Lake Accotink Discovery Report

Interim Deliverables October 5, 2023

prepared for:

Fairfax County, VA

Draft

October 5, 2023

LimnoTech

Water Environment | Scientists Engineers

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Interim Deliverables October 5, 2023

prepared by:
LimnoTech

under contract to:
WSP USA for Fairfax County, VA

ACKNOWLEDGEMENTS
We would like to acknowledge the Lake Accotink Task Force who assembled the discovery questions and Charles Smith who served as our liaison throughout this project.

Note:
All materials in this report are based on high-level, rapid assessments and should be considered preliminary.

Introduction

The sections of this report are formatted to reflect the eight primary questions posed in the Task Force's discovery scope document. This deliverable report documents responses to:

- Question 2, parts 2.2, 2.3, 2.4, and 2.5. Question 2 part 2.1 and 2.6 were discussed in the 9/19/23 deliverable. Question 2 parts 2.7 and 2.8 will be addressed in a future deliverable.
- Question 3, parts 3.1 and 3.2. Other parts of this question will be addressed in a future deliverable.
- Question 4, parts 4.1, 4.2, 4.3, and 4.4. Other parts of this question will be addressed in a future deliverable.
- Question 5, all parts.

PLEASE NOTE: The original deliverables timeline has been modified in the following ways:

- QUESTION 2G (REGULATORY REQUIREMENTS) will be discussed under a future deliverable.
- QUESTION 5 (FEATURES, AMENITIES, BENEFITS) is introduced and discussed under this deliverable.

1 WHAT WILL HAPPEN TO THE LAKE IF NOTHING IS DONE?

1.1 Will mud flat form?

Previously discussed in the 9/19/23 deliverable.

1.2 b. Will there be quicksand that poses a risk to park users?

Previously discussed in the 9/19/23 deliverable.

1.3 Will there be nuisances such as mosquitos, odors, etc.?

Previously discussed in the 9/19/23 deliverable.

1.4 Will it become overrun with invasive species?

Previously discussed in the 9/19/23 deliverable.

1.5 Will flood risk increase?

Previously discussed in the 9/19/23 deliverable.

2 IS MANAGING THE LAKE AS A WETLAND A VIABLE OR POTENTIALLY DESIRABLE OPTION?

2.1 What is a stream/wetland complex? How is it different than what we typically think of as wetlands?

Previously discussed in the 9/19/23 deliverable.

2.2 What is required to develop a plan to manage the lake footprint as a wetland?

An overall project implementation roadmap is provided in Figure 2-1. Given the complexity of the challenges faced by the community, a good strategy for developing a plan to manage the lake in a new/different way such as a wetland would be to start with a park master planning process.

The master planning process should:

- Seek community input on their vision for the park
- Conduct feasibility analyses for the potential interventions and/or management strategies
- Identify potential funding mechanisms

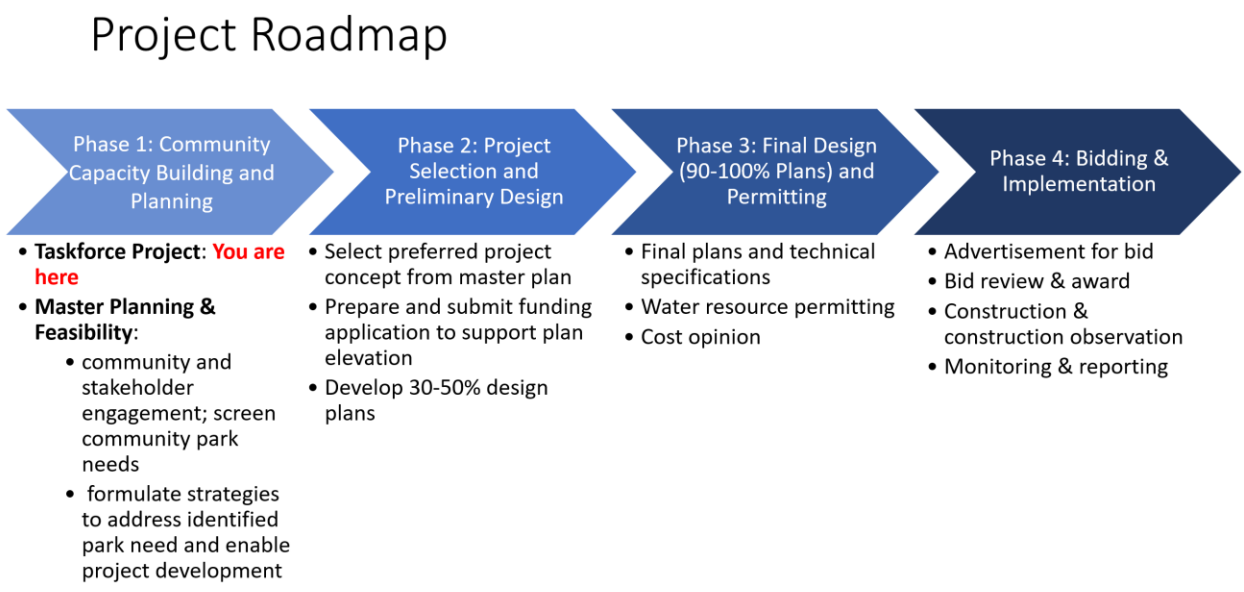


Figure 2-1 Project Implementation Roadmap

2.3 What might it look like?

The islands and wetlands that are naturally forming at the upstream end of the lake have a river delta appearance (Figure 2-2). If the lake were allowed to infill on its own, we can expect the delta to continue to grow downstream towards the dam. The ultimate condition would likely be an anastomosing stream with a layout similar to Figure 2-3. There are several partial dredge scenarios which include managed wetland options and will be discussed in Section 3.

Figure 2-2 2021 Aerial Image of the Lake Accotink Delta (image from Google Earth Pro)

Figure 2-3 Potential ultimate condition if the lake were allowed to fill in

2.4 How long will it take to create a managed wetland that is a community asset providing environmental and recreational benefits?

Infilling with No Interventions

The lake is infilling at a relatively rapid pace. To assess the potential timeline in which infilling may occur, we have divided the lake into 5 zones (Figure 2-4). Zone 1 is already a delta system and, for the purposes of this analysis, is considered fully filled. Zones 2-5 have been laid out using our best professional estimates of how the delta may grow in the future. The infilling timelines are estimated using to two methods:

1. Bulk lake sediment retention volumes from HDR's 2002 report "Lake Accotink Sediment Management Program Study"
    a. Estimated Retention Rate = 17,411 cubic yards per year
    b. This estimate is likely high and will decrease as the lake infills.
    c. The lower-bound timelines generated from this analysis are likely lower than the true timeline.
2. Bedload inflow rates only

a. Assumes that all bedload is captured within the lake and all suspended loads pass through the lake.

b. Total sediment load from HDR 2002 is 33,900 cubic yards per year and the bedload is estimated as ~13% of the total load.

c. The upper-bound timelines generated from this analysis are likely higher than the true timeline.

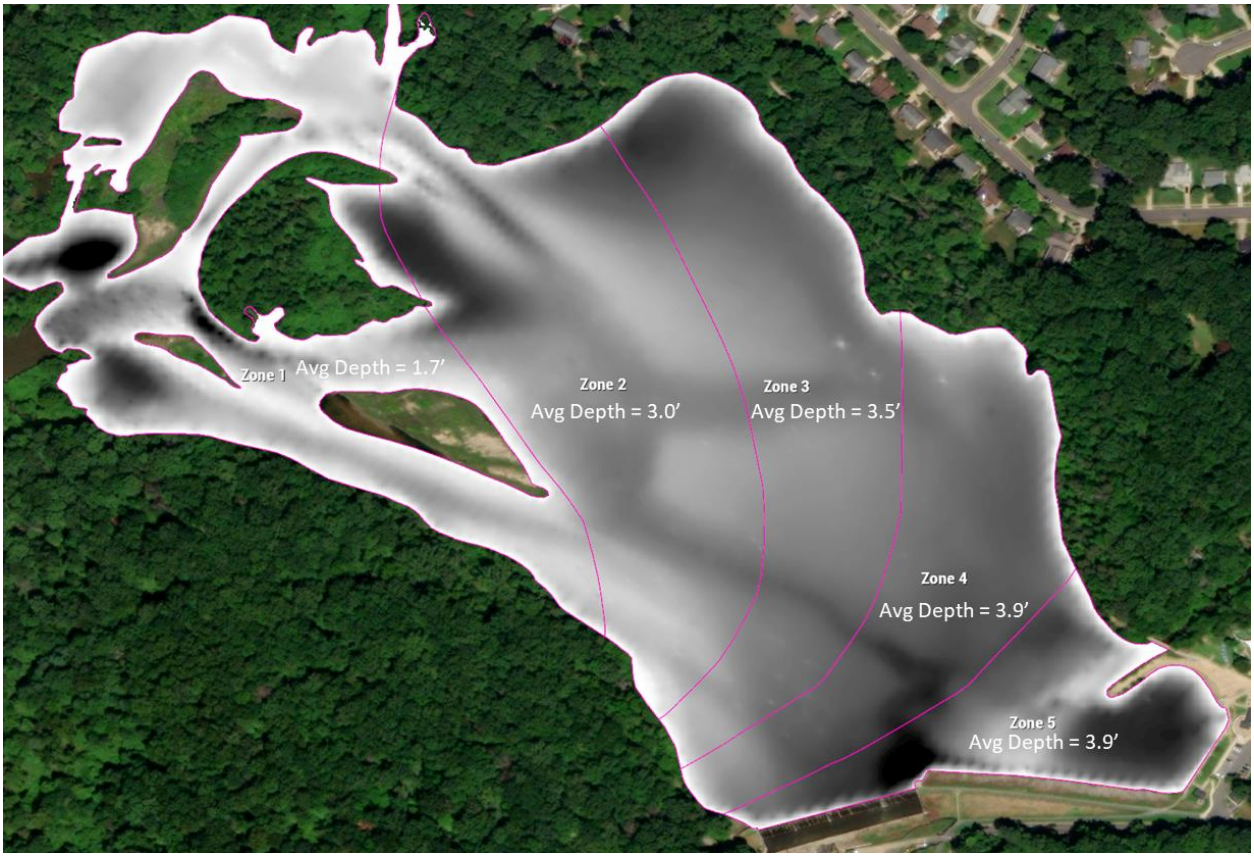


Figure 2-4 Lake Bathymetry with delta infilling zones identified.

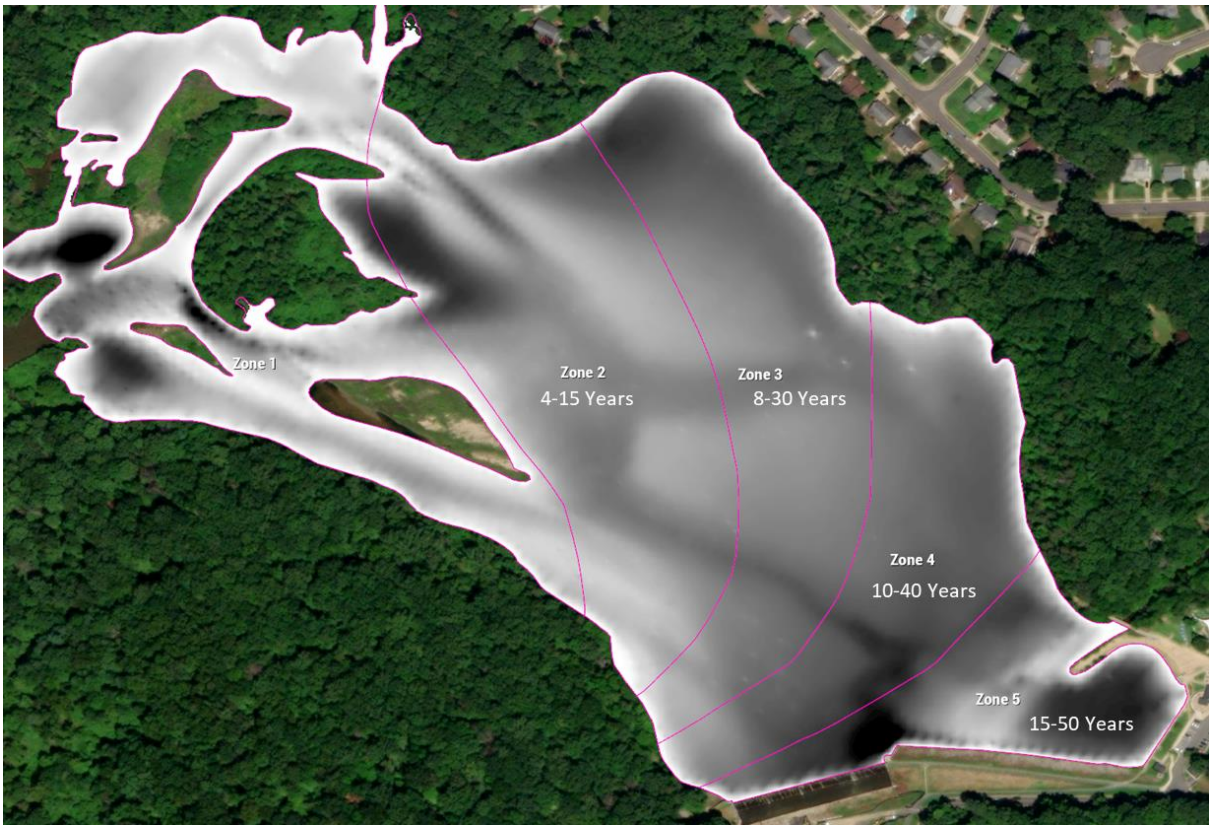


Figure 2-5 Lake bathymetry with potential infilling timelines for each zone.

Water Level Manipulation

Water level manipulation could help establish the riparian wetlands more rapidly. Lowering the crest of the dam, and consequently the surface elevation of the lake, would expose bed sediments. The sediments are likely nutrient rich and should readily grow wetland plants. Coupling the lake level lowering with an active planting/seeding project would help establish riparian wetlands even more quickly.

Figure 2-6 through Figure 2-9 provide bathymetric maps of Lake Accotink with its normal pool elevation as well as 1, 2, and 3- foot reduction in pond elevation. The 1 and 2 -foot crest reductions could be achieved by manipulating the flash boards along the crest of the dam. This project would likely take a few months and plant establishment could be achieved within 2 years. A 3-foot crest reduction would require altering the structure of the dam and would take at least 2 years; consequently, plant establishment could be achieved within 4 years.

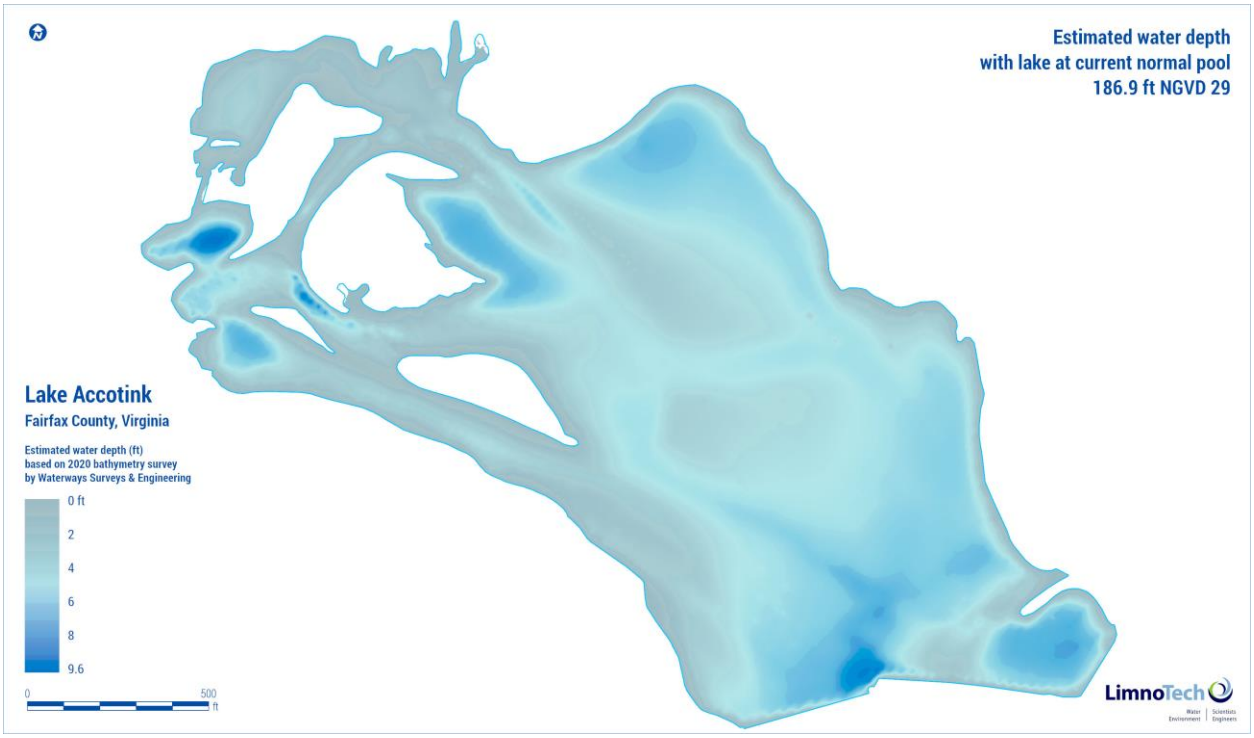


Figure 2-6 Lake bathymetry based on 2020 survey data

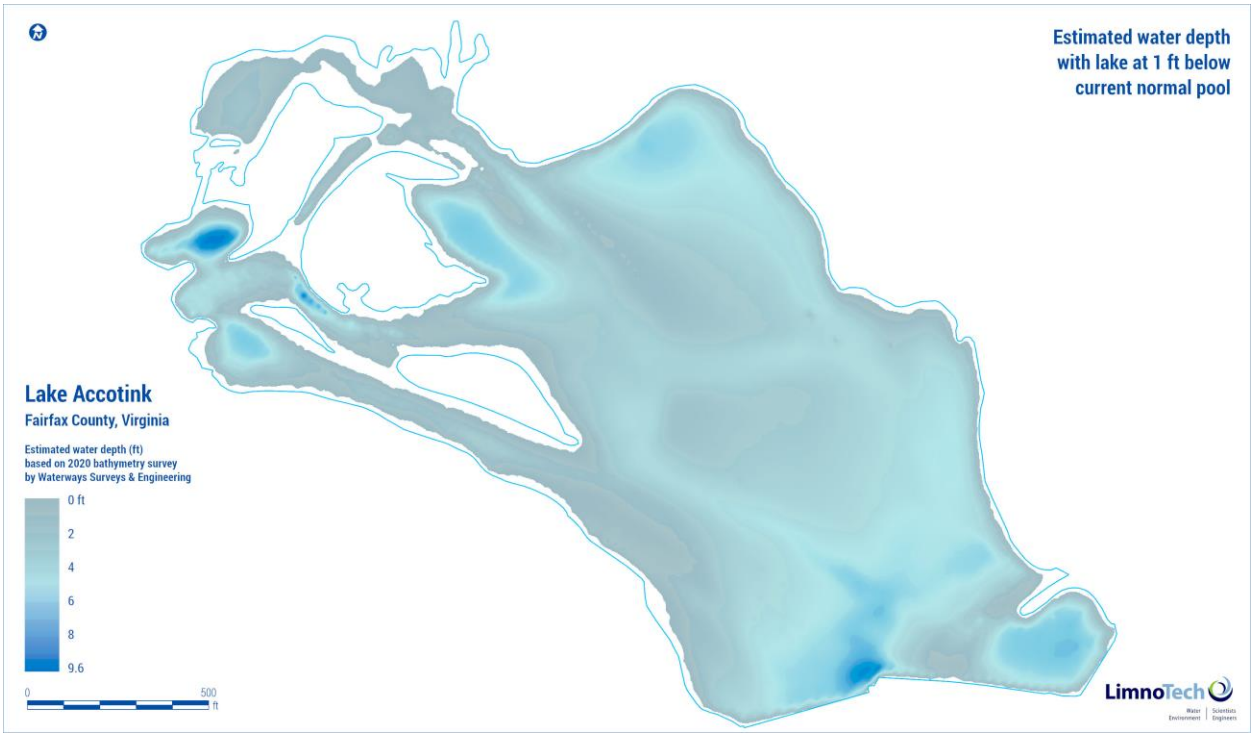


Figure 2-7 Lake bathymetry with a 1-foot lowering of the dam crest

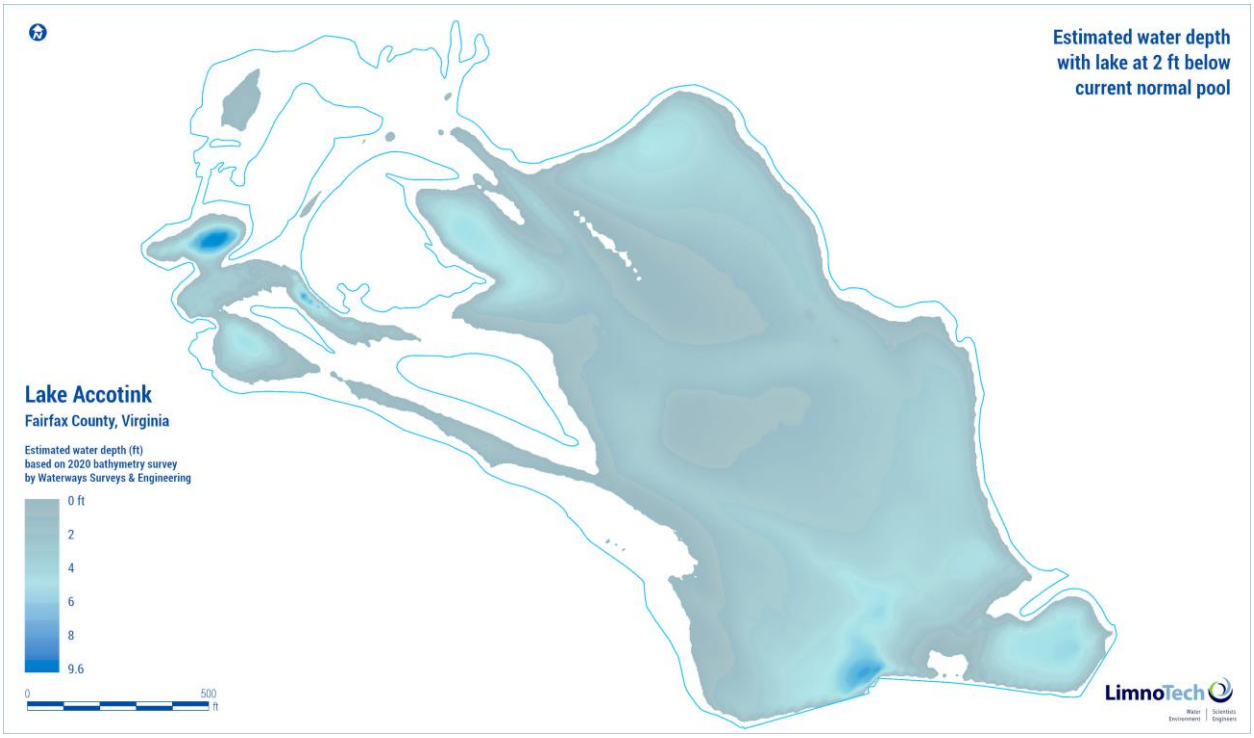


Figure 2-8 Lake bathymetry with a 2-foot lowering of the dam crest

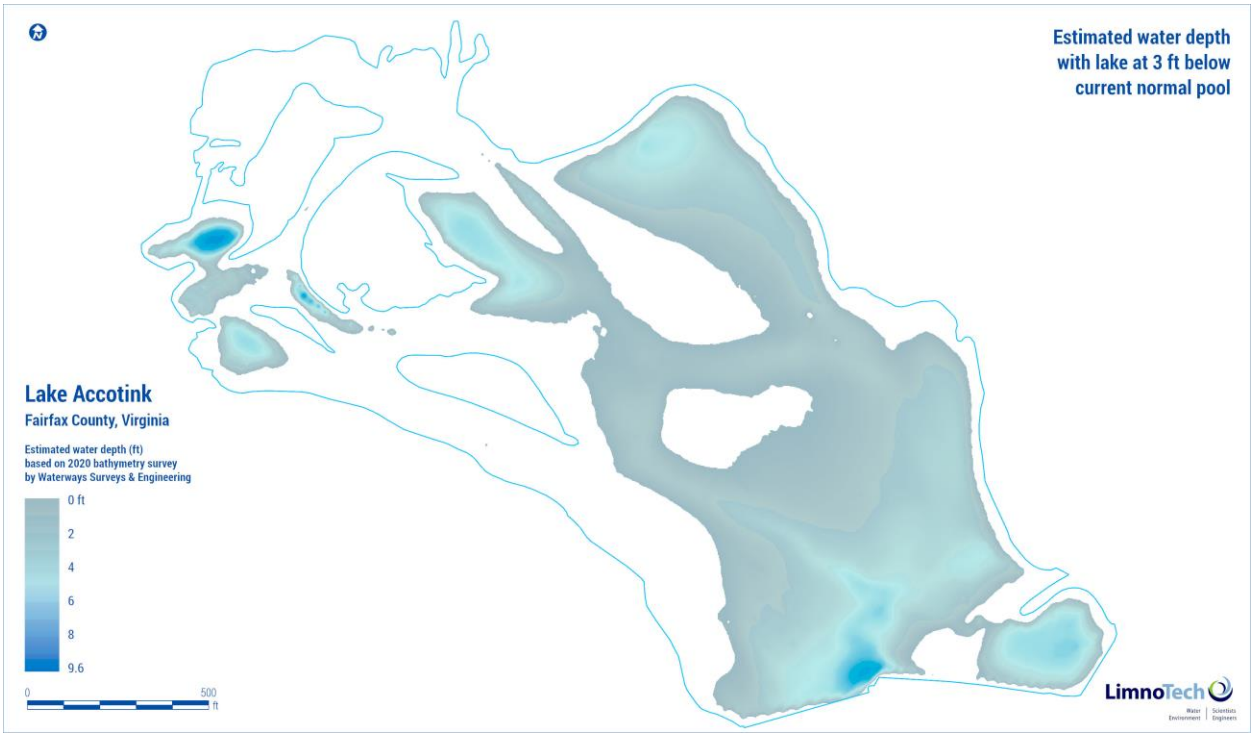


Figure 2-9 Lake bathymetry with a 3-foot lowering of the dam crest

Intervention strategies

There are several partial dredge and open water strategies discussed on Section 3. These strategies will all likely take at least 5 years to implement and stabilize.

2.5 Will a managed wetland be "overcome" by storm pulses and sediment loading with emphasis on extreme events?

Previously discussed in the 9/19/23 deliverable.

2.6 Will a wetland have a less cooling effect on the environment than an eight-foot or more depth lake? Will a wetland create a heat island?

Previously discussed in the 9/19/23 deliverable.

2.7 Would managed wetlands have different regulatory requirements than a lake, and if so, summarize them?

To be addressed under a future deliverable.

2.8 What is the cost to design, permit, and construct and maintain a managed wetland?

To be addressed under a future deliverable.

3 COULD A MANAGED WETLAND OPTION INCLUDE OPEN WATER AREAS?

All potential scenarios regarding the future configuration of Lake Accotink include open water areas. Since Accotink Creek flows through the site, at a minimum there will always need to be enough open water area to convey Accotink Creek flows through the site.

3.1 Where might open water be located?

If the site were managed as a stream and riparian wetland, the open water would extend in creek form throughout the length of the current lake footprint but would be appreciably narrower.

If all or a portion of the site were managed as a lake, the deepest portion of the lake would be at the downstream end near the dam or near a future outlet structure.

3.2 What type of open water could be maintained?

With enough money and political will, any type of open water (within reason) can be maintained. In this section we will present seven alternate open water scenarios and discuss the opportunities and challenges of each.

It should be noted that none of these scenarios have considered potential geotechnical challenges, nor has a cut/fill analysis been conducted. If one or several of these scenarios is progressed forward, a master plan and feasibility study should be conducted.

Full Dredge Scenario (Figure 3-1):

This scenario would fully dredge the lake per the original dredge plan. This option would restore the lake to its original design condition. If this option were coupled with in-lake improvements and lake management strategies, it could temporarily improve the fishery. Re-dredging would likely be required every 5-15 years to maintain the lake's depth. Regular re-dredging could have detrimental effects on the fishery and aquatic ecosystems. This is likely the most expensive long-term option.

Do Nothing Ultimate Condition Scenario (Figure 3-2)

This scenario would allow the lake to fill in with sediment as discussed in Section 2.4. The ultimate condition of this scenario would likely be an anastomosing (multi-threaded) stream. In its ultimate condition, all of the sediment load that enters from upstream will eventually be discharged to downstream below the dam; consequently, the long-term maintenance of the system would be limited to the maintenance of the dam. If maintained and managed during the infilling process, the ultimate condition has potential to be a rich and vibrant habitat.

The primary challenge to this scenario is the long duration and lake condition while the lake is filling with sediment (see Figure 2-5). While the lake is filling with sediment, the lake areas will remain shallow and continue to possess limited habitat. Furthermore, as the lake fills in, the downstream end may be more prone to algal blooms and bad odors.

Dam Removal Scenario (Figure 3-3)

This scenario would partially or completely remove the dam and restore Accotink Creek through the site. Removing the dam would increase the longitudinal slope of the creek and it would likely revert to a single-thread channel with a similar character to Accotink Creek both upstream and downstream of the lake.

This scenario would restore the sediment flow from the upper creek to the lower creek. This scenario has the highest long-term sustainability and lowest long-term costs.

Under this scenario, the park would lose the lake experience. Other unique experiences (discussed in Section 5) would still be possible.

Partial Dredge Island Scenario (Figure 3-4)

A partial dredge scenario could dredge the downstream end of the lake and utilize the dredge spoils to build islands in the upstream end. The extent of the dredge zone and island zone will depend on the cut/fill balance of the sediment excavated.

The lake will continue to infill with sediment after the dredging and island building project; consequently, there could be multiple rounds of dredging and island building that gradually shift the site from more lake to more island. Eventually, regular maintenance dredging will be required to maintain an open water lake in a portion of the site.

The first round of island building will likely yield a smaller dredge/lake area than the first round of anastomosing stream building.

In this scenario, the presence of more water between the islands (as compared with the anastomosing scenario) means that there will continue to be sediment accumulation between the islands, which would reduce navigability and bury aquatic habitat.

The ongoing maintenance cost of the dam may eventually become prohibitively expensive. If the next generation of park managers choose to remove the dam, this scenario would result in a more challenging and expensive dam removal scenario.

Partial Dredge Anastomosing Scenario (Figure 3-5)

A partial dredge scenario could dredge the downstream end of the lake and utilize the dredge spoils to build riparian wetland and an anastomosing stream at the upstream end. The extent of the dredge zone and stream zone will depend on the cut/fill balance of the sediment excavated.

The lake will continue to infill with sediment after the dredging and stream building project; consequently, there could be multiple rounds of dredging and stream building at gradually shift the site from more lake to more stream. Eventually, regular maintenance dredging will be required to maintain an open water lake in a portion of the site. Alternatively, once the stream zone fully covers the lake, the system could be transitioned to a stream-only complex.

The first round of anastomosing stream building will likely yield a larger dredge/lake area than the first round of stream building.

In this scenario, the narrower stream channels between the riparian zones/wetlands/islands would encourage sediment transport through the stream and towards the lake portion. This would help maintain navigability and aquatic habitat. On the other hand, more sediment transport through the stream zone would increase the infilling rate, and consequently dredge frequency, of the lake zone during the building phase.

The ongoing maintenance cost of the dam may eventually become prohibitively expensive. If the next generation of park managers choose to remove the dam, this scenario would result in a more challenging and expensive dam removal scenario.

Partial Dredge with Partial Dam Removal Scenario (Figure 3-6)

This scenario is a hybrid approach. It would likely yield a single-thread stream at the upstream end and a less dynamic stream channel with more stable riparian wetlands. The partial removal of the dam would expose more lakebed sediments and establish riparian wetlands more quickly (Figure 2-9). The partial removal of the dam would also make a fish passage structure more feasible.

This option would reduce the overall lake size and may require a greater dredging depth at the downstream and may provide less disposal area at the upstream end of the site.

This scenario may reduce the hazard classification of the dam but would likely not remove it from dam regulations entirely.

Partial Dredge Horseshoe Island Scenario (Figure 3-7)

This scenario would utilize dredge materials to construct horseshoe islands. The shape of the islands would promote sediment settling within the curvature of the horseshoes and may slow down the infilling rate of the dredged lake portion of the site. This scenario would utilize relatively little dredge volume when compared to the other partial dredge scenarios.

This scenario would likely be the most challenging to implement because the full sediment transport and depositional patterns will need to be vetted in order to properly design this scenario. It is also possible that the vetting process would ultimately deem this scenario infeasible.

The ongoing maintenance cost of the dam may eventually become prohibitively expensive. If the next generation of park managers choose to remove the dam, this scenario would result in a more challenging and expensive dam removal scenario.

Outlet relocation scenario (Figure 3-8)

This scenario could be coupled with most of the other scenarios. It would relocate the primary outlet of the lake closer to the beach area. The outlet would likely be a drop inlet structure with a concrete pipe that discharges downstream of the dam. The crest of the outlet would need to be at or below the current elevation of the dam crest and implementing this scenario may require slightly lowering the normal lake level.

The scenario would be designed to relocate the deepest area of the lake from the east end of the dam to the new outlet location. It should be noted that the current deepest portion of the lake is relatively small (see bathymetric map in Figure 2-6) and can be expected to be of a similar sized in this scenario.

This scenario would likely make a fish passage structure infeasible.

Figure 3-1 Full dredge scenario

Figure 3-2 Do nothing ultimate condition scenario

Figure 3-3 Dam removal scenario

Figure 3-4 Partial dredge island scenario

Figure 3-5 Partial dredge anastomosing scenario

Figure 3-6 Partial dredge with dam modification scenario

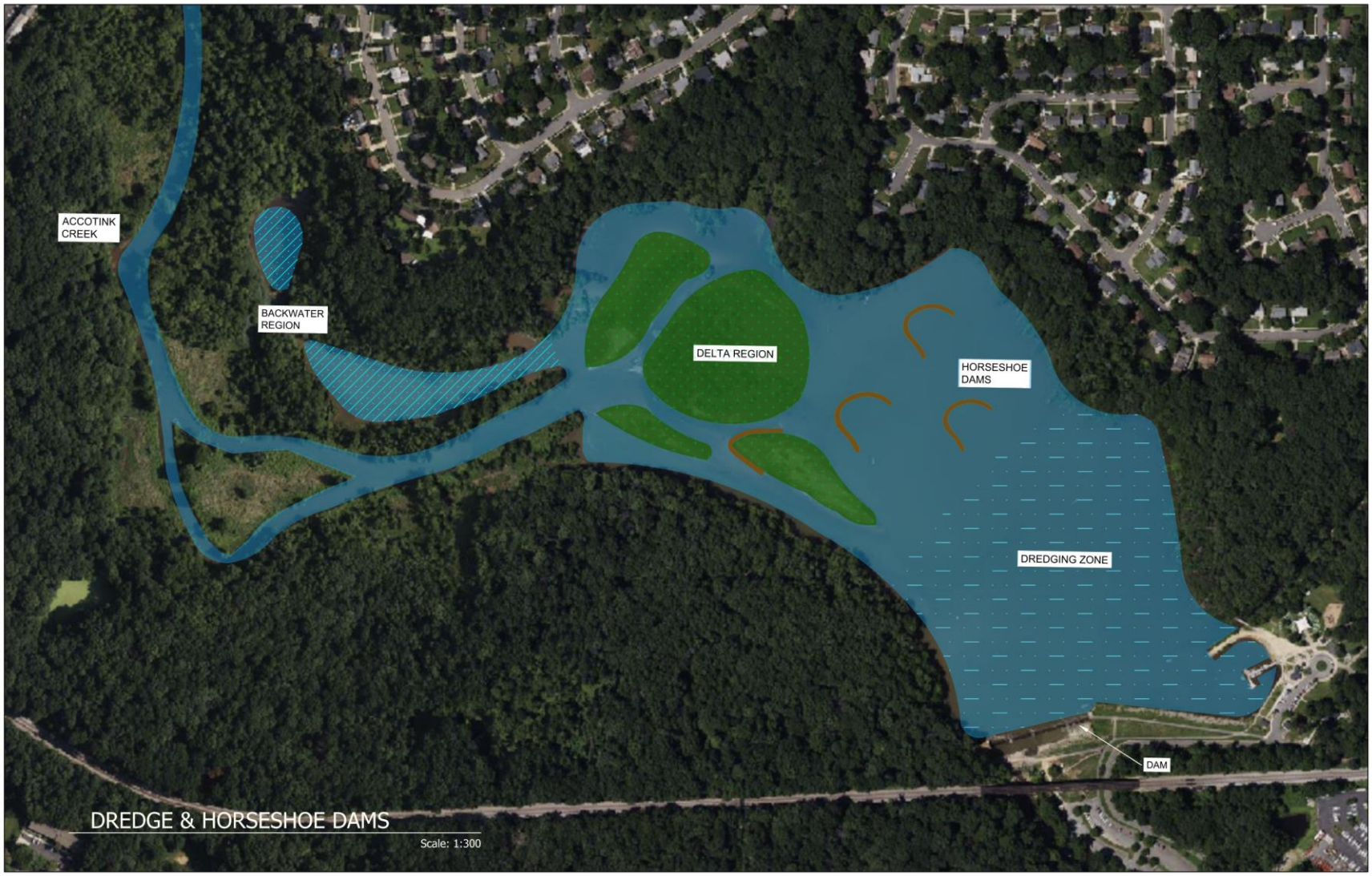


Figure 3-7 Partial dredge horseshoe island scenario

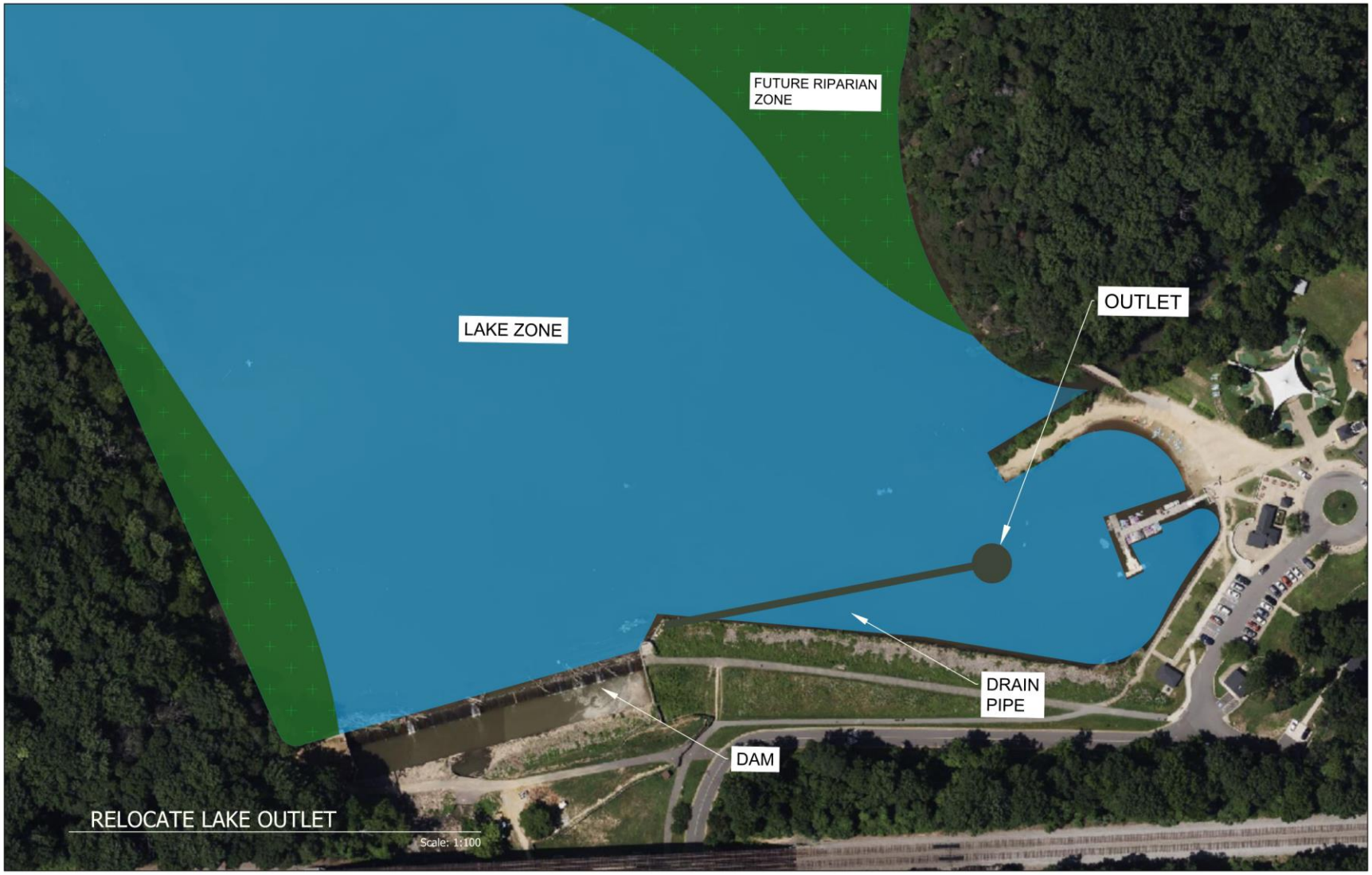


Figure 3-8 Outlet relocation scenario

4 HOW WOULD LAKE ACCOTINK DAM BE INCORPORATED INTO A MANAGED WETLAND OPTION?

4.1 Could the dam remain as is?

Yes, the dam can remain as is. Beyond normal dam maintenance, the primary consideration is the low-flow bypass built into that dam that is utilized to draw down the lake for dredging and maintenance activities. In the scenarios that allow sediment to fill the lake up to the dam, this draw down system may need to be revised.

4.2 Could the dam be modified to improve wetland function and maintenance?

Yes, manipulating the water level of the dam is one strategy for managing a wetland. If the water level of the lake were drawn down 1-3 feet, the bed sediments would be exposed and wetland vegetation could be established. Figure 2-7 to Figure 2-9 indicate the approximate extent of potential new wetland zones under three draw down scenarios.

If the crest of the dam was lowered and the normal pool of the lake was reduced to create more riparian wetland, occasionally increasing the lake level is one strategy to help control invasive species.

4.3 Would management options be improved by removal of any portion of the dam?

Potentially, yes. Removing all or part of the dam could reduce the total number of management options you have; however, most of the remaining options would require less expensive long-term maintenance.

Options that remove all or a portion of the dam shift the management regime from reservoir management to stream management. A stream environment is more consistent with the historic, natural condition of the site and therefore should require fewer maintenance interventions.

4.4 How could fish passage be incorporated into dam/lake management options?

Fish passage design is easier for lower head obstruction, so naturally, full dam removal would be the most conducive to fish passage, followed by partial dam removal. That said, fish passage can be incorporated into all of the lake scenarios.

The type of fish passage strategy depends on the target species, flow rates, obstruction height, and time of year. All of these would need to be considered.

Given the constrained nature of the site downstream of the dam, a fish passage structure would likely need to be asynchronous with the normal channel alignment (such as along the face of the dam, see Figure 4-1).

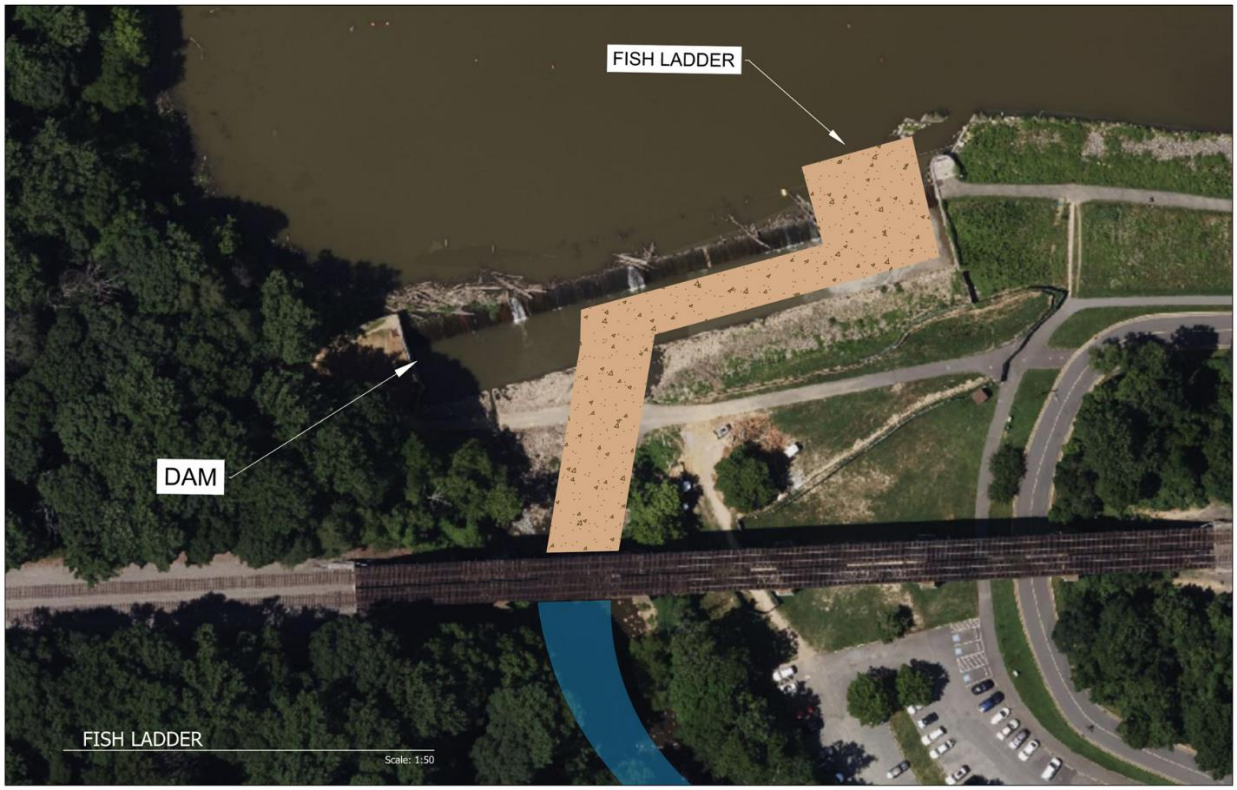


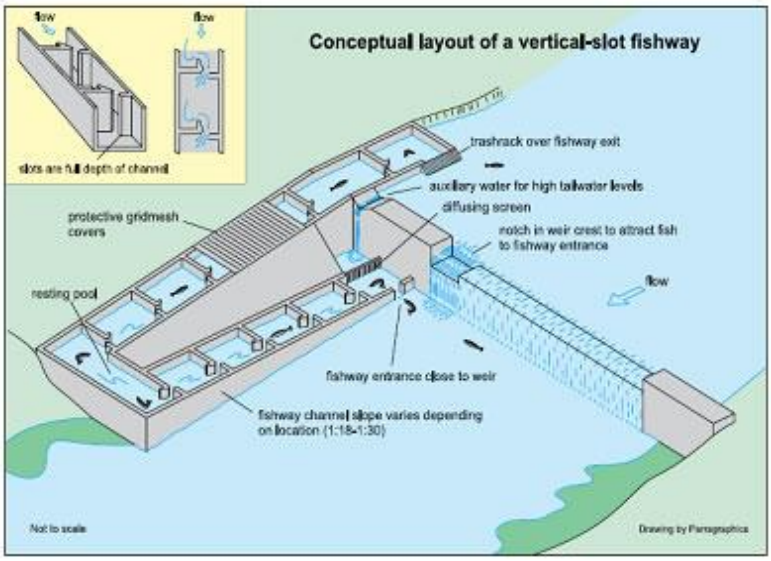
Figure 4-1 Potential fish passage structure layout

Rock ramps (Figure 4-2 and Figure 4-3) are often good passage options for panfish and bass, which have been observed in the lake. These types of structures mimic a natural stream and can provide passage for other aquatic organisms, such as crawfish. The chaotic nature of the flows through rock ramps creates countless flow paths for an individual fish to navigate as they migrate upstream. The stone and sand substrate provide an asset to the fish but can be more challenging to retain. The biggest challenge of these types of structures is that they tend to require more space.

Technical fishways (Figure 4-4) tend to be more appropriate for fish species with a strong drive to migrate upstream. These structures typically provide fewer flow paths, and are, consequently, passable by a narrow range of fish species. These types of structures typically require less space than comparable rock ramp structures.

Figure 4-2 Little Creek rock ramp fish passage structure

Figure 4-3 Waterloo Park Riffle Run rock ramp fish passage structure



Vertical-slot fishway example . Image credit: Partgraphics

Figure 4-4 Technical fishway fish passage structure

5 WHAT FEATURES/AMENITIES/BENEFITS/IMPACTS WILL A MANAGED WETLAND PROVIDE/HAVE?

To address this question, we will first provide a set of example images to illustrate the range of options (Section 5.1). We will then address the specific question (Sections 5.2 to 5.5)

5.1 Example images of features and amenities

The task force's discovery questions have shown particular interest in the following features and amenities:

- Aesthetic resource
- Water trails, pedestrian access/trails
- Education
- Recreational boating
- Recreational fishing
- Water quality
- Bird habitat
- Aquatic and terrestrial habitat

This section provides 13 precedent images of the types of features and amenities that could be adapted to the site in one or more of the future scenarios. Please note that most of the images are of built landscapes, so we can have confidence that they can be built again.

Figure 5-1 is a matrix of the precedent images along with the features and amenities listed above. The dots in the matrix indicate which features and amenities are readily visible in the precedent images.

Project/Site	Aesthetic resource	Water trails, pedestrian access/trails	Education	Recreational boating	Recreational fishing	Water quality	Bird habitat	Aquatic and terrestrial habitat
Lake Accotink Fish Habitat	●		●		●			●
Lake Accotink Bird Habitat	●		●				●	
Wellesley College Constructed Wetland	●					●	●	●
Clackamas River	●	●	●		●	●	●	●
Waterloo Greenway	●	●	●		●			●
The Wild Mile Vision Plan	●	●	●	●	●	●	●	●
Perrot State Park	●	●			●			
Garden of the Phoenix	●	●			●			
Chattahoochee Riverlands	●							
The Wild Mile boardwalk	●	●	●					●
Bush Presidential Center Prairie Trail	●	●	●			●	●	
Bush Presidential Center Boardwalk	●	●				●		
Lincoln Park	●	●	●			●	●	●

Figure 5-1 Features and Amenities Matrix

LAKE ACCOTINK FISH HABITAT

Image from Fishbrain.com

Correspondence from the VA Dept. of Game and Inland Fisheries indicates that the fish habitat is poor and has been for a long time. The dam also acts as a fish barrier.

"Great place to have a good day – 5 stars. So since I fish Burke a lot I thought that this lake was gonna be the exact same but it surprised me because you would literally catch 2 and 3 pounders easily. These fish are so aggressive and since it's spawning it's crazy"

Review from Fishbrain.com

"This lake is very shallow. Most of the lake is only a few feet deep. i was dragging bottum in a lot of the lake. Best fishing is done by kayak an Limited due to depth. though I have caught bass at the lake."

Review from Fishbrain.com

LAKE ACCOTINK BIRD HABITAT

An American bald eagle sits on a log in Acadia National Park Pond in Acadia National Park, ME on September 30, 2020.Image credit: Will Newton/Friends of Acadia. https://www.nps.gov/acad/learn/nature/eagles.htm

WELLESLEY COLLEGE CONSTRUCTED WETLAND

Image credit: MVVA

Wellesley College Constructed Wetland
Wellesley, MA

CLACKAMAS RIVER

Pools and riffles in the restored river. Image credit: Inter-Fluve

Clackamas River
Clackamas, OR

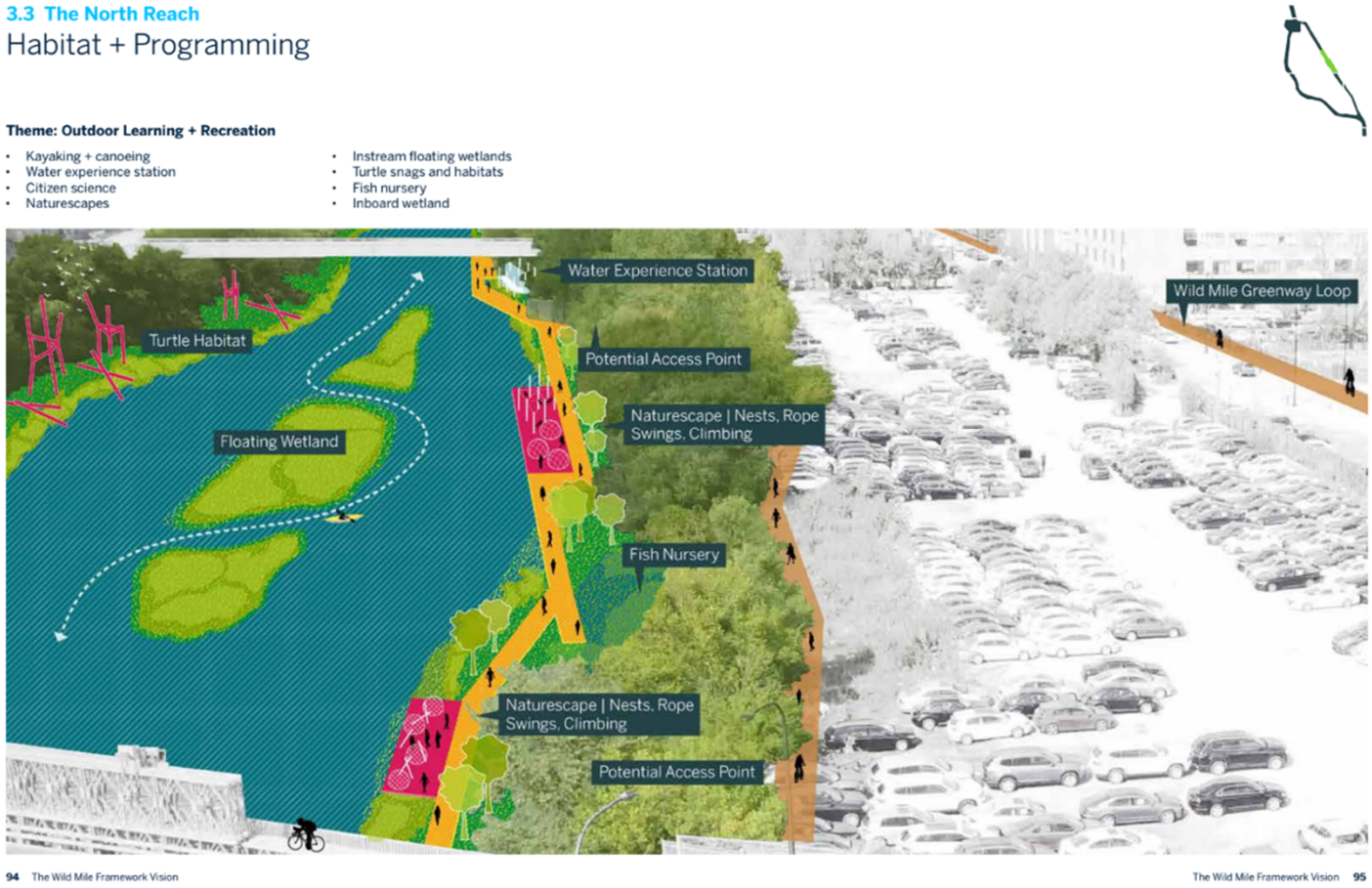
Strategically placed large wood in side channels mimic naturally occurring debris in the floodplain.
Image credit: Inter-Fluve

WATERLOO GREENWAY

Image credit: MVVA

The Confluence at Waterloo Greenway
Austin, TX

THE WILD MILE VISION PLAN



3.3 The North Reach

Habitat + Programming

Theme: Outdoor Learning + Recreation

- Kayaking + canoeing
- Water experience station
- Citizen science
- Naturescapes
- Instream floating wetlands
- Turtle snags and habitats
- Fish nursery
- Inboard wetland

Water Experience Station

Wild Mile Greenway Loop

Turtle Habitat

Potential Access Point

Naturescape | Nests, Rope Swings, Climbing

Floating Wetland

Fish Nursery

Naturescape | Nests, Rope Swings, Climbing

Potential Access Point

94 The Wild Mile Framework Vision

The Wild Mile Framework Vision 95

The Wild Mile Vision Plan, excerpt
Image source: https://drive.google.com/file/d/1-2r5WLF-TKCiqJSDM14tkKNz0vznWELo/view

The Wild Mile
Chicago, IL

PERROT STATE PARK

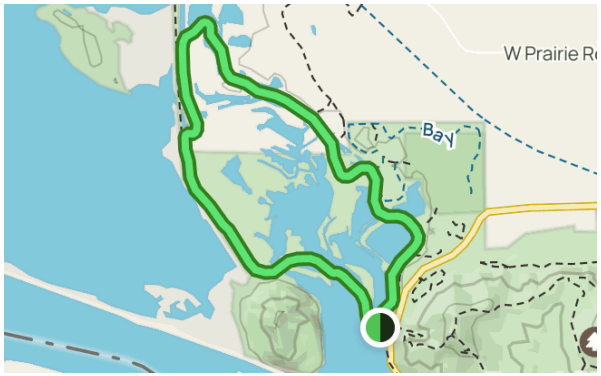


Photo By: Joshua Mayer, https://live.staticflickr.com/2828/9467327381_a2cb21cc7f.jpg, Water Trail Added

GARDEN OF THE PHOENIX

Garden of the Phoenix, Jackson Park, Chicago, IL
Image source: http://www.connectingthewindycity.com/2020/08/

CHATTAHOOCHEE RIVERLANDS

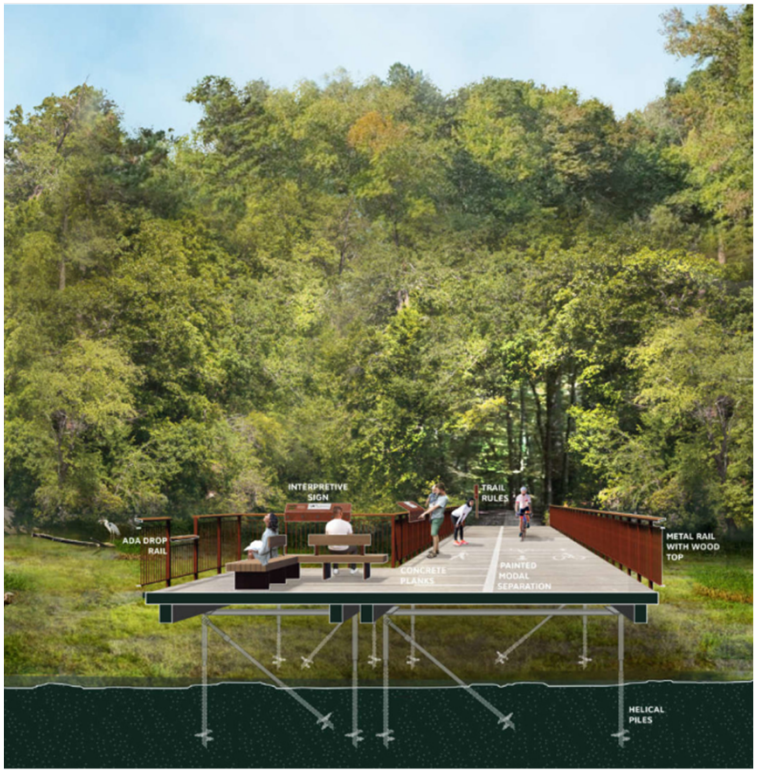


Image credits: SCAPE

Chattahoochee Riverlands Design Guidelines
Chattahoochee River, AL/GA/FL

THE WILD MILE BOARDWALK

Floating walks, gardens, and docks on the north branch of the Chicago River
Image credit: Dave Hampton

The Wild Mile
Chicago, IL

BUSH PRESIDENTIAL CENTER PRAIRIE TRAIL

Image credit: MVVA

George W. Bush Presidential Center
Dallas, TX

BUSH PRESIDENTIAL CENTER BOARDWALK

Image credit: MVVA

George W. Bush Presidential Center
Dallas, TX

LINCOLN PARK

Nature Boardwalk at South Pond, Lincoln Park, Chicago, IL
Image source: Dave Hampton

5.2 Will a managed wetland change the usefulness/value of amenities (playground, picnicking, carousel, marina, etc.) in Lake Accotink Park as compared to having a lake?

Most of the existing park amenities will not be directly impacted by the various management scenarios. Park amenities may be indirectly impacted by the management scenarios. For example, if a selected management scenario incorporates new destination features, the park may draw more community members in general and result in greater utilization of the existing amenities. Similarly, new programing for potential new features could increase the utilization of existing amenities.

Under some of the management scenarios, in-lake or on-the-water amenities will change. For example, the types and locations of fishing opportunities may change. Boating opportunities may also shift from paddle boating to kayaking.

5.3 Recreational Fishing: Would the fishery improve/worsen? Would there be restrictions on fishing in any area?

Reports from The State of Virginia indicate that the fish habitat in the lake is poor. Most of the scenarios would seek to improve the fish habitat.

Scenarios that include dredging may temporarily improve the fishery, but frequent dredging can ultimately be detrimental to the fishery. A more riverine scenario will support more diverse fish habitat, but that habitat may not be the bass habitat that exists today. Overall, one can expect that the fishery will change under any of the scenarios, but whether that change is better or worse is a matter of opinion.

Fishing restrictions are typically imposed for reasons of safety or park etiquette. These types of restrictions are not likely to be significantly altered from their current condition in any of the scenarios.

5.4 Would a wetland support the family of nesting eagles and other birds of prey native to the Lake Accotink watershed ecosystem?

A managed wetland can maintain – and enhance - bird of prey habitat with:

- Edge buffer zones that preserve existing trees often used for nesting. See **BLM guidelines** and **VA DWR Raptor guidelines**.
- Improved aquatic habitat (pond) as a food source.
- Logs, former beaver dams, woody debris, new nature-based solutions (NBS), process based restoration BMPs, and other perching areas can provide more locations for undisturbed feeding (photo above).

5.5 Would a managed wetland positively or negatively impact other aquatic and terrestrial wildlife in comparison to maintaining a lake? Would these impacts displace wildlife?

Managing for more wetlands will increase the diversity of the park. More diverse habitats support more diverse populations of aquatic and terrestrial wildlife. Higher diversity is generally considered a positive for natural systems.

Increasing overall species diversity may also decrease the abundance of an individual species that is currently dominant in the park, but this won't necessarily be the case. The reduction in abundance of an individual species could be viewed as a displacement, but it is a matter of opinion if that is a bad thing. For example, most people would not view a decrease in mosquito population as a bad thing.