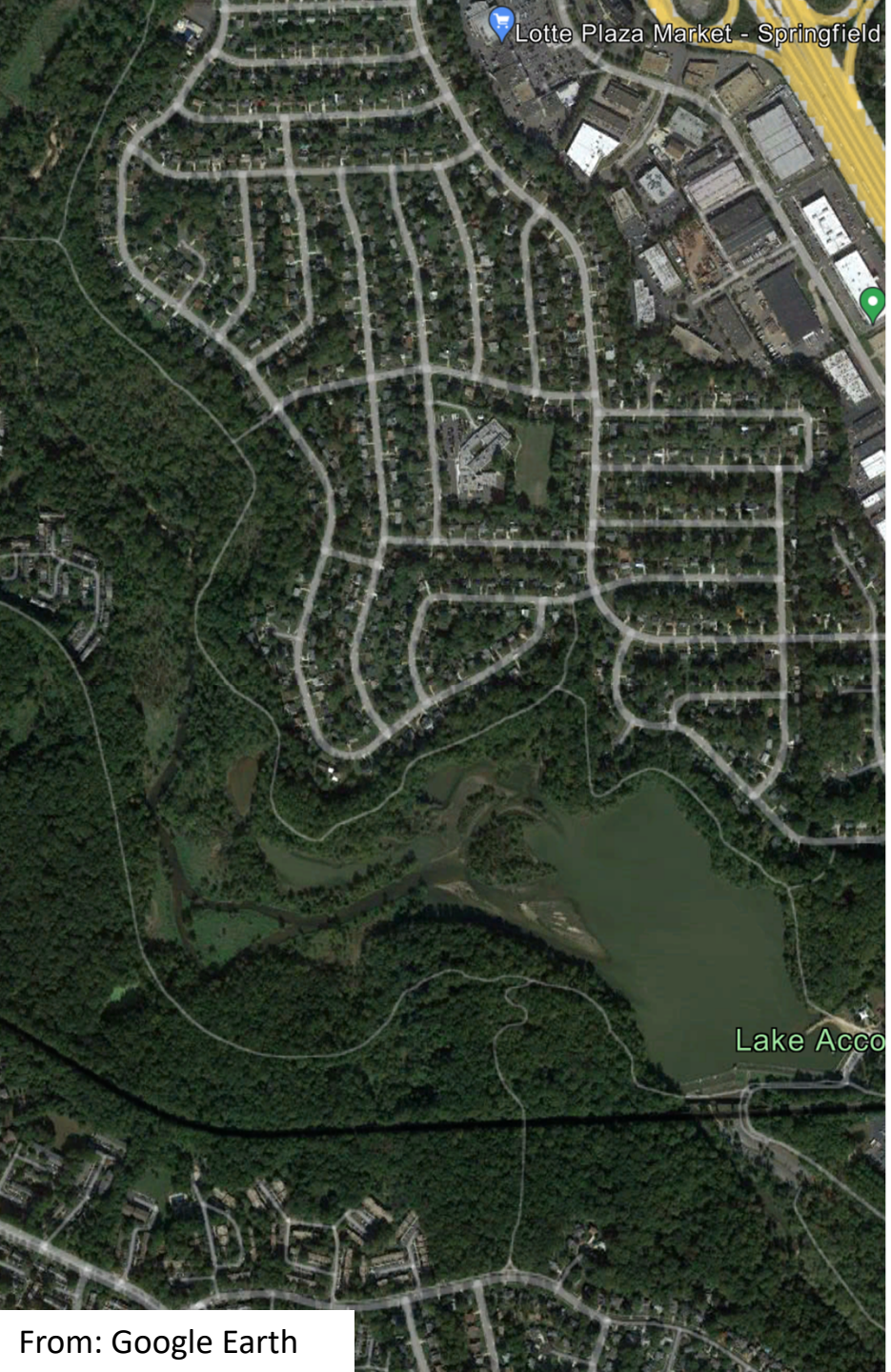


From: Google Earth

LAKE ACCOTINK FORECASTING

TASK FORCE MEETING – SEPTEMBER 11, 2023

CRAIG TAYLOR

Note: all materials in this presentation are based on high-level assessments and should be considered preliminary.

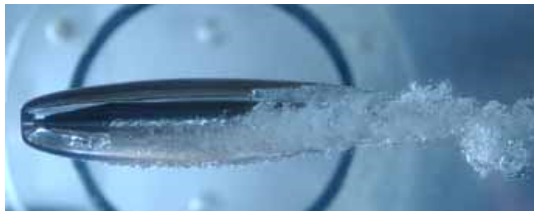
LimnoTech
Water Environment | Scientists Engineers

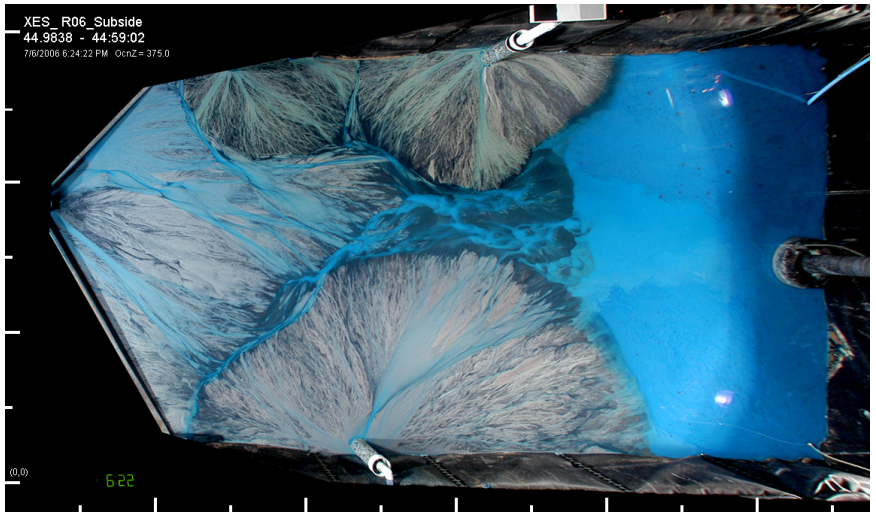
OUTLINE

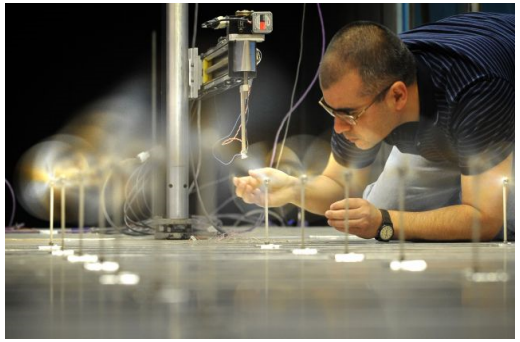
- Introduction
- Project Understanding & Approach
- Questions

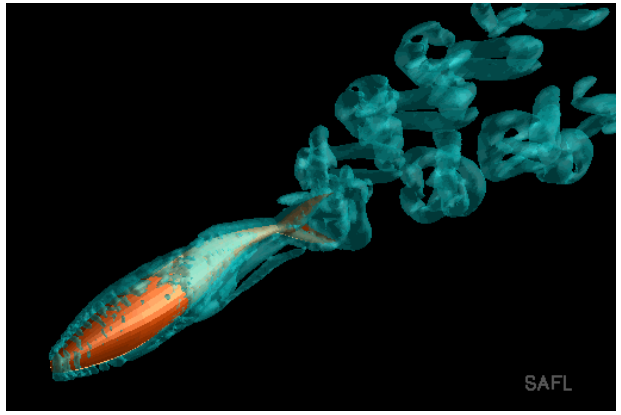
I’m just a guy who loves water

Past Training: St. Anthony Falls Laboratory (SAFL)

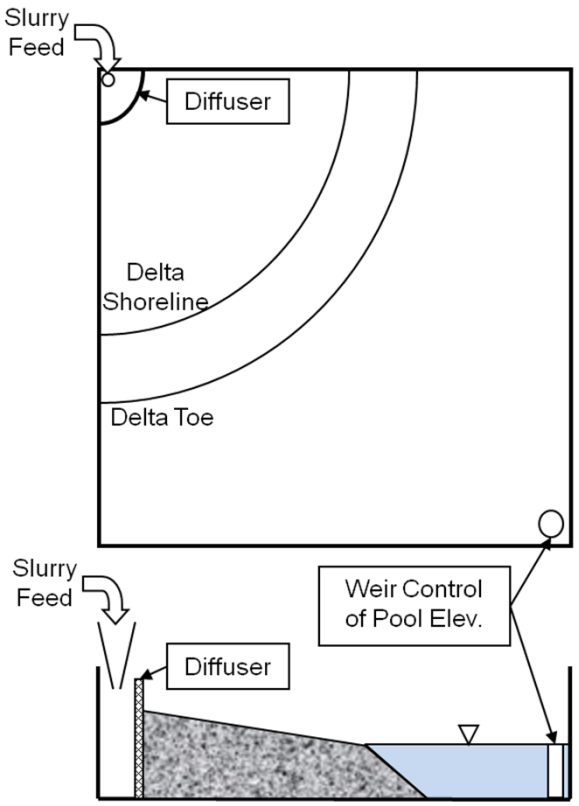


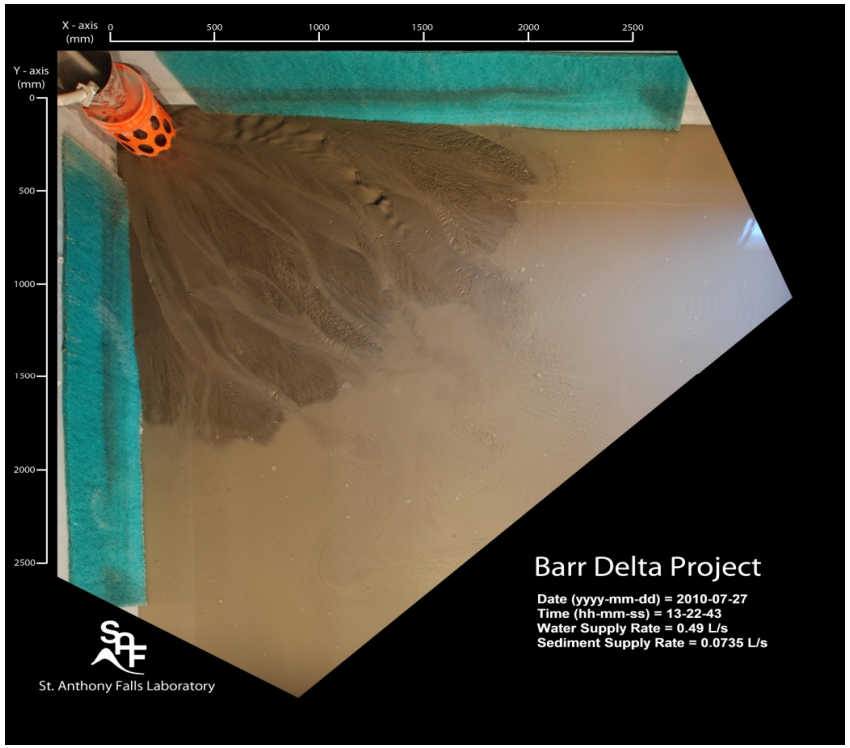


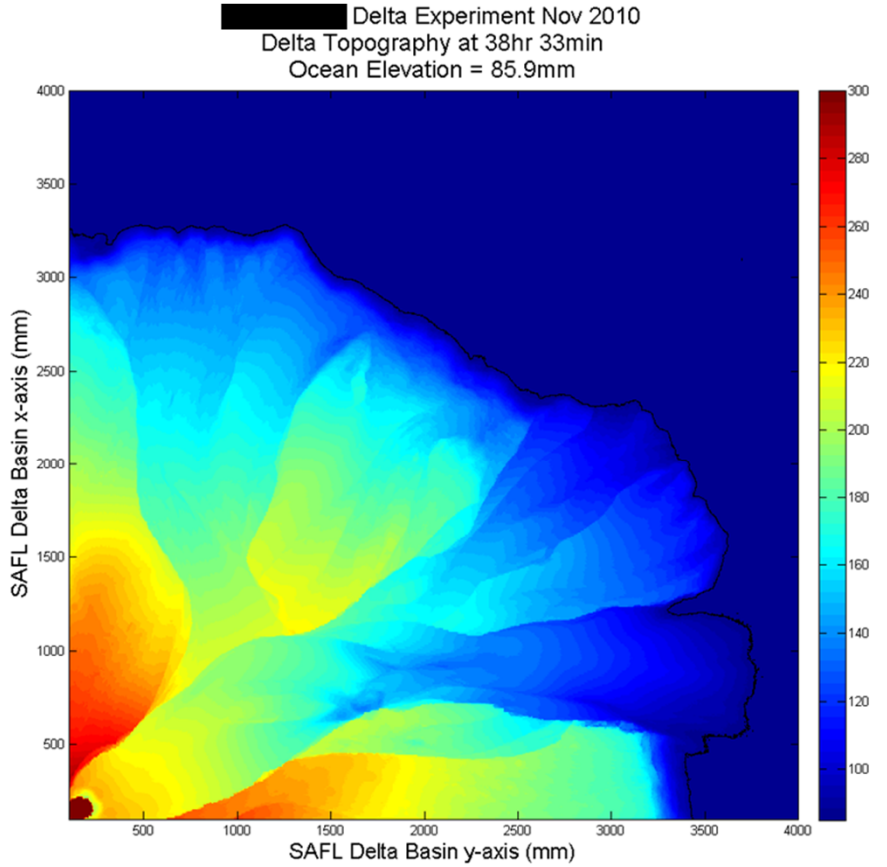




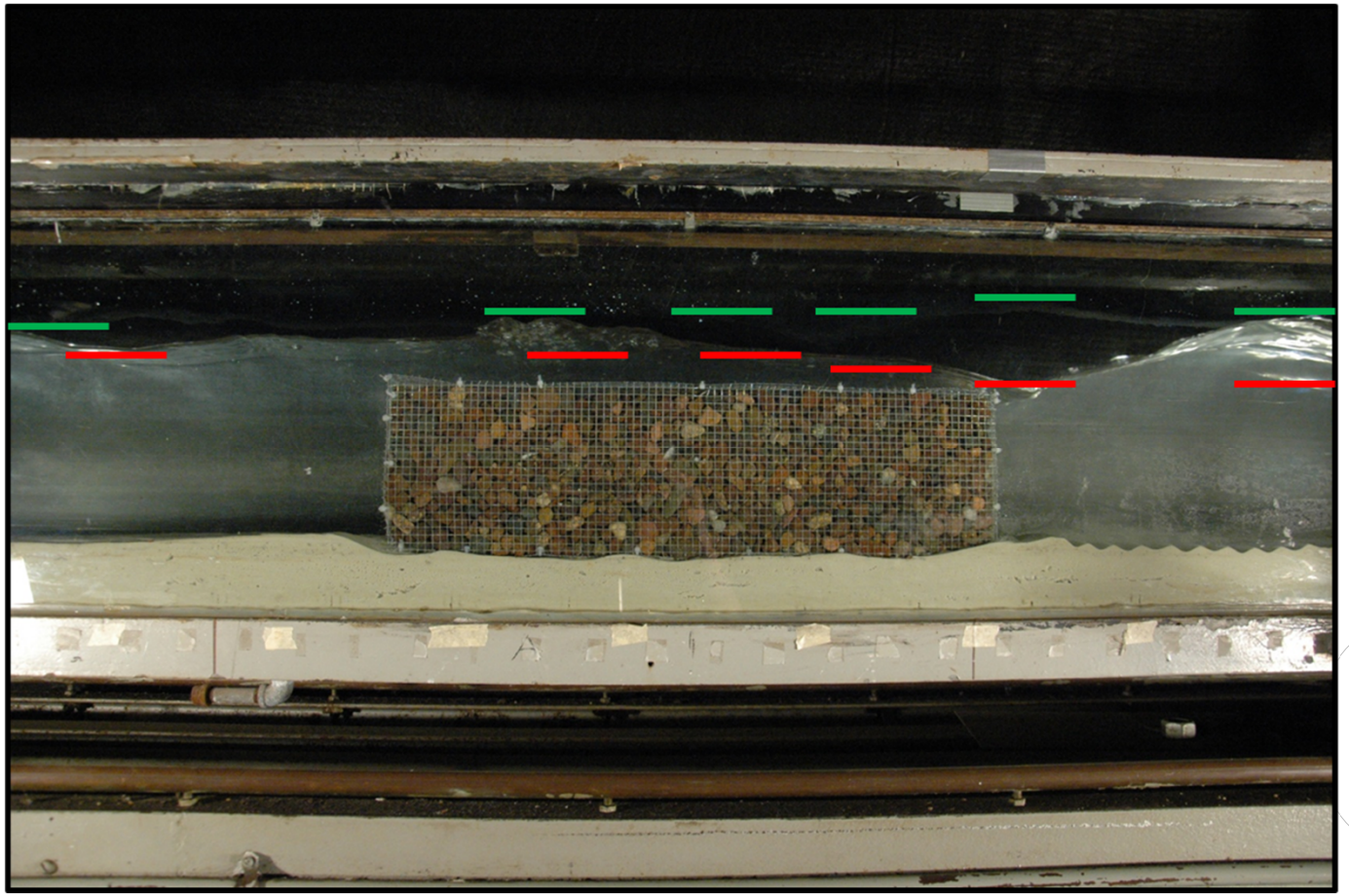
Growing Deltas



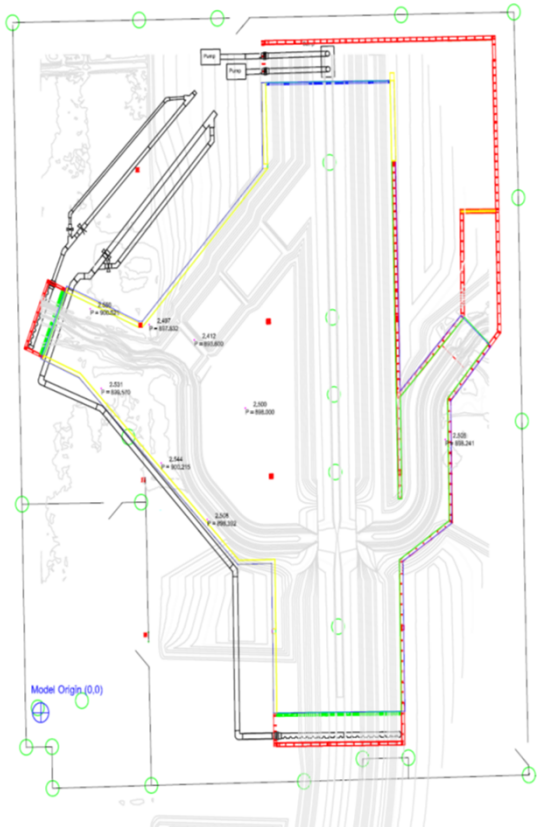


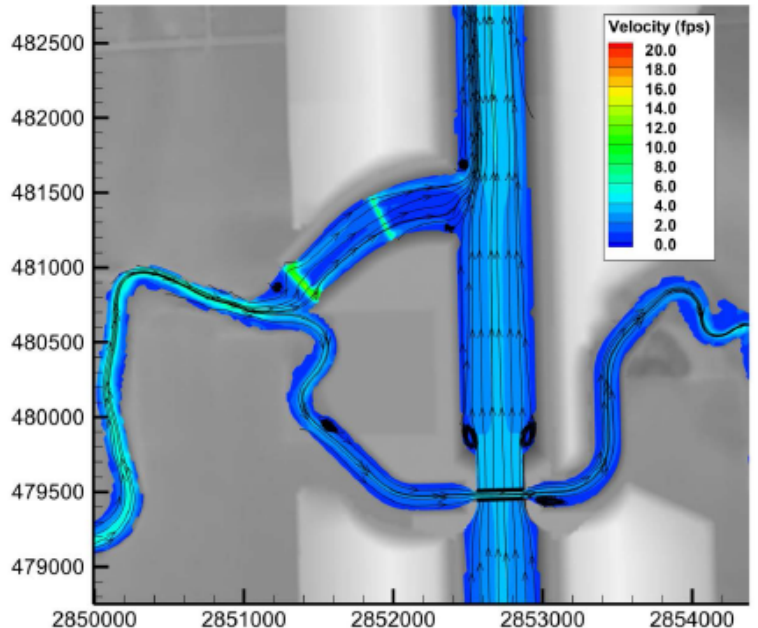


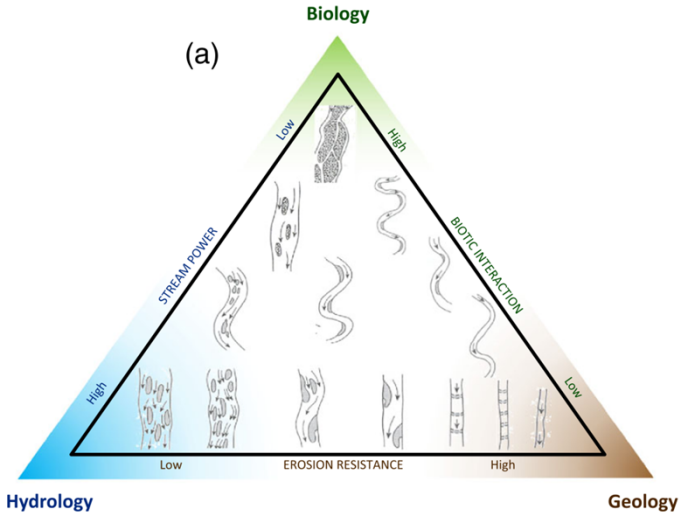
Hydrodynamic Studies

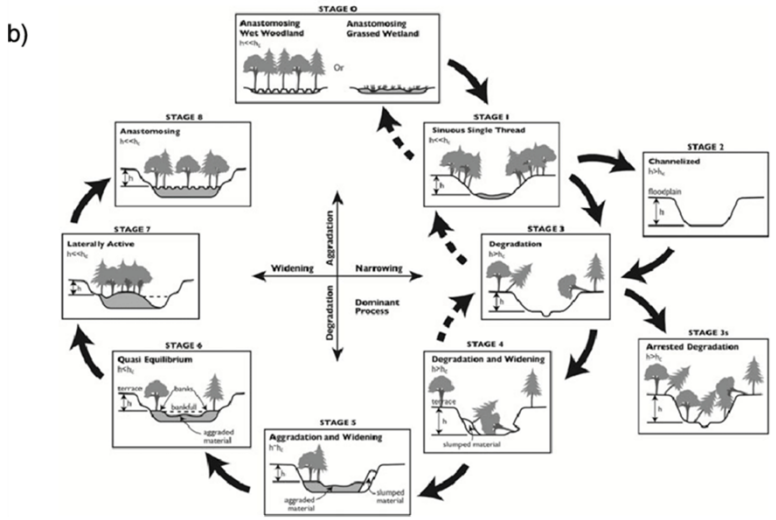


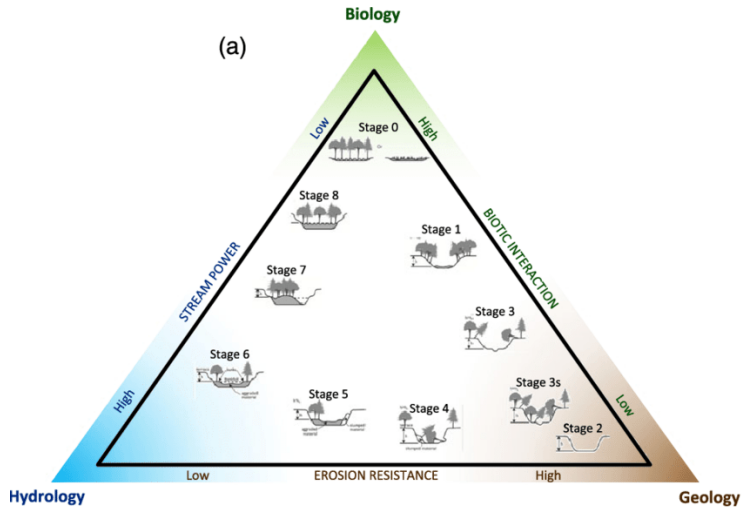
Large Physical Models







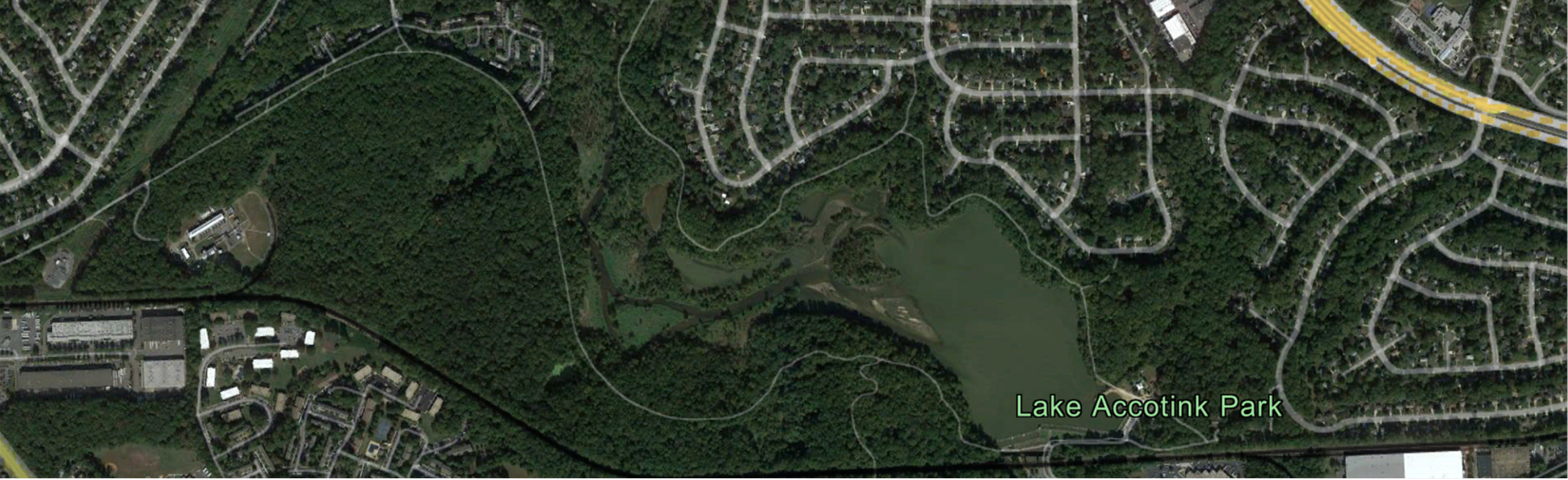




LIMNOTECH'S PHILOSOPHY

All fluvial (sediment dominated) water bodies are constantly evolving. Our goal is to understand where the river and lake are on their evolutionary path and where that path is headed. Only from there can we identify ways to work with the natural evolutionary processes develop a water body that functions as both an ecological system and as a community amenity.

(Images from Castro & Thorne, 2019)



PROJECT UNDERSTANDING AND APPROACH

Lake Accotink is trying to evolve into a stream/wetland complex. The question we are faced with is:
How quickly will it get there and what will it look like along the way?

There are physical and numeric modelling tools that would require well over $500,000 to develop and years to calibrate. Instead, we will use high-level analyses and decades of experience to predict the likely lake evolution.

OPTIONS & CONSEQUENCES NOT OPINIONS

Dredge the Lake to Restore the Bathymetry

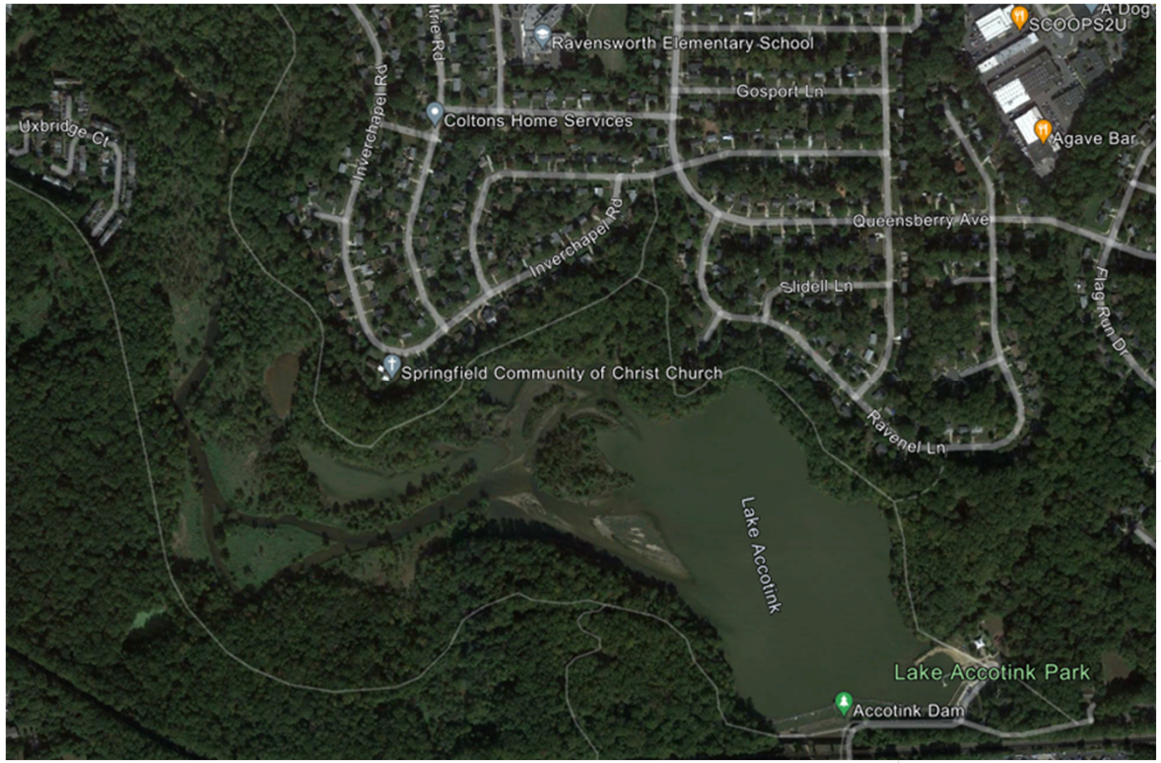
Design a strategic intervention

Manage our way to a new solution

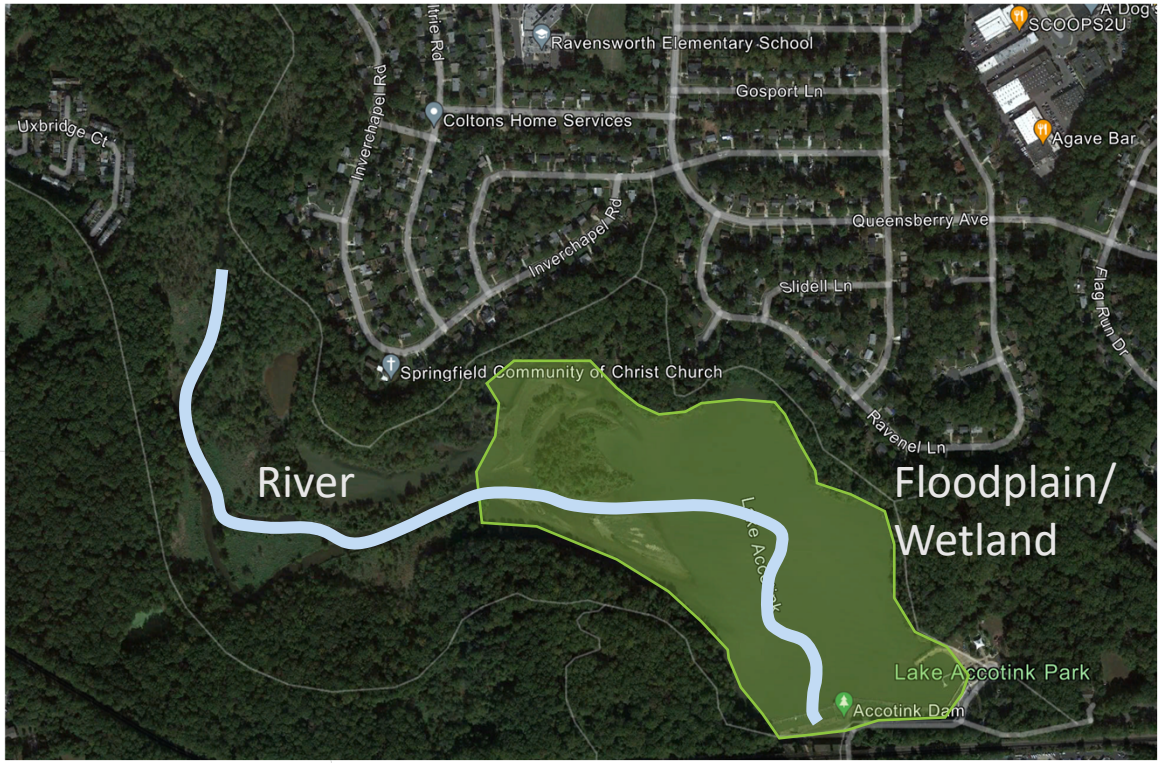
Do Nothing

LAKE BOOK ENDING

Current Condition



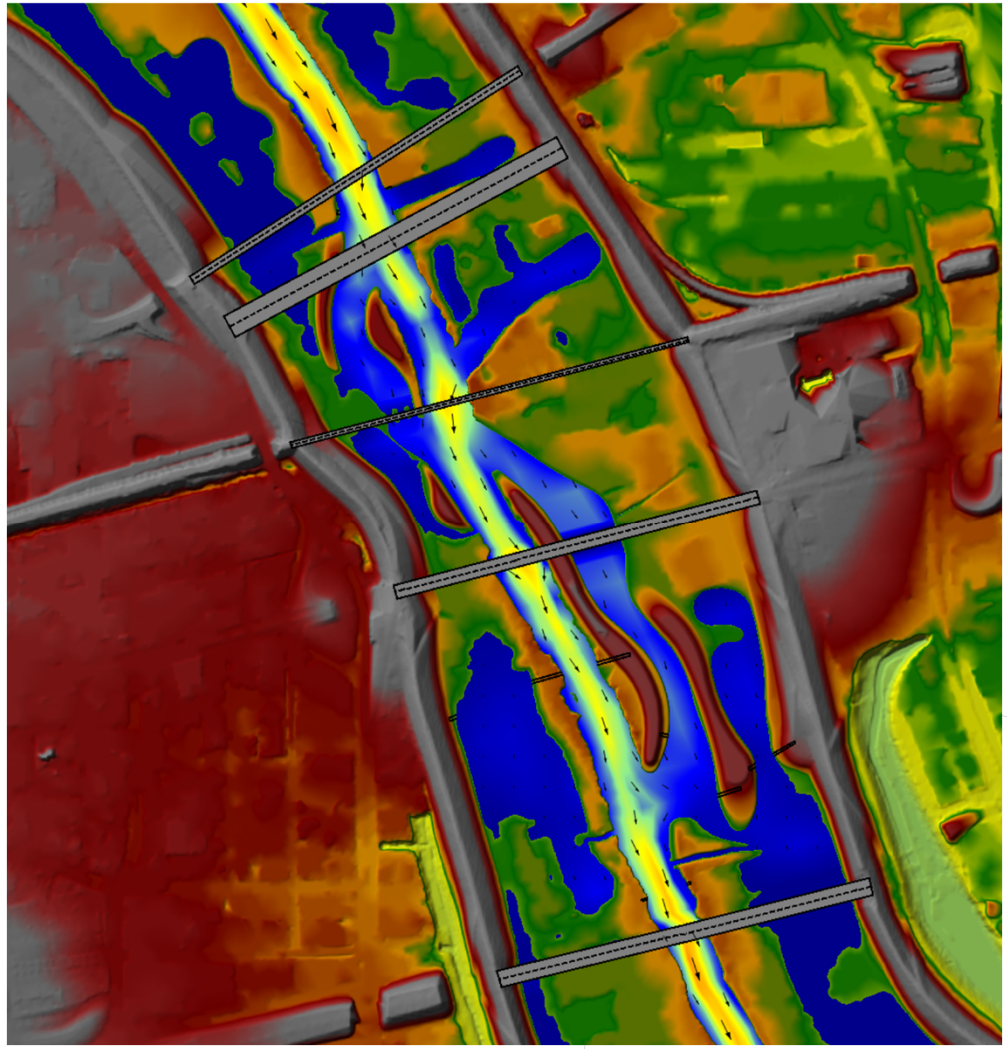
Ultimate Condition – River & Floodplain



Time Scale Analysis

TASK: Address how quickly processes are happening in the lake. Analysis includes:

- Transport based deposition
  - Settling based
  - Delta based
- Vertical translation of bathymetry to mimic infilling
- Horizontal translation of shoreline to mimic infilling
- Simple HEC-RAS 2D Modeling to identify likely deposition
  - Run for range of infilling scenarios.
  - Proportional deposition based on shear stress results from HEC-RAS 2D.



DISCOVERY QUESTIONS

Lake Accotink Task Force: Wetland Management Option Questions and Areas of Discovery

1. What will happen to the lake if nothing is done?
    a. Mud Flats:
        i. Will the lake fill in and become a mudflat and how long would that take?
        ii. Will "mud flats" dry and become windborne?
        iii. Under a managed wetland option, would mud flats ever develop?
    b. Will there be quicksand that poses a risk to park users?
    c. Will there be nuisances such as mosquitos, odors, etc.?
    d. Will it become overrun with invasive species?
    e. Will flood risk increase?

2. Is managing the lake as a wetland a viable or potentially desirable option?
    a. What is a stream/wetland complex? How is it different than what we typically think of as wetlands?
    b. What is required to develop a plan to manage the lake footprint as a wetland?
    c. What might it look like?
    d. How long will it take to create a managed wetland that is a community asset providing environmental and recreational benefits?
    e. Will a managed wetland be "overcome" by storm pulses and sediment loading with emphasis on extreme events?
    f. 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?
    g. Would managed wetlands have different regulatory requirements than a lake, and if so, summarize them?
    h. What is the cost to design, permit, ~~and~~ construct and maintain a managed wetland?

3. Could a managed wetland option include open water areas?
    a. Where might open water be located?
    b. What type of open water could be maintained?
    c. How large and deep could an open water feature be?
    d. Would an open water feature need to be dredged periodically?
    e. How could an open water ("lake") area be sized to maximize the open water but minimize impacts from any necessary maintenance dredging operations to include:
        i. Eliminate or reduce the need for pipelines and offsite processing areas,
        ii. Utilize existing open spaces in Lake Accotink Park for operations,
        iii. Maximizing the extent to which dredged sediment can be kept and used onsite, and
        iv. Minimize impacts from trucking materials out?
    f. What would it take to maintain an open water area and how much would it cost?

4. How would Lake Accotink Dam be incorporated into a managed wetland option?
    a. Could the dam remain as is?
    b. Could the dam be modified to improve wetland function and maintenance?
    c. Would management options be improved by removal of any portion of the dam?
    d. How could fish passage be incorporated into dam/lake management options?
    e. How much would it cost to modify the dam under the scenarios in items b. and c. above?
    f. Describe the regulatory requirements for Lake Accotink Dam and potential impacts on sediment fate and transport downstream in Accotink Creek for the following scenarios:
        i. No action is taken and the dam is left as is.
        ii. A managed wetland is created and the dam is left as is.
        iii. A managed wetland is created and the dam is modified.
        iv. The dam is partially or wholly removed and Accotink Creek returned to a flowing stream.

5. What features/amenities/benefits/impacts will a managed wetland provide/have?
    a. Aesthetic resource
    b. Water trails, pedestrian access/trails
    c. 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?
    d. What would the community value of a managed wetland have as compared to having a lake?
    e. Education
    f. Recreation
        i. Boating
        ii. Fishing:
            1. Would the fishery improve/worsen?
            2. Would there be restrictions on fishing in any area?
    g. Water quality
    h. Wildlife habitat
        i. Would a wetland support the family of nesting eagles and other birds of prey native to the Lake Accotink watershed ecosystem?
        ii. Would a managed wetland positively or negatively impact other aquatic and terrestrial wildlife in comparison to maintaining a lake? Would these impacts displace wildlife?

6. What maintenance would be necessary for a managed wetland?
    a. What would be required to manage a wetland complex?
    b. What would maintenance cycles look like?
    c. How much would maintenance cost?

7. What are the sediment loads within Accotink Creek and how will they change?
    a. What are the current sediment loads in Accotink Creek and what are the likely trends for sediment generation in the future?
    b. What loads are leaving the lake in its current condition?
    c. How will these loads change if no action were taken?
    d. What would the loads leaving the lake be like if the lake were managed as a wetland?
    e. What would the sediment loads be in Accotink Creek if the dam were removed?
    f. How will these loads affect downstream resources:
        i. How will they impact instream fauna?
        ii. How much sediment could be expected to be captured by the floodplains?
        iii. How might these loads affect Gunston Cove?
        iv. How could these effects be mitigated?
    g. What regulatory implications are there for Fairfax County due to increased sediment loads downstream of Lake Accotink and how much could mitigating these increased loads cost?

8. Other:
    a. Account for climate change in modeling and analysis of options.
    b. Conduct differential carbon footprint analysis of managed wetland, hybrid wetland – open water, and full dredge options.

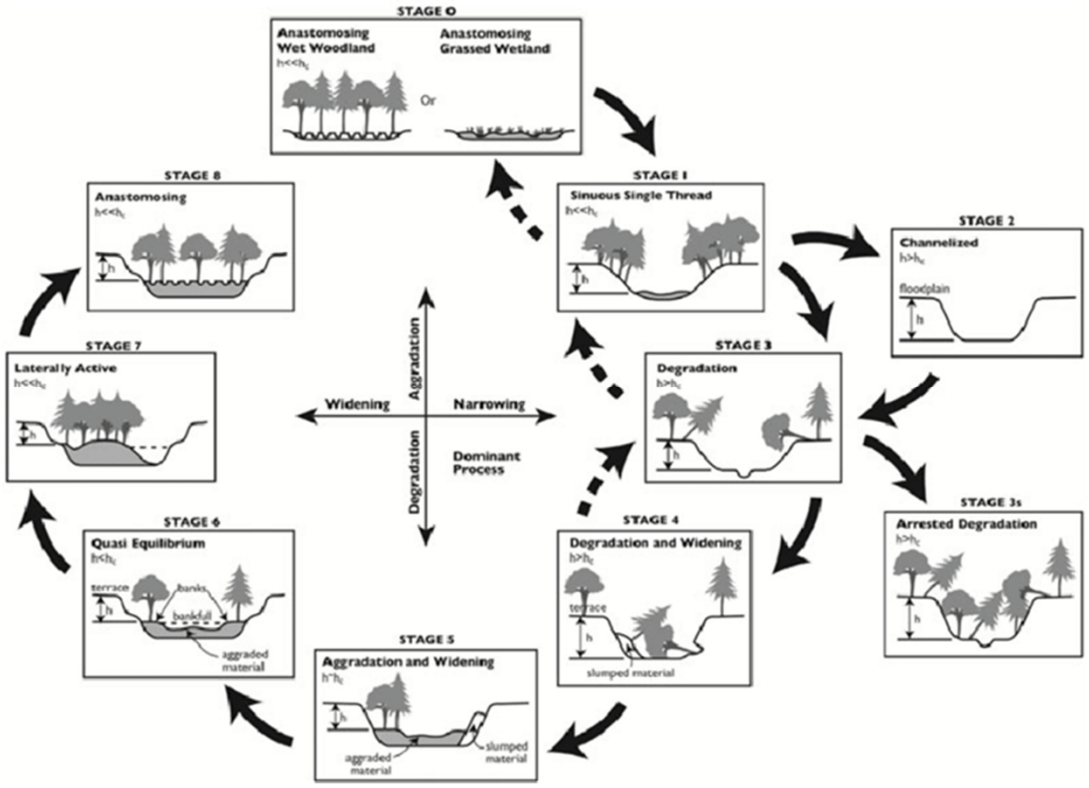
Is managing the lake as a wetland a viable or potentially desirable option?

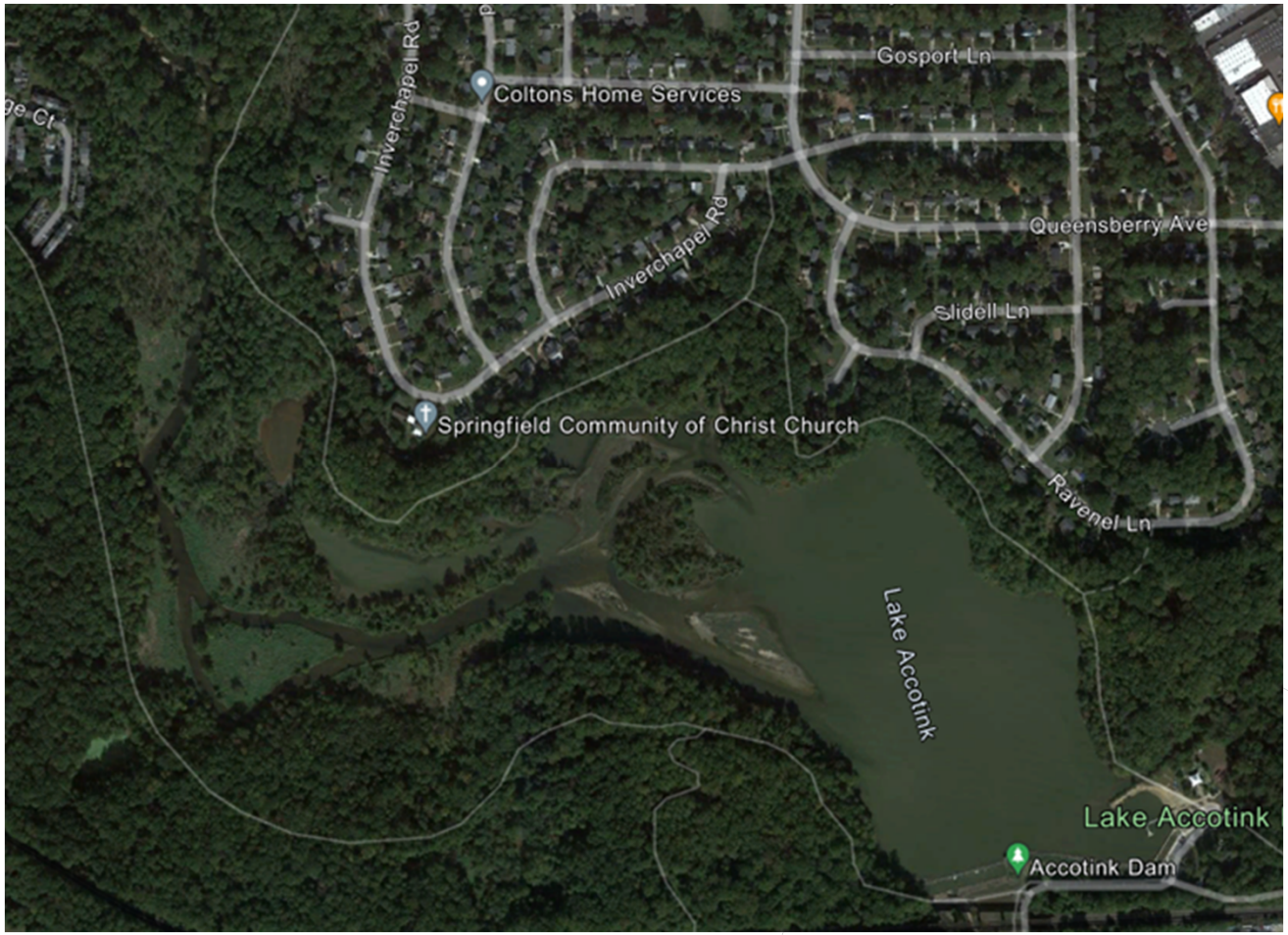
- What is a stream/wetland complex? How is it different that what we typically think of as wetlands?

Backwater of the Mississippi
(Photo by: Google Earth)

Lost Creek
(Project by: The Nature Conservancy, Photo by: Richard Scott Nelson)

Stream Wetland Complex





(Images from Castro & Thorne, 2019)

What if nothing is done: Mud Flats

- Will the lake fill in and become a mudflat and how long would that take?
- Will "mud flats" dry and become windborne?
- Under a managed wetland option, would mud flats ever develop?

- Coastal mud flats caused by salt water tides

- Depositional mud flats caused by sediment deposition
  - Common in flash flood zones.
  - The lake will likely infill too slow to form a depositional mudflat.

- Marsh mud flats cause by shore bird herbivory
  - If there is a large shore bird population, a mud flat could be developed in managed wetland.
  - Bird exclusions that interrupt flight paths relatively simple and are proven effective.

Burke Lake

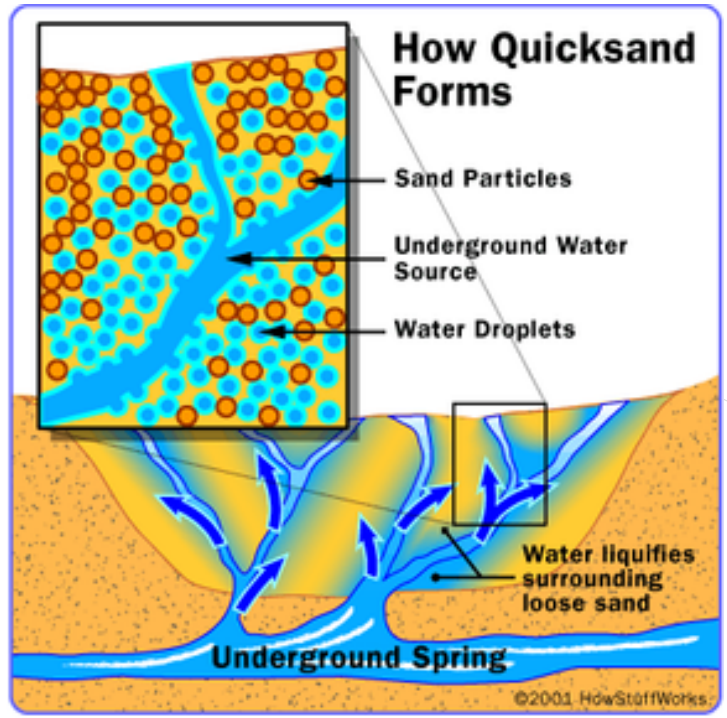
What if nothing is done?

- Will there be quicksand that poses a risk to park users?

- Quicksand is formed by confined aquifer who's groundwater bubbling to the surface.
- Since the groundwater and lake are at the same level, quicksand is not likely.
- Infilling of the lake will not increase the likelihood of quicksand.

- Soft, sticky mud is possible and is likely present now.
  - In my experience soft, sticky mud is typically 6-18 inches deep.
  - As muck accumulates it compacts the lower layers and makes it firmer.
  - It is often more of a nuisance than safety hazard.

  - Emergent vegetation can help make soft mud firmer.



What if nothing is done?

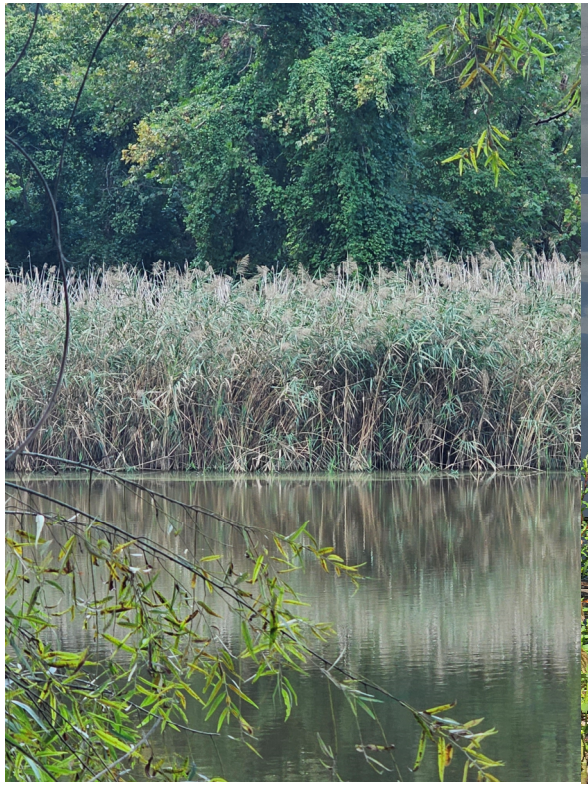
- Will there be nuisances such as mosquitos, odors, etc.?

- Wherever there is standing water, there is mosquitos.
  - Mosquitos are more common is small water bodies (pools and puddles). To that end, shallow areas with emergent vegetation are more likely to produce mosquitos than open water lakes.
  - More mosquitos also feed more panfish, more dragonflies, and more bats, so it is difficult to define when/if they will be a nuisance.
  - In my experience, mosquitos are more of a nuisance in the woods, where there is less wind.
- Shallow, stagnate water is also more likely to produce algal blooms which cause bad odors.
  - Algal and duckweed blooms tend to accumulate in wind-blown bays.
- Replacing shallow water bodies with wetlands reduces the production of algae.

What if nothing is done?

- Will it become overrun with invasive species?

- There is a high risk of invasive species under all scenarios. Whatever invasive species in the upstream watershed are a threat to Lake Accotink.
- As the lake infills the vegetation pallet will need to adapt to the new conditions. Changing conditions can create opertunities for invasive species to push out existing species.



- Managing lake levels can help manage invasive species.
- A “manage our way to a solution” strategy will require ongoing invasive management.
- A constructed wetland will require active invasives management for at least 5 years.

What if nothing is done?

- Will flood risk increase?

- No. The dam is the primary flood control. Weather the reservoir is full of water or sediment, the dam will function similarly.
  - There are many scenarios, such as in actively managed reservoirs, where sedimentation impacts flood risk, but not in this case.
  - This dam appears to be managed as “run of the river” meaning that flows into the reservoir are similar to flows out of the reservoir.

- If large landforms were introduced to the lake, they would need to be designed in such a way that they do not increase flood risk.

Is managing the lake as a wetland a viable or potentially desirable option?

- Will a managed wetland be “overcome” by storm pulses and sediment loading with emphasis on extreme events?
  - Including wetland vegetation should reduce the risk of scour within the current reservoir footprint.
  - A stream channel similar to the size of Accotink Creek will be needed within the wetland complex.
    - If the wetlands are designed, the creek channel will also need to be designed.
    - If the wetland is allowed to develop naturally, the creek channel will also develop naturally.

- 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?
  - Evaporation is the primary cooling process in a lake. Wetlands provide both evaporation and transpiration. Wetland plants also provide direct shading to the water and a stream less surface area than a lake. In theory a wetland will have greater cooling effects than a lake. For all practical purposes, I doubt anyone would be able to notice the difference without using a thermometer.

Is managing the lake as a wetland a viable or potentially desirable option?

- What is required to develop a plan to manage the lake footprint as a wetland?
- What might it look like?
- How long will it take to create a managed wetland that is a community asset providing environmental and recreational benefits?
- Would managed wetlands have different regulatory requirements than a lake, and if so, summarize them?
- What is the cost to design, permit, and construct and maintain a managed wetland?