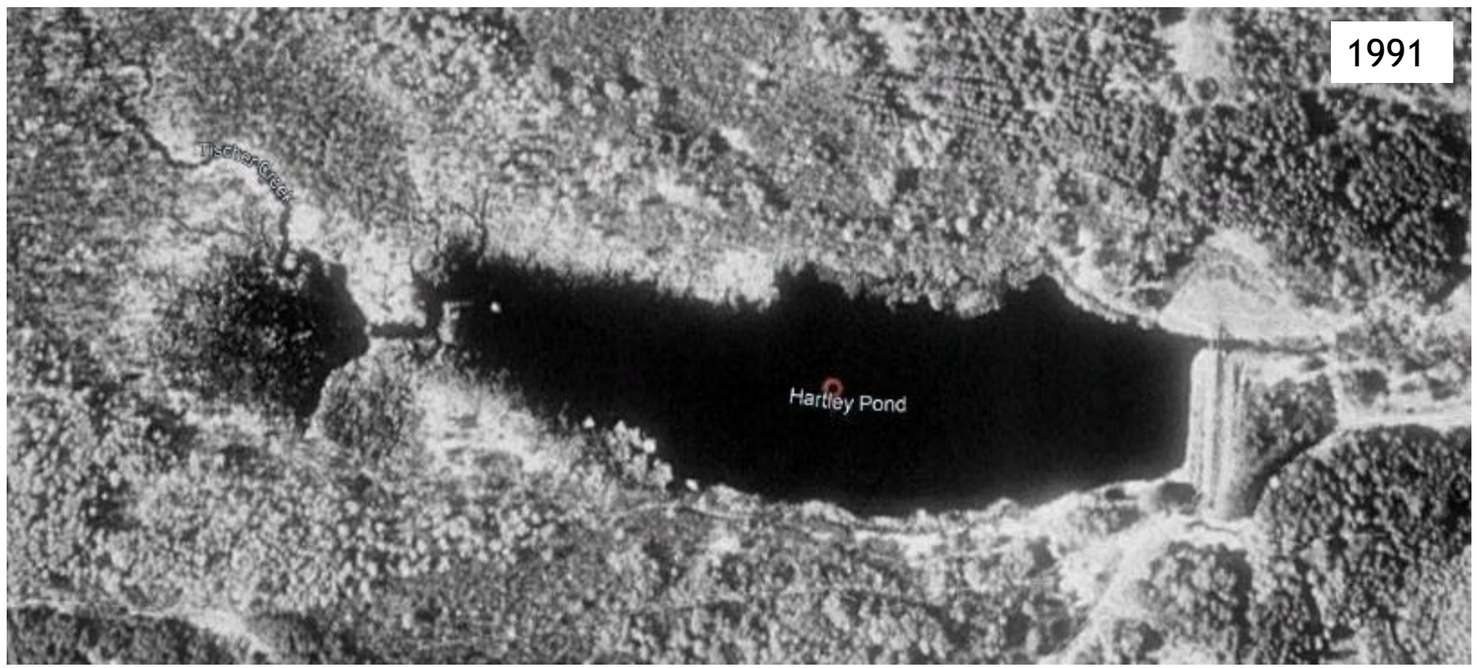
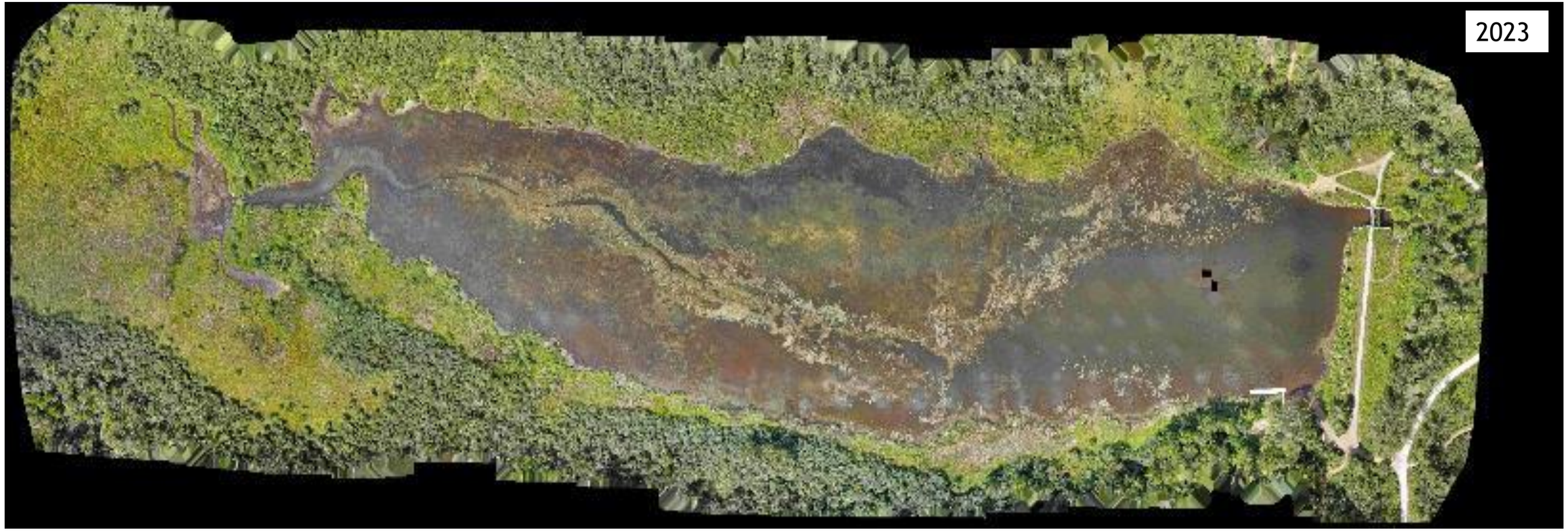
Hartley Pond and Dam Feasibility Study, Report and Next Steps

March 1, 2024

Feasibility Study Scope





Feasibility Study Process

Purpose: Assess the most effective and efficient alternatives for eliminating negative impacts on brook trout and other cold-water resources while maintaining flood attenuation benefits of the impoundment considering mainly engineering and environmental factors.

Modeling:

- ***Existing Conditions***
  - *UMD Hartley Pond Water Budget*
  - *Floodplain Status*
  - *Hydrologic and Hydraulic Modeling*
  - *Preliminary Calibration*
- ***Alternatives Modeling***
  - *Hydrologic and Hydraulic Modeling of each alternative in comparison to preliminarily calibrated existing conditions model*
  - *Peak flow reduction target for the 100-year precipitation event*
  - *SWMM model and UMD pond water balance data to assess how well various alternatives could achieve project hydraulic objectives*
  - *Natural channel design principles and advanced LiDAR data to approximate channel shape for model cross-sections*

Multi –Criteria Decision Analysis (MCDA): *Ranking the strengths and weaknesses of each alternative.*

- *Ecological Restoration*
- *Channel/Floodplain Connectivity*
- *Direct Human Benefits*

Recommendations based on MCDA and Project Objectives

Proposed Alternatives

Alternative 1: **No Action**

Alternative 2: **Stream Route Around**
Leave dam in place, route a channel around the dam, and excavate small portion of pond

Alternative 3: **Dam Removal**
Remove existing dam and restore stream channel in the original stream valley. Excavate off-line pond.

Alternative 4: **Open-Bottom Culvert**
Keep existing earthen berm, construct culvert through dam embankment, and restore stream channel in the original stream valley.

4a: Excavate off-line pond
4b: without excavated off-line pond

Other Alternatives Considered:

- Rock Arch Rapids
- Double Limiting Culvert
- Spillway Flood Gate

Photo Courtesy of Tim Beaster, South St. Louis SWCD

ALTERNATIVE 1: NO ACTION

Alternative 1 maintains the current status quo, where the dam structure remains in place without any modifications or interventions. This alternative serves as a baseline against which impacts of other alternatives are compared. The existing dam structure will continue to function as is.

ASSUMPTIONS:

- Ongoing inspection and maintenance will be required to ensure that the dam, including the embankment is currently and continues to be structurally sound. The dam will have to be rebuilt when it reaches the end of its serviceable life.
- The pond is in an active state of anthropogenic succession to a wetland and without intervention (e.g., dredging) it will result in an emergent wetland and reduced open water area.
- The dam will continue to meet its current purpose of flood flow reduction.
- No permitting or regulatory processes associated with dam modification or removal.
- No immediate new costs; only ongoing maintenance and future replacement.

STRENGTHS:

- No immediate capital costs.
- Does not disrupt current stakeholder interests or land uses.
- Continues to reduce the 100-year storm peak flows.

WEAKNESSES:

- Maintains a Class I - High Hazard Dam.
- Is a fish passage barrier.
- Degrades water quality, affecting temperature and dissolved oxygen levels.
- Traps sediment, causing stream instability both upstream and downstream.
- Alters natural flow pattern and connectivity.
- Ongoing maintenance costs (emergency spillway clean-out and embankment maintenance).
- Potential for higher future costs due to repairs or emergency actions.
- Dam safety concerns increase with age.
- Loss of potential benefits from restoration, such as improved ecosystem function and connectivity.
- Vulnerability to climate change impacts.

UNKNOWNS/CONSIDERATIONS:

- Long-term maintenance

Feasibility Criteria	Criteria Score[1]	Comment
Restore natural stream hydrology	1	Impoundment negatively alters natural stream hydrology
Restore a stable floodplain and habitat diversity	1	Not possible with impoundment
Enhance temperature and sediment transport	1	Not possible with impoundment
Restore longitudinal and lateral connectivity	1	Not possible with impoundment
Maintain recreational services	4	Requires ongoing maintenance of the pond
Enhance brook trout fishing	1	Not possible with impoundment
Restore to natural conditions	1	Impoundment is not the natural condition
Maintain or enhance educational opportunities	3	Requires ongoing maintenance of the pond
Do not increase risk of flood damage downstream	5	There will be no change in risk of flood damage downstream but leaves a high hazard dam in-place
Total Criteria Score	**18**	

Notes: [1]Criteria scoring scale of 1 to 5. 1 = lowest potential for meeting criteria and 5 = highest potential for meeting criteria.

FEASIBILITY SCORE: 18/45

ALTERNATIVE 2: STREAM ROUTE AROUND

Alternative 2 proposes to re-direct the stream to a new, naturalized channel running along the north side of the pond and through the existing emergency spillway while maintaining the existing dam structure. Flows at or below bankfull will be directed to this new channel. An earthen berm will be constructed linearly between the new channel and the north side of the pond. This will, serve as a physical barrier between the newly created stream channel and the pond, preventing direct hydraulic interaction and controlling uncontrolled overbank flows and potential erosion. Upstream of the reconfigured channel, a control structure will be installed at the juncture of Tischer Creek and the new channel. This feature will be engineered to initiate a deliberate overflow into the pond behind the existing dam when the creek is at or above bankfull stage, thereby utilizing the dam's capacity for flood storage during peak flow events.

ASSUMPTIONS:

- Bankfull flows manageable with an upstream diversion structure.
- Existing dam and new berm will maintain structural integrity.
- Constructed berm and channel resistant to erosion in high-flow events.
- Sufficient depth to bedrock for channel construction.
- Groundwater input maintains baseflow for both the channel and pond.
- Existing pond will be excavated to improve and maintain water quality.

STRENGTHS:

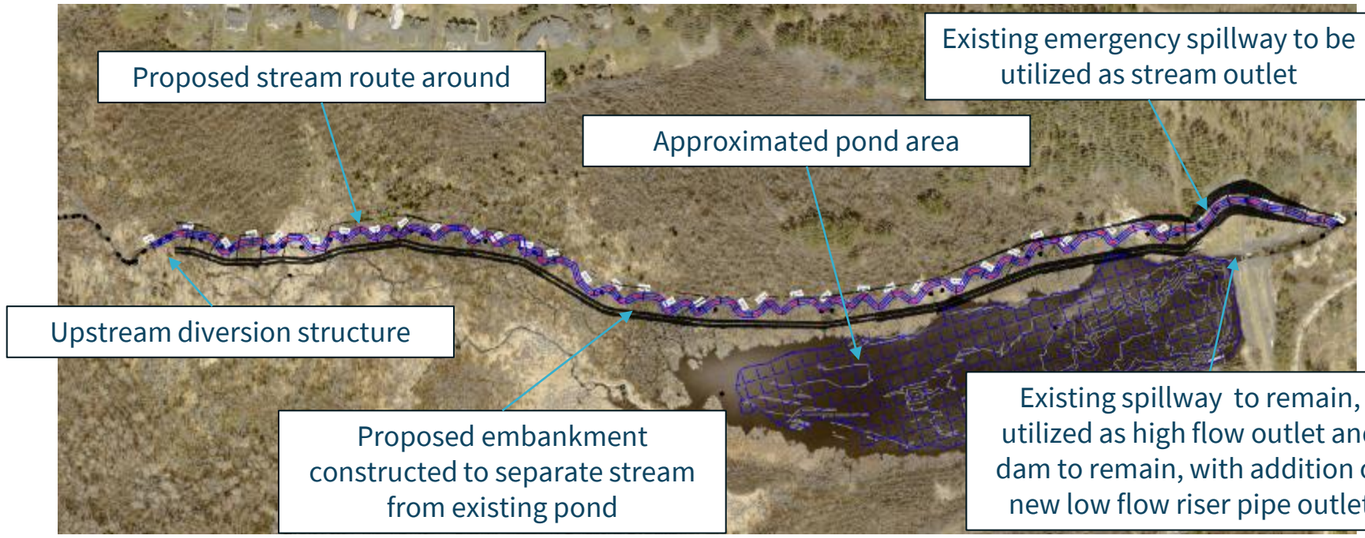
- Remove fish passage barrier.
- Restores longitudinal connectivity.
- Improves water quality.
- The low flow riser pipe offers water level management.
- Hartley Pond may remain a "public water" post-project.

WEAKNESSES:

- Maintains a Class I – High Hazard Dam.
- Design complexities due to dam and unforeseen environmental conditions along the new route.
- Risk of not meeting objectives if the new route and pond under-perform.
- Significant future monitoring and maintenance required.
- Potential sediment deposition maintenance upstream and in the pond area.
- Channel around the impoundment may sometimes be a "losing stream," with water potentially seeping into the bed and into groundwater.
- Long-term maintenance will be required on the existing dam embankment.

UNKNOWNS/CONSIDERATIONS:

- Retains existing pond services.
- Berm and channel through the emergency spillway will require on-going maintenance.



Feasibility Criteria	Criteria Score[1]	Comment
Restore natural stream hydrology	3	A stream will be restored; however, it will not be within the natural valley and will have engineered geomorphology
Restore a stable floodplain and habitat diversity	3	A floodplain will be constructed for the stream channel, but not in original valley
Enhance temperature and sediment transport	4	During low flow conditions, water and sediment will be routed through the constructed channel
Restore longitudinal and lateral connectivity	4	The constructed channel will have longitudinal connectivity
Maintain recreational services	5	The restored stream and pond will maintain and enhance recreational services
Enhance brook trout fishing	4	The restored stream will improve temperatures and connectivity for brook trout populations
Restore to natural conditions	3	Not natural conditions, but improvement on the stream
Maintain or enhance educational opportunities	5	Educational opportunities relative to the stream and pond will be maintained and enhanced
Do not increase risk of flood damage downstream	5	Hydrology and hydraulic modeling has shown reduction in peak discharge
Total Criteria Score	**36**	

Notes: [1]Criteria scoring scale of 1 to 5. 1 = lowest potential for meeting criteria and 5 = highest potential for meeting criteria.

FEASIBILITY SCORE: 36/45

ALTERNATIVE 3: DAM REMOVAL

Alternative 3 proposes the removal of the existing dam, with the subsequent restoration of the stream channel within the valley's natural topography. This process involves channel restoration through the valley enhancing the existing remnant channel and restoring the channel where one does not currently exist with reference channel pattern and dimensions. Some removal of sediment and grading of a floodplain and new channel will be required. The inclusion of a pond feature in this alternative would function primarily as a landscape element rather than a flood control mechanism. We have specified that the pond is approximately 3 acres in size fed by groundwater with no direct connection to Tischer Creek on the upstream side. The pond outlet could be connected to the channel through a small flow-in flow-out channel to allow for overwintering of fish populations.

ASSUMPTIONS:

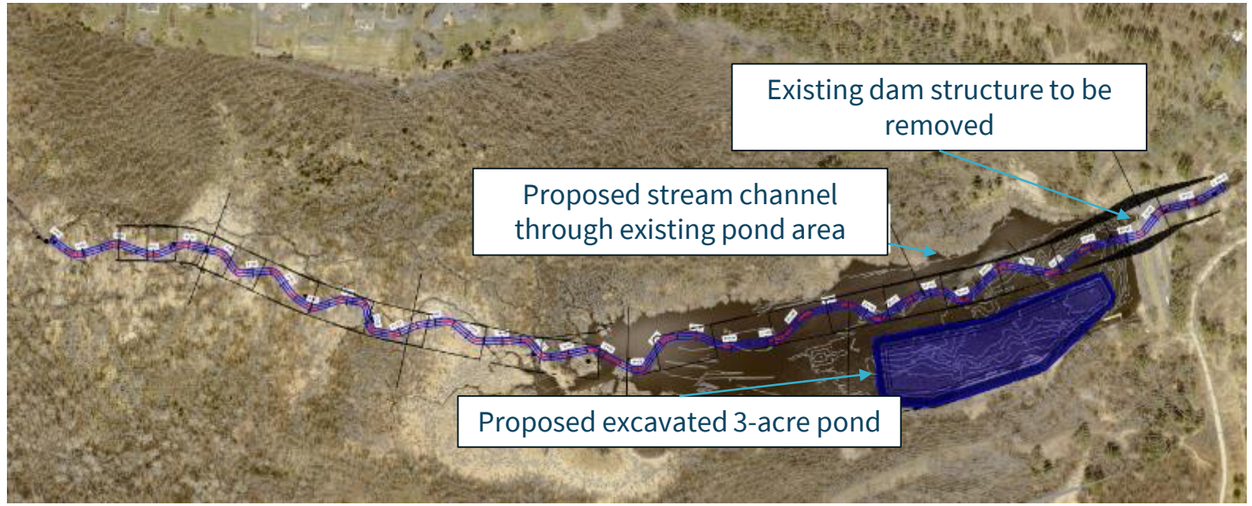
- Stream and valley ecosystem recovers post-restoration.
- Groundwater input maintains baseflow.
- Excavate pond to improve and maintain water quality.
- No changes to FEMA preliminary floodplain maps.

STRENGTHS:

- Eliminates Class I – High Hazard Dam, reducing safety risks.
- Removes fish passage barrier.
- Restores longitudinal connectivity and biodiversity.
- Improves water quality.
- More effective sediment transport management.
- Greatest resilience to climate variability.
- Design and construction process may be less complicated and more cost-effective.
- May not require an EIS for removal of the public water of the state (pond), if changes to the pond are considered partial drainage/changing the dimensions of the pond, rather than elimination.

WEAKNESSES:

- Removing the dam does not provide peak flow attenuation.



Feasibility Criteria	Criteria Score[1]	Comment
Restore natural stream hydrology	5	Restore the stream through the natural valley
Restore a stable floodplain and habitat diversity	5	Restores stream channel and floodplain in existing natural valley
Enhance temperature and sediment transport	5	Removing impoundment will enhance stream temperature and restore sediment transport
Restore longitudinal and lateral connectivity	5	Removing the dam will remove the fish passage barrier
Maintain recreational services	5	The restored stream and pond will maintain and enhance recreational services
Enhance brook trout fishing	5	Removing impoundment and restoring the stream channel will improve temperatures and connectivity for brook trout populations
Restore to natural conditions	5	The stream will be restored to the natural valley
Maintain or enhance educational opportunities	5	Educational opportunities relative to the stream and pond will be maintained and enhanced
Do not increase risk of flood damage downstream	1	Does not reduce peak flood flows
Total Criteria Score	**41**	

Notes: [1]Criteria scoring scale of 1 to 5. 1 = lowest potential for meeting criteria and 5 = highest potential for meeting criteria.

FEASIBILITY SCORE: 41/45

ALTERNATIVE 4A AND 4B: OPEN-BOTTOM CULVERT WITH AND WITHOUT POND

Alternative 4 proposes the installation of an open-bottom culvert through the dam embankment at the approximate elevation of the original channel through the impoundment. The culvert would be sized to pass fish and bankfull flows without restriction but would restrict flows above bankfull flow. This alternative would leave the rest of the dam embankment, the spillway, and the emergency spillway in place. The channel will be restored within its natural valley, thus restoring the channel connectivity and floodplain ecology. During intense rainfall, the floodplain in the former impoundment can temporarily hold back flood flows. This controlled inundation is intended to be brief to minimize any long-term impact on the vegetation.

ASSUMPTIONS:

- Flow-limiting culvert design will effectively reduce flood flows.
- Design will withstand peak flow stresses.
- Excavate pond to improve and maintain water quality.

STRENGTHS:

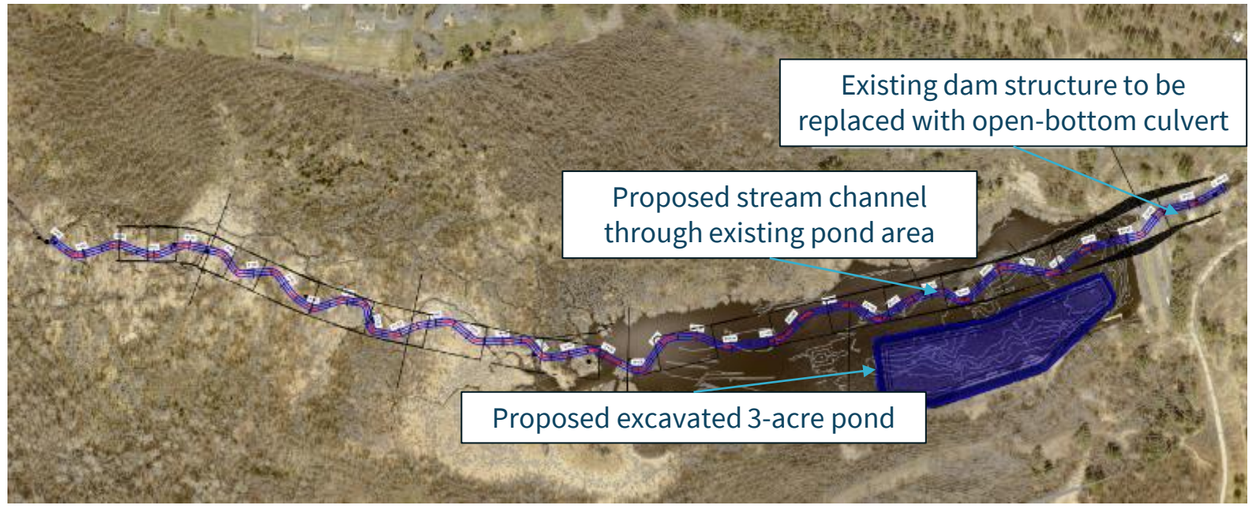
- Reduces continuous water head/energy pressure on the embankment.
- Removes fish passage barrier.
- Restores channel longitudinal connectivity.
- Improves water quality.
- Natural river design can help manage sediment transport more effectively, reducing downstream erosion and upstream aggradation.
- Passive flood control, reducing/maintaining downstream flood impacts.
- May not require an EIS for removal of the public water of the state (pond), if changes to the pond are considered partial drainage/changing the dimensions of the pond, rather than elimination.

WEAKNESSES:

- Long-term maintenance will be required on the existing dam embankment.
- Short-term ecological and geomorphological impacts (e.g., sediment deposition on upstream floodplain and aggradation in the channel).
- Potential need for downstream hard armoring.
- Impedes on floodplain connectivity.

UNKNOWNS/CONSIDERATIONS:

- Substrate within the culvert must be appropriately sized for peak flows while also passing fish.



MCDA Scores for Alternatives 4a and 4b: Open-Bottom Culvert with and without Pond (revised scores without pond are shown in parentheses)

Feasibility Criteria	Criteria Score[1]	Comment
Restore natural stream hydrology	4	Restore the stream through the natural valley; however, stream will flow through a culvert at dam structure
Restore a stable floodplain and habitat diversity	4	Restores channel and floodplain in existing natural valley; however, the structure will be constricting
Enhance temperature and sediment transport	4	Removing impoundment will reduce and maintain channel temperatures; however, the structure will be constricting during higher flows and may cause aggradation
Restore longitudinal and lateral connectivity	4	Removing the dam will remove the fish passage barrier; however, during high flows the structure may be a velocity barrier
Maintain recreational services	5 (4)	The restored stream and pond will maintain and enhance recreational services
Enhance brook trout fishing	5	Removing impoundment and restoring the stream channel will improve temperatures and connectivity for brook trout populations
Restore to natural conditions	4	The stream will be restored to the natural valley; however, the structure will be constricting
Maintain or enhance educational opportunities	5 (4)	Educational opportunities relative to the stream and pond will be maintained and enhanced
Do not increase risk of flood damage downstream	5	Culvert will be used to reduce peak flood flows
Total Criteria Score	**40 (38)**	

Notes: [1]Criteria scoring scale of 1 to 5. 1 = lowest potential for meeting criteria and 5 = highest potential for meeting criteria.

FEASIBILITY SCORE: 40 (38)/45

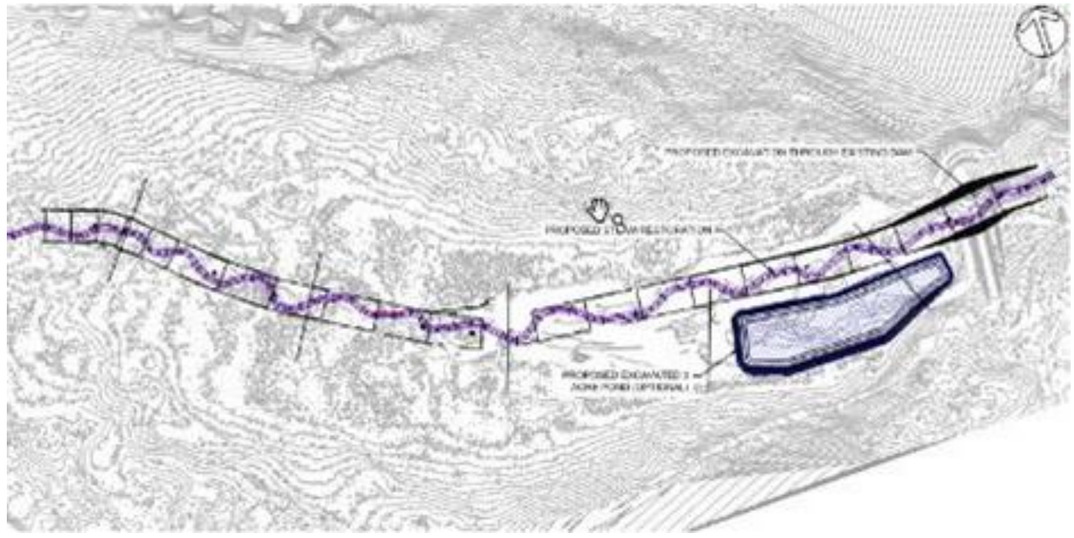
COMBINED MCDA TABLE

Alternatives:	Feasibility Criteria											
	Restore Natural Stream Hydrology	Restore a stable floodplain and habitat diversity	Enhance temperature and sediment transport	Restore longitudinal and lateral connectivity	Maintain recreational services	Enhance brook trout fishing	Restore to natural conditions	Maintain or enhance educational opportunities	Do not increase risk of flood damage downstream	Permit Consideration	Projected Cost	Score
1 – No Action	1	1	1	1	4	1	1	3	5	NA	Maintenance	**18**
2 – Stream Route Around	3	3	4	4	5	4	3	5	5	Possibility to permit / EAW considering partial drainage / changing dimensions of Hartley Pond	3.6 million	**36**
3 – Dam Removal	5	5	5	5	5	5	5	5	1	Possibility to permit / EAW considering partial drainage / changing dimensions of Hartley Pond	2.5 million	**41**
4a and 4b – Open-Bottom Culvert with and without Pond	4	3	4	4	5 (4)	5	4	5 (4)	5	Possibility to permit / EAW considering partial drainage / changing dimensions of Hartley Pond	3.4 million	**40 (38)**

Recommended Alternatives

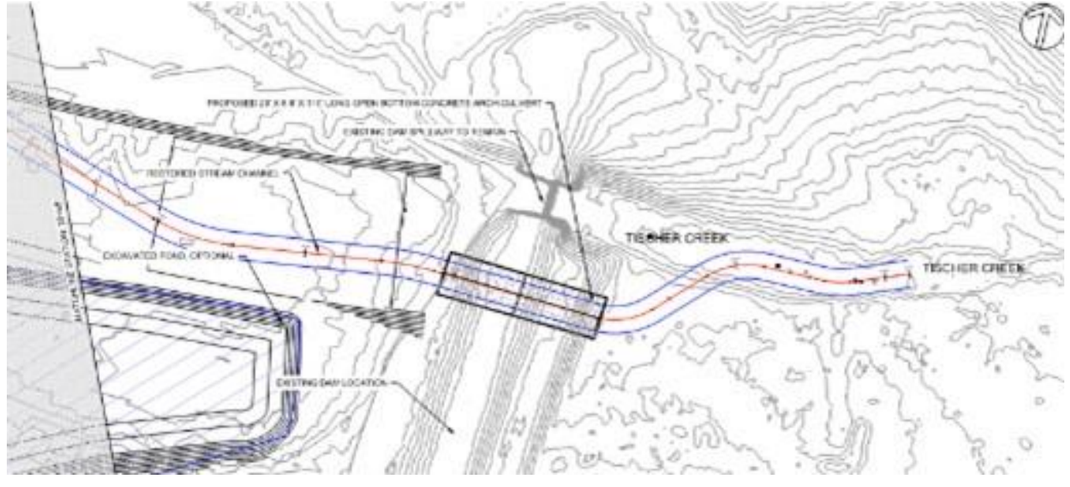
Alternative 3: **Dam Removal**

- Most Climate-Resilient and Sustainable Alternative
- Restores Natural Stream Hydrology
- Eliminates Risk of Dam Failure
- Requires Property Acquisition within Floodplain



Alternative 4a: **Open-Bottom Culvert with Off-line Pond**

- Most Cost-Effective, Fish Passage, and Flood Attenuation Alternative
- Restores Natural Stream Hydrology
- Reduces Risk of Dam Failure by Preserving the Dam Embankment, Spillway, and Emergency Spillway
- Reduces Continuous Water Head/Energy/Pressure on the Embankment



Thank You!

Questions?

Hartley Pond and Dam Feasibility Study

March 1, 2024