Burlington (Echo Lake) Dam

Spillway Improvement and Dam Removal Feasibility Study

Prepared for:

City of Burlington
Burlington, Wisconsin

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Dam Removal Feasibility Study

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Executive Summary

Situation

Burlington (Echo Lake) Dam is located on the White River in Burlington, Wisconsin. The dam is located about 1,500 ft upstream of the White River's confluence with the Fox River. As reported by the Wisconsin Department of Natural Resources (WDNR), the dam is primarily used for recreational purposes and creates an upstream storage of approximately 130 acre-ft at normal pool. (One acre-foot is equal to the volume of water created by 1 ft of water covering an area of 1 acre.) Normal pool is maintained just above the overflow spillway crest elevation of 761.93 feet NAVD 88. From north to south, project features include a 120-foot earthen embankment with a minimum crest elevation of 764.42 ft NAVD 88, one 16-foot-wide radial (tainter) gate spillway, and a 246-foot-long uncontrolled ogee-crest spillway. Per WDNR records, the discharge capacity of the dam is 5,516 cfs.

A dam failure analysis (DFA) was completed for Echo Lake Dam in 2015 and later approved by the WDNR. The DFA assigned a hazard rating of "Significant" to the dam. With this hazard rating, per Table I in Wisconsin State Statutes Chapter NR 333.07(1), the dam's spillways must be capable of passing the 500-year flood without overtopping the embankment. (The 500-yr flood is a flood that has a 1-in-500 chance of being exceeded in magnitude during a year.) If meeting this requirement is not possible, Chapter NR 333.07(2)(a) states that "all dams which will be submerged by flows less than the minimum hydraulic capacity specified in Table I shall be designed to pass the flow of the river at submergence."

The 2015 DFA concluded that, as currently configured, Echo Lake Dam does not meet NR 333 spillway capacity requirements. Therefore, the WDNR issued a directive for the City to increase spillway capacity to achieve compliance with NR 333. The current due date to meet this directive is July 8, 2025.

Tasks

Ayres was retained by the City of Burlington to evaluate potential spillway upgrades for Echo Lake Dam to increase its capacity as required by the WDNR's directive. For each spillway upgrade alternative, our evaluations include conceptual drawings, a description of benefits and drawbacks, and an engineer's opinion of probable cost. In addition to spillway modification alternative, we were also tasked with evaluating a dam removal option.

Actions

To complete the feasibility study, we:

1. Developed a 2-dimensional (2-D) hydraulic model of Echo Lake, the existing dam, and the White and Fox rivers downstream.
2. Validated the 2-D hydraulic model by simulating the July 2017 flood-of-record event and simulated various additional hypothetical flood events (e.g., the 10-yr, 100-yr, and 500-yr).
3. Modified the existing dam's geometry within the 2-D hydraulic model to represent alternatives capable of meeting the WDNR's spillway capacity requirements.
4. Coordinated with the WDNR to obtain general buyoff of the conceptual alternatives analyzed. (Note: Whichever alternative the City chooses to implement will be subject to a complete WDNR permit application review process. The WDNR's general buyoff of a conceptual plan does not negate the need for this review process.)

5. Developed concept-level drawings of the three dam modification alternatives, as well as a dam removal scenario. For the dam removal scenario, we also included recreational enhancements for the City's consideration.
6. Compiled and described the pros and cons associated with each of the three modification alternatives and the dam removal scenario.
7. Estimated total project costs—including construction and engineering services (design/permitting, bidding, and construction administration)—for each of the spillway modification alternatives and the dam removal scenario.
8. Provided recommendations to assist the City with determining the next steps and described available funding mechanisms.

Results

During our 2-D hydraulic modeling effort, we concluded that there is no feasible way to increase Echo Lake Dam's spillway capacity such that the 500-yr flood can be passed without overtopping the dam's north embankment and the railroad grade to the south. Instead, through additional hydraulic modeling and coordination with the WDNR, we determined that the dam could be modified to pass a smaller submergence flood, as allowed by NR 333.07(2)(a). To accomplish this, the dam's northern embankment would need to be raised to an elevation of 766 ft NAVD 88 (about 1 to 2 feet higher than existing) using a concrete floodwall and earthen berm combination. In addition, the existing steel tainter gate, operator deck, and the far northern portion of the overflow spillway would be removed and replaced with three new moveable gates—each 16 ft wide and 6 ft high. Finally, the downstream retaining wall and sidewalk on the north river bank immediately below the dam would be removed and rebuilt, as recent dam inspections have indicated ongoing undermining and deterioration of these structures.

For the three proposed 16-ft x 6-ft gates, we analyzed three options. Each of the three options includes the proposed flood wall/earthen berm and reconstructed downstream retaining wall and sidewalk. The options include:

- Option 1: Three 16-ft wide x 6-ft high tainter gates with electrically controlled hoists.
- Option 2: Three 16-ft wide x 6-ft high crest gates with hydraulic controls.
- Option 3: Three 16-ft wide x 6-ft high slide gates with electrically controlled actuators.

For the dam removal option (hereby referred to as Option 4), we included not only a removal of the existing dam structure, but also river bank stabilization, ecological restoration, and various recreational and municipal enhancements. These project add-ons are intended to provide the City with ideas for what is possible at the site should the dam be removed and the estimated costs associated with these possibilities. Should the dam removal be pursued, the City may scale the project scope accordingly, up or down, based on community input, budget, and funding opportunities.

Estimated total project costs for all four alternatives are provided in Table 1. For each alternative, costs include engineering services (design, bidding, and construction administration), construction, permitting, and a 30-percent contingency.

Table 1. Estimated total project costs for alternatives considered

Alternative	Estimated Total Project Cost
Option 1: Three 16-ft x 6-ft tainter gates	$2,439,840
Option 2: Three 16-ft x 6-ft crest gates	$2,646,150
Option 3: Three 16-ft x 6-ft slide gates	$1,548,820
Option 4: Dam removal with enhancements[1]	$6,061,463

1. Cost includes significant rehabilitation measures and recreational enhancements. The total estimated cost of a dam removal with basic rehabilitation is approximately $1.5 - $2.0 million.

Of the three gate options analyzed, Option 3 (slide gates) is the lowest cost alternative and affords relatively minor operation and maintenance requirements. Option 2 (crest gates) is the most expensive alternative but provides the best debris and water level control.

We estimate the cost of a complete dam removal accompanied by basic stream and wetland rehabilitation measures to be approximately $1.5 to $2.0 million. If significant ecological, municipal, and recreational enhancements are included in the project, the dam removal option cost may exceed $6 million.

Basis of Design

To commence this feasibility study, we developed a 2-D hydraulic model of the study area. The model's geometry extends from the White River near the upstream boundary of Echo Lake and the Fox River about 0.7 mi upstream of the confluence with the White River to the Fox River about 1 mi downstream of Echo Lake Dam. We developed the model using HEC-RAS version 6.1.0.

To confirm that our 2-D hydraulic model could produce reasonable results, we first simulated the July 2017 flood-of-record and validated our results by comparing the computed inundated area against surveyed high water marks measured during the event. A comparison of our simulated inundation boundary to the surveyed high water marks is provided in Figure 1. As can be seen, the outer extent of the modeled flood boundary compares well with the surveyed high water mark points.

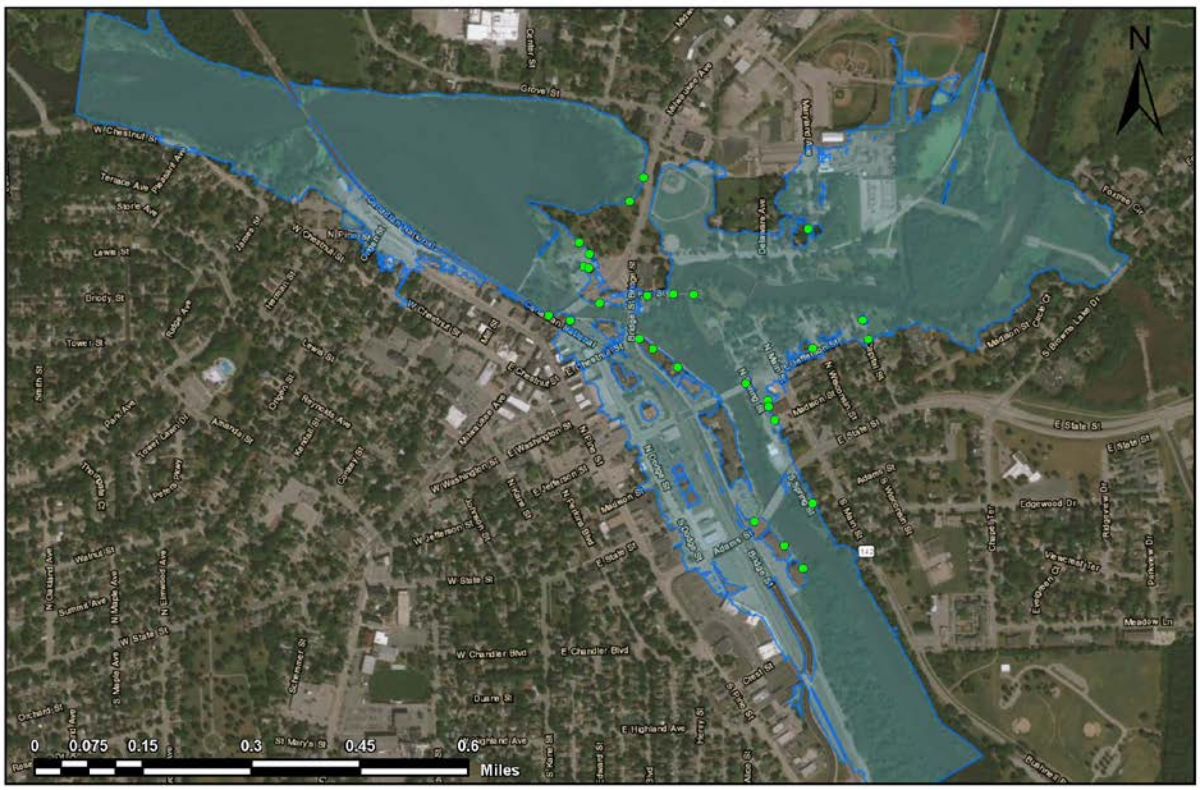

Figure 1. July 2017 flood validation results

After confirming that our 2-D hydraulic model could produce accurate results for a large historical flood event, we simulated 50-, 100-, and 500-yr floods to estimate the flooding that would be expected for large hypothetical flood events with the existing dam in place. (A N-yr flood is a flood with a 1-in-N chance of being exceeded in magnitude during a year.) The 50-, 100-, and 500-yr flow rates used for our analysis were taken from the Racine County Flood Insurance Study (FIS) for the White River and the Upper (Illinois) Fox River Hydrologic Model for the Fox River. Our simulations indicated that the dam's north embankment would overtop by a maximum of 2.5, 1.4, and 1.0 ft during the 500-, 100-, and 50-yr floods, respectively. These simulations confirmed that the existing dam is not capable of passing the 500-yr flood as required by NR 333.07(1).

After simulating the hypothetical floods for the existing condition, we simulated a condition where the entire 246-ft fixed-crest spillway is replaced with a moveable crest spillway such as an inflatable rubber dam or a hinged crest gate. Both gate scenarios can be operated to behave as though no water control structure is in place: For the case of the rubber dam, by completely deflating it, and for the case of the hinged crest gate, by completely lowering it. We chose to simulate an alternative such as this to illustrate the maximum possible spillway capacity achievable with retrofits to Echo Lake Dam. After simulating the 500-yr flood with the 246-ft moveable crest spillway in place (in a completely lowered condition), we determined that the north embankment would still need to be raised by approximately 2 to 2.5 ft to prevent overtopping. The south bank adjacent to the railroad grade would still overtop and bypass the dam under this scenario. From these results, we concluded that there are no feasible dam improvement alternatives that could be implemented to achieve the 500-yr spillway capacity required by NR 333.07(1).

Next, we sought to determine if we could achieve spillway compliance with NR 333.07(2)(a). For this, we needed to determine if the existing dam configuration could feasibly be modified to pass the flood at submergence instead of the 500-yr flood. According to NR 333.03(25), a dam is submerged when the "difference between the water surface elevations upstream and downstream from a dam is one foot or less." Conceptually, a submerged dam can be thought of as a structure that is no longer controlling the flow of water through it.

To determine if modifying the existing dam to pass the flow at submergence was feasible, we needed to achieve the following design goals:

- Pass the submergence flood without overtopping any portion of the dam not designed for overtopping.
- Pass the 100-yr flood without increasing the 100-yr flood profile.
- Prevent water from flowing over the north embankment, which provides access for operation of gates and mitigates against head cutting occurring adjacent to the spillway's north abutment.

By modifying the dam in our 2-D hydraulic model, we were able to meet the three objectives listed above by replacing a portion of the existing overflow spillway with two additional moveable gates, each 16 ft wide and 6 ft high, the approximate dimensions of the dam's existing tainter gate. This would bring the total number of 16-ft x 6-ft gates on the dam to three. Beyond adding these gates, raising the dam's north embankment to an elevation of 766 ft NAVD 88 is required, which represents an increase in the existing grade of about 1 to 2 feet. With this alternative, we determined that a flow of 7,600 cfs submerges the dam, as the computed upstream and downstream water surface elevations for this scenario differed by 0.95 ft, which is less than the WDNR's 1-ft threshold.

With the improvements described above, we then increased the flow until we overtopped the raised north embankment. Doing so, we found that spillway capacity just prior to overtopping the raised left embankment is 8,570 cfs, which is just under the peak flow rate for the 200-yr flood. This represents a significant improvement over the dam's existing spillway capacity of 5,516 cfs. The improvements also allow for safe operator access to the dam during larger flood events than currently possible, as our models show the existing embankment overtops during floods smaller than the 50-yr. Similarly, the proposed improvements mitigate against the risk of erosion occurring as the embankment overtops during smaller flood events.

We presented our models, results, and findings to the WDNR to obtain general buyoff of the design direction in which we were headed. The WDNR confirmed that the conceptual design described above is acceptable, with the caveat that a more detailed analysis and a more thorough review would be required as the dam repair permit application review process. This caveat was expected given that we are currently only in the planning phase of the project. Therefore, we moved forward with analyzing construction alternatives containing the following elements:

- Three new moveable 16-ft wide x 6-ft high gates to replace the dam's existing tainter gate and the northern portion of the dam's existing fixed-crest overflow spillway. Replacing the existing tainter gate is necessary because it is significantly deteriorated, leaks, and cannot currently be raised out of the water to the extent needed to pass the submergence flood.
- An increased north embankment overtopping elevation of 766 ft NAVD 88.
- A new concrete retaining wall and sidewalk on the north riverbank downstream of the dam, as these structures are currently undermining and deteriorating.

Complete documentation of our hydraulic analyses and findings can be found in our *Echo Lake Dam Spillway Upgrade Feasibility Study: Design Criteria Determination*, dated October 7, 2021. This document is included here as Appendix A.

Option 1: Three 16-ft x 6-ft Tainter Gates

For our first option, we investigated the feasibility of accomplishing the needed modification using three 16-ft wide x 6-ft high tainter gates. Echo Lake Dam's existing moveable gate is a tainter gate, so studying the feasibility of continuing to use tainter gates to control flows through the dam was a logical choice. A photo of the dam's existing tainter gate is provided in Figure 2. In Figure 3, we provide a photo of Bloomer Mill Dam, an Ayres-designed structure in Bloomer, Wisconsin that includes three tainter gates with electrical hoist systems. A drawing of a typical tainter gate configuration is provided in Figure 4.

Figure 2. Echo Lake Dam's existing tainter gate viewed from downstream operator bridge

Figure 3. Bloomer Mill Dam viewed from downstream. Three tainter gates with electrical hoists shown on the left side of the photograph.

The tainter gate configuration shown in Figure 3 is conceptually similar to what could be implemented at Echo Lake Dam. Tainter gates pass flow through a bottom draw, so as the gates are hoisted to an increasing distance above the sill, flow through the gates also increases. Echo Lake Dam's existing tainter gate is raised through a hand-operated crank, which rotates a shaft and winds a wire rope around a spool attached to the shaft. As the crank is turned, the wire rope is wound around the spool and lifts the tainter gate into the air. The gate is lowered by reversing the direction of cranking. Gates are raised and lowered at Bloomer Mill Dam in a similar manner, but cranking is accomplished using an electrically controlled gearbox (with a hand-operated backup). For the replacement gates at Echo Lake Dam, we recommend an electrically controlled hoist system, as well, because opening the three gates by hand, while feasible, is likely to be too slow of a process to rely upon during an emergency. As a backup, the gates would still be designed to be operable by hand in case electrical power is lost. Tainter gates can be held in variable open positions between fully open and fully closed.

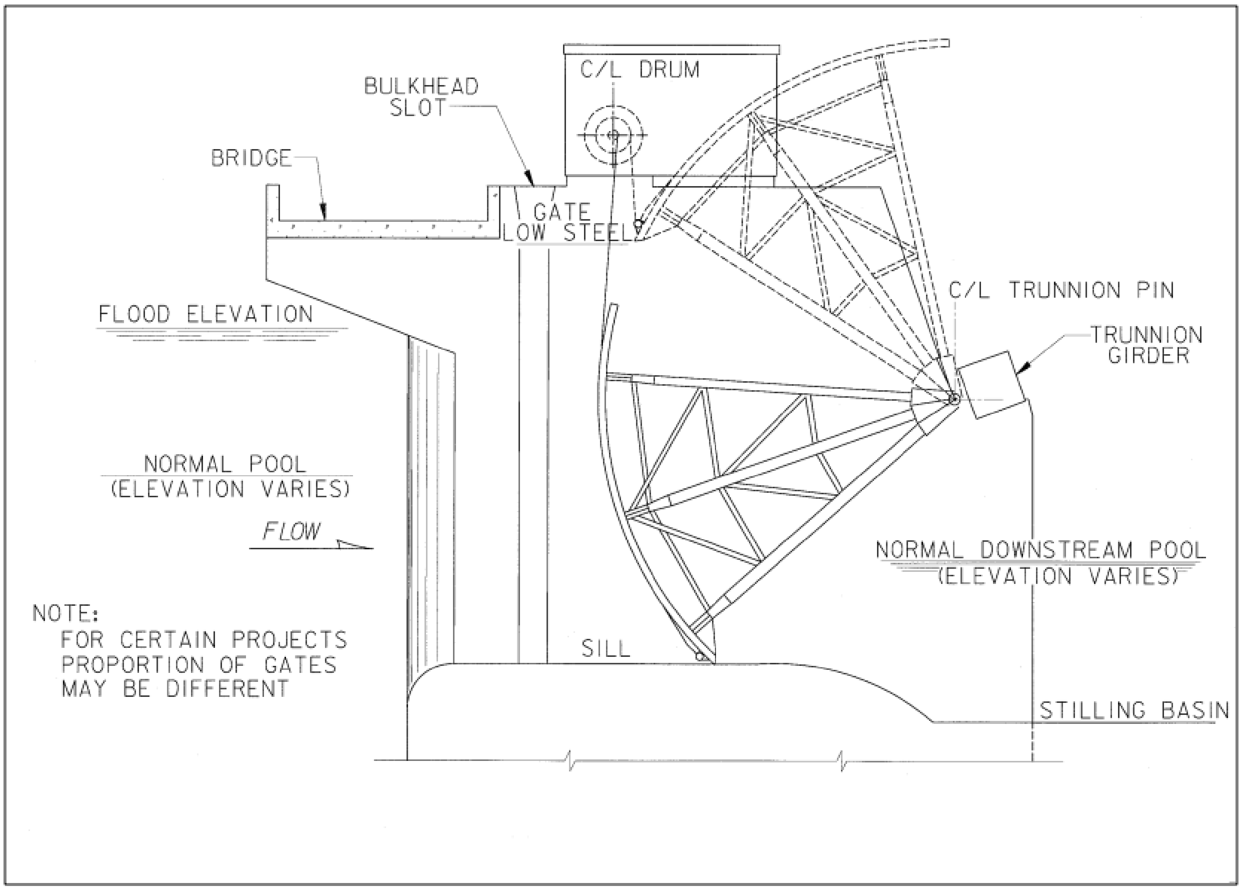

Figure 4. Typical tainter gate configuration (Source: US Army Corps of Engineers Engineer Manual (EM) 1110-2-2702, Design of Spillway Tainter Gates, January 1, 2000)

Advantages of tainter gates include:

- Hydraulic efficiency. The curved surface and bottom draw capabilities of a tainter gate take advantage of the available hydraulic head to maximize release efficiency with respect to gate opening distance.

- The bottom-draw capability of a tainter gate may assist with flushing sediment through the lake and dam.
- The radial shape transfers hydrostatic loadings through the trunnion, requiring a lower hoist capacity than is often required for other similarly sized gate types.
- Comparatively fast opening and closing times.

Disadvantages of tainter gates include:

- Longer piers and foundations, in the direction of flow, are needed to accommodate the location of the gate's trunnion. This requires a larger supporting structure and more concrete than that which is needed by other gate types.
- The gate's frame may impede the flow of water. This is especially true at Echo Lake Dam, where there are high tailwater conditions and gates need to be completely lifted out of the water to pass the submergence flow.
- The bottom-draw characteristics of a tainter gate can make them more susceptible to collecting debris upstream.
- Ice formation during cold weather may make these gates difficult to open. Heated side seals and sills are sometimes employed if a dam requires winter operation. Upstream water circulation or aerators can also be installed during winter months.

Conceptual drawings for the tainter gate option at Echo Lake Dam are provided in Appendix B. As can be seen in the drawings, the downstream retaining wall and sidewalk and the floodwall/berm to the north of the dam are also included. Access would be accomplished using a steel walkway mounted on top of the piers that separate the gate bays.

For Echo Lake Dam, we estimate the cost to construct a new gated spillway with three electrically-controlled 16-ft x 6-ft tainter gates to be approximately $2.4 million. This cost includes the new downstream retaining wall and sidewalk and the embankment floodwall and berm that are also required for this option. Engineering services (design, bidding, and construction administration), as well as a 30-percent contingency in construction costs are also included in that total estimate. A breakdown of this construction cost is provided in Table 2, and a more complete itemization of costs is included in Appendix C.

Table 2. Total Project Cost Estimate for Tainter Gate Option

Item	Estimated Cost
Construction (Material, Labor, Equipment, Overhead, and Profit)	$1,632,000
Contingency (30%)	$489,600
Total Construction Cost	$2,121,600
Engineering Services (Estimated at 15% of Total Construction Cost)	$318,240
Total Project Cost	$2,439,840

Option 2: Three 16-ft x 6-ft Crest Gates

For our second option, we investigated the feasibility of accomplishing the needed modification using three 16-ft wide x 6-ft high crest gates. Unlike tainter gates, which pass flow through a bottom opening, crest gates pass flow over the top. In Figure 5, we show a crest gate installed at Bridge Street Dam in Grafton, Wisconsin. The crest gate shown was added to the dam as part of an Ayres-led design project and was built adjacent to an existing overflow spillway, like would be the case at Echo Lake Dam. The Bridge Street Dam crest gate is of comparable size to each of the three crest gates needed at Echo Lake Dam.

Crest gates open by rotating downward toward that gate's sill, and they close by rotating upward away from the gate's sill. Crest gates can be held in variable open positions between fully open and fully closed, providing excellent water level control. At Echo Lake Dam, each of the three crest gates would be operated using hydraulic controls, as is also the case in Grafton. As can be seen in Figure 5, a hydraulic cylinder is mounted on the spillway's land-side abutment. This hydraulic cylinder controls the opening and closing of the gate. An electrically-powered hydraulic pump is protected in a nearby locked enclosure, as identified in Figure 6. The dam is operated using the controls that are inside this enclosure.

Figure 5. Crest gate at Bridge Street Dam in Grafton, Wisconsin viewed from downstream

Advantages of crest gates include the following:

- Intuitive and variable water level control. For example, if the operator desires to lower the upstream pool level by one inch, lowering the gate crest by one inch will likely come close to accomplishing this task. Relationships between gate opening and upstream water level are more complicated with bottom opening gates.
- Crest gates generally pass ice and floating debris better than bottom-opening gates.
- Crest gates open (rotate downward) by releasing the hydraulic pressure in the cylinder, thus allowing upstream water pressure to push the gate down. During emergencies, this is advantageous

because the gate can be quickly opened even without access to electrical power. If crest gates need to be closed (raised) during a time when electrical power is not available, the hydraulics are operable using a backup handpump.

Disadvantages of crest gates include the following:

- Crest gates are generally more expensive than other gate types.
- Top-draw releases through a crest gate may not provide the sediment-flushing capabilities of bottom-draw gates.
- Ice may form and accumulate at the downstream base of the crest gate, which may prevent the gate from fully opening during cold-period operations. If the upstream water pressure is not sufficient to break the ice and open the gate, ice buildup is often mitigated against using heated sills and/or side seals, and ice buildup can also be removed mechanically or with steam/hot water.

Figure 6. Crest gate at Bridge Street Dam in Grafton, Wisconsin viewed from opposite bank. Enclosure for hydraulic controls identified with arrow.

Conceptual drawings for the crest gate option at Echo Lake Dam are provided in Appendix B. As can be seen in the drawings, the downstream retaining wall and sidewalk and the floodwall/berm to the north of the dam are also included. Access would be accomplished using a steel walkway mounted on top of the piers that separate the gate bays.

For Echo Lake Dam, we estimate the cost to construct a new gated spillway with three hydraulically-controlled 16-ft x 6-ft crest gates to be approximately $2.6 million. This cost includes the new downstream retaining wall and sidewalk and the embankment floodwall and berm that are also required for this option. Engineering services (design, bidding, and construction administration), as well as a 30-percent contingency in construction costs are also included in that total estimate. A breakdown of this construction cost is provided in Table 3, and a more complete itemization of costs is included in Appendix C.

Table 3. Total Project Cost Estimate for Crest Gate Option

Item	Estimated Cost
Construction (Material, Labor, Equipment, Overhead, and Profit)	$1,770,000
Contingency (30%)	$531,000
Total Construction Cost	$2,301,000
Engineering Services (Estimated at 15% of Total Construction Cost)	$345,150
Total Project Cost	$2,646,150

Option 3: Three 16-ft x 6-ft Slide Gates

For our third option, we investigated the feasibility of accomplishing the needed modification using three 16-ft wide x 6-ft high vertically rising slide gates. Ayres designed a spillway with three vertically rising slide gates at Moose Lake Dam in Hayward, Wisconsin, as shown in Figure 7. The gates shown in the figure are each 12-ft wide and 11.5-ft high, so they are 4 ft narrower and 5.5 ft higher than the gates that would be installed at Echo Lake Dam. Nonetheless, the configuration is generally the same. Slide gates release flow by lifting vertically above the sill, which allows water to pass through underneath. Slide gates can also be sized and designed to allow flow over the top under normal-pool conditions when closed. At Echo Lake Dam, the gates are large enough that we recommend electrically-controlled actuators be used for operation. The actuators are also configured to be operable using a handwheel or battery-powered drill should primary electrical power be lost during an emergency.

Figure 7. Slide gates at Moose Lake Dam in Hayward, Wisconsin

Advantages of slide gates include the following:

- Slides gates have the lowest cost of the options analyzed for this study.
- Slide gates have lower operation and maintenance requirements than the other options analyzed.
- Bottom-draw capabilities may help with flushing sediment from the lake.

Disadvantages of slide gates include the following:

- Significant gear ratios may be required to lift these gates. This may make operation more time consuming than what is required for the other gate options analyzed, particularly if manual opening using a handwheel is required.
- Upstream water level control using a bottom-draw gate is not as straightforward as water level control using an overflow gate.
- Bottom draw gates are more likely to catch debris.

- Ice formation and accumulation may make these gates difficult to open during cold-weather operations. Sizing the gate so that it flows over the top when closed, under normal pool conditions, may help to prevent ice formation. Some dam owners also circulate water upstream of the gates or use aerators to mitigate against ice formation.

Conceptual drawings for the slide gate option at Echo Lake Dam are provided in Appendix B. As can be seen in the drawings, the downstream retaining wall and sidewalk and the floodwall/berm to the north of the dam are also included. Access would be accomplished using a steel walkway mounted on top of the piers that separate the gate bays, as is proposed for the other two gate options analyzed.

For Echo Lake Dam, we estimate the cost to construct a new gated spillway with three electrically-controlled 16-ft x 6-ft slide gates to be approximately $1.5 million. This cost includes the new downstream retaining wall and sidewalk and the embankment floodwall and berm that are also required for this option. Engineering services (design, bidding, and construction administration), as well as a 30-percent contingency in construction costs are also included in that total estimate. A breakdown of this construction cost is provided in Table 4, and a more complete itemization of costs is included in Appendix C.

Table 4. Total Project Cost Estimate for Slide Gate Option

Item	Estimated Cost
Construction (Material, Labor, Equipment, Overhead, and Profit)	$1,036,000
Contingency (30%)	$310,800
Total Construction Cost	$1,346,800
Engineering Services (Estimated at 15% of Total Construction Cost)	$202,020
Total Project Cost	$1,548,820

Option 4: Dam Removal with Enhancements

For Option 4, we investigated the feasibility of removing Echo Lake Dam in lieu of modifying it to meet WDNR's spillway capacity requirements. We developed a conceptual plan for dam removal that includes some ecological, municipal, and recreational enhancements to the site. Major project components, as included in our conceptual plan, include:

- Removal of the entire existing concrete dam structure.
- Streambank stabilization using riprap.
- Wetland space.
- Stormwater retention pond with surrounding berm and pedestrian path.
- Pedestrian bridge over the White River leading to enhanced wetland area.
- Scenic boardwalk through the enhanced wetland area.
- Fishing ponds and docks.
- Boardwalk and kayak launch upstream at Wagner Park.

A drawing illustrating this plan is included in Appendix B. Our removal plan includes extensive enhancements because public commentary during City Council meetings attended by Ayres generally indicated that, if a dam removal is to be pursued, the public is likely not interested in simply turning the formerly impounded area into a large, unkept wetland space. In other words, some level of enhancement is expected. Our plan includes many enhancements to give the City ideas for possibilities and for what various project components can be expected to cost should they be implemented as part of the project. We encourage these components to be thought of as "a la carte" items that can be added or removed from the conceptual plan, as desired.

A summarized cost breakdown for the entire plan, as presented, is provided in Table 5. For this breakdown we have separated the costs associated with basic dam removal and rehabilitation from the costs associated with the enhancements. If dam removal and rehabilitation is pursued without the enhancements, we estimate total costs to be in the range of $1.5 to $2 million. The total estimated cost if removal and rehabilitation are coupled with all the enhancements included in our plan is about $6.1 million. Our estimated costs include engineering services (design, bidding, and construction administration), as well as a 30-percent contingency in construction costs. A detailed cost breakdown, which shows the individual cost of the various enhancements, is provided in Appendix C.

Table 5. Total Project Cost Estimate for Dam Removal Option with Enhancements

Item	Estimated Cost
Construction (Removal and Rehabilitation)	$1,171,500
Construction (Enhancements)	$2,882,990
Contingency (30%)	$1,216,347
Total Construction Cost	$5,270,837
Engineering Services (Estimated at 15% of Total Construction Cost)	$790,626
Total Project Cost	$6,061,463

Following are the steps required in the State of Wisconsin to pursue removal of a dam (from the WDNR *Dam Abandonment and Removal Fact Sheet*):

1. Prepare conceptual drawings, a narrative description of the proposed dam removal project, and contact the WDNR's Regional Water Management Engineer to discuss the project and confirm the requirements for pursuing the dam removal.
2. Prepare detailed drawings and specifications (construction-ready level of detail), prepared and stamped by a professional engineer licensed in the State of Wisconsin, and submit to the WDNR a Chapter 31 permit application to remove the dam. Along with the drawings and specifications, the permit application will require a detailed narrative description of the project, including the:

    - Purpose of the project.
    - Drawdown procedure to be used prior to dismantling the dam.
    - Parts of the dam to be removed.
    - Method by which the dam is to be removed.
    - Disposal site for the dam materials.
    - Stream channel and flowage bed restoration and protection needs.

    To support the permit application, the dam owner will also need to include a:

    - Hydrologic and hydraulic report. For dam removals, these reports usually must include an estimate of the 100-yr flood and a computed profile of the 100-yr flood, both upstream and downstream, without the dam in place.
    - Sediment management plan. This plan that explains existing sediment conditions, how sediment transport will be managed during dam removal, and how the bed will be stabilized after removal. Sediment sampling and testing is usually required prior to a dam removal. For Echo Lake Dam, this has already been accomplished as part of a 2021 pre-dredging study completed by Ayres (see Appendix D).

3. After the dam owner submits the Chapter 31 permit application, the owner must prepare and publish a notice to inform the public of the proposed dam removal. Public hearings are not required,

but state law requires that one must be held if requested in response to the public notice. If there are any objections to the dam removal, state law requires a 120-day waiting period. During this waiting period, the dam owner should be prepared to defend and justify the request for abandonment.

4. After the Chapter 31 permit application has been submitted, public notice and hearing requirements have been met, and the owner has responded to WDNR review comments and requests for more information, a Chapter 31 permit to remove the dam may be issued.

In addition to the WDNR's Chapter 31 permitting requirements described above, the Federal Emergency Management Agency (FEMA) will also have requirements that need to be addressed before removal can take place because Echo Lake Dam is within a Special Flood Hazard Area (SFHA)—specifically Zone AE—which will be inundated by the 100-yr flood. Before removal, therefore, FEMA requires that the owner obtain a permit for floodplain development. As part of the permit application process, the owner will need to apply for a Conditional Letter of Map Revision (CLOMR). After the permit for floodplain development is approved and the CLOMR is issued by FEMA, dam removal can take place (presuming the WDNR's Chapter 31 permit to remove the dam has also been issued). Following construction, the owner will need to apply for FEMA to issue a Letter of Map Revision (LOMR). It is important for the owner to keep these FEMA requirements in mind because they are in addition to the WDNR's Chapter 31 requirements and have their own associated timelines and costs.

Conclusions

If the City decides to keep Echo Lake Dam in place, options 1 through 3 will all meet the WDNR's directive to increase spillway capacity. All three options use gate types that are commonly employed at similar dams, and the raised embankment and reconstructed downstream retaining wall will improve safety and access to the dam.

If cost is the City's primary concern, then Option 3 (slide gates) will likely prove to be the lowest-cost alternative. If ease of operation and superior water level control are the City's primary concern, then Option 2 (crest gates) is likely the best alternative.

In any case, design and construction of the chosen alternative are eligible for partial reimbursement under the WDNR's Municipal Dam Grant program. Grant funding under this program is competitive, and applications for the current cycle are due on March 4, 2022. If awarded, the grant covers:

- 50 percent of the first $1 million of eligible project costs, and
- 25 percent of the next $2 million of eligible project costs.

Based on the grant funding cost share described above, the maximum funding for a project is $1 million. We cannot predict with certainty if Echo Lake Dam is likely to receive funding under this program. However, as a Significant-hazard dam in need of additional spillway capacity, the dam repair project should score well on the application.

Aside from the dam modifications described above, the City is also considering dredging Echo Lake should they elect to keep the dam in place. Ayres completed a pre-dredging study for Echo Lake in June 2021, a copy of which is included as Appendix D of this report. Based on our findings, the current estimated cost to dredge Echo Lake is about $2.5 million. This cost estimate, however, can be scaled up or down should the City decide to dredge more or less than the proposed 115,000 cubic yards described in the study report. The cost of dredging is separate from and additional to the dam repair costs estimated for this feasibility study, and dredging costs would not be eligible for reimbursement under the Municipal Dam Grant program.

If the City decides to remove Echo Lake Dam, the total costs associated with the removal and rehabilitation are estimated to be approximately $1.5 to $2 million (this does not include costs for optional enhancements). Under the WDNR's Municipal Dam Grant program, grant awards for a dam removal project cover 100 percent of the first $1 million of eligible project costs. Extra points are awarded on the Municipal Dam Grant application for dam removal projects, so while we cannot predict with certainty whether the grant would be awarded for removing Echo Lake Dam, we know from experience that dam removal projects score well on the application and are usually grant award recipients. Costs for municipal and recreational enhancements following dam removal are not eligible for reimbursement under the Municipal Dam Grant program. However, various other state and federal funding programs may be available to offset some of the costs of restoring natural habitat and creating recreational space after the dam is removed.

Should the City decide to move forward with a dam removal, we recommend a planning study and outreach program be initiated to solicit input from the community on the overall vision for the project, to determine a budget, and to identify additional sources of funding based on what the community decides.

Study Limitations

The goal of this feasibility study is to provide the City of Burlington with information that can be used to assist with developing a plan to repair or remove Echo Lake Dam. Technical analyses completed for this study were of an appropriate level of detail for the planning phase of a project, but they not of a design level of detail. Therefore, the alternatives presented may be subject to modification and refinement during the design phase. Furthermore, the cost estimates provided here are engineers' opinions of probable total project costs. We based these cost estimates on published construction data, our own experience with similar local projects, and budgetary cost estimates provided to us by a gate fabricator and vendors. Estimates for engineering fees, which include design and permitting, bidding, and construction administration, are generally 15 percent of the total construction costs. We believe our cost estimates to be conservative and appropriate for budgetary planning purposes. But we do not guarantee that actual project costs will fall within the estimates provided here.

Appendix A

Hydraulic Report

Echo Lake Dam Spillway Upgrade Feasibility Study: Design Criteria Determination

City of Burlington

Prepared for:

City of Burlington
Burlington, WI

October 7, 2021

Echo Lake Dam Spillway Upgrade Feasibility Study: Design Criteria Determination

City of Burlington
Burlington, WI

I hereby certify that I am a licensed Professional Engineer in the state of Wisconsin, and this report was prepared by me or under my supervision:

WISCONSIN
ADAM J.
SCHNEIDER
42932-6
SOBIESKI,
WI
PROFESSIONAL ENGINEER

10/7/2021

AYRES

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Ayres Project No. 26-1244.00

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Introduction

Ayres Associates was retained by the City of Burlington to evaluate potential spillway upgrades for Echo Lake (also called Burlington) Dam. The hazard classification for the dam is Significant, as determined from results of a dam failure analysis (DFA) completed in 2015. The same study found that, as currently configured, the dam does not pass the 500-year flood without overtopping the dam's embankment. The Wisconsin Department of Natural Resources (WDNR) requires that dams with a Significant hazard classification must pass the 500-year (0.2 percent-annual-chance) flood without overtopping. As such, upgrades to the spillway and dam to increase capacity are necessary to meet this requirement.

Background

Echo Lake Dam is located on the White River about 1,500 ft upstream of the confluence with the Fox River. As reported by WDNR, the dam is used for recreation purposes and has a storage of 130 acre-ft at normal pool. Normal pool is maintained just above the spillway crest elevation of 761.93 feet NAVD 88. From left to right, project features include a 120-foot-long left earthen embankment with a minimum crest elevation of 764.42 ft NAVD 88, one 16-foot-wide radial gate spillway, and a 246-foot-long uncontrolled ogee-crest spillway. Per WDNR records, the discharge capacity of the dam is 5,516 cfs.

Data Collection

In April 2021, Ayres Associates completed a bathymetric survey of Echo Lake and a topographical survey of key project features. A plan view of the bathymetric survey contours is provided in Appendix A.

2017 LiDAR topographic data were obtained from the Wisconsin Elevation and LiDAR data inventory hosted by the Wisconsin State Cartographer's Office (SCO). We used the LiDAR data to define modeled topography outside of the lake's surveyed extent. The WDNR-approved 2015 HEC-RAS model for the Echo Lake Dam DFA was provided by the City of Burlington, and a 2016 HEC-RAS model for Rochester Dam on the Fox River was obtained from WDNR's Surface Water Data Viewer. Downstream channel bathymetry and bridge geometries were sourced from these two models.

Peak flood-flow frequency values for the White River were obtained from the February 2019 Racine County Flood Insurance Study (FIS). Streamflow data for the Upper Fox River (above the White River confluence) were obtained from the January 2015 report "Upper (Illinois) Fox River Hydrologic Model", which we obtained from the WDNR.

Validation data for the July 2017 flood event were obtained from a survey of high-water points provided by the City of Burlington with flow data estimated based on data from USGS stream gage 05545750, Fox River near New Munster (about 5 miles downstream of Echo Lake Dam).

Hydrology

An independent hydrologic analysis was not completed as part of this hydraulic study. Flows for the White River were sourced directly from the Racine County FIS at location "Echo Lake Dam to Burlington City Limit". The 10-year (10-percent-annual-chance) peak flow for the Upper Fox River was assumed for all modeled events examined in this study. The 10-year flow for the Upper Fox River was determined via a drainage area transfer of the 10-year flow at Rochester Dam given in the January 2015 WDNR report

“Upper (Illinois) Fox River Hydrologic Model”. The drainage area transfer is based on the method described in USGS Open-File Report 80-1214, “Techniques for estimating magnitude and frequency of floods for Wisconsin streams”. Flows used for the flood profiles modeled in this study are summarized in Table 1.

Table 1. Modeled Flows

	Peak Flow (cfs)		
	50-year	100-year	500-year
White River	6,350	7,450	10,450
Upper Fox River[1]	2,230	2,230	2,230

1. Estimated 10-year peak flow used as the Upper Fox River boundary condition for all scenarios analyzed.

Model Development

Geometry

We completed the hydraulic analysis using HEC-RAS version 6.1.0. We utilized the 2D capabilities of HEC-RAS to more accurately model overbank flooding conditions, with the availability of bathymetric data and ground-surface LiDAR allowing for more accurate and detailed results. The latest version of HEC-RAS, version 6.1.0 can model hydraulic structures, including weirs and bridges, within the 2D area.

We generated the terrain surface using three sources:

- Bathymetric survey data for Echo Lake obtained by Ayres Associates in April 2021.
- 2017 Racine County LiDAR (LAS) downloaded from the Wisconsin Elevation and LiDAR data inventory hosted by the Wisconsin SCO. We used the LiDAR data to model overbank topography.
- 2015 DFA model for Echo Lake Dam. We used the geometry from this model to obtain bathymetric and bridge data for the White River and the Lower Fox River.
- 2017 DFA model for Rochester Dam. We used the geometry from this model to obtain bathymetric and bridge data for the Upper Fox River, upstream of the confluence with the White River.

Aerial images from several sources were used to ensure a representative terrain surface. The mesh boundary was extended far enough upstream to a location with high overbank terrain to ensure full coverage of any out-of-bank flow that may affect the site. The project area and model extents are shown in Figure 1.

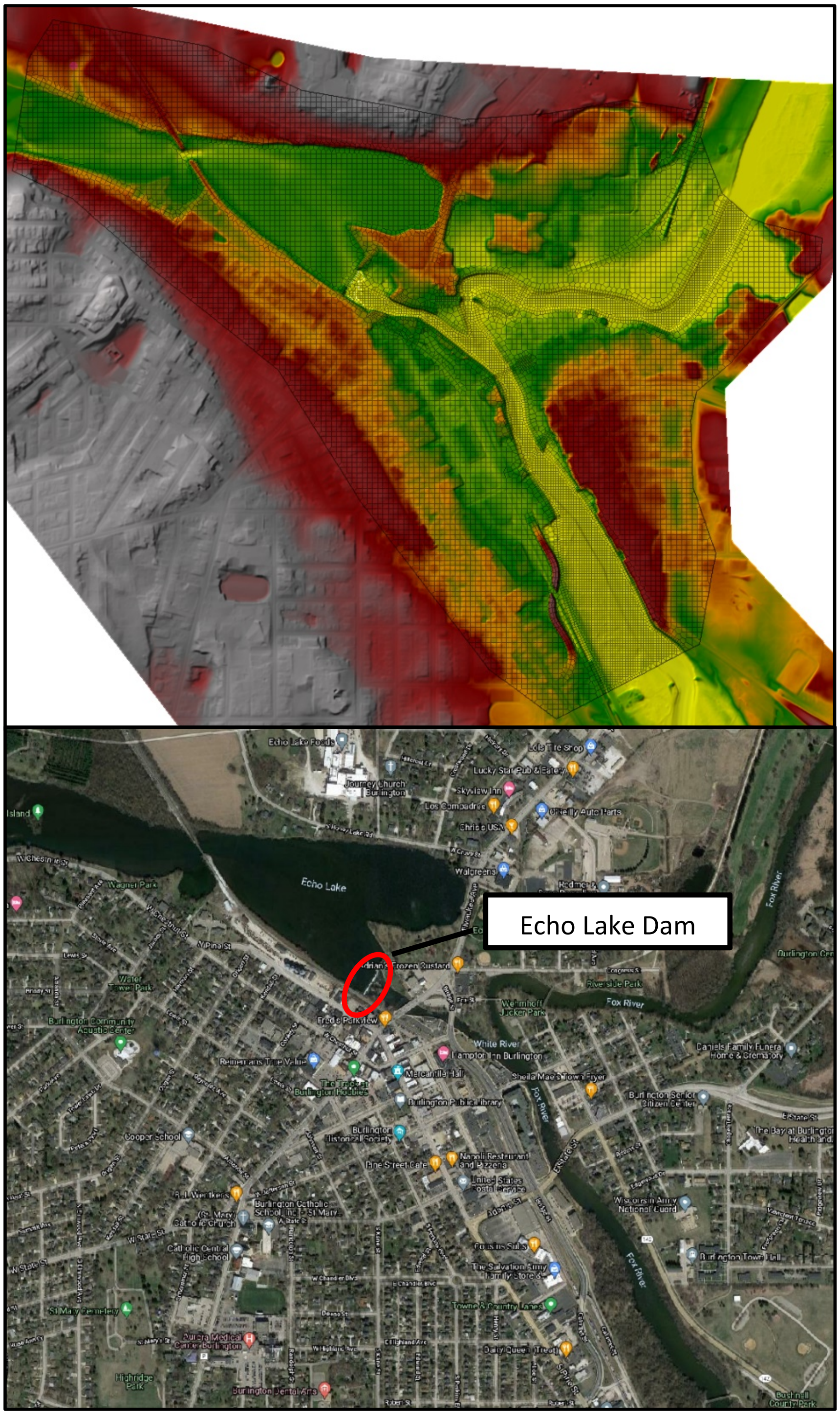


Figure 1. Project area and HEC-RAS model extents

We generated the 2D mesh with attention given to capturing riverbanks, natural high ground, and hydraulic control structures using the placement of internal break lines. The exterior mesh perimeter was set for 50-ft spacing. Refinement regions were used to set 25-ft cell size spacing for the river channel and the area where Milwaukee Avenue passes near Echo Lake. Cell spacing at Echo Lake Dam was set to 20 feet. The final element count for the mesh is 14,361.

Geometry for the Echo Lake Dam spillway and left embankment, plus a total of six bridges were modeled using HEC-RAS internal SA/2D connections. The elevation profile for the left embankment was obtained from LiDAR. Some localized low points in this profile were raised (where applicable) to the embankment low crest elevation (764.42 ft NAVD) determined during the April 2021 survey. Elevations and dimensions for all bridges were obtained from the 2015 Echo Lake and 2017 Rochester Dam DFA models.

Boundary Conditions

Flows for the analysis were based on the Racine County FIS and Upper (Illinois) Fox River Hydrologic Model by WDNR as described previously. We entered the HEC-RAS 2D flow inputs as constant value hydrographs (i.e., steady-flow upstream boundary conditions). This approach, while more conservative than translating peak flows to full inflow hydrographs, provided results more generally applicable for establishing compliance with Wisconsin State regulatory requirements. Furthermore, Echo Lake Dam is generally operated as run-of-the-river, with minimal storage capacity available.

For the downstream boundary condition, we used a normal depth boundary based on the energy grade slope at this location from the 2017 DFA model. Sensitivity runs confirmed that the model was carried far enough downstream to minimize effects of the downstream boundary condition on results in the study area.

Manning's *n* – Surface Roughness

We used the National Land Cover Database of 2016 (NLCD) to assign Manning's *n* values for the modeled 2D area. The Manning's *n* values assigned to each land cover classification, as shown in Table 2, generally follow suggested values prescribed in HEC-RAS. A Manning's *n* polygon was assigned for the river channel to enforce use of the channel value in areas of water as identified using aerial images. The Manning's *n* used for the for the river channel was 0.035, which is the channel value used in the 2015 DFA and is within the range of values used for existing floodplain studies of the White and Fox rivers (according to the Racine County Flood Insurance Study).

Surface roughness for the dam removal analysis geometry was adjusted upstream of the dam to be "Emergent Herbaceous Wetlands."

Table 2. Manning's *n* Values

Land Cover Classification	Manning's *n*
Cultivated Crops	0.05
Deciduous Forest	0.1
Woody Wetlands	0.07
Developed, Low Intensity	0.1
Evergreen Forest	0.15
Mixed Forest	0.12
Open Water	0.035
Developed, Open Space	0.035
Developed, Medium Intensity	0.12
Emergent Herbaceous Wetlands	0.045
Pasture/Hay	0.045
Shrub/Scrub	0.05
Barren Land Rock/Sand/Clay	0.03
Grassland/Herbaceous	0.04
Developed, High Intensity	0.15
River Channel	0.035

Model Validation

The model was checked for reasonableness of results by validating the model using data collected during the historic flood event that occurred in July 2017. The recorded peak flow during this flood event, on July 13, 2017 at UGSS Gage 05545750 Fox River near New Munster (about 5 miles downstream of Echo Lake Dam) is 7,900 cfs. However, there are no operating streamflow gage stations on the White River or Upper Fox River reaches near Echo Lake Dam. We approximated distribution of flows between the White and Upper Fox River reaches by selecting the White River inflow for which the resulting modeled reservoir headwater was approximately the reservoir high water elevation as surveyed during the 2017 flood event. The peak Upper Fox River inflow was then selected to maintain continuity based on the combined flow recorded at the New Munster USGS gage. Complete inflow hydrographs for the event were estimated by scaling down 500-year inflow hydrographs developed using HEC-HMS for the 2015 Echo Lake DFA.

The resulting simulated water surface elevations are generally within half a foot of surveyed high water marks. A comparison of the modeled peak flood inundation area compared to the surveyed high-water marks is provided in Figure 2. The results of this validation show that our model produces a reasonable representation of observed hydraulics in the study area during a large flood event.

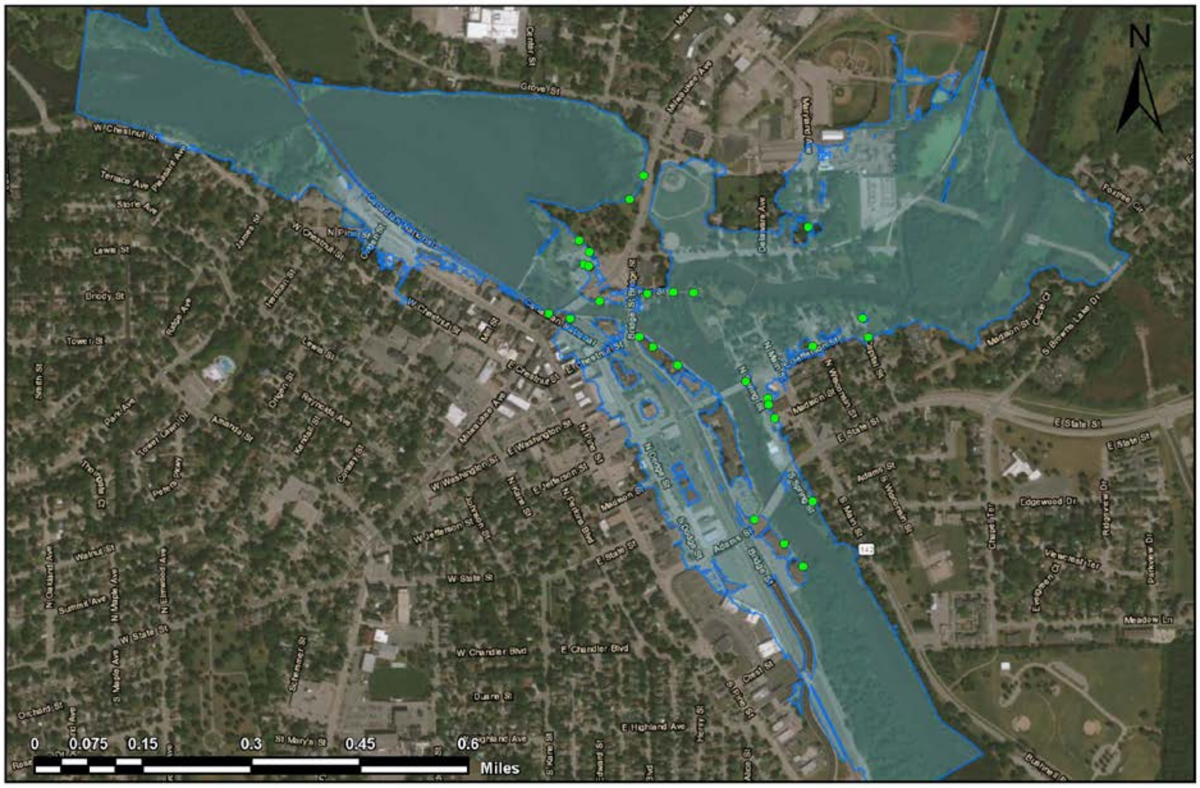


Figure 2. July 2017 Flood Event Modeled Inundation

Alternatives Evaluated

We considered proposed design alternatives based on the following design criteria:

- Pass the 500-year flood or submergence flood without overtopping any portion of the dam not designed for overtopping.
- Pass the 100-year flood without increasing the 100-year flood profile.
- Prevent water from flowing over the left embankment, which provides access for operation of gates and mitigates against head cutting occurring adjacent to the spillway's left abutment during an overflow event.

Based on these criteria, the following alternatives were evaluated:

- Do nothing (existing conditions).
- Dam improvements to increase spillway capacity by raising the left embankment and either:
  - Replacing the 246-foot spillway with an operable lowerable-crest option (e.g., an inflatable rubber dam or a crest gate), or
  - Adding two radial spillway gates.
- Complete dam removal.

As a significant hazard dam, Table I found in NR333.07 (1) specifies that Echo Lake Dam must pass the 500-year (0.2-percent-annual-chance) flood discharge (10,450 cfs according to the Racine County FIS). However, Wisconsin administrative code NR333.07 (2) (a) includes the provision that, if a dam is submerged by flows less than the minimum hydraulic capacity specified in Table I, then the dam is required to pass the river flow at the point of submergence. NR333.03 (25) specifies that a dam is "submerged" when the difference between the water surface elevations upstream and downstream of a dam is one foot or less.

Currently, the dam's estimated spillway capacity just before overtopping the left embankment is less than half of the 500-year flood and also less than the 100-year flood of 7,450 cfs. Therefore, to comply with the requirement that modifications cannot raise the 100-year flood profile, any remedial design that includes raising the left embankment will need to compensate for the portion of the 100-year discharge that would pass over the left embankment crest under current conditions.

Multiple options for dam improvements to pass the design flood were evaluated. As a baseline, these improvements included raising the elevation of the left embankment to prevent overtopping and increasing the spillway capacity to maintain the 100-year floodplain elevation. Adequate spillway capacity per NR333 was then evaluated based on both the 500-year and 1-foot-difference submergence criteria.

The submergence criterium was evaluated by comparing headwater and tailwater elevations results from the HEC-RAS model at the internal SA/2D Connection used to model Echo Lake Dam.

Results

Do Nothing (Existing Conditions)

Results of the existing conditions analysis indicated that the left embankment overtops during all flood events modeled in this study. This result is in line with the DNR published capacity for Echo Lake Dam of 5,516 cfs (less than the 50-year flood of 6,350 cfs). x

Results of the model indicate that the left embankment would overtop by a maximum of 2.5 feet, 1.4 feet, and 1.0 foot during the 500-, 100-, and 50-year floods, respectively. Flood inundation and water surface elevation results are shown Figure 3 through Figure 5.

During the 500-year flood, the headwater above the dam exceeds the elevation of the top of the embankment of the Canadian National rail line adjacent to the right side of the dam, allowing flow around the dam at this location.

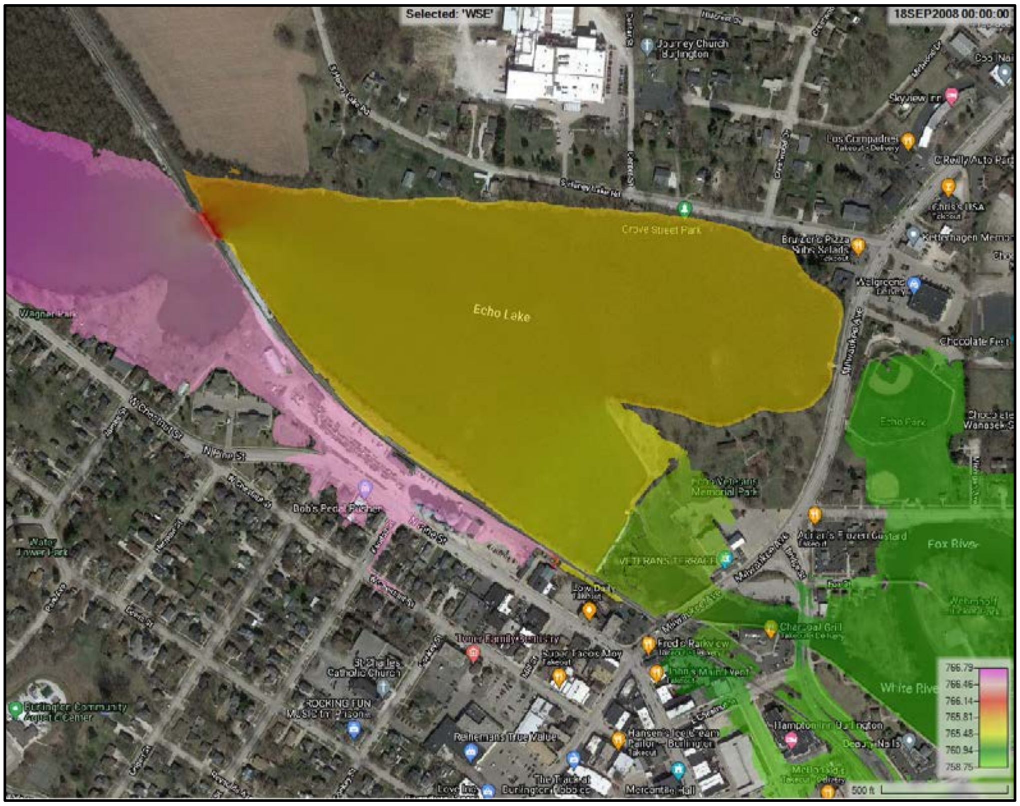


Figure 3. 50-yr Flood Inundation, Existing

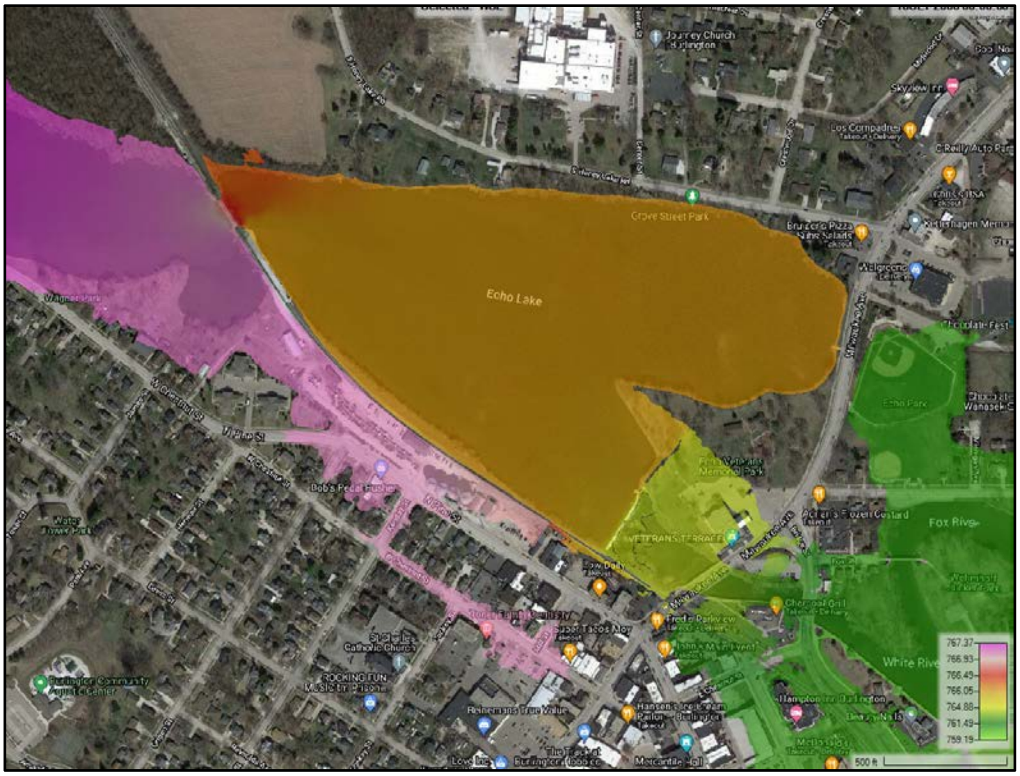


Figure 4. 100-yr Flood Inundation, Existing

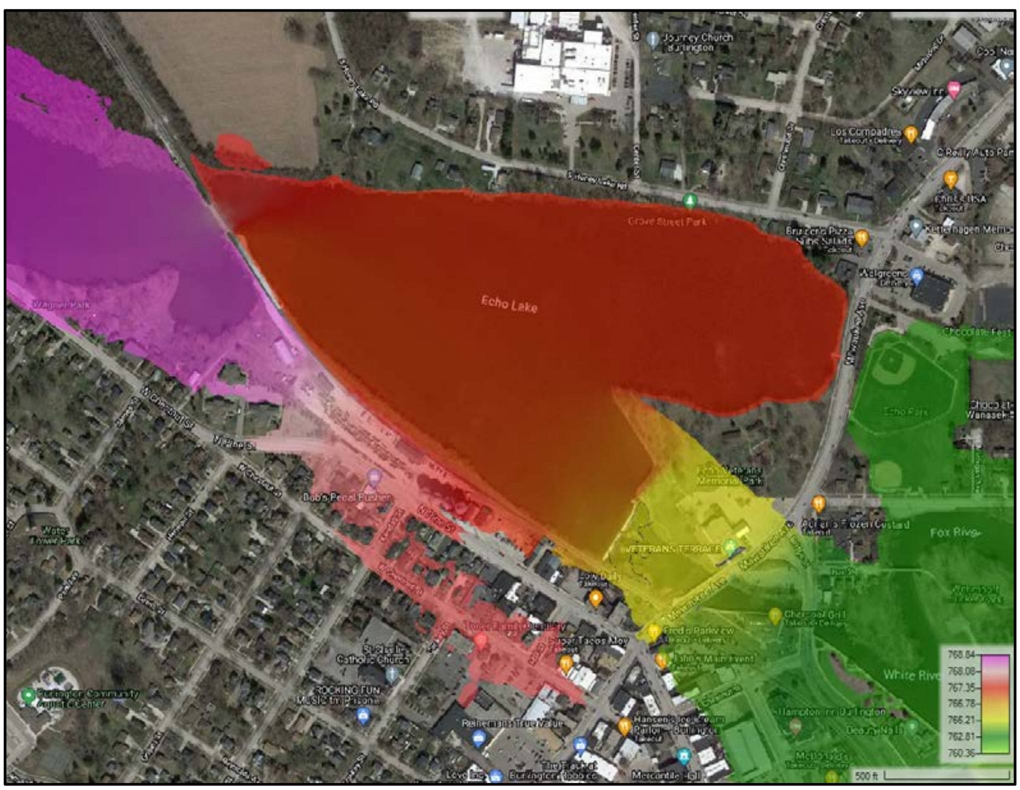


Figure 5. 500-yr Flood Inundation, Existing

Dam Improvements

Moveable Crest Spillway

We evaluated several dam improvements options for compliance with the 500-year flood criteria as described in NR333. None of these options provided sufficient capacity to pass the 500-year flood without flooding around the right (railroad) side of the dam.

To determine the maximum possible spillway capacity achievable with retrofits to Echo Lake Dam, replacement of the entire 246-foot fixed-crest spillway with an adjustable-crest configuration was evaluated. An example of such a structure would be an inflatable rubber dam or a crest gate. The low elevation for the movable crest was set to one foot above the reservoir bottom elevation, as determined during the April 2021 survey. The existing 16-ft tainter gate was left in place to serve as a low-level release structure. For this proposed option, it was necessary to raise the left embankment approximately 2 to 2.5 ft (to elevation 767.2 ft, NAVD88) for a length of approximately 300 ft to prevent overtopping during the 500-year flood.

With the modified spillway described above, results of the model indicated that flooding of the right overbank still occurred during the 500-year flood. Computed inundation for this scenario is shown in Figure 6. From these results, we determined that there are no feasible dam improvement alternatives that could achieve the 500-year spillway capacity required by NR333.

Figure 6. 500-year Flood Inundation, 246' Wide Adjustable-Crest Spillway

Addition of Radial Gates

We examined an additional alternative to replace a portion of the existing fixed crest spillway with two 16-foot-wide radial gates, in addition to raising the elevation of the left embankment to elevation 766.0 ft NAVD 88. This option does not increase capacity sufficiently to pass the 500-year flood but was found to experience submergence, according to NR333, at a flow of 7,600 cfs.

NR333.03(25) specifies that a dam is "submerged" when the difference between the water surface elevations upstream and downstream from a dam is one foot or less. To determine the submergence flow, the calculated headwater and tailwater values at the SA/2D connection used to model the Echo Lake spillway were identified as the upstream and downstream water surface elevations for establishing this submergence criterium. Figure 7 shows the Echo Lake water surface profile at the at the submergence flow at which the difference between the dam headwater and tailwater drops to just below one foot.

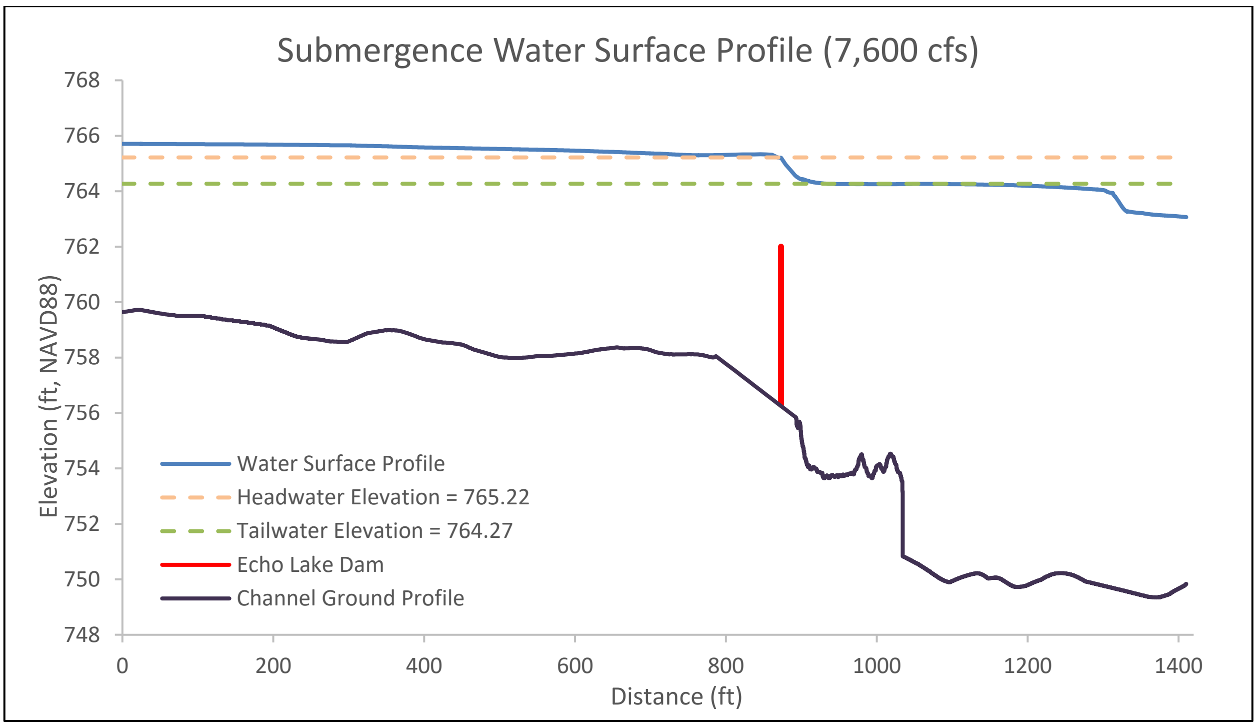


Figure 7. Submergence Water Surface Profile

With the improvements described above, spillway capacity just prior to overtopping of the raised left embankment increases to 8,570 cfs (just under the 200-year flood), and this option also maintains the existing 100-year headwater elevation above the dam. The proposed embankment elevation was selected to allow overtopping during extreme events to prevent or reduce increased incremental flooding while also providing operator access to the spillway during more common flood events. The raised embankment also mitigates against headcutting adjacent to the spillway's left abutment, which may be a potential failure mechanism if the dam overtops during moderate flood events. Of importance to note is that the raised embankment does not serve to decrease flooding downstream of the dam, as flooding below the dam is a result of tailwater conditions, not overtopping.

The water level of Echo Lake is increased slightly during the 500-year flood (less than 0.05 ft) due to submergence affects limiting the dam's capacity at higher flows. Figure 8 through Figure 10 show a comparison of flooding given existing conditions and after implementation of proposed improvements.

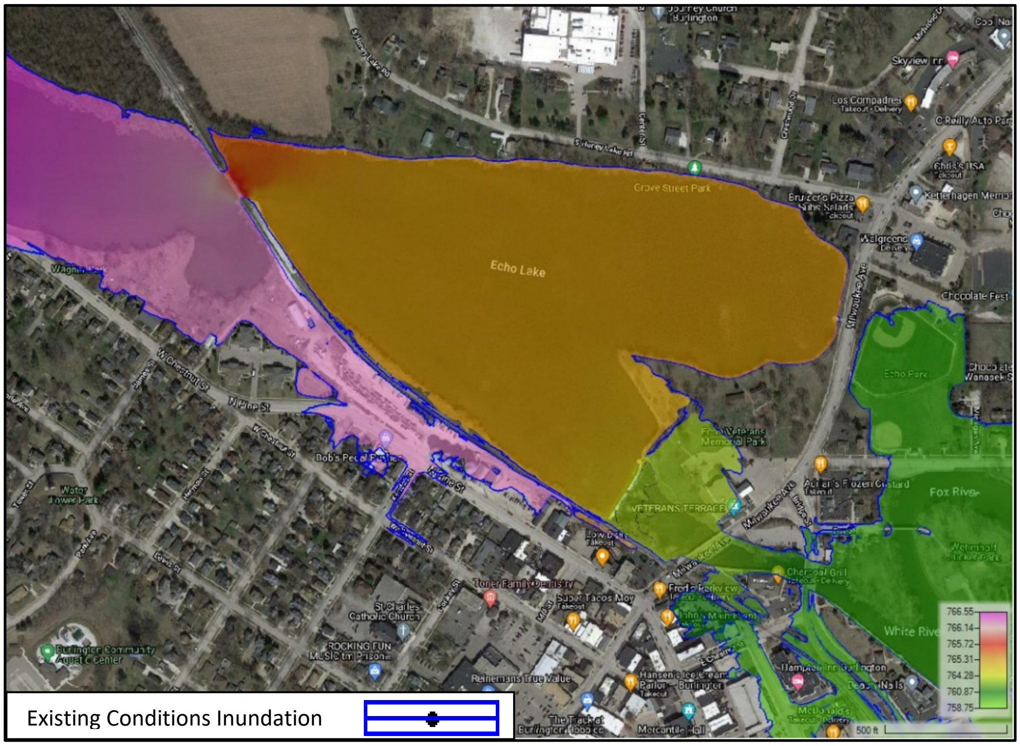


Figure 8. 50-yr Flood Inundation, Add Radial Gates

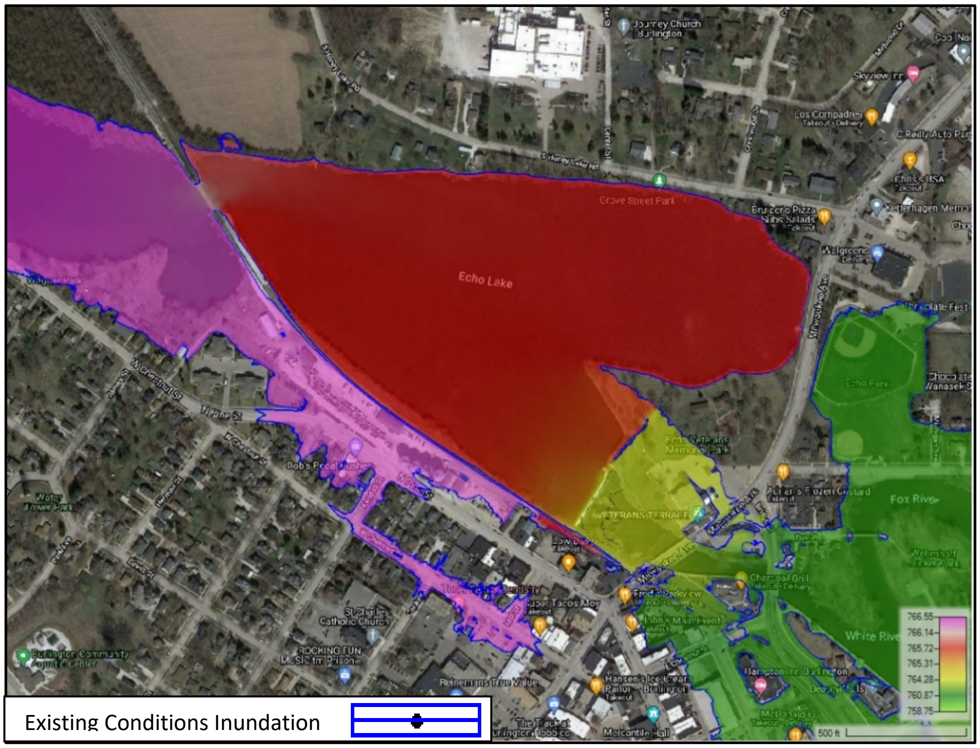


Figure 9. 100-yr Flood Inundation, Add Radial Gates

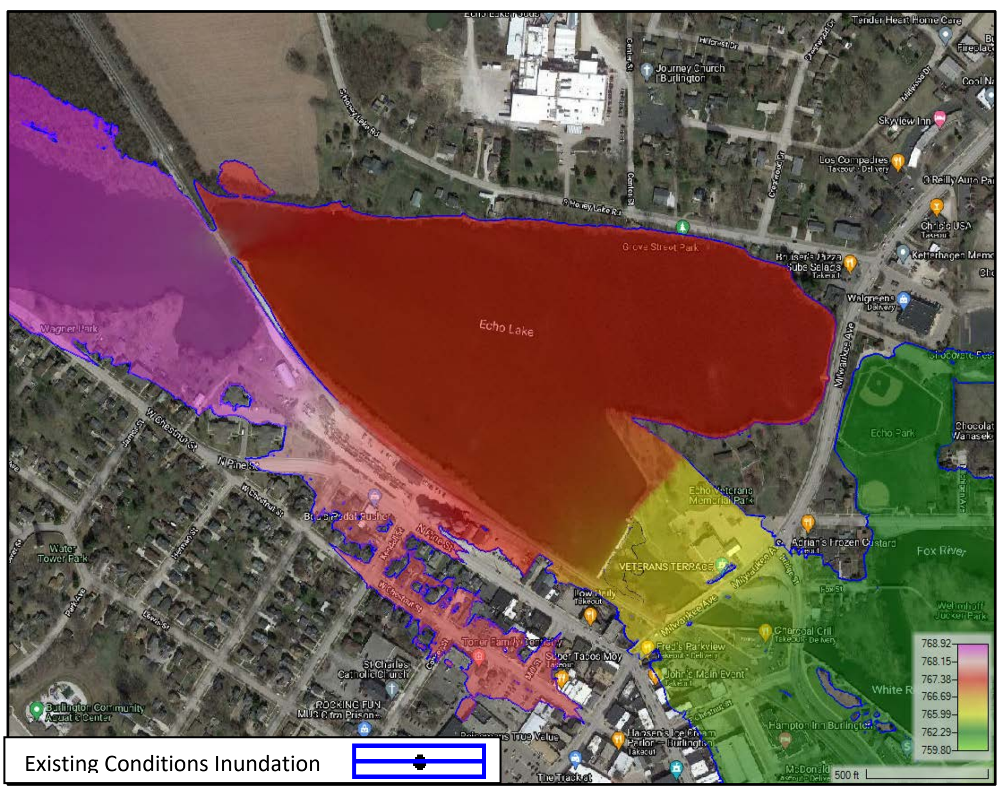


Figure 10. 500-yr Flood Inundation, Add Radial Gates

Dam Removal

The final option we evaluated is a complete removal of the dam. For this analysis, we assumed the channel above Echo Lake Dam returned to an approximation of pre-dam conditions. We approximated pre-dam conditions based on sediment probes taken during our April 2021 bathymetric survey and historical aerial imagery of the lake in a drawn-down state. Analysis results indicate the dam headwater (and associated upstream flooding) would decrease as indicated in Table 3.

Table 3. Upstream Elevation Change Due to Dam Removal

Profile	Headwater Elevation (ft, NAVD) Existing Conditions	Dam Removal	Difference (ft)
10-yr	764.7	760.9	3.8
50-yr	765.6	763.4	2.2
100-yr	766.1	764.4	1.7
500-yr	767.2	766.5	0.7

Figure 11 through Figure 13 show resulting reduced flooding upstream following dam removal.

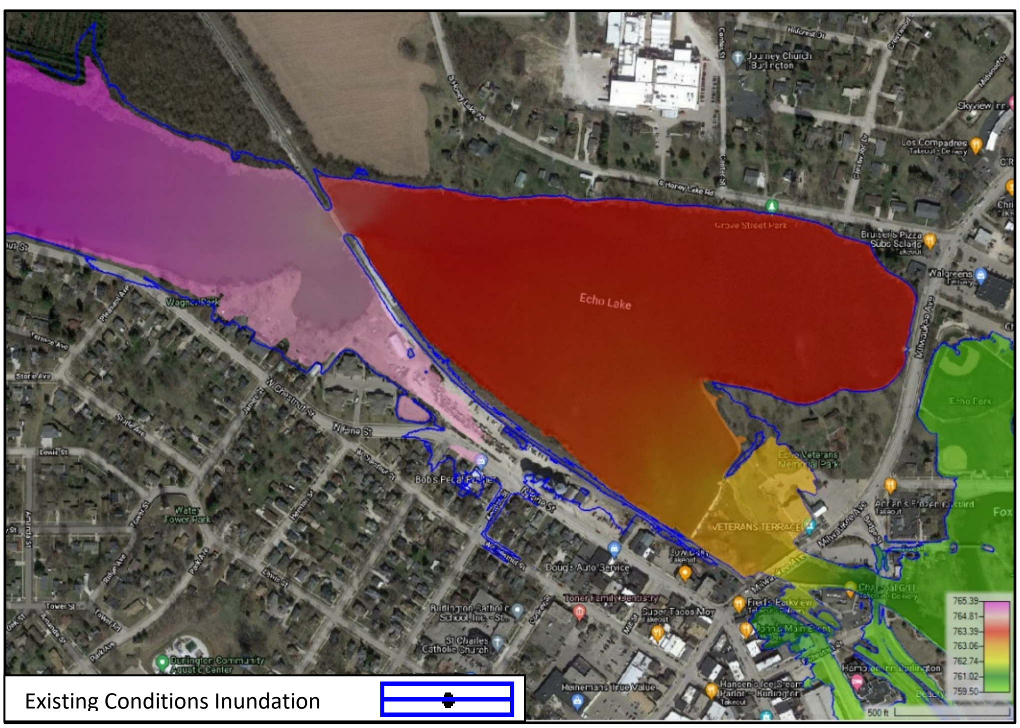


Figure 11. 50-yr Flood Inundation, Dam Removed

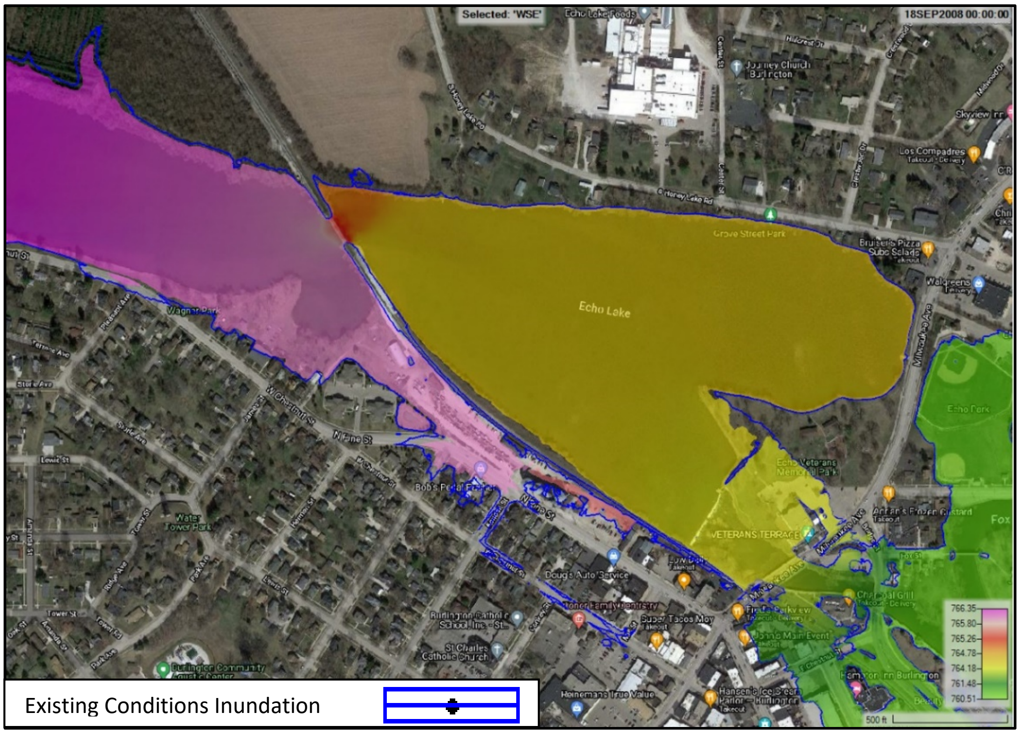


Figure 12. 100-yr Flood Inundation, Dam Removed

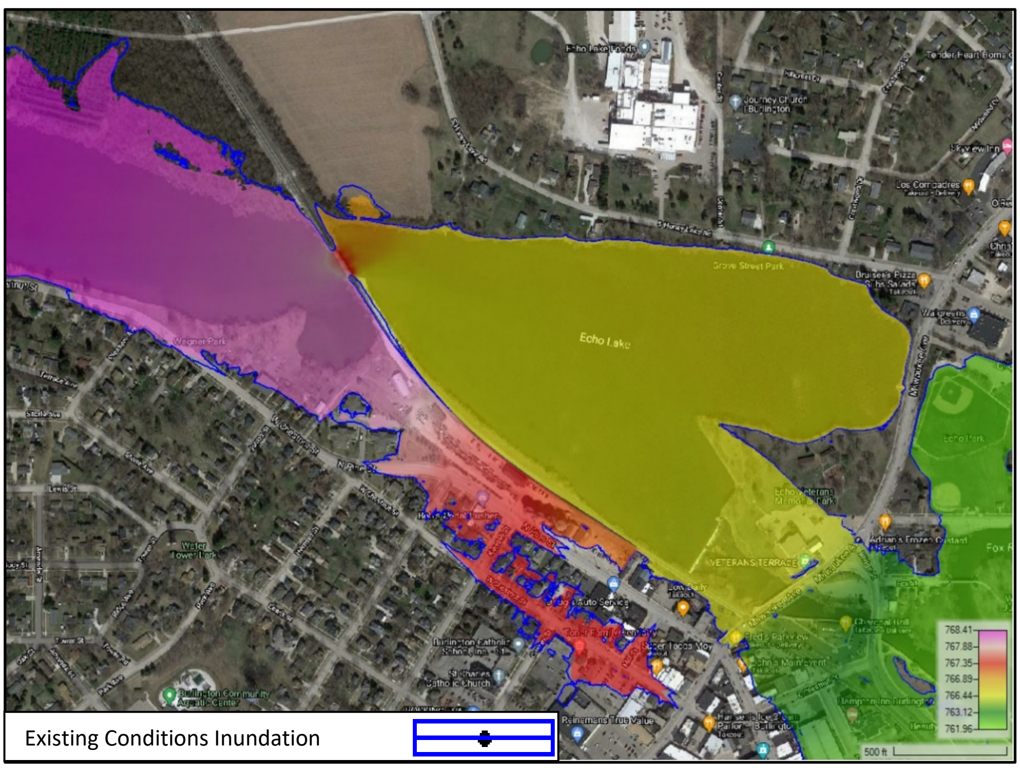


Figure 13. 500-yr Flood Inundation, Dam Removed

Conclusions

Our results indicate that there are no feasible improvements to Echo Lake Dam to achieve capacity to pass the 500-year flood as required in State of Wisconsin Code of Regulations NR333. This is due in large part to submergence effects at the dam that result in diminishing returns for adding larger and/or deeper spillways or gates. However, the one-foot submergence criterium provision of NR333.07(2)(a) allows for a reduced design capacity achievable through viable upgrades to the dam.

We recommend improvements to Echo Lake Dam that include raising the left embankment crest to 766 ft, NAVD and adding two 16-foot-wide radial gates (replacing a portion of the existing overflow spillway). For this configuration the required design capacity is 7,600 cfs. This is the flow of the river at submergence which replaces the minimum required hydraulic capacity per the reduced requirements provision of NR 333.07(2)(a).

These improvements would provide significant benefits over existing conditions including capacity to pass up to 8,570 cfs (between the 100- and 200-year flood) and safe operator access to spillway gates during flood conditions via the raised embankment crest.

Appendix A

Bathymetric Survey

HYDROSURVEY NOTES:

1. BENCHMARK INFORMATION: NGS PID DF9471 ELEVATION 762.41 FEET, NAVD88. DISK LOCATED ON SPILLWAY WALL.
2. WATER SURFACE ELEVATION (4/29/2021): 762.15 FEET.
3. SOUNDINGS WERE OBTAINED USING A DUAL FREQUENCY ECHOSOUNDER (200\33 kHz) AND POSITIONED WITH A TRIMBLE GEOHX GPS.
4. ALL DEPTHS ARE IN FEET AND ARE REFERENCE TO THE WATER SURFACE ELEVATION STATED ABOVE.
5. BASE MAP INFORMATION SHOWN ON THIS DRAWING SHALL BE CONSIDERED APPROXIMATE.

DES BY RJW		NOT FOR CONSTRUCTION		
DR BY RJW	PROJ NO 26-1258.00			
CHK BY AJS	DATE MAY 2021	NO	DATE	REVISION

ECHO LAKE PRE-DREDGING STUDY
CITY OF BURLINGTON
RACINE COUNTY, WISCONSIN

AYRES
EAU CLAIRE, WI

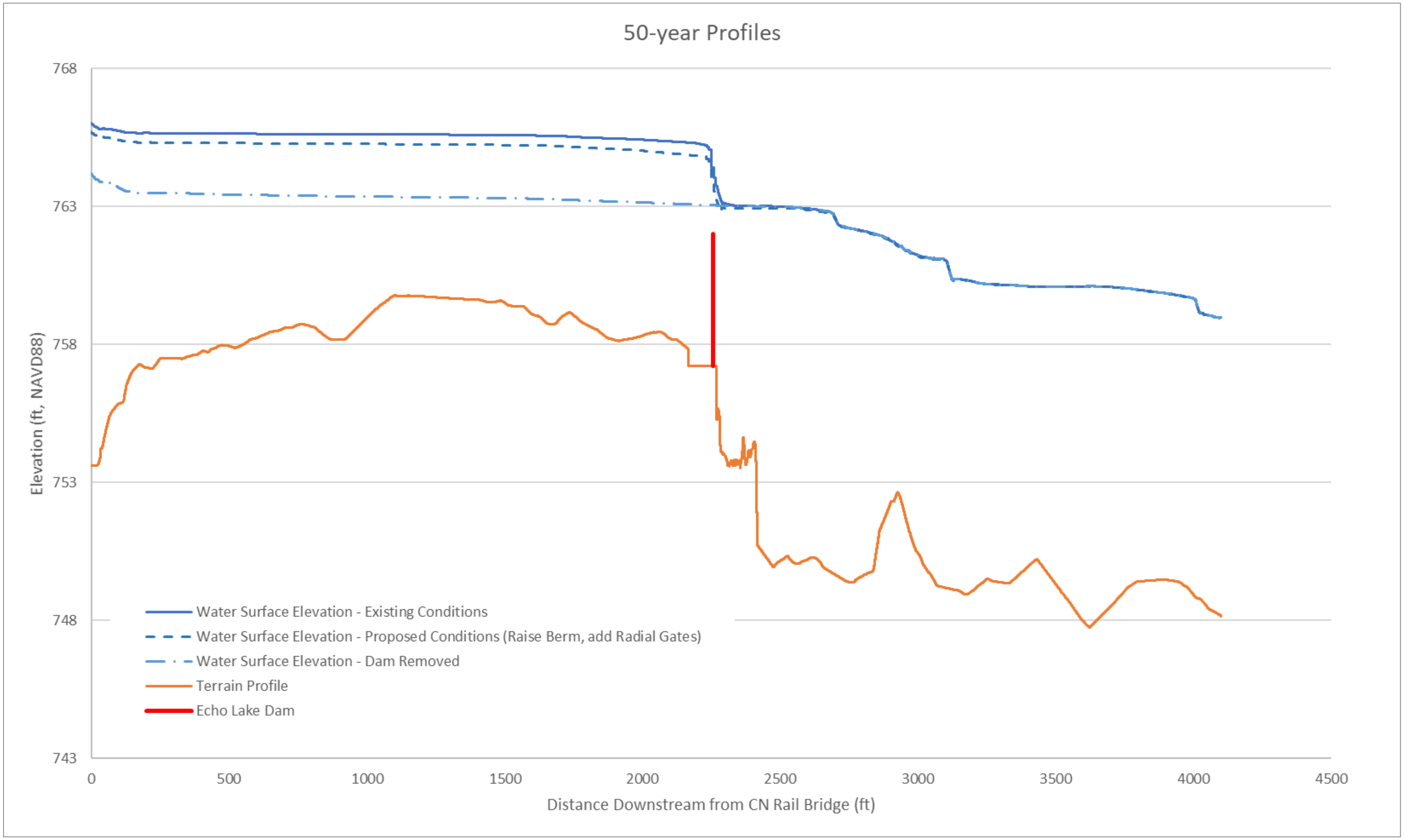
2021 BATHYMETRIC MAP

SHEET NO. 1

AA-Standard.stb
5/5/2021
I:\26\Burlington City of\Dam\26-1258.00 Echo Lake Pre-Dredging Study\CAD\Echo Lake Pre-Dredging Study.dwg, Layout: 2021 BATHYMETRIC MAP

Appendix B

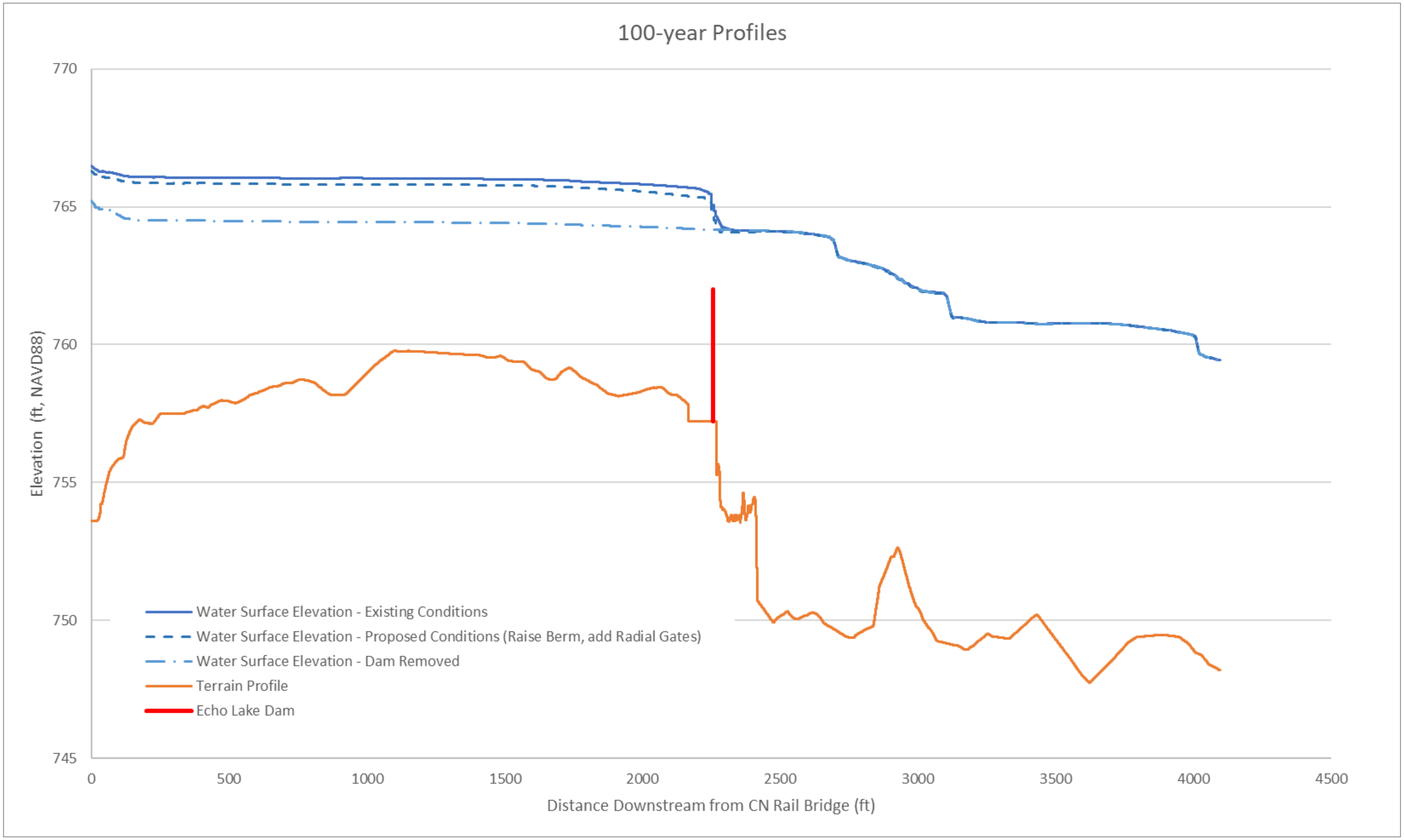
Profile Plots – 50-year



50-year Profiles
768
763
758
753
748
743
Elevation (ft, NAVD88)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Distance Downstream from CN Rail Bridge (ft)
Water Surface Elevation - Existing Conditions
Water Surface Elevation - Proposed Conditions (Raise Berm, add Radial Gates)
Water Surface Elevation - Dam Removed
Terrain Profile
Echo Lake Dam

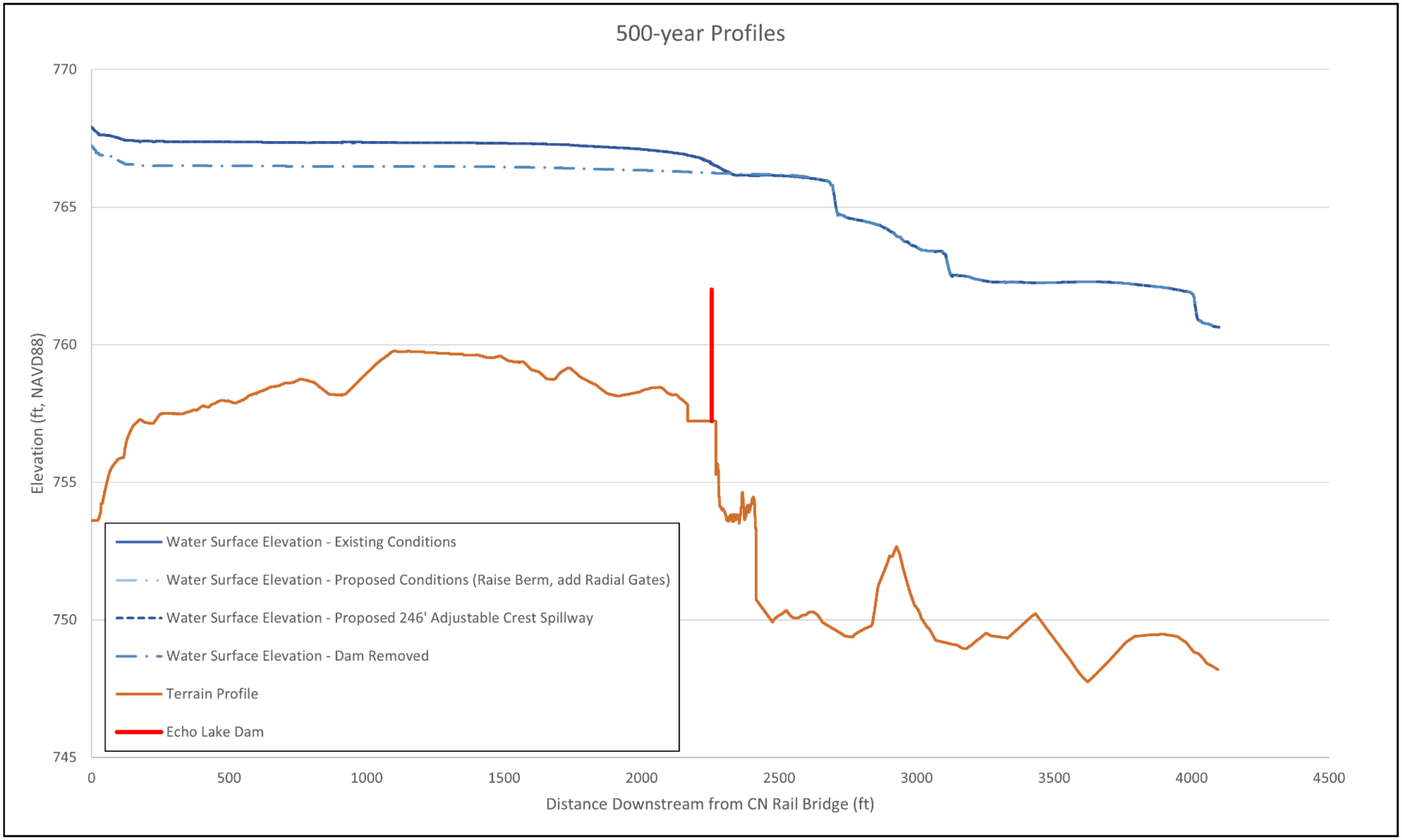
Appendix C

Profile Plots – 100-year


100-year Profiles
Elevation (ft, NAVD88)
770
765
760
755
750
745
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Distance Downstream from CN Rail Bridge (ft)
Water Surface Elevation - Existing Conditions
Water Surface Elevation - Proposed Conditions (Raise Berm, add Radial Gates)
Water Surface Elevation - Dam Removed
Terrain Profile
Echo Lake Dam

Appendix D

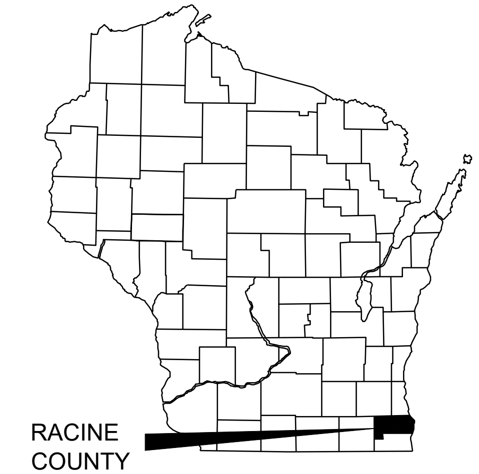
Profile Plots – 500-year


500-year Profiles
770
765
760
755
750
745
Elevation (ft, NAVD88)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Distance Downstream from CN Rail Bridge (ft)
Water Surface Elevation - Existing Conditions
Water Surface Elevation - Proposed Conditions (Raise Berm, add Radial Gates)
Water Surface Elevation - Proposed 246' Adjustable Crest Spillway
Water Surface Elevation - Dam Removed
Terrain Profile
Echo Lake Dam

Appendix B

Conceptual Drawings

ECHO LAKE DAM REPAIR ALTERNATIVES
CITY OF BURLINGTON
NOVEMBER 2021



COUNTY MAP
NTS

RACINE COUNTY

NORTH

UTILITY CONTACTS

GAS
COMPANY NAME
STREET ADDRESS
CITY, STATE ZIP
ATTN: CONTACT NAME
OFFICE: CONTACT INFO
EMAIL:
MOBILE:

ELECTRIC
COMPANY NAME
STREET ADDRESS
CITY, STATE ZIP
ATTN: CONTACT NAME
OFFICE: CONTACT INFO
EMAIL:
MOBILE:

CABLE & INTERNET
COMPANY NAME
STREET ADDRESS
CITY, STATE ZIP
ATTN: CONTACT NAME
OFFICE: CONTACT INFO
EMAIL:
MOBILE:

WATER
COMPANY NAME
STREET ADDRESS
CITY, STATE ZIP
ATTN: CONTACT NAME
OFFICE: CONTACT INFO
EMAIL:
MOBILE:

DIGGERS HOTLINE
1-800-242-8511 OR 811

DIGGERS HOTLINE
Dial 811 or (800)242-8511
www.DiggersHotline.com

SHEET INDEX

SHEET NUMBER	SHEET TITLE
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2	LEGEND
3	EXISTING CONDITIONS
4	OPTION 1 - TAINTER GATES
5	OPTION 2 - CREST GATES
6	OPTION 3 - SLIDE GATES
7	FLOOD WALL & RETAINING WALL

DES BY	ARR		NOT FOR CONSTRUCTION	
DR BY	ARR	PROJ NO	26-1244.00	
CHK BY	AJS	DATE	NOV 2021	

NO	DATE	REVISION	NO	DATE	REVISION
####			####		
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ECHO LAKE DAM REPAIRS
CITY OF BURLINGTON
RACINE COUNTY, WI

AYRES
EAU CLAIRE, WI

TITLE

SHEET NO.
1

EXISTING

- SANITARY SEWER (TRACER BOX, SAN MH, SAN, SAN VLV)
- WATER MAIN (WTR MH, HYD, CS, WV, WATER VALVE, WELL)
- STORM SEWER (INL, AREA INL, STM MH, SS)
- UNDERGROUND GAS (GAS MH, GAS, GV, G, TANK)
- UNDERGROUND ELECTRIC (ELECTRIC MH, EPED, ELECTRIC PED, ETRAN, ELECTRIC TRANSFORMER)
- UNDERGROUND FIBER OPTIC (FIBER MH, FO, PED)
- UNDERGROUND TELEPHONE (TELEPHONE MH, T, TPED)
- UNDERGROUND VIDEO (TELEVISION MH, TV, TVPD)
- OVERHEAD ELECTRIC (OH)
- OVERHEAD UTILITY (OH)
- UTILITY POLES: (POWER POLE, W/ MAST ARM, W/ LIGHT)
- TELEPHONE POLE
- LIGHT POLE (W/ MAST ARM)
- CURB AND GUTTER
- HARD SURFACED ROADWAY (ASPHALT, CONCRETE, ETC.)
- NON-SURFACED ROADWAY (GRAVEL, DIRT, ETC.)
- SIDEWALK (SIDEWALK)
- STREET CENTERLINE
- RETAINING WALL
- TREES (DECIDUOUS, CONIFEROUS)
- TREE LINE
- HEDGE OR BUSH LINE
- BUSH / SHRUB
- CONTOURS (100, 99)
- DITCH
- FENCE
- FENCE CHAIN LINK
- FENCE WOOD
- RIGHT OF WAY (ROW MARKER, IP, IRON PIPE)
- PROPERTY LINE (IP)
- SECTION LINE (SECTION CORNER, MON, MONUMENT)
- WETLAND
- SWAMP EDGE
- WATER'S EDGE
- RAILROAD
- BUILDING (OVER/DECK)
- GUARD RAIL
- ANCHOR (ANCHOR)
- CONTROL BOX
- METER
- PARKING METER
- POLE
- PULLBOX
- RR SIGNAL FLASHER / BOX
- SIGN
- SPRINKLER HEAD
- TRAFFIC SIGNAL (W/ MAST ARM)
- VALVE (VLV)

NEW

- SANITARY SEWER (TRACER WIRE ACCESS BOX, SAN LATERAL WITH CLEAN OUT, CO, SAN MH, SAN)
- FORCE MAIN (FM)
- WATER MAIN (HYDRANT, WTR SERVICE & CURB STOP, W, REDUCER, INSULATION, GATE VALVE & BOX, BEND)
- STORM SEWER (UNDERDRAIN, APRON ENDWALL AND RIP RAP, STM MH, INL, AREA INL, STRUCTURE LABEL ID, STRUCTURE TYPE SIZE-CASTING)
- HARD SURFACE ROADWAY (ASPHALT, CONCRETE, ETC)
- NON-SURFACED ROADWAY (GRAVEL, DIRT, ETC)
- CURB AND GUTTER
- SIDEWALK (SIDEWALK)
- BASELINE (10+00)
- CONTOURS (100, 99)
- FENCE
- PERMANENT EASEMENT
- TEMPORARY EASEMENT
- UTILITY EASEMENT
- SETBACK
- RETAINING WALL
- POND
- DITCH
- SILT FENCE (SF)
- EROSION BALES
- EROSION MAT
- EROSION LOG
- SAW CUT
- DEMOLITION / REMOVAL
- GUARD RAIL
- TOP OF CUT
- TOP OF FILL
- SPOT ELEVATION (800.80)
- CONTROL POINT (CP1)
- BENCHMARK (BM100)

ABBREVIATIONS:

A/E	ARCHITECT/ENGINEER
AL	ALUMINUM
ALT/	ALTERNATE
APPROX	APPROXIMATE
ASPH	ASPHALT
AUTO	AUTOMATIC
AVE	AVENUE
@	AT
BC	BACK OF CURB
BIT	BITUMINOUS
BLDG	BUILDING
BLK	BLOCK
BLVD	BOULEVARD
BM	BENCHMARK
BO	BREAKOFF
BOW	BACK OF SIDEWALK
BTM	BOTTOM
B/L	BASELINE
C&G	CURB AND GUTTER
CB	CATCH BASIN
CF	CUBIC FOOT
CI	CAST IRON
C/L	CENTERLINE
CHL	CHLORINE
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CO	CLEANOUT
CONC	CONCRETE
CP	CONTROL POINT
CPLG	COUPLING
CSP	CORRUGATED STEEL PIPE
CTH	COUNTY TRUNK HIGHWAY
CULV	CULVERT
CV	CHECK VALVE
CW	COLD WATER
CY	CUBIC YARD
DEG °	DEGREE
DI	DUCTILE IRON
DIA	DIAMETER
DIM	DIMENSION
DR	DOOR
DTL	DETAIL
DW	DRIVEWAY
DWG	DRAWING
E	EAST
EA	EACH
EFF	EFFLUENT
EL	ELEVATION
ELB	ELBOW
ELEC	ELECTRICAL
EQ	EQUAL
ER	END RADIUS BACK OF CURB
EW	EACH WAY
EX	EXISTING
EXP	EXPANSION
FF	FINISHED FOOR
FD	FLOOR DRAIN
FDN	FOUNDATION
FERT	FERTILIZER
F-F	FACE TO FACE
FIN	FINISHED
FL	FLOWLINE
FLG	FLANGED
FM	FORCE MAIN
FT (')	FOOT
FTG	FOOTING
FV	FIELD VERIFY
G	GAS
GA	GAGE
GALV	GALVANIZED
GAR	GARAGE
GEN	GENERAL
GRD	GRADE, GROUND
GV	GATE VALVE
GRAV	GRAVEL
GW	GROUNDWATER
HSE	HOUSE
HW	HOT WATER
HWR	HOT WATER RETURN
HYD	HYDRANT
ID	INSIDE DIAMETER
IN (")	INCHES
INF	INFLUENT
INL	INLET
INSUL	INSULATION
INV	INVERT
IP	IRON PIPE
JT	JOINT
LC	LENGTH OF CURVE
LF	LINEAL FEET
LP	LIGHT POLE
LS	LUMP SUM
LT	LEFT
MAS	MASONRY
MAX	MAXIMUM
MFG	MANUFACTURER
MH	MANHOLE
MIN	MINIMUM
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
MP	MID POINT
MR	MID RADIUS BACK OF CURB
N	NORTH
NO #	NUMBER
NOM	NOMINAL
NPW	NON-POTABLE WATER
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OH	OVERHEAD
PC	POINT OF CURVE
PE	PRIVATE ENTRANCE
PED	PEDESTAL
PERF	PERFORATE
PI	POINT OF INTERSECTION
P/L	PROPERTY LINE
PP	POWER POLE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE
PVMT	PAVEMENT
%	PERCENT
QTY	QUANTITY
RAD	RADIUS
RCP	REINFORCED CONCRETE PIPE
RD	ROAD
RDWY	ROADWAY
RED	REDUCER
REF	REFERENCE
REQD	REQUIRED
REV	REVISED
RR	RAILROAD
RT	RIGHT
RW	RIGHT OF WAY
S	SOUTH
SAN	SANITARY
SAMH	SANITARY MANHOLE
SCH	SCHEDULE
SF	SQUARE FOOT
SHT	SHEET
SL	SLOPE
SPEC	SPECIFICATION
SQ	SQUARE
SS	STAINLESS STEEL
SSMH	STORM SEWER MANHOLE
ST	STREET
STD	STANDARD
STH	STATE TRUNK HIGHWAY
STL	STEEL
STM	STORM
SW	SIDEWALK
SY	SQUARE YARD
TC	TOP BACK OF CURB
TEL	TELEPHONE
THK	THICKNESS
THRU	THROUGH
TYP	TYPICAL
UNEXC	UNEXCAVATED
USH	UNITED STATES HIGHWAY
V	VALVE
V&B	VALVE & BOX
VAR	VARIABLE
VC	VERTICAL CURVE
W	WEST
W/	WITH
W/O	WITHOUT
WM	WATER MAIN
WS	WATER SURFACE
WTP	WATER TREATMENT PLANT
WTR	WATER
WWF	WELDED WIRE FABRIC
WWM	WOVEN WIRE MESH
WWTP	WASTEWATER TREATMENT PLANT

DES BY	ARR			NOT FOR CONSTRUCTION			
DR BY	ARR	PROJ NO	26-1244.00				
CHK BY	AJS	DATE	NOV 2021	NO	DATE	REVISION	NO	DATE	REVISION

ECHO LAKE DAM REPAIRS
CITY OF BURLINGTON
RACINE COUNTY, WISCONSIN

AYRES
EAU CLAIRE, WI

EXISTING CONDITIONS

SHEET NO. 3

AA-Standard.stb
11/3/2021
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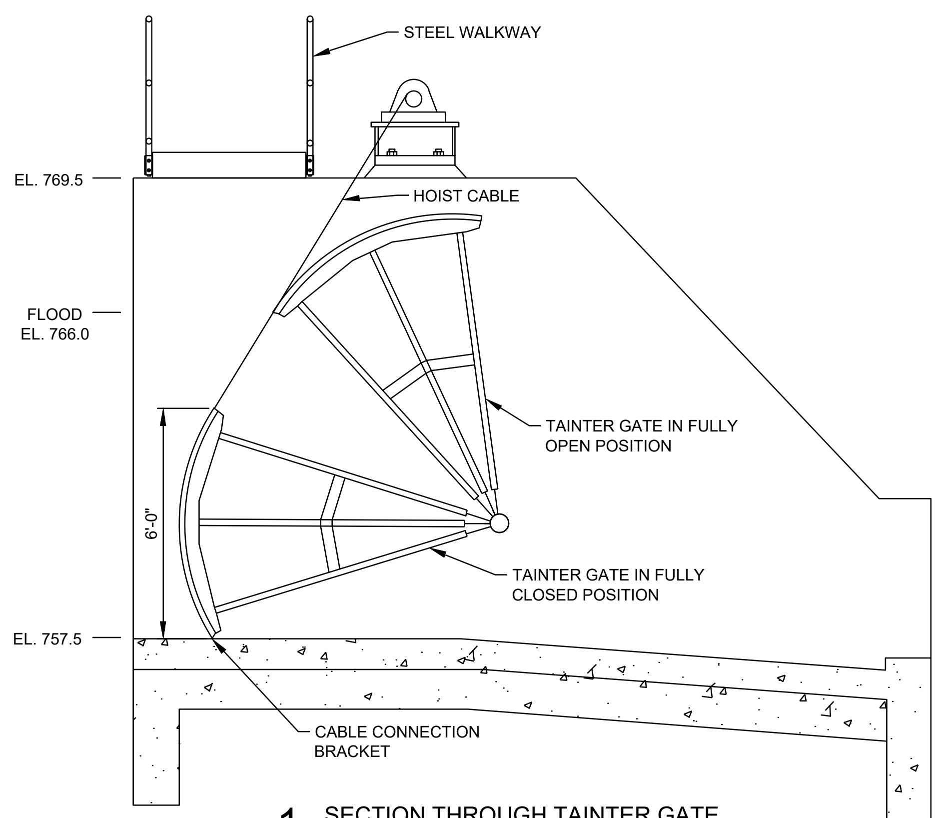
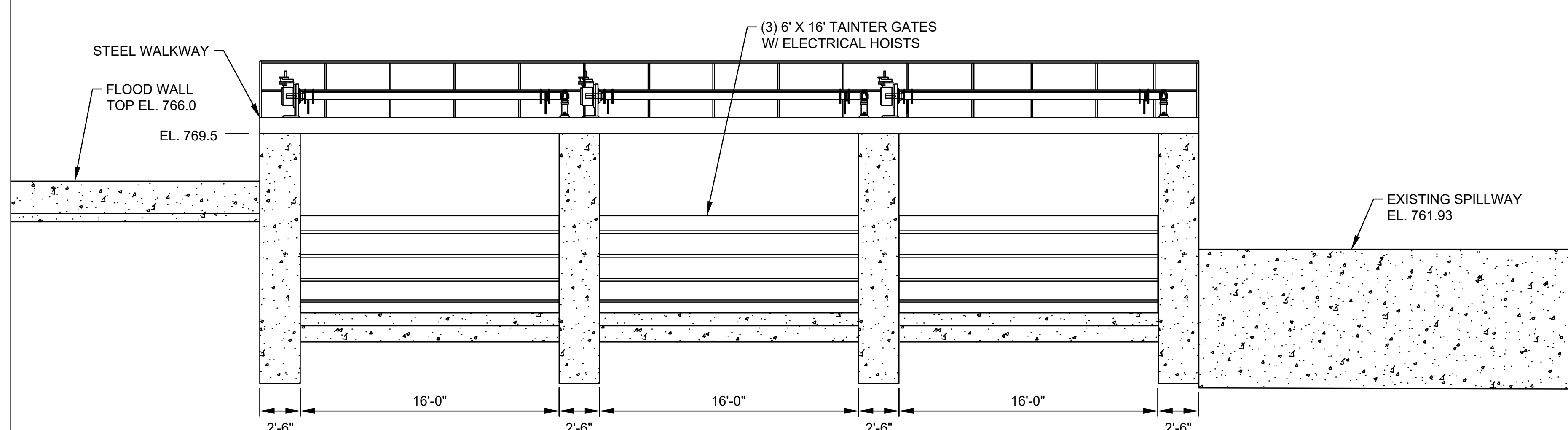


1 SECTION THROUGH TAINTER GATE



2 TAINTER GATE ELEVATION VIEW (LOOKING DOWNSTEAM)

AA-Standard.stb
11/3/2021
i:\26\burlington city of dam\26-1244.00 echo lake dam spillway feasibility study\CAD\Echo Lake Proposed Conditions.dwg, Layout: 4 OPTION 1 - TAINTER GATES

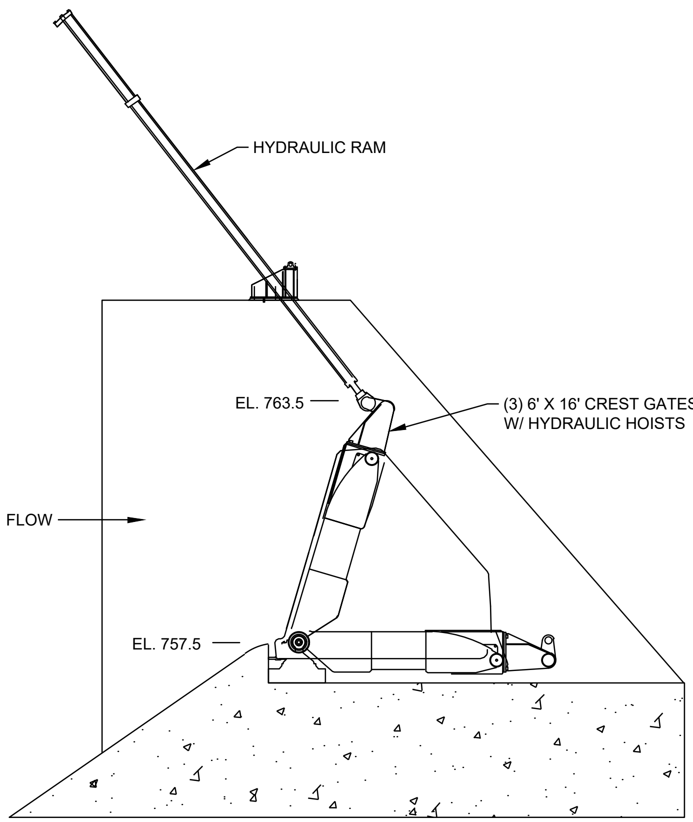
DES BY	ARR				NOT FOR CONSTRUCTION			
DR BY	ARR	PROJ NO 26-1244.00						
CHK BY	AJS	DATE NOV 2021	NO	DATE	REVISION	NO	DATE	REVISION

ECHO LAKE DAM REPAIRS
CITY OF BURLINGTON
RACINE COUNTY, WISCONSIN

AYRES
EAU CLAIRE, WI

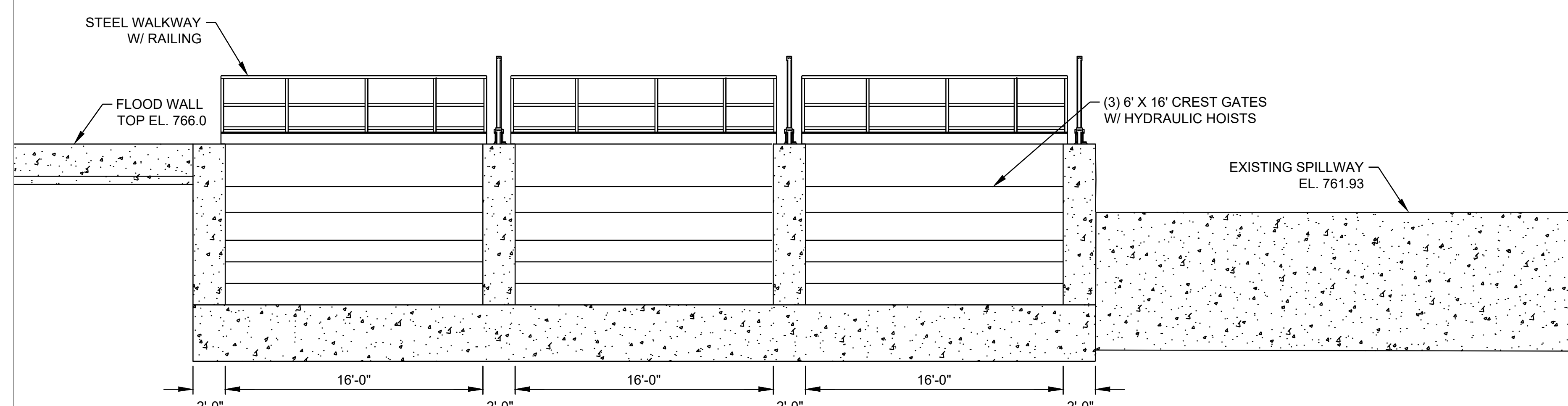
OPTION 1 - TAINTER GATES

SHEET NO. 4



1 SECTION THROUGH CREST GATE

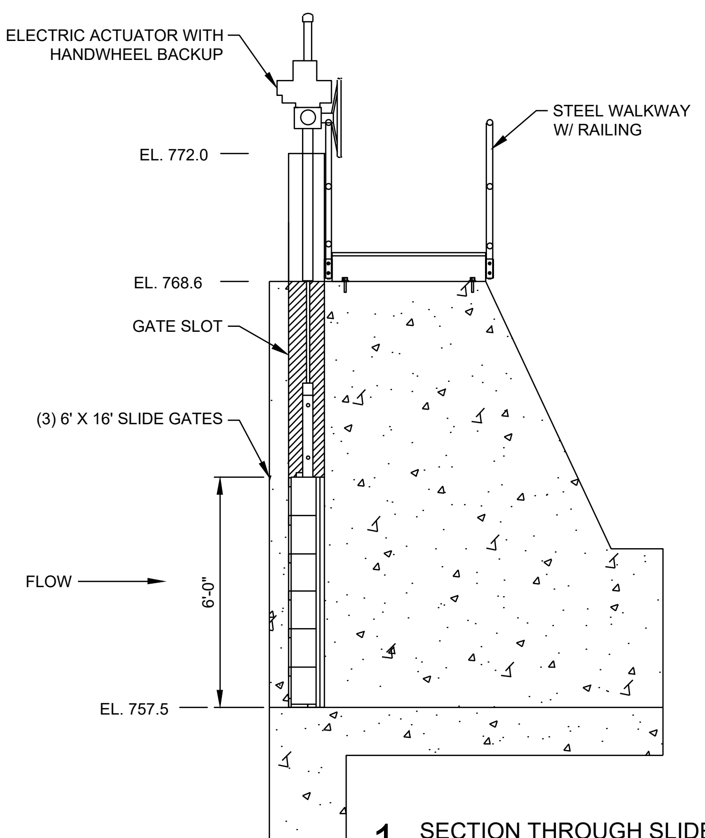
0 2.5 5



2 CREST GATE ELEVATION VIEW (LOOKING DOWNSTREAM)

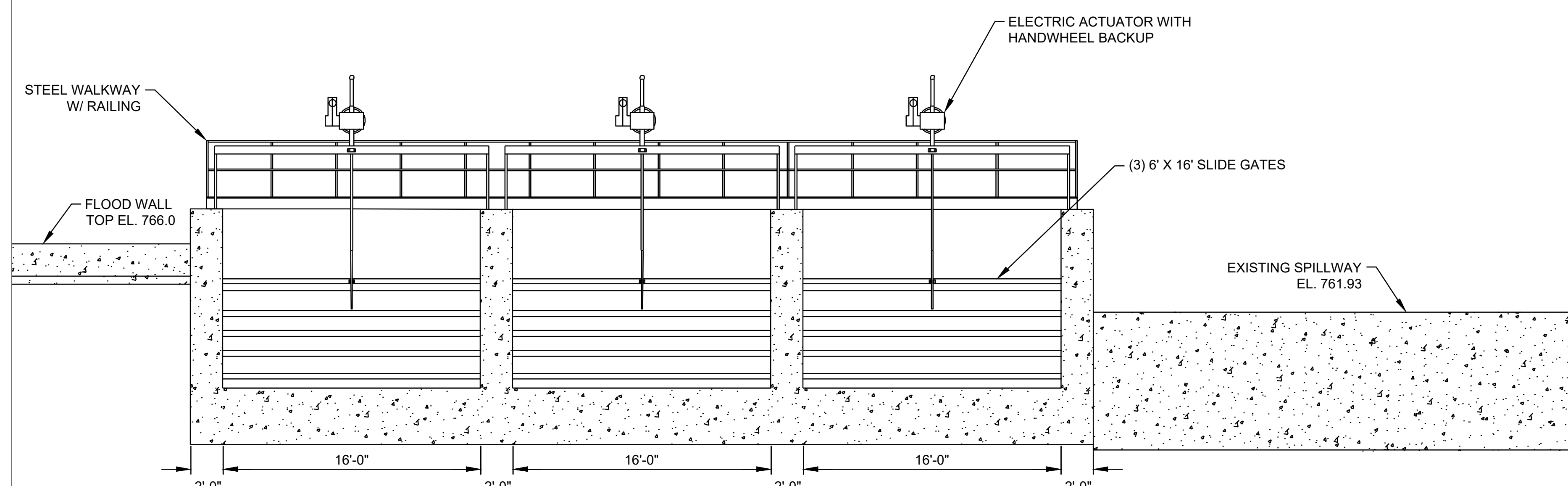
0 5 10

DES BY ARR		NOT FOR CONSTRUCTION		ECHO LAKE DAM REPAIRS CITY OF BURLINGTON RACINE COUNTY, WISCONSIN	AYRES EAU CLAIRE, WI	OPTION 2 - CREST GATES
DR BY ARR	PROJ NO 26-1244.00					SHEET NO. 5
CHK BY AJS	DATE NOV 2021	NO DATE REVISION	NO DATE REVISION			



1 SECTION THROUGH SLIDE GATE

0 2.5 5



2 SLIDE GATE ELEVATION VIEW (LOOKING DOWNSTREAM)

0 5 10

DES BY	ARR			NOT FOR CONSTRUCTION			
DR BY	ARR	PROJ NO	26-1244.00				
CHK BY	AJS	DATE	NOV 2021				
				NO / DATE / REVISION		NO / DATE / REVISION	

ECHO LAKE DAM REPAIRS
CITY OF BURLINGTON
RACINE COUNTY, WISCONSIN

AYRES
EAU CLAIRE, WI

OPTION 3 - SLIDE GATES

SHEET NO.
6

AA-Standard.stb
11/3/2021
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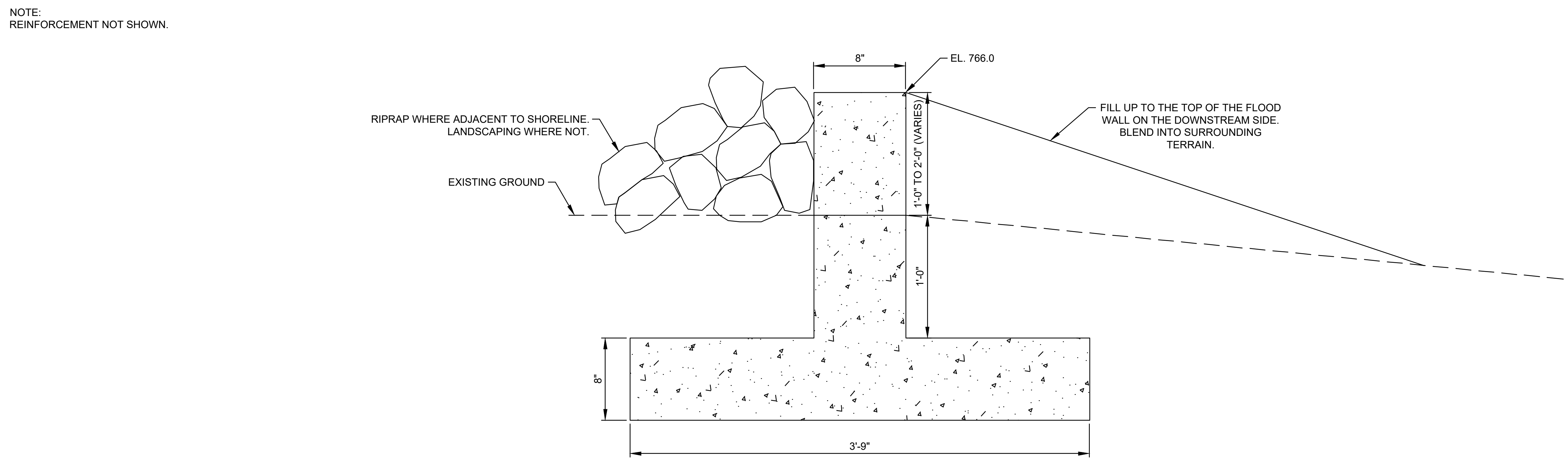
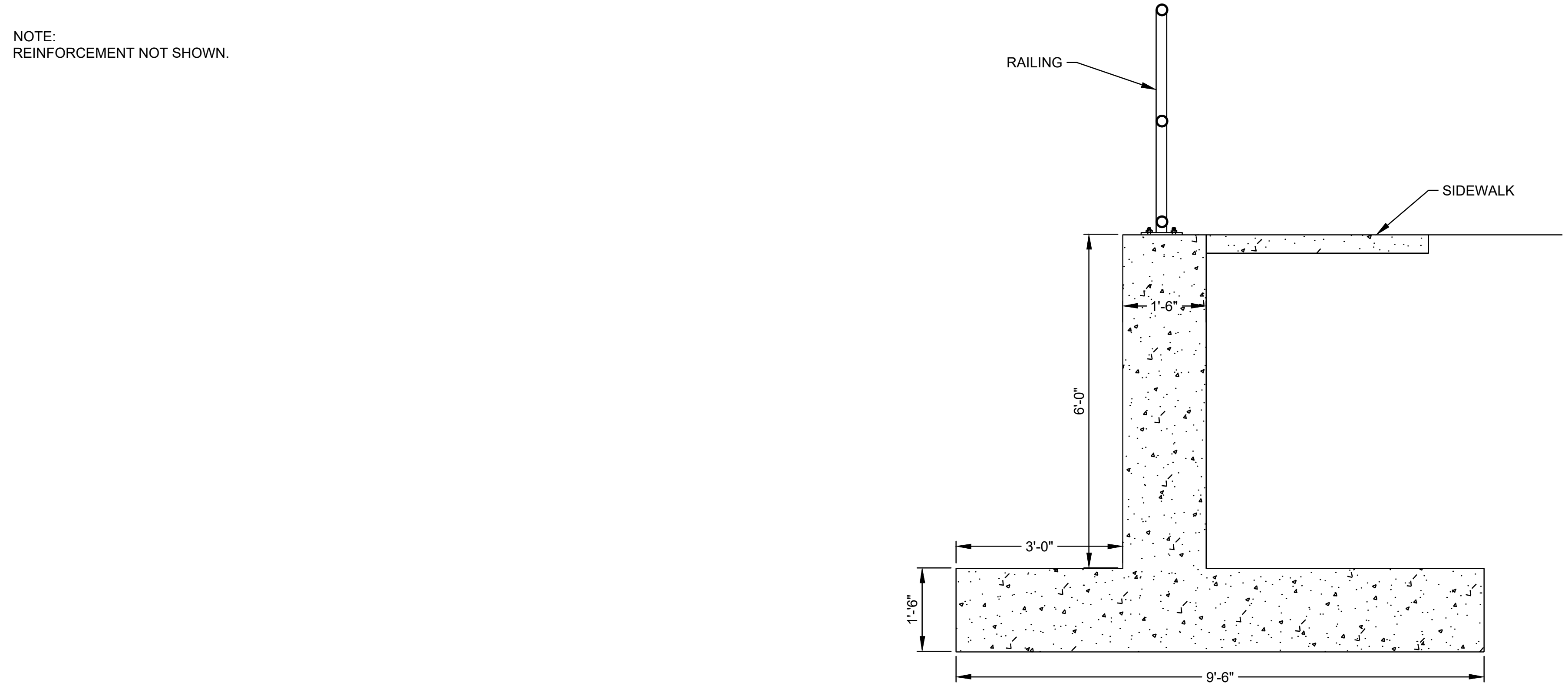


1 FLOOD WALL SECTION VIEW (TYP.)

N.T.S.



2 RETAINING WALL SECTION VIEW (TYP.)

N.T.S.

DES BY ARR				NOT FOR CONSTRUCTION	----			
DR BY ARR	PROJ NO 26-1244.00	----			----			
CHK BY AJS	DATE NOV 2021	----			----			
		NO	DATE	REVISION	NO	DATE	REVISION	

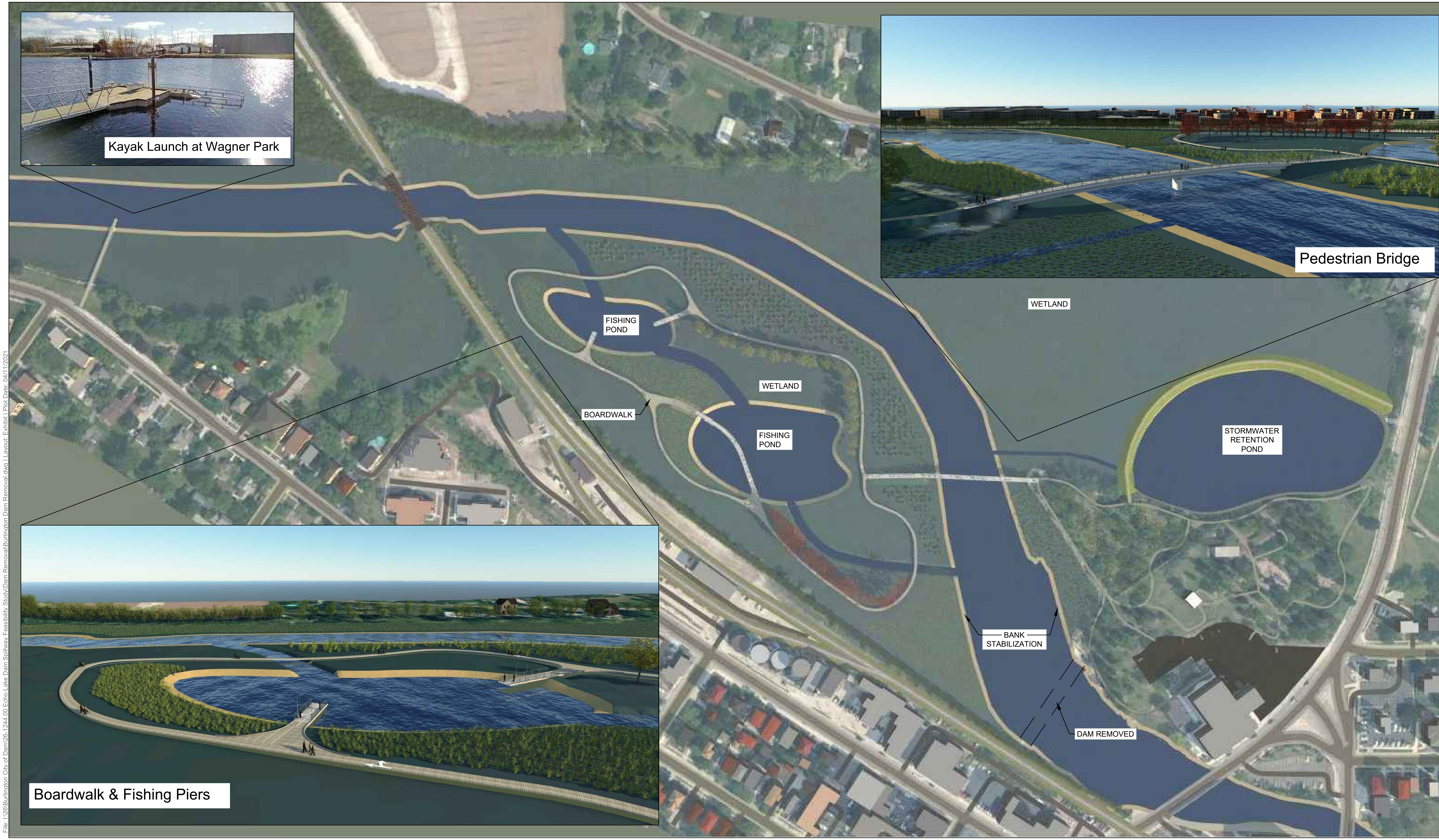
ECHO LAKE DAM REPAIRS
CITY OF BURLINGTON
RACINE COUNTY, WISCONSIN

AYRES
EAU CLAIRE, WI

FLOOD WALL & RETAINING WALL

SHEET NO. 7

AA-Standard.stb
11/3/2021
i:\26\burlington city of dam\26-1244.00 echo lake dam spillway feasibility study\CAD\Echo Lake Proposed Conditions.dwg, Layout: 7 FLOOD WALL & RETAINING WALL



File: I:\26\Burlington City of Dam\26-1244.00 Echo Lake Dam Spillway Feasibility Study\Dam Removal\Burlington Dam Removal.dwg | Layout: Exhibit | Plot Date: 04/11/2021

AYRES

City of Burlington - Burlington, WI | OPTION 4: DAM REMOVAL WITH ENHANCEMENTS

11/02/2021

Ayres Associates | 3433 Oakwood Hills Parkway, Eau Claire, WI 54701 | 715.834.3161 | www.AyresAssociates.com | # 26-1244

Appendix C

Cost Estimates

AYRES

Opinion of Probable Cost November 2021 Original: ARR

Project: Echo Lake Dam Feasibility Study Check Set: AJS

Client: City of Burlington

Location: Racine County, WI

Project No.: 26-0988.03

Alternative: **Option 1: Tainter Gates**

References: 1.) *Heavy Construction Cost Data* . RSMeans. 2021 Quarter 4, Racine WI

	RS Means Item Number and Description	Unit	Quantity	2021Bare Costs Material	Labor	Equipment	Total	Total Incl O&P		Total Item Cost Incl O&P	Notes:
	Tainter Gate Alternative										
024113304200	Minor site demolition, sidewalk, concrete, mesh reinforced, 4" thick, remove, excludes hauling	S.Y.	62	0	7.88	1.43	9.31	13.36	$	831.29	Sidewalk Removal
024113900400	Selective demolition, retaining walls, concrete retaining wall, 6' high, includes reinforcing	L.F.	140	0	5.04	10.21	15.25	18.73	$	2,622.20	Retaining Wall Removal
030505100060	Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping	C.Y.	35	0	126.56	21.91	148.47	213.11	$	7,458.85	Existing Tainter Gate Removal
033053404050	Structural concrete, in place, foundation mat (3000 psi), over 20 C.Y., includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C.Y.	80	235	113.67	0.48	349.28	429.12	$	34,329.60	Dam Footing
033053404500	Structural concrete, in place, free-standing wall (3000 psi), 15" thick x 18' high, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C.Y.	95	203.78	243.74	9.16	456.68	594.43	$	56,470.85	Piers
038116500800	Concrete sawing, concrete walls, plain, per inch of depth, hydraulic saw	L.F.	408	0.04	3.77	6.23	10.04	12.5	$	5,100.00	Dam Removal Saw Cut (8.5' high * 48" width ave)
055213500020	Railing, pipe, aluminum, satin finish, 2 rails, 3'-6" high, posts @ 5' OC, 1-1/4" diameter, shop fabricated	L.F.	150	70.65	13	0.93	84.58	99.48	$	14,922.00	Retaining Wall Railing
055213500020	Railing, pipe, aluminum, satin finish, 2 rails, 3'-6" high, posts @ 5' OC, 1-1/4" diameter, shop fabricated	L.F.	58	70.65	13	0.93	84.58	99.48	$	5,769.84	Walkway Railing
055313100111	Floor grating, aluminum, 1" x 1/8" bearing bars @ 1-3/16" OC, cross bars @ 4" OC, up to 300 S.F., field fabricated from panels	S.F.	204	34.28	2.31	0.17	36.76	41.53	$	8,472.12	Walkway
312213200130	Rough grading sites, 1,100-3,000 S.F., skid steer & labor	EA.	1	0	791.56	119.52	911.08	1313.67	$	1,313.67	Fill Grading
3.10513E+11	Soils for earthwork, screened loam borrow, spread with 200 HP dozer, includes load at pit and haul	C.Y.	60	27.76	4.61	7.33	39.7	45.54	$	2,732.40	Fill
312323200048	Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 10 min wait/load/unload, 8 C.Y. truck, cycle 8 miles, 25 MPH, excludes loading equipment	L.C.Y.	110	0	3.3	3.17	6.47	8.41	$	925.10	Retaining wall, tainter gate, spillway removal
315216100020	Cofferdams, shore driven, includes mobilization, temporary sheeting	S.F.	900	25.41	3.9	3.67	32.98	38.19	$	34,371.00	50' Long x 6' High (12' buried)
323213102900	Cast-in place retaining walls, reinforced concrete cantilever, 33 degree slope embankment, 6' high, includes excavation, backfill & reinforcing	L.F.	140	89.89	115.22	15.59	220.7	289.47	$	40,525.80	Retaining Wall
323213102900	Cast-in place retaining walls, reinforced concrete cantilever, 33 degree slope embankment, 6' high, includes excavation, backfill & reinforcing	L.F.	335	89.89	115.22	15.59	220.7	289.47	$	96,972.45	Flood Wall
N/A	Tainter Gates	EA.	3					120000	$	360,000.00	
N/A	Hoist, 240-Volt 3 Phase	EA.	3					110000	$	330,000.00	
N/A	Sill and Side Plates	EA.	3					70000	$	210,000.00	
N/A	Heated Sill and Side Plates - Additional	EA.	3					25000	$	75,000.00	
N/A	Install Price for 3 Gates and Hoists	EA.	3					55000	$	165,000.00	
N/A	240-Volt, 3-Phase Electrical Hookup	L.S.	1					30000	$	30,000.00	
N/A	Mobilization 10%	L.S.	1						$	148,281.72	
								Subtotal =	**$**	**1,632,000.00**	
								Contingency (30%) =	**$**	**489,600**	
								Total Construction Cost=	**$**	**2,121,600**	
								Engineering/Construction Administrative =	**$**	**318,240**	15% of Total Construction Cost
								Total Project Cost=	**$**	**2,439,840.00**	

AYRES

Opinion of Probable Cost November 2021 Original: ARR

Project: Echo Lake Dam Feasibility Study Check Set: AJS

Client: City of Burlington

Location: Racine County, WI

Project No.: 26-0988.03

Alternative: **Option 2: Crest Gates**

References: 1.) *Heavy Construction Cost Data* . RSMeans. 2021 Quarter 4, Racine WI

RS Means Item Number and Description		Unit	Quantity	2021Bare Costs Material	Labor	Equipment	Total	Total Incl O&P	Total Item Cost Incl O&P	Notes:
	Tainter Gate Alternative									
024113304200	Minor site demolition, sidewalk, concrete, mesh reinforced, 4" thick, remove, excludes hauling	S.Y.	62	0	7.88	1.43	9.31	13.36	$ 831.29	Sidewalk Removal
024113900400	Selective demolition, retaining walls, concrete retaining wall, 6' high, includes reinforcing	L.F.	140	0	5.04	10.21	15.25	18.73	$ 2,622.20	Retaining Wall Removal
030505100060	Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping	C.Y.	35	0	126.56	21.91	148.47	213.11	$ 7,458.85	Existing Tainter Gate Removal
033053404050	Structural concrete, in place, foundation mat (3000 psi), over 20 C.Y., includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C.Y.	112	235	113.67	0.48	349.28	429.12	$ 48,061.44	Dam Footing
033053404500	Structural concrete, in place, free-standing wall (3000 psi), 15" thick x 18' high, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C.Y.	33	203.78	243.74	9.16	456.68	594.43	$ 19,616.19	Piers
038116500800	Concrete sawing, concrete walls, plain, per inch of depth, hydraulic saw	L.F.	408	0.04	3.77	6.23	10.04	12.5	$ 5,100.00	Dam Removal Saw Cut (8.5' high * 48" width ave)
055213500020	Railing, pipe, aluminum, satin finish, 2 rails, 3'-6" high, posts @ 5' OC, 1-1/4" diameter, shop fabricated	L.F.	150	70.65	13	0.93	84.58	99.48	$ 14,922.00	Retaining Wall Railing
055213500020	Railing, pipe, aluminum, satin finish, 2 rails, 3'-6" high, posts @ 5' OC, 1-1/4" diameter, shop fabricated	L.F.	50	70.65	13	0.93	84.58	99.48	$ 4,974.00	Walkway Railing
055313100111	Floor grating, aluminum, 1" x 1/8" bearing bars @ 1-3/16" OC, cross bars @ 4" OC, up to 300 S.F., field fabricated from panels	S.F.	198	34.28	2.31	0.17	36.76	41.53	$ 8,222.94	Walkway
312213200130	Rough grading sites, 1,100-3,000 S.F., skid steer & labor	EA.	1	0	791.56	119.52	911.08	1313.67	$ 1,313.67	Fill Grading
3.10513E+11	Soils for earthwork, screened loam borrow, spread with 200 HP dozer, includes load at pit and haul	C.Y.	60	27.76	4.61	7.33	39.7	45.54	$ 2,732.40	Fill
312323200048	Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 10 min wait/load/unload, 8 C.Y. truck, cycle 8 miles, 25 MPH, excludes loading equipment	L.C.Y.	110	0	3.3	3.17	6.47	8.41	$ 925.10	
315216100020	Cofferdams, shore driven, includes mobilization, temporary sheeting	S.F.	900	25.41	3.9	3.67	32.98	38.19	$ 34,371.00	Retaining wall, tainter gate, spillway removal 50' Long x 6' High (12' buried)
323213102900	Cast-in place retaining walls, reinforced concrete cantilever, 33 degree slope embankment, 6' high, includes excavation, backfill & reinforcing	L.F.	140	89.89	115.22	15.59	220.7	289.47	$ 40,525.80	Retaining Wall
323213102900	Cast-in place retaining walls, reinforced concrete cantilever, 33 degree slope embankment, 6' high, includes excavation, backfill & reinforcing	L.F.	335	89.89	115.22	15.59	220.7	289.47	$ 96,972.45	Flood Wall
N/A	Crest gates with hydraulic hoists	EA.	3					240000	$ 720,000.00	
N/A	Sill and Side Plates	EA.	3					90000	$ 270,000.00	
N/A	Heated Sill and Side Plates - Additional	EA.	3					25000	$ 75,000.00	
N/A	Install Price for 3 Gates and Hoists	EA.	3					75000	$ 225,000.00	
N/A	240-Volt, 3-Phase Electrical Hookup	L.S.	1					30000	$ 30,000.00	
N/A	Mobilization 10%	L.S.	1						$ 160,864.93	
								Subtotal =	**$ 1,770,000.00**	
								Contingency (30%) =	**$ 531,000**	
								Total Construction Cost=	**$ 2,301,000**	
								Engineering/Construction Administrative =	**$ 345,150**	15% of Total Construction Cost
								Total Project Cost=	**$ 2,646,150.00**	

AYRES

Opinion of Probable Cost November 2021 Original: ARR

Project: Echo Lake Dam Feasibility Study Check Set: AJS

Client: City of Burlington

Location: Racine County, WI

Project No.: 26-0988.03

Alternative: **Option 3: Slide Gates**

References: 1.) *Heavy Construction Cost Data* . RSMeans. 2021 Quarter 4, Racine WI

	RS Means Item Number and Description	**Unit**	**Quantity**	**2021Bare Costs**				**Total Incl O&P**	**Total Item Cost Incl O&P**	**Notes:**
				Material	**Labor**	**Equipment**	**Total**			
	Tainter Gate Alternative									
024113304200	Minor site demolition, sidewalk, concrete, mesh reinforced, 4" thick, remove, excludes hauling	S.Y.	62	0	7.88	1.43	9.31	13.36	$ 831.29	Sidewalk Removal
024113900400	Selective demolition, retaining walls, concrete retaining wall, 6' high, includes reinforcing	L.F.	140	0	5.04	10.21	15.25	18.73	$ 2,622.20	Retaining Wall Removal
030505100060	Selective concrete demolition, reinforcing 1% - 2% of cross-sectional area, break up into small pieces, excludes shoring, bracing, saw or torch cutting, loading, hauling, dumping	C.Y.	35	0	126.56	21.91	148.47	213.11	$ 7,458.85	Existing Tainter Gate Removal
033053404050	Structural concrete, in place, foundation mat (3000 psi), over 20 C.Y., includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C.Y.	37	235	113.67	0.48	349.28	429.12	$ 15,877.44	Dam Footing
033053404500	Structural concrete, in place, free-standing wall (3000 psi), 15" thick x 18' high, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C.Y.	23	203.78	243.74	9.16	456.68	594.43	$ 13,671.89	Piers
038116500800	Concrete sawing, concrete walls, plain, per inch of depth, hydraulic saw	L.F.	408	0.04	3.77	6.23	10.04	12.5	$ 5,100.00	Dam Removal Saw Cut (8.5' high * 48" width ave)
055213500020	Railing, pipe, aluminum, satin finish, 2 rails, 3'-6" high, posts @ 5' OC, 1-1/4" diameter, shop fabricated	L.F.	150	70.65	13	0.93	84.58	99.48	$ 14,922.00	Retaining Wall Railing
055213500020	Railing, pipe, aluminum, satin finish, 2 rails, 3'-6" high, posts @ 5' OC, 1-1/4" diameter, shop fabricated	L.F.	54	70.65	13	0.93	84.58	99.48	$ 5,371.92	Walkway Railing
055313100111	Floor grating, aluminum, 1" x 1/8" bearing bars @ 1-3/16" OC, cross bars @ 4" OC, up to 300 S.F., field fabricated from panels	S.F.	216	34.28	2.31	0.17	36.76	41.53	$ 8,970.48	Walkway
312213200130	Rough grading sites, 1,100-3,000 S.F., skid steer & labor	EA.	1	0	791.56	119.52	911.08	1313.67	$ 1,313.67	Fill Grading
3.10513E+11	Soils for earthwork, screened loam borrow, spread with 200 HP dozer, includes load at pit and haul	C.Y.	60	27.76	4.61	7.33	39.7	45.54	$ 2,732.40	Fill
312323200048	Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 10 min wait/load/unload, 8 C.Y. truck, cycle 8 miles, 25 MPH, excludes loading equipment	L.C.Y.	110	0	3.3	3.17	6.47	8.41	$ 925.10	
315216100020	Cofferdams, shore driven, includes mobilization, temporary sheeting	S.F.	900	25.41	3.9	3.67	32.98	38.19	$ 34,371.00	Retaining wall, tainter gate, spillway removal 50' Long x 6' High (12' buried)
323213102900	Cast-in place retaining walls, reinforced concrete cantilever, 33 degree slope embankment, 6' high, includes excavation, backfill & reinforcing	L.F.	140	89.89	115.22	15.59	220.7	289.47	$ 40,525.80	Retaining Wall
323213102900	Cast-in place retaining walls, reinforced concrete cantilever, 33 degree slope embankment, 6' high, includes excavation, backfill & reinforcing	L.F.	335	89.89	115.22	15.59	220.7	289.47	$ 96,972.45	Flood Wall
N/A	Slide gate, frame, and electric actuators	EA.	3					153600	$ 460,800.00	
N/A	Install Price for 3 Gates and Hoists	EA.	3					61440	$ 184,320.00	
N/A	Deicing System	EA.	3					5000	$ 15,000.00	
N/A	240-Volt, 3-Phase Electrical Hookup	L.S.	1					30000	$ 30,000.00	
N/A	Mobilization 10%	L.S.	1						$ 94,178.65	
								Subtotal =	**$ 1,036,000.00**	
								Contingency (30%) =	**$ 310,800**	
								Total Construction Cost=	**$ 1,346,800**	
								Engineering/Construction Administrative =	**$ 202,020**	15% of Total Construction Cost
								Total Project Cost=	**$ 1,548,820.00**	

Opinion of Probable Cost
Option 4: Dam Removal With Enhancements

City of Burlington
Burlington, WI

November 2021

	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	TOTAL PRICE
1	Mobilization/Demobilization	LS	1	$ 368,590	$ 368,590.00
2	Temporary erosion control	LS	1	$ 50,000	$ 50,000.00
DAM REMOVAL & RIVER RESTORATION					
3	Construction Dewatering	LS	1	$ 25,000	$ 25,000.00
4	Remove and Dispose of Trapped Sediment near Dam	CY	5000	$ 22	$ 110,000.00
5	Dam Demolition and Disposal	CY	590	$ 80	$ 47,200.00
6	Turbidity Barrier	LF	150	$ 12	$ 1,800.00
7	Riprap stabilization and permanent erosion control	CY	8060	$ 100	$ 806,000.00
8	Seeding (Wetland)	AC	29	$ 875	$ 25,000.00
MUNICIPAL & RECREATIONAL UPGRADES					
9	Stormwater Retention Earthwork	CY	3500	$ 15	$ 52,500.00
10	Box Culvert	LF	70	$ 350	$ 24,500.00
11	Pedestrian Bridge	LS	1	$ 674,400	$ 674,400.00
12	Fishing pond Earthwork	CY	19500	$ 15	$ 292,500.00
13	Furnish & Install Boardwalk	SF	30400	$ 50	$ 1,520,000.00
14	Furnish & Install Kayak launch and boardwalk at Wagner Park (ADA Accessible)	LS	1	$ 57,000.00	$ 57,000.00
Subtotal:					$4,054,490
				Contingency of 30%	$1,216,347
				Construction Total:	**$5,270,837**
				Engineering Total (Design, Bidding, and Construction Administration)	**$790,626**
				Project Total:	**$6,061,463**

Appendix D

Pre-Dredging Study

Echo Lake Pre-Dredging Study

City of Burlington
Racine County, Wisconsin

Prepared for:

City of Burlington

June 2021

Echo Lake Pre-Dredging Study

City of Burlington
Racine County, WI

June 2021

AYRES

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Ashwaubenon, WI 54115
920.498.1200
www.AyresAssociates.com

Ayres Project No. 26-1258.00
File: i:\26\burlington city of dam\26-1258.00 echo lake pre-dredging study\report\echo lake pre-dredging study.docx

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1. Introduction

Echo Lake is 70-acre reservoir that is fed by the White River and Honey Creek. The lake is controlled by the 300-foot-long Burlington (Echo Lake) Dam located at the southeast end near the Milwaukee Avenue bridge. After leaving the dam, the White River joins the Fox River approximately 0.25 miles downstream.

The City of Burlington is considering adaptive management options to control phosphorus levels in its waterways. One option of interest is possibly dredging Echo Lake to remove phosphorus-contaminated sediments. Sediment removal may also have a secondary benefit of improving recreational opportunities in Echo Lake. Ayres was retained to complete a pre-dredging study which included surveying the impoundment, estimating sediment volumes, estimating the total phosphorus load, and identifying other significant contaminants within the sediment.

A sediment sampling plan was prepared and submitted to the Wisconsin Department of Natural Resources (DNR) on April 13, 2021. Ayres requested follow up on April 26th and 28th prior to the scheduled survey but no response was provided.

2. Survey Conditions

The bathymetric survey and sampling were completed on April 29, 2021 with Ayres arriving onsite at 9:30 AM and departing around 4:45 PM. *Table **1*** lists the Milwaukee Mitchell International Airport weather during the survey period.

Table 1. Milwaukee International Airport weather during the survey period

	April 29, 2021
Precipitation	0
Maximum temperature	62 F
Minimum temperature	53 F
Maximum windspeed	12 mph

Ayres was unable to survey the entire lake due to shallow water depths and/or obstructions (e.g., fallen trees along the shore). Generally, shallow areas with less than 1 foot of water depth were not surveyable. Ayres did attempt to survey the outer limits of the shallow areas so that their extents would be accurately represented in the lake bathymetry.

3. Survey Methods and Data Processing

Ayres survey equipment used to complete the survey are presented in *Table **2***.

The depth soundings were obtained using a dual-frequency echosounder that was positioned with a submeter global positioning system (GPS). The collected soundings were displayed in real time by Hypack Max 2021 to provide quality control of collected data. Over 10,000 depth soundings were collected during the survey but approximately 2,200 soundings were filtered out during post processing. Soundings were filtered first in Hypack Max to remove excessive bed roughness, fish and water column obstructions, anomalous propagation (multiple reflections of sonar beam off bed and water surface), and other common hydrographic survey errors.

Table 2. Equipment used during survey of Echo Lake

	Survey Equipment
Echosounder	Sonarmite DFX 200kHz/33kHz
Connection Method	RS232 / Hypack Max 2021
Positioning	Trimble GeoXH GNSS
Land Survey	Trimble Geo7x RTK
Boat Length	14 feet
Boat Motor	8HP Mercury
Sediment Sampler	AMS Multistage Sampler
Sediment Probes	Survey Range Poles

In *Figure **1***, the blue dots are 33-kilohertz data points, which tend to penetrate leaf litter and sediment fluff, while the red dots show 200-kilohertz data points that do not penetrate into the bed. Sediment fluff is the detritus, finer silty sediment, and biota that has the consistency of thick soup. Generally, the 200-kilohertz signal will bounce off the fluff while the 33-kilohertz signal tends to have a peak return from the slightly more compacted sediment. A depth check was done multiple times with a survey rod to confirm the 33-kilohertz depth readings were correctly recorded in Hypack.

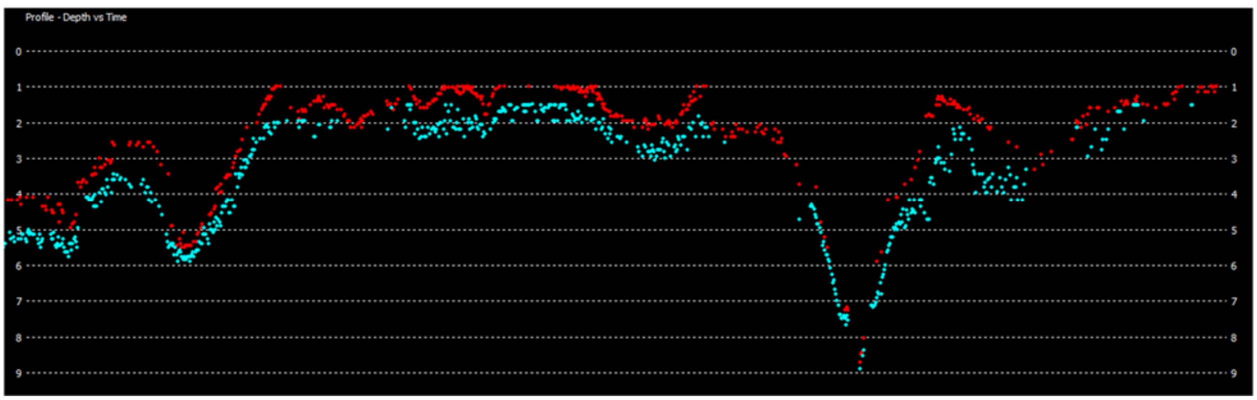


Figure 1. Single Beam Max showing dual-frequency echosounder soundings plotting depth over time

The processed data were then exported to a comma-separated values file and Excel was used to correct for the draft of the sounder from the water surface and to convert the depth soundings into elevations. The sounder was positioned below the water surface approximately 9 inches while surveying. Each depth was increased by 9 inches and then subtracted from the surveyed water surface elevation of 762.15 feet NAVD88. The water surface elevation was obtained by using the Trimble Geo7x RTK survey grade GPS. The nearby NGS benchmark located on the dam was also shot to confirm the water surface accuracy.

The last step in processing was to import all the Excel data to AutoCAD 2018 Civil 3D to add the water's edge breaklines (based on 2010 Racine County 2-ft contour LiDAR data), structure breaklines (edges of the dam), and island breaklines. After using breaklines, data points are replotted to check for anomalies like shoreline zigzags that reflect lateral transects or spikes in contours where two transects cross and have slightly different elevations. These artificial surface flaws are corrected by deleting the points thought to be least reliable or adding breaklines to eliminate excessively narrow triangulation.

After the data set produces a reasonable set of contours, the jaggedness of contours is removed through gridding. This final process helps create smoother 1-foot contours. The final bathymetric map is shown in Appendix A. In general, depths in the lake average about 2 feet.

4. Sediment Sampling Results

Six samples were collected during the survey with an AMS multistage sediment sampler. Pace Analytical Laboratories in Green Bay were retained to conduct the sediment testing. Pace provided the necessary sample collection jars/bags and transportation cooler to facilitate the sampling. All samples were delivered to Pace on ice the same day as collected. Sample locations are shown in the Appendix A *2021 Probe and Samples Map* drawing.

Samples #1 and #4 were collected near or within the assumed original lake bed, and samples #2 and #5 were collected in sediment that is likely to be dredged. Samples #3 and #6 were also collected in sediment that is likely to be dredged but were only tested for phosphorus, while the remaining samples were tested for all the proposed analytes including phosphorus (see the Sediment Sampling Plan in Appendix B). The summarized sampling results that were entered into the DNR's residual contaminant levels (RCLs) spreadsheet are shown in *Table **3***, and the complete sampling report created by Pace is provided in Appendix B.

The testing results showed several metals above Groundwater RCL (*italic red*), but there are no exceedances detected for non-industrial or industrial RCLs. The Cumulative Risk Calculation does not appear to propose any concern either, but the full sampling results will be submitted to the DNR for review and final determination of direct contact risks.

5. Sediment Volume

Sediment depth was estimated by pushing survey range poles into the sediment until refusal. The depths were measured from the water surface and recorded with the Trimble GeoXH GPS. The depths were later converted into elevations in Excel and imported into AutoCAD 2018 Civil 3D to create a refusal surface.

A volume computing comparison surface was created to estimate the total sediment in the entire lake from the boat landing on Bieneman Road to the dam. This surface was created by comparing the very top of the sediment (red dots, 200kHz) to the refusal surface (probes), which calculated approximately 279,645 cubic yards of accumulated material.

Two more volume computing comparison surfaces were created to estimate the volumes of potential dredge material. For these computations, we considered a feasible dredging area to be the lake from the railroad trestle to the dam. Within this dredging area, we set the dredged lake bottom elevation to a uniform 758.0 ft, which would result in approximately 4 ft of water depth throughout. The first surface was the very top of sediment (red dots, 200kHz) compared to the proposed dredge contours which calculated approximately 130,482 cubic yards of material that could be dredged. This volume includes the top sediment fluff that would likely compact down or be flushed out of the reservoir during drawdown. The second surface of the slightly more compacted sediment (blue dots, 33kHz) was compared to the proposed dredge contours which calculated approximately 99,980 cubic yards of material. Ayres used the average volume of 115,231 to the estimate the sediment that could be dredged for recreational purposes and phosphorus removal.

Table 3. Summarized sediment sampling results for Echo Lake

Summary of Soil Analytical Results Echo Lake Pre-Dredging Study											
		Samples									
		1	**2**	**3**	**4**	**5**	**6**				
		Lake Bed	Sediment	Sediment	Lake Bed	Sediment	Sediment				
	Date	4/29/21	4/29/21	4/29/21	4/29/21	4/29/21	4/29/21				
	Soil Type	Silt	Silt	n/a	Silt	Silt	n/a	**NR 720 WDNR Spreadsheet RCLs**			
Parameter	**CAS**							**Non-industrial Direct Contact**	**Industrial Direct Contact**	**Protection of Ground Water**	**Back Ground Threshold Value**
Metals											
Arsenic	7440-38-2	6.5	7.0	---	5.5	8.0	---	0.677	3	0.584	8
Barium	7440-39-3	134	97.0	---	134	109	---	15,300	100,000	164.8	364
Cadmium	7440-43-9	*1.2 J*	*1.3 J*	---	0.58 J	0.48 J	---	71.1	985	0.752	1
Chromium	7440-47-3	24.8	51.1	---	23.7	26.9	---	100,000	100,000	360,000	44
Copper	7440-50-8	15.8	15.1	---	16.5	16.1	---	3,130	46,700	92	35
Lead	7439-92-1	18.7	18.1	---	24.3	26.9	---	400	800	27	52
Manganese	7439-96-5	744	477	---	654	473	---	1,830	---	---	2,937
Mercury	7439-97-6	0.17	0.18	---	*0.21*	0.19	---	3.13	3.13	0.208	---
Nickel	91-20-3	16.9	*56.6*	---	16.6	27.5	---	1,550	22,500	13.061	31
Selenium	7782-49-2	*3.7*	*3.1*	---	*2.9*	*2.7*	---	391	5,840	0.52	---
Zinc	7440-66-6	74.7	63.5	---	79.6	76.0	---	23,500	100,000	---	150
Nutrients											
Phosphorus	7723-14-0	965	1330	1710	738	803	873	---	---	---	---
Nitrogen, Ammonia	7664-41-7	293	621	---	468	264	---	---	---	---	---
Nitrogen, Kjeldahl, Total	7727-37-9	4380	5090	---	4360	4000	---	---	---	---	---
Mean Total Organic Carbon	7440-44-0	46900	66200	---	52400	46300	---	---	---	---	---
Total Organic Carbon	7440-44-0	48000	78200	---	55300	47400	---	---	---	---	---
Polychlorinated Biphenyls (PCBs)											
PCB, Total	1336-36-3	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
PCB-1016 (Aroclor 1016)	12674-11-2	<0.0319	<0.0400	---	<0.0304	<0.0309	---	4.11	51.30	---	---
PCB-1221 (Aroclor 1221)	11104-28-2	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
PCB-1232 (Aroclor 1232)	11141-16-5	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
PCB-1242 (Aroclor 1242)	53469-21-9	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
PCB-1248 (Aroclor 1248)	12672-29-6	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
PCB-1254 (Aroclor 1254)	11097-69-1	<0.0319	<0.0400	---	<0.0304	<0.0309	---	1.17	14.70	---	---
PCB-1260 (Aroclor 1260)	11096-82-5	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
Polycyclic Aromatic Hydrocarbons (PAHs)											
1-Methylnaphthalene	90-12-0	<0.0051	<0.0064	---	0.0243 J	<0.0050	---	4,180	52,700	---	---
Acenaphthene	83-32-9	<0.0045	<0.0057	---	<0.0043	<0.0044	---	3,590	45,200	---	---
Acenaphthylene	208-96-8	<0.0044	<0.0055	---	0.0055 J	<0.0043	---	---	---	---	---
Anthracene	120-12-7	<0.0045	0.0241 J	---	0.0098 J	0.0350	---	17,900	100,000	196.94915	---
Benzo(a)anthracene	56-55-3	<0.0040	0.0202 J	---	0.0055 J	0.0356	---	1.14	20.8	---	---
Benzo(a)pyrene	50-32-8	<0.0049	0.0250 J	---	0.0103 J	0.0511	---	0.115	2.11	0.47	---
Benzo(b)fluoranthene	205-99-2	<0.0041	0.0143 J	---	0.0055 J	0.0258 J	---	1.15	21.1	0.4780876	---
Benzo(g,h,i)perylene	191-24-2	<0.0061	0.0129 J	---	<0.0059	0.0234 J	---	---	---	---	---
Benzo(k)fluoranthene	207-08-9	<0.0045	0.0137 J	---	0.0045 J	0.0182 J	---	11.5	211	---	---
Chrysene	218-01-9	<0.0066	0.0248 J	---	0.0095 J	0.0402	---	115	2110	0.1442231	---
Dibenz(a,h)anthracene	53-70-3	<0.0048	<0.0061	---	<0.0046	0.0074 J	---	0.115	2.11	---	---
Fluoranthene	206-44-0	<0.0041	0.0548	---	0.0282 J	0.0859	---	2,390	30,100	88.877805	---
Fluorene	86-73-7	<0.0042	<0.0052	---	0.0094 J	<0.0041	---	2,390	30,100	14.829932	---
Indeno(1,2,3-cd)pyrene	193-39-5	<0.0073	0.0115 J	---	<0.0070	0.0220 J	---	1.15	21.1	---	---
Naphthalene	91-20-3	<0.0034	<0.0043	---	0.0232 J	<0.0033	---	5.52	24.1	0.6581818	---
Phenanthrene	85-01-8	<0.0040	0.0328 J	---	0.0242 J	0.0386	---	---	---	---	---
Pyrene	129-00-0	<0.0051	0.0450	---	0.0223 J	0.0697	---	1,790	22,600	54.545455	---
Cumulative Risk Calculation (Non-Industrial Direct Contact)											
Exceedances		0	0	---	0	0	---	1	1	---	---
Hazard Index		0.0724	0.1193	---	0.0546	0.0550	---	1	1	---	---
Cancer Risk		1.1E-06	1.5E-06	---	1.1E-06	1.1E-04	---	1.00E-05	1.00E-05	---	---

Notes:
Samples 3 and 6 only analyzed for Phosphorus
J = Estimated concrentration at or above the Limit of Detection and below the Limit of Quantification
< = less than detection limit (analyte not detected)
Groundw ater RCL exceedances are in *Italic red* font
Non-Industrial Direct Contact RCL exceedances are in **bold red** font
Industrial RCL exceedances are boxed.

6. Phosphorous Load

A total of six samples were tested for phosphorus with two of the samples collected in assumed lake bed material and four samples located in more recently deposited sediment that could potentially be dredged. Sample 6 was taken upstream of the railroad bridge and the current dredging plans do not propose dredging upstream of the bridge. The phosphorus testing results of the three sediment samples within the proposed dredge area showed an average of 1,281 mg/kg of phosphorus within the sediment. Ayres estimates approximately 502,000 pounds of phosphorous will be removed if 115,231 cubic yards of sediment is dredged from the impoundment. The calculation is shown in *Table **4*** and provided in Appendix B.

Table 4. Estimated phosphorus load within proposed dredged sediment

Dredge volume estimate	115,231 cy	(average of 33/200kHz sediment surfaces)
Avg sediment density	2,018 kg/m^3	(average value from "Earth Manual" correlating to testing results)
Phosphorus in sediment	1,281 mg/kg	(average of 3 sediment samples within dredge area (not lake bed samples))

Phosphorus Load Estimate Calculation	115,231 cy	x	0.764554858 m^3/cy	=	88,100.42 m^3
	88,100.42 m^3	x	2,018 kg/m^3	=	177,786,649.26 kg
	177,786,649.26 kg	x	1,281 mg/kg	=	227,744,697,701.49 mg
	227,744,697,701.49 mg	x	0.000002204 lb/mg	=	501,949.31 lb of phosphorus in sediment

7. Opinion of Probable Cost

The Opinion of Probable Costs is based on dredging the main portion of Echo Lake from the railroad trestle to Milwaukee Avenue and the dam. At this time, Ayres anticipates that dredging upstream of the railroad bridge may be infeasible because it would increase the total project cost significantly. The railroad trestle has insufficient clearance to allow contractors to mobilize between upstream and downstream dredging areas. Therefore, two separate offloading and staging areas would likely be required, which would result in significant additional mobilization costs. However, if the City is interested in dredging upstream of the railroad trestle, Ayres can provide sediment volume and phosphorus loading calculations to support the expanded scope.

The dredge area as shown in the *Proposed Dredge Map* drawing (Appendix A) depicts a dredge bottom elevation of 758.0 ft which would provide approximately 4 feet of water depth in the lake between the trestle and the dam. Elevation 758.0 ft was also proposed because it was the sediment probe elevation where most refusals occurred. The DNR does not allow dredging within 10 feet of the shoreline. This no-dredge buffer allows for fish and other aquatic animals' habitat to remain undisturbed. Ayres recommends extending the no dredge buffer to 15 feet to account for LiDAR inconsistencies and to provide the contractor some leeway to maintain the minimum buffer distance. The dredging side slope starts at the edge of the 15-foot no-dredge buffer and extends 3 feet horizonal to 1 foot vertical until reaching the dredge bottom elevation of 758.0 ft.

This Opinion of Probable calculation breakdown is provided in *Table **5***. As shown, Ayres estimates the total cost to dredge the lake as described above to be approximately $2.5 million. The cost estimate is based on RS Means Heavy Construction Cost Data from 2020, but the resulting cost per cubic yard of sediment removal (about $22 per cubic yard) is consistent in magnitude with what we have encountered for other local and comparable dredging projects. The cost estimate assumes mechanical dredging in the winter after the lake has been drawn down, and that the City will secure a nearby offloading and staging area and a disposal site within 2 miles of the lake. Several other Ayres dredging clients have found local farmers willing to accept the nutrient-rich sediment to be spread on agricultural fields. The sediment testing results indicate that disposal of dredged sediments on agricultural fields should be acceptable as no dangerous levels of contamination were encountered. However, the DNR must ultimately approve of any disposal sites chosen for the project.

Table 5. Opinion of probable cost for dredging

Opinion of Probable Cost

May-21

Project: Echo Lake Pre-Dredging Study
Client: City of Burlington
Location: Racine County, WI
Project No.: 26-1258.00

References: 1.) *Heavy Construction Cost Data*. RSMeans. 34th Annual Edition. 2020.

RS Means Item Number and Description		Unit	Quantity	2020 Bare Costs				Total Incl O&P	Total Item Cost Incl O&P	Notes:
				Material	Labor	Equipment	Total			
Division 35-Waterway and Marine										
35 24 23.13	**Dredging**									
1100	Mobilization	Total	1		31,000	29000.00	60,200	78,500	$ 78,500.00	*assumes nearby offloading site
0510	Mechanical dredging	C.Y.	115231		4.85	3.35	8.20	12.1	$ 1,394,295.10	
Division 31 - Earthwork										
31 23 23.20	**Hauling**									
1050	12CY truck, 30 mph, cycle 4 miles	C.Y.	115231		1.55	2.27	3.82	4.83	$ 556,565.73	*assumes clean sediment & nearby farm field for disposal
Misc										
	Offloading Site Preparation	L.S.	1						$ 10,000.00	
	Offloading Site Restoration	L.S.	1						$ 5,000.00	
									$ 2,044,360.83	
								Subtotal for All Divisions =	**$ 2,044,360.83**	
								Contingency (20%) =	**$ 408,872.17**	
								Total Construction Cost =	**$ 2,453,233.00**	

8. Recommendation

If the City would like to pursue dredging, the next step is to identify potential staging/offloading areas and disposal site options. Once these sites have been selected and 90% final dredging plans and specifications have been prepared, a pre-permit application can be submitted to the DNR to initiate the Individual Dredging Permit application process.

9. Conclusions

Surveyed water depths within Echo Lake were generally in the 1- to 2-foot range below the assumed normal lake elevation of 762.15 feet NAVD88. Dredging of the main portion of the lake as described previously will increase these depths to about 4 feet and will decrease the phosphorous load in the lake sediments by an estimated 502,000 pounds.

Ayres appreciates the opportunity to complete this pre-dredging study. As with all studies, Ayres has based the opinions rendered herein on data reviewed at the time this report was published, and it may be possible that additional data unavailable to Ayres at publishing will change our opinions. If additional new data is found that contradicts this report, please provide to Ayres so that we can re-evaluate our opinions.

Appendix A: Drawings

HYDROSURVEY NOTES:

1. BENCHMARK INFORMATION: NGS PID DF9471 ELEVATION 762.41 FEET, NAVD88. DISK LOCATED ON SPILLWAY WALL.
2. WATER SURFACE ELEVATION (4/29/2021): 762.15 FEET.
3. SOUNDINGS WERE OBTAINED USING A DUAL FREQUENCY ECHOSOUNDER (200\33 kHz) AND POSITIONED WITH A TRIMBLE GEOHX GPS.
4. ALL DEPTHS ARE IN FEET AND ARE REFERENCE TO THE WATER SURFACE ELEVATION STATED ABOVE.
5. BASE MAP INFORMATION SHOWN ON THIS DRAWING SHALL BE CONSIDERED APPROXIMATE.

DES BY RJW				NOT FOR CONSTRUCTION	----		
DR BY RJW	PROJ NO 26-1258.00	----			----		
CHK BY AJS	DATE MAY 2021	----			----		
		NO	DATE	REVISION	NO	DATE	REVISION

ECHO LAKE PRE-DREDGING STUDY
CITY OF BURLINGTON
RACINE COUNTY, WISCONSIN

AYRES
EAU CLAIRE, WI

2021 BATHYMETRIC MAP

SHEET NO. 1

AA-Standard.stb
5/5/2021
I:\26\Burlington City of Dam\26-1258.00 Echo Lake Pre-Dredging Study\CAD\Echo Lake Pre-Dredging Study.dwg, Layout: 2021 BATHYMETRIC MAP

PROBE AND SAMPLING NOTES:

1. BENCHMARK INFORMATION: NGS PID DF9471 ELEVATION 762.41 FEET, NAVD88. DISK LOCATED ON SPILLWAY WALL.
2. WATER SURFACE ELEVATION (4/29/2021): 762.15 FEET.
3. SEDIMENT DEPTH WAS DETERMINED BY PUSHING SURVEY POLES INTO THE SEDIMENT UNTIL REFUSAL. DEPTH WAS MEASURED FROM WATER SURFACE.
4. SAMPLES WERE OBTAINED BY USING AN AMS MULTISTAGE SEDIMENT SAMPLER.
5. BASE MAP INFORMATION SHOWN ON THIS DRAWING SHALL BE CONSIDERED APPROXIMATE.

DES BY	RJW		NOT FOR CONSTRUCTION		
DR BY	RJW	PROJ NO 26-1258.00			
CHK BY	AJS	DATE MAY 2021	NO	DATE	REVISION

NO	DATE	REVISION

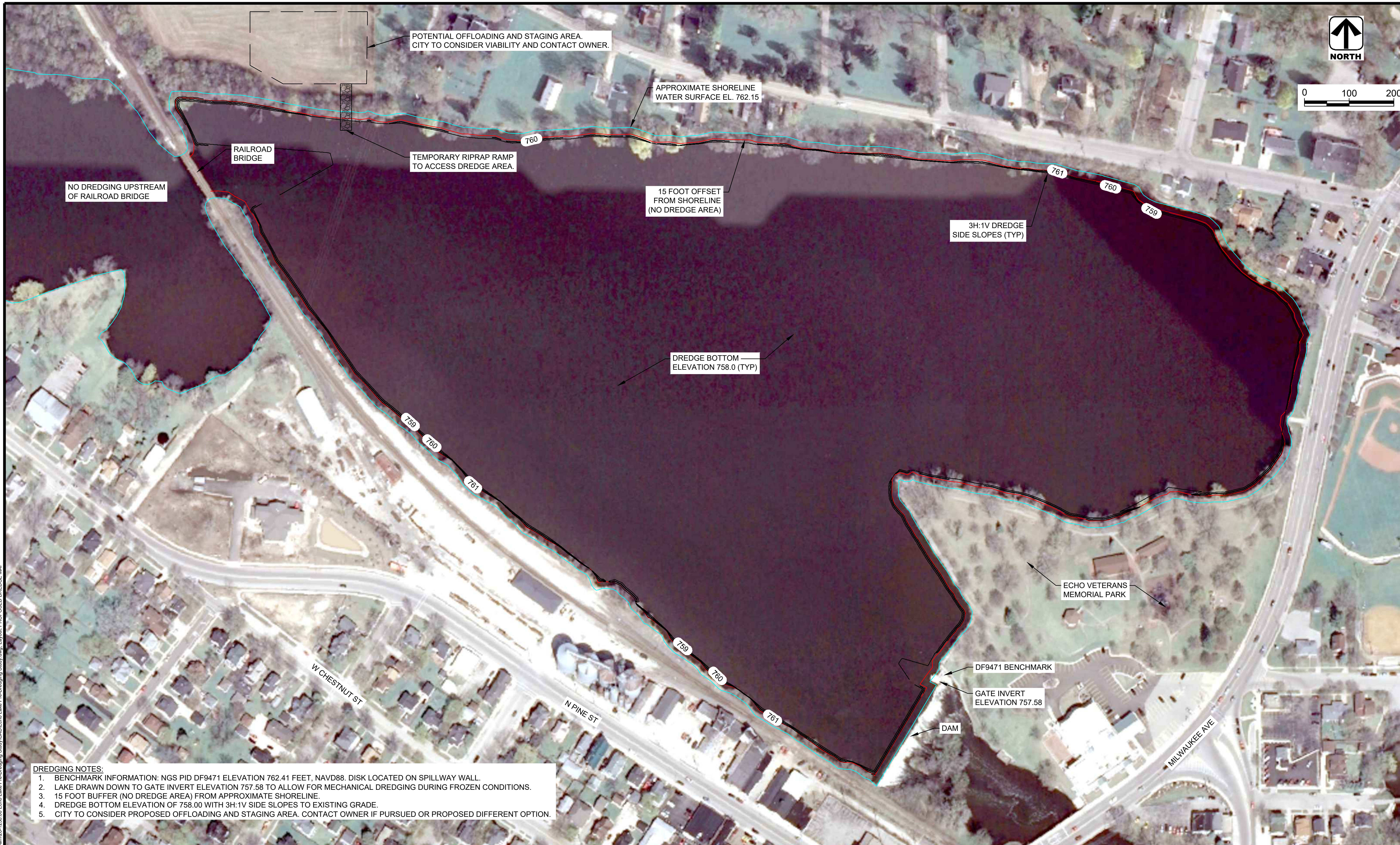
ECHO LAKE PRE-DREDGING STUDY
CITY OF BURLINGTON
RACINE COUNTY, WISCONSIN

AYRES
EAU CLAIRE, WI

2021 PROBE AND SAMPLES MAP

SHEET NO. 2

AA-Standard.stb
5/5/2021
I:\26\Burlington City of Dam\26-1258.00 Echo Lake Pre-Dredging Study\CAD\Echo Lake Pre-Dredging Study.dwg, Layout: 2021 PROBE AND SAMPLES MAP



DREDGING NOTES:

1. BENCHMARK INFORMATION: NGS PID DF9471 ELEVATION 762.41 FEET, NAVD88. DISK LOCATED ON SPILLWAY WALL.
2. LAKE DRAWN DOWN TO GATE INVERT ELEVATION 757.58 TO ALLOW FOR MECHANICAL DREDGING DURING FROZEN CONDITIONS.
3. 15 FOOT BUFFER (NO DREDGE AREA) FROM APPROXIMATE SHORELINE.
4. DREDGE BOTTOM ELEVATION OF 758.00 WITH 3H:1V SIDE SLOPES TO EXISTING GRADE.
5. CITY TO CONSIDER PROPOSED OFFLOADING AND STAGING AREA. CONTACT OWNER IF PURSUED OR PROPOSED DIFFERENT OPTION.

AA-Standard stb
5/26/2021
I:\26\Burlington City of Dam\26-1258.00 Echo Lake Pre-Dredging Study\CAD\Echo Lake Pre-Dredging Study.dwg, Layout: PROPOSED DREDGE MAP

DES BY	RJW			NOT FOR CONSTRUCTION	
DR BY	RJW	PROJ NO	26-1258.00		
CHK BY	AJS	DATE	MAY 2021	NO / DATE / REVISION	NO / DATE / REVISION

ECHO LAKE PRE-DREDGING STUDY
CITY OF BURLINGTON
RACINE COUNTY, WISCONSIN

AYRES
EAU CLAIRE, WI

PROPOSED DREDGE MAP

SHEET NO. 3

Appendix B: Sediment Sampling Information

From:	Wayne, Robert
To:	"theresa.alvarez@wisconsin.gov"
Cc:	Schneider, Adam; "priggs@burlington-wi.gov"
Subject:	FW: Echo Lake Sampling Plan - City of Burlington
Date:	Monday, April 26, 2021 10:29:00 AM
Attachments:	Echo Lake Sampling Plan.pdf image001.png image002.png image003.png image004.png

---

Hi Theresa,

We are looking at surveying and sampling on Thursday 4/26. Do you have any modifications to the sampling plan?

Thanks,

Rob

Robert J Wayne
Environmental Scientist

Ayres Associates Inc
Office: 715.834.3161 | **Direct:** 715.831.7506
WayneR@AyresAssociates.com
www.AyresAssociates.com

From: Wayne, Robert
Sent: Tuesday, April 13, 2021 4:08 PM
To: theresa.alvarez@wisconsin.gov
Cc: Schneider, Adam <SchneiderA@ayresassociates.com>; priggs@burlington-wi.gov
Subject: Echo Lake Sampling Plan - City of Burlington

Hi Theresa,

Please see the attached sediment sampling plan for Echo Lake in the City of Burlington.

Let us know if you have any questions.

Thanks,

Rob

Ayres

Robert J Wayne | **Environmental Scientist**
Office: 715.834.3161 | **Direct:** 715.831.7506
3433 Oakwood Hills Parkway | Eau Claire, WI 54701-7698
Ayres Associates Inc | www.AyresAssociates.com

Ingenuity, Integrity, and Intelligence.

AYRES

Ingenuity, Integrity,
and Intelligence.

April 13, 2021

Theresa Alvarez
Wisconsin Department of Natural Resources
Milwaukee Service Center
2300 North Dr Martin Luther King Jr Drive
Milwaukee, WI 53212

Submitted via email: theresa.alvarez@wisconsin.gov

Subject: Echo Lake Sampling Plan, Racine County

Dear Ms. Alvarez,

The purpose of this letter is to submit a sampling and analysis plan for the dredging of Echo Lake in the City of Burlington, Wisconsin. The City of Burlington is considering adaptive management options to control phosphorus levels in its waterways. One option of interest is possibly dredging Echo Lake to remove phosphate-contaminated sediments. Sediment removal may also have a secondary benefit of improving recreational opportunities in the lake. The sampling is planned to occur concurrently with a sediment profile survey which we are tentatively planning on the week of April 26, 2021. The sediment profile survey will provide a basis for estimating a potential volumetric range of sediment that could be dredged from Echo Lake.

Please approve or advise modifications to the attached sediment sampling and analysis plan.

If the plan is approved, the completed sampling report and analytical results will be submitted to your office.

Sincerely,

Ayres Associates Inc

Adam Schneider, PE
Project Manager
920-327-7842
SchneiderA@AyresAssociates.com

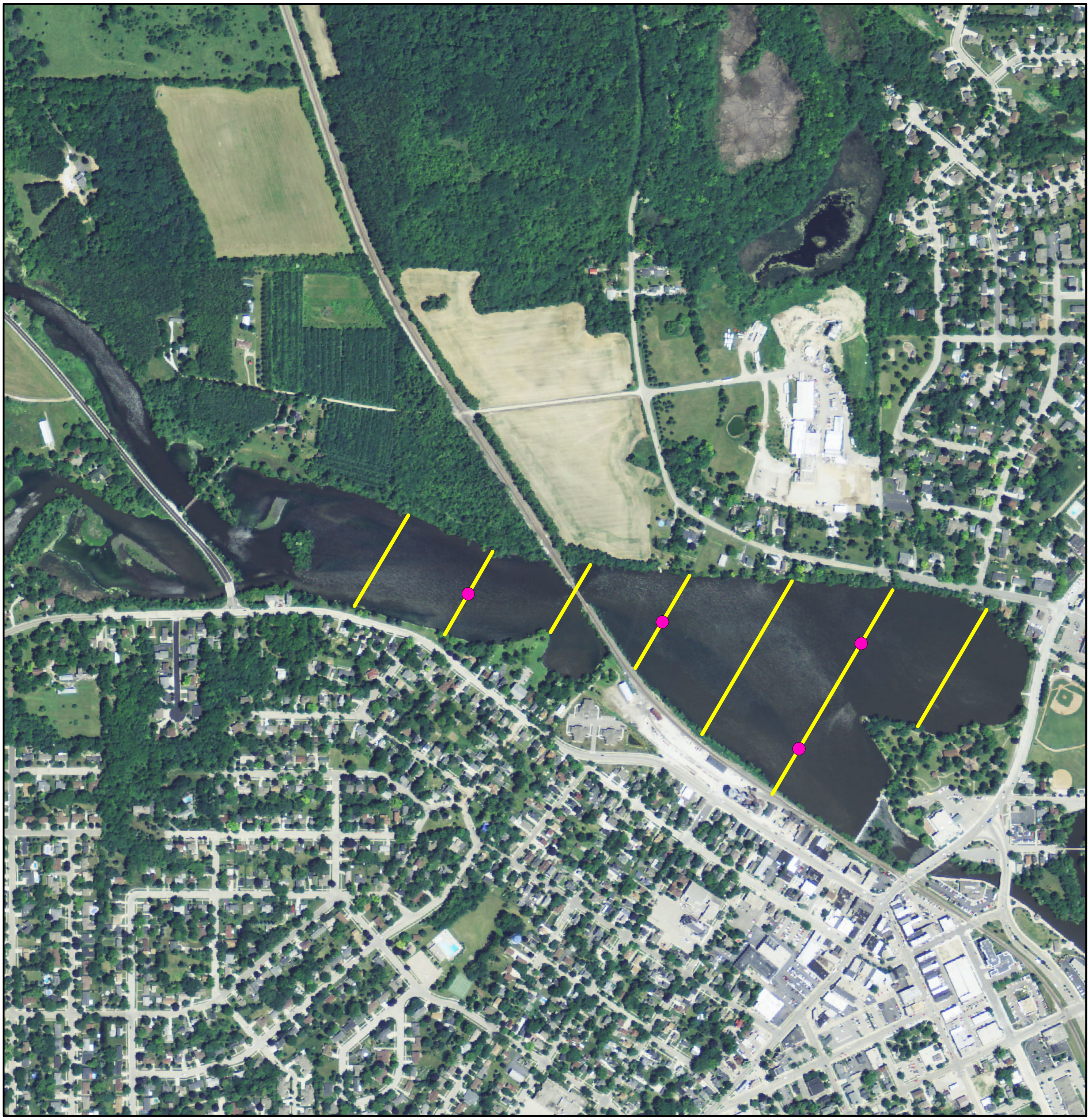
Sediment Sampling and Analysis Plan
Echo Lake – Burlington, WI

Preliminary Application Summary, per NR 347.05:

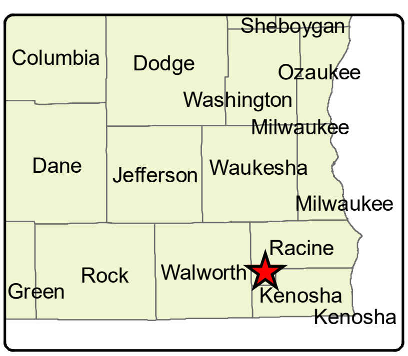
- Name of waterbody and project location:
    - Echo Lake– Located in the City of Burlington
- Volume of material to be dredged:
    - Purpose of this study is to determine the volumetric build-up of sediment in Echo Lake to more accurately determine amount of sediment that could be dredged.
- Dredging method and disposal method:
    - Mechanical dredging is assumed method. The City of Burlington is currently looking into disposal site options.
- Brief description of known historical chemical use in the waterbody for vegetation / algae control, including year, chemical, and amount applied:
    - It is unknown if chemicals were previously used to treat Echo Lake.
    - Most land in the Echo Lake watershed is agriculture (44.8%), forest (14.4%), wetland (11.3%) and other uses (29.5%).
- Any previous sediment sampling:
    - Unknown.
- Copy of a map showing area to be dredged, depth of cut, and proposed sediment sampling site, bathymetry of area to be dredged:
    - See attached map for proposed sediment sampling locations and cross sections for probing sediment depths. Exact locations may vary due to field conditions. Bathymetry of existing Echo Lake will be mapped during the sediment sampling work.
- Anticipated starting and completion dates of the proposed project:
    - Preliminary Design by September 2021

Sampling and Analysis Plan:

- Parameters to be analyzed for, including analytical methods and detection levels:
    - See highlighted rows in attached Table 1.
- Planned sample and cross section locations:
    - We plan to collect sediment and lakebed samples at 2 locations (4 total samples) and collect only sediment samples at 2 additional locations (2 total samples). This will result in 4 total sediment samples and 2 total lakebed samples.
    - Along each cross-section line, a probe will be extended to the bottom of the impoundment to measure the top elevation of the bed. Then, the probe will be hand-pushed into the sediment until refusal to measure depth to 'hard bottom'.
- Sampling methods and sample handling procedures:
    - Sampling will be done from a boat with a AMS multistage sampler.
    - Sampling will be completed in accordance with section 6.2 of the referenced document, *Guidance for Applying the Sediment Sampling and Analysis Requirements of Chapter NR 347, Wisconsin Administrative Code.*
- Analytical laboratory certified under NR 149, Adm. Code to conduct parameter analysis.
    - Samples will be tested at a WI DNR approved lab.
        - Pace Analytical Services, LLC in Green Bay, WI.



Sediment Sample Plan
Echo Lake



Location
City of Burlington
Racine County, Wisconsin

0 500 1,000
Feet

Legend
Sediment Sample Locations
Cross Sections

Ingenuity, Integrity, and Intelligence.

Echo Lake Sediment Sampling - Planned Samples include all highlighted fields.

Table 1. Sediment Sampling Parameters with Suggested Methods and Analyses

Parameter	Suggested Analytical Method (Suggested Detection Level) *(mg/kg, dry weight unless noted)*	Suggested Base Parameter Analyses[1]	
		Great Lakes or Urban/ Industrial	Inland Waters (Rural/ Forested)
Inorganics – Metals			
Arsenic	SW-846 3050B/6010B EPA 6010 or 7060 (5)	X	X
Barium	SW-846 3050B/6010B (0.2)		
Cadmium	SW-846 3050B/6010B EPA 7131 (0.6)	X	X
Chromium (total)	SW-846 3050B/6010B EPA 6010 or 7191 (0.6)	X	X
Copper	SW-846 3050B/6010B EPA 6010 or 7211 (0.5)	X	X
Cyanide	SW-846 9010B/9014 (0.4)		
Lead	SW-846 3050B/6010B EPA 6010 or 7421 (3)	X	X
Manganese	SW-846 3050B/6010B (0.1)		
Mercury	SW-846 7471A EPA 7471 (0.015)	X	X
Nickel	SW-846 3050B/6010B EPA 6010 (2)	X	X
Selenium	SW-846 3050B/6010B (8)	X	
Zinc	SW-846 3050B/6010B EPA 6010 or 7951 (2)	X	X
Inorganics – Nutrients			
Oil & Grease	SW-846 9070	X	
Total Phosphorus	EPA 365.2/365.3 or USGS I-6600-85 (9.9)	X	X
Nitrate + Nitrite	LACHAT 12-107-04-1-B (0.25)	X	X
Ammonia-Nitrogen	LACHAT 12-107-06-1-A (0.16)	X	X
Total Kjeldahl Nitrogen		X	X
Organics			
Aldrin	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)		
Chlordane	SW-846 8081 EPA 8081, 354440B, 3541 (0.009)	X	
Dieldrin	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)		
Endrin	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)		
Heptachlor	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)		
Lindane (Gamma BHC)	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)		

[1] Suggested base parameter list reflects additions to NR347 Table 1, based on scientific research and experience with dredging projects.

Parameter	**Suggested Analytical Method (Suggested Detection Level)** *(mg/kg, dry weight unless noted)*	**Suggested Base Parameter Analyses**[1]	
		Great Lakes or Urban/ Industrial	**Inland Waters (Rural/ Forested)**
DDT	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)	X	
DDD & DDE	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)	X	
Toxaphene	SW-846 8081 (0.01)		
PCBs (Total)	SW-846 8081 EPA 8081, 3540B, 3541 (0.04)	X Tied to Fish Advisories	X
2,3,7,8-dioxin, 2,3,7,8-furan and 15 2,3,7,8-substituted dioxin and furan congeners	EPA 8290 (1 – 10 pg/g)		
Total Organic Carbon	SW 846 8081 SW846-EPA 9060 (0.2%)	X	X
Polycyclic Aromatic Hydrocarbons (PAHs)	EPA 8310	X	
Naphthalene	(0.019)		
Phenanthrene	(0.017)		
Pyrene	(0.012)		
Fluorene	(0.058)		
2-Methylnapthelene			
Acenapthene	(0.017)		
Acenaphthlyene	(0.021)		
Anthracene	(0.0071)		
Benzo (a) anthracene	(0.019)		
Benzo (a) pyrene	(0.023)		
Benzo (e) pyrene			
Benzo (b) fluoranthene	(0.032)		
Benzo (g,h,i) perylene	(0.022)		
Benzo (k) fluoranthene	(0.021)		
Chrysene	(0.0074)		
Dibenzo(a,h)anthracene	(0.008)		
Fluoranthene	(0.029)		
Indeno (1,2,3-cd) pyrene	(0.034)		
Physical Tests			
Particle Size Analysis – Sieve and Hydrometer Analysis	ASTM D-422 (%)	X	X
Moisture Content	ASTM D-2216 (%)	X	X
Atterburg Limits (Liquid Limit and Plastic Limit)	ASTM D4318 (as moisture content)		
Specific Gravity	ASTM D-854 (Ratio, unitless)		

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

May 14, 2021

Robert Wayne
AYRES & ASSOCIATES - EAU CLAIRE
3433 Oakwood Hills Parkway
Eau Claire, WI 54701

RE: Project: ECHO LAKE
Pace Project No.: 40226039

Dear Robert Wayne:

Enclosed are the analytical results for sample(s) received by the laboratory on April 30, 2021. 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 - Green Bay

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

Sincerely,

Dan Milewsky
dan.milewsky@pacelabs.com
(920)469-2436
Project Manager

Enclosures

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

CERTIFICATIONS

Project: ECHO LAKE
Pace Project No.: 40226039

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
Virginia VELAP ID: 460263
South Carolina Certification #: 83006001
Texas Certification #: T104704529-14-1
Wisconsin Certification #: 405132750
Wisconsin DATCP Certification #: 105-444
USDA Soil Permit #: P330-16-00157
Federal Fish & Wildlife Permit #: LE51774A-0

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

SAMPLE SUMMARY

Project: ECHO LAKE
Pace Project No.: 40226039

Lab ID	Sample ID	Matrix	Date Collected	Date Received
40226039001	**S1**	Solid	04/29/21 13:00	04/30/21 07:30
40226039002	**S2**	Solid	04/29/21 13:00	04/30/21 07:30
40226039003	**S3**	Solid	04/29/21 13:00	04/30/21 07:30
40226039004	**S4**	Solid	04/29/21 13:00	04/30/21 07:30
40226039005	**S5**	Solid	04/29/21 13:00	04/30/21 07:30
40226039006	**S6**	Solid	04/29/21 13:00	04/30/21 07:30

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

SAMPLE ANALYTE COUNT

Project: ECHO LAKE
Pace Project No.: 40226039

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
40226039001	**S1**	EPA 8082	BLM	10	PASI-G
		EPA 6020	KXS	10	PASI-G
		EPA 7471	AJT	1	PASI-G
		EPA 8270E by SIM	JJB	20	PASI-G
		ASTM D2974-87	AH	1	PASI-G
		EPA 350.1	TMK	1	PASI-G
		EPA 351.2	TMK	1	PASI-G
		EPA 353.2	DAW	1	PASI-G
		EPA 365.4	DAW	1	PASI-G
		EPA 9060	TJJ	6	PASI-G
40226039002	**S2**	EPA 8082	BLM	10	PASI-G
		EPA 6020	KXS	10	PASI-G
		EPA 7471	AJT	1	PASI-G
		EPA 8270E by SIM	JJB	20	PASI-G
		ASTM D2974-87	AH	1	PASI-G
		EPA 350.1	TMK	1	PASI-G
		EPA 351.2	TMK	1	PASI-G
		EPA 353.2	DAW	1	PASI-G
		EPA 365.4	DAW	1	PASI-G
		EPA 9060	TJJ	6	PASI-G
40226039003	**S3**	ASTM D2974-87	AH	1	PASI-G
		EPA 365.4	DAW	1	PASI-G
40226039004	**S4**	EPA 8082	BLM	10	PASI-G
		EPA 6020	KXS	10	PASI-G
		EPA 7471	AJT	1	PASI-G
		EPA 8270E by SIM	JJB	20	PASI-G
		ASTM D2974-87	AH	1	PASI-G
		EPA 350.1	TMK	1	PASI-G
		EPA 351.2	TMK	1	PASI-G
		EPA 353.2	DAW	1	PASI-G
		EPA 365.4	DAW	1	PASI-G
		EPA 9060	TJJ	6	PASI-G
40226039005	**S5**	EPA 8082	BLM	10	PASI-G
		EPA 6020	KXS	10	PASI-G
		EPA 7471	AJT	1	PASI-G
		EPA 8270E by SIM	JJB	20	PASI-G
		ASTM D2974-87	AH	1	PASI-G

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

SAMPLE ANALYTE COUNT

Project: ECHO LAKE
Pace Project No.: 40226039

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		EPA 350.1	TMK	1	PASI-G
		EPA 351.2	TMK	1	PASI-G
		EPA 353.2	DAW	1	PASI-G
		EPA 365.4	DAW	1	PASI-G
		EPA 9060	TJJ	6	PASI-G
40226039006	**S6**	ASTM D2974-87	AH	1	PASI-G
		EPA 365.4	DAW	1	PASI-G

PASI-G = Pace Analytical Services - Green Bay

Pace Analytical
www.pacelabs.com

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

ANALYTICAL RESULTS

Project: ECHO LAKE
Pace Project No.: 40226039

Sample: S1 **Lab ID: 40226039001** Collected: 04/29/21 13:00 Received: 04/30/21 07:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS PCB	Analytical Method: EPA 8082 Preparation Method: EPA 3541								
	Pace Analytical Services - Green Bay								
PCB-1016 (Aroclor 1016)	**<31.9**	ug/kg	105	31.9	1	05/03/21 06:45	05/04/21 04:14	12674-11-2	
PCB-1221 (Aroclor 1221)	**<31.9**	ug/kg	105	31.9	1	05/03/21 06:45	05/04/21 04:14	11104-28-2	
PCB-1232 (Aroclor 1232)	**<31.9**	ug/kg	105	31.9	1	05/03/21 06:45	05/04/21 04:14	11141-16-5	
PCB-1242 (Aroclor 1242)	**<31.9**	ug/kg	105	31.9	1	05/03/21 06:45	05/04/21 04:14	53469-21-9	
PCB-1248 (Aroclor 1248)	**<31.9**	ug/kg	105	31.9	1	05/03/21 06:45	05/04/21 04:14	12672-29-6	
PCB-1254 (Aroclor 1254)	**<31.9**	ug/kg	105	31.9	1	05/03/21 06:45	05/04/21 04:14	11097-69-1	
PCB-1260 (Aroclor 1260)	**<31.9**	ug/kg	105	31.9	1	05/03/21 06:45	05/04/21 04:14	11096-82-5	
PCB, Total	**<31.9**	ug/kg	105	31.9	1	05/03/21 06:45	05/04/21 04:14	1336-36-3	
Surrogates									
Tetrachloro-m-xylene (S)	83	%	67-102		1	05/03/21 06:45	05/04/21 04:14	877-09-8	
Decachlorobiphenyl (S)	84	%	47-114		1	05/03/21 06:45	05/04/21 04:14	2051-24-3	
6020 MET ICPMS	Analytical Method: EPA 6020 Preparation Method: EPA 3050								
	Pace Analytical Services - Green Bay								
Arsenic	**6.5**	mg/kg	1.8	0.55	6.667	05/05/21 06:46	05/07/21 11:38	7440-38-2	
Barium	**134**	mg/kg	1.8	0.55	6.667	05/05/21 06:46	05/07/21 11:38	7440-39-3	
Cadmium	**1.2J**	mg/kg	1.4	0.20	6.667	05/05/21 06:46	05/07/21 11:38	7440-43-9	D3
Chromium	**24.8**	mg/kg	4.2	1.3	6.667	05/05/21 06:46	05/07/21 11:38	7440-47-3	
Copper	**15.8**	mg/kg	3.7	1.1	6.667	05/05/21 06:46	05/07/21 11:38	7440-50-8	
Lead	**18.7**	mg/kg	1.4	0.38	6.667	05/05/21 06:46	05/07/21 11:38	7439-92-1	
Manganese	**744**	mg/kg	11.5	3.5	20	05/05/21 06:46	05/11/21 09:10	7439-96-5	
Nickel	**16.9**	mg/kg	1.8	0.55	6.667	05/05/21 06:46	05/07/21 11:38	7440-02-0	
Selenium	**3.7**	mg/kg	1.4	0.38	6.667	05/05/21 06:46	05/07/21 11:38	7782-49-2	
Zinc	**74.7**	mg/kg	48.7	14.6	6.667	05/05/21 06:46	05/07/21 11:38	7440-66-6	
7471 Mercury	Analytical Method: EPA 7471 Preparation Method: EPA 7471								
	Pace Analytical Services - Green Bay								
Mercury	**0.17**	mg/kg	0.066	0.019	1	05/10/21 09:19	05/11/21 13:25	7439-97-6	
8270E MSSV PAH by SIM	Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
	Pace Analytical Services - Green Bay								
Acenaphthene	**<4.5**	ug/kg	35.0	4.5	1	05/11/21 07:58	05/12/21 08:07	83-32-9	
Acenaphthylene	**<4.4**	ug/kg	35.0	4.4	1	05/11/21 07:58	05/12/21 08:07	208-96-8	
Anthracene	**<4.3**	ug/kg	35.0	4.3	1	05/11/21 07:58	05/12/21 08:07	120-12-7	
Benzo(a)anthracene	**<4.5**	ug/kg	35.0	4.5	1	05/11/21 07:58	05/12/21 08:07	56-55-3	
Benzo(a)pyrene	**<4.0**	ug/kg	35.0	4.0	1	05/11/21 07:58	05/12/21 08:07	50-32-8	
Benzo(b)fluoranthene	**<4.9**	ug/kg	35.0	4.9	1	05/11/21 07:58	05/12/21 08:07	205-99-2	
Benzo(e)pyrene	**<4.1**	ug/kg	35.0	4.1	1	05/11/21 07:58	05/12/21 08:07	192-97-2	
Benzo(g,h,i)perylene	**<6.1**	ug/kg	35.0	6.1	1	05/11/21 07:58	05/12/21 08:07	191-24-2	
Benzo(k)fluoranthene	**<4.5**	ug/kg	35.0	4.5	1	05/11/21 07:58	05/12/21 08:07	207-08-9	
Chrysene	**<6.6**	ug/kg	35.0	6.6	1	05/11/21 07:58	05/12/21 08:07	218-01-9	
Dibenz(a,h)anthracene	**<4.8**	ug/kg	35.0	4.8	1	05/11/21 07:58	05/12/21 08:07	53-70-3	
Fluoranthene	**<4.1**	ug/kg	35.0	4.1	1	05/11/21 07:58	05/12/21 08:07	206-44-0	
Fluorene	**<4.2**	ug/kg	35.0	4.2	1	05/11/21 07:58	05/12/21 08:07	86-73-7	

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ANALYTICAL RESULTS

Project: ECHO LAKE
Pace Project No.: 40226039

Sample: S1 **Lab ID: 40226039001** Collected: 04/29/21 13:00 Received: 04/30/21 07:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM	Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546 Pace Analytical Services - Green Bay								
Indeno(1,2,3-cd)pyrene	**<7.3**	ug/kg	35.0	7.3	1	05/11/21 07:58	05/12/21 08:07	193-39-5	
1-Methylnaphthalene	**<5.1**	ug/kg	35.0	5.1	1	05/11/21 07:58	05/12/21 08:07	90-12-0	
Naphthalene	**<3.4**	ug/kg	35.0	3.4	1	05/11/21 07:58	05/12/21 08:07	91-20-3	
Phenanthrene	**<4.0**	ug/kg	35.0	4.0	1	05/11/21 07:58	05/12/21 08:07	85-01-8	
Pyrene	**<5.1**	ug/kg	35.0	5.1	1	05/11/21 07:58	05/12/21 08:07	129-00-0	
Surrogates									
2-Fluorobiphenyl (S)	52	%	36-86		1	05/11/21 07:58	05/12/21 08:07	321-60-8	
Terphenyl-d14 (S)	64	%	41-97		1	05/11/21 07:58	05/12/21 08:07	1718-51-0	
Percent Moisture	Analytical Method: ASTM D2974-87 Pace Analytical Services - Green Bay								
Percent Moisture	**52.2**	%	0.10	0.10	1		04/30/21 11:44		
350.1 Ammonia	Analytical Method: EPA 350.1 Preparation Method: EPA 350.1 Pace Analytical Services - Green Bay								
Nitrogen, Ammonia	**293**	mg/kg	43.8	13.1	1	05/06/21 17:20	05/06/21 18:56	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - Green Bay								
Nitrogen, Kjeldahl, Total	**4380**	mg/kg	371	78.6	2	05/04/21 14:20	05/05/21 15:05	7727-37-9	P6
353.2 Nitrogen, NO2/NO3	Analytical Method: EPA 353.2 Preparation Method: EPA 353.2 Pace Analytical Services - Green Bay								
Nitrogen, NO2 plus NO3	**<2.0**	mg/kg	6.6	2.0	1	05/10/21 12:00	05/11/21 14:26		
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - Green Bay								
Phosphorus	**965**	mg/kg	41.7	6.1	1	05/03/21 10:25	05/03/21 16:05	7723-14-0	
Total Organic Carbon Quad	Analytical Method: EPA 9060 Pace Analytical Services - Green Bay								
Total Organic Carbon	**48000**	mg/kg	8210	2460	1		05/14/21 03:42	7440-44-0	
Total Organic Carbon	**46900**	mg/kg	8000	2400	1		05/14/21 03:47	7440-44-0	
Total Organic Carbon	**45700**	mg/kg	8390	2520	1		05/14/21 03:52	7440-44-0	
Total Organic Carbon	**47100**	mg/kg	8460	2540	1		05/14/21 03:58	7440-44-0	
Mean Total Organic Carbon	**46900**	mg/kg	8270	2480	1		05/14/21 03:42	7440-44-0	
Surrogates									
RSD%	**2.0**	%			1		05/14/21 03:42		

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ANALYTICAL RESULTS

Project: ECHO LAKE
Pace Project No.: 40226039

Sample: S2 **Lab ID: 40226039002** Collected: 04/29/21 13:00 Received: 04/30/21 07:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS PCB	Analytical Method: EPA 8082 Preparation Method: EPA 3541 Pace Analytical Services - Green Bay								
PCB-1016 (Aroclor 1016)	**<40.0**	ug/kg	131	40.0	1	05/03/21 06:45	05/04/21 04:38	12674-11-2	
PCB-1221 (Aroclor 1221)	**<40.0**	ug/kg	131	40.0	1	05/03/21 06:45	05/04/21 04:38	11104-28-2	
PCB-1232 (Aroclor 1232)	**<40.0**	ug/kg	131	40.0	1	05/03/21 06:45	05/04/21 04:38	11141-16-5	
PCB-1242 (Aroclor 1242)	**<40.0**	ug/kg	131	40.0	1	05/03/21 06:45	05/04/21 04:38	53469-21-9	
PCB-1248 (Aroclor 1248)	**<40.0**	ug/kg	131	40.0	1	05/03/21 06:45	05/04/21 04:38	12672-29-6	
PCB-1254 (Aroclor 1254)	**<40.0**	ug/kg	131	40.0	1	05/03/21 06:45	05/04/21 04:38	11097-69-1	
PCB-1260 (Aroclor 1260)	**<40.0**	ug/kg	131	40.0	1	05/03/21 06:45	05/04/21 04:38	11096-82-5	
PCB, Total	**<40.0**	ug/kg	131	40.0	1	05/03/21 06:45	05/04/21 04:38	1336-36-3	
Surrogates									
Tetrachloro-m-xylene (S)	84	%	67-102		1	05/03/21 06:45	05/04/21 04:38	877-09-8	
Decachlorobiphenyl (S)	86	%	47-114		1	05/03/21 06:45	05/04/21 04:38	2051-24-3	
6020 MET ICPMS	Analytical Method: EPA 6020 Preparation Method: EPA 3050 Pace Analytical Services - Green Bay								
Arsenic	**7.0**	mg/kg	2.3	0.68	6.667	05/05/21 06:46	05/07/21 12:21	7440-38-2	
Barium	**97.0**	mg/kg	2.2	0.67	6.667	05/05/21 06:46	05/07/21 12:21	7440-39-3	
Cadmium	**1.3J**	mg/kg	1.7	0.25	6.667	05/05/21 06:46	05/07/21 12:21	7440-43-9	D3
Chromium	**51.1**	mg/kg	5.2	1.6	6.667	05/05/21 06:46	05/07/21 12:21	7440-47-3	
Copper	**15.1**	mg/kg	4.6	1.4	6.667	05/05/21 06:46	05/07/21 12:21	7440-50-8	
Lead	**18.1**	mg/kg	1.7	0.46	6.667	05/05/21 06:46	05/07/21 12:21	7439-92-1	
Manganese	**477**	mg/kg	4.7	1.4	6.667	05/05/21 06:46	05/07/21 12:21	7439-96-5	
Nickel	**56.6**	mg/kg	2.3	0.67	6.667	05/05/21 06:46	05/07/21 12:21	7440-02-0	
Selenium	**3.1**	mg/kg	1.7	0.47	6.667	05/05/21 06:46	05/07/21 12:21	7782-49-2	
Zinc	**63.5**	mg/kg	59.5	17.8	6.667	05/05/21 06:46	05/07/21 12:21	7440-66-6	
7471 Mercury	Analytical Method: EPA 7471 Preparation Method: EPA 7471 Pace Analytical Services - Green Bay								
Mercury	**0.18**	mg/kg	0.088	0.025	1	05/10/21 09:19	05/11/21 13:28	7439-97-6	
8270E MSSV PAH by SIM	Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546 Pace Analytical Services - Green Bay								
Acenaphthene	**<5.7**	ug/kg	43.8	5.7	1	05/11/21 07:58	05/12/21 08:24	83-32-9	
Acenaphthylene	**<5.5**	ug/kg	43.8	5.5	1	05/11/21 07:58	05/12/21 08:24	208-96-8	
Anthracene	**5.4J**	ug/kg	43.8	5.4	1	05/11/21 07:58	05/12/21 08:24	120-12-7	
Benzo(a)anthracene	**24.1J**	ug/kg	43.8	5.7	1	05/11/21 07:58	05/12/21 08:24	56-55-3	
Benzo(a)pyrene	**20.2J**	ug/kg	43.8	5.0	1	05/11/21 07:58	05/12/21 08:24	50-32-8	
Benzo(b)fluoranthene	**25.0J**	ug/kg	43.8	6.1	1	05/11/21 07:58	05/12/21 08:24	205-99-2	
Benzo(e)pyrene	**14.3J**	ug/kg	43.8	5.1	1	05/11/21 07:58	05/12/21 08:24	192-97-2	
Benzo(g,h,i)perylene	**12.9J**	ug/kg	43.8	7.7	1	05/11/21 07:58	05/12/21 08:24	191-24-2	
Benzo(k)fluoranthene	**13.7J**	ug/kg	43.8	5.6	1	05/11/21 07:58	05/12/21 08:24	207-08-9	
Chrysene	**24.8J**	ug/kg	43.8	8.3	1	05/11/21 07:58	05/12/21 08:24	218-01-9	
Dibenz(a,h)anthracene	**<6.1**	ug/kg	43.8	6.1	1	05/11/21 07:58	05/12/21 08:24	53-70-3	
Fluoranthene	**54.8**	ug/kg	43.8	5.2	1	05/11/21 07:58	05/12/21 08:24	206-44-0	
Fluorene	**<5.2**	ug/kg	43.8	5.2	1	05/11/21 07:58	05/12/21 08:24	86-73-7	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: ECHO LAKE
Pace Project No.: 40226039

Sample: S2 **Lab ID: 40226039002** Collected: 04/29/21 13:00 Received: 04/30/21 07:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM	Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546 Pace Analytical Services - Green Bay								
Indeno(1,2,3-cd)pyrene	**11.5J**	ug/kg	43.8	9.1	1	05/11/21 07:58	05/12/21 08:24	193-39-5	
1-Methylnaphthalene	**<6.4**	ug/kg	43.8	6.4	1	05/11/21 07:58	05/12/21 08:24	90-12-0	
Naphthalene	**<4.3**	ug/kg	43.8	4.3	1	05/11/21 07:58	05/12/21 08:24	91-20-3	
Phenanthrene	**32.8J**	ug/kg	43.8	5.0	1	05/11/21 07:58	05/12/21 08:24	85-01-8	
Pyrene	**45.0**	ug/kg	43.8	6.4	1	05/11/21 07:58	05/12/21 08:24	129-00-0	
Surrogates									
2-Fluorobiphenyl (S)	58	%	36-86		1	05/11/21 07:58	05/12/21 08:24	321-60-8	
Terphenyl-d14 (S)	65	%	41-97		1	05/11/21 07:58	05/12/21 08:24	1718-51-0	
Percent Moisture	Analytical Method: ASTM D2974-87 Pace Analytical Services - Green Bay								
Percent Moisture	**61.9**	%	0.10	0.10	1		04/30/21 11:44		
350.1 Ammonia	Analytical Method: EPA 350.1 Preparation Method: EPA 350.1 Pace Analytical Services - Green Bay								
Nitrogen, Ammonia	**621**	mg/kg	53.3	16.0	1	05/06/21 17:20	05/06/21 18:56	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2 Pace Analytical Services - Green Bay								
Nitrogen, Kjeldahl, Total	**5090**	mg/kg	473	100	2	05/04/21 14:20	05/05/21 15:07	7727-37-9	
353.2 Nitrogen, NO2/NO3	Analytical Method: EPA 353.2 Preparation Method: EPA 353.2 Pace Analytical Services - Green Bay								
Nitrogen, NO2 plus NO3	**<2.5**	mg/kg	8.3	2.5	1	05/10/21 12:00	05/11/21 14:27		
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - Green Bay								
Phosphorus	**1330**	mg/kg	47.9	7.0	1	05/03/21 10:25	05/03/21 16:06	7723-14-0	
Total Organic Carbon Quad	Analytical Method: EPA 9060 Pace Analytical Services - Green Bay								
Total Organic Carbon	**61800**	mg/kg	8870	2660	1		05/14/21 04:49	7440-44-0	
Total Organic Carbon	**60400**	mg/kg	8880	2660	1		05/14/21 04:55	7440-44-0	
Total Organic Carbon	**64500**	mg/kg	8520	2560	1		05/14/21 05:00	7440-44-0	
Total Organic Carbon	**78200**	mg/kg	8840	2650	1		05/14/21 05:06	7440-44-0	
Mean Total Organic Carbon	**66200**	mg/kg	8780	2630	1		05/14/21 04:49	7440-44-0	
Surrogates									
RSD%	**12.3**	%			1		05/14/21 04:49		

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ANALYTICAL RESULTS

Project: ECHO LAKE
Pace Project No.: 40226039

Sample: S3 **Lab ID: 40226039003** Collected: 04/29/21 13:00 Received: 04/30/21 07:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
Percent Moisture	Analytical Method: ASTM D2974-87 Pace Analytical Services - Green Bay								
Percent Moisture	**71.0**	%	0.10	0.10	1		04/30/21 11:44		
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - Green Bay								
Phosphorus	**1710**	mg/kg	60.5	8.9	1	05/03/21 10:25	05/03/21 16:07	7723-14-0	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: ECHO LAKE
Pace Project No.: 40226039

Sample: S4 **Lab ID: 40226039004** Collected: 04/29/21 13:00 Received: 04/30/21 07:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS PCB	Analytical Method: EPA 8082 Preparation Method: EPA 3541								
	Pace Analytical Services - Green Bay								
PCB-1016 (Aroclor 1016)	**<30.4**	ug/kg	100	30.4	1	05/03/21 06:45	05/04/21 05:51	12674-11-2	
PCB-1221 (Aroclor 1221)	**<30.4**	ug/kg	100	30.4	1	05/03/21 06:45	05/04/21 05:51	11104-28-2	
PCB-1232 (Aroclor 1232)	**<30.4**	ug/kg	100	30.4	1	05/03/21 06:45	05/04/21 05:51	11141-16-5	
PCB-1242 (Aroclor 1242)	**<30.4**	ug/kg	100	30.4	1	05/03/21 06:45	05/04/21 05:51	53469-21-9	
PCB-1248 (Aroclor 1248)	**<30.4**	ug/kg	100	30.4	1	05/03/21 06:45	05/04/21 05:51	12672-29-6	
PCB-1254 (Aroclor 1254)	**<30.4**	ug/kg	100	30.4	1	05/03/21 06:45	05/04/21 05:51	11097-69-1	
PCB-1260 (Aroclor 1260)	**<30.4**	ug/kg	100	30.4	1	05/03/21 06:45	05/04/21 05:51	11096-82-5	
PCB, Total	**<30.4**	ug/kg	100	30.4	1	05/03/21 06:45	05/04/21 05:51	1336-36-3	
Surrogates									
Tetrachloro-m-xylene (S)	85	%	67-102		1	05/03/21 06:45	05/04/21 05:51	877-09-8	
Decachlorobiphenyl (S)	90	%	47-114		1	05/03/21 06:45	05/04/21 05:51	2051-24-3	
6020 MET ICPMS	Analytical Method: EPA 6020 Preparation Method: EPA 3050								
	Pace Analytical Services - Green Bay								
Arsenic	**5.5**	mg/kg	1.6	0.49	6.667	05/05/21 06:46	05/07/21 12:35	7440-38-2	
Barium	**134**	mg/kg	1.6	0.49	6.667	05/05/21 06:46	05/07/21 12:35	7440-39-3	
Cadmium	**0.58J**	mg/kg	1.2	0.18	6.667	05/05/21 06:46	05/07/21 12:35	7440-43-9	D3
Chromium	**23.7**	mg/kg	3.7	1.1	6.667	05/05/21 06:46	05/07/21 12:35	7440-47-3	
Copper	**16.5**	mg/kg	3.3	0.99	6.667	05/05/21 06:46	05/07/21 12:35	7440-50-8	
Lead	**24.3**	mg/kg	1.2	0.34	6.667	05/05/21 06:46	05/07/21 12:35	7439-92-1	
Manganese	**654**	mg/kg	3.4	1.0	6.667	05/05/21 06:46	05/07/21 12:35	7439-96-5	
Nickel	**16.6**	mg/kg	1.6	0.49	6.667	05/05/21 06:46	05/07/21 12:35	7440-02-0	
Selenium	**2.9**	mg/kg	1.2	0.34	6.667	05/05/21 06:46	05/07/21 12:35	7782-49-2	
Zinc	**79.6**	mg/kg	43.0	12.9	6.667	05/05/21 06:46	05/07/21 12:35	7440-66-6	
7471 Mercury	Analytical Method: EPA 7471 Preparation Method: EPA 7471								
	Pace Analytical Services - Green Bay								
Mercury	**0.21**	mg/kg	0.069	0.020	1	05/10/21 09:19	05/11/21 13:30	7439-97-6	
8270E MSSV PAH by SIM	Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
	Pace Analytical Services - Green Bay								
Acenaphthene	**<4.3**	ug/kg	33.4	4.3	1	05/11/21 07:58	05/12/21 22:12	83-32-9	
Acenaphthylene	**5.5J**	ug/kg	33.4	4.2	1	05/11/21 07:58	05/12/21 22:12	208-96-8	
Anthracene	**5.6J**	ug/kg	33.4	4.1	1	05/11/21 07:58	05/12/21 22:12	120-12-7	
Benzo(a)anthracene	**9.8J**	ug/kg	33.4	4.3	1	05/11/21 07:58	05/12/21 22:12	56-55-3	
Benzo(a)pyrene	**5.5J**	ug/kg	33.4	3.8	1	05/11/21 07:58	05/12/21 22:12	50-32-8	
Benzo(b)fluoranthene	**10.3J**	ug/kg	33.4	4.6	1	05/11/21 07:58	05/12/21 22:12	205-99-2	
Benzo(e)pyrene	**5.5J**	ug/kg	33.4	3.9	1	05/11/21 07:58	05/12/21 22:12	192-97-2	
Benzo(g,h,i)perylene	**<5.9**	ug/kg	33.4	5.9	1	05/11/21 07:58	05/12/21 22:12	191-24-2	
Benzo(k)fluoranthene	**4.5J**	ug/kg	33.4	4.3	1	05/11/21 07:58	05/12/21 22:12	207-08-9	
Chrysene	**9.5J**	ug/kg	33.4	6.3	1	05/11/21 07:58	05/12/21 22:12	218-01-9	
Dibenz(a,h)anthracene	**<4.6**	ug/kg	33.4	4.6	1	05/11/21 07:58	05/12/21 22:12	53-70-3	
Fluoranthene	**28.2J**	ug/kg	33.4	4.0	1	05/11/21 07:58	05/12/21 22:12	206-44-0	
Fluorene	**9.4J**	ug/kg	33.4	4.0	1	05/11/21 07:58	05/12/21 22:12	86-73-7	

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: ECHO LAKE
Pace Project No.: 40226039

Sample: S4 **Lab ID: 40226039004** Collected: 04/29/21 13:00 Received: 04/30/21 07:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM	Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
	Pace Analytical Services - Green Bay								
Indeno(1,2,3-cd)pyrene	**<7.0**	ug/kg	33.4	7.0	1	05/11/21 07:58	05/12/21 22:12	193-39-5	
1-Methylnaphthalene	**24.3J**	ug/kg	33.4	4.9	1	05/11/21 07:58	05/12/21 22:12	90-12-0	
Naphthalene	**23.2J**	ug/kg	33.4	3.3	1	05/11/21 07:58	05/12/21 22:12	91-20-3	
Phenanthrene	**24.2J**	ug/kg	33.4	3.8	1	05/11/21 07:58	05/12/21 22:12	85-01-8	
Pyrene	**22.3J**	ug/kg	33.4	4.9	1	05/11/21 07:58	05/12/21 22:12	129-00-0	
Surrogates									
2-Fluorobiphenyl (S)	54	%	36-86		1	05/11/21 07:58	05/12/21 22:12	321-60-8	
Terphenyl-d14 (S)	52	%	41-97		1	05/11/21 07:58	05/12/21 22:12	1718-51-0	
Percent Moisture	Analytical Method: ASTM D2974-87								
	Pace Analytical Services - Green Bay								
Percent Moisture	**50.0**	%	0.10	0.10	1		04/30/21 11:44		
350.1 Ammonia	Analytical Method: EPA 350.1 Preparation Method: EPA 350.1								
	Pace Analytical Services - Green Bay								
Nitrogen, Ammonia	**468**	mg/kg	41.9	12.6	1	05/06/21 17:20	05/06/21 18:57	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2								
	Pace Analytical Services - Green Bay								
Nitrogen, Kjeldahl, Total	**4360**	mg/kg	352	74.7	2	05/04/21 14:20	05/05/21 15:08	7727-37-9	
353.2 Nitrogen, NO2/NO3	Analytical Method: EPA 353.2 Preparation Method: EPA 353.2								
	Pace Analytical Services - Green Bay								
Nitrogen, NO2 plus NO3	**<1.9**	mg/kg	6.2	1.9	1	05/10/21 12:00	05/11/21 14:28		
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4								
	Pace Analytical Services - Green Bay								
Phosphorus	**738**	mg/kg	28.7	4.2	1	05/03/21 10:25	05/03/21 16:09	7723-14-0	
Total Organic Carbon Quad	Analytical Method: EPA 9060								
	Pace Analytical Services - Green Bay								
Total Organic Carbon	**52000**	mg/kg	6480	1940	1		05/14/21 05:12	7440-44-0	
Total Organic Carbon	**49900**	mg/kg	6490	1950	1		05/14/21 05:18	7440-44-0	
Total Organic Carbon	**52400**	mg/kg	6580	1970	1		05/14/21 05:23	7440-44-0	
Total Organic Carbon	**55300**	mg/kg	6760	2030	1		05/14/21 05:29	7440-44-0	
Mean Total Organic Carbon	**52400**	mg/kg	6570	1970	1		05/14/21 05:12	7440-44-0	
Surrogates									
RSD%	**4.2**	%			1		05/14/21 05:12		

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ANALYTICAL RESULTS

Project: ECHO LAKE
Pace Project No.: 40226039

Sample: S5 **Lab ID: 40226039005** Collected: 04/29/21 13:00 Received: 04/30/21 07:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8082 GCS PCB	Analytical Method: EPA 8082 Preparation Method: EPA 3541								
	Pace Analytical Services - Green Bay								
PCB-1016 (Aroclor 1016)	**<30.9**	ug/kg	102	30.9	1	05/03/21 06:45	05/04/21 06:15	12674-11-2	
PCB-1221 (Aroclor 1221)	**<30.9**	ug/kg	102	30.9	1	05/03/21 06:45	05/04/21 06:15	11104-28-2	
PCB-1232 (Aroclor 1232)	**<30.9**	ug/kg	102	30.9	1	05/03/21 06:45	05/04/21 06:15	11141-16-5	
PCB-1242 (Aroclor 1242)	**<30.9**	ug/kg	102	30.9	1	05/03/21 06:45	05/04/21 06:15	53469-21-9	
PCB-1248 (Aroclor 1248)	**<30.9**	ug/kg	102	30.9	1	05/03/21 06:45	05/04/21 06:15	12672-29-6	
PCB-1254 (Aroclor 1254)	**<30.9**	ug/kg	102	30.9	1	05/03/21 06:45	05/04/21 06:15	11097-69-1	
PCB-1260 (Aroclor 1260)	**<30.9**	ug/kg	102	30.9	1	05/03/21 06:45	05/04/21 06:15	11096-82-5	
PCB, Total	**<30.9**	ug/kg	102	30.9	1	05/03/21 06:45	05/04/21 06:15	1336-36-3	
Surrogates									
Tetrachloro-m-xylene (S)	83	%	67-102		1	05/03/21 06:45	05/04/21 06:15	877-09-8	
Decachlorobiphenyl (S)	78	%	47-114		1	05/03/21 06:45	05/04/21 06:15	2051-24-3	
6020 MET ICPMS	Analytical Method: EPA 6020 Preparation Method: EPA 3050								
	Pace Analytical Services - Green Bay								
Arsenic	**8.0**	mg/kg	1.7	0.52	6.667	05/05/21 06:46	05/07/21 12:42	7440-38-2	
Barium	**109**	mg/kg	1.7	0.52	6.667	05/05/21 06:46	05/07/21 12:42	7440-39-3	
Cadmium	**0.48J**	mg/kg	1.3	0.19	6.667	05/05/21 06:46	05/07/21 12:42	7440-43-9	D3
Chromium	**26.9**	mg/kg	4.0	1.2	6.667	05/05/21 06:46	05/07/21 12:42	7440-47-3	
Copper	**16.1**	mg/kg	3.5	1.1	6.667	05/05/21 06:46	05/07/21 12:42	7440-50-8	
Lead	**26.9**	mg/kg	1.3	0.36	6.667	05/05/21 06:46	05/07/21 12:42	7439-92-1	
Manganese	**473**	mg/kg	3.6	1.1	6.667	05/05/21 06:46	05/07/21 12:42	7439-96-5	
Nickel	**27.5**	mg/kg	1.7	0.52	6.667	05/05/21 06:46	05/07/21 12:42	7440-02-0	
Selenium	**2.7**	mg/kg	1.3	0.36	6.667	05/05/21 06:46	05/07/21 12:42	7782-49-2	
Zinc	**76.0**	mg/kg	46.0	13.8	6.667	05/05/21 06:46	05/07/21 12:42	7440-66-6	
7471 Mercury	Analytical Method: EPA 7471 Preparation Method: EPA 7471								
	Pace Analytical Services - Green Bay								
Mercury	**0.19**	mg/kg	0.071	0.020	1	05/10/21 09:19	05/11/21 13:32	7439-97-6	
8270E MSSV PAH by SIM	Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
	Pace Analytical Services - Green Bay								
Acenaphthene	**<4.4**	ug/kg	33.9	4.4	1	05/11/21 07:58	05/12/21 22:29	83-32-9	
Acenaphthylene	**<4.3**	ug/kg	33.9	4.3	1	05/11/21 07:58	05/12/21 22:29	208-96-8	
Anthracene	**5.6J**	ug/kg	33.9	4.2	1	05/11/21 07:58	05/12/21 22:29	120-12-7	
Benzo(a)anthracene	**35.0**	ug/kg	33.9	4.4	1	05/11/21 07:58	05/12/21 22:29	56-55-3	
Benzo(a)pyrene	**35.6**	ug/kg	33.9	3.9	1	05/11/21 07:58	05/12/21 22:29	50-32-8	
Benzo(b)fluoranthene	**51.1**	ug/kg	33.9	4.7	1	05/11/21 07:58	05/12/21 22:29	205-99-2	
Benzo(e)pyrene	**25.8J**	ug/kg	33.9	4.0	1	05/11/21 07:58	05/12/21 22:29	192-97-2	
Benzo(g,h,i)perylene	**23.4J**	ug/kg	33.9	6.0	1	05/11/21 07:58	05/12/21 22:29	191-24-2	
Benzo(k)fluoranthene	**18.2J**	ug/kg	33.9	4.3	1	05/11/21 07:58	05/12/21 22:29	207-08-9	
Chrysene	**40.2**	ug/kg	33.9	6.4	1	05/11/21 07:58	05/12/21 22:29	218-01-9	
Dibenz(a,h)anthracene	**7.4J**	ug/kg	33.9	4.7	1	05/11/21 07:58	05/12/21 22:29	53-70-3	
Fluoranthene	**85.9**	ug/kg	33.9	4.0	1	05/11/21 07:58	05/12/21 22:29	206-44-0	
Fluorene	**<4.1**	ug/kg	33.9	4.1	1	05/11/21 07:58	05/12/21 22:29	86-73-7	

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ANALYTICAL RESULTS

Project: ECHO LAKE
Pace Project No.: 40226039

Sample: S5 **Lab ID: 40226039005** Collected: 04/29/21 13:00 Received: 04/30/21 07:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
8270E MSSV PAH by SIM	Analytical Method: EPA 8270E by SIM Preparation Method: EPA 3546								
	Pace Analytical Services - Green Bay								
Indeno(1,2,3-cd)pyrene	**22.0J**	ug/kg	33.9	7.1	1	05/11/21 07:58	05/12/21 22:29	193-39-5	
1-Methylnaphthalene	**<5.0**	ug/kg	33.9	5.0	1	05/11/21 07:58	05/12/21 22:29	90-12-0	
Naphthalene	**<3.3**	ug/kg	33.9	3.3	1	05/11/21 07:58	05/12/21 22:29	91-20-3	
Phenanthrene	**38.6**	ug/kg	33.9	3.9	1	05/11/21 07:58	05/12/21 22:29	85-01-8	
Pyrene	**69.7**	ug/kg	33.9	5.0	1	05/11/21 07:58	05/12/21 22:29	129-00-0	
Surrogates									
2-Fluorobiphenyl (S)	64	%	36-86		1	05/11/21 07:58	05/12/21 22:29	321-60-8	
Terphenyl-d14 (S)	71	%	41-97		1	05/11/21 07:58	05/12/21 22:29	1718-51-0	
Percent Moisture	Analytical Method: ASTM D2974-87								
	Pace Analytical Services - Green Bay								
Percent Moisture	**50.8**	%	0.10	0.10	1		04/30/21 11:44		
350.1 Ammonia	Analytical Method: EPA 350.1 Preparation Method: EPA 350.1								
	Pace Analytical Services - Green Bay								
Nitrogen, Ammonia	**264**	mg/kg	38.7	11.6	1	05/06/21 17:20	05/06/21 19:00	7664-41-7	
351.2 Total Kjeldahl Nitrogen	Analytical Method: EPA 351.2 Preparation Method: EPA 351.2								
	Pace Analytical Services - Green Bay								
Nitrogen, Kjeldahl, Total	**4000**	mg/kg	389	82.4	2	05/04/21 14:20	05/05/21 15:11	7727-37-9	
353.2 Nitrogen, NO2/NO3	Analytical Method: EPA 353.2 Preparation Method: EPA 353.2								
	Pace Analytical Services - Green Bay								
Nitrogen, NO2 plus NO3	**<1.9**	mg/kg	6.4	1.9	1	05/10/21 12:00	05/11/21 14:28		
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4								
	Pace Analytical Services - Green Bay								
Phosphorus	**803**	mg/kg	31.5	4.6	1	05/03/21 10:25	05/03/21 16:10	7723-14-0	
Total Organic Carbon Quad	Analytical Method: EPA 9060								
	Pace Analytical Services - Green Bay								
Total Organic Carbon	**45800**	mg/kg	6880	2060	1		05/14/21 05:35	7440-44-0	
Total Organic Carbon	**45800**	mg/kg	6600	1980	1		05/14/21 05:40	7440-44-0	
Total Organic Carbon	**47400**	mg/kg	6680	2000	1		05/14/21 05:46	7440-44-0	
Total Organic Carbon	**46300**	mg/kg	6860	2060	1		05/14/21 05:51	7440-44-0	
Mean Total Organic Carbon	**46300**	mg/kg	6760	2030	1		05/14/21 05:35	7440-44-0	
Surrogates									
RSD%	**1.6**	%			1		05/14/21 05:35		

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ANALYTICAL RESULTS

Project: ECHO LAKE
Pace Project No.: 40226039

Sample: S6 **Lab ID: 40226039006** Collected: 04/29/21 13:00 Received: 04/30/21 07:30 Matrix: Solid

Results reported on a "dry weight" basis and are adjusted for percent moisture, sample size and any dilutions.

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
Percent Moisture	Analytical Method: ASTM D2974-87 Pace Analytical Services - Green Bay								
Percent Moisture	**43.8**	%	0.10	0.10	1		04/30/21 11:44		
365.4 Total Phosphorus	Analytical Method: EPA 365.4 Preparation Method: EPA 365.4 Pace Analytical Services - Green Bay								
Phosphorus	**873**	mg/kg	35.1	5.2	1	05/03/21 10:25	05/03/21 16:11	7723-14-0	

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

QC Batch:	384605	Analysis Method:	EPA 7471
QC Batch Method:	EPA 7471	Analysis Description:	7471 Mercury
		Laboratory:	Pace Analytical Services - Green Bay

Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

METHOD BLANK: 2218652 Matrix: Solid

Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Mercury	mg/kg	0.010J	0.035	05/11/21 12:27	

LABORATORY CONTROL SAMPLE: 2218653

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mercury	mg/kg	0.83	0.81	97	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2218654 2218655

Parameter	Units	40225904001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mercury	mg/kg	0.013J	0.84	0.85	0.81	0.83	96	97	85-115	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.

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

QC Batch: 384293
QC Batch Method: EPA 3050
Analysis Method: EPA 6020
Analysis Description: 6020 MET
Laboratory: Pace Analytical Services - Green Bay
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

METHOD BLANK: 2216879 Matrix: Solid
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Arsenic	mg/kg	<0.040	0.13	05/07/21 11:23	
Barium	mg/kg	<0.039	0.13	05/07/21 11:23	
Cadmium	mg/kg	<0.015	0.10	05/07/21 11:23	
Chromium	mg/kg	<0.091	0.30	05/07/21 11:23	
Copper	mg/kg	<0.080	0.27	05/07/21 11:23	
Lead	mg/kg	<0.027	0.10	05/07/21 11:23	
Manganese	mg/kg	<0.083	0.28	05/07/21 11:23	
Nickel	mg/kg	<0.040	0.13	05/07/21 11:23	
Selenium	mg/kg	<0.027	0.10	05/07/21 11:23	
Zinc	mg/kg	<1.0	3.5	05/07/21 11:23	

LABORATORY CONTROL SAMPLE: 2216880

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Arsenic	mg/kg	50	48.9	98	80-120	
Barium	mg/kg	50	48.8	98	80-120	
Cadmium	mg/kg	50	50.9	102	80-120	
Chromium	mg/kg	50	47.9	96	80-120	
Copper	mg/kg	50	49.5	99	80-120	
Lead	mg/kg	50	48.0	96	80-120	
Manganese	mg/kg	50	47.0	94	80-120	
Nickel	mg/kg	50	48.5	97	80-120	
Selenium	mg/kg	50	50.2	100	80-120	
Zinc	mg/kg	50	50.2	100	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2216881 2216882

Parameter	Units	40226039001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic	mg/kg	6.5	104	104	106	106	96	96	75-125	1	20	
Barium	mg/kg	134	104	104	246	262	107	123	75-125	6	20	
Cadmium	mg/kg	1.2J	104	104	102	102	96	97	75-125	0	20	
Chromium	mg/kg	24.8	104	104	123	126	94	97	75-125	2	20	
Copper	mg/kg	15.8	104	104	111	114	91	94	75-125	2	20	
Lead	mg/kg	18.7	104	104	122	123	99	100	75-125	1	20	
Manganese	mg/kg	744	104	104	842	828	93	80	75-125	2	20	
Nickel	mg/kg	16.9	104	104	114	114	93	94	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.

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2216881 2216882

Parameter	Units	40226039001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Selenium	mg/kg	3.7	104	104	105	104	97	96	75-125	1	20	
Zinc	mg/kg	74.7	104	104	170	180	92	102	75-125	6	20	

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

QC Batch: 384033
QC Batch Method: EPA 3541
Analysis Method: EPA 8082
Analysis Description: 8082 GCS PCB
Laboratory: Pace Analytical Services - Green Bay
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

METHOD BLANK: 2215697 Matrix: Solid
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
PCB-1016 (Aroclor 1016)	ug/kg	<15.2	50.0	05/03/21 23:22	
PCB-1221 (Aroclor 1221)	ug/kg	<15.2	50.0	05/03/21 23:22	
PCB-1232 (Aroclor 1232)	ug/kg	<15.2	50.0	05/03/21 23:22	
PCB-1242 (Aroclor 1242)	ug/kg	<15.2	50.0	05/03/21 23:22	
PCB-1248 (Aroclor 1248)	ug/kg	<15.2	50.0	05/03/21 23:22	
PCB-1254 (Aroclor 1254)	ug/kg	<15.2	50.0	05/03/21 23:22	
PCB-1260 (Aroclor 1260)	ug/kg	<15.2	50.0	05/03/21 23:22	
Decachlorobiphenyl (S)	%	84	47-114	05/03/21 23:22	
Tetrachloro-m-xylene (S)	%	85	67-102	05/03/21 23:22	

LABORATORY CONTROL SAMPLE: 2215698

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
PCB-1016 (Aroclor 1016)	ug/kg		<15.2			
PCB-1221 (Aroclor 1221)	ug/kg		<15.2			
PCB-1232 (Aroclor 1232)	ug/kg		<15.2			
PCB-1242 (Aroclor 1242)	ug/kg		<15.2			
PCB-1248 (Aroclor 1248)	ug/kg		<15.2			
PCB-1254 (Aroclor 1254)	ug/kg		<15.2			
PCB-1260 (Aroclor 1260)	ug/kg	500	441	88	69-115	
Decachlorobiphenyl (S)	%			91	47-114	
Tetrachloro-m-xylene (S)	%			87	67-102	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2215699 2215700

Parameter	Units	40225865001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
PCB-1016 (Aroclor 1016)	ug/kg	<106			<106	<106					20	
PCB-1221 (Aroclor 1221)	ug/kg	<106			<106	<106					20	
PCB-1232 (Aroclor 1232)	ug/kg	<106			<106	<106					20	
PCB-1242 (Aroclor 1242)	ug/kg	<106			<106	<106					20	
PCB-1248 (Aroclor 1248)	ug/kg	<106			<106	<106					20	
PCB-1254 (Aroclor 1254)	ug/kg	<106			<106	<106					20	
PCB-1260 (Aroclor 1260)	ug/kg	<106	3480	3490	2230	2300	64	66	45-120	3	20	
Decachlorobiphenyl (S)	%						60	62	47-114			
Tetrachloro-m-xylene (S)	%						79	82	67-102			

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

QC Batch:	384808	Analysis Method:	EPA 8270E by SIM
QC Batch Method:	EPA 3546	Analysis Description:	8270E/3546 MSSV PAH by SIM
		Laboratory:	Pace Analytical Services - Green Bay

Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

METHOD BLANK: 2219991 Matrix: Solid

Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1-Methylnaphthalene	ug/kg	<2.4	16.7	05/11/21 11:38	
Acenaphthene	ug/kg	<2.2	16.7	05/11/21 11:38	
Acenaphthylene	ug/kg	<2.1	16.7	05/11/21 11:38	
Anthracene	ug/kg	<2.1	16.7	05/11/21 11:38	
Benzo(a)anthracene	ug/kg	<2.2	16.7	05/11/21 11:38	
Benzo(a)pyrene	ug/kg	<1.9	16.7	05/11/21 11:38	
Benzo(b)fluoranthene	ug/kg	<2.3	16.7	05/11/21 11:38	
Benzo(e)pyrene	ug/kg	<1.9	16.7	05/11/21 11:38	
Benzo(g,h,i)perylene	ug/kg	<2.9	16.7	05/11/21 11:38	
Benzo(k)fluoranthene	ug/kg	<2.1	16.7	05/11/21 11:38	
Chrysene	ug/kg	<3.1	16.7	05/11/21 11:38	
Dibenz(a,h)anthracene	ug/kg	<2.3	16.7	05/11/21 11:38	
Fluoranthene	ug/kg	<2.0	16.7	05/11/21 11:38	
Fluorene	ug/kg	<2.0	16.7	05/11/21 11:38	
Indeno(1,2,3-cd)pyrene	ug/kg	<3.5	16.7	05/11/21 11:38	
Naphthalene	ug/kg	<1.6	16.7	05/11/21 11:38	
Phenanthrene	ug/kg	<1.9	16.7	05/11/21 11:38	
Pyrene	ug/kg	<2.5	16.7	05/11/21 11:38	
2-Fluorobiphenyl (S)	%	79	36-86	05/11/21 11:38	
Terphenyl-d14 (S)	%	89	41-97	05/11/21 11:38	

LABORATORY CONTROL SAMPLE: 2219992

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1-Methylnaphthalene	ug/kg	333	246	74	53-100	
Acenaphthene	ug/kg	333	287	86	62-120	
Acenaphthylene	ug/kg	333	291	87	61-120	
Anthracene	ug/kg	333	323	97	62-111	
Benzo(a)anthracene	ug/kg	333	301	90	61-120	
Benzo(a)pyrene	ug/kg	333	333	100	65-120	
Benzo(b)fluoranthene	ug/kg	333	325	98	64-108	
Benzo(e)pyrene	ug/kg	333	330	99	56-116	
Benzo(g,h,i)perylene	ug/kg	333	333	100	71-120	
Benzo(k)fluoranthene	ug/kg	333	321	96	76-120	
Chrysene	ug/kg	333	318	96	74-120	
Dibenz(a,h)anthracene	ug/kg	333	342	103	71-120	
Fluoranthene	ug/kg	333	312	94	67-112	
Fluorene	ug/kg	333	298	89	65-120	
Indeno(1,2,3-cd)pyrene	ug/kg	333	341	102	74-120	

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

LABORATORY CONTROL SAMPLE: 2219992

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Naphthalene	ug/kg	333	264	79	53-120	
Phenanthrene	ug/kg	333	309	93	67-120	
Pyrene	ug/kg	333	313	94	60-103	
2-Fluorobiphenyl (S)	%			82	36-86	
Terphenyl-d14 (S)	%			89	41-97	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2219993 2219994

Parameter	Units	40226163006 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
1-Methylnaphthalene	ug/kg	<2.9	399	399	209	257	53	64	41-100	20	29	
Acenaphthene	ug/kg	<2.6	399	399	258	284	65	71	43-120	10	27	
Acenaphthylene	ug/kg	<2.5	399	399	263	293	66	73	51-120	11	26	
Anthracene	ug/kg	<2.5	399	399	312	316	78	79	46-111	1	29	
Benzo(a)anthracene	ug/kg	<2.6	399	399	287	285	71	71	48-120	1	23	
Benzo(a)pyrene	ug/kg	<2.3	399	399	320	315	80	79	46-108	2	30	
Benzo(b)fluoranthene	ug/kg	<2.8	399	399	296	292	74	73	45-108	1	30	
Benzo(e)pyrene	ug/kg	<2.3	399	399	316	309	79	77	21-122	2	24	
Benzo(g,h,i)perylene	ug/kg	<3.5	399	399	309	302	77	75	39-120	2	37	
Benzo(k)fluoranthene	ug/kg	<2.6	399	399	338	336	85	84	47-120	1	31	
Chrysene	ug/kg	<3.8	399	399	312	311	78	78	54-120	0	21	
Dibenz(a,h)anthracene	ug/kg	<2.8	399	399	319	313	80	79	46-120	2	34	
Fluoranthene	ug/kg	<2.4	399	399	302	302	76	76	53-112	0	27	
Fluorene	ug/kg	<2.4	399	399	279	293	70	73	48-120	5	29	
Indeno(1,2,3-cd)pyrene	ug/kg	<4.2	399	399	317	311	79	78	40-120	2	34	
Naphthalene	ug/kg	<1.9	399	399	213	281	53	70	47-120	28	25	R1
Phenanthrene	ug/kg	<2.3	399	399	296	302	74	76	49-120	2	28	
Pyrene	ug/kg	<2.9	399	399	308	307	77	77	43-103	0	31	
2-Fluorobiphenyl (S)	%						58	66	36-86			
Terphenyl-d14 (S)	%						73	71	41-97			

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

QC Batch: 383952 | Analysis Method: ASTM D2974-87
QC Batch Method: ASTM D2974-87 | Analysis Description: Dry Weight/Percent Moisture
Laboratory: Pace Analytical Services - Green Bay
Associated Lab Samples: 40226039001, 40226039002, 40226039003, 40226039004, 40226039005, 40226039006

SAMPLE DUPLICATE: 2214854

Parameter	Units	40226034002 Result	Dup Result	RPD	Max RPD	Qualifiers
Percent Moisture	%	49.5	48.1	3	10	

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

QC Batch: 384498 | Analysis Method: EPA 350.1
QC Batch Method: EPA 350.1 | Analysis Description: 350.1 Ammonia
Laboratory: Pace Analytical Services - Green Bay
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

METHOD BLANK: 2217916 Matrix: Solid
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Ammonia	mg/kg	<6.4	21.5	05/06/21 18:49	

LABORATORY CONTROL SAMPLE: 2217917

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Ammonia	mg/kg	300	293	98	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2217918 2217919

Parameter	Units	10557184001 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	62.9	299	302	354	303	98	80	80-120	15	20	

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

QC Batch: 384222
QC Batch Method: EPA 351.2
Analysis Method: EPA 351.2
Analysis Description: 351.2 TKN
Laboratory: Pace Analytical Services - Green Bay
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

METHOD BLANK: 2216399 Matrix: Solid
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Kjeldahl, Total	mg/kg	<21.2	100	05/05/21 13:27	

LABORATORY CONTROL SAMPLE: 2216400

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Kjeldahl, Total	mg/kg	500	490	98	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2216401 2216402

Parameter	Units	10556682001 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	10900	2350	2350	13900	13400	586	566	80-120	4	20	P6

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2216403 2216404

Parameter	Units	40226039001 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	4380	919	915	4970	4820	536	523	80-120	3	20	P6

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

QC Batch: 384718
QC Batch Method: EPA 353.2
Analysis Method: EPA 353.2
Analysis Description: 353.2 Nitrate + Nitrite
Laboratory: Pace Analytical Services - Green Bay
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

METHOD BLANK: 2219664 Matrix: Solid
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, NO2 plus NO3	mg/kg	<0.97	3.2	05/11/21 14:21	

LABORATORY CONTROL SAMPLE: 2219665

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, NO2 plus NO3	mg/kg	25	24.7	99	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2219666 2219667

Parameter	Units	40226535001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nitrogen, NO2 plus NO3	mg/kg	<47.1	1210	1210	1230	1210	98	96	80-120	2	20	

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REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

QC Batch: 384030 | Analysis Method: EPA 365.4
QC Batch Method: EPA 365.4 | Analysis Description: 365.4 Total Phosphorus
Laboratory: Pace Analytical Services - Green Bay
Associated Lab Samples: 40226039001, 40226039002, 40226039003, 40226039004, 40226039005, 40226039006

METHOD BLANK: 2215684 Matrix: Solid
Associated Lab Samples: 40226039001, 40226039002, 40226039003, 40226039004, 40226039005, 40226039006

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Phosphorus	mg/kg	3.1J	20.0	05/03/21 15:46	

LABORATORY CONTROL SAMPLE: 2215685

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Phosphorus	mg/kg	500	518	104	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2215686 2215687

Parameter	Units	40225810001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Phosphorus	mg/kg	333	493	484	692	837	73	104	80-120	19	20	M0

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2215688 2215689

Parameter	Units	40226039006 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Phosphorus	mg/kg	873	908	933	1740	1710	95	90	80-120	1	20	

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QUALITY CONTROL DATA

Project: ECHO LAKE
Pace Project No.: 40226039

QC Batch: 385114 | Analysis Method: EPA 9060
QC Batch Method: EPA 9060 | Analysis Description: 9060 TOC Average
Laboratory: Pace Analytical Services - Green Bay
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

METHOD BLANK: 2221902 Matrix: Solid
Associated Lab Samples: 40226039001, 40226039002, 40226039004, 40226039005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Mean Total Organic Carbon	mg/kg	<194	647	05/14/21 02:30	

LABORATORY CONTROL SAMPLE: 2221903

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mean Total Organic Carbon	mg/kg	120000	119000	99	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 2221904 2221905

Parameter	Units	40226039001 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	46900	76600	75000	111000	111000	84	85	50-150	0	30	

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QUALIFIERS

Project: ECHO LAKE
Pace Project No.: 40226039

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 LOD.

J - Estimated concentration at or above the LOD and below the LOQ.

LOD - Limit of Detection adjusted for dilution factor, percent moisture, initial weight and final volume.

LOQ - Limit of Quantitation adjusted for dilution factor, percent moisture, initial weight and final volume.

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 at or above the adjusted LOD.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

ANALYTE QUALIFIERS

D3	Sample was diluted due to the presence of high levels of non-target analytes or other matrix interference.
M0	Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
P6	Matrix spike recovery was outside laboratory control limits due to a parent sample concentration notably higher than the spike level.
R1	RPD value was outside control limits.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: ECHO LAKE
Pace Project No.: 40226039

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
40226039001	**S1**	EPA 3541	384033	EPA 8082	384034
40226039002	**S2**	EPA 3541	384033	EPA 8082	384034
40226039004	**S4**	EPA 3541	384033	EPA 8082	384034
40226039005	**S5**	EPA 3541	384033	EPA 8082	384034
40226039001	**S1**	EPA 3050	384293	EPA 6020	384367
40226039002	**S2**	EPA 3050	384293	EPA 6020	384367
40226039004	**S4**	EPA 3050	384293	EPA 6020	384367
40226039005	**S5**	EPA 3050	384293	EPA 6020	384367
40226039001	**S1**	EPA 7471	384605	EPA 7471	384731
40226039002	**S2**	EPA 7471	384605	EPA 7471	384731
40226039004	**S4**	EPA 7471	384605	EPA 7471	384731
40226039005	**S5**	EPA 7471	384605	EPA 7471	384731
40226039001	**S1**	EPA 3546	384808	EPA 8270E by SIM	384860
40226039002	**S2**	EPA 3546	384808	EPA 8270E by SIM	384860
40226039004	**S4**	EPA 3546	384808	EPA 8270E by SIM	384860
40226039005	**S5**	EPA 3546	384808	EPA 8270E by SIM	384860
40226039001	**S1**	ASTM D2974-87	383952		
40226039002	**S2**	ASTM D2974-87	383952		
40226039003	**S3**	ASTM D2974-87	383952		
40226039004	**S4**	ASTM D2974-87	383952		
40226039005	**S5**	ASTM D2974-87	383952		
40226039006	**S6**	ASTM D2974-87	383952		
40226039001	**S1**	EPA 350.1	384498	EPA 350.1	384532
40226039002	**S2**	EPA 350.1	384498	EPA 350.1	384532
40226039004	**S4**	EPA 350.1	384498	EPA 350.1	384532
40226039005	**S5**	EPA 350.1	384498	EPA 350.1	384532
40226039001	**S1**	EPA 351.2	384222	EPA 351.2	384279
40226039002	**S2**	EPA 351.2	384222	EPA 351.2	384279
40226039004	**S4**	EPA 351.2	384222	EPA 351.2	384279
40226039005	**S5**	EPA 351.2	384222	EPA 351.2	384279
40226039001	**S1**	EPA 353.2	384718	EPA 353.2	384865
40226039002	**S2**	EPA 353.2	384718	EPA 353.2	384865
40226039004	**S4**	EPA 353.2	384718	EPA 353.2	384865
40226039005	**S5**	EPA 353.2	384718	EPA 353.2	384865
40226039001	**S1**	EPA 365.4	384030	EPA 365.4	384071
40226039002	**S2**	EPA 365.4	384030	EPA 365.4	384071
40226039003	**S3**	EPA 365.4	384030	EPA 365.4	384071
40226039004	**S4**	EPA 365.4	384030	EPA 365.4	384071
40226039005	**S5**	EPA 365.4	384030	EPA 365.4	384071
40226039006	**S6**	EPA 365.4	384030	EPA 365.4	384071
40226039001	**S1**	EPA 9060	385114		
40226039001	**S1**	EPA 9060	385115		
40226039002	**S2**	EPA 9060	385114		

REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: ECHO LAKE
Pace Project No.: 40226039

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
40226039002	**S2**	EPA 9060	385115		
40226039004	**S4**	EPA 9060	385114		
40226039004	**S4**	EPA 9060	385115		
40226039005	**S5**	EPA 9060	385114		
40226039005	**S5**	EPA 9060	385115		

(Please Print Clearly)

Company Name:	Ayres
Branch/Location:	Eau Claire
Project Contact:	Rob Wayne
Phone:	715-495-2126
Project Number:	
Project Name:	Echo Lake
Project State:	WI
Sampled By (Print):	RJW / AJS
Sampled By (Sign):	[signature]
PO #:	

Regulatory Program:

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UPPER MIDWEST REGION
MN: 612-607-1700 WI: 920-469-2436

40226039

CHAIN OF COUSTODY

*Preservation Codes
A=None B=HCL C=H2SO4 D=HNO3 E=DI Water F=Methanol G=NaOH
H=Sodium Bisulfate Solution I=Sodium Thiosulfate J=Other

Quote #:	
Mail To Contact:	Rob Wayne
Mail To Company:	Ayres
Mail To Address:	3433 Oakwood Hills Parkway EC, WI 54701
Invoice To Contact:	Rob Wayne
Invoice To Company:	Ayres
Invoice To Address:	" "
Invoice To Phone:	715-495-2126

Data Package Options (billable)
- ☐ EPA Level III
- ☐ EPA Level IV

MS/MSD
- ☐ On your sample (billable)
- ☐ NOT needed on your sample

Matrix Codes
A = Air, B = Biota, C = Charcoal, O = Oil, S = Soil, Sl = Sludge
W = Water, DW = Drinking Water, GW = Ground Water, SW = Surface Water, WW = Waste Water, WP = Wipe

FILTERED? (YES/NO): Y/N
PRESERVATION (CODE)*: Pick Letter

PACE LAB #	CLIENT FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX	Metals	TKN, NH3, Ammonia pH	TOC	Sieve	PCB / PAH	Phosph Total			CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)	Profile #
001	S1	4/29	13:00	S											
002	S2	|	|	|											
003	S3 (Only PH)	|	|	|						X					
004	S4	|	|	|											
005	S5	|	|	|											
006	S6 (Only PH)	|	|	|						X					

Rush Turnaround Time Requested - Prelims
(Rush TAT subject to approval/surcharge)
Date Needed:

Transmit Prelim Rush Results by (complete what you want):

Email #1:	
Email #2:	
Telephone:	
Fax:	

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
[signature]	4/29/2021 1930	[signature]	4/30/21 0730

PACE Project No. 40226039

Receipt Temp = 5 °C

Sample Receipt pH OK / Adjusted

Cooler Custody Seal
Present / Not Present
Intact / Not Intact

Version 6.0 06/14/06

C019a(27Jun2006)

Sample Preservation Receipt Form

Pace Analytical Services, LLC
1241 Bellevue Street, Suite 9
Green Bay, WI 54302

Client Name: Ayres

Project # 40226039

All containers needing preservation have been checked and noted below: □Yes □No ~~□N/A~~

Lab Lot# of pH paper:

Lab Std #ID of preservation (if pH adjusted):

Initial when completed:

Date/ Time:

Pace Lab #	Glass								Plastic					Vials						Jars				General			VOA Vials (>6mm) *	H2SO4 pH ≤2	NaOH+Zn Act pH ≥9	NaOH pH ≥12	HNO3 pH ≤2	pH after adjusted	Volume (mL)
	AG1U	BG1U	AG1H	AG4S	AG4U	AG5U	AG2S	BG3U	BP1U	BP3U	BP3B	BP3N	BP3S	VG9A	DG9T	VG9U	VG9H	VG9M	VG9D	JGFU	JG9U	WGFU	WPFU	SP5T	ZPLC	GN							
001																					2		2		1								2.5 / 5 / 10
002																					2		2		1								2.5 / 5 / 10
003																							1										2.5 / 5 / 10
004																					2		2		1								2.5 / 5 / 10
005																					2		2		1								2.5 / 5 / 10
006																							1										2.5 / 5 / 10
007																																	2.5 / 5 / 10
008																																	2.5 / 5 / 10
009																																	2.5 / 5 / 10
010																																	2.5 / 5 / 10
011																																	2.5 / 5 / 10
012																																	2.5 / 5 / 10
013																																	2.5 / 5 / 10
014																																	2.5 / 5 / 10
015																					[illegible] 4/30/21												2.5 / 5 / 10
016																																	2.5 / 5 / 10
017																																	2.5 / 5 / 10
018																																	2.5 / 5 / 10
019																																	2.5 / 5 / 10
020																																	2.5 / 5 / 10

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	**VG9A**	40 mL clear ascorbic	**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	**WGFU**	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
AG4U	120 mL amber glass unpres	**BP3S**	250 mL plastic H2SO4	**VG9M**	40 mL clear vial MeOH	**SP5T**	120 mL plastic Na Thiosulfate
AG5U	100 mL amber glass unpres			**VG9D**	40 mL clear vial DI	**ZPLC**	ziploc bag
AG2S	500 mL amber glass H2SO4					**GN**	
BG3U	250 mL clear glass unpres						

Pace Analytical® 1241 Bellevue Street, Green Bay, WI 54302	Document Name: **Sample Condition Upon Receipt (SCUR)**	Document Revised: 26Mar2020
	Document No.: **ENV-FRM-GBAY-0014-Rev.00**	Author: Pace Green Bay Quality Office

Sample Condition Upon Receipt Form (SCUR)

Project #:

WO# : 40226039

40226039

Client Name: Ayres

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

Tracking #:

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 - 92 **Type of Ice:** Wet Blue Dry None ☑ Samples on ice, cooling process has begun

Cooler Temperature Uncorr: 5 /Corr: 5

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: 4/30/21 /Initials: [illegible]
Labeled By Initials: [illegible]

Chain of Custody Present:	☑Yes ☐No ☐N/A	1.
Chain of Custody Filled Out:	☐Yes ☑No ☐N/A	2. proj #, pg #, analyis not checked [illegible]
Chain of Custody Relinquished:	☐Yes ☐No ☐N/A	3.
Sampler Name & Signature on COC:	☑Yes ☐No ☐N/A	4.
Samples Arrived within Hold Time:	☑Yes ☐No	5.
- 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.
-Pace Containers Used:	☑Yes ☐No ☐N/A	
-Pace IR Containers Used:	☐Yes ☐No ☑N/A	
Containers Intact:	☑Yes ☐No	10.
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: S		
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:

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

Page 2 of 2

Echo Lake Sediment Sampling - Planned Samples include all highlighted fields.

Table 1. Sediment Sampling Parameters with Suggested Methods and Analyses

Parameter	**Suggested Analytical Method (Suggested Detection Level)** *(mg/kg, dry weight unless noted)*	**Suggested Base Parameter Analyses[1]**	
		Great Lakes or Urban/ Industrial	**Inland Waters (Rural/ Forested)**
Inorganics – Metals			
Arsenic	SW-846 3050B/6010B EPA 6010 or 7060 (5)	X	X
Barium	SW-846 3050B/6010B (0.2)		
Cadmium	SW-846 3050B/6010B EPA 7131 (0.6)	X	X
Chromium (total)	SW-846 3050B/6010B EPA 6010 or 7191 (0.6)	X	X
Copper	SW-846 3050B/6010B EPA 6010 or 7211 (0.5)	X	X
Cyanide	SW-846 9010B/9014 (0.4)		
Lead	SW-846 3050B/6010B EPA 6010 or 7421 (3)	X	X
Manganese	SW-846 3050B/6010B (0.1)		
Mercury	SW-846 7471A EPA 7471 (0.015)	X	X
Nickel	SW-846 3050B/6010B EPA 6010 (2)	X	X
Selenium	SW-846 3050B/6010B (8)	X	
Zinc	SW-846 3050B/6010B EPA 6010 or 7951 (2)	X	X
Inorganics – Nutrients			
Oil & Grease	SW-846 9070	X	
Total Phosphorus	EPA 365.2/365.3 or USGS I-6600-85 (9.9)	X	X
Nitrate + Nitrite	LACHAT 12-107-04-1-B (0.25)	X	X
Ammonia-Nitrogen	LACHAT 12-107-06-1-A (0.16)	X	X
Total Kjeldahl Nitrogen		X	X
Organics			
Aldrin	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)		
Chlordane	SW-846 8081 EPA 8081, 354440B, 3541 (0.009)	X	
Dieldrin	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)		
Endrin	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)		
Heptachlor	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)		
Lindane (Gamma BHC)	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)		

[1] Suggested base parameter list reflects additions to NR347 Table 1, based on scientific research and experience with dredging projects.

Parameter	Suggested Analytical Method **(Suggested Detection Level)** *(mg/kg, dry weight unless noted)*	Suggested Base Parameter Analyses[1]	
		Great Lakes or Urban/ Industrial	**Inland Waters (Rural/ Forested)**
DDT	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)	X	
DDD & DDE	SW-846 8081 EPA 8081, 354440B, 3541 (0.01)	X	
Toxaphene	SW-846 8081 (0.01)		
PCBs (Total)	SW-846 8081 EPA 8081, 3540B, 3541 (0.04)	X Tied to Fish Advisories	X
2,3,7,8-dioxin, 2,3,7,8-furan and 15 2,3,7,8-substituted dioxin and furan congeners	EPA 8290 (1 – 10 pg/g)		
Total Organic Carbon	SW 846 8081 SW846-EPA 9060 (0.2%)	X	X
Polycyclic Aromatic Hydrocarbons (PAHs)	EPA 8310	X	
Naphthalene	(0.019)		
Phenanthrene	(0.017)		
Pyrene	(0.012)		
Fluorene	(0.058)		
2-Methylnapthelene			
Acenapthene	(0.017)		
Acenaphthlyene	(0.021)		
Anthracene	(0.0071)		
Benzo (a) anthracene	(0.019)		
Benzo (a) pyrene	(0.023)		
Benzo (e) pyrene			
Benzo (b) fluoranthene	(0.032)		
Benzo (g,h,i) perylene	(0.022)		
Benzo (k) fluoranthene	(0.021)		
Chrysene	(0.0074)		
Dibenzo(a,h)anthracene	(0.008)		
Fluoranthene	(0.029)		
Indeno (1,2,3-cd) pyrene	(0.034)		
Physical Tests			
Particle Size Analysis – Sieve and Hydrometer Analysis	ASTM D-422 (%)	X	X
Moisture Content	ASTM D-2216 (%)	X	X
Atterburg Limits (Liquid Limit and Plastic Limit)	ASTM D4318 (as moisture content)		
Specific Gravity	ASTM D-854 (Ratio, unitless)		

Pace Analytical® Formerly Inter-Mountain Laboratories
1673 Terra Avenue Sheridan, WY 82801 ph: (307) 672-8945

Date: 5/13/2021

CLIENT: Pace Analytical Green Bay
Project: 40226039 ECHO LAKE
Lab Order: S2105012

CASE NARRATIVE

Report ID: S2105012001

Samples S1, S2, S4 and S5 were received on May 3, 2021.

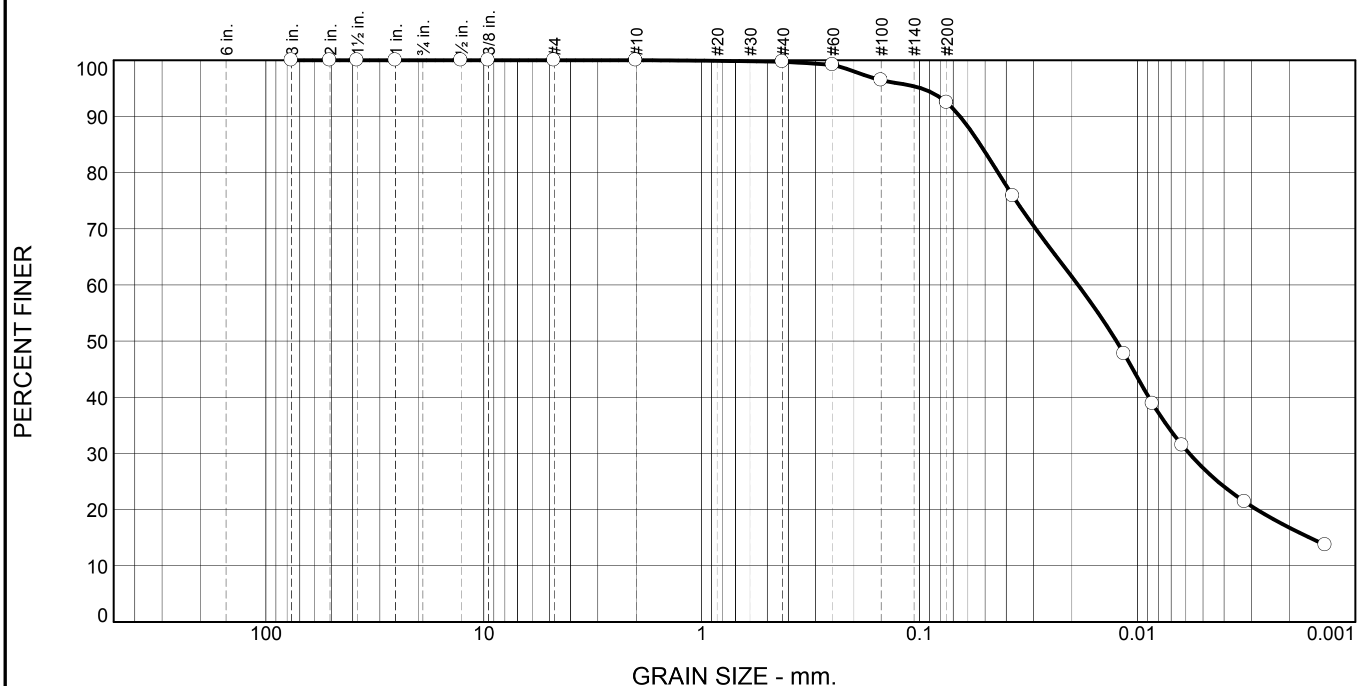
Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Pace Analytical (Formerly Inter-Mountain Laboratories) except as indicated in this case narrative.

Reviewed by: Steve Kasa
Steve Kasa, Mining Lab Supervisor

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	7.3	65.0	27.4

TEST RESULTS (ASTM D 422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
0.5	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#40	99.7		
#60	99.2		
#100	96.4		
#200	92.4		
0.0373 mm.	75.8		
0.0115 mm.	47.7		
0.0085 mm.	38.8		
0.0062 mm.	31.4		
0.0032 mm.	21.4		
0.0014 mm.	13.7		

* (no specification provided)

Material Description

S1: silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.0653 D_{85}= 0.0527 D_{60}= 0.0187
D_{50}= 0.0125 D_{30}= 0.0058 D_{15}= 0.0016
D_{10}= C_u= C_c=

Remarks

Date Received: 5/3/2021 **Date Tested:** 5/13/2021
Tested By: Steve Holzerland
Checked By: Brandon Sadler
Title:

Sample Number: S2105012-001A **Date Sampled:** 4/29/2021

Pace Analytical Services, Inc.

Sheridan, Wyoming

Client: Pace Analytical Green Bay
Project: 40226039 ECHO LAKE
Project No: S2105012 **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

5/13/2021

Client: Pace Analytical Green Bay
Project: 40226039 ECHO LAKE
Project Number: S2105012
Sample Number: S2105012-001A
Material Description: S1: silt
Sample Date: 4/29/2021
Date Received: 5/3/2021 **PL:** NP **LL:** NV
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D 422
Tested By: Steve Holzerland **Test Date:** 5/13/2021
Checked By: Brandon Sadler

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
520.30	0.00	3	0.00	0.00	100.0
		2	0.00	0.00	100.0
		1.5	0.00	0.00	100.0
		1	0.00	0.00	100.0
		0.5	0.00	0.00	100.0
		.375	0.00	0.00	100.0
		#4	0.00	0.00	100.0
		#10	0.00	0.00	100.0
62.49	0.00	#40	0.17	0.00	99.7
		#60	0.35	0.00	99.2
		#100	1.70	0.00	96.4
		#200	2.50	0.00	92.4

Hydrometer Test Data

Hydrometer test uses material passing #200
Percent passing #200 based upon complete sample = 92.4
Weight of hydrometer sample =62.49
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -3.5
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	19.0	55.0	51.3	0.0138	55.0	7.3	0.0373	75.8
15.00	19.0	36.0	32.3	0.0138	36.0	10.4	0.0115	47.7
30.00	19.0	30.0	26.3	0.0138	30.0	11.4	0.0085	38.8
60.00	19.0	25.0	21.3	0.0138	25.0	12.2	0.0062	31.4
240.00	20.0	18.0	14.5	0.0136	18.0	13.3	0.0032	21.4
1440.00	19.0	13.0	9.3	0.0138	13.0	14.2	0.0014	13.7

Pace Analytical Services, Inc.

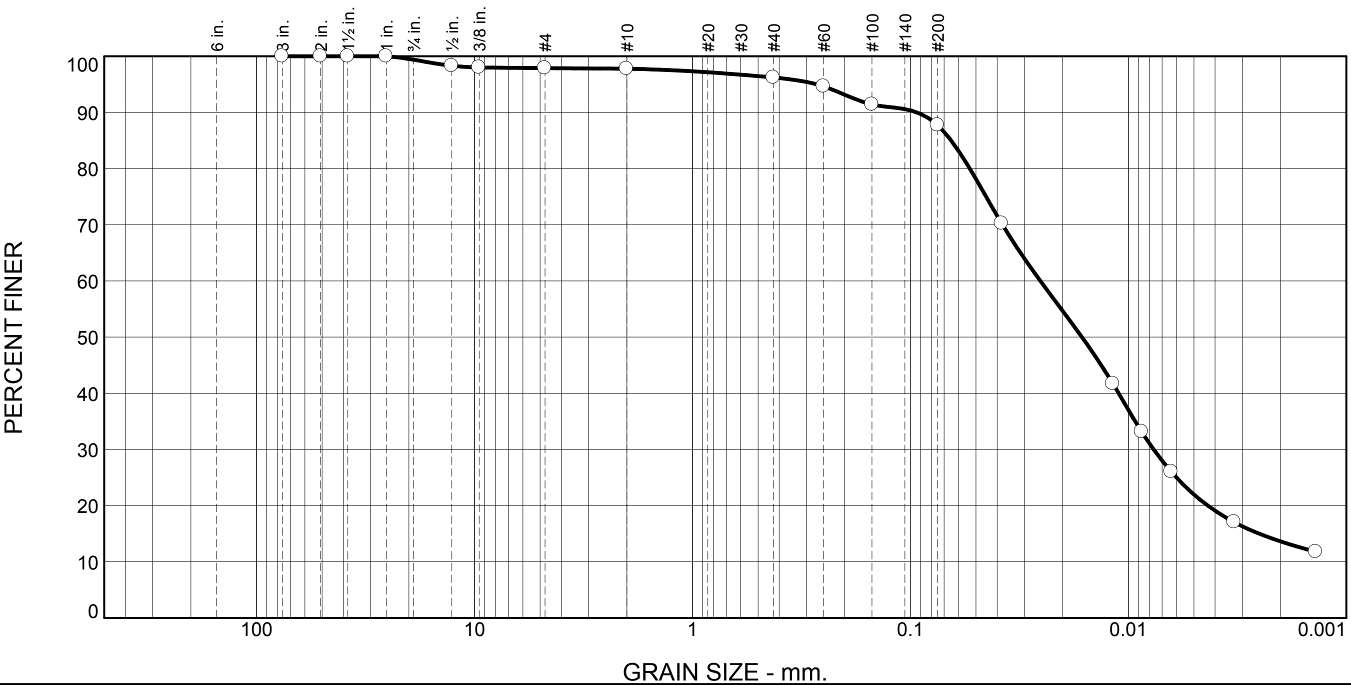
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	0.3	7.3	7.6	65.0	27.4	92.4

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0016	0.0028	0.0058	0.0089	0.0125	0.0187	0.0436	0.0527	0.0653	0.0980

Fineness Modulus
0.04

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.6	1.5	0.1	1.6	8.5	65.7	22.0

TEST RESULTS (ASTM D 422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
0.5	98.3		
.375	98.0		
#4	97.9		
#10	97.8		
#40	96.2		
#60	94.6		
#100	91.4		
#200	87.7		
0.0381 mm.	70.2		
0.0118 mm.	41.7		
0.0087 mm.	33.2		
0.0064 mm.	26.0		
0.0033 mm.	17.1		
0.0014 mm.	11.8		

* (no specification provided)

Material Description

S2: silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.0933 D_{85}= 0.0650 D_{60}= 0.0253
D_{50}= 0.0163 D_{30}= 0.0077 D_{15}= 0.0025
D_{10}= C_u= C_c=

Remarks

Date Received: 5/3/2021 **Date Tested:** 5/13/2021

Tested By: Steve Holzerland

Checked By: Brandon Sadler

Title:

Sample Number: S2105012-002A **Date Sampled:** 4/29/2021

Pace Analytical Services, Inc.

Sheridan, Wyoming

Client: Pace Analytical Green Bay
Project: 40226039 ECHO LAKE

Project No: S2105012 **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

5/13/2021

Client: Pace Analytical Green Bay
Project: 40226039 ECHO LAKE
Project Number: S2105012
Sample Number: S2105012-002A
Material Description: S2: silt
Sample Date: 4/29/2021
Date Received: 5/3/2021 **PL:** NP **LL:** NV
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D 422
Tested By: Steve Holzerland **Test Date:** 5/13/2021
Checked By: Brandon Sadler

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
917.40	0.00	3	0.00	0.00	100.0
		2	0.00	0.00	100.0
		1.5	0.00	0.00	100.0
		1	0.00	0.00	100.0
		0.5	15.60	0.00	98.3
		.375	2.80	0.00	98.0
		#4	1.00	0.00	97.9
		#10	0.90	0.00	97.8
61.53	0.00	#40	0.99	0.00	96.2
		#60	1.00	0.00	94.6
		#100	2.02	0.00	91.4
		#200	2.32	0.00	87.7

Hydrometer Test Data

Hydrometer test uses material passing #200
Percent passing #200 based upon complete sample = 87.7
Weight of hydrometer sample =61.53
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -3.5
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	19.0	53.0	49.3	0.0138	53.0	7.6	0.0381	70.2
15.00	19.0	33.0	29.3	0.0138	33.0	10.9	0.0118	41.7
30.00	19.0	27.0	23.3	0.0138	27.0	11.9	0.0087	33.2
60.00	19.0	22.0	18.3	0.0138	22.0	12.7	0.0064	26.0
240.00	20.0	15.5	12.0	0.0136	15.5	13.8	0.0033	17.1
1440.00	19.0	12.0	8.3	0.0138	12.0	14.3	0.0014	11.8

Pace Analytical Services, Inc.

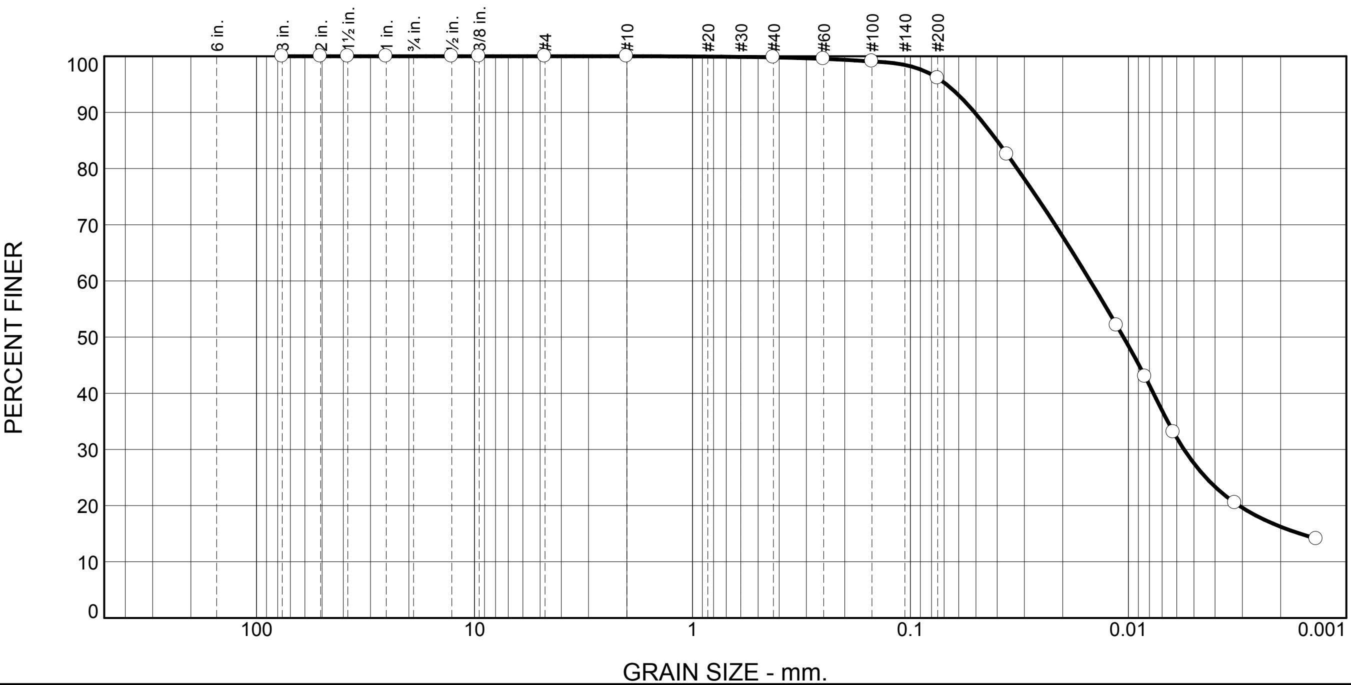
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.6	1.5	2.1	0.1	1.6	8.5	10.2	65.7	22.0	87.7

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0025	0.0043	0.0077	0.0111	0.0163	0.0253	0.0534	0.0650	0.0933	0.2690

Fineness Modulus
0.26

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	3.7	68.6	27.5

TEST RESULTS (ASTM D 422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
0.5	100.0		
.375	100.0		
#4	100.0		
#10	100.0		
#40	99.8		
#60	99.5		
#100	99.1		
#200	96.1		
0.0360 mm.	82.5		
0.0113 mm.	52.1		
0.0084 mm.	43.0		
0.0062 mm.	33.1		
0.0032 mm.	20.5		
0.0014 mm.	14.1		

* (no specification provided)

Material Description

S4: silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.0507 D_{85}= 0.0401 D_{60}= 0.0150
D_{50}= 0.0105 D_{30}= 0.0056 D_{15}= 0.0016
D_{10}= C_u= C_c=

Remarks

Date Received: 5/3/2021 **Date Tested:** 5/13/2021
Tested By: Steve Holzerland
Checked By: Brandon Sadler
Title:

Sample Number: S2105012-003A **Date Sampled:** 4/29/2021

Pace Analytical Services, Inc.

Sheridan, Wyoming

Client: Pace Analytical Green Bay
Project: 40226039 ECHO LAKE
Project No: S2105012 **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

5/13/2021

Client: Pace Analytical Green Bay
Project: 40226039 ECHO LAKE
Project Number: S2105012
Sample Number: S2105012-003A
Material Description: S4: silt
Sample Date: 4/29/2021
Date Received: 5/3/2021 **PL:** NP **LL:** NV
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D 422
Tested By: Steve Holzerland **Test Date:** 5/13/2021
Checked By: Brandon Sadler

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
371.00	0.00	3	0.00	0.00	100.0
		2	0.00	0.00	100.0
		1.5	0.00	0.00	100.0
		1	0.00	0.00	100.0
		0.5	0.00	0.00	100.0
		.375	0.00	0.00	100.0
		#4	0.00	0.00	100.0
		#10	0.00	0.00	100.0
63.20	0.00	#40	0.13	0.00	99.8
		#60	0.16	0.00	99.5
		#100	0.29	0.00	99.1
		#200	1.87	0.00	96.1

Hydrometer Test Data

Hydrometer test uses material passing #200
Percent passing #200 based upon complete sample = 96.1
Weight of hydrometer sample =63.2
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -3.5
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	19.0	58.0	54.3	0.0138	58.0	6.8	0.0360	82.5
15.00	19.0	38.0	34.3	0.0138	38.0	10.1	0.0113	52.1
30.00	19.0	32.0	28.3	0.0138	32.0	11.0	0.0084	43.0
60.00	19.0	25.5	21.8	0.0138	25.5	12.1	0.0062	33.1
240.00	20.0	17.0	13.5	0.0136	17.0	13.5	0.0032	20.5
1440.00	19.0	13.0	9.3	0.0138	13.0	14.2	0.0014	14.1

Pace Analytical Services, Inc.

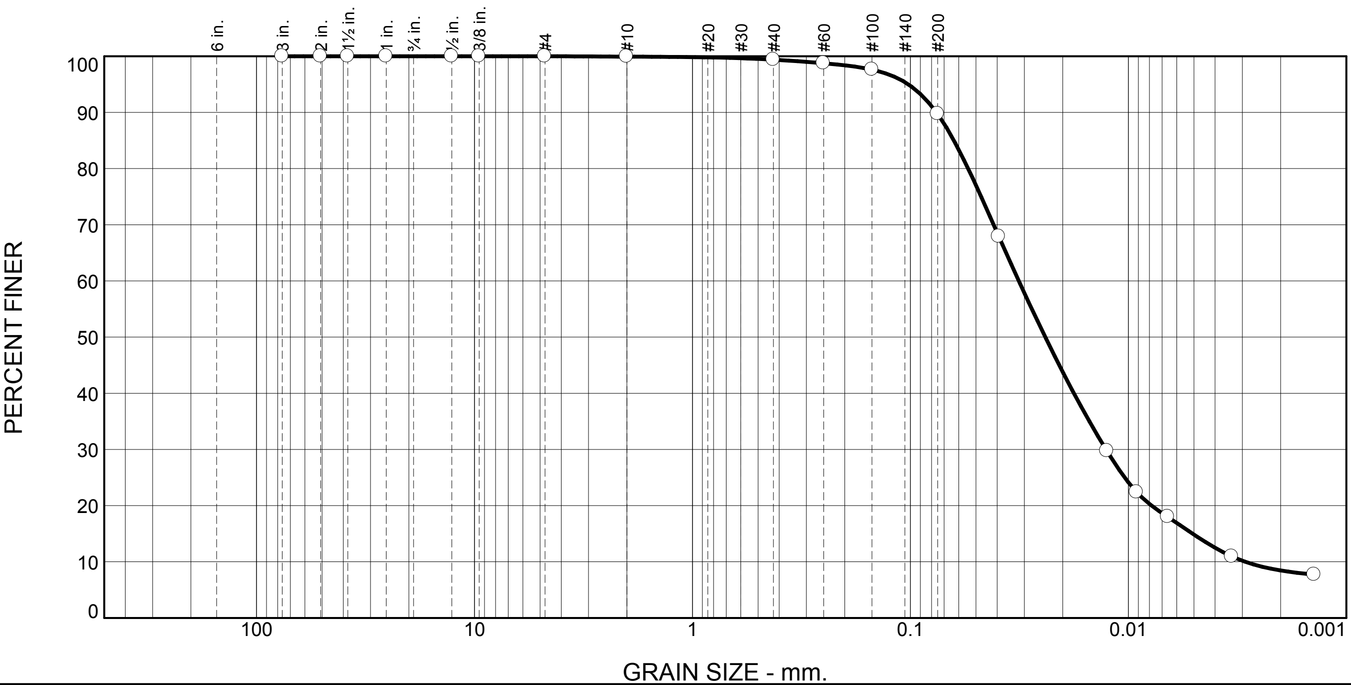
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	0.2	3.7	3.9	68.6	27.5	96.1

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0016	0.0031	0.0056	0.0077	0.0105	0.0150	0.0324	0.0401	0.0507	0.0684

Fineness Modulus
0.01

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.5	9.7	74.9	14.8

TEST RESULTS (ASTM D 422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
0.5	100.0		
.375	100.0		
#4	100.0		
#10	99.9		
#40	99.4		
#60	98.8		
#100	97.6		
#200	89.7		
0.0393 mm.	67.9		
0.0125 mm.	29.7		
0.0092 mm.	22.4		
0.0066 mm.	18.0		
0.0034 mm.	11.0		
0.0014 mm.	7.7		

* (no specification provided)

Material Description

S5: silt

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=** A-4(0)

Coefficients

D_{90}= 0.0759 D_{85}= 0.0632 D_{60}= 0.0318
D_{50}= 0.0240 D_{30}= 0.0127 D_{15}= 0.0051
D_{10}= 0.0029 C_u= 10.93 C_c= 1.73

Remarks

Date Received: 5/3/2021 **Date Tested:** 5/13/2021

Tested By: Steve Holzerland

Checked By: Brandon Sadler

Title:

Sample Number: S2105012-004A **Date Sampled:** 4/29/2021

Pace Analytical Services, Inc.

Sheridan, Wyoming

Client: Pace Analytical Green Bay
Project: 40226039 ECHO LAKE

Project No: S2105012 **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

5/13/2021

Client: Pace Analytical Green Bay
Project: 40226039 ECHO LAKE
Project Number: S2105012
Sample Number: S2105012-004A
Material Description: S5: silt
Sample Date: 4/29/2021
Date Received: 5/3/2021 **PL:** NP **LL:** NV
USCS Classification: ML **AASHTO Classification:** A-4(0)
Grain Size Test Method: ASTM D 422
Tested By: Steve Holzerland **Test Date:** 5/13/2021
Checked By: Brandon Sadler

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
570.30	0.00	3	0.00	0.00	100.0
		2	0.00	0.00	100.0
		1.5	0.00	0.00	100.0
		1	0.00	0.00	100.0
		0.5	0.00	0.00	100.0
		.375	0.00	0.00	100.0
		#4	0.00	0.00	100.0
		#10	0.40	0.00	99.9
61.10	0.00	#40	0.33	0.00	99.4
		#60	0.39	0.00	98.8
		#100	0.70	0.00	97.6
		#200	4.82	0.00	89.7

Hydrometer Test Data

Hydrometer test uses material passing #200
Percent passing #200 based upon complete sample = 89.7
Weight of hydrometer sample =61.1
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -3.5
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	19.0	50.0	46.3	0.0138	50.0	8.1	0.0393	67.9
15.00	19.0	24.0	20.3	0.0138	24.0	12.4	0.0125	29.7
30.00	19.0	19.0	15.3	0.0138	19.0	13.2	0.0092	22.4
60.00	19.0	16.0	12.3	0.0138	16.0	13.7	0.0066	18.0
240.00	20.0	11.0	7.5	0.0136	11.0	14.5	0.0034	11.0
1440.00	19.0	9.0	5.3	0.0138	9.0	14.8	0.0014	7.7

Pace Analytical Services, Inc.

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.1	0.5	9.7	10.3	74.9	14.8	89.7

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0029	0.0051	0.0078	0.0127	0.0178	0.0240	0.0318	0.0543	0.0632	0.0759	0.1022

Fineness Modulus	C_u	C_c
0.04	10.93	1.73

Pace Analytical Services, Inc.

Internal Transfer Chain of Custody

Pace Analytical®
www.pacelabs.com

☐ Samples Pre-Logged into eCOC.

State Of Origin: WI
Cert. Needed: ☐ Yes ☒ No
Owner Received Date: 4/30/2021 **Results Requested By:** 5/14/2021

Workorder: 40226039 **Workorder Name:** ECHO LAKE

Report To

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

Subcontract To

Pace Analytical Sheridan WY
1673 Terra Avenue
Sheridan, WY 82801
Phone (307)672-8945

Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Preserved Containers: None	ASTM D422 Sieve & Hydrometer	LAB USE ONLY
1	S1	PS	4/29/2021 13:00	40226039001	Solid	1	X	S2105012
2	S2	PS	4/29/2021 13:00	40226039002	Solid	1	X	
3	S4	PS	4/29/2021 13:00	40226039004	Solid	1	X	
4	S5	PS	4/29/2021 13:00	40226039005	Solid	1	X	
5								

Transfers	Released By	Date/Time	Received By	Date/Time
1	[signature]	4/30/21 1600	[signature]	5/3/21
2				
3				

Comments

Cooler Temperature on Receipt ____ °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.*

Summary of Soil Analytical Results
Echo Lake Pre-Dredging Study

		Samples						NR 720 WDNR Spreadsheet RCLs			
		1	2	3	4	5	6				
		Lake Bed	Sediment	Sediment	Lake Bed	Sediment	Sediment				
	Date	4/29/21	4/29/21	4/29/21	4/29/21	4/29/21	4/29/21				
	Soil Type	Silt	Silt	n/a	Silt	Silt	n/a				
Parameter	**CAS**							**Non-industrial Direct Contact**	**Industrial Direct Contact**	**Protection of Ground Water**	**Back Ground Threshold Value**
Metals											
Arsenic	7440-38-2	6.5	7.0	---	5.5	8.0	---	0.677	3	0.584	8
Barium	7440-39-3	134	97.0	---	134	109	---	15,300	100,000	164.8	364
Cadmium	7440-43-9	*1.2 J*	*1.3 J*	---	0.58 J	0.48 J	---	71.1	985	0.752	1
Chromium	7440-47-3	24.8	51.1	---	23.7	26.9	---	100,000	100,000	360,000	44
Copper	7440-50-8	15.8	15.1	---	16.5	16.1	---	3,130	46,700	92	35
Lead	7439-92-1	18.7	18.1	---	24.3	26.9	---	400	800	27	52
Manganese	7439-96-5	744	477	---	654	473	---	1,830	---	---	2,937
Mercury	7439-97-6	0.17	0.18	---	*0.21*	0.19	---	3.13	3.13	0.208	---
Nickel	91-20-3	16.9	*56.6*	---	16.6	27.5	---	1,550	22,500	13.061	31
Selenium	7782-49-2	*3.7*	*3.1*	---	*2.9*	*2.7*	---	391	5,840	0.52	---
Zinc	7440-66-6	74.7	63.5	---	79.6	76.0	---	23,500	100,000	---	150
Nutrients											
Phosphorus	7723-14-0	965	1330	1710	738	803	873	---	---	---	---
Nitrogen, Ammonia	7664-41-7	293	621	---	468	264	---	---	---	---	---
Nitrogen, Kjeldahl, Total	7727-37-9	4380	5090	---	4360	4000	---	---	---	---	---
Mean Total Organic Carbon	7440-44-0	46900	66200	---	52400	46300	---	---	---	---	---
Total Organic Carbon	7440-44-0	48000	78200	---	55300	47400	---	---	---	---	---
Polychlorinated Biphenyls (PCBs)											
PCB, Total	1336-36-3	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
PCB-1016 (Aroclor 1016)	12674-11-2	<0.0319	<0.0400	---	<0.0304	<0.0309	---	4.11	51.30	---	---
PCB-1221 (Aroclor 1221)	11104-28-2	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
PCB-1232 (Aroclor 1232)	11141-16-5	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
PCB-1242 (Aroclor 1242)	53469-21-9	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
PCB-1248 (Aroclor 1248)	12672-29-6	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
PCB-1254 (Aroclor 1254)	11097-69-1	<0.0319	<0.0400	---	<0.0304	<0.0309	---	1.17	14.70	---	---
PCB-1260 (Aroclor 1260)	11096-82-5	<0.0319	<0.0400	---	<0.0304	<0.0309	---	---	---	---	---
Polycyclic Aromatic Hydrocarbons (PAHs)											
1-Methylnaphthalene	90-12-0	<0.0051	<0.0064	---	0.0243 J	<0.0050	---	4,180	52,700	---	---
Acenaphthene	83-32-9	<0.0045	<0.0057	---	<0.0043	<0.0044	---	3,590	45,200	---	---
Acenaphthylene	208-96-8	<0.0044	<0.0055	---	0.0055 J	<0.0043	---	---	---	---	---
Anthracene	120-12-7	<0.0045	0.0241 J	---	0.0098 J	0.0350	---	17,900	100,000	196.94915	---
Benzo(a)anthracene	56-55-3	<0.0040	0.0202 J	---	0.0055 J	0.0356	---	1.14	20.8	---	---
Benzo(a)pyrene	50-32-8	<0.0049	0.0250 J	---	0.0103 J	0.0511	---	0.115	2.11	0.47	---
Benzo(b)fluoranthene	205-99-2	<0.0041	0.0143 J	---	0.0055 J	0.0258 J	---	1.15	21.1	0.4780876	---
Benzo(g,h,i)perylene	191-24-2	<0.0061	0.0129 J	---	<0.0059	0.0234 J	---	---	---	---	---
Benzo(k)fluoranthene	207-08-9	<0.0045	0.0137 J	---	0.0045 J	0.0182 J	---	11.5	211	---	---
Chrysene	218-01-9	<0.0066	0.0248 J	---	0.0095 J	0.0402	---	115	2110	0.1442231	---
Dibenz(a,h)anthracene	53-70-3	<0.0048	<0.0061	---	<0.0046	0.0074 J	---	0.115	2.11	---	---
Fluoranthene	206-44-0	<0.0041	0.0548	---	0.0282 J	0.0859	---	2,390	30,100	88.877805	---
Fluorene	86-73-7	<0.0042	<0.0052	---	0.0094 J	<0.0041	---	2,390	30,100	14.829932	---
Indeno(1,2,3-cd)pyrene	193-39-5	<0.0073	0.0115 J	---	<0.0070	0.0220 J	---	1.15	21.1	---	---
Naphthalene	91-20-3	<0.0034	<0.0043	---	0.0232 J	<0.0033	---	5.52	24.1	0.6581818	---
Phenanthrene	85-01-8	<0.0040	0.0328 J	---	0.0242 J	0.0386	---	---	---	---	---
Pyrene	129-00-0	<0.0051	0.0450	---	0.0223 J	0.0697	---	1,790	22,600	54.545455	---
Cumulative Risk Calculation (Non-Industrial Direct Contact)											
Exceedances		0	0	---	0	0	---	1	1	---	---
Hazard Index		0.0724	0.1193	---	0.0546	0.0550	---	1	1	---	---
Cancer Risk		1.1E-06	1.5E-06	---	1.1E-06	1.1E-04	---	1.00E-05	1.00E-05	---	---

Notes:
Samples 3 and 6 only analyzed for Phosphorus
J = Estimated concrentration at or above the Limit of Detection and below the Limit of Quantification
< = less than detection limit (analyte not detected)
Groundwater RCL exceedances are in *Italic red* font
Non-Industrial Direct Contact RCL exceedances are in **bold red** font
Industrial RCL exceedances are boxed.

Phosphorus Load Estimate
May-21

Project:	Echo Lake Pre-Dredging Study
Client:	City of Burlington
Location:	Racine County, WI
Project No.:	26-1258.00
References:	1.) *Earth Manual* . US Department of Interior. Third Edition. 1998.

Dredge volume estimate	115,231	cy	(average of 33/200kHz sediment surfaces)
Avg sediment density	2,018	kg/m^3	(average value from "Earth Manual" correlating to testing results)
Phosphorus in sediment	1,281	mg/kg	(average of 3 sediment samples within dredge area (not lake bed samples))

Phosphorus Load Estimate Calculation	115,231 cy	x	0.764554858 m^3/cy	=	88,100.42 m^3
	88,100.42 m^3	x	2,018 kg/m^3	=	177,786,649.26 kg
	177,786,649.26 kg	x	1,281 mg/kg	=	227,744,697,701.49 mg
	227,744,697,701.49 mg	x	0.000002204 lb/mg	=	501,949.31 lb of phosphorus in sediment

Conversions
1 cy = 0.764554858 m3/cy
1 mg = 0.000002204 mg/lbs