW	1	PASI-M
		ASTM D2974	JDL	1	PASI-M
		EPA 8270E by SIM	GY1	18	PASI-M
		ASTM D6913/D7928	SRG	22	PASI-G
		EPA 350.1	DS3	1	PASI-DU
		EPA 351.2	GMH	1	PASI-DU
		EPA 365.1	DS3	1	PASI-DU
		EPA 9060A	DW3	4	PASI-DU
		EPA 6010D	DM	8	PASI-M
		EPA 7471B	LMW	1	PASI-M
		ASTM D2974	JDL	1	PASI-M
		EPA 8270E by SIM	GY1	18	PASI-M
		ASTM D6913/D7928	SRG	22	PASI-G
10716716007	Sed Cr 11 Sec 1	EPA 350.1	DS3	1	PASI-DU
		EPA 351.2	GMH	1	PASI-DU
		EPA 365.1	DS3	1	PASI-DU
		EPA 9060A	DW3	4	PASI-DU
		EPA 6010D	DM	8	PASI-M
		EPA 7471B	LMW	1	PASI-M
		ASTM D2974	JDL	1	PASI-M
		EPA 8270E by SIM	GY1	18	PASI-M
		ASTM D6913/D7928	SRG	22	PASI-G
		EPA 350.1	DS3	1	PASI-DU
		EPA 351.2	GMH	1	PASI-DU
		EPA 365.1	DS3	1	PASI-DU
		EPA 9060A	DW3	4	PASI-DU
		EPA 6010D	DM	8	PASI-M
		EPA 7471B	LMW	1	PASI-M
		ASTM D2974	JDL	1	PASI-M
		EPA 8270E by SIM	GY1	18	PASI-M
10716716008	Sed Cr 11 Sec 2	ASTM D6913/D7928	SRG	22	PASI-G
		EPA 350.1	DS3	1	PASI-DU
		EPA 351.2	GMH	1	PASI-DU
		EPA 365.1	DS3	1	PASI-DU
		EPA 9060A	DW3	4	PASI-DU
		EPA 6010D	DM	8	PASI-M
		EPA 7471B	LMW	1	PASI-M
		ASTM D2974	JDL	1	PASI-M
		EPA 8270E by SIM	GY1	18	PASI-M
		ASTM D6913/D7928	SRG	22	PASI-G
		EPA 350.1	DS3	1	PASI-DU
		EPA 351.2	GMH	1	PASI-DU
		EPA 365.1	DS3	1	PASI-DU
		EPA 9060A	DW3	4	PASI-DU
		EPA 6010D	DM	8	PASI-M
		EPA 7471B	LMW	1	PASI-M
		ASTM D2974	JDL	1	PASI-M
		EPA 8270E by SIM	GY1	18	PASI-M

PASI-DU = Pace Analytical Services - Duluth, MN

PASI-G = Pace Analytical Services - Green Bay

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



SAMPLE ANALYTE COUNT

Project: 227706430
Pace Project No.: 10716716

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
--------	-----------	--------	----------	-------------------	------------

PASI-M = Pace Analytical Services - Minneapolis

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 3 Sec 1 Lab ID: 10716716001 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
350.1 Ammonia Solids DU								
Analytical Method: EPA 350.1 Preparation Method: EPA 350.1								
Pace Analytical Services - Duluth, MN								
Nitrogen, Ammonia	83.5	mg/kg	9.5	1	12/11/24 12:00	12/12/24 10:11	7664-41-7	
351.2 TKN Solids DU								
Analytical Method: EPA 351.2 Preparation Method: EPA 351.2								
Pace Analytical Services - Duluth, MN								
Nitrogen, Kjeldahl, Total	3990	mg/kg	140	1	12/03/24 16:05	12/05/24 12:00	7727-37-9	
365.1 Phos, Total Solids DU								
Analytical Method: EPA 365.1 Preparation Method: SM 4500-P B								
Pace Analytical Services - Duluth, MN								
Phosphorus	1050	mg/kg	14.9	2	12/03/24 12:30	12/03/24 18:32	7723-14-0	
9060 TOC, 2 Rep Solids DU								
Analytical Method: EPA 9060A								
Pace Analytical Services - Duluth, MN								
RPD%	88.8	%		1		12/10/24 13:35		R1
Total Organic Carbon	60000	mg/kg	3010	1		12/10/24 13:27	7440-44-0	
Total Organic Carbon	23100	mg/kg	3060	1		12/10/24 13:35	7440-44-0	
Mean Total Organic Carbon	41500	mg/kg	3040	1		12/10/24 13:35	7440-44-0	
6010D MET ICP								
Analytical Method: EPA 6010D Preparation Method: EPA 3050B								
Pace Analytical Services - Minneapolis								
Arsenic	ND	mg/kg	3.1	1	12/04/24 12:26	12/06/24 14:02	7440-38-2	
Cadmium	ND	mg/kg	0.46	1	12/04/24 12:26	12/06/24 14:02	7440-43-9	
Chromium	28.0	mg/kg	1.5	1	12/04/24 12:26	12/06/24 14:02	7440-47-3	
Copper	19.5	mg/kg	1.5	1	12/04/24 12:26	12/06/24 14:02	7440-50-8	
Lead	11.3	mg/kg	1.5	1	12/04/24 12:26	12/06/24 14:02	7439-92-1	
Manganese	516	mg/kg	1.5	1	12/04/24 12:26	12/06/24 14:02	7439-96-5	M1
Nickel	13.4	mg/kg	3.1	1	12/04/24 12:26	12/06/24 14:02	7440-02-0	
Zinc	58.2	mg/kg	6.2	1	12/04/24 12:26	12/06/24 14:02	7440-66-6	
7471B Mercury								
Analytical Method: EPA 7471B Preparation Method: EPA 7471B								
Pace Analytical Services - Minneapolis								
Mercury	0.097	mg/kg	0.059	1	12/04/24 13:19	12/06/24 12:38	7439-97-6	
Dry Weight / %M by ASTM D2974								
Analytical Method: ASTM D2974								
Pace Analytical Services - Minneapolis								
Percent Moisture	68.3	%	0.10	1		12/04/24 16:12		N2
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Acenaphthene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	83-32-9	
Acenaphthylene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	208-96-8	
Anthracene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	120-12-7	
Benzo(a)anthracene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	56-55-3	
Benzo(a)pyrene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	50-32-8	
Benzo(b)fluoranthene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	205-99-2	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 3 Sec 1 Lab ID: 10716716001 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Benzo(g,h,i)perylene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	191-24-2	
Benzo(k)fluoranthene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	207-08-9	
Chrysene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	218-01-9	
Dibenz(a,h)anthracene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	53-70-3	
Fluoranthene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	206-44-0	
Fluorene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	86-73-7	
Indeno(1,2,3-cd)pyrene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	193-39-5	
Naphthalene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	91-20-3	
Phenanthrene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	85-01-8	
Pyrene	ND	ug/kg	31.0	1	11/26/24 11:56	11/29/24 22:50	129-00-0	
Surrogates								
2-Fluorobiphenyl (S)	65	%	48-125	1	11/26/24 11:56	11/29/24 22:50	321-60-8	
p-Terphenyl-d14 (S)	82	%	51-139	1	11/26/24 11:56	11/29/24 22:50	1718-51-0	

ASTM D6913D7928 GrainsizeHydro Analytical Method: ASTM D6913/D7928

Pace Analytical Services - Green Bay

Sieve 3.0"	100.0	%		1		01/02/25 17:40
Sieve 2.0"	100.0	%		1		01/02/25 17:40
Sieve 1.5"	100.0	%		1		01/02/25 17:40
Sieve 1.0"	100.0	%		1		01/02/25 17:40
Sieve 0.75"	100.0	%		1		01/02/25 17:40
Sieve 0.375"	100.0	%		1		01/02/25 17:40
Sieve #4	100.0	%		1		01/02/25 17:40
Sieve #10	100.0	%		1		01/02/25 17:40
Sieve #20	99.3	%		1		01/02/25 17:40
Sieve #40	97.2	%		1		01/02/25 17:40
Sieve #60	91.0	%		1		01/02/25 17:40
Sieve #100	76.1	%		1		01/02/25 17:40
Sieve #140	72.5	%		1		01/02/25 17:40
Sieve #200	69.8	%		1		01/02/25 17:40
Hydrometer 1 Passing	54.7	%		1		01/02/25 17:40
Hydrometer 2 Passing	40.7	%		1		01/02/25 17:40
Hydrometer 3 Passing	29.3	%		1		01/02/25 17:40
Hydrometer 4 Passing	17.9	%		1		01/02/25 17:40
Hydrometer 5 Passing	14.1	%		1		01/02/25 17:40
Hydrometer 6 Passing	9.0	%		1		01/02/25 17:40
Hydrometer 7 Passing	6.0	%		1		01/02/25 17:40
Hydrometer 8 Passing	3.5	%		1		01/02/25 17:40

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 3 Sec 2 Lab ID: 10716716002 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
350.1 Ammonia Solids DU								
Analytical Method: EPA 350.1 Preparation Method: EPA 350.1								
Pace Analytical Services - Duluth, MN								
Nitrogen, Ammonia	4.7	mg/kg	4.0	1	12/11/24 12:00	12/12/24 10:14	7664-41-7	
351.2 TKN Solids DU								
Analytical Method: EPA 351.2 Preparation Method: EPA 351.2								
Pace Analytical Services - Duluth, MN								
Nitrogen, Kjeldahl, Total	611	mg/kg	66.3	1	12/03/24 16:05	12/05/24 12:01	7727-37-9	
365.1 Phos, Total Solids DU								
Analytical Method: EPA 365.1 Preparation Method: SM 4500-P B								
Pace Analytical Services - Duluth, MN								
Phosphorus	183	mg/kg	3.3	1	12/03/24 12:30	12/03/24 18:13	7723-14-0	
9060 TOC, 2 Rep Solids DU								
Analytical Method: EPA 9060A								
Pace Analytical Services - Duluth, MN								
RPD%	14.5	%		1		12/10/24 13:51		
Total Organic Carbon	4930	mg/kg	599	1		12/10/24 13:43	7440-44-0	
Total Organic Carbon	5700	mg/kg	594	1		12/10/24 13:51	7440-44-0	
Mean Total Organic Carbon	5310	mg/kg	596	1		12/10/24 13:51	7440-44-0	
6010D MET ICP								
Analytical Method: EPA 6010D Preparation Method: EPA 3050B								
Pace Analytical Services - Minneapolis								
Arsenic	ND	mg/kg	1.3	1	12/04/24 12:26	12/06/24 14:10	7440-38-2	
Cadmium	ND	mg/kg	0.19	1	12/04/24 12:26	12/06/24 14:10	7440-43-9	
Chromium	10.9	mg/kg	0.63	1	12/04/24 12:26	12/06/24 14:10	7440-47-3	
Copper	8.1	mg/kg	0.63	1	12/04/24 12:26	12/06/24 14:10	7440-50-8	
Lead	2.6	mg/kg	0.63	1	12/04/24 12:26	12/06/24 14:10	7439-92-1	
Manganese	71.7	mg/kg	0.63	1	12/04/24 12:26	12/06/24 14:10	7439-96-5	
Nickel	7.8	mg/kg	1.3	1	12/04/24 12:26	12/06/24 14:10	7440-02-0	
Zinc	16.5	mg/kg	2.5	1	12/04/24 12:26	12/06/24 14:10	7440-66-6	
7471B Mercury								
Analytical Method: EPA 7471B Preparation Method: EPA 7471B								
Pace Analytical Services - Minneapolis								
Mercury	ND	mg/kg	0.026	1	12/04/24 13:19	12/06/24 12:43	7439-97-6	
Dry Weight / %M by ASTM D2974								
Analytical Method: ASTM D2974								
Pace Analytical Services - Minneapolis								
Percent Moisture	25.4	%	0.10	1		12/04/24 16:12		N2
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Acenaphthene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	83-32-9	
Acenaphthylene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	208-96-8	
Anthracene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	120-12-7	
Benzo(a)anthracene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	56-55-3	
Benzo(a)pyrene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	50-32-8	
Benzo(b)fluoranthene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	205-99-2	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 3 Sec 2 Lab ID: 10716716002 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Benzo(g,h,i)perylene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	191-24-2	
Benzo(k)fluoranthene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	207-08-9	
Chrysene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	218-01-9	
Dibenz(a,h)anthracene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	53-70-3	
Fluoranthene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	206-44-0	
Fluorene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	86-73-7	
Indeno(1,2,3-cd)pyrene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	193-39-5	
Naphthalene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	91-20-3	
Phenanthrene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	85-01-8	
Pyrene	ND	ug/kg	13.3	1	11/26/24 11:56	11/30/24 00:00	129-00-0	
Surrogates								
2-Fluorobiphenyl (S)	66	%	48-125	1	11/26/24 11:56	11/30/24 00:00	321-60-8	
p-Terphenyl-d14 (S)	83	%	51-139	1	11/26/24 11:56	11/30/24 00:00	1718-51-0	

ASTM D6913D7928 GrainsizeHydro Analytical Method: ASTM D6913/D7928

Pace Analytical Services - Green Bay

Sieve 3.0"	100.0	%		1		01/02/25 17:40	
Sieve 2.0"	100.0	%		1		01/02/25 17:40	
Sieve 1.5"	100.0	%		1		01/02/25 17:40	
Sieve 1.0"	100.0	%		1		01/02/25 17:40	
Sieve 0.75"	100.0	%		1		01/02/25 17:40	
Sieve 0.375"	99.5	%		1		01/02/25 17:40	
Sieve #4	97.6	%		1		01/02/25 17:40	
Sieve #10	95.1	%		1		01/02/25 17:40	
Sieve #20	89.1	%		1		01/02/25 17:40	
Sieve #40	65.3	%		1		01/02/25 17:40	
Sieve #60	32.0	%		1		01/02/25 17:40	
Sieve #100	14.8	%		1		01/02/25 17:40	
Sieve #140	12.0	%		1		01/02/25 17:40	
Sieve #200	10.5	%		1		01/02/25 17:40	
Hydrometer 1 Passing	6.8	%		1		01/02/25 17:40	
Hydrometer 2 Passing	5.9	%		1		01/02/25 17:40	
Hydrometer 3 Passing	4.9	%		1		01/02/25 17:40	
Hydrometer 4 Passing	3.9	%		1		01/02/25 17:40	
Hydrometer 5 Passing	3.0	%		1		01/02/25 17:40	
Hydrometer 6 Passing	3.0	%		1		01/02/25 17:40	
Hydrometer 7 Passing	1.7	%		1		01/02/25 17:40	
Hydrometer 8 Passing	0.7	%		1		01/02/25 17:40	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 4 Sec 1 Lab ID: 10716716003 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
350.1 Ammonia Solids DU								
Analytical Method: EPA 350.1 Preparation Method: EPA 350.1								
Pace Analytical Services - Duluth, MN								
Nitrogen, Ammonia	64.1	mg/kg	7.8	1	12/11/24 12:00	12/12/24 10:18	7664-41-7	
351.2 TKN Solids DU								
Analytical Method: EPA 351.2 Preparation Method: EPA 351.2								
Pace Analytical Services - Duluth, MN								
Nitrogen, Kjeldahl, Total	3480	mg/kg	147	1	12/03/24 16:05	12/05/24 12:06	7727-37-9	
365.1 Phos, Total Solids DU								
Analytical Method: EPA 365.1 Preparation Method: SM 4500-P B								
Pace Analytical Services - Duluth, MN								
Phosphorus	1200	mg/kg	14.9	2	12/03/24 12:30	12/03/24 18:34	7723-14-0	
9060 TOC, 2 Rep Solids DU								
Analytical Method: EPA 9060A								
Pace Analytical Services - Duluth, MN								
RPD%	83.7	%		1		12/10/24 14:07		R1
Total Organic Carbon	28800	mg/kg	7430	1		12/10/24 13:59	7440-44-0	
Total Organic Carbon	70200	mg/kg	7450	1		12/10/24 14:07	7440-44-0	
Mean Total Organic Carbon	49500	mg/kg	7440	1		12/10/24 14:07	7440-44-0	
6010D MET ICP								
Analytical Method: EPA 6010D Preparation Method: EPA 3050B								
Pace Analytical Services - Minneapolis								
Arsenic	3.0	mg/kg	2.9	1	12/04/24 12:26	12/06/24 14:12	7440-38-2	
Cadmium	ND	mg/kg	0.43	1	12/04/24 12:26	12/06/24 14:12	7440-43-9	
Chromium	30.8	mg/kg	1.4	1	12/04/24 12:26	12/06/24 14:12	7440-47-3	
Copper	22.6	mg/kg	1.4	1	12/04/24 12:26	12/06/24 14:12	7440-50-8	
Lead	13.5	mg/kg	1.4	1	12/04/24 12:26	12/06/24 14:12	7439-92-1	
Manganese	667	mg/kg	1.4	1	12/04/24 12:26	12/06/24 14:12	7439-96-5	
Nickel	15.3	mg/kg	2.9	1	12/04/24 12:26	12/06/24 14:12	7440-02-0	
Zinc	64.5	mg/kg	5.8	1	12/04/24 12:26	12/06/24 14:12	7440-66-6	
7471B Mercury								
Analytical Method: EPA 7471B Preparation Method: EPA 7471B								
Pace Analytical Services - Minneapolis								
Mercury	0.16	mg/kg	0.054	1	12/04/24 13:19	12/06/24 12:45	7439-97-6	
Dry Weight / %M by ASTM D2974								
Analytical Method: ASTM D2974								
Pace Analytical Services - Minneapolis								
Percent Moisture	66.7	%	0.10	1		12/04/24 16:13		N2
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Acenaphthene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	83-32-9	
Acenaphthylene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	208-96-8	
Anthracene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	120-12-7	
Benzo(a)anthracene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	56-55-3	
Benzo(a)pyrene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	50-32-8	
Benzo(b)fluoranthene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	205-99-2	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 4 Sec 1 Lab ID: 10716716003 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Benzo(g,h,i)perylene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	191-24-2	
Benzo(k)fluoranthene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	207-08-9	
Chrysene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	218-01-9	
Dibenz(a,h)anthracene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	53-70-3	
Fluoranthene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	206-44-0	
Fluorene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	86-73-7	
Indeno(1,2,3-cd)pyrene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	193-39-5	
Naphthalene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	91-20-3	
Phenanthrene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	85-01-8	
Pyrene	ND	ug/kg	29.9	1	11/26/24 11:56	11/30/24 00:23	129-00-0	
Surrogates								
2-Fluorobiphenyl (S)	66	%	48-125	1	11/26/24 11:56	11/30/24 00:23	321-60-8	
p-Terphenyl-d14 (S)	75	%	51-139	1	11/26/24 11:56	11/30/24 00:23	1718-51-0	

ASTM D6913D7928 GrainsizeHydro Analytical Method: ASTM D6913/D7928

Pace Analytical Services - Green Bay

Sieve 3.0"	100.0	%		1		01/02/25 17:40	
Sieve 2.0"	100.0	%		1		01/02/25 17:40	
Sieve 1.5"	100.0	%		1		01/02/25 17:40	
Sieve 1.0"	100.0	%		1		01/02/25 17:40	
Sieve 0.75"	100.0	%		1		01/02/25 17:40	
Sieve 0.375"	100.0	%		1		01/02/25 17:40	
Sieve #4	100.0	%		1		01/02/25 17:40	
Sieve #10	100.0	%		1		01/02/25 17:40	
Sieve #20	99.5	%		1		01/02/25 17:40	
Sieve #40	98.4	%		1		01/02/25 17:40	
Sieve #60	96.7	%		1		01/02/25 17:40	
Sieve #100	93.3	%		1		01/02/25 17:40	
Sieve #140	88.1	%		1		01/02/25 17:40	
Sieve #200	81.5	%		1		01/02/25 17:40	
Hydrometer 1 Passing	57.4	%		1		01/02/25 17:40	
Hydrometer 2 Passing	46.2	%		1		01/02/25 17:40	
Hydrometer 3 Passing	33.7	%		1		01/02/25 17:40	
Hydrometer 4 Passing	21.3	%		1		01/02/25 17:40	
Hydrometer 5 Passing	17.5	%		1		01/02/25 17:40	
Hydrometer 6 Passing	13.8	%		1		01/02/25 17:40	
Hydrometer 7 Passing	8.4	%		1		01/02/25 17:40	
Hydrometer 8 Passing	4.6	%		1		01/02/25 17:40	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 4 Sec 2 Lab ID: 10716716004 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
350.1 Ammonia Solids DU								
Analytical Method: EPA 350.1 Preparation Method: EPA 350.1								
Pace Analytical Services - Duluth, MN								
Nitrogen, Ammonia	9.3	mg/kg	4.1	1	12/11/24 12:00	12/12/24 10:19	7664-41-7	
351.2 TKN Solids DU								
Analytical Method: EPA 351.2 Preparation Method: EPA 351.2								
Pace Analytical Services - Duluth, MN								
Nitrogen, Kjeldahl, Total	889	mg/kg	71.7	1	12/03/24 16:05	12/05/24 12:07	7727-37-9	
365.1 Phos, Total Solids DU								
Analytical Method: EPA 365.1 Preparation Method: SM 4500-P B								
Pace Analytical Services - Duluth, MN								
Phosphorus	203	mg/kg	3.6	1	12/03/24 12:30	12/03/24 18:16	7723-14-0	
9060 TOC, 2 Rep Solids DU								
Analytical Method: EPA 9060A								
Pace Analytical Services - Duluth, MN								
RPD%	0.10	%		1		12/10/24 14:24		
Total Organic Carbon	12800	mg/kg	1100	1		12/10/24 14:16	7440-44-0	
Total Organic Carbon	12700	mg/kg	1070	1		12/10/24 14:24	7440-44-0	
Mean Total Organic Carbon	12700	mg/kg	1090	1		12/10/24 14:24	7440-44-0	
6010D MET ICP								
Analytical Method: EPA 6010D Preparation Method: EPA 3050B								
Pace Analytical Services - Minneapolis								
Arsenic	ND	mg/kg	1.4	1	12/04/24 12:26	12/06/24 14:14	7440-38-2	
Cadmium	ND	mg/kg	0.21	1	12/04/24 12:26	12/06/24 14:14	7440-43-9	
Chromium	12.5	mg/kg	0.70	1	12/04/24 12:26	12/06/24 14:14	7440-47-3	
Copper	7.9	mg/kg	0.70	1	12/04/24 12:26	12/06/24 14:14	7440-50-8	
Lead	2.7	mg/kg	0.70	1	12/04/24 12:26	12/06/24 14:14	7439-92-1	
Manganese	63.4	mg/kg	0.70	1	12/04/24 12:26	12/06/24 14:14	7439-96-5	
Nickel	7.5	mg/kg	1.4	1	12/04/24 12:26	12/06/24 14:14	7440-02-0	
Zinc	20.2	mg/kg	2.8	1	12/04/24 12:26	12/06/24 14:14	7440-66-6	
7471B Mercury								
Analytical Method: EPA 7471B Preparation Method: EPA 7471B								
Pace Analytical Services - Minneapolis								
Mercury	ND	mg/kg	0.025	1	12/04/24 13:19	12/06/24 12:46	7439-97-6	
Dry Weight / %M by ASTM D2974								
Analytical Method: ASTM D2974								
Pace Analytical Services - Minneapolis								
Percent Moisture	31.1	%	0.10	1		12/04/24 16:13		N2
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Acenaphthene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	83-32-9	
Acenaphthylene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	208-96-8	
Anthracene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	120-12-7	
Benzo(a)anthracene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	56-55-3	
Benzo(a)pyrene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	50-32-8	
Benzo(b)fluoranthene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	205-99-2	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 4 Sec 2 Lab ID: 10716716004 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Benzo(g,h,i)perylene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	191-24-2	
Benzo(k)fluoranthene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	207-08-9	
Chrysene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	218-01-9	
Dibenz(a,h)anthracene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	53-70-3	
Fluoranthene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	206-44-0	
Fluorene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	86-73-7	
Indeno(1,2,3-cd)pyrene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	193-39-5	
Naphthalene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	91-20-3	
Phenanthrene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	85-01-8	
Pyrene	ND	ug/kg	14.3	1	11/26/24 11:56	11/30/24 00:46	129-00-0	
Surrogates								
2-Fluorobiphenyl (S)	69	%	48-125	1	11/26/24 11:56	11/30/24 00:46	321-60-8	
p-Terphenyl-d14 (S)	73	%	51-139	1	11/26/24 11:56	11/30/24 00:46	1718-51-0	

ASTM D6913D7928 GrainsizeHydro Analytical Method: ASTM D6913/D7928

Pace Analytical Services - Green Bay

Sieve 3.0"	100.0	%		1		01/02/25 17:40	
Sieve 2.0"	100.0	%		1		01/02/25 17:40	
Sieve 1.5"	100.0	%		1		01/02/25 17:40	
Sieve 1.0"	100.0	%		1		01/02/25 17:40	
Sieve 0.75"	100.0	%		1		01/02/25 17:40	
Sieve 0.375"	98.3	%		1		01/02/25 17:40	
Sieve #4	97.4	%		1		01/02/25 17:40	
Sieve #10	95.6	%		1		01/02/25 17:40	
Sieve #20	91.6	%		1		01/02/25 17:40	
Sieve #40	76.3	%		1		01/02/25 17:40	
Sieve #60	56.2	%		1		01/02/25 17:40	
Sieve #100	31.8	%		1		01/02/25 17:40	
Sieve #140	21.2	%		1		01/02/25 17:40	
Sieve #200	17.2	%		1		01/02/25 17:40	
Hydrometer 1 Passing	14.0	%		1		01/02/25 17:40	
Hydrometer 2 Passing	12.0	%		1		01/02/25 17:40	
Hydrometer 3 Passing	9.0	%		1		01/02/25 17:40	
Hydrometer 4 Passing	7.0	%		1		01/02/25 17:40	
Hydrometer 5 Passing	6.0	%		1		01/02/25 17:40	
Hydrometer 6 Passing	5.1	%		1		01/02/25 17:40	
Hydrometer 7 Passing	1.7	%		1		01/02/25 17:40	
Hydrometer 8 Passing	1.7	%		1		01/02/25 17:40	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 8 Sec 1 Lab ID: 10716716005 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
350.1 Ammonia Solids DU								
Analytical Method: EPA 350.1 Preparation Method: EPA 350.1								
Pace Analytical Services - Duluth, MN								
Nitrogen, Ammonia	52.1	mg/kg	6.5	1	12/11/24 12:00	12/12/24 10:23	7664-41-7	
351.2 TKN Solids DU								
Analytical Method: EPA 351.2 Preparation Method: EPA 351.2								
Pace Analytical Services - Duluth, MN								
Nitrogen, Kjeldahl, Total	1580	mg/kg	109	1	12/03/24 16:05	12/05/24 12:07	7727-37-9	
365.1 Phos, Total Solids DU								
Analytical Method: EPA 365.1 Preparation Method: SM 4500-P B								
Pace Analytical Services - Duluth, MN								
Phosphorus	302	mg/kg	5.1	1	12/03/24 12:30	12/03/24 18:17	7723-14-0	
9060 TOC, 2 Rep Solids DU								
Analytical Method: EPA 9060A								
Pace Analytical Services - Duluth, MN								
RPD%	26.2	%		1		12/10/24 14:40		
Total Organic Carbon	35800	mg/kg	3800	1		12/10/24 14:32	7440-44-0	
Total Organic Carbon	27500	mg/kg	3990	1		12/10/24 14:40	7440-44-0	
Mean Total Organic Carbon	31700	mg/kg	3900	1		12/10/24 14:40	7440-44-0	
6010D MET ICP								
Analytical Method: EPA 6010D Preparation Method: EPA 3050B								
Pace Analytical Services - Minneapolis								
Arsenic	ND	mg/kg	2.0	1	12/04/24 12:26	12/06/24 14:19	7440-38-2	
Cadmium	ND	mg/kg	0.30	1	12/04/24 12:26	12/06/24 14:19	7440-43-9	
Chromium	19.4	mg/kg	1.0	1	12/04/24 12:26	12/06/24 14:19	7440-47-3	
Copper	11.5	mg/kg	1.0	1	12/04/24 12:26	12/06/24 14:19	7440-50-8	
Lead	7.3	mg/kg	1.0	1	12/04/24 12:26	12/06/24 14:19	7439-92-1	
Manganese	167	mg/kg	1.0	1	12/04/24 12:26	12/06/24 14:19	7439-96-5	
Nickel	9.1	mg/kg	2.0	1	12/04/24 12:26	12/06/24 14:19	7440-02-0	
Zinc	32.3	mg/kg	4.0	1	12/04/24 12:26	12/06/24 14:19	7440-66-6	
7471B Mercury								
Analytical Method: EPA 7471B Preparation Method: EPA 7471B								
Pace Analytical Services - Minneapolis								
Mercury	0.054	mg/kg	0.039	1	12/04/24 13:19	12/06/24 12:51	7439-97-6	
Dry Weight / %M by ASTM D2974								
Analytical Method: ASTM D2974								
Pace Analytical Services - Minneapolis								
Percent Moisture	54.1	%	0.10	1		12/04/24 16:13		N2
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Acenaphthene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	83-32-9	
Acenaphthylene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	208-96-8	
Anthracene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	120-12-7	
Benzo(a)anthracene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	56-55-3	
Benzo(a)pyrene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	50-32-8	
Benzo(b)fluoranthene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	205-99-2	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 8 Sec 1 Lab ID: 10716716005 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Benzo(g,h,i)perylene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	191-24-2	
Benzo(k)fluoranthene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	207-08-9	
Chrysene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	218-01-9	
Dibenz(a,h)anthracene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	53-70-3	
Fluoranthene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	206-44-0	
Fluorene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	86-73-7	
Indeno(1,2,3-cd)pyrene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	193-39-5	
Naphthalene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	91-20-3	
Phenanthrene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	85-01-8	
Pyrene	ND	ug/kg	21.4	1	11/26/24 11:56	11/30/24 01:09	129-00-0	
Surrogates								
2-Fluorobiphenyl (S)	63	%	48-125	1	11/26/24 11:56	11/30/24 01:09	321-60-8	
p-Terphenyl-d14 (S)	76	%	51-139	1	11/26/24 11:56	11/30/24 01:09	1718-51-0	

ASTM D6913D7928 GrainsizeHydro Analytical Method: ASTM D6913/D7928

Pace Analytical Services - Green Bay

Sieve 3.0"	100	%		1		01/02/25 17:40	
Sieve 2.0"	100	%		1		01/02/25 17:40	
Sieve 1.5"	100	%		1		01/02/25 17:40	
Sieve 1.0"	100	%		1		01/02/25 17:40	
Sieve 0.75"	100	%		1		01/02/25 17:40	
Sieve 0.375"	100	%		1		01/02/25 17:40	
Sieve #4	97	%		1		01/02/25 17:40	
Sieve #10	97	%		1		01/02/25 17:40	
Sieve #20	96	%		1		01/02/25 17:40	
Sieve #40	90	%		1		01/02/25 17:40	
Sieve #60	69	%		1		01/02/25 17:40	
Sieve #100	43	%		1		01/02/25 17:40	
Sieve #140	40	%		1		01/02/25 17:40	
Sieve #200	37	%		1		01/02/25 17:40	
Hydrometer 1 Passing	26	%		1		01/02/25 17:40	
Hydrometer 2 Passing	20	%		1		01/02/25 17:40	
Hydrometer 3 Passing	17	%		1		01/02/25 17:40	
Hydrometer 4 Passing	11	%		1		01/02/25 17:40	
Hydrometer 5 Passing	7	%		1		01/02/25 17:40	
Hydrometer 6 Passing	3	%		1		01/02/25 17:40	
Hydrometer 7 Passing	1	%		1		01/02/25 17:40	
Hydrometer 8 Passing	1	%		1		01/02/25 17:40	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 8 Sec 2 Lab ID: 10716716006 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
350.1 Ammonia Solids DU								
Analytical Method: EPA 350.1 Preparation Method: EPA 350.1								
Pace Analytical Services - Duluth, MN								
Nitrogen, Ammonia	25.2	mg/kg	5.1	1	12/11/24 12:00	12/12/24 10:24	7664-41-7	
351.2 TKN Solids DU								
Analytical Method: EPA 351.2 Preparation Method: EPA 351.2								
Pace Analytical Services - Duluth, MN								
Nitrogen, Kjeldahl, Total	1620	mg/kg	77.5	1	12/03/24 16:05	12/05/24 12:08	7727-37-9	
365.1 Phos, Total Solids DU								
Analytical Method: EPA 365.1 Preparation Method: SM 4500-P B								
Pace Analytical Services - Duluth, MN								
Phosphorus	214	mg/kg	4.0	1	12/03/24 12:30	12/03/24 18:18	7723-14-0	
9060 TOC, 2 Rep Solids DU								
Analytical Method: EPA 9060A								
Pace Analytical Services - Duluth, MN								
RPD%	22.7	%		1		12/10/24 14:57		
Total Organic Carbon	25900	mg/kg	3460	1		12/10/24 14:49	7440-44-0	
Total Organic Carbon	20600	mg/kg	3460	1		12/10/24 14:57	7440-44-0	
Mean Total Organic Carbon	23300	mg/kg	3460	1		12/10/24 14:57	7440-44-0	
6010D MET ICP								
Analytical Method: EPA 6010D Preparation Method: EPA 3050B								
Pace Analytical Services - Minneapolis								
Arsenic	ND	mg/kg	1.6	1	12/04/24 12:26	12/06/24 14:20	7440-38-2	
Cadmium	ND	mg/kg	0.24	1	12/04/24 12:26	12/06/24 14:20	7440-43-9	
Chromium	20.0	mg/kg	0.79	1	12/04/24 12:26	12/06/24 14:20	7440-47-3	
Copper	9.4	mg/kg	0.79	1	12/04/24 12:26	12/06/24 14:20	7440-50-8	
Lead	5.0	mg/kg	0.79	1	12/04/24 12:26	12/06/24 14:20	7439-92-1	
Manganese	57.4	mg/kg	0.79	1	12/04/24 12:26	12/06/24 14:20	7439-96-5	
Nickel	8.2	mg/kg	1.6	1	12/04/24 12:26	12/06/24 14:20	7440-02-0	
Zinc	24.6	mg/kg	3.2	1	12/04/24 12:26	12/06/24 14:20	7440-66-6	
7471B Mercury								
Analytical Method: EPA 7471B Preparation Method: EPA 7471B								
Pace Analytical Services - Minneapolis								
Mercury	ND	mg/kg	0.029	1	12/04/24 13:19	12/06/24 12:53	7439-97-6	
Dry Weight / %M by ASTM D2974								
Analytical Method: ASTM D2974								
Pace Analytical Services - Minneapolis								
Percent Moisture	38.4	%	0.10	1		12/04/24 16:13		N2
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Acenaphthene	ND	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	83-32-9	
Acenaphthylene	ND	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	208-96-8	
Anthracene	ND	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	120-12-7	
Benzo(a)anthracene	ND	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	56-55-3	
Benzo(a)pyrene	18.9	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	50-32-8	
Benzo(b)fluoranthene	24.2	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	205-99-2	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 8 Sec 2 Lab ID: 10716716006 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Benzo(g,h,i)perylene	ND	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	191-24-2	
Benzo(k)fluoranthene	ND	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	207-08-9	
Chrysene	16.7	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	218-01-9	
Dibenz(a,h)anthracene	ND	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	53-70-3	
Fluoranthene	31.4	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	206-44-0	
Fluorene	ND	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	86-73-7	
Indeno(1,2,3-cd)pyrene	ND	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	193-39-5	
Naphthalene	ND	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	91-20-3	
Phenanthrene	16.2	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	85-01-8	
Pyrene	28.8	ug/kg	16.0	1	11/26/24 11:56	11/30/24 01:33	129-00-0	
Surrogates								
2-Fluorobiphenyl (S)	62	%	48-125	1	11/26/24 11:56	11/30/24 01:33	321-60-8	
p-Terphenyl-d14 (S)	75	%	51-139	1	11/26/24 11:56	11/30/24 01:33	1718-51-0	

ASTM D6913D7928 GrainsizeHydro Analytical Method: ASTM D6913/D7928

Pace Analytical Services - Green Bay

Sieve 3.0"	100.0	%		1		01/02/25 17:40	
Sieve 2.0"	100.0	%		1		01/02/25 17:40	
Sieve 1.5"	100.0	%		1		01/02/25 17:40	
Sieve 1.0"	100.0	%		1		01/02/25 17:40	
Sieve 0.75"	100.0	%		1		01/02/25 17:40	
Sieve 0.375"	100.0	%		1		01/02/25 17:40	
Sieve #4	100.0	%		1		01/02/25 17:40	
Sieve #10	99.9	%		1		01/02/25 17:40	
Sieve #20	98.7	%		1		01/02/25 17:40	
Sieve #40	94.7	%		1		01/02/25 17:40	
Sieve #60	77.0	%		1		01/02/25 17:40	
Sieve #100	34.4	%		1		01/02/25 17:40	
Sieve #140	25.7	%		1		01/02/25 17:40	
Sieve #200	23.0	%		1		01/02/25 17:40	
Hydrometer 1 Passing	17.9	%		1		01/02/25 17:40	
Hydrometer 2 Passing	14.5	%		1		01/02/25 17:40	
Hydrometer 3 Passing	13.3	%		1		01/02/25 17:40	
Hydrometer 4 Passing	7.7	%		1		01/02/25 17:40	
Hydrometer 5 Passing	5.4	%		1		01/02/25 17:40	
Hydrometer 6 Passing	4.2	%		1		01/02/25 17:40	
Hydrometer 7 Passing	2.0	%		1		01/02/25 17:40	
Hydrometer 8 Passing	2.0	%		1		01/02/25 17:40	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 11 Sec 1 Lab ID: 10716716007 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
350.1 Ammonia Solids DU								
Analytical Method: EPA 350.1 Preparation Method: EPA 350.1								
Pace Analytical Services - Duluth, MN								
Nitrogen, Ammonia	21.7	mg/kg	6.5	1	12/11/24 12:00	12/12/24 10:25	7664-41-7	
351.2 TKN Solids DU								
Analytical Method: EPA 351.2 Preparation Method: EPA 351.2								
Pace Analytical Services - Duluth, MN								
Nitrogen, Kjeldahl, Total	2070	mg/kg	89.5	1	12/03/24 16:05	12/05/24 12:09	7727-37-9	
365.1 Phos, Total Solids DU								
Analytical Method: EPA 365.1 Preparation Method: SM 4500-P B								
Pace Analytical Services - Duluth, MN								
Phosphorus	664	mg/kg	10.2	2	12/03/24 12:30	12/03/24 18:35	7723-14-0	
9060 TOC, 2 Rep Solids DU								
Analytical Method: EPA 9060A								
Pace Analytical Services - Duluth, MN								
RPD%	12.5	%		1		12/10/24 15:13		
Total Organic Carbon	19400	mg/kg	3000	1		12/10/24 15:05	7440-44-0	
Total Organic Carbon	17100	mg/kg	3050	1		12/10/24 15:13	7440-44-0	
Mean Total Organic Carbon	18300	mg/kg	3030	1		12/10/24 15:13	7440-44-0	
6010D MET ICP								
Analytical Method: EPA 6010D Preparation Method: EPA 3050B								
Pace Analytical Services - Minneapolis								
Arsenic	ND	mg/kg	2.0	1	12/04/24 12:26	12/06/24 14:22	7440-38-2	
Cadmium	ND	mg/kg	0.30	1	12/04/24 12:26	12/06/24 14:22	7440-43-9	
Chromium	17.4	mg/kg	1.0	1	12/04/24 12:26	12/06/24 14:22	7440-47-3	
Copper	14.4	mg/kg	1.0	1	12/04/24 12:26	12/06/24 14:22	7440-50-8	
Lead	6.7	mg/kg	1.0	1	12/04/24 12:26	12/06/24 14:22	7439-92-1	
Manganese	255	mg/kg	1.0	1	12/04/24 12:26	12/06/24 14:22	7439-96-5	
Nickel	9.6	mg/kg	2.0	1	12/04/24 12:26	12/06/24 14:22	7440-02-0	
Zinc	35.8	mg/kg	4.1	1	12/04/24 12:26	12/06/24 14:22	7440-66-6	
7471B Mercury								
Analytical Method: EPA 7471B Preparation Method: EPA 7471B								
Pace Analytical Services - Minneapolis								
Mercury	0.067	mg/kg	0.037	1	12/04/24 13:19	12/06/24 12:55	7439-97-6	
Dry Weight / %M by ASTM D2974								
Analytical Method: ASTM D2974								
Pace Analytical Services - Minneapolis								
Percent Moisture	51.3	%	0.10	1		12/04/24 16:13		N2
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Acenaphthene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	83-32-9	
Acenaphthylene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	208-96-8	
Anthracene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	120-12-7	
Benzo(a)anthracene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	56-55-3	
Benzo(a)pyrene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	50-32-8	
Benzo(b)fluoranthene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	205-99-2	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 11 Sec 1 Lab ID: 10716716007 Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Benzo(g,h,i)perylene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	191-24-2	
Benzo(k)fluoranthene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	207-08-9	
Chrysene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	218-01-9	
Dibenz(a,h)anthracene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	53-70-3	
Fluoranthene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	206-44-0	
Fluorene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	86-73-7	
Indeno(1,2,3-cd)pyrene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	193-39-5	
Naphthalene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	91-20-3	
Phenanthrene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	85-01-8	
Pyrene	ND	ug/kg	19.7	1	11/26/24 11:56	11/30/24 01:56	129-00-0	
Surrogates								
2-Fluorobiphenyl (S)	68	%	48-125	1	11/26/24 11:56	11/30/24 01:56	321-60-8	
p-Terphenyl-d14 (S)	76	%	51-139	1	11/26/24 11:56	11/30/24 01:56	1718-51-0	

ASTM D6913D7928 GrainsizeHydro Analytical Method: ASTM D6913/D7928

Pace Analytical Services - Green Bay

Sieve 3.0"	100	%		1		01/02/25 17:40
Sieve 2.0"	100	%		1		01/02/25 17:40
Sieve 1.5"	100	%		1		01/02/25 17:40
Sieve 1.0"	100	%		1		01/02/25 17:40
Sieve 0.75"	100	%		1		01/02/25 17:40
Sieve 0.375"	100	%		1		01/02/25 17:40
Sieve #4	100	%		1		01/02/25 17:40
Sieve #10	100	%		1		01/02/25 17:40
Sieve #20	99	%		1		01/02/25 17:40
Sieve #40	95	%		1		01/02/25 17:40
Sieve #60	87	%		1		01/02/25 17:40
Sieve #100	66	%		1		01/02/25 17:40
Sieve #140	42	%		1		01/02/25 17:40
Sieve #200	35	%		1		01/02/25 17:40
Hydrometer 1 Passing	25	%		1		01/02/25 17:40
Hydrometer 2 Passing	21	%		1		01/02/25 17:40
Hydrometer 3 Passing	15	%		1		01/02/25 17:40
Hydrometer 4 Passing	8	%		1		01/02/25 17:40
Hydrometer 5 Passing	5	%		1		01/02/25 17:40
Hydrometer 6 Passing	4	%		1		01/02/25 17:40
Hydrometer 7 Passing	2	%		1		01/02/25 17:40
Hydrometer 8 Passing	2	%		1		01/02/25 17:40

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 11 Sec 2 **Lab ID: 10716716008** Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
350.1 Ammonia Solids DU								
Analytical Method: EPA 350.1 Preparation Method: EPA 350.1 Pace Analytical Services - Duluth, MN								
Nitrogen, Ammonia	19.9	mg/kg	4.8	1	12/11/24 12:00	12/12/24 10:26	7664-41-7	
351.2 TKN Solids DU								
Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - Duluth, MN								
Nitrogen, Kjeldahl, Total	2880	mg/kg	74.7	1	12/03/24 16:05	12/05/24 12:10	7727-37-9	
365.1 Phos, Total Solids DU								
Analytical Method: EPA 365.1 Preparation Method: SM 4500-P B Pace Analytical Services - Duluth, MN								
Phosphorus	495	mg/kg	8.4	2	12/03/24 12:30	12/03/24 18:36	7723-14-0	
9060 TOC, 2 Rep Solids DU								
Analytical Method: EPA 9060A Pace Analytical Services - Duluth, MN								
RPD%	128	%		1		12/10/24 15:30		R1
Total Organic Carbon	9300	mg/kg	4310	1		12/10/24 15:22	7440-44-0	
Total Organic Carbon	42000	mg/kg	4490	1		12/10/24 15:30	7440-44-0	
Mean Total Organic Carbon	25600	mg/kg	4400	1		12/10/24 15:30	7440-44-0	
6010D MET ICP								
Analytical Method: EPA 6010D Preparation Method: EPA 3050B Pace Analytical Services - Minneapolis								
Arsenic	ND	mg/kg	1.6	1	12/04/24 12:26	12/06/24 14:23	7440-38-2	
Cadmium	ND	mg/kg	0.25	1	12/04/24 12:26	12/06/24 14:23	7440-43-9	
Chromium	28.8	mg/kg	0.82	1	12/04/24 12:26	12/06/24 14:23	7440-47-3	
Copper	21.8	mg/kg	0.82	1	12/04/24 12:26	12/06/24 14:23	7440-50-8	
Lead	6.9	mg/kg	0.82	1	12/04/24 12:26	12/06/24 14:23	7439-92-1	
Manganese	157	mg/kg	0.82	1	12/04/24 12:26	12/06/24 14:23	7439-96-5	
Nickel	18.1	mg/kg	1.6	1	12/04/24 12:26	12/06/24 14:23	7440-02-0	
Zinc	48.4	mg/kg	3.3	1	12/04/24 12:26	12/06/24 14:23	7440-66-6	
7471B Mercury								
Analytical Method: EPA 7471B Preparation Method: EPA 7471B Pace Analytical Services - Minneapolis								
Mercury	0.035	mg/kg	0.032	1	12/04/24 13:19	12/06/24 12:56	7439-97-6	
Dry Weight / %M by ASTM D2974								
Analytical Method: ASTM D2974 Pace Analytical Services - Minneapolis								
Percent Moisture	40.5	%	0.10	1		12/04/24 16:14		N2
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546 Pace Analytical Services - Minneapolis								
Acenaphthene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	83-32-9	
Acenaphthylene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	208-96-8	
Anthracene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	120-12-7	
Benzo(a)anthracene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	56-55-3	
Benzo(a)pyrene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	50-32-8	
Benzo(b)fluoranthene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	205-99-2	

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



ANALYTICAL RESULTS

Project: 227706430

Pace Project No.: 10716716

Sample: Sed Cr 11 Sec 2 **Lab ID: 10716716008** Collected: 11/20/24 15:00 Received: 11/22/24 08:53 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	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM								
Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
Pace Analytical Services - Minneapolis								
Benzo(g,h,i)perylene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	191-24-2	
Benzo(k)fluoranthene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	207-08-9	
Chrysene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	218-01-9	
Dibenz(a,h)anthracene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	53-70-3	
Fluoranthene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	206-44-0	
Fluorene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	86-73-7	
Indeno(1,2,3-cd)pyrene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	193-39-5	
Naphthalene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	91-20-3	
Phenanthrene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	85-01-8	
Pyrene	ND	ug/kg	16.6	1	11/26/24 11:56	11/30/24 02:19	129-00-0	
Surrogates								
2-Fluorobiphenyl (S)	70	%	48-125	1	11/26/24 11:56	11/30/24 02:19	321-60-8	
p-Terphenyl-d14 (S)	74	%	51-139	1	11/26/24 11:56	11/30/24 02:19	1718-51-0	

ASTM D6913D7928 GrainsizeHydro Analytical Method: ASTM D6913/D7928
Pace Analytical Services - Green Bay

Sieve 3.0"	100.0	%		1		01/02/25 17:40
Sieve 2.0"	100.0	%		1		01/02/25 17:40
Sieve 1.5"	100.0	%		1		01/02/25 17:40
Sieve 1.0"	100.0	%		1		01/02/25 17:40
Sieve 0.75"	100.0	%		1		01/02/25 17:40
Sieve 0.375"	100.0	%		1		01/02/25 17:40
Sieve #4	99.9	%		1		01/02/25 17:40
Sieve #10	99.2	%		1		01/02/25 17:40
Sieve #20	97.3	%		1		01/02/25 17:40
Sieve #40	90.1	%		1		01/02/25 17:40
Sieve #60	81.8	%		1		01/02/25 17:40
Sieve #100	72.1	%		1		01/02/25 17:40
Sieve #140	64.0	%		1		01/02/25 17:40
Sieve #200	58.9	%		1		01/02/25 17:40
Hydrometer 1 Passing	44.1	%		1		01/02/25 17:40
Hydrometer 2 Passing	39.4	%		1		01/02/25 17:40
Hydrometer 3 Passing	32.4	%		1		01/02/25 17:40
Hydrometer 4 Passing	23.0	%		1		01/02/25 17:40
Hydrometer 5 Passing	18.4	%		1		01/02/25 17:40
Hydrometer 6 Passing	14.9	%		1		01/02/25 17:40
Hydrometer 7 Passing	10.2	%		1		01/02/25 17:40
Hydrometer 8 Passing	5.5	%		1		01/02/25 17:40

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



QUALITY CONTROL DATA

Project: 227706430

Pace Project No.: 10716716

QC Batch:	983509	Analysis Method:	EPA 350.1
QC Batch Method:	EPA 350.1	Analysis Description:	350.1 Ammonia DU
		Laboratory:	Pace Analytical Services - Duluth, MN
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

METHOD BLANK:	5138022	Matrix:	Solid
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Ammonia	mg/kg	ND	3.0	12/12/24 10:08	

LABORATORY CONTROL SAMPLE: 5138023

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/kg	30	30.8	103	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 5138024 5138025

Parameter	Units	10716716001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nitrogen, Ammonia	mg/kg	83.5	86.1	99.7	174	190	105	107	80-120	9	10	E

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 5138026 5138027

Parameter	Units	10716716002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nitrogen, Ammonia	mg/kg	4.7	38.3	40.2	45.9	49.5	108	111	80-120	8	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.

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



QUALITY CONTROL DATA

Project: 227706430

Pace Project No.: 10716716

QC Batch:	982533	Analysis Method:	EPA 351.2
QC Batch Method:	EPA 351.2	Analysis Description:	351.2 TKN Soil DU
		Laboratory:	Pace Analytical Services - Duluth, MN
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

METHOD BLANK:	5133110	Matrix:	Solid
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Kjeldahl, Total	mg/kg	ND	50.0	12/05/24 11:53	

LABORATORY CONTROL SAMPLE: 5133111

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/kg	1000	1030	103	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 5133112 5133113

Parameter	Units	10716230001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nitrogen, Kjeldahl, Total	mg/kg	465	1160	1270	1760	1900	111	113	80-120	8	10	H3

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

Date: 01/16/2025 09:31 AM

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

Page 24 of 45



QUALITY CONTROL DATA

Project: 227706430

Pace Project No.: 10716716

QC Batch:	982461	Analysis Method:	EPA 365.1
QC Batch Method:	SM 4500-P B	Analysis Description:	3651 Phos, Total Solids DU
		Laboratory:	Pace Analytical Services - Duluth, MN
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

METHOD BLANK:	5132885	Matrix:	Solid
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Phosphorus	mg/kg	ND	2.5	12/03/24 17:53	

LABORATORY CONTROL SAMPLE: 5132886

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Phosphorus	mg/kg	100	104	104	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 5132887 5132888

Parameter	Units	10715901001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Phosphorus	mg/kg	285	111	111	414	372	116	78	80-120	11	10	M1,R1

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 5132889 5132890

Parameter	Units	10715901002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Phosphorus	mg/kg	213	114	114	343	368	115	136	80-120	7	10	M1

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

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



QUALITY CONTROL DATA

Project: 227706430

Pace Project No.: 10716716

QC Batch:	983497	Analysis Method:	EPA 9060A
QC Batch Method:	EPA 9060A	Analysis Description:	9060 TOC Average DU
		Laboratory:	Pace Analytical Services - Duluth, MN
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

METHOD BLANK:	5137999	Matrix:	Solid
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Mean Total Organic Carbon	mg/kg	ND	599	12/09/24 14:27	

LABORATORY CONTROL SAMPLE: 5138000

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mean Total Organic Carbon	mg/kg	6810	5950	87	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 5138001 5138002

Parameter	Units	10717167001 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	33800	57500	56600	91200	87400	100	95	75-125	4	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 5138003 5138004

Parameter	Units	10717168001 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	17100	31600	31300	49600	48700	103	101	75-125	2	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

Date: 01/16/2025 09:31 AM

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

Page 26 of 45



QUALITY CONTROL DATA

Project: 227706430

Pace Project No.: 10716716

QC Batch:	982187	Analysis Method:	EPA 7471B
QC Batch Method:	EPA 7471B	Analysis Description:	7471B Mercury Solids
		Laboratory:	Pace Analytical Services - Minneapolis
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

METHOD BLANK:	5132105	Matrix:	Solid
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Mercury	mg/kg	ND	0.018	12/06/24 12:35	

LABORATORY CONTROL SAMPLE: 5132106

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mercury	mg/kg	0.46	0.46	100	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 5132107 5132108

Parameter	Units	10716716001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mercury	mg/kg	0.097	1.5	1.4	1.5	1.5	96	99	80-120	1	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: 227706430

Pace Project No.: 10716716

QC Batch:	982163	Analysis Method:	EPA 6010D
QC Batch Method:	EPA 3050B	Analysis Description:	6010D Solids
		Laboratory:	Pace Analytical Services - Minneapolis

Associated Lab Samples: 10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008

METHOD BLANK:	5132020	Matrix:	Solid
---------------	---------	---------	-------

Associated Lab Samples: 10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Arsenic	mg/kg	ND	0.95	12/06/24 13:59	
Cadmium	mg/kg	ND	0.14	12/06/24 13:59	
Chromium	mg/kg	ND	0.47	12/06/24 13:59	
Copper	mg/kg	ND	0.47	12/06/24 13:59	
Lead	mg/kg	ND	0.47	12/06/24 13:59	
Manganese	mg/kg	ND	0.47	12/06/24 13:59	
Nickel	mg/kg	ND	0.95	12/06/24 13:59	
Zinc	mg/kg	ND	1.9	12/06/24 13:59	

LABORATORY CONTROL SAMPLE: 5132021

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Arsenic	mg/kg	48.1	42.8	89	80-120	
Cadmium	mg/kg	48.1	46.8	97	80-120	
Chromium	mg/kg	48.1	47.0	98	80-120	
Copper	mg/kg	48.1	47.2	98	80-120	
Lead	mg/kg	48.1	46.8	97	80-120	
Manganese	mg/kg	48.1	47.9	100	80-120	
Nickel	mg/kg	48.1	47.4	98	80-120	
Zinc	mg/kg	48.1	46.2	96	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 5132022 5132023

Parameter	Units	10716716001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic	mg/kg	ND	149	147	133	135	88	90	75-125	1	20	
Cadmium	mg/kg	ND	149	147	132	135	89	91	75-125	2	20	
Chromium	mg/kg	28.0	149	147	166	167	93	95	75-125	0	20	
Copper	mg/kg	19.5	149	147	165	167	98	100	75-125	1	20	
Lead	mg/kg	11.3	149	147	144	146	89	92	75-125	1	20	
Manganese	mg/kg	516	149	147	597	593	55	53	75-125	1	20	M1
Nickel	mg/kg	13.4	149	147	148	151	91	93	75-125	2	20	
Zinc	mg/kg	58.2	149	147	185	185	85	86	75-125	0	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

Date: 01/16/2025 09:31 AM

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.

Page 28 of 45



QUALITY CONTROL DATA

Project: 227706430

Pace Project No.: 10716716

QC Batch:	982667	Analysis Method:	ASTM D2974
QC Batch Method:	ASTM D2974	Analysis Description:	Dry Weight / %M by ASTM D2974
		Laboratory:	Pace Analytical Services - Minneapolis
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

SAMPLE DUPLICATE: 5134471

Parameter	Units	10716716001 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	68.3	70.3	3	30	N2

SAMPLE DUPLICATE: 5134472

Parameter	Units	10716716008 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	40.5	40.7	0	30	N2

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: 227706430

Pace Project No.: 10716716

QC Batch:	981746	Analysis Method:	EPA 8270E by SIM
QC Batch Method:	EPA 3546	Analysis Description:	8270E Solid PAH by SIM MSSV
		Laboratory:	Pace Analytical Services - Minneapolis
Associated Lab Samples:	10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008		

METHOD BLANK: 5129476

Matrix: Solid

Associated Lab Samples: 10716716001, 10716716002, 10716716003, 10716716004, 10716716005, 10716716006, 10716716007, 10716716008

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Acenaphthene	ug/kg	ND	10.0	11/29/24 21:40	
Acenaphthylene	ug/kg	ND	10.0	11/29/24 21:40	
Anthracene	ug/kg	ND	10.0	11/29/24 21:40	
Benzo(a)anthracene	ug/kg	ND	10.0	11/29/24 21:40	
Benzo(a)pyrene	ug/kg	ND	10.0	11/29/24 21:40	
Benzo(b)fluoranthene	ug/kg	ND	10.0	11/29/24 21:40	
Benzo(g,h,i)perylene	ug/kg	ND	10.0	11/29/24 21:40	
Benzo(k)fluoranthene	ug/kg	ND	10.0	11/29/24 21:40	
Chrysene	ug/kg	ND	10.0	11/29/24 21:40	
Dibenz(a,h)anthracene	ug/kg	ND	10.0	11/29/24 21:40	
Fluoranthene	ug/kg	ND	10.0	11/29/24 21:40	
Fluorene	ug/kg	ND	10.0	11/29/24 21:40	
Indeno(1,2,3-cd)pyrene	ug/kg	ND	10.0	11/29/24 21:40	
Naphthalene	ug/kg	ND	10.0	11/29/24 21:40	
Phenanthrene	ug/kg	ND	10.0	11/29/24 21:40	
Pyrene	ug/kg	ND	10.0	11/29/24 21:40	
2-Fluorobiphenyl (S)	%	67	48-125	11/29/24 21:40	
p-Terphenyl-d14 (S)	%	82	51-139	11/29/24 21:40	

LABORATORY CONTROL SAMPLE: 5129477

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Acenaphthene	ug/kg	100	64.0	64	45-125	
Acenaphthylene	ug/kg	100	63.1	63	43-125	
Anthracene	ug/kg	100	78.5	79	59-125	
Benzo(a)anthracene	ug/kg	100	83.4	83	66-125	
Benzo(a)pyrene	ug/kg	100	84.3	84	65-125	
Benzo(b)fluoranthene	ug/kg	100	85.7	86	61-125	
Benzo(g,h,i)perylene	ug/kg	100	81.7	82	64-125	
Benzo(k)fluoranthene	ug/kg	100	83.4	83	65-125	
Chrysene	ug/kg	100	85.1	85	63-125	
Dibenz(a,h)anthracene	ug/kg	100	84.5	84	63-125	
Fluoranthene	ug/kg	100	75.2	75	62-125	
Fluorene	ug/kg	100	63.6	64	51-125	
Indeno(1,2,3-cd)pyrene	ug/kg	100	85.6	86	61-125	
Naphthalene	ug/kg	100	56.9	57	37-125	
Phenanthrene	ug/kg	100	76.2	76	60-125	

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

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



QUALITY CONTROL DATA

Project: 227706430

Pace Project No.: 10716716

LABORATORY CONTROL SAMPLE: 5129477

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Pyrene	ug/kg	100	84.6	85	65-125	
2-Fluorobiphenyl (S)	%.			63	48-125	
p-Terphenyl-d14 (S)	%.			81	51-139	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 5129478 5129479

Parameter	Units											
		10716716001	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Acenaphthene	ug/kg	ND	311	311	224	231	72	74	30-131	3	30	
Acenaphthylene	ug/kg	ND	311	311	216	226	69	73	36-125	5	30	
Anthracene	ug/kg	ND	311	311	242	259	78	83	35-131	7	30	
Benzo(a)anthracene	ug/kg	ND	311	311	253	263	81	85	30-150	4	30	
Benzo(a)pyrene	ug/kg	ND	311	311	260	271	84	87	30-148	4	30	
Benzo(b)fluoranthene	ug/kg	ND	311	311	252	275	81	89	30-150	9	30	
Benzo(g,h,i)perylene	ug/kg	ND	311	311	233	227	75	73	34-142	2	30	
Benzo(k)fluoranthene	ug/kg	ND	311	311	250	259	80	83	30-150	3	30	
Chrysene	ug/kg	ND	311	311	244	255	78	82	30-150	5	30	
Dibenz(a,h)anthracene	ug/kg	ND	311	311	227	227	73	73	50-125	0	30	
Fluoranthene	ug/kg	ND	311	311	240	270	77	87	30-150	12	30	
Fluorene	ug/kg	ND	311	311	230	241	74	78	35-128	5	30	
Indeno(1,2,3-cd)pyrene	ug/kg	ND	311	311	236	246	76	79	30-150	4	30	
Naphthalene	ug/kg	ND	311	311	182	192	59	62	30-125	5	30	
Phenanthrene	ug/kg	ND	311	311	233	254	75	82	30-150	8	30	
Pyrene	ug/kg	ND	311	311	265	257	85	83	30-150	3	30	
2-Fluorobiphenyl (S)	%.						67	71	48-125			
p-Terphenyl-d14 (S)	%.						74	73	51-139			

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

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, LLC.



QUALIFIERS

Project: 227706430
Pace Project No.: 10716716

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.
TNTC - Too Numerous To Count
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 - The lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.
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.
Reported results are not rounded until the final step prior to reporting. Therefore, calculated parameters that are typically reported as "Total" may vary slightly from the sum of the reported component parameters.
Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.
TNI - The NELAC Institute.

WORKORDER QUALIFIERS

WO: 10716716

[1] The samples were received outside of required temperature range. Analysis was completed upon client approval.

BATCH QUALIFIERS

Batch: 494066

[1] coarse sieved 1/10/25, fines sieved 1/15/25; added one drop of Antifoam B Silicone Emulsion; assisted by SRG

Batch: 494067

[1] coarse sieved 1/14/25, fines sieved 1/15/24; added one drop of Antifoam B Silicone Emulsion

ANALYTE QUALIFIERS

E Analyte concentration exceeded the calibration range. The reported result is estimated.
H3 Sample was received or analysis requested beyond the recognized method holding time.
M1 Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.
N2 The lab does not hold NELAC/TNI accreditation for this parameter but other accreditations/certifications may apply. A complete list of accreditations/certifications is available upon request.
R1 RPD value was outside control limits.

REPORT OF LABORATORY ANALYSIS



QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 227706430

Pace Project No.: 10716716

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10716716001	Sed Cr 3 Sec 1	EPA 350.1	983509	EPA 350.1	984089
10716716002	Sed Cr 3 Sec 2	EPA 350.1	983509	EPA 350.1	984089
10716716003	Sed Cr 4 Sec 1	EPA 350.1	983509	EPA 350.1	984089
10716716004	Sed Cr 4 Sec 2	EPA 350.1	983509	EPA 350.1	984089
10716716005	Sed Cr 8 Sec 1	EPA 350.1	983509	EPA 350.1	984089
10716716006	Sed Cr 8 Sec 2	EPA 350.1	983509	EPA 350.1	984089
10716716007	Sed Cr 11 Sec 1	EPA 350.1	983509	EPA 350.1	984089
10716716008	Sed Cr 11 Sec 2	EPA 350.1	983509	EPA 350.1	984089
10716716001	Sed Cr 3 Sec 1	EPA 351.2	982533	EPA 351.2	983104
10716716002	Sed Cr 3 Sec 2	EPA 351.2	982533	EPA 351.2	983104
10716716003	Sed Cr 4 Sec 1	EPA 351.2	982533	EPA 351.2	983104
10716716004	Sed Cr 4 Sec 2	EPA 351.2	982533	EPA 351.2	983104
10716716005	Sed Cr 8 Sec 1	EPA 351.2	982533	EPA 351.2	983104
10716716006	Sed Cr 8 Sec 2	EPA 351.2	982533	EPA 351.2	983104
10716716007	Sed Cr 11 Sec 1	EPA 351.2	982533	EPA 351.2	983104
10716716008	Sed Cr 11 Sec 2	EPA 351.2	982533	EPA 351.2	983104
10716716001	Sed Cr 3 Sec 1	SM 4500-P B	982461	EPA 365.1	982604
10716716002	Sed Cr 3 Sec 2	SM 4500-P B	982461	EPA 365.1	982604
10716716003	Sed Cr 4 Sec 1	SM 4500-P B	982461	EPA 365.1	982604
10716716004	Sed Cr 4 Sec 2	SM 4500-P B	982461	EPA 365.1	982604
10716716005	Sed Cr 8 Sec 1	SM 4500-P B	982461	EPA 365.1	982604
10716716006	Sed Cr 8 Sec 2	SM 4500-P B	982461	EPA 365.1	982604
10716716007	Sed Cr 11 Sec 1	SM 4500-P B	982461	EPA 365.1	982604
10716716008	Sed Cr 11 Sec 2	SM 4500-P B	982461	EPA 365.1	982604
10716716001	Sed Cr 3 Sec 1	EPA 9060A	983497		
10716716001	Sed Cr 3 Sec 1	EPA 9060A	983501		
10716716002	Sed Cr 3 Sec 2	EPA 9060A	983497		
10716716002	Sed Cr 3 Sec 2	EPA 9060A	983501		
10716716003	Sed Cr 4 Sec 1	EPA 9060A	983497		
10716716003	Sed Cr 4 Sec 1	EPA 9060A	983501		
10716716004	Sed Cr 4 Sec 2	EPA 9060A	983497		
10716716004	Sed Cr 4 Sec 2	EPA 9060A	983501		
10716716005	Sed Cr 8 Sec 1	EPA 9060A	983497		
10716716005	Sed Cr 8 Sec 1	EPA 9060A	983501		
10716716006	Sed Cr 8 Sec 2	EPA 9060A	983497		
10716716006	Sed Cr 8 Sec 2	EPA 9060A	983501		
10716716007	Sed Cr 11 Sec 1	EPA 9060A	983497		
10716716007	Sed Cr 11 Sec 1	EPA 9060A	983501		
10716716008	Sed Cr 11 Sec 2	EPA 9060A	983497		
10716716008	Sed Cr 11 Sec 2	EPA 9060A	983501		

REPORT OF LABORATORY ANALYSIS



QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 227706430

Pace Project No.: 10716716

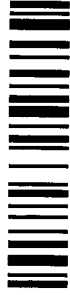
Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10716716001	Sed Cr 3 Sec 1	EPA 3050B	982163	EPA 6010D	982944
10716716002	Sed Cr 3 Sec 2	EPA 3050B	982163	EPA 6010D	982944
10716716003	Sed Cr 4 Sec 1	EPA 3050B	982163	EPA 6010D	982944
10716716004	Sed Cr 4 Sec 2	EPA 3050B	982163	EPA 6010D	982944
10716716005	Sed Cr 8 Sec 1	EPA 3050B	982163	EPA 6010D	982944
10716716006	Sed Cr 8 Sec 2	EPA 3050B	982163	EPA 6010D	982944
10716716007	Sed Cr 11 Sec 1	EPA 3050B	982163	EPA 6010D	982944
10716716008	Sed Cr 11 Sec 2	EPA 3050B	982163	EPA 6010D	982944
10716716001	Sed Cr 3 Sec 1	EPA 7471B	982187	EPA 7471B	982976
10716716002	Sed Cr 3 Sec 2	EPA 7471B	982187	EPA 7471B	982976
10716716003	Sed Cr 4 Sec 1	EPA 7471B	982187	EPA 7471B	982976
10716716004	Sed Cr 4 Sec 2	EPA 7471B	982187	EPA 7471B	982976
10716716005	Sed Cr 8 Sec 1	EPA 7471B	982187	EPA 7471B	982976
10716716006	Sed Cr 8 Sec 2	EPA 7471B	982187	EPA 7471B	982976
10716716007	Sed Cr 11 Sec 1	EPA 7471B	982187	EPA 7471B	982976
10716716008	Sed Cr 11 Sec 2	EPA 7471B	982187	EPA 7471B	982976
10716716001	Sed Cr 3 Sec 1	ASTM D2974	982667		
10716716002	Sed Cr 3 Sec 2	ASTM D2974	982667		
10716716003	Sed Cr 4 Sec 1	ASTM D2974	982667		
10716716004	Sed Cr 4 Sec 2	ASTM D2974	982667		
10716716005	Sed Cr 8 Sec 1	ASTM D2974	982667		
10716716006	Sed Cr 8 Sec 2	ASTM D2974	982667		
10716716007	Sed Cr 11 Sec 1	ASTM D2974	982667		
10716716008	Sed Cr 11 Sec 2	ASTM D2974	982667		
10716716001	Sed Cr 3 Sec 1	EPA 3546	981746	EPA 8270E by SIM	982112
10716716002	Sed Cr 3 Sec 2	EPA 3546	981746	EPA 8270E by SIM	982112
10716716003	Sed Cr 4 Sec 1	EPA 3546	981746	EPA 8270E by SIM	982112
10716716004	Sed Cr 4 Sec 2	EPA 3546	981746	EPA 8270E by SIM	982112
10716716005	Sed Cr 8 Sec 1	EPA 3546	981746	EPA 8270E by SIM	982112
10716716006	Sed Cr 8 Sec 2	EPA 3546	981746	EPA 8270E by SIM	982112
10716716007	Sed Cr 11 Sec 1	EPA 3546	981746	EPA 8270E by SIM	982112
10716716008	Sed Cr 11 Sec 2	EPA 3546	981746	EPA 8270E by SIM	982112
10716716001	Sed Cr 3 Sec 1	ASTM D6913/D7928	494066		
10716716002	Sed Cr 3 Sec 2	ASTM D6913/D7928	494066		
10716716003	Sed Cr 4 Sec 1	ASTM D6913/D7928	494066		
10716716004	Sed Cr 4 Sec 2	ASTM D6913/D7928	494066		
10716716005	Sed Cr 8 Sec 1	ASTM D6913/D7928	494067		
10716716006	Sed Cr 8 Sec 2	ASTM D6913/D7928	494067		
10716716007	Sed Cr 11 Sec 1	ASTM D6913/D7928	494067		
10716716008	Sed Cr 11 Sec 2	ASTM D6913/D7928	494067		

REPORT OF LABORATORY ANALYSIS

CHAIN-OF-CUSTODY Analytical Request Document

Chain-of-Custody is a LEGAL DOCUMENT - Complete all relevant fields

W0#:10716716



10716716

Company Name: Startec	Contract/Report To: Katie Hembre		
Street Address: One Carlson Parkway Suite 100 Plymouth, MN 55447	Phone #: katie.hembre@stantec.com Cc E-Mail:		
Customer Project #: 227706430	Invoice To: Startec Payable Invoice E-Mail: sapinvoices@stantec.com Purchase Order # (if applicable): Quote #:		
Site Collection Info/Facility ID (as applicable):	County / State origin of sample(s): Minnesota		
Time Zone Collected: [] AK [] MT [] PT [] UT [] ET []	Regulatory Program (DW, RCRA, etc.) as applicable: Reportable [] Yes [] No		
Data Deliverables: [] Level II [] Level III [] Level IV [] LEQUIS [] Other	Rush (Pre-approval required): [] Same Day [] 1 Day [] 2 Day [] 3 Day [] Other		
Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Waste Water (WW), Product (P), Soil/Solid (SS), Oil (OL), Waste (WP), Tissue (TS), Bioassay (B), Vapor (V), Surface Water (SW), Sediment (SED), Sludge (SL), Leachate (LL), Biosolid (BS), Other (OT)	DW PWSID # or WW Permit # as applicable:		
Customer Sample ID	Field Filtered (if applicable): [] Yes [] No Analysis:		
Matrix *	Composite Start		
Comp / Grab	Date		
Time	Time		
Collected or Composite End	#		
Cont.	Results		
Units	Res. Chlorine		
SED Cr 3 Sec 1	11-20-24 3pm 9		
SED Cr 3 Sec 2	11-20-24 3pm 9		
SED Cr 4 Sec 1	11-20-24 3pm 9		
SED Cr 4 Sec 2	11-20-24 3pm 9		
SED Cr 8 Sec 1	11-20-24 3pm 9		
SED Cr 8 Sec 2	11-20-24 3pm 9		
SED Cr 11 Sec 1	11-20-24 3pm 8		
SED Cr 11 Sec 2	11-20-24 3pm 9		
Additional Instructions from Pace: -2 Cores - Sediment Core Samples.	Collected By: (Printed Name) Signature: Lucas Clapp		
Relinquished by/Company: (Signature) Lucas Clapp / Startec	Received by/Company: (Signature) Cory Clapp		
Relinquished by/Company: (Signature)	Received by/Company: (Signature)		
Relinquished by/Company: (Signature)	Received by/Company: (Signature)		
Relinquished by/Company: (Signature)	Received by/Company: (Signature)		

Specify Container Size **									
Identify Container Preservative Type***									
Analysis Requested									
350.1 Ammonia Solids DU	351.2 TKN Solids DU	365.1 Phos, Total Solids DU	6010D MET ICP; 7471B Mercury	8270E MSSV PAH by SIM	9060 TOC, 2 Rep Solids DU	Dry Weight	Particle Size with Hydrometer (Face GB)		
1	1	1	1	1	1	1	2		
1	1	1	1	1	1	1	2		
1	1	1	1	1	1	1	2		
1	1	1	1	1	1	1	2		
1	1	1	1	1	1	1	2		
1	1	1	1	1	1	1	2		
1	1	1	1	1	1	1	2		
1	1	1	1	1	1	1	2		
1	1	1	1	1	1	1	2		

*** Preservative Types: (1) None, (2) HNO₃, (3) H₂SO₄, (4) HCl, (5) NaOH, (6) Zn Acetate, (7) NaHSO₄, (8) Sod. Thiosulfate, (9) Ascorbic Acid, (10) MeOH, (11) Other

*** Container Size: (1) 1L, (2) 500mL, (3) 250mL, (4) 125mL, (5) 100mL, (6) 40mL vial, (7) EnCore, (8) TerraCore, (9) 90mL, (10) Other

Proj. Mgr:
Annika Asp

AccNum / Client ID:
47502

Table #:
EZ 3169949

Profile / Template:
47502

Prelog / Bottle Ord. ID:
EZ 3169949

Sample Comment

001

002

003

004

005

006

second hydr wad
- 200g/min, rest 007

008

Lab Use Only

Preservation non-conformance identified for

Obs. Temp. (°C)

Corrected Temp. (°C)

On Ice:

Thermometer ID: **79**

Correction Factor (°C): **-0.4**

Date/Time: **11/22/24 08:53**

Date/Time:

Date/Time:

Date/Time:

Customer Remarks / Special Conditions / Possible Hazards:

Tracking Number:

Delivered by: [] In-Person [] Courier

[] FedEx [] UPS [] Other

Containers: **2**

Page: **1** of **1**

ENV-FRM-MIN4-0150 v17_Sample Condition Upon Receipt

CLIENT NAME:

Stantec

PROJECT #:

WO#: 10716716

COURIER:

☐ Client☒ Commercial☐ FedEx☐ Pace☐ Speedee☐ UPS☐ USPS

PM: AKA

Due Date: 12/10/24

CLIENT: STANTEC-MN

TRACKING NUMBER:

☐ See Exceptions form

ENV-FRM-MIN4-0142

Custody Seal on Cooler/Box Present:

☐ YES☒ NO

Seals Intact:

☐ YES☒ NO

Biological Tissue Frozen:

☐ YES☐ NO☒ N/A

Packing Material:

☒ Bubble Bags☒ Bubble Wrap☐ None☐ Other

Temp Blank:

☒ YES☐ NO

Type of Ice:

☐ Blue☐ Dry☒ Wet

Thermometer:

☐ T1 (0461)☐ T2 (0436)☐ T3 (0459)☐ T4 (0402)☐ T5 (0178)☐ T6 (0235)☐ Melted☐ None☐ T7 (0042)☐ T8 (0775)☒ T9 (0727)☐ 01339252 (1710)

Did Samples Originate in West Virginia:

☐ YES☒ NO

Were All Container Temps taken:

☐ YES☐ NO☒ N/A

Correction Factor: -0.4

Cooler Temp Read w/Temp Blank: 7.6, 6.7°C

Average Corrected Temp (no Temp Blank Only): _____°C

Cooler Temp Corrected w/Temp Blank: 7.2, 6.3°C

NOTE: Temp should be above freezing to 6°C.

☐ See Exceptions Form ENV-FRM-MIN4-0142☐ 1 ContainerUSDA Regulated Soil: ☐ N/A - Water Sample/Other (describe):Did Samples originate from one of the following states (check maps) - AL, AR, AZ, CA, FL, GA, ID, LA, MS, NC, NM, NY, OK, OR, SC, TN, TX, or VA: ☐ YES ☒ NO

Initials & Date of Person Examining Contents: CM 11/22/24

Did samples originate from a foreign source (international, including Hawaii and Puerto Rico): ☐ YES ☒ NO

NOTE: If YES to either question, fill out a Regulated Soil Checklist (ENV-FRM-MIN4-0154) and include with SCUR/COC paperwork.

LOCATION (check one):	☐ DULUTH	☒ MINNEAPOLIS	☐ VIRGINIA	YES	NO	N/A	COMMENT(S)								
Chain of Custody Present and Filled Out?		☒		☒	☐		1.								
Chain of Custody Relinquished?		☒		☒	☐		2.								
Sampler Name and/or Signature on COC?		☒		☒	☐		3.								
Samples Arrived within Hold Time?		☒		☒	☐		4. If Fecal: ☐ <8 hrs ☐ >8 hr, <24 hr ☐ No								
Short Hold Time Analysis (<72 hr)?		☐		☐	☒		5. ☐ BOD / cBOD ☐ Fecal coliform ☐ Hex Chrom- ☐ HPC ☐ Nitrate ☐ Nitrite ☐ Ortho Phos ☐ Total coliform/E. coli ☐ Other:								
Rush Turn Around Time Requested?		☐		☐	☒		6.								
Sufficient Sample Volume?		☐		☐	☒		7. limited volume for grain size								
Correct Containers Used?		☒		☒	☐		8.								
- Pace Containers Used?		☒		☒	☐										
Containers Intact?		☒		☒	☐		9.								
Field Filtered Volume Received for Dissolved Tests?		☐		☐	☐	☒	10. Is sediment visible in the dissolved container: ☐ YES ☐ NO								
Is sufficient information available to reconcile the samples to the COC? NOTE: If ID/Date/Time don't match fill out section 11. Matrix: ☐ Oil ☒ Soil ☐ Water ☐ Other		☒		☒	☐		11. If NO, write ID/Date/Time of container below: ☐ See Exceptions form ENV-FRM-MIN4-0142								
All containers needing acid/base preservation have been checked? All containers needing preservation are found to be in compliance with EPA recommendation? (HNO ₃ , H ₂ SO ₄ , < 2 pH, NaOH > 9 Sulfide, NaOH > 10 Cyanide) Exceptions: VOA, Coliform, TOC/DOC, Oil & Grease, DRO/8015 (water) and Dioxins/PFAS		☐		☐	☐	☒	12. Sample #: ☐ HNO ₃ ☐ H ₂ SO ₄ ☐ NaOH ☐ Zinc Acetate Positive for Residual Chlorine: ☐ YES ☐ NO pH Paper Lot # <table border="1"><thead><tr><th>Residual Chlorine</th><th>0-6 Roll</th><th>0-6 Strip</th><th>0-14 Strip</th></tr></thead><tbody><tr><td></td><td></td><td></td><td></td></tr></tbody></table> ☐ See Exceptions form ENV-FRM-MIN4-0142	Residual Chlorine	0-6 Roll	0-6 Strip	0-14 Strip				
Residual Chlorine	0-6 Roll	0-6 Strip	0-14 Strip												
Headspace in Methyl Mercury Container?		☐		☐	☐	☒	13.								
Extra labels present on soil VOA or WIDRO containers?		☐		☐	☐	☒	14.								
Headspace in VOA Vials (greater than 6mm)?		☐		☐	☐	☒	☐ See Exceptions form ENV-FRM-MIN4-0140								
Trip Blanks Present?		☐		☐	☐	☒	15.								
Trip Blank Custody Seals Present?		☐		☐	☐	☒	Pace Trip Blank Lot # (if purchased):								

CLIENT NOTIFICATION / RESOLUTION

FIELD DATA REQUIRED: ☐ YES ☐ NO

Person Contacted:

KH

Date & Time:

11/25/2024 1319

Comments / Resolution:

Client was notified of temperature exceedance and limited volume for Grain Size Hydrometer analysis.

Project Manager Review:

Amu Asp

Date:

11/25/2024

NOTE: When there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEQ Certification Office (i.e., out of hold, incorrect preservative, out of temp, incorrect containers).

Labeled By:

CM1

Line:

3

ENV-FRM-MIN4-0142 v03_Sample Condition Upon Receipt - Exceptions

Workorder #: _____

No Temp Blank		
Read Temp	Corrected Temp	Average temp

PM Notified of Out of Temp Cooler? ☒ YES ☐ NO If yes, indicate who was contacted, date and time. If no, indicate reason why. AKA @ 1454 not enough ice, temp blanks not directly on ice Multiple Cooler Project? ☒ YES ☐ NO
--

If anything is OVER 6.0°C, you **MUST** document containers in this section HERE



Tracking Number	Temperature



limited volume for grainsize Out of Temp Sample ID			Container Type	# of Containers
sed cr11 sec1			ZPLU	1
sed cr11 sec2			ZPLU	2
sed cr4 sec1			ZPLU	2
sed cr8 sec1			ZPLU	2
sed cr3 sec1			ZPLU	2

pH Adjustment Log for Preserved Samples

Sample ID	Type Of Preserve	pH Upon Receipt	Date Adjusted	Time Adjusted	Amount Added (mL)	Lot # Added	pH After	In Compliance After Addition?		Initials
								YES	NO	
								☐	☐	
								☐	☐	
								☐	☐	
								☐	☐	
								☐	☐	
								☐	☐	
								☐	☐	
								☐	☐	

Comments:

Pace Container Order #3169949

austin.coon@pacelabs.com

Addresses	Ship To :	Return To:
Order By :	Ship To :	Return To:
Company Stantec	Company Stantec	Company Minneapolis, MN (Pace Analytical)
Contact Katie Hembre	Contact Katie Hembre	Contact Annika Asp
Email katie.hembre@stantec.com	Email katie.hembre@stantec.com	Email annika.asp@pacelabs.com
Address One Carlson Parkway	Address One Carlson Parkway	Address 1700 Elm Street
Address 2 Suite 100	Address 2 Suite 100	Address 2 Suite 200
City Plymouth	City Plymouth	City Minneapolis
State MN Zip 55447	State MN Zip 55447	State MN Zip 55414
Phone	Phone	Phone (612)607-1700

Info			
Project Name 227706430	Due Date 11/07/2024	Profile 47502	Quote
Project Manager Asp, Annika	Return Date	Carrier Pace Courier	Location MN

Return Shipping Labels Return Label Type ☐ No Shipper ☐ With Shipper	Bottle Labels ☐ Blank ☒ Pre-Printed No Sample IDs ☐ Pre-Printed With Sample IDs	Bottles ☐ Boxed Cases ☐ Individually Wrapped ☒ Grouped By Sample ID/Matrix
Trip Blanks ☐ Include Trip Blanks	Misc ☐ Sampling Instructions ☒ Custody Seal ☒ Temp. Blanks ☒ Coolers ☒ Syringes 8 ☐ Extra Bubble Wrap ☐ Short Hold/Rush Stickers ☐ DI Water ☐ USDA Regulated Soils ☒ Dry Weight 8	
COC Options ☐ Number of Blanks ☒ Pre-Printed 1		

# of Samp Matrix	Analysis	Qty / Samp	Container	Total	# of QC	Lot #	Notes
8	SL 350.1 Ammonia Solids DU	1	4oz amber wide jar	8		091624-1KM	
8	SL 351.2 TKN Solids DU	1	4oz amber wide jar	8		091624-1KM	
8	SL 6010D MET ICP; 7471B Mercury	1	4oz amber wide jar	8		091624-1KM	
8	SL 8270E MSSV PAH by SIM	1	4oz amber wide jar	8		091624-1KM	
8	SL 9060 TOC, 2 Rep Solids DU	1	4oz amber wide jar	8		091624-1KM	
8	SL 365.1 Phos, Total Solids DU	1	4oz wide jar unpreserved	8		091624-1KM	
8	SL Dry Weight	1	DRY WEIGHT CONTAINER	8		072424-5	
8	SL Particle Size with Hydrometer (Pace GB)	2	Ziploc Bag	16		NA	

Hazard Shipping Placard In Place : N/A

*Sample receiving hours are typically 8am-5pm, but may differ by location. Please check with your Pace 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/disposal.

*Payment term are net 30 days.

*Please include the proposal number on the chain of custody to ensure proper billing.

Sample Notes :

LAB USE:

Ship Date :	11/07/2024
Prepared By:	HWF
Verified By:	

CLIENT USE (Optional):

Date Rec'd:	
Received By:	

[illegible]

Workorder: 10716716 **Workorder Name:** 227706430

Owner Received Date: 11/22/2024 Due Date: 12/10/2024

Received at:		Send To Lab:		Requested Analysis														
Pace Analytical Minnesota 1700 Elm Street Minneapolis, MN 55414 Phone (612)607-1700		Pace Analytical Duluth 4730 Oneota St. Duluth, MN 55807 Phone (218) 727-6380																
Report To: Annika Asp																		
Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Preserved Containers				EPA 351.2	EPA 9060A	EPA 350.1	EPA 365.1					LAB USE ONLY
						Unpreserved												
1	Sed Cr 3 Sec 1	PS	11/20/2024 15:00	10716716001	Solid	4				X	X	X	X					
2	Sed Cr 3 Sec 2	PS	11/20/2024 15:00	10716716002	Solid	4				X	X	X	X					
3	Sed Cr 4 Sec 1	PS	11/20/2024 15:00	10716716003	Solid	4				X	X	X	X					
4	Sed Cr 4 Sec 2	PS	11/20/2024 15:00	10716716004	Solid	4				X	X	X	X					
5	Sed Cr 8 Sec 1	PS	11/20/2024 15:00	10716716005	Solid	4				X	X	X	X					
6	Sed Cr 8 Sec 2	PS	11/20/2024 15:00	10716716006	Solid	4				X	X	X	X					
7	Sed Cr 11 Sec 1	PS	11/20/2024 15:00	10716716007	Solid	4				X	X	X	X					
8	Sed Cr 11 Sec 2	PS	11/20/2024 15:00	10716716008	Solid	4				X	X	X	X					
Comments																		
Transfers		Released By		Date/Time		Received By		Date/Time										
1		11/25/24 Carey Pace		15:00		Annika Asp		11/26/24 10:00										
2																		
3																		
4																		
Cooler Temperature on Receipt 2.6 °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.

ENV-FRM-MIN4-0150 v17 Sample Condition Upon Receipt

CLIENT NAME: NPLS

PROJECT #:

COURIER: ☐ Client ☐ Commercial ☒ FedEx ☐ Pace
☐ Speedee ☐ UPS ☐ USPS

TRACKING NUMBER: 42435576 4460 ☐ See Exceptions form
 ENV-FRM-MIN4-0142

10716716

Place LIMS WO Label Here

Custody Seal on Cooler/Box Present: ☒ YES ☐ NO Seals Intact: ☒ YES ☐ NO Biological Tissue Frozen: ☐ YES ☐ NO ☒ N/A

Packing Material: ☐ Bubble Bags ☒ Bubble Wrap ☐ None ☐ Other Temp Blank: ☒ YES ☐ NO Type of Ice: ☐ Blue ☐ Dry ☒ Wet

Thermometer: ☐ T1 (0461) ☐ T2 (0436) ☐ T3 (0459) ☐ T4 (0402) ☐ T5 (0178) ☐ T6 (0235)

☐ Melted ☐ None

☐ T7 (0042) ☐ T8 (0775) ☐ T9 (0727) ☒ 01339252 (1710)

Did Samples Originate in West Virginia: ☐ YES ☒ NO	Were All Container Temps taken: ☐ YES ☐ NO ☒ N/A
Correction Factor: <u>-0.1</u> Cooler Temp Read w/Temp Blank: <u>2.7</u> °C	Average Corrected Temp (no Temp Blank Only): _____ °C
Cooler Temp Corrected w/Temp Blank: <u>2.6</u> °C	
NOTE: Temp should be above freezing to 6°C.	
☐ See Exceptions Form ENV-FRM-MIN4-0142 ☐ 1 Container	

USDA Regulated Soil: ☒ N/A – Water Sample/Other (describe): _____	Initials & Date of Person Examining Contents: <u>AK 11/26/24</u>
Did Samples originate from one of the following states (check maps) – AL, AR, AZ, CA, FL, GA, ID, LA, MS, NC, NM, NY, OK, OR, SC, TN, TX, or VA: ☐ YES ☒ NO	Did samples originate from a foreign source (international, including Hawaii and Puerto Rico): ☐ YES ☒ NO
NOTE: IF YES to either question, fill out a Regulated Soil Checklist (ENV-FRM-MIN4-0154) and include with SCUR/COC paperwork.	

LOCATION (check one): ☒ DULUTH ☐ MINNEAPOLIS ☐ VIRGINIA	YES	NO	N/A	COMMENT(S)								
Chain of Custody Present and Filled Out?	☒	☐		1.								
Chain of Custody Relinquished?	☒	☐		2.								
Sampler Name and/or Signature on COC?	☐	☐	☒	3.								
Samples Arrived within Hold Time?	☒	☐		4. If Fecal: ☐ <8 hrs ☐ >8 hr, <24 hr ☐ No								
Short Hold Time Analysis (<72 hr)?	☐	☒		5. ☐ BOD / cBOD ☐ Fecal coliform ☐ Hex Chrom ☐ HPC ☐ Nitrate ☐ Nitrite ☐ Ortho Phos ☐ Total coliform/E. coli ☐ Other: _____								
Rush Turn Around Time Requested?	☐	☒		6.								
Sufficient Sample Volume?	☒	☐		7.								
Correct Containers Used?	☒	☐	☐	8.								
– Pace Containers Used?	☒	☐										
Containers Intact?	☒	☐		9.								
Field Filtered Volume Received for Dissolved Tests?	☐	☐	☒	10. Is sediment visible in the dissolved container: ☐ YES ☐ NO								
Is sufficient information available to reconcile the samples to the COC? NOTE: If ID/Date/Time don't match fill out section 11. Matrix: ☐ Oil ☒ Soil ☐ Water ☐ Other	☒	☐		11. If NO, write ID/Date/Time of container below: ☐ See Exceptions form ENV-FRM-MIN4-0142								
All containers needing acid/base preservation have been checked? All containers needing preservation are found to be in compliance with EPA recommendation? (HNO ₃ , H ₂ SO ₄ , < 2 pH, NaOH > 9 Sulfide, NaOH > 10 Cyanide) Exceptions: VOA, Coliform, TOC/DOC, Oil & Grease, DRO/8015 (water) and Dioxins/PFAS NOTE: If adding preservation to the container, verify with the PM first. Clients may require adding preservative to the field and equipment blanks when this occurs.	☐	☐	☒	12. Sample #: ☐ HNO ₃ ☐ H ₂ SO ₄ ☐ NaOH ☐ Zinc Acetate Positive for Residual Chlorine: ☐ YES ☐ NO pH Paper Lot # <table border="1"> <tr> <th>Residual Chlorine</th> <th>0-6 Roll</th> <th>0-6 Strip</th> <th>0-14 Strip</th> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table> ☐ See Exceptions form ENV-FRM-MIN4-0142	Residual Chlorine	0-6 Roll	0-6 Strip	0-14 Strip				
Residual Chlorine	0-6 Roll	0-6 Strip	0-14 Strip									
Headspace in Methyl Mercury Container?	☐	☐	☒	13.								
Extra labels present on soil VOA or WIDRO containers?	☐	☐	☒	14.								
Headspace in VOA Vials (greater than 6mm)?	☐	☐	☒	☐ See Exceptions form ENV-FRM-MIN4-0140								
Trip Blanks Present?	☐	☐	☒	15.								
Trip Blank Custody Seals Present?	☐	☐	☒	Pace Trip Blank Lot # (if purchased): _____								

CLIENT NOTIFICATION / RESOLUTION

FIELD DATA REQUIRED: ☐ YES ☐ NO

Person Contacted: _____ Date & Time: _____

Comments / Resolution: _____

Project Manager Review: Anna Asp

Date: 11/27/2024

NOTE: When there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEQ Certification Office (i.e., out of hold, incorrect preservative, out of temp, incorrect containers).

Labeled By: _____ Line: _____

Internal Transfer Chain of Custody



☐ Rush Multiplier ☒ X

☒ Samples Pre-Logged into eCOC

State Of Origin: MN

Cert. Needed: ☒ Yes ☐ No

Owner Received Date: 11/22/2024 Results Requested By: 12/10/2024

Workorder: 10716716 Workorder Name: 227706430

Report To

Subcontract To

Annika Asp
Pace Analytical Minnesota
1700 Elm Street
Minneapolis, MN 55414
Phone (612)607-1700

Pace Analytical Green Bay
1241 Bellevue Street
Suite 9
Green Bay, WI 54302
Phone (920)469-2436

ZPLU1/2 -2/2

Preserved Containers:

Gransize with Hydrometer (Pace GB)

LAB USE ONLY

Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Unpreserved	Preserved	Gransize with Hydrometer (Pace GB)	LAB USE ONLY
1	Sed Cr 3 Sec 1	PS	11/20/2024 15:00	10716716001	Solid	2		X	CO1
2	Sed Cr 3 Sec 2	PS	11/20/2024 15:00	10716716002	Solid	2		X	CO2
3	Sed Cr 4 Sec 1	PS	11/20/2024 15:00	10716716003	Solid	2		X	CO3
4	Sed Cr 4 Sec 2	PS	11/20/2024 15:00	10716716004	Solid	2		X	CO4
5	Sed Cr 8 Sec 1	PS	11/20/2024 15:00	10716716005	Solid	2		X	CO5
6	Sed Cr 8 Sec 2	PS	11/20/2024 15:00	10716716006	Solid	2		X	CO6
7	Sed Cr 11 Sec 1	PS	11/20/2024 15:00	10716716007	Solid	2		X	CO7
8	Sed Cr 11 Sec 2	PS	11/20/2024 15:00	10716716008	Solid	2		X	CO8

Comments

Limited volume submitted for below listed samples
Please contact Annika Asp if analysis is not possible.

Transfers	Released By	Date/Time	Received By	Date/Time	Cooler Temperature on Receipt	°C	Custody Seal	Y or N	Received on Ice	Y or N	Samples Intact	Y or N
1	Annika Asp	11/25/24	15:00									
2	Walters	11/26/24	07:45	Ma								
3												

***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.

40288042

Pace

40288042

ENV-FRM-MIN4-0150 v17 Sample Condition Upon Receipt

CLIENT NAME:

Stantec

PROJECT #:

WO#: 10716716

COURIER:

☐ Client☐ Speedee☒ Commercial☐ UPS☐ FedEx☐ USPS☐ Pace

PM: AKA

Due Date: 12/10/24

CLIENT: STANTEC-MN

TRACKING NUMBER:

☐ See Exceptions form
ENV-FRM-MIN4-0142

Custody Seal on Cooler/Box Present:

☐ YES ☒ NO

Seals Intact:

☐ YES ☒ NO

Biological Tissue Frozen:

☐ YES ☐ NO ☒ N/A

Packing Material:

☒ Bubble Bags☒ Bubble Wrap☐ None☐ Other

Temp Blank:

☒ YES ☐ NO

Type of Ice:

☐ Blue ☐ Dry☒ Wet

Thermometer:

☐ T1 (0461)☐ T2 (0436)☐ T3 (0459)☐ T4 (0402)☐ T5 (0178)☐ T6 (0235)☐ Melted☐ None☐ T7 (0042)☐ T8 (0775)☒ T9 (0727)☐ 01339252 (1710)Did Samples Originate in West Virginia: ☐ YES ☒ NOWere All Container Temps taken: ☐ YES ☐ NO ☒ N/A

Correction Factor: -0.4

Cooler Temp Read w/Temp Blank: 1.6, 6.7 °C

Cooler Temp Corrected w/Temp Blank: 1.2, 6.3 °C

Average Corrected Temp (no Temp Blank Only): °C

NOTE: Temp should be above freezing to 6°C.

☐ See Exceptions Form ENV-FRM-MIN4-0142☐ 1 ContainerUSDA Regulated Soil: ☐ N/A - Water Sample/Other (describe):

Initials & Date of Person Examining Contents: CM 11/22/24

Did Samples originate from one of the following states (check maps) - AL, AR, AZ, CA, FL, GA, ID, LA, MS, NC, NM, NY, OK, OR, SC, TN, TX, or VA: ☐ YES ☒ NODid samples originate from a foreign source (international, including Hawaii and Puerto Rico): ☐ YES ☒ NO

NOTE: IF YES to either question, fill out a Regulated Soil Checklist (ENV-FRM-MIN4-0154) and include with SCUR/COC paperwork.

LOCATION (check one):	DULUTH	MINNEAPOLIS	VIRGINIA	YES	NO	N/A	COMMENT(S)								
Chain of Custody Present and Filled Out?	☒	☒	☐	☒	☐	☐	1.								
Chain of Custody Relinquished?	☒	☒	☐	☒	☐	☐	2.								
Sampler Name and/or Signature on COC?	☒	☒	☐	☒	☐	☐	3.								
Samples Arrived within Hold Time?	☒	☒	☐	☒	☐	☐	4. If Fecal: ☐ <8 hrs ☐ >8 hr, <24 hr ☐ No								
Short Hold Time Analysis (<72 hr)?	☐	☒	☐	☐	☒	☐	5. ☐ BOD / ☐ cBOD ☐ Fecal coliform ☐ Hex Chrom- ☐ HPC ☐ Nitrate ☐ Nitrite ☐ Ortho Phos ☐ Total coliform/E. coli ☐ Other:								
Rush Turn Around Time Requested?	☐	☒	☐	☐	☒	☐	6.								
Sufficient Sample Volume?	☐	☒	☐	☐	☒	☐	7. Limited volume for grain size								
Correct Containers Used?	☒	☒	☐	☒	☐	☐	8.								
- Pace Containers Used?	☒	☒	☐	☒	☐	☐	9.								
Containers Intact?	☒	☒	☐	☒	☐	☐	10. Is sediment visible in the dissolved container: ☐ YES ☐ NO								
Field Filtered Volume Received for Dissolved Tests?	☐	☐	☒	☐	☐	☒	11. If NO, write ID/Date/Time of container below: ☐ See Exceptions form ENV-FRM-MIN4-0142								
Is sufficient information available to reconcile the samples to the COC? NOTE: If ID/Date/Time don't match fill out section 11. Matrix: ☐ Oil ☒ Soil ☐ Water ☐ Other	☒	☒	☐	☒	☐	☐	12. Sample #: ☐ HNO ₃ ☐ H ₂ SO ₄ ☐ NaOH ☐ Zinc Acetate Positive for Residual Chlorine: ☐ YES ☐ NO pH Paper Lot # <table border="1"> <tr> <td>Residual Chlorine</td> <td>0-5 Roll</td> <td>0-5 Strip</td> <td>0-14 Strip</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table> ☐ See Exceptions form ENV-FRM-MIN4-0142	Residual Chlorine	0-5 Roll	0-5 Strip	0-14 Strip				
Residual Chlorine	0-5 Roll	0-5 Strip	0-14 Strip												
All containers needing acid/base preservation have been checked? All containers needing preservation are found to be in compliance with EPA recommendation? (HNO ₃ , H ₂ SO ₄ < 2 pH, NaOH > 9 Sulfide, NaOH > 10 Cyanide) Exceptions: VOA, Coliform, TOC/DOC, Oil & Grease, DRO/8015 (water) and Dioxins/PFAS	☐	☐	☒	☐	☐	☒	13.								
Headspace in Methyl Mercury Container?	☐	☐	☒	☐	☐	☒	14.								
Extra labels present on soil VOA or WIDRO containers?	☐	☐	☒	☐	☐	☒	☐ See Exceptions form ENV-FRM-MIN4-0140								
Headspace in VOA Vials (greater than 6mm)?	☐	☐	☒	☐	☐	☒	15.								
Trip Blanks Present?	☐	☐	☒	☐	☐	☒	Pace Trip Blank Lot # (if purchased):								
Trip Blank Custody Seals Present?	☐	☐	☒	☐	☐	☒									

CLIENT NOTIFICATION / RESOLUTION

FIELD DATA REQUIRED: ☐ YES ☐ NO

Person Contacted:

KH

Date & Time:

11/25/2024 1319

Comments / Resolution:

Client was notified of temperature exceedance and limited volume for Grain Size Hydrometer analysis.

Project Manager Review:

Amu Asp

Date:

11/25/2024

NOTE: When there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEQ Certification Office (i.e., out of hold, incorrect preservative, out of temp, incorrect containers).

Labeled By:

Cm1

Line:

3

40288042

ENV-FRM-MIN4-0142 v03_Sample Condition Upon Receipt - Exceptions

Workorder #:

No Temp Blank		
Read Temp	Corrected Temp	Average temp

PM Notified of Out of Temp Cooler? ☒ YES ☐ NO
 If yes, indicate who was contacted, date and time.
 If no, indicate reason why.
AKA @ 1454
not enough ice, temp blanks not directly on ice
 Multiple Cooler Project? ☒ YES ☐ NO

If anything is OVER 6.0°C, you MUST document containers in this section HERE

Tracking Number	Temperature

limited volume for ^{grain size} Out of Temp Sample ID

Container Type	# of Containers
Sed CR11 sec1	1
Sed CR11 sec2	2
Sed CR4 sec1	2
Sed CR8 sec1	2
Sed CR3 sec1	2

pH Adjustment Log for Preserved Samples										
Sample ID	Type Of Preserve	pH Upon Receipt	Date Adjusted	Time Adjusted	Amount Added (mL)	Lot # Added	pH After	In Compliance After Addition?		Initials
								YES	NO	
								☐	☐	
								☐	☐	
								☐	☐	
								☐	☐	
								☐	☐	
								☐	☐	
								☐	☐	
								☐	☐	

Comments:

Client Name: PALL MN
Sample Preservation Receipt Form
Project # 40286042
All containers needing preservation have been checked and noted below:
Lab Lot# of pH paper: ☐ Yes ☐ No ☒ N/A
Lab Std #ID of preservation (if pH adjusted):

Initial when completed: Date/Time:

Page Lab #	Glass					Plastic					Vials					Jars				General				Volume (mL)				
	AG1U	BG1U	AG1H	AG4S	AG5U	AG2S	BG3U	BP1U	BP3U	BP3B	BP3N	BP3S	BP2Z	VG9C	DG9T	VG9U	VG9H	VG9M	VG9D	JGFU	JG9U	WGFU	WPFU		SP5T	ZPLC	GN 1	GN 2
001																								2				2.5 / 5
002																								2				2.5 / 5
003																								2				2.5 / 5
004																								2				2.5 / 5
005																								2				2.5 / 5
006																								2				2.5 / 5
007																								2				2.5 / 5
008																								2				2.5 / 5
009																								2				2.5 / 5
010																								2				2.5 / 5
011																								2				2.5 / 5
012																								2				2.5 / 5
013																								2				2.5 / 5
014																								2				2.5 / 5
015																								2				2.5 / 5
016																								2				2.5 / 5
017																								2				2.5 / 5
018																								2				2.5 / 5
019																								2				2.5 / 5
020																								2				2.5 / 5
VOA Vials (>6mm) *																												
H2SO4 pH ≤2																												
NaOH+Zn Act pH ≥9																												
NaOH pH ≥12																												
HNO3 pH ≤2																												
pH after adjusted																												

Exceptions to preservation check: VOA, Coliform, TOC, TOX, TOH, O&G, WI DRO, Phenolics, Other: Headspace in VOA Vials (>6mm): ☐ Yes ☒ No ☐ N/A *If yes look in headspace column

AG1U	1 liter amber glass	BP1U	1 liter plastic unpres	VG9C	40 mL clear ascorbic w/ HCl	JGFU	4 oz amber jar unpres
BG1U	1 liter clear glass	BP3U	250 mL plastic unpres	DG9T	40 mL amber Na Thio	JG9U	9 oz amber jar unpres
AG1H	1 liter amber glass HCL	BP3B	250 mL plastic NaOH	VG9U	40 mL clear vial unpres	WG9U	4 oz clear jar unpres
AG4S	125 mL amber glass H2SO4	BP3N	250 mL plastic HNO3	VG9H	40 mL clear vial HCL	WPFU	4 oz plastic jar unpres
AG5U	100 mL amber glass unpres	BP3S	250 mL plastic H2SO4	VG9M	40 mL clear vial MeOH	SP5T	120 mL plastic Na Thiosulfate
AG2S	500 mL amber glass H2SO4	BP2Z	500 mL plastic NaOH + Zn	VG9D	40 mL clear vial DI	ZPLC	ziploc bag
BG3U	250 mL clear glass unpres					GN 1	
						GN 2	

Sample Condition Upon Receipt Form (SCUR)

Project #:

Client Name: Pace MN

Courier: ☐ CS Logistics ☐ Fed Ex ☐ Speedee ☐ UPS ☒ Waltco
☐ Client ☐ Pace Other: _____

WO#: 40288042



Tracking #: 4054409

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-12.14 Type of Ice: ☒ Wet ☐ Blue ☐ Dry ☐ None ☐ Meltwater Only

Cooler Temperature Uncorr: 1.0 /Corr: 1.0

Temp Blank Present: ☒ yes ☐ no

Biological Tissue is Frozen: ☐ yes ☐ no

Temp should be above freezing to 6°C.

Biota Samples may be received at ≤ 0°C if shipped on Dry Ice.

Person examining contents:

Date: 8/17/2022 /Initials: mh

Labeled By Initials: KKS

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. <u>IRMO met mh</u>
Samples Arrived within Hold Time:	☒ Yes ☐ No	5.
- DI VOA Samples frozen upon receipt	☐ Yes ☐ No	Date/Time:
Short Hold Time Analysis (<72hr):	☐ Yes ☒ No	6.
Rush Turn Around Time Requested:	☐ Yes ☒ No	7.
Sufficient Volume:		8.
For Analysis: ☒ Yes ☐ No MS/MSD: ☐ Yes ☒ No ☐ N/A		
Correct Containers Used:	☒ Yes ☐ No	9.
Correct Type: Pace Green Bay <u>Pace IR</u> , Non-Pace		
Containers Intact:	☒ Yes ☐ No	10. <u>One ziploc bag of COC has a hole met mh</u>
Filtered volume received for Dissolved tests	☐ Yes ☐ No ☒ N/A	11.
Sample Labels match COC:	☒ Yes ☐ No ☐ N/A	12.
-Includes date/time/ID/Analysis Matrix: <u>S</u>		
Trip Blank Present:	☐ Yes ☐ No ☒ N/A	13.
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: COF: only one bag was stickered and received. met mh

PM Review is documented electronically in LIMs. By releasing the project, the PM acknowledges they have reviewed the sample login

Page 2 of 2

Attachment 6

Parameter	Sed Cr 3 Sec 1	Sed Cr 3 Sec 2	Sed Cr 4 Sec 1	Sed Cr 4 Sec 2	Sed Cr 8 Sec 1	Sed Cr 8 Sec 2	Sed Cr 11 Sec 1	Sed Cr 11 Sec 2	Units	Reporting Limit
Nitrogen, Ammonia	83.5	4.7	64.1	9.3	52.1	25.2	21.7	19.9	mg/kg	9.5
Nitrogen, Kjeldahl, Total	3990	611	3480	889	1580	1620	2070	2880	mg/kg	140
Phosphorus	1050	183	1200	203	302	214	664	495	mg/kg	14.9
RPD %	88.8	14.5	83.7	0.1	26.2	22.7	12.5	128	%	
Total Organic Carbon	60000	4930	28800	12800	35800	25900	19400	9300	mg/kg	3010
Total Organic Carbon	23100	5700	70200	12700	27500	20600	17100	42000	mg/kg	3060
Mean Total Organic Carbon	41500	5310	49500	12700	31700	23300	18300	25600	mg/kg	3040
Arsenic	ND	ND	3	ND	ND	ND	ND	ND	mg/kg	3.1
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	mg/kg	0.46
Chromium	28	10.9	30.8	12.5	19.4	20	17.4	28.8	mg/kg	1.5
Copper	19.5	8.1	22.6	7.9	11.5	9.4	14.4	21.8	mg/kg	1.5
Lead	11.3	2.6	13.5	2.7	7.3	5	6.7	6.9	mg/kg	1.5
Manganese	516	71.7	667	63.4	167	57.4	255	157	mg/kg	1.5
Nickel	13.4	7.8	15.3	7.5	9.1	8.2	9.6	18.1	mg/kg	3.1
Zinc	58.2	16.5	64.5	20.2	32.3	24.6	35.8	48.4	mg/kg	6.2
Mercury	0.097	ND	0.16	ND	0.054	ND	0.067	0.035	mg/kg	0.059
Percent Moisture	68.3	25.4	66.7	31.1	54.1	38.4	51.3	40.5	%	0.1
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ug/kg	31
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ug/kg	31
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ug/kg	31
Benz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ug/kg	31
Benz(b)fluoranthene	ND	ND	ND	ND	ND	24.2	ND	ND	ug/kg	31
Benz(k)fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ug/kg	31
Benz(a)pyrene	ND	ND	ND	ND	ND	18.9	ND	ND	ug/kg	31
Benz(ghi)perylene	ND	ND	ND	ND	ND	ND	ND	ND	ug/kg	31
Chrysene	ND	ND	ND	ND	ND	16.7	ND	ND	ug/kg	31
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ug/kg	31
Fluoranthene	ND	ND	ND	ND	ND	31.4	ND	ND	ug/kg	31
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ug/kg	31
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ug/kg	31
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ug/kg	31
Phenanthrene	ND	ND	ND	ND	ND	16.2	ND	ND	ug/kg	31
Pyrene	ND	ND	ND	ND	ND	28.8	ND	ND	ug/kg	31
2-Fluorobiphenyl (S)	65	66	66	69	63	62	68	70	%	1
p-terphenyl-d14 (S)	82	83	75	73	76	75	76	74	%	1

Attachment 7

Sed Cr 3 Sec 1								
Metal	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Antimony	---	2	---	13.5	---	25	---	NOAA (1991)
Arsenic	ND	9.8		21.4		33		CBSQG (2000a)
Cadmium	ND	0.99		3		5		CBSQG (2000a)
Chromium	28	43		76.5		110		CBSQG (2000a)
Copper	19.5	32		91		150		CBSQG (2000a)
Iron	---	20000	---	30000	---	40000	---	Ontario (1993)
Lead	11.3	36		83		130		CBSQG (2000a)
Manganese		460	516	780		1100		Ontario (1993)
Mercury	0.097	0.18		0.64		1.1		CBSQG (2000a)
Nickel	13.4	23		36		49		CBSQG (2000a)
Silver	---	1.6	---	1.9	---	2.2	---	BC (1999)
Zinc	58.2	120		290		460		CBSQG (2000a)

Sed Cr 3 Sec 2								
Metal	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Antimony	---	2	---	13.5	---	25	---	NOAA (1991)
Arsenic	ND	9.8		21.4		33		CBSQG (2000a)
Cadmium	ND	0.99		3		5		CBSQG (2000a)
Chromium	10.9	43		76.5		110		CBSQG (2000a)
Copper	8.1	32		91		150		CBSQG (2000a)
Iron	---	20000	---	30000	---	40000	---	Ontario (1993)
Lead	2.6	36		83		130		CBSQG (2000a)
Manganese	71.7	460		780		1100		Ontario (1993)
Mercury	ND	0.18		0.64		1.1		CBSQG (2000a)
Nickel	7.8	23		36		49		CBSQG (2000a)
Silver	---	1.6	---	1.9	---	2.2	---	BC (1999)
Zinc	16.5	120		290		460		CBSQG (2000a)

Sed Cr 4 Sec 1								
Metal	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Antimony	---	2	---	13.5	---	25	---	NOAA (1991)
Arsenic	3	9.8		21.4		33		CBSQG (2000a)
Cadmium	ND	0.99		3		5		CBSQG (2000a)
Chromium	30.8	43		76.5		110		CBSQG (2000a)
Copper	22.6	32		91		150		CBSQG (2000a)
Iron	---	20000	---	30000	---	40000	---	Ontario (1993)
Lead	13.5	36		83		130		CBSQG (2000a)
Manganese		460	667	780		1100		Ontario (1993)
Mercury	0.16	0.18		0.64		1.1	15.3	CBSQG (2000a)
Nickel	15.3	23		36		49		CBSQG (2000a)
Silver	---	1.6	---	1.9	---	2.2	---	BC (1999)
Zinc	64.5	120		290		460		CBSQG (2000a)

Sed Cr 4 Sec 2								
Metal	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Antimony	---	2	---	13.5	---	25	---	NOAA (1991)
Arsenic	ND	9.8		21.4		33		CBSQG (2000a)
Cadmium	ND	0.99		3		5		CBSQG (2000a)
Chromium	12.5	43		76.5		110		CBSQG (2000a)
Copper	7.9	32		91		150		CBSQG (2000a)

Iron	---	20000	---	30000	---	40000	---	Ontario (1993)
Lead	2.7	36		83		130		CBSQG (2000a)
Manganese	63.4	460		780		1100		Ontario (1993)
Mercury	ND	0.18		0.64		1.1		CBSQG (2000a)
Nickel	7.5	23		36		49		CBSQG (2000a)
Silver	---	1.6	---	1.9	---	2.2	---	BC (1999)
Zinc	20.2	120		290		460		CBSQG (2000a)

Sed Cr 8 Sec 1

Metal	mg/kg dry wt.							Source of SQG Effect-Based Concentrations
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	
Antimony	---	2	---	13.5	---	25	---	NOAA (1991)
Arsenic	ND	9.8		21.4		33		CBSQG (2000a)
Cadmium	ND	0.99		3		5		CBSQG (2000a)
Chromium	19.4	43		76.5		110		CBSQG (2000a)
Copper	11.5	32		91		150		CBSQG (2000a)
Iron	---	20000	---	30000	---	40000	---	Ontario (1993)
Lead	7.3	36		83		130		CBSQG (2000a)
Manganese	167	460		780		1100		Ontario (1993)
Mercury	0.054	0.18		0.64		1.1		CBSQG (2000a)
Nickel	9.1	23		36		49		CBSQG (2000a)
Silver	---	1.6	---	1.9	---	2.2	---	BC (1999)
Zinc	32.3	120		290		460		CBSQG (2000a)

Sed Cr 8 Sec 2

Metal	mg/kg dry wt.							Source of SQG Effect-Based Concentrations
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	
Antimony	---	2	---	13.5	---	25	---	NOAA (1991)
Arsenic	ND	9.8		21.4		33		CBSQG (2000a)
Cadmium	ND	0.99		3		5		CBSQG (2000a)
Chromium	20	43		76.5		110		CBSQG (2000a)
Copper	9.4	32		91		150		CBSQG (2000a)
Iron	---	20000	---	30000	---	40000	---	Ontario (1993)
Lead	5	36		83		130		CBSQG (2000a)
Manganese	57.4	460		780		1100		Ontario (1993)
Mercury	ND	0.18		0.64		1.1		CBSQG (2000a)
Nickel	8.2	23		36		49		CBSQG (2000a)
Silver	---	1.6	---	1.9	---	2.2	---	BC (1999)
Zinc	24.6	120		290		460		CBSQG (2000a)

Sed Cr 11 Sec 1

Metal	mg/kg dry wt.							Source of SQG Effect-Based Concentrations
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	
Antimony	---	2	---	13.5	---	25	---	NOAA (1991)
Arsenic	ND	9.8		21.4		33		CBSQG (2000a)
Cadmium	ND	0.99		3		5		CBSQG (2000a)
Chromium	17.4	43		76.5		110		CBSQG (2000a)
Copper	14.4	32		91		150		CBSQG (2000a)
Iron	---	20000	---	30000	---	40000	---	Ontario (1993)
Lead	6.7	36		83		130		CBSQG (2000a)
Manganese	255	460		780		1100		Ontario (1993)
Mercury	0.067	0.18		0.64		1.1		CBSQG (2000a)
Nickel	9.6	23		36		49		CBSQG (2000a)
Silver	---	1.6	---	1.9	---	2.2	---	BC (1999)
Zinc	35.8	120		290		460		CBSQG (2000a)

Sed Cr 11 Sec 2

	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	

Metal	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Antimony	---	2	---	13.5	---	25	---	NOAA (1991)
Arsenic	ND	9.8		21.4		33		CBSQG (2000a)
Cadmium	ND	0.99		3		5		CBSQG (2000a)
Chromium	28.8	43		76.5		110		CBSQG (2000a)
Copper	21.8	32		91		150		CBSQG (2000a)
Iron	---	20000	---	30000	---	40000	---	Ontario (1993)
Lead	6.9	36		83		130		CBSQG (2000a)
Manganese	157	460		780		1100		Ontario (1993)
Mercury	0.035	0.18		0.64		1.1		CBSQG (2000a)
Nickel	18.1	23		36		49		CBSQG (2000a)
Silver	---	1.6	---	1.9	---	2.2	---	BC (1999)
Zinc	48.4	120		290		460		CBSQG (2000a)

Attachment 8

Sed Cr 3 Sec 1								
PAH	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Low Molecular Weight PAHs (3 or less benzene rings)								
Acenaphthene	ND	6.7		48		89		CCME (1999)
Acenaphthylene	ND	5.9		67		128		CCME (1999)
Anthracene	ND	57.2		451		845		CBSQG (2000a)
Fluorene	ND	77.4		307		536		CBSQG (2000a)
Naphthalene	ND	176		369		561		CBSQG (2000a)
2-methylnaphthalene	---	20.2	---	111	---	201	---	CCME (1999)
Phenanthrene	ND	204		687		1170		CBSQG (2000a)
High Molecular Weight PAHs (4 or more benzene rings)								
Benzo(a)anthracene	ND	108		579		1050		CBSQG (2000a)
Benzo(a)pyrene	ND	150		800		1450		CBSQG (2000a)
Benzo(e)pyrene	---	150	---	800	---	1450	---	Similar as above
Benzo(b)fluoranthene	ND	240		6820		13400		Similar as below
Benzo(k)fluoranthene	ND	240		6820		13400		Persaud <i>et al.</i> 1993
Benzo(g,h,i)perylene	ND	170		1685		3200		Persaud <i>et al.</i> 1993
Chrysene	ND	166		728		1290		CBSQG (2000a)
Dibenz(a,h)anthracene	ND	33		84		135		CBSQG (2000a)
Fluoranthene	ND	423		1327		2230		CBSQG (2000a)
Indeno(1,2,3-cd)pyrene	ND	200		1700		3200		CBSQG (2000a)
Pyrene	ND	195		858		1520		CBSQG (2000a)
Total PAHs								
Total PAHs	ND	1610		12205		22800		CBSQG (2000a)
Sed Cr 3 Sec 2								
PAH	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Low Molecular Weight PAHs (3 or less benzene rings)								
Acenaphthene	ND	6.7		48		89		CCME (1999)
Acenaphthylene	ND	5.9		67		128		CCME (1999)
Anthracene	ND	57.2		451		845		CBSQG (2000a)
Fluorene	ND	77.4		307		536		CBSQG (2000a)
Naphthalene	ND	176		369		561		CBSQG (2000a)
2-methylnaphthalene	---	20.2	---	111	---	201	---	CCME (1999)
Phenanthrene	ND	204		687		1170		CBSQG (2000a)
High Molecular Weight PAHs (4 or more benzene rings)								
Benzo(a)anthracene	ND	108		579		1050		CBSQG (2000a)
Benzo(a)pyrene	ND	150		800		1450		CBSQG (2000a)
Benzo(e)pyrene	---	150	---	800	---	1450	---	Similar as above
Benzo(b)fluoranthene	ND	240		6820		13400		Similar as below
Benzo(k)fluoranthene	ND	240		6820		13400		Persaud <i>et al.</i> 1993
Benzo(g,h,i)perylene	ND	170		1685		3200		Persaud <i>et al.</i> 1993
Chrysene	ND	166		728		1290		CBSQG (2000a)
Dibenz(a,h)anthracene	ND	33		84		135		CBSQG (2000a)
Fluoranthene	ND	423		1327		2230		CBSQG (2000a)
Indeno(1,2,3-cd)pyrene	ND	200		1700		3200		CBSQG (2000a)
Pyrene	ND	195		858		1520		CBSQG (2000a)
Total PAHs								
Total PAHs	ND	1610		12205		22800		CBSQG (2000a)
Sed Cr 4 Sec 1								
PAH	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Low Molecular Weight PAHs (3 or less benzene rings)								
Acenaphthene	ND	6.7		48		89		CCME (1999)
Acenaphthylene	ND	5.9		67		128		CCME (1999)
Anthracene	ND	57.2		451		845		CBSQG (2000a)

Fluorene	ND	77.4		307		536		CBSQG (2000a)
Naphthalene	ND	176		369		561		CBSQG (2000a)
2-methylnapthalene	---	20.2	---	111	---	201	---	CCME (1999)
Phenanthrene	ND	204		687		1170		CBSQG (2000a)
High Molecular Weight PAHs (4 or more benzene rings)								
Benzo(a)anthracene	ND	108		579		1050		CBSQG (2000a)
Benzo(a)pyrene	ND	150		800		1450		CBSQG (2000a)
Benzo(e)pyrene	---	150	---	800	---	1450	---	Similar as above
Benzo(b)fluoranthene	ND	240		6820		13400		Similar as below
Benzo(k)fluoranthene	ND	240		6820		13400		Persaud <i>et al.</i> 1993
Benzo(g,h,i)perylene	ND	170		1685		3200		Persaud <i>et al.</i> 1993
Chrysene	ND	166		728		1290		CBSQG (2000a)
Dibenz(a,h)anthracene	ND	33		84		135		CBSQG (2000a)
Fluoranthene	ND	423		1327		2230		CBSQG (2000a)
Indeno(1,2,3-cd)pyrene	ND	200		1700		3200		CBSQG (2000a)
Pyrene	ND	195		858		1520		CBSQG (2000a)
Total PAHs								
Total PAHs	ND	1610		12205		22800		CBSQG (2000a)
Sed Cr 4 Sec 2								
PAH	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Low Molecular Weight PAHs (3 or less benzene rings)								
Acenaphthene	ND	6.7		48		89		CCME (1999)
Acenaphthylene	ND	5.9		67		128		CCME (1999)
Anthracene	ND	57.2		451		845		CBSQG (2000a)
Fluorene	ND	77.4		307		536		CBSQG (2000a)
Naphthalene	ND	176		369		561		CBSQG (2000a)
2-methylnapthalene	---	20.2	---	111	---	201	---	CCME (1999)
Phenanthrene	ND	204		687		1170		CBSQG (2000a)
High Molecular Weight PAHs (4 or more benzene rings)								
Benzo(a)anthracene	ND	108		579		1050		CBSQG (2000a)
Benzo(a)pyrene	ND	150		800		1450		CBSQG (2000a)
Benzo(e)pyrene	---	150	---	800	---	1450	---	Similar as above
Benzo(b)fluoranthene	ND	240		6820		13400		Similar as below
Benzo(k)fluoranthene	ND	240		6820		13400		Persaud <i>et al.</i> 1993
Benzo(g,h,i)perylene	ND	170		1685		3200		Persaud <i>et al.</i> 1993
Chrysene	ND	166		728		1290		CBSQG (2000a)
Dibenz(a,h)anthracene	ND	33		84		135		CBSQG (2000a)
Fluoranthene	ND	423		1327		2230		CBSQG (2000a)
Indeno(1,2,3-cd)pyrene	ND	200		1700		3200		CBSQG (2000a)
Pyrene	ND	195		858		1520		CBSQG (2000a)
Total PAHs								
Total PAHs	ND	1610		12205		22800		CBSQG (2000a)
Sed Cr 8 Sec 1								
PAH	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Low Molecular Weight PAHs (3 or less benzene rings)								
Acenaphthene	ND	6.7		48		89		CCME (1999)
Acenaphthylene	ND	5.9		67		128		CCME (1999)
Anthracene	ND	57.2		451		845		CBSQG (2000a)
Fluorene	ND	77.4		307		536		CBSQG (2000a)
Naphthalene	ND	176		369		561		CBSQG (2000a)
2-methylnapthalene	---	20.2	---	111	---	201	---	CCME (1999)
Phenanthrene	ND	204		687		1170		CBSQG (2000a)
High Molecular Weight PAHs (4 or more benzene rings)								
Benzo(a)anthracene	ND	108		579		1050		CBSQG (2000a)
Benzo(a)pyrene	ND	150		800		1450		CBSQG (2000a)
Benzo(e)pyrene	---	150	---	800	---	1450	---	Similar as above
Benzo(b)fluoranthene	ND	240		6820		13400		Similar as below

Benzo(k)fluoranthene	ND	240		6820		13400		Persaud <i>et al.</i> 1993
Benzo(g,h,i)perylene	ND	170		1685		3200		Persaud <i>et al.</i> 1993
Chrysene	ND	166		728		1290		CBSQG (2000a)
Dibenz(a,h)anthracene	ND	33		84		135		CBSQG (2000a)
Fluoranthene	ND	423		1327		2230		CBSQG (2000a)
Indeno(1,2,3-cd)pyrene	ND	200		1700		3200		CBSQG (2000a)
Pyrene	ND	195		858		1520		CBSQG (2000a)

Total PAHs

Total PAHs	ND	1610		12205		22800		CBSQG (2000a)
------------	----	------	--	-------	--	-------	--	---------------

Sed Cr 8 Sec 2

PAH	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations

Low Molecular Weight PAHs (3 or less benzene rings)

Acenaphthene	ND	6.7		48		89		CCME (1999)
Acenaphthylene	ND	5.9		67		128		CCME (1999)
Anthracene	ND	57.2		451		845		CBSQG (2000a)
Fluorene	ND	77.4		307		536		CBSQG (2000a)
Naphthalene	ND	176		369		561		CBSQG (2000a)
2-methylnapthalene	---	20.2	---	111	---	201	---	CCME (1999)
Phenanthrene	0.0162	204		687		1170		CBSQG (2000a)

High Molecular Weight PAHs (4 or more benzene rings)

Benzo(a)anthracene	ND	108		579		1050		CBSQG (2000a)
Benzo(a)pyrene	0.0189	150		800		1450		CBSQG (2000a)
Benzo(e)pyrene	---	150	---	800	---	1450	---	Similar as above
Benzo(b)fluoranthene	0.0242	240		6820		13400		Similar as below
Benzo(k)fluoranthene	ND	240		6820		13400		Persaud <i>et al.</i> 1993
Benzo(g,h,i)perylene	ND	170		1685		3200		Persaud <i>et al.</i> 1993
Chrysene	0.0167	166		728		1290		CBSQG (2000a)
Dibenz(a,h)anthracene	ND	33		84		135		CBSQG (2000a)
Fluoranthene	0.0314	423		1327		2230		CBSQG (2000a)
Indeno(1,2,3-cd)pyrene	ND	200		1700		3200		CBSQG (2000a)
Pyrene	0.0288	195		858		1520		CBSQG (2000a)

Total PAHs

Total PAHs	0.1362	1610		12205		22800		CBSQG (2000a)
------------	--------	------	--	-------	--	-------	--	---------------

Sed Cr 11 Sec 1

PAH	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations

Low Molecular Weight PAHs (3 or less benzene rings)

Acenaphthene	ND	6.7		48		89		CCME (1999)
Acenaphthylene	ND	5.9		67		128		CCME (1999)
Anthracene	ND	57.2		451		845		CBSQG (2000a)
Fluorene	ND	77.4		307		536		CBSQG (2000a)
Naphthalene	ND	176		369		561		CBSQG (2000a)
2-methylnapthalene	---	20.2	---	111	---	201	---	CCME (1999)
Phenanthrene	ND	204		687		1170		CBSQG (2000a)

High Molecular Weight PAHs (4 or more benzene rings)

Benzo(a)anthracene	ND	108		579		1050		CBSQG (2000a)
Benzo(a)pyrene	ND	150		800		1450		CBSQG (2000a)
Benzo(e)pyrene	---	150	---	800	---	1450	---	Similar as above
Benzo(b)fluoranthene	ND	240		6820		13400		Similar as below
Benzo(k)fluoranthene	ND	240		6820		13400		Persaud <i>et al.</i> 1993
Benzo(g,h,i)perylene	ND	170		1685		3200		Persaud <i>et al.</i> 1993
Chrysene	ND	166		728		1290		CBSQG (2000a)
Dibenz(a,h)anthracene	ND	33		84		135		CBSQG (2000a)
Fluoranthene	ND	423		1327		2230		CBSQG (2000a)
Indeno(1,2,3-cd)pyrene	ND	200		1700		3200		CBSQG (2000a)
Pyrene	ND	195		858		1520		CBSQG (2000a)

Total PAHs

Total PAHs	ND	1610		12205		22800		CBSQG (2000a)
------------	----	------	--	-------	--	-------	--	---------------

Sed Cr 11 Sec 2

PAH	mg/kg dry wt.							
	Level 1 Concern		Level 2 Concern		Level 3 Concern		Level 4 Concern	
	<= TEC	TEC	> TEC <= MEC	MEC	> MEC <= PEC	PEC	> PEC	Source of SQG Effect-Based Concentrations
Low Molecular Weight PAHs (3 or less benzene rings)								
Acenaphthene	ND	6.7		48		89		CCME (1999)
Acenaphthylene	ND	5.9		67		128		CCME (1999)
Anthracene	ND	57.2		451		845		CBSQG (2000a)
Fluorene	ND	77.4		307		536		CBSQG (2000a)
Naphthalene	ND	176		369		561		CBSQG (2000a)
2-methylnaphthalene	---	20.2	---	111	---	201	---	CCME (1999)
Phenanthrene	ND	204		687		1170		CBSQG (2000a)
High Molecular Weight PAHs (4 or more benzene rings)								
Benzo(a)anthracene	ND	108		579		1050		CBSQG (2000a)
Benzo(a)pyrene	ND	150		800		1450		CBSQG (2000a)
Benzo(e)pyrene	---	150	---	800	---	1450	---	Similar as above
Benzo(b)fluoranthene	ND	240		6820		13400		Similar as below
Benzo(k)fluoranthene	ND	240		6820		13400		Persaud <i>et al.</i> 1993
Benzo(g,h,i)perylene	ND	170		1685		3200		Persaud et al. 1993
Chrysene	ND	166		728		1290		CBSQG (2000a)
Dibenz(a,h)anthracene	ND	33		84		135		CBSQG (2000a)
Fluoranthene	ND	423		1327		2230		CBSQG (2000a)
Indeno(1,2,3-cd)pyrene	ND	200		1700		3200		CBSQG (2000a)
Pyrene	ND	195		858		1520		CBSQG (2000a)
Total PAHs								
Total PAHs	ND	1610		12205		22800		CBSQG (2000a)

Attachment 9

Parameter	Units	Sediment Core # and Section #							
		Sed Cr 3 Sec 1	Sed Cr 3 Sec 2	Sed Cr 4 Sec 1	Sed Cr 4 Sec 2	Sed Cr 8 Sec 1	Sed Cr 8 Sec 2	Sed Cr 11 Sec 1	Sed Cr 11 Sec 2
Total Organic Carbon	mg/kg	60,000	4,930	28,800	12,800	35,800	25,900	19,400.0	9,300
Total Organic Carbon	mg/kg	23,100	5,700	70,200	12,700	27,500	20,600	17,100.0	42,000
Mean Total Organic Carbon	mg/kg	41,500	5,310	49,500	12,700	31,700.0	23,300	18,300.0	25,600
Nitrogen, Ammonia	mg/kg	83.5	4.7	64.1	9.3	52.1	25.2	21.7	19.9
Nitrogen, Kjeldahl, Total	mg/kg	3,990	611	3,480	889	1,580.0	1,620	2,070.0	2,880
Total Nitrogen*	mg/kg	4,074	616	3,544	898	1,632.1	1,645	2,091.7	2,900
Total Phosphorus	mg/kg	1,050	183	1,200	203	302.0	214	664.0	495
Percent Moisture	%	68.3	25.4	66.7	31.1	54.1	38.4	51.3	40.5
RPD% (%)	%	88.8	14.5	83.7	0.1	26.2	22.7	12.5	128
Sieve #10 (%)	%	100.0	95.1	100.0	95.6	97.0	99.9	100.0	99.2
Sieve #100 (%)	%	76.1	14.8	93.3	31.8	43.0	34.4	66.0	72.1
Sieve #140 (%)	%	72.5	12.0	88.1	21.2	40.0	25.7	42.0	64.0
Sieve #20 (%)	%	99.3	89.1	99.5	91.6	96.0	98.7	99.0	97.3
Sieve #200 (%)	%	69.8	10.5	81.5	17.2	37.0	23.0	35.0	58.9
Sieve #4 (%)	%	100.0	97.6	100.0	97.4	97.0	100.0	100.0	99.9
Sieve #40 (%)	%	97.2	65.3	98.4	76.3	90.0	94.7	95.0	90.1
Sieve #60 (%)	%	91.0	32.0	96.7	56.2	69.0	77.0	87.0	81.8
Sieve 0.375" (%)	%	100.0	99.5	100.0	98.3	100.0	100.0	100.0	100.0
Sieve 0.75" (%)	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Sieve 1.0" (%)	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Sieve 1.5" (%)	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Sieve 2.0" (%)	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Sieve 3.0" (%)	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Hydrometer 1 Passing	%	54.7	6.8	57.4	14.0	26.0	17.9	25.0	44.1
Hydrometer 2 Passing	%	40.7	5.9	46.2	12.0	20.0	14.5	21.0	39.4
Hydrometer 3 Passing	%	29.3	4.9	33.7	9.0	17.0	13.3	15.0	32.4
Hydrometer 4 Passing	%	17.9	3.9	21.3	7.0	11.0	7.7	8.0	23.0
Hydrometer 5 Passing	%	14.1	3.0	17.5	6.0	7.0	5.4	5.0	18.4
Hydrometer 6 Passing	%	9.0	3.0	13.8	5.1	3.0	4.2	4.0	14.9
Hydrometer 7 Passing	%	6.0	1.7	8.4	1.7	1.0	2.0	2.0	10.2
Hydrometer 8 Passing	%	3.5	0.7	4.6	1.7	1.0	2.0	2.0	5.5

* calculated by summing ammonia and TKN

Attachment 4

CORRESPONDENCE/MEMORANDUM State of Wisconsin

DATE: April 9, 2025 FILE REF: Lake Mallalieu Dredging Project
TO: Dendy Lofton, Stantec
FROM: Kurt Rasmussen, WDNR
SUBJECT: Lake Mallalieu Sediment Sampling

Thank you for submitting the Lake Mallalieu Dredging Feasibility Study to the Wisconsin Department of Natural Resources (WDNR) for review on March 11, 2025. The report includes the results from eight lab analyzed sediment samples that were collected from four sediment cores. The lab results from the sediment samples were compared to the WDNR Consensus Based Sediment Quality Guidelines (CBSQG). Most of the lab results were reported as No Detect or less than the Threshold Effect Concentration (TEC). Two samples, Sed Cr 3 Sec 1 and Sed Cr 4 Sec 1, had Manganese concentrations that exceeded the TEC but were less than the Midpoint Effect Concentration (MEC).

Sed Cr 3 Sec 1 – 516 mg/kg Manganese

Sed Cr 4 Sec 1 – 667 mg/kg Manganese

According to the CBSQGs, the presence of Manganese between TEC and MEC is a Level 2 Concern and likely negatively impacting the benthic macroinvertebrate species found in these areas of Lake Mallalieu. Manganese is also naturally occurring and found in virtually all soils¹. Surface soil samples analyzed from this region of Wisconsin have been found to have elevated background manganese concentrations². Based on this information, it is possible that the elevated Manganese values are due to natural background concentrations.

The quality of the sediments summarized in the Feasibility Study will not impede management activities like dredging or a drawdown from occurring on Lake Mallalieu. No additional sampling is required at this time.

¹Agency for Toxic Substances and Disease Registry – 'Manganese' <http://www.atsdr.cdc.gov/toxprofiles/tp151-c6.pdf>

² Stensvold, Krista A., 2011, Distribution and Variation of Arsenic in Wisconsin Surface Soils, with Data on Other Trace Elements, USGS Scientific Investigations Report 2011-5202, <https://pubs.er.usgs.gov/sir/2011/5202/>

Attachment 5

Attachment 5: Lake Mallalieu Drawdown Natural Resource Impacts

Aquatic Vegetation

Invasive aquatic vegetation is abundant in Lake Mallalieu and drawdowns have been used in the past to control invasive vegetation. Previous drawdowns have appeared to successfully control Eurasian water milfoil by freezing root structures. Drawdowns across Wisconsin have seen reductions in Eurasian watermilfoil and increases in native vegetation diversity. While the drawdown may also directly affect native vegetation, the outcome of controlling invasive vegetation will provide a positive benefit which has been seen with previous drawdowns.

Wetlands

Most types of wetlands are adapted to fluctuating water levels which generally occur seasonally but can vary from year to year. Some wetland plant species require bare soil to germinate, while others may require consolidated soils to root. Drawdowns contribute to both these conditions and are often an element of wetland management. The reservoir drawdown will simulate natural water fluctuations that are currently uncommon due to the operation of the dam. Significant wetland impacts are not anticipated as a result of the drawdown in Lake Mallalieu.

Fish

Fish are very mobile and will naturally move to deeper water as the water levels decrease. At an estimated drawdown rate of five inches per day fish will easily be able to move into deeper water. Previous drawdowns have not significantly affected fish communities. Some fish species may experience a benefit in improved spawning substrate by exposing more coarse sediments. Significant impacts to fish populations are not anticipated with this drawdown.

Turtles and Amphibians

The timing of the drawdown is planned for September, before amphibians and turtles will be burrowing into the mud for overwintering. This timing should minimize effects on turtles and amphibians, significant impacts are not anticipated.

Mussels

Dams have contributed to the reduction in mussel abundance and diversity across the country. Dams affect mussel populations through habitat fragmentation, conversion of lotic habitat to lentic habitat, altered flow regimes, altered physicochemical parameters, increased siltation, and alteration of host fish assemblages. The current state of any mussel populations in Lake Mallalieu are unknown. The accumulation of fine sediment in the upper reaches of Lake Mallalieu has likely created unsuitable habitat for many species of mussels. Many mussel species also prefer depths around 5 feet or deeper. The drawdown may affect some mussels within the lake, if present, but these effects are not expected to be significant and have not been an issue for previous drawdowns. The effects of mussels downstream of the dam are expected to be minimal to non-existent due to the small contribution of flow the Willow River has on the St. Croix River. In addition, as shown in the Sediment Transport Modeling Report (Attachment 2), we expect an increase in the concentration of suspended sediments, but significant deposition is not anticipated as most of the suspended sediments are silts and clays; the sand fractions are expected to drop out in the lower pool of Lake Mallalieu. Therefore, impacts to the mussel community in the St. Croix River downstream of the Hudson Lower Power Dam are not anticipated.

Other Wildlife

Migratory waterfowl will not be nesting during the drawdown timeframe, and most will be migrating south to warmer weather for the winter. The absence of most waterfowl will limit impacts. Effects to other wildlife will be minimal to non-existent as animals will move to and from the water as needed. Significant wildlife impacts are not anticipated.

Sensitive Habitat Areas

A 2006 Wisconsin DNR report¹ identified five sensitive areas within Lake Mallalieu to help protect critical habitats and natural features that support water quality, wildlife, and aesthetic value. The dam breaches that occurred at the Little Falls Dam between 2015-2019 led to significant sediment accumulation in the upper reaches of Lake Mallalieu and alteration of habitat, which was documented in the approved 2022 Lake Mallalieu Management Plan which recommended detailed surveys to update the quality of those sensitive areas and designation². On September 13, 2023, Wisconsin DNR conducted a site visit but did not collect any field measurements. Upon visual observations, WDNR identified the Willow River delta area in the middle of the lake as sandy, shallow, and providing little functional habitat, but advised against dredging in stream channels upstream of the lake (Attachment 5a). Stantec's field surveys to update bathymetry and quantify the soft sediment depth accumulation provided field measurements and geospatial documentation of the sediment accumulation (refer to Attachment 3) in the region designated as sensitive habitat. The drawdown will help transport sediment out of the delta channel, removing soft sediment, and enhancing habitat complexity.

¹ Designation of Sensitive Areas Lake Mallalieu, St. Croix County. March 2006. Prepared by Wisconsin Department of Natural Resources. Eau Claire, WI.

² Lake Mallalieu Lake Management Plan. February 17, 2022. Prepared by Lake Mallalieu Association and Resource Environmental Solutions

Attachment 6



Stantec Consulting Services Inc.
733 Marquette Avenue, Suite 1000
Minneapolis MN 55402-2314

April 30, 2026

Project/File: 227706430

Jeff Lavers (LMA)
Jill Schoen (WDNR)
Crystal Von Holdt (WDNR)

Reference: Potential Phosphorus Loading from Lake Mallalieu Drawdown

This letter is intended to summarize the concerns over phosphorus loading from Lake Mallalieu as a result of a proposed drawdown. In 2025, Stantec Consulting Services Inc. (Stantec) submitted a drawdown application to the Wisconsin Department of Natural Resources (WDNR) on behalf of the Lake Mallalieu Association (LMA) to request a drawdown of the Lower Hudson Power Dam. The purpose of the drawdown is to mobilize sediment that was deposited in the upper reaches of Lake Mallalieu (Lake) by a series of dam breaches upstream on the Willow River Dam from 2015 through 2019.¹ The drawdown was not approved in 2025 in part due to concerns by the City of Hudson related to sediment transport into Lake St. Croix and exacerbation of water quality problems in the North Bay, which is just downstream of the secondary dam on the Lower Hudson Power Dam. Stantec and LMA are resubmitting the drawdown application for a 7.5 ft drawdown on Lake Mallalieu to begin in September 2026. The purpose of this letter is to address concerns presented to WDNR during the public comment period in 2025 and provide some additional clarification on those issues causing concern about the water quality and ecological impacts of the drawdown.

Stantec, LMA and the City of Hudson have met to discuss the results of the sediment transport modeling, which indicated that larger, heavier material like sands will likely drop out of suspension and deposit in lower reaches of Lake Mallalieu. Finer material like silt and clays are anticipated to remain in suspension with flows in the St. Croix River. To demonstrate the impact of the drawdown on sediment concentrations in the St. Croix River, we compared monthly average total suspended solid (TSS) concentrations in the St. Croix under current conditions as reported in Magdalene et al. (2018)² to the predicted monthly TSS concentration in the St. Croix River under a 7.5 ft drawdown scenario. The monthly average TSS concentration in the St. Croix from Taylor's Fall, MN to Prescott, WI ranged from 5-12 mg/L. The predicted monthly average TSS in the St. Croix under current conditions plus the sediment load from the drawdown are not estimated to exceed the observed mean TSS concentrations.

The City expressed concerns that the drawdown could exacerbate water quality issues in the North Bay by allowing more sediment to accumulate in the North Bay during the drawdown. The secondary dam can only take up to 25% of the total flows across the Lower Hudson Power Dam and should not be used during the

¹ Lake Mallalieu Desktop Analysis. Technical Memo. October 11, 2022. Prepared by Stantec for the Lake Mallalieu Association.

² Magdalene, Suzanne, et al. (2018). Report on the State of the Lake Assessing Lake St. Croix in 2018 On the Way to the 2020 TMDL Goals. Science Museum of Minnesota.

Reference: Potential Phosphorus Loading from Lake Mallalieu Drawdown

drawdown to avoid sediment deposition in the North Bay. The City can utilize the operation of the secondary dam to flush the North Bay opportunistically with flows throughout the year as part of an ongoing maintenance regime. Consequently, using the secondary dam to flush the North Bay should be decoupled from the drawdown.

In addition to sediment concerns, members of the public submitted concerns about phosphorus loading to Lake St. Croix as a result of the drawdown on Lake Mallalieu. Stantec appreciates the concerns over phosphorus loading to Lake St. Croix as a result of sediment mobilization from Lake Mallalieu. Developing phosphorus reduction strategies for water quality protection and restoration is a cornerstone of the work that our team executes on a daily basis, so we fully support an assessment of phosphorus loading from the drawdown.

While we agree that some phosphorus will likely be mobilized from Lake Mallalieu sediments during the proposed drawdown, we would like to clarify a significant error in the load calculations previously submitted to the Wisconsin Department of Natural Resources. Correcting this error substantially lowers the estimated total phosphorus (TP) load associated with the drawdown and indicates that the resulting load would remain well within the existing range of TP inputs to Lake Mallalieu from the upstream Willow River watershed. Table 1 compares the original calculations submitted by the Wild River Conservancy (left panel) with the corrected calculations (right panel). Both analyses rely on TP concentration data and estimated sediment erosion rates presented in Stantec's Sediment Transport Model report³, which was included in the 2025 drawdown application package submitted to the Wisconsin Department of Natural Resources. As shown in Table 1, the original calculations applied an inappropriate sediment bulk density conversion factor derived from a 1993 handbook addressing radioactive soil transport modeling. That factor is not representative of regional lacustrine sediments. In the corrected analysis, we instead applied a bulk density value reported for sediments in nearby Lake Pepin, which provides a more scientifically defensible regional analog for Lake Mallalieu conditions. Using this regionally appropriate bulk density factor, the estimated TP load associated with a 7.5-foot drawdown beginning in September 2026 and extending through May 2027 is approximately 6,676 to 13,352 pounds. This range is substantially lower than the baseline TP load from the Willow River subwatershed (75,729 pounds per year) and also below the phosphorus load reduction target of 28,016 pounds per year.

Although an estimated 6,676 to 12,352 pounds of total phosphorus (TP) may be mobilized from Lake Mallalieu sediments during the drawdown, several factors indicate that the resulting water quality impacts are likely to be limited. First, this load would not be released as a single pulse; rather, phosphorus transport would occur episodically in response to precipitation-runoff and elevated flow events between September 1, 2026, and May 2027. As a result, the phosphorus mass would be distributed over time rather than concentrated under a single high-impact event. Second, the drawdown would occur during a season characterized by colder water temperatures, reduced daylight, and periods of ice cover, all of which substantially suppress algal productivity relative to peak summer growing conditions. Third, these estimates represent total phosphorus mobilization, which includes both dissolved and particulate fractions. Because particulate phosphorus is not immediately bioavailable for algal uptake, the fraction capable of directly stimulating algal growth during the drawdown period would be lower than the reported total phosphorus

³ Stantec. 2026. Lake Mallalieu Sediment Transport Model. Prepared by Stantec for the Lake Mallalieu Association.

Reference: Potential Phosphorus Loading from Lake Mallalieu Drawdown

mass. Collectively, these factors suggest that the ecological response to phosphorus mobilization during the proposed drawdown would likely be less pronounced than implied by total load estimates alone.

To illustrate the magnitude of phosphorus loading entering Lake Mallalieu from upstream in the Willow River subwatershed compared to the release of phosphorus from the sediments, we developed a simple lake response model that shows the proportion of phosphorus from various sources like a pie chart. The methods and results are described in Stantec (2026)⁴ and are briefly described here for additional context concerning phosphorus loading from Lake Mallalieu sediments. Using the same sediment TP concentrations as were applied in the estimates shown in Table 1, we calculated an internal phosphorus load (i.e., release of phosphorus from lake sediments) of 750 lbs/year from Lake Mallalieu. The external phosphorus load was determined from WDNR's Wisconsin Lake Modeling Suite⁴ (WiLMS), which provides a range of low, medium and high loading estimates (25,500 – 205,201 lbs/yr). We applied the low end of the WiLMS estimated external phosphorus to the model which was 25,500 lbs/yr. When compared to the estimated internal phosphorus load of 750 lbs/yr, we can see that the magnitude of phosphorus release from the sediments is 34 times lower than the estimated phosphorus load entering Lake Mallalieu from the upstream Willow River subwatershed. The phosphorus budget in Figure 1 shows that the internal sediment phosphorus release is less than 3% of the annual total phosphorus budget to Lake Mallalieu. Consequently, the potential phosphorus load from Lake Mallalieu sediments is significantly overshadowed by upstream loads from the Willow River subwatershed.

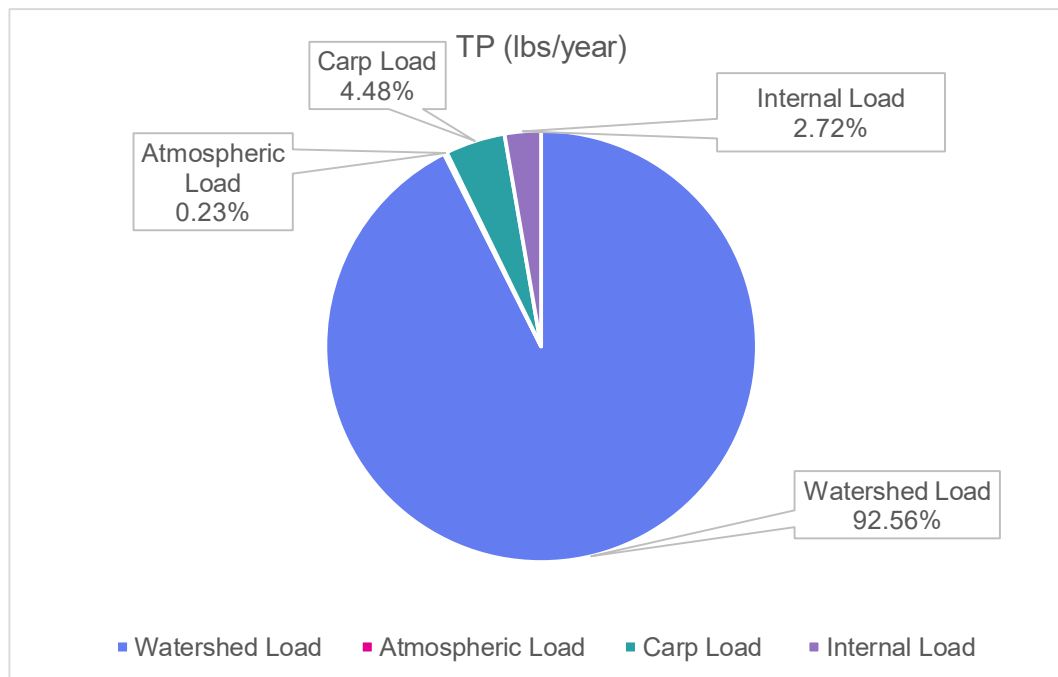


Figure 1. Estimated annual phosphorus budget for Lake Mallalieu.

⁴ Stantec. 2026. Phosphorus Budget for Lake Mallalieu. Prepared by Stantec for the Lake Mallalieu Association.



Error in Public Estimation of Sediment P Load

Yu and others (1993). Data collection handbook to support modeling the impacts of radioactive material in soil. 10.2172/10162250.

7.5' drawdown from September 1 to the beginning of June

Metric	Value
Estimated Dry Weight of Loamy Soil (g/cm ³)	1.36
g/Kg	1,000
cm ³ /m ³	1,000,000
Estimated Dry Weight of Loamy Soil (Kg/m ³)	1,360
Average [P] in L. Mallalieu Sediment Samples (mg/Kg dry weight)	539
mg/lb	453,592
Average [P] in L. Mallalieu Sediment Samples (lbs/Kg dry weight)	0.001188
Estimated Minimum Sediment Erosion Volume (CY)	15,000
Estimated Maximum Sediment Erosion Volume (CY)	30,000
m ³ /yd ³	0.764555
Estimated Minimum Sediment Erosion Volume (m ³)	11,468
Estimated Maximum Sediment Erosion Volume (m ³)	22,937
Estimated Minimum Sediment Erosion Dry Weight (Kg)	15,596,922
Estimated Maximum Sediment Erosion Dry Weight (Kg)	31,193,844
Estimated Minimum P loading to lower L. Mallalieu and L. St. Croix (mg)	8,404,791,343
Estimated Minimum P loading to lower L. Mallalieu and L. St. Croix (tmg)	16,809,582,686
Estimated Minimum P loading to lower L. Mallalieu and L. St. Croix (lbs.)	18,529
Estimated Maximum P loading to lower L. Mallalieu and L. St. Croix (lbs.)	37,059

Willow R. Subwatershed P Baseline Loading (lbs/yr)	75,729
Willow R. Subwatershed P Loading Reduction Goal (lbs/yr)	28,016

St Croix Co Estimate

Engstrom and others 2009. Historical changes in sediment and phosphorus loading to the upper Mississippi River: mass-balance reconstructions from the sediments of Lake Pepin. J. of Paleolimnology 41: 563-588.

7.5' drawdown from September 1 to the beginning of June

Metric	Value
Estimated Dry Weight of Loamy Soil (g/cm ³)	0.49
g/Kg	1,000
cm ³ /m ³	1,000,000
Estimated Dry Weight of Loamy Soil (Kg/m ³)	490
Average [P] in L. Mallalieu Sediment Samples (mg/Kg dry weight)	539
mg/lb	453,592
Average [P] in L. Mallalieu Sediment Samples (lbs/Kg dry weight)	0.001188
Estimated Minimum Sediment Erosion Volume (CY)	15,000
Estimated Maximum Sediment Erosion Volume (CY)	30,000
m ³ /yd ³	0.764555
Estimated Minimum Sediment Erosion Volume (m ³)	11,468
Estimated Maximum Sediment Erosion Volume (m ³)	22,937
Estimated Minimum Sediment Erosion Dry Weight (Kg)	5,619,479
Estimated Maximum Sediment Erosion Dry Weight (Kg)	11,238,959
Estimated Minimum P loading to lower L. Mallalieu and L. St. Croix (mg)	3,028,196,881
Estimated Minimum P loading to lower L. Mallalieu and L. St. Croix (tmg)	6,056,393,762
Estimated Minimum P loading to lower L. Mallalieu and L. St. Croix (lbs.)	6,676
Estimated Maximum P loading to lower L. Mallalieu and L. St. Croix (lbs.)	13,352

Willow R. Subwatershed P Baseline Loading (lbs/yr)	75,729
Willow R. Subwatershed P Loading Reduction Goal (lbs/yr)	28,016

Stantec Corrected Estimate

Please feel free to reach out to me directly with any questions or requests for additional information.

Respectfully,

Stantec Consulting Services Inc.

A handwritten signature in blue ink, appearing to read "Dendy Lofton".

Dendy Lofton PhD, CLM
Senior Associate, Senior Project Manager
Phone: (612) 712-2072
dendy.lofton@stantec.com

stantec.com

Attachment 7

To: Jeff Lavers, President
Lake Mallalieu Association

From: Dendy Lofton, PhD, CLM
Adrianna Gorsky, PhD
Plymouth, MN

Project/File: 227706430

Date: April 29, 2026

Reference: Lake Mallalieu Lake Response Model

Overview

Lake Mallalieu has been listed as impaired by Wisconsin Department of Natural Resources (WDNR) since 2004 due to elevated phosphorus concentrations. Water quality improvements in Lake Mallalieu (Lake) will largely depend on the implementation of phosphorus load reductions activities in the upstream Willow River watershed¹, which has assigned load reductions and allocations determined through the Lake St. Croix Phosphorus TMDL² and Implementation Plan³.

In 2025, Stantec Consulting Services Inc. (Stantec) supported the Lake Mallalieu Association with a drawdown application to the WDNR, with the goal of mobilizing sediments that were deposited to the upper reaches of the Lake due to a series of dam breaches upstream on the Willow River Dam from 2015-2019⁴. included a public comment period. During that period, some members of the public expressed concerns over the potential phosphorus due to sediment mobilization in Lake Mallalieu from a drawdown. Stantec has developed a separate technical memo that addresses an erroneous conversion factor that was applied in the calculations submitted by the public to the WDNR, which overestimated the potential phosphorus load from Lake sediments during the drawdown by approximately threefold⁵. Details of the calculations, assumptions, and implications on water quality can be found in Stantec (2026)⁵. In addition, we developed a lake response model to simulate a phosphorus budget that characterizes the magnitude of phosphorus loading from various sources.

This technical memorandum describes the lake response model and methods, results, and conclusions.

¹ Lake Mallalieu Lake Management Plan. 2022. Prepared for Lake Mallalieu Association by RES.
<https://www.lakemallalieu.org>

² Lake St. Croix Nutrient TMDL. 2012. Prepared by Minnesota Pollution Control Agency and Wisconsin Department of Natural Resources. https://dnr.wisconsin.gov/sites/default/files/topic/TMDLs/LakeStCroix_TMDLFinalReport.pdf

³ Implementation Plan for the Lake St. Croix Nutrient TMDL. 2013.
https://dnr.wisconsin.gov/sites/default/files/topic/TMDLs/LakeStCroix_TMDLImplementationPlan.pdf

⁴ Lake Mallalieu Desktop Analysis. Technical Memo. 2022. Prepared by Stantec for the Lake Mallalieu Association.

⁵ Stantec. 2026. Potential Phosphorus Loading from Lake Mallalieu Drawdown. Technical Memo. Prepared by Stantec for the Lake Mallalieu Association and Wisconsin Department of Natural Resources.

Stantec's approach relied on the following datasets:

- WDNR in-lake water quality data (available through SWIMS data)
- Sediment phosphorus concentrations collected from Lake Mallalieu in 2024
- External load estimates from Wisconsin Lake Modelling Suite (WiLMS)

These datasets were characterized for input into a lake response model, which provides a vetted method for numerical evaluation of sources of phosphorus to the lake. The results of the lake response model demonstrate the relative magnitude of each contributing source to the lake, namely external sources (i.e., runoff), sediment release (internal loading), bioturbation (i.e., carp), and natural deposition (i.e., atmospheric). Below is a detailed explanation of Stantec's development of the lake response model and a discussion of the results.

Morphometric and Water Quality Data

Lake Mallalieu is a 289-acre shallow lake, with a mean depth of 4.8 ft and a maximum depth of 17 ft. Approximately 60% of the lake's surface area is <5 ft deep. It also has a short retention time of 3 to 7 days¹. The Lake does not maintain a stable thermal stratification and thermally mixes multiple times throughout the year (polymictic). Attachment A includes lake profile plots of temperature and dissolved oxygen by depth for all 2024 sampling dates.

Lake morphometry and mixing regimes provide fundamental information about lake dynamics that help guide inferences from in-lake TP concentrations. TP concentrations across time were used to develop assumptions for lake response modelling and to explain mechanistic lake processes that may not be adequately captured by the lake response model. Average surface summer (May-September) TP concentrations from 2006-2025 are visualized in Figure 1. The average surface summer TP concentration from the past 5-years was 60.6 µg/L.

Reference: Lake Mallalieu Lake Response Model

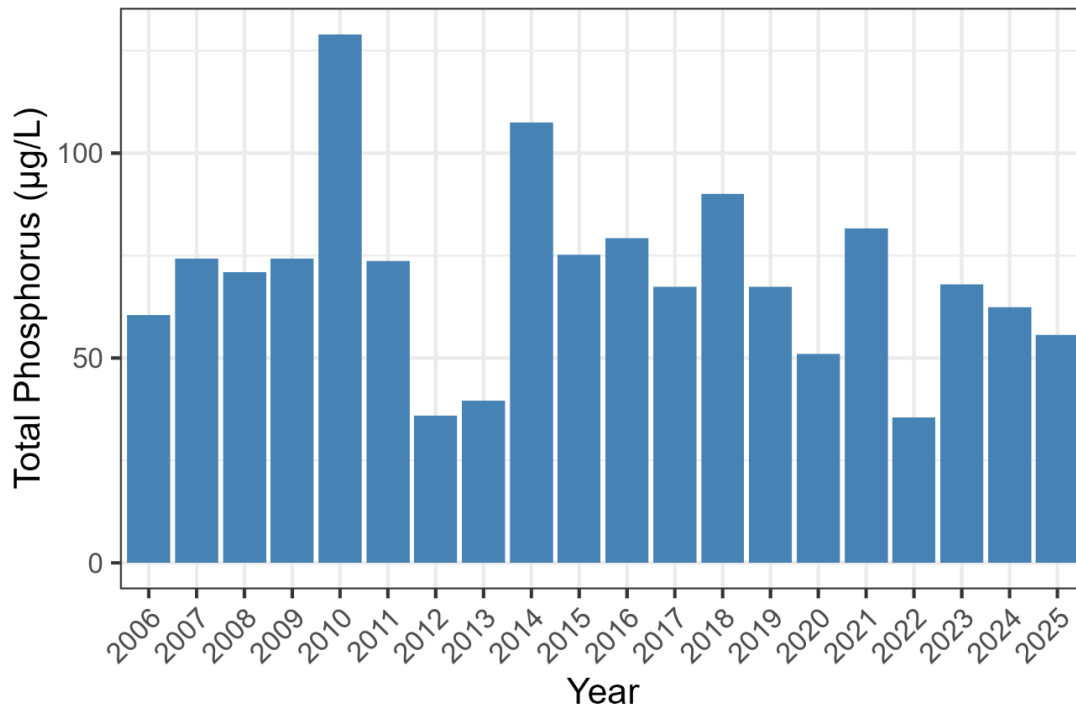


Figure 1. Lake Mallalieu average summer surface (May-Sept) total phosphorus (TP) concentrations, 2006-2025.

Sediment P Release Rates and Anoxic Factor Calculations

We relied on the results from the Lake Mallalieu dredging feasibility study to provide an estimate for sediment surface concentrations of phosphorus that we used in our internal load calculation. Four TP measurements were obtained from sediment cores collected in the upper reaches of the Lake⁶, with concentrations of 1050, 1200, 203, and 664 mg/kg. We used the average of 0.804 mg/g and the regression model developed by Nürnberg 1988⁷ to predict sediment P release rates (RR) (mg P/m²/day). The RR equation is shown below:

$$\log(RR) = 0.80 + 0.76 \log(TP_{\text{sediment}})$$

The modelled anoxic release rate for Lake Mallalieu was 5.35 mg/m²-day.

The spatial extent of anoxia in lakes can be estimated from a robust set of dissolved oxygen profiles at high frequency to evaluate anoxic extent. In the absence of the high frequency dissolved oxygen data, regression equations to estimate the spatial extent of anoxia in thermally stratified and polymictic lakes

⁶ Stantec. 2025. Lake Mallalieu Sediment Chemistry Results as part of the Dredging Feasibility Study. Prepared by Stantec for Wisconsin Department of Natural Resources.

⁷Nürnberg, GK. (1988). Prediction of Phosphorus Release Rates from Total and Reductant-Soluble Phosphorus in Anoxic Lake Sediments. *Can. J. Fish. Aquat. Sci.* 45: 453-362.

have been developed² to facilitate estimation of an “anoxic factor”, which represents the number of days where the anoxic sediment area is equal to the lake surface area. We used the anoxic factor equation for polymictic lakes⁸, which is shown below:

$$AF_{pred} = -36.2 + 50.2 \log(TP_{summer}) + 0.762 z/A_0^{0.5}$$

Where:

- AF_{pred} = predicted anoxic factor
- TP = average summer total phosphorus
- $z/A_0^{0.5}$ = morphometric factor (with z, mean depth in meters and A_0 , lake surface area in km^2)

Other Model Inputs & Assumptions

Phosphorus loads originating from sources external to the lake were estimated for landscape processes (i.e., direct runoff) and atmospheric deposition using a combination of empirically derived values and previously modeled results. Lake Mallalieu has a large contributing watershed (301 sq. miles) that is dominated by agriculture (44% cultivated crops and 23% hay/pasture). This large watershed area to lake surface area ratio (667:1) indicates that the watershed load overwhelmingly influences water quality in the lake relative to other sources of phosphorus (e.g. internal sediment phosphorus loading, or atmospheric deposition).

Initial estimates of external phosphorus loading were based on the range of total nonpoint phosphorus load (lbs/yr) and watershed runoff depth (in/yr) generated using WiLMs. We then adjusted this estimate based on the calibrated fit of our lake response model with the assumption that deposition is occurring in the upper reaches of the watershed and so the delivery ratio is likely smaller than what WiLMS is capturing, even in the low estimate. The atmospheric TP load was estimated using an areal TP loading rate representative of average conditions, as reported by a Minnesota-based assessment of atmospheric deposition⁹. Internal load (lb/yr) was estimated by multiplying the modelled sediment release rate with the number of anoxic days in the hypolimnion (both methods outlined above) relative to the lake surface area.

Common Carp

Carp can exacerbate sediment phosphorus release through their nesting and foraging behaviors. When carp population densities exceed 100 kg/ha they are likely to cause significant impacts to aquatic vegetation in shallow lakes and densities above 200 kg/ha tend to negatively impact water quality¹⁰. Stantec conducted a common carp survey in fall 2024 and estimated the common carp population to be 242.8 kg/ha.

⁸Nürnberg, GK. (2009). Assessing internal phosphorus load- problems to be solved. *Lake and Reservoir Mgmt* 25: 419-432.

⁹Barr Enginerring. (2007). Detailed Assessment of Phosphorus Sources to Minnesota Watersheds. Prepared for the Minnesota Pollution Control Agency, St. Paul. MN.

¹⁰Bajer, P., G. Sullivan, and P.W. Sorenson. (2009). Effects of a rapidly increasing population of common carp on vegetative cover and waterfowl in a recently restored Midwestern shallow lake. *Hydrobiologia*. 632(1): 235-245.

Reference: Lake Mallalieu Lake Response Model

To estimate TP load contribution from carp, we used carp sediment P release rate estimate of 2.18 mg P/m²/day from the Ramsey-Washington Metro Watershed District's Phalen Chain of Lakes Carp Population Study¹¹, which was based on carp populations of 200 kg/ha. Since 60% of the lake has a depth less than 5 ft, we estimated the littoral area, where carp are most likely to inhabit, to be 173 acres.

Each phosphorus source and its corresponding source dataset are summarized in Table 1 below.

Table 1. Summary of dataset sources for phosphorus loading estimates used for lake response model development.

Phosphorus Source	Dataset
Watershed	WiLMS external phosphorus predictions and watershed runoff depth.
Atmospheric	Atmospheric loading rate estimates from Barr (2004) ³ (0.22 lb/acre/yr)
Internal -- Anoxic	(1) Modelled anoxic sediment release rates and (2) derived equation for estimating number of days of anoxia
Carp	Carp sediment P release from RWMWD (2006) ⁵

Lake Response Model Setup

A simple spreadsheet-based lake response model was set up for Lake Mallalieu to employ the Canfield-Bachmann equation for artificial lakes. The Canfield-Bachmann equation "models" in-lake TP concentrations based on an empirically based regression analysis of lake data for artificial lakes in North America. More details on the Canfield-Bachmann equation can be found in the WiLMS documentation¹². The equation is summarized below:

$$P = \frac{L}{z(.114(L/z)^{0.589} + p)}$$

Each of the model (equation) variables are listed in

Table 1 below. The resulting value, *P*, is used for comparison with the observed in-lake mean concentration. The fit of observed versus simulated concentration is used as a performance benchmark for

¹¹ Ramsey-Washington Metro Watershed District (RWMWD). November 2006. Phalen Chain of Lakes Carp Population Study.

¹²Wisconsin DNR. (2003). Wisconsin Lake Modeling Suite Program Documentation and User's Manual Version 3.3 for Windows.

verifying the accuracy and completeness of model inputs. Values for the primary model inputs, characterized in detail by source, are summarized in **Lake Response Model Results**

The model predicted a surface TP concentration of 60.4 µg/L, similar to the 60.6 µg/L in-lake mean TP surface concentration. Values for the primary model inputs and outputs are shown below in Table 3, with a more detailed summary in Attachment B.

Table 2.

Table 1. Canfield Bachmann equation variables for natural lakes.

Variable Name	Variable Description
<i>P</i>	Predicted mixed layer TP concentration (µg/L)
<i>L</i>	Areal TP load (mg/m ² -yr)
<i>Z</i>	Mean lake depth (m)
<i>p</i>	Flushing rate (yr ⁻¹)

Lake Mallalieu met the conditional model constraints of applying the Canfield-Bachmann equation for artificial lakes, which are as follows:

- $6 < P < 1500 \text{ mg/m}^3$
- $40 < L < 820,000 \text{ mg/m}^2/\text{yr}$
- $0.6 < z < 59 \text{ m}$
- $0.019 < p < 1800/\text{yr}$

Lake Response Model Results

The model predicted a surface TP concentration of 60.4 µg/L, similar to the 60.6 µg/L in-lake mean TP surface concentration. Values for the primary model inputs and outputs are shown below in Table 3, with a more detailed summary in Attachment B.

Table 2. Summary of primary model inputs and outputs.

Category	Parameter	Value	Unit
Watershed Load	Direct TP Load	25,500	lbs/year
Watershed Load	Direct Surface Discharge	138,005	acre-feet/year
Atmospheric Load	Inflow	0.0	acre-feet/year
Atmospheric Load	TP Load	63.6	lbs/year
Carp Load	TP Load	1,235	lbs/year
Internal Load	TP Load	750	lbs/year
Total Load	TP Load	27,548.6	lbs/year
Model Equation	L^*	10,684.4	mg/m ²
Model Equation	p^*	99.43	yr ⁻¹
Model Equation	z^*	1.5	m
Model Equation	P^*	60.4	µg/L
Observed Data	In-lake mean surface TP concentration	60.6	µg/L

Reference: Lake Mallalieu Lake Response Model

We calibrated the external TP load estimate based on the assumption that the large watershed to lake ratio (667:1) would likely lead to lower delivery ratios of P to the lake. Even the lowest range of external TP load from WiLMS (36,592 lbs/year), overestimated in-lake concentrations.

Model results indicate that the overwhelming majority of phosphorus loading to Lake Mallalieu is derived from external watershed sources (Figure 2). Internal phosphorus loading contributed less than 3% of the total estimated phosphorus load, suggesting that internal recycling is currently a minor component of the lake's phosphorus budget.

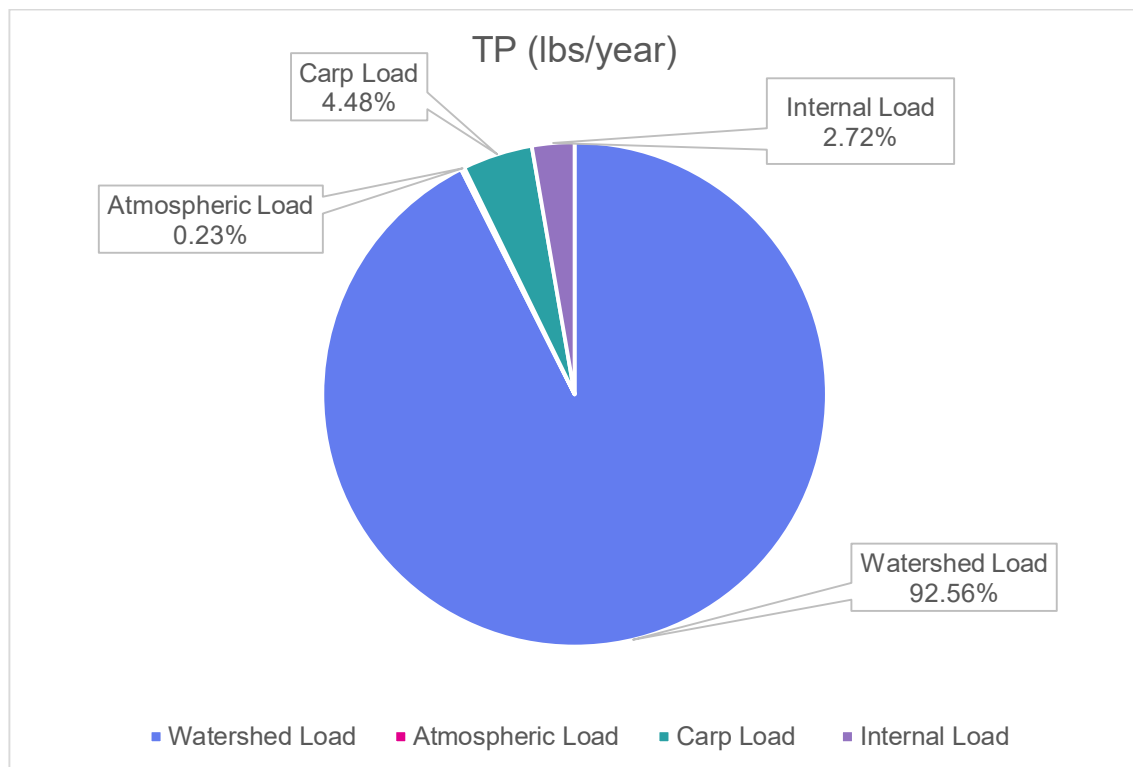


Figure 2. Lake Mallalieu total phosphorus budget with annual percent contribution by source as estimated by lake response model.

While internal loading is often a concern in shallow, eutrophic systems, these results indicate that sediment phosphorus release is not a dominant driver of in-lake concentrations under existing conditions. Currently, phosphorus levels in Lake Mallalieu are completely dependent upon what is delivered from its enormous drainage area, which is 667 times larger than the surface area of Lake Mallalieu. Actions to reduce phosphorus loading from the watershed for compliance with the Lake St. Croix TMDL will also benefit Lake Mallalieu.

Appendix A- Lake Profiles

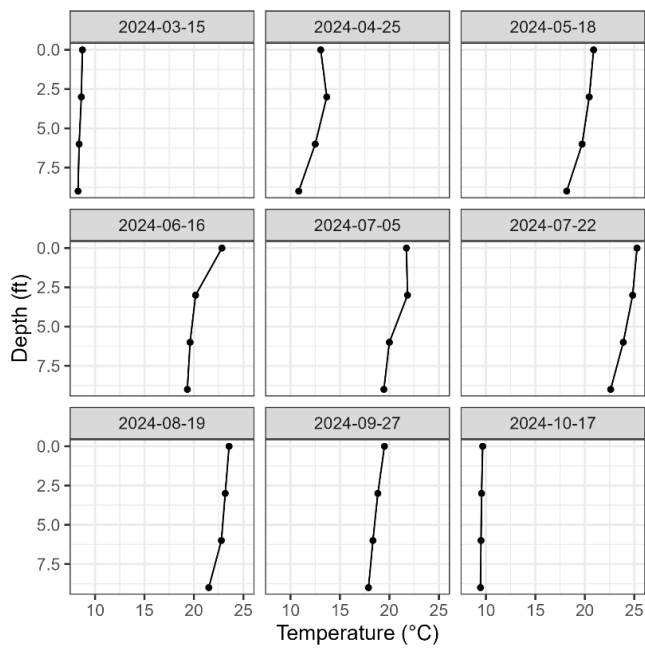


Figure A1. Lake Mallalieu temperature profiles from 2024.

Reference: Lake Mallalieu Lake Response Model

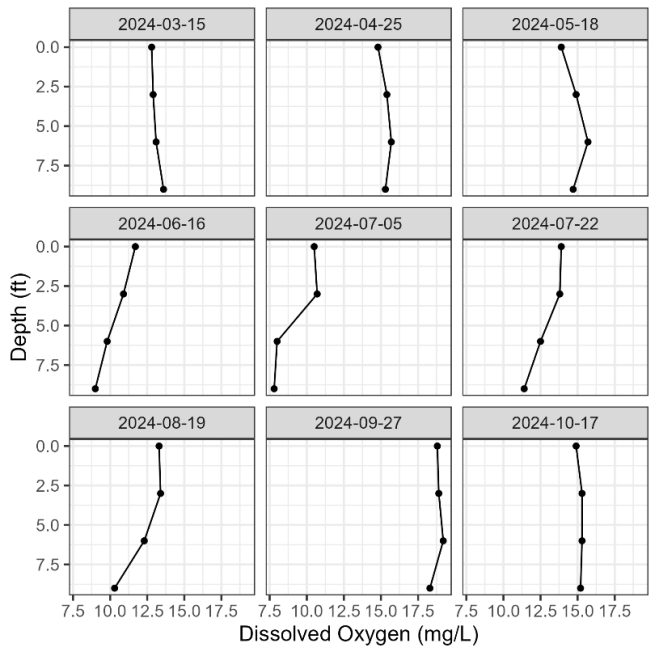


Figure A2. Lake Mallalieu dissolved oxygen profiles from 2024.

Appendix B- Lake Response Model Equation Parameters

Category	Description	Value	Unit
Lake Morphometry	Lake Area	289	acres
Lake Morphometry	Mean Depth	4.8	feet
Lake Morphometry	Max Depth	17	feet
Lake Morphometry	Volume	1,388	acre-feet
Watershed Load	TP (calibrated estimate)	25,500	lbs/year
Watershed Load	TP (WiLMS low estimate)	36,592	lbs/year
Watershed Load	TP (WiLMS likely estimate)	78,807	lbs/year
Watershed Load	TP (WiLMS high estimate)	205,201	lbs/year
Atmospheric Load	TP	63.58	lbs/year
Carp Load	TP	1,235	lbs/year
Internal Load	Anoxic Release Rate (Nurnberg)	5.35	mg/m ² /year
Internal Load	Anoxic Factor (Nurnberg)	54.37	days
Internal Load	TP	750.0	lbs/year

Total Water Load	Total Annual Discharge	138,005.0	acre-ft/year
Total Load	TP	27,548.6	lbs/year
Model Equation	L*	10,684.4	mg/m ² /year
Model Equation	p*	99.43	year ⁻¹
Model Equation	z*	1.5	m
Model Equation	P*	60.4	µg/L
Model Equation	Observed TP Concentration	60.6	µg/L