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Executive Summary of Alternatives Analysis: Knox Cattle Company Dam

Mount Vernon, Ohio

July 1, 2022

Prepared for:

Frost Brown Todd LLC

Prepared by:

Stantec Consulting Services Inc.

1.0 INTRODUCTION

The Knox Cattle Company Dam is located east of downtown Mount Vernon in Knox County, Ohio. (See the Overview map on page 2). Although initially constructed for agricultural purposes, the dam is a key element in managing the stormwater originating from the surrounding residential development.

According to the Ohio Department of Natural Resources (ODNR), The existing Dam is an earthen embankment constructed in 1945 and is approximately 20-feet tall and 375-feet long with a top crest width of 15 feet, as noted in the Dam Inventory Sheet from the Ohio Department of Natural Resources (ODNR). It has a drainage area of approximately 0.2 square miles and creates a permanent pool[1] with a surface area of approximately 4.5 acres at its crest.

In 2008, ODNR reclassified the Dam as a Class I dam due to the risk associated with a potential failure and development downstream of the property. ODNR's analyses indicate the dam does not comply with OAC 1501:21-13-02 because it cannot safely discharge the runoff of the Probable Maximum Flood (PMF) event.[2] ODNR dam safety inspections in 2008, 2010, 2015, and 2020 document multiple violations of Ohio's dam safety standards, including emergency spillway channel erosion, seepage, maintenance issues, and inability of the spillway to pass the design flood (PMF).

In 2020, due to the risk posed by the dam, the City of Mount Vernon agreed to perform interim risk reduction measures (IRRMs), lowering the reservoir water level and installing riprap on the emergency spillway channel. In 2021, the City performed additional IRRMs: repairing the emergency spillway outlet and removing the rusted outlet pipe. See Figure 1 for general arrangement of dam features.

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[1] The terms "pool," "pond," "reservoir," and "impoundment" are used interchangeably in this report to refer to the body of water that is caused by the presence of the Dam.
[2] The PMF is defined as the largest flood that could result from a combination of the most severe meteorological and hydrologic conditions that could conceivably occur in a given area.

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Legend

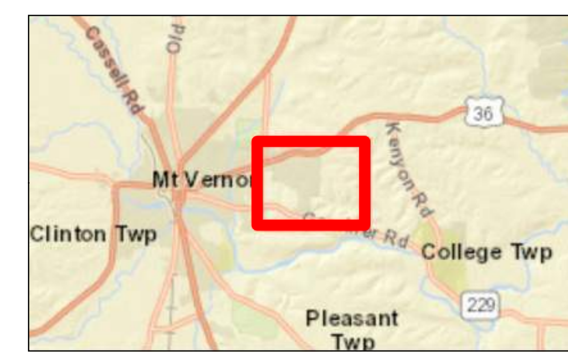
Parcels

N

0 750 1,500 Feet

(At original document size of 11x17)
1:10,000

Notes
1. Coordinate System: NAD 1983 2011 StatePlane Ohio North FIPS 3401 Ft US
2. Background: 2019 Aerial Photography, Hancock County Auditor GIS Data Downloads



Project Location
Monroe Township
Knox County, Ohio

Prepared by DMB on 2022-03-02
Review by NMM on 2022-03-02

Client/Project 173410617 REVA
Frost Brown Todd LLC
Mt. Vernon Dam Study
Knox Cattle Company Dam

Figure No.
Overview

Title
Project Location

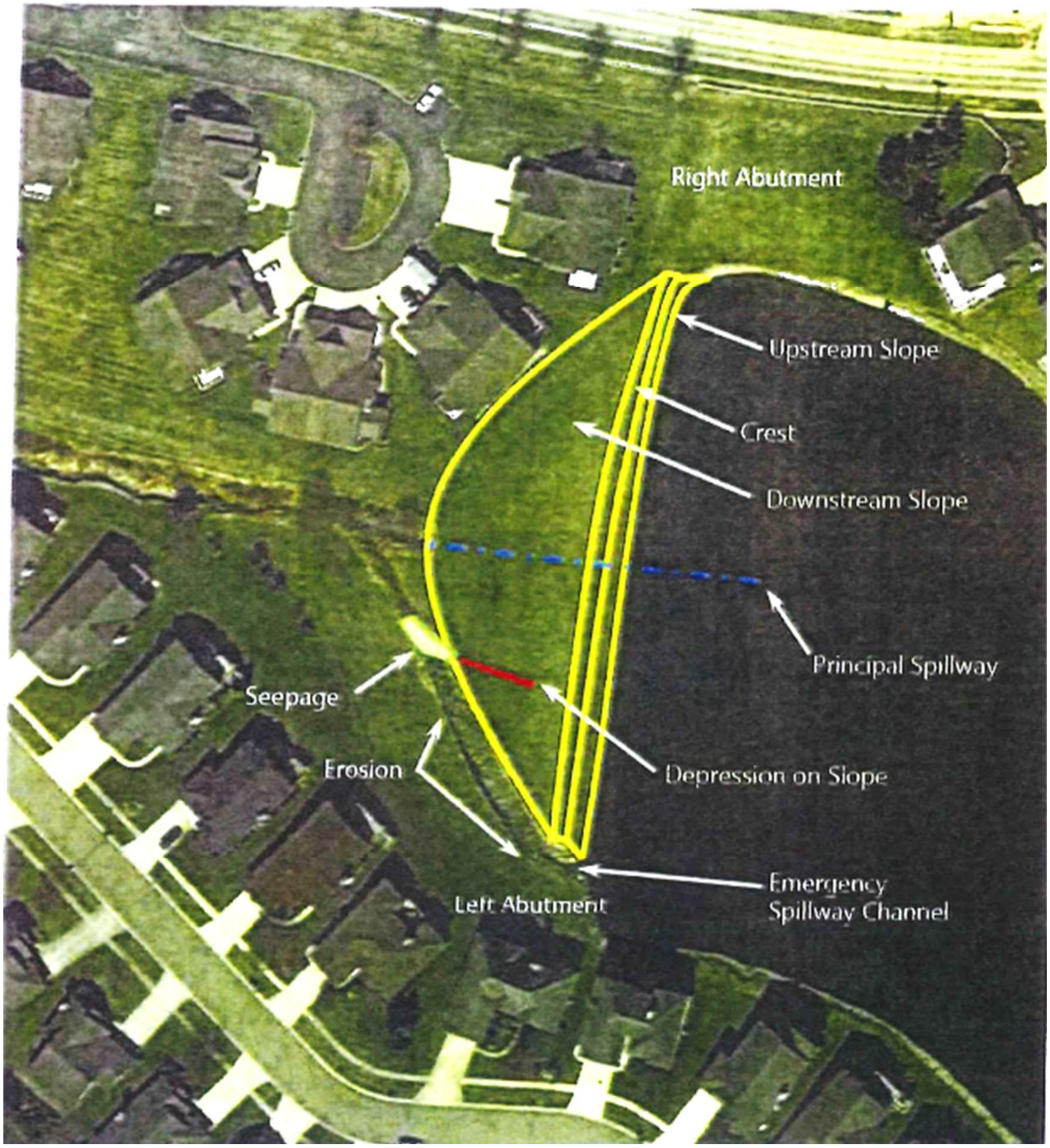


Figure 1 – Existing Dam Features Source: ODNR Dam Safety Inspection Report Nov. 25, 2019

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1.1 PROJECT SCOPE

There are three conceptual alternatives to address the dam deficiencies identified by ODNR, mitigate the risks posed by the dam, and manage stormwater. They are:

1. Rehabilitate the dam and maintain the existing pool;
2. Remove the dam and pool and implement alternative stormwater management measures; and
3. Reduce the dam embankment height such that the dam is no longer subject to ODNR dam safety jurisdiction and implement alternative stormwater management measures.

For each alternative, a planning-level opinion of probable construction costs (OPCC) and operation and maintenance (O&M) costs were developed. The level of accuracy of the OPCC at this time is +/- 30% due to the conceptual level nature of this study.

2.0 EXISTING CONDITIONS

2.1 EXISTING DAM DEFICIENCIES

ODNR rules require the dam to safely pass 100% of the PMF. The dam can pass only 12% as currently configured. The principal spillway structure for the dam is an 8-inch diameter pipe. ODNR requires one no less than 24 inches in diameter. The dam does not have a required lake drain to enable controlled drawdown of the reservoir. A lake drain is typically a pipe with a gate or valve that can be operated to reduce the elevation of the reservoir during an emergency or for O&M purposes. Dam safety laws require a dam this size to have an Emergency Action Plan (EAP) and dam failure inundation study, neither of which were ever prepared. Also, as noted in ODNR's inspection reports, the existing structure needs significant maintenance.

2.2 SEDIMENT

The dam reservoir acts as a sediment trap. The energy of the water flowing into the reservoir dissipates as it spreads out. As a result, the water can no longer carry the sediment it has collected, which drops to the bottom of the reservoir. Over time, the sediment accumulates reducing the dam's storage capacity.

The sediment accumulation surface, shown in Figure 2, was used to evaluate the extent of sedimentation in the reservoir. Sediment accumulation was greatest in the upstream portions of the reservoir, where the two streams enter the pool. Total sediment accumulation volume in the reservoir was estimated at 7,300 cubic yards, which is approximately 15% of the approximately 30-acre-feet storage capacity of the dam.

Figure 2. Sediment accumulation depths in the reservoir

The quantity (and possibly quality) of sediment in the reservoir has a significant impact on the alternatives analysis. Dredging, removal, and disposal of sediment is costly and affects the upstream reservoir grading plans. Periodic dredging to maintain storage capacity of the reservoir will also be required as part of the management plans for the alternatives presented.

2.3 HYDROLOGIC AND HYDRAULIC ANALYSIS

Stantec performed a hydrologic and hydraulic (H&H) analysis for the project watershed using industry accepted methodology to estimate the rate and quantity of stormwater runoff and water surface elevations within the watershed. Analysis was performed for existing conditions and following potential modifications to the dam and reservoir. The results of the analysis show that the existing structure provides substantial storage of flows during flood events. This storage reduces downstream flows and water surface elevations during and after significant rainfall events. Table 1 shows the peak flow entering, and the reduced flows leaving, the reservoir during various storm events.

Table 1 – Existing Conditions Dam Inflow and Outflow Rates

Recurrence Interval Flood Event	Peak Inflow to Reservoir (cubic feet / second)	Peak Outflow from Reservoir (cubic feet / second)
1-yr	28	10
2-yr	50	16
5-yr	89	26
10-yr	132	36
25-yr	196	53
50-yr	244	69
100-yr	300	127

3.0 PROJECT DESIGN CRITERIA

The following criteria were used to inform the design of the Knox Cattle Company Dam conceptual alternatives and stormwater management features.

- Reduce the risk to public health and safety posed by flooding in the areas served or affected by the existing dam.
- Not increase the magnitude or frequency of flooding of habitable structures (i.e., houses) upstream and downstream of the existing dam.
- Subject to the other design criteria, increases in flow rates upstream and downstream of the dam (including areas of non-habitable structures and lawns) may be necessary.
- Not substantially increase the frequency or severity of roadway overtopping.

4.0 CONCEPTUAL DESIGN ALTERNATIVES

Conceptual level, plan view figures are attached for the Alternatives described below.

4.1 ALTERNATIVE 1: REPAIR AND REHABILITATION

Alternative 1 includes repair and rehabilitation of the existing dam to address the deficiencies and maintenance issues identified in the ODNR Dam Safety Inspection Report, which are required for the existing dam to comport with OAC Section 1501. The principal elements include:

- Construct a labyrinth spillway to safely pass the design flood and discharge into a riprap-lined channel downstream. A concrete slab with concrete abutment walls would be placed just downstream of the spillway for energy dissipation. The outlet channel would transition to riprap and converge to a bottom width of 12 feet to meet the existing downstream channel.
- Downstream improvements include installing riprap in the downstream receiving channel. This channel would be sized to convey discharge from the dam outlet structure.
- The existing principal spillway pipe would be replaced with a low-level outlet pipe and sluice gate to allow for controlled draining of the reservoir. The existing emergency spillway channel would be re-graded.
- Areas where seepage may be occurring must be investigated and monitored until repairs are made. For opinion of probable construction cost estimating purposes, a filtered seepage control berm is proposed.
- Other repairs and monitoring actions include filling low areas along the dam crest, filling rodent burrows along the embankment and crest, removing trees and brush around the principal spillway outlet pipe, removing cattails in the emergency spillway channel, and re-establishing grass in bare or disturbed areas.

4.1.1 Design and Analyses

Additional design and analyses will be necessary to advance the design of Alternative 1. Probable Maximum Precipitation (PMP) and PMF hydrologic and hydraulic (H&H) analyses are necessary to determine the magnitude of the inflow design flood for the spillway design. These analyses would inform the design criteria for the principal and emergency spillway and structural stability analysis of the labyrinth structure. Erosion and scour analysis is necessary to determine channel armoring measures. Geotechnical investigations and analyses are also required to advance Alternative 1 to design.

4.1.2 Dam Safety Considerations

Per ODNR requirements, a Class 1 Dam must be able to safely pass 100% of the PMF. If the dam is rehabilitated to meet this requirement, it must be maintained and inspected and it must have an operation, maintenance, and inspection (OMI) manual and an EAP. The EAP must include an upstream and downstream inundation map and an H&H study is required to document the design capacity of the rehabilitated dam. Expected O&M costs are included in the costs section below. Costs to develop an EAP and OMI document are in addition to the OMI costs noted in this report.

4.1.3 Stormwater Management and Flooding Impacts

Rehabilitating the dam would maintain the current storage capacity of the reservoir. It is assumed that the existing top of embankment elevation would be preserved. A combination of modifying the labyrinth spillway cycle elevations and the top of the dam embankment could yield additional flood water attenuation resulting in a decrease in localized downstream flood elevations, particularly in smaller flood events.

4.1.4 Regulatory Agency Permitting

This Alternative would be subject to federal and state permitting requirements, including those pertaining to excavation and filling (administered by the Army Corps of Engineers), water quality certification (administered by Ohio EPA), the National Historic Preservation Act, OEPA stormwater construction permit, and possibly wetland and endangered species issues under the Clean Water Act and Endangered Species Act, respectively.

4.2 ALTERNATIVE 2: DAM REMOVAL

Alternative 2 involves dewatering of the impoundment, removal of the embankment, restoration of the stream through the former dam footprint, and construction of new stormwater basins. This alternative would result in a more natural landscape as the valley would be restored to its approximate pre-dam topography. Additionally, there would be space to create open water features in the former reservoir footprint. The conceptual design includes two ponds to be excavated in the former reservoir on each side of the restored channel, both approximately 0.5 acres in area.

The principal actions needed to implement this alternative include embankment excavation, channel and pool excavation, construction of a roughened channel through the footprint of the former dam, and revegetation. Removal of the dam and grading of the valley side slopes through the former dam area would require approximately 5,900 yd^3 of excavation. Excavation of the two ponds would require approximately 11,100 yd^3 of excavation. Except for excavation of the new channel and ponds, some existing sediment in the former reservoir would remain unless grading is required to ensure stability of the new stream channels.

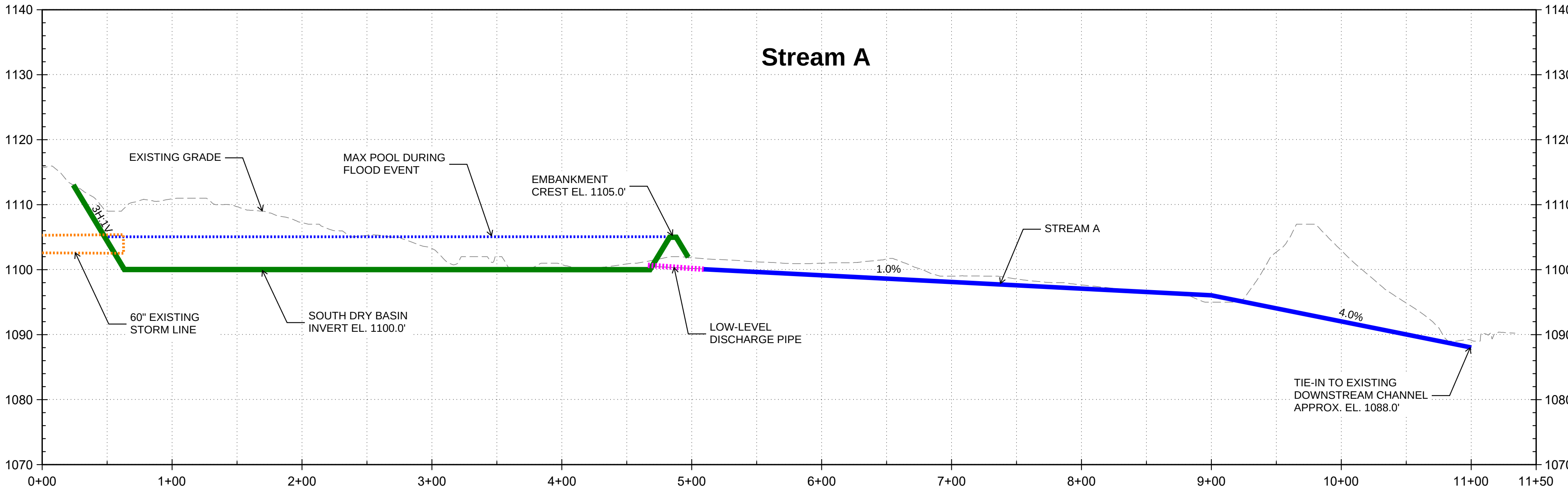
Within the former reservoir, full channel re-establishment would be performed. The design of the channel will be primarily driven by slope, bankfull[3] discharge, existing site development, and the transition of the channel between the basin and the stream downstream of the dam. Upstream of the dam, topographic data suggest that an ~8-foot-wide stream is likely the most effective for channeling stormwater.

Alternative 2 proposes construction of two dry, in-line stormwater basins (approximately 0.5 acres and 1.0 acre) upstream of the to-be-removed reservoir. The basins would provide flood storage capacity to offset the loss of storage provided by the existing dam. These would remain dry except during storm events, when water would be temporarily stored and slowly released. Stormwater management features such as these basins are necessary for flood risk reduction. The northern dry basin would be formed by repairing the existing concrete weir forming the pond upstream of the impoundment and excavating soil. The weir would be modified to allow low flows to pass through unimpeded; flow from larger events would be temporarily stored. The southern dry basin would be formed by the construction of an earthen embankment and excavating soil. Stormwater flow would be controlled with a low-level outlet pipe sized to reduce peak flows in larger events.

Profiles for Stream A (main channel) and Stream B (tributary to Stream A) are shown below in Figure 3. Stream A would be a multi-slope channel following the existing valley to minimize the amount of grading. The slope of Stream A would be approximately 1% through the impoundment. The drop across the area through the former dam footprint would be approximately 4%. This slope could be accommodated by the construction of a roughened cascade channel with boulder clusters to dissipate energy and provide grade control. Re-establishment of Stream B would begin downstream of the existing gravel spillway from Pond 1B. The slope of Stream B would vary from approximately 1% to 2.8% through the impoundment. Basin streams are anticipated to be low to medium sinuosity. Features such as constructed riffles, woody material, and live branch layering could be installed in the streams to enhance aquatic habitat and provide hydraulic variability.

Exposed reservoir sediments and disturbed areas would be seeded and stabilized. A riparian buffer could be planted adjacent to the re-established channel banks to promote long-term channel stability and water quality. Riparian buffers typically consist of herbaceous cover, which require annual or semi-annual brush hogging maintenance to avoid colonization by woody plants. Riparian herbaceous cover would enhance riparian zone function, bank stability, and aquatic habitat. Pathways or gaps in vegetation could be left to allow for stream access. The remainder of the former reservoir footprint could be planted with turf grass.

[3] The term bankfull refers to the stream water level that just begins to spill out of the stream channel.



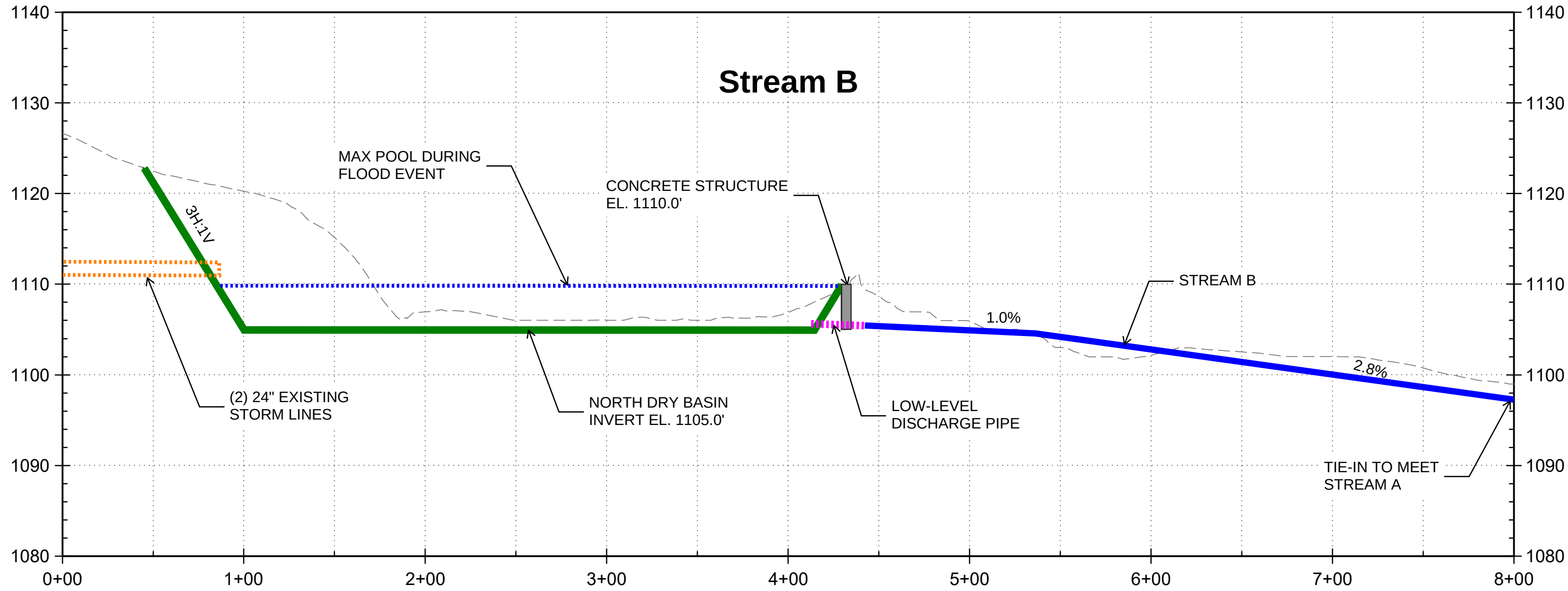


Figure 3. Alternative 2   Stream and Basin Profiles

4.2.1 Design and Analyses

Additional design and analyses will be required to advance the design of Alternative 2. The final design configuration would be analyzed using the watershed H&H model to confirm post-project water surface elevations and flow rates. During the detailed design phase, erosion and scour analysis would be necessary to determine the type and extent of the erosion prevention materials that would be needed within the proposed streams and downstream receiving channel. A detailed reservoir regrading plan will need to be developed for the restoration of the natural stream and excavation of the two smaller ponds. A dam embankment regrading plan is necessary for the dam embankment removal, stabilization of the stream slopes, and revegetation of the disturbed areas.

4.2.2 Dam Safety Considerations

Removal of the dam eliminates the ODNR dam safety requirements.

4.2.3 Stormwater Management and Flooding Impacts

Removal of the existing dam will result in loss of the flood storage in the current reservoir. To offset that loss, stormwater retention would be accomplished with two new in-line dry storage basins. In addition, some stormwater retention and infiltration will be achieved through inundation of the floodplain and ponds which will take the place of the existing reservoir. The floodplain, riparian corridor, and ponds will also provide nutrient reduction benefits.

Basin 2 and Pond 3, located downstream of the reservoir, currently receive discharges from the dam spillway (Figure 4). Following completion of Alternative 2, maintenance and inspection will be needed to determine if localized areas of scour and erosion have formed due to removal of the dam. Pond 3, located downstream of Basin 2, may accumulate moderate amounts of sediment that would have been captured by the existing reservoir.

Figure 4. Downstream Stormwater Features

4.2.4 Regulatory Agency Permitting

Federal and state regulation associated with this alternative is similar to, though less intensive and less time-consuming than, Alternative 1.

4.3 ALTERNATIVE 3: DAM MODIFICATION / LOWERING

4.3.1 Conceptual Alternative

Two variations of Alternative 3 are presented.

4.3.1.1 Conceptual Alternative 3A

Alternative 3A involves lowering the height of the dam to under six feet to remove the structure from ODNR jurisdiction and reduce dam safety related risk; and the establishment of a new, smaller, permanent pond upstream of the modified dam. The current elevation of the embankment would be lowered from 1108' to approximately 1094', such that the new dam crest is less than six feet in height. The modified embankment would have a crest width of 15' with the upstream face of the embankment graded to a 5:1 slope. Since the new embankment height (1094') would be lower than the existing reservoir bottom elevation (1094.8'), modification of the dam would result in loss of the existing pool. To maintain a pool, a new pond would need to be excavated which would be approximately 3 acres in area with a permanent pond area of 2 acres and an assumed retained water depth of 4 feet. Excavation of a new pond and modification of the dam would require approximately 41,100 yd^3 of earthwork, more substantial than Alternative 2, and drives much of the cost for this alternative.

To offset the loss of flood storage due to dam modification, Alternative 3A proposes construction of two dry, in-line storage basins upstream of the to-be-removed reservoir. This approach is similar to concept 2. The profile of the proposed pond and dry basins can be seen in the diagrams in Figure 5. There are other potential configurations which vary the shape and geometry of the north and south basin, or revise the footprint of the permanent pond shown in 3A. In any event, additional excavation will be required to create the necessary flood storage. It would be feasible to create a deeper (than 4-foot) permanent pond, but at additional cost for excavation.

This alternative would allow for minor opportunities for stream re-establishment in the area between the existing headwaters of the channels to the new pool. A floodplain depression would be graded to allow for inlet channel development above the pool for Stream A and B. Re-establishment of Stream B would begin downstream of the existing gravel spillway from Pond 1B. This alternative would also allow for the development of fringe wetlands (if desired) along the perimeter of the new reservoir.

Because sedimentation will, over time, impact the depth and storage capacity of the new reservoir, periodic dredging of reservoir sediment will need to be incorporated into the long-term maintenance plan. However, as sediment load to the reservoir appears to be low, maintenance dredging is likely to be needed less than every 10 years.

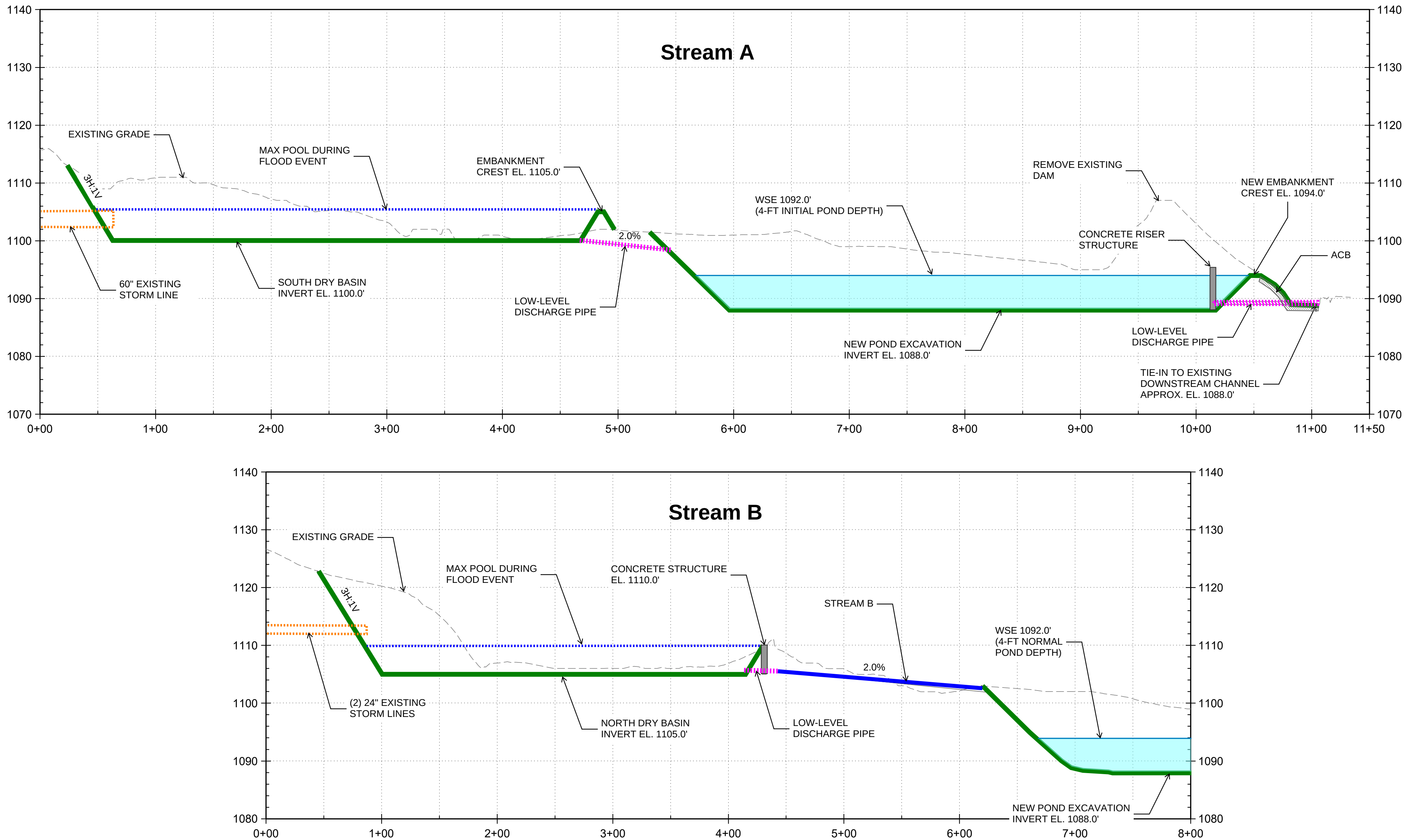


Figure 5. Alternative 3A Stream and Basin Profiles

4.3.1.2 Conceptual Alternative 3B

Alternative 3B provides another option to manage stormwater while reducing the risk associated with the current dam. This Alternative proposes excavation of a single dry, in-line storage basin in the former reservoir footprint. The dry basin would be constructed similar in size to Alternative 3A (approximately 3 acres of grading), but would remain dry due to the installation of a low-level outlet pipe to keep normal flows moving through the basin. During larger storm events, the basin would temporarily store floodwater, thereby reducing downstream flow rates. The existing small pond upstream of the main reservoir (~0.3 acres) would be retained.

Alternative 3B should not require the construction of additional stormwater basins upstream as shown in Alternatives 2 and 3A because the stormwater storage is achieved with the construction of the dry basin. The cost savings of this Alternative (versus 3A) is attributable to the substantial reduction in necessary earthwork. A conceptual profile of this configuration is shown in Figure 6 on the following page.

4.3.2 Design and Analyses

Additional design and analyses will be required to advance the design of Alternative 3A or 3B. Similar to Alternative 2, the final design would be analyzed using the H&H model to confirm post-project water surface elevations and flow rates. Erosion and scour analysis is necessary to determine the type and extent of erosion prevention materials. A detailed grading plan is also recommended. A detailed dam embankment regrading plan is necessary for the lowering of the dam embankment, stabilizing slopes, and revegetation of the disturbed areas.

4.3.3 Dam Safety Considerations

Alternatives 3A and 3B would change the ODNR dam classification from Class I to Class IV, which would exempt the modified structure from ODNR dam safety rules. However, the impoundment would still have potential to cause damage to downstream structures should an overtopping event occur, with the dam owner potentially liable for those damages.

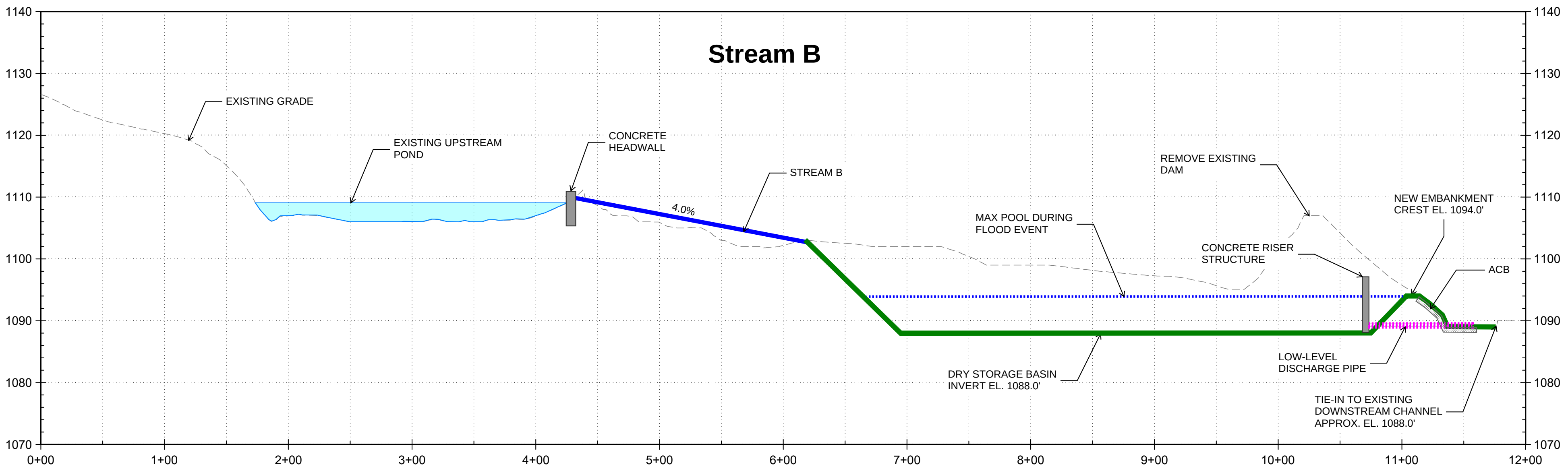


Figure 6. Alternative 3B Stream and Basin Profile

4.3.4 Stormwater Management and Flooding Impacts

The stormwater management/flood control value of alternatives 3A and 3B is limited by the maximum height of the new embankment and whether a permanent pool of water is maintained during baseflow conditions (Alt. 3A). Alternative 3A maintains a similar freeboard height as the existing pond but would have a smaller surface area (approximately 2 acres, or 450 x 250 feet). An outlet control structure to manage higher flows is proposed for both Alternatives 3A and 3B. The results of the H&H analysis indicate the embankment will overtop during larger events, and overtopping protection will be required on the downstream face of the embankment. Options that may be considered for overtopping protection are riprap or articulated concrete blocks.

Alternative 3A will provide the stormwater management function through the construction of upstream dry-storage basins. Alternative 3B provides stormwater management through use of a dry-storage basin in the former reservoir footprint.

The impact to the sediment transport function on Basin 2 and Pond 3 resulting from Alternative 3 is likely less than Alternative 2. By maintaining a significant reservoir upstream of the remaining embankment, the sediment accumulating function of the reservoir would likely be comparable to its current function. Therefore, significant change in sediment accumulation downstream of the reservoir is unlikely.

4.3.5 Regulatory Agency Permitting

The complexity and permitting issues are similar to that of Alternative 1.

5.0 COMPARISON OF ALTERNATIVES

OPCC have been developed for each Alternative. The OPCC is based on conceptual level planning and should be considered accurate to within +/-30%. Construction costs include a 25% or 30% estimate for field survey, design services, permitting and construction administration services. An estimate of the long-term O&M costs for each Alternative is included below. Maintaining the dam as described in Alternative 1 will require annual and periodic O&M activities. The primary contributor to O&M costs for Alternatives 2, 3A and 3B is mowing and vegetation management. Detailed line-item costs for each Alternative are attached. These costs are based on historic unit rate bids for similar types of projects. However, ongoing global supply chain issues, increased commodity prices, and inflation could have significant impacts on these OPCCs. Nevertheless, the estimates can be used as a basis for comparing the cost of alternatives.

5.1 OPINION OF PROBABLE CONSTRUCTION COSTS

Table 2 – Alternative OPCC

Alternative	Description	Total Capital Cost
1	*Repair and Rehabilitate Dam, Maintain Pond*	$ 2,560,000
2	*Remove Dam, Construct Smaller Ponds and Upstream Dry Basins*	$ 1,390,000
3A	*Modify Dam, Construct Permanent Pond, and Upstream Dry Basins*	$ 2,120,000
3B	*Modify Dam, Construct Dry Basin*	$ 1,610,000

5.2 LONG-TERM OPERATION AND MAINTENANCE COSTS

Table 3 – O&M Costs

Alternative	Description	Annualized Operations & Maintenance Cost
1	*Repair and Rehabilitate Dam, Maintain Pond*	$ 36,500
2	*Remove Dam, Construct Smaller Ponds and Upstream Dry Basins*	$ 38,500
3A	*Modify Dam, Construct Permanent Pond, and Upstream Dry Basins*	$ 34,200
3B	*Modify Dam, Construct Dry Basin*	$ 35,700

5.3 CONSTRUCTION SCHEDULE

An estimated construction duration is included below. Because the current bidding and construction environment has been and is likely to continue to be impacted by labor and supply shortages, construction duration may be significantly longer than outlined below.

Table 4 – Construction Duration Estimate

Alternative	Description	Estimated Construction Duration
1	*Repair and Rehabilitate Dam, Maintain Pond*	6 – 9 months
2	*Remove Dam, Construct Smaller Ponds and Upstream Dry Basins*	4 – 6 months
3A / 3B	*Modify Dam, Construct Permanent Pond, and Upstream Dry Basins*	4 – 6 months

6.0 CONCLUSION

Multiple factors are relevant in determining the next steps for the dam and reservoir. To assist in that process, a matrix has been developed below to qualitatively assess various impacts associated with each alternative. Green, yellow, and red cell colors are used to indicate the overall impact to the category noted. Green represents the most advantageous while red is the least advantageous impact for the category noted.

Table 5 – Alternatives Comparison Matrix

Alternatives Matrix							
	Category						
Alternative	Dam Safety	Downstream Risk	Stormwater & Flooding	Permitting	Aesthetics/ Environment	OPCC	Long Term O&M
1 (Rehab)	Addresses Dam Safety Requirements	Dam remains and potential residual risk downstream remains	Stormwater management, flood risk reduction achieved through rehab and maintaining permanent pond	ODNR Dam Safety, USACE, Ohio EPA permitting may be required	Pool remains for aesthetics, ecological benefits are low relative to Alt. 2	Highest	O&M costs similar to other alternatives, but additional requirements to maintain dam safety related aspects
2 (Removal)	Dam is Removed	Downstream residual risk associated with dam eliminated	Some stormwater management and flood risk reduction function primarily achieved with upstream dry basins	ODNR Dam Safety, USACE, Ohio EPA permitting may be required	Ecological benefits improved. New ponds incorporate aesthetic benefits	Lowest	O&M costs necessary, largely for mowing
3A (Lower, Permanent Pond)	Dam sufficiently lowered and removed from Dam Safety Inventory	Risk reduced, but embankment still present leading to some residual risk	Stormwater management and flood risk reduction primarily achieved with upstream dry basins.	ODNR Dam Safety, USACE, Ohio EPA permitting may be required	Pool remains, however ecological benefits are low relative to Alt. 2	High	O&M costs necessary, largely for mowing
3B (Lower, Dry Basin)	Dam sufficiently lowered and removed from Dam Safety Inventory	Risk reduced, but embankment still present leading to some residual risk	Stormwater Management and flood risk reduction achieved through construction of larger dry basin in former reservoir footprint.	ODNR Dam Safety, USACE, Ohio EPA permitting may be required	No permanent pool, area remains largely mowed lawn outside of small defined channels	Middle	O&M costs necessary, largely for mowing

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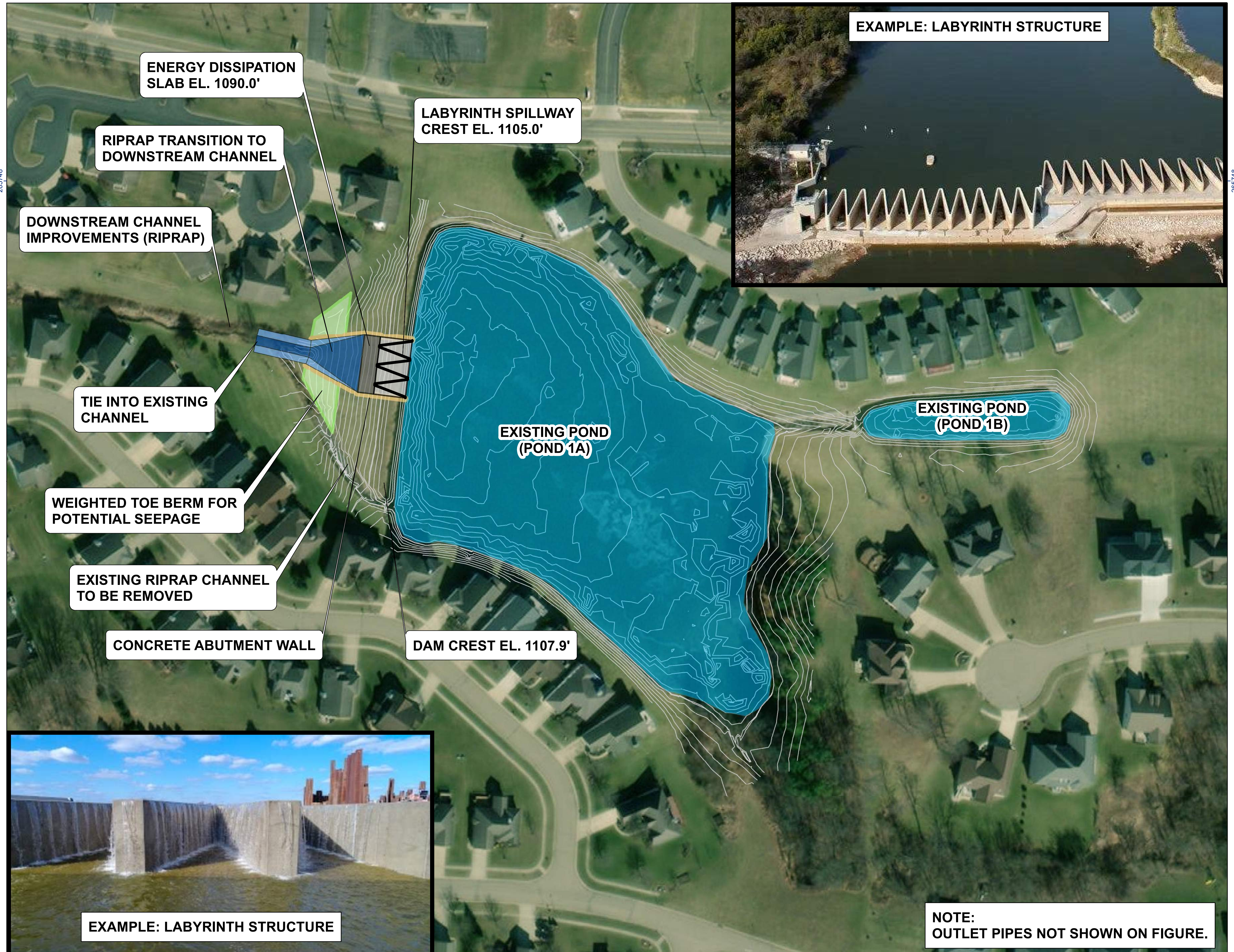

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Legend

- Existing 1-ft Contours
- Extents of Preserved Pond
- Labyrinth Spillway
- Abutment Wall
- Concrete Bottom Slab
- Riprap Channel Bottom
- Riprap Side Slope
- Seepage Toe Berm

N

0 100 200 Feet

Notes
1. Coordinate System: NAD 1983 2011 StatePlane Ohio North FIPS 3401 Ft US
2. Background: Microsoft Virtual Earth BING layer

Project Location
Monroe Township
Knox County, Ohio

Prepared by DMB on 2022-06-28
Reviewed by NMM on 2022-06-28

Client/Project 173410617 REVA
Frost Brown Todd LLC
Mount Vernon Dam Study
Knox Cattle Company Dam

Figure No.
1

CONCEPT

Title
Alternative 1

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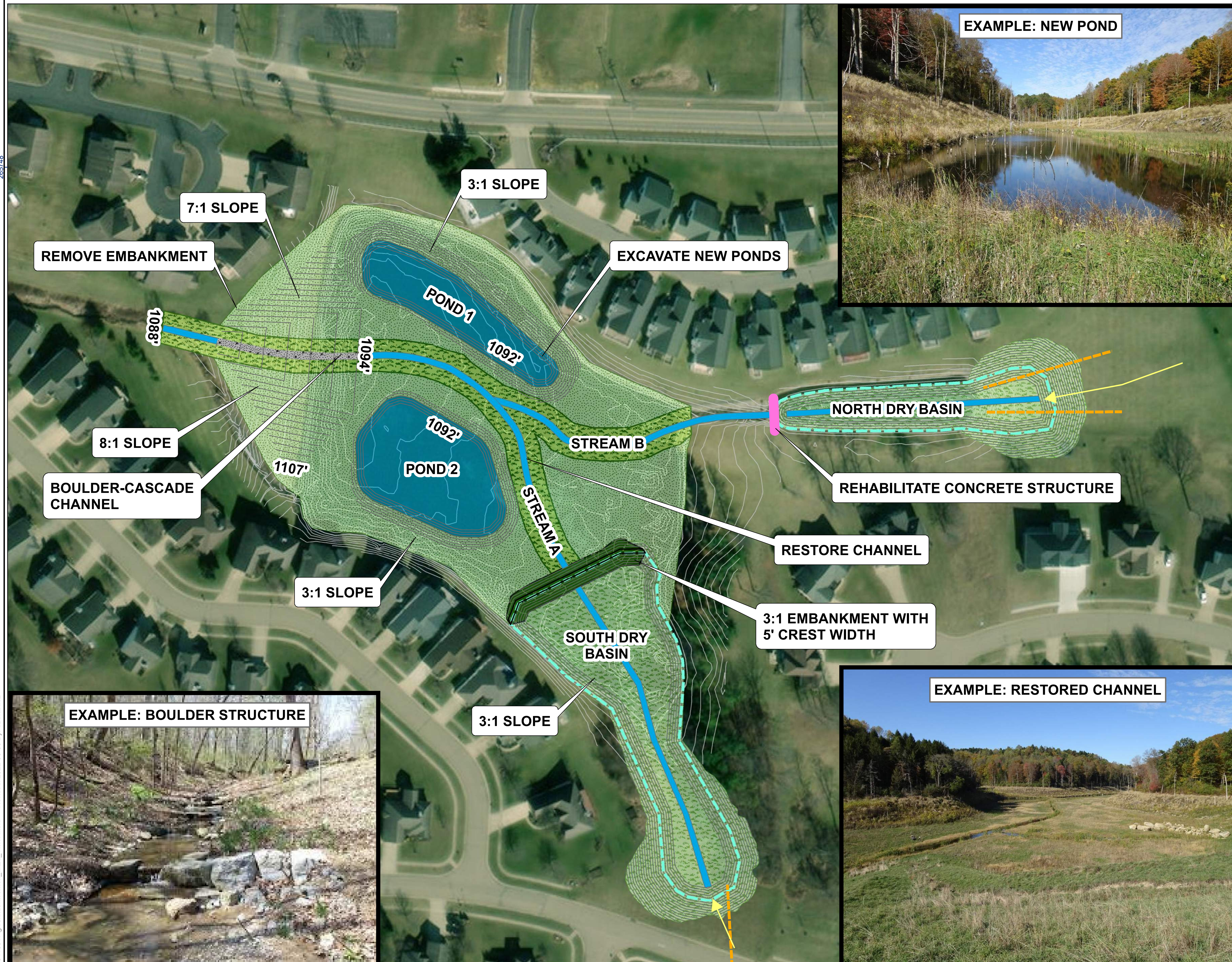
Mt. Vernon Dam Study

Alternative 1 - Opinion of Probable Construction Cost (OPCC)

Repair and Rehab Dam, Maintain Pond

Item #	Description	Quantity	Unit	Unit Cost	Total Cost
	CONSTRUCTION ACTIVITIES				
1	Mobilization / Demobilization	1	LS	$166,730	$166,730
2	Temporary Erosion & Sediment Control	1	LS	$20,000	$20,000
3	Clearing and Grubbing	0.2	AC	$15,000	$3,000
4	Dam Embankment Excavation and Grading	2,150	CY	$22	$47,300
5	Dredge Sediment	7,280	CY	$25	$182,000
6	Temporary Diversion / Care of Water	1	LS	$15,000	$15,000
7	Concrete for Labyrinth Spillway	700	CY	$1,350	$945,000
8	Concrete Abutment Walls	210	CY	$1,350	$283,500
9	Low-Level Outlet and Sluice Gate	1	EA	$24,000	$24,000
10	Regrade Emergency Spillway Channel	333	CY	$10	$3,333
11	Riprap (ODOT Type C) in Outlet Channel	100	CY	$150	$15,000
12	Fill Low Areas Along Crest and Rodent Burrows	333	SY	$20	$6,667
13	Filtered Seepage Control Berm	800	CY	$150	$120,000
14	Topsoil and Seeding	1.0	AC	$2,500	$2,500
15	Construction Observation	1	LS	$133,384	$133,384
				Base Construction Cost	**$1,968,000**
				Survey, Design, Permitting, Construction Administration (30% of base cost)	**$590,400**
				Alt 1. Total Construction Cost Estimate (+/- 30%)	**$2,558,400**

	ANNUALIZED OPERATION AND MAINTENANCE COSTS				
1	Periodic Dredging to Maintain Storage Capacity	1	EA	$8,000	$8,000
2	Debris, Vegetation Removal from Spillway Structures	1	LS	$6,000	$6,000
3	Concrete Surface O&M	1	LS	$5,000	$5,000
4	Repair / Fill Rodent Burrows	1	LS	$4,000	$4,000
5	Mowing and Vegetation Trimming	1	LS	$12,800	$12,800
6	Annual Dam Fee (ODNR)	1	LS	$532	$532
				Alt. 1 Total Annual O&M Cost Estimate	**$36,332**



Stantec

Legend

- Existing 1-ft Contours
- Proposed 1-ft Contours
- Existing Storm Pipe
- Flow Arrow
- Grass
- Riparian Buffer - Native Plantings
- Boulder-Cascade Channel (3%)
- Restored Channel
- Dry Basin
- Embankment
- Pond (4-ft depth)

N

0 100 200 Feet

(At original document size of 11x17)
1:1,500

Notes
1. Coordinate System: NAD 1983 StatePlane Ohio North FIPS 3401 Feet
2. Background: 2019 Aerial Photography, Hancock County Auditior GIS Data Downloads

Project Location
Monroe Township
Knox County, Ohio

Prepared by DMB on 2022-06-28
Review by NMM on 2022-06-28

Client/Project
173410617 REVA
Frost Brown Todd LLC
Mount Vernon Dam Study
Knox Cattle Company Dam

Figure No.
2

CONCEPT

Title
Alternative 2

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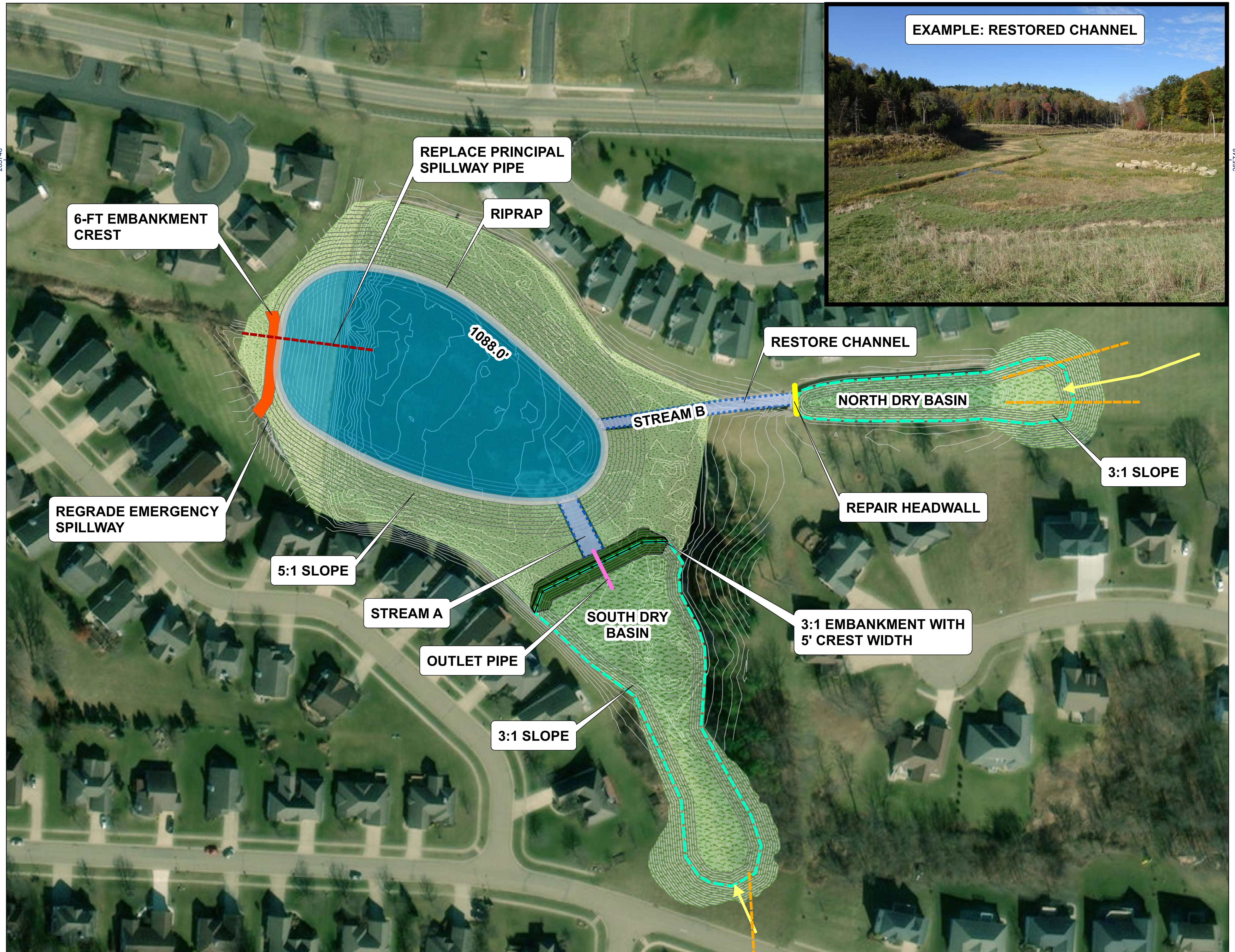
Mt. Vernon Dam Study

Alternative 2 - Opinion of Probable Construction Cost (OPCC)

Remove Dam, Construct Smaller Ponds and Upstream Dry Basins

Item #	Description	Quantity	Unit	Unit Cost	Total Cost
	CONSTRUCTION COST ITEMS				
1	Mobilization / Demobilization	1	LS	$94,008	$94,008
2	Temporary Erosion & Sediment Control	1	LS	$25,000	$25,000
3	Clearing and Grubbing	3.0	AC	$5,000	$15,000
4	Demolition (Utilities, Drains, Spillways)	1	LS	$50,000	$50,000
5	Excavate New Ponds within Former Reservoir	11,100	CY	$22	$244,200
6	North Dry Basin	5,100	CY	$22	$112,200
7	North Dry Basin Outlet Structure	1	LS	$20,000	$20,000
8	South Dry Basin	8,300	CY	$22	$182,600
9	South Dry Basin Embankment and Outlet Structure	1	LS	$25,000	$25,000
10	Dam Embankment Excavation and Placement	5,850	CY	$25	$146,250
11	Natural Channel Excavation and Grading / Channel Stabilization	1,740	LF	$40	$69,600
12	Boulder Cascade Channel	175	LF	$175	$30,625
13	Topsoil and Seeding	5.6	AC	$3,500	$19,600
14	Construction Observation	1	LS	$75,206	$75,206
				Base Construction Cost	**$1,110,000**
				Survey, Design, Permitting, Construction Administration (25% of base cost)	**$277,500**
				Alt. 2 Total Construction Cost Estimate (+/- 30%)	**$1,387,500**
	ANNUALIZED OPERATION AND MAINTENANCE COSTS				
1	Mowing and Vegetation Trimming	1	LS	$26,000	$26,000
2	Two Year Stream Maintenance	1	LS	$7,500	$7,500
3	Periodic Dredging of Ponds / Dry Basins	1	EA	$5,000	$5,000
				Alt. 2 Total Annual O&M Cost Estimate	**$38,500**



Stantec

Legend

- Existing 1-ft Contours
- Proposed 1-ft Contours
- Existing Storm Pipe
- Flow Arrows
- New Embankment Crest (<6 ft)
- New Upstream Pond (4-ft depth)
- Riprap
- Inlet Channels
- Dry Basin
- Embankment
- Grass

N

0 100 200 Feet

(At original document size of 11x17)
1:1,500

Notes
1. Coordinate System: NAD 1983 StatePlane Ohio North FIPS 3401 Feet
2. Background: 2019 Aerial Photography, Hancock County Auditior GIS Data Downloads

Project Location
Monroe Township
Knox County, Ohio

Prepared by DMB on 2022-06-28
Review by NMM on 2022-06-28

Client/Project
173410617 REVA
Frost Brown Todd LLC
Mount Vernon Dam Study
Knox Cattle Company Dam

Figure No.
3
CONCEPT

Title
Alternative 3A

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Mt. Vernon Dam Study

Alternative 3A - Opinion of Probable Construction Cost (OPCC)

Modify Dam, Construct Permanent Pond, and Upstream Dry Basins

Item #	Description	Quantity	Unit	Unit Cost	Total Cost
	CONSTRUCTION COST ITEMS				
1	Mobilization / Demobilization	1	LS	$143,710	$143,710
2	Temporary Erosion & Sediment Control	1	LS	$25,000	$25,000
3	Temporary Diversion / Care of Water	1	LS	$15,000	$15,000
4	Clearing and Grubbing	3.0	AC	$5,000	$15,000
5	Dam Embankment Excavation, Grading of New Pool	41,050	CY	$22	$903,100
6	Concrete Riser Structure	1	LS	$35,000	$35,000
7	North Dry Basin	5,100	CY	$22	$112,200
8	North Dry Basin Outlet Structure	1	LS	$20,000	$20,000
9	South Dry Basin	8,300	CY	$22	$182,600
10	South Dry Basin Embankment and Outlet Structure	1	LS	$25,000	$25,000
11	Grading of Inlet Channels	500	LF	$35	$17,500
12	Replace Principal Spillway Pipe	175	LF	$75	$13,125
13	Rehabilitate Emergency Spillway Outlet Channel	1	LS	$10,000	$10,000
14	Regrade Downstream Receiving Channel	80	SY	$25	$2,000
15	Downstream Embankment ACB Protection	2,250	SF	$11	$23,625
16	Downstream Channel and Pond Riprap Protection	165	CY	$150	$24,750
17	Topsoil and Seeding	4.4	AC	$3,000	$13,200
18	Construction Observation	1	LS	$114,968	$114,968
				Base Construction Cost	**$1,696,000**
				Survey, Design, Permitting, Construction Administration (25% of base cost)	**$424,000**
				Alt. 3 Total Construction Cost Estimate (+/- 30%)	**$2,120,000**

Item #	Description	Quantity	Unit	Unit Cost	Total Cost
	ANNUALIZED OPERATION AND MAINTENANCE COSTS				
1	Periodic Dredging to Maintain Storage Capacity	1	EA	$2,500	$2,500
2	Annual Inspection and Monitoring	1	LS	$2,500	$2,500
3	Debris Removal	1	LS	$3,200	$3,200
4	Mowing and Vegetation Trimming	1	LS	$26,000	$26,000
				Alt. 3 Total Annual O&M Cost Estimate	**$34,200**

Stantec

Legend

- Existing 1-ft Contours
- Proposed 1-ft Contours
- Existing Storm Pipe
- Flow Arrows
- New Embankment Crest (<6 ft)
- Pilot Channel
- Grass
- Dry Storage Basin
- Water

N

0 110 220 Feet

(At original document size of 11x17)
1:1,500

Notes
1. Coordinate System: NAD 1983 StatePlane Ohio North FIPS 3401 Feet
2. Background: 2019 Aerial Photography, Hancock County Auditior GIS Data Downloads

Project Location
Monroe Township
Knox County, Ohio

Prepared by DMB on 2022-06-28
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Client/Project 173410617 REVA
Frost Brown Todd LLC
Mount Vernon Dam Study
Knox Cattle Company Dam

Figure No.
4

CONCEPT

Title
Alternative 3B

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Mt. Vernon Dam Study

Alternative 3B - Opinion of Probable Construction Cost (OPCC)

Modify Dam, Construct Dry Basin

Item #	Description	Quantity	Unit	Unit Cost	Total Cost
	CONSTRUCTION COST ITEMS				
1	Mobilization / Demobilization	1	LS	$109,135	$109,135
2	Temporary Erosion & Sediment Control	1	LS	$25,000	$25,000
3	Temporary Diversion / Care of Water	1	LS	$15,000	$15,000
4	Clearing and Grubbing	1.0	AC	$5,000	$5,000
5	Dam Embankment Excavation, Grading of New Dry Storage Basin	41,050	CY	$22	$903,100
6	Concrete Riser Structure	1	LS	$35,000	$35,000
7	Replace Principal Spillway Pipe	175	LF	$75	$13,125
8	Repair Concrete Headwall	1	LS	$15,000	$15,000
9	Grading of Inlet Channels	500	LF	$35	$17,500
10	Rehabilitate Emergency Spillway Outlet Channel	1	LS	$10,000	$10,000
11	Downstream Embankment ACB Protection	2,250	SF	$11	$23,625
12	Regrade Downstream Receiving Channel	80	SY	$25	$2,000
13	Downstream Channel Riprap Protection	80	CY	$150	$12,000
14	Topsoil and Seeding	5.0	AC	$3,000	$15,000
15	Construction Observation	1	LS	$87,308	$87,308
				Base Construction Cost	**$1,288,000**
				Survey, Design, Permitting, Construction Administration (25% of base cost)	**$322,000**
				Alt. 3 Total Construction Cost Estimate (+/- 30%)	**$1,610,000**
	ANNUALIZED OPERATION AND MAINTENANCE COSTS				
1	Periodic Dredging to Maintain Storage Capacity	1	EA	$4,000	$4,000
2	Annual Inspection and Monitoring	1	LS	$2,500	$2,500
3	Debris Removal	1	LS	$3,200	$3,200
4	Mowing and Vegetation Trimming	1	LS	$26,000	$26,000
				Alt. 3 Total Annual O&M Cost Estimate	**$35,700**