Stony Point Hydrology LLC

Technical Memorandum

Project:	Woodfield Dam Evaluation
Project No:	1704
Subject:	Evaluation Summary
Prepared for:	Ron Grall – Waukesha Parks, Recreation and Forestry Department
Prepared by:	Michael Schwar, PE - SPH
Date:	August 30, 2017

Background

Woodfield Park Dam is located approximately 600 feet north of the intersection of W. St. Paul Avenue and Harris Highland Drive (Figure 1) and is managed by the City of Waukesha Parks, Recreation and Forestry Department. The dam was constructed prior to 1950, before non-agricultural development occurred in its watershed, and is now owned by the City. The 2.1 acre pond behind the dam is designated as an urban fishing water and it is stocked annually by the Wisconsin Department of Natural Resources (DNR) with rainbow trout.

Over time portions of the dam have fallen into disrepair and upgrades are needed to meet current State dam safety requirements. The DNR has determined that the City must either bring the dam into compliance with current standards or remove the dam. In a memorandum dated July 13, 2015, Patrick Engineering provided an assessment of the improvements to the embankment, spillway and outlet structure that would be required to bring the facility up to current safety standards.

Figure 1. Woodfield Dam Site

In August 2017 the City of Waukesha contracted with Stony Point Hydrology (SPH) in order to develop additional information regarding both dam improvement and dam removal options in order to support the City's decision-making process with regard to the future of the dam. One important consideration is that bringing the dam up to current standards

and obtaining a State dam permit would not be sufficient to sustain the resource value to the City. Because of the sediment that has accrued within the dam's impoundment over time little deep water habitat remains and what is present is likely to decline in the future. Along with rehabilitating the dam, some degree of sediment removal would be necessary to rehabilitate and extend the life of the fishing resource. Alternatively, the impoundment provided by the dam could be removed and a free-flowing stream restored to the area, an option that would have the advantages of reducing both the maintenance responsibilities and the potential liabilities associated with dam ownership.

Site Conditions

Prior to conducting this study SPH staff participated in a site visit with Michelle Hase, WDNR. Ms. Hase noted that past work had removed trees and placed backfill material to strengthen the embankment. However, the berm is still subject to overtopping and the materials composing the dam are not known. The current outlet structure is undersized and in disrepair (Figure 2); in order to meet dam safety standards an engineered spillway capable of passing the 100-year flow must be provided. Also, the current outlet does not allow full drawdown of the pond and this would also be required to meet permit conditions. Upstream of the pond an inlet culvert was historically fitted with stoplogs in order to back water up into the area immediately north of the pond (Figure 3). Because the embankment in this area is not believed to have been engineered to hold back water the capability to retain stoplogs must be removed in order to comply with dam safety regulations. Over time sediment has filled in the area upstream of the pond as well as the northern end of the pond, reducing water depth and resulting in colonization by cattails and other wetland plants (Figure 4).

SPH used a GIS analysis with Waukesha County LIDAR data to estimate that 0.45 square miles of the City of Waukesha drains to the pond and the dam (Figure 5). Although a hydrologic study is necessary to determine a precise number, using USGS regression equations for urban streams in Wisconsin (Conger 1986) the 100-year flow from this area

Figure 2. Woodfield Dam Outlet Structure

Figure 3. Woodfield Dam Pond Inlet Structure

Figure 4. Sediment Plug in Woodfield Dam Pond

Figure 5. Watershed Draining to Woodfield Dam (Approximate)

is estimated to be on the order of 300-350 cfs. The improved outlet spillway would have to be designed to accommodate a flow of this magnitude or greater.

Alternatives

For this study, SPH developed two conceptual alternative approaches, one involving dam repairs and pond dredging and the other involving partial dam removal and stream restoration. For each alternative SPH developed a list of measures to be implemented, the required permitting and project development steps, a general timeline for implementation and potential additional funding sources. SPH developed planning-level costs based on approximate quantities and unit costs from similar projects. These should be considered to be sufficient to make general comparisons between alternatives but are subject to change as design further progresses or currently unknown site conditions are identified (such as the discovery of contamination within the sediment deposits).

Alternative 1 - Repair Dam and Dredge Pond

Dam Repairs

Based on the site visit and discussions with WDNR staff, the following items are needed to bring the dam up to State dam safety requirements and obtain a permit for this dam:

1. Characterize the makeup of the berm,
2. Increase spillway capacity to at least the 100-year flow and allow for safe conveyance of higher flows,
3. Provide of means to manage/draw down the impoundment,
4. Ensure the stability of the area immediately downstream of the existing outlet structure, and
5. Refit the upstream culvert to prevent management by stoplogs.

With the exception of Item 5, these were investigated and described in the Patrick Engineering memorandum. SPH reviewed the memorandum and found that it seems to adequately capture the items of work required.

Pond Dredging

The sediment deposited in the pond has apparently resulted in a generally shallow water depth with possibly a few deep holes. In order to increase the depth, thereby increasing

the habitat potential for game fish, a large quantity of sediment must be removed by dredging. There are two potentially feasible approaches to dredging:

- Hydraulic/suction dredging, and
- Drawdown and sediment removal by conventional construction equipment.

If the water level in the pond can be drawn down and the sediments allowed to consolidate it would generally be preferable to accomplish dredging by the second approach. Dredging project costs tend to be driven by three items:

- Removing sediment from the pond,
- Dewatering the sediment, and
- Transporting sediment to the final disposal site.

Hydraulic dredging tends to result in higher costs because of costs to operate the equipment and because the higher water content in the dredged materials increases the effort necessary for dewatering.

The dredging project assumed for this study is shown on Figure 6. The assumed dredge area covers approximately 1.1 acres of the pond, and for this alternative we assumed that three feet of sediment, on average, is removed from this area. This would amount to 7,000 cubic yards, or approximately 350 dump truck loads, of material to be removed. Dewatering the sediment prior to transport would likely reduce costs and Sites A and B in Figure 6 are potential locations for sediment dewatering. For purposes of this project we assumed that the dredged material would be dewatered on site and then loaded into trucks for local disposal by spreading on available open land.

Costs

The planning-level estimates of the project costs to repair the dam and perform dredging are $360,000 and $311,000, respectively (Table 1 and Table 2). Estimated costs to construct are based on approximate quantities of major construction items and unit costs developed from comparable projects. These should be appropriate for planning- or budgeting-level but are subject to change as more information becomes evident through

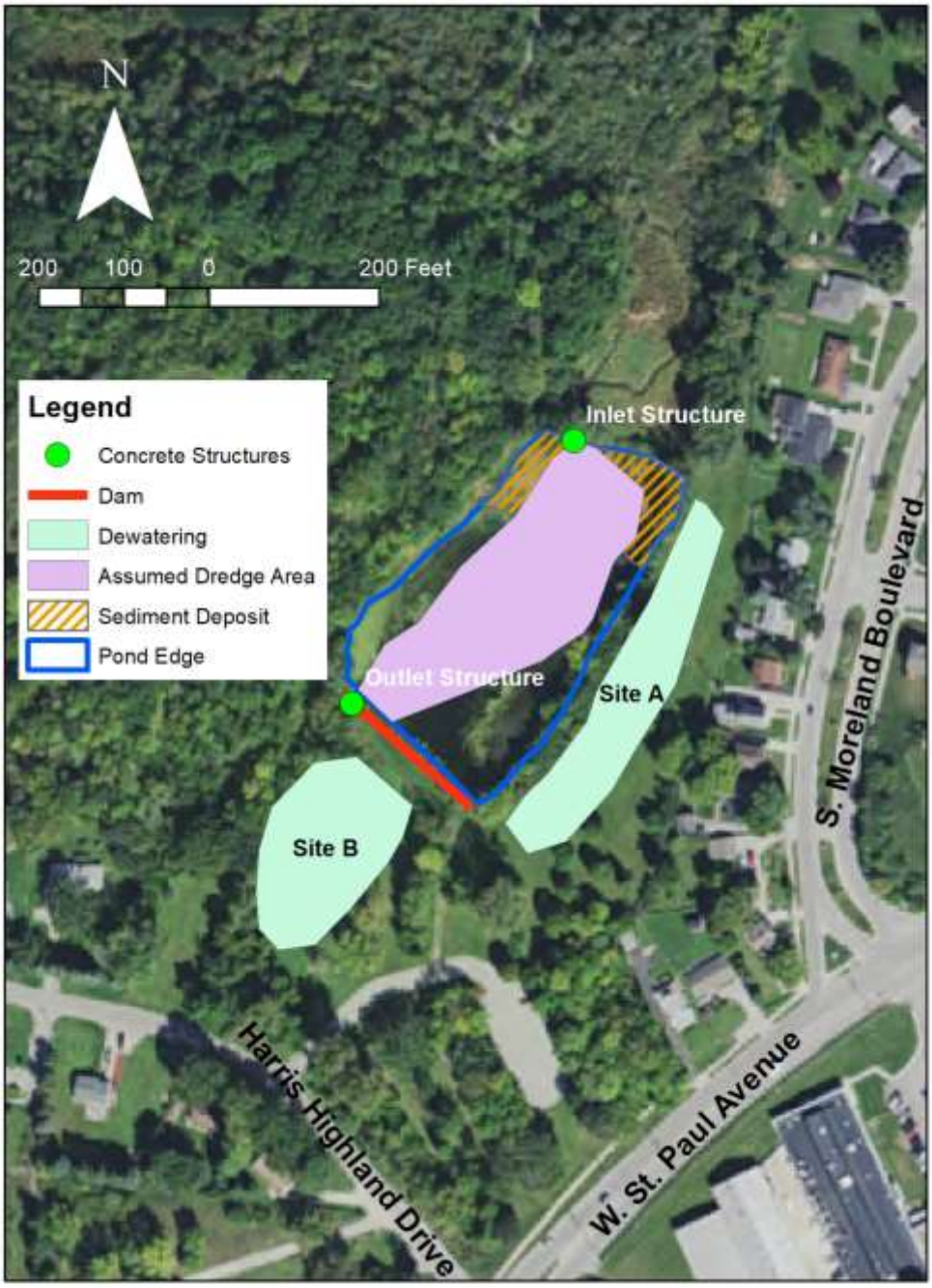

Figure 6. Alternative 1 - Repair Dam and Dredge Pond

Table 1. Planning-Level Cost Estimate to Repair Dam
(adapted from Patrick Engineering)

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Clearing	150	ID	$ 35.00	$5,250
2	Grubbing	150	ID	$ 35.00	$5,250
3	Removing Old Structure	1	LS	$ 3,500.00	$3,500
4	Excavation for Structures	1	LS	$ 5,000.00	$5,000
5	Coffer Dam	1	LS	$ 7,500.00	$7,500
6	Concrete Spillway Structure	22	LF	$ 650.00	$14,300
7	Inlet Control and Drawdown Structure	1	LS	$ 7,500.00	$7,500
8	Sheet Pile Cutoff and Anti-Seepage Walls	800	SF	$ 45.00	$36,000
9	Mobilization	1.0	LS	$ 25,000.00	$25,000
10	Restoration	1,500	SY	$ 7.00	$10,500
11	Water Diversion	1	LS	$ 5,000.00	$5,000
12	Survey	1	LS	$ 3,500.00	$3,500
13	Grading and Shaping	1	LS	$ 20,000.00	$20,000
14	Fill Type SM	1,700	CY	$ 40.00	$68,000
15	Riprap Heavy	20	CY	$ 70.00	$1,400
16	Refit Inlet Structure	1	LS	$ 1,000.00	$1,000
			Subtotal		$219,000
			Contingency (20%)		$44,000
			Total Construction =		$263,000
			Engineering Design -		$61,000
			Permitting		$10,000
			Construction Management -		$26,000
				Total -	**$360,000**

* - Source: Patrick Engineering memo dated July 13, 2015

the planning and design process. One of the key cost assumptions is that after drawdown the pond sediments will be stable enough to allow construction equipment access. If this is not the case, an alternate means of sediment removal may have to be considered. Also, we assume that the dredged sediment would be clean enough to allow spreading on available open land; if significant contamination is found special handling and disposal would be required, increasing costs.

Table 2. Planning-Level Cost Estimate to Remove Pond Sediments

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization (15% of total)	1	LS	$ 29,000.00	$29,000
2	Clearing and Grubbing	0.5	AC	$ 6,000.00	$3,000
3	Site Tracking Pad	1	LS	$ 1,000.00	$1,000
4	Perimeter Erosion Control	320	LF	$ 4.00	$1,280
5	Water Diversion	1	LS	$ 7,500.00	$7,500
6	Silt Curtain	400	LF	$ 12.00	$4,800
7	Construct Haul Road	450	SY	$ 15.00	$6,750
8	Construct Containment Area	1,000	CY	$ 6.00	$6,000
9	Excavation and Local Placement	7,000	CY	$ 5.00	$35,000
10	Haul off and Local Disposal	7,000	CY	$ 14.00	$98,000
11	Site Restoration - Seed and Mulch	3,200	SY	$ 1.00	$3,200
			Subtotal		$196,000
			Contingency (20%)		$40,000
			Total Construction =		$236,000
			Engineering Design -		$45,000
			Permitting		$10,000
			Construction Management -		$20,000
				Total -	**$311,000**

Permits

Table 3 is a list of permits likely to be required to implement Alternative 1; additional permit requirements may be identified over the course of design.

Potential Funding

If funded in the next State budget, the Muncipal Dam Grant Program is a potential source of funding for matching funds for dam repair or modification. In the 2015-17 biennial budget these funds could match up to 50% of the cost of repairs up to $400,000 and 25% of the cost of the next $800,000. Grants would be awarded competitively based on a point system including hazard rating, past maintenance efforts and community financial need. As a low hazard dam this project would likely score lower than some other potential projects throughout the state. Dredging projects are not eligible for most grants and are usually 100% funded by the owner.

Table 3. Permits Required for Alternative 1.

Agency	Permit	Notes
U.S. Army Corps of Engineers	Sections 10 and 404	Activities may be covered by Nationwide Permits 13, 27 and/or 53
Wisconsin DNR	Chapter 30	Impoundment Dredging Bridge Permit (work at inlet structure)
	Chapter 31	Dam Modification
	NR 216 NOI	If disturbed area above ordinary high water (including sediment dewatering and disposal) is greater than one acre.
City of Waukesha	Erosion Control/ Storm Water	
	Shoreland	Pond is presumed to be a navigable waterway

Alternative 2 – Remove Dam and Restore Creek

Dam Removal

Dam removal would consist of removing the existing concrete outlet structure and enough of the embankment to allow the 100-year flow to safely pass without overtopping the rest of the embankment. Also, the removal would incorporate a transition from the impoundment outlet to the downstream creek. This study assumes that removing up to four feet along 36 linear feet of the embankment (Figure 7) would be sufficient to allow the 100-year flow to pass and that two 1.5-foot high rock weirs (Figure 8) would form the transition at the outlet. Turf reinforcement matting would be installed on a portion of the excavated area to provide protection against scouring.

Stream Restoration

Concurrent with removal of the dam, some degree of stabilization of the pond sediments would likely be required to encourage the development of a stream course and to prevent large-scale movement of the pond sediments downstream. Figure 9 demonstrates the

Figure 7. Alternative 2 - Remove Dam and Restore Creek

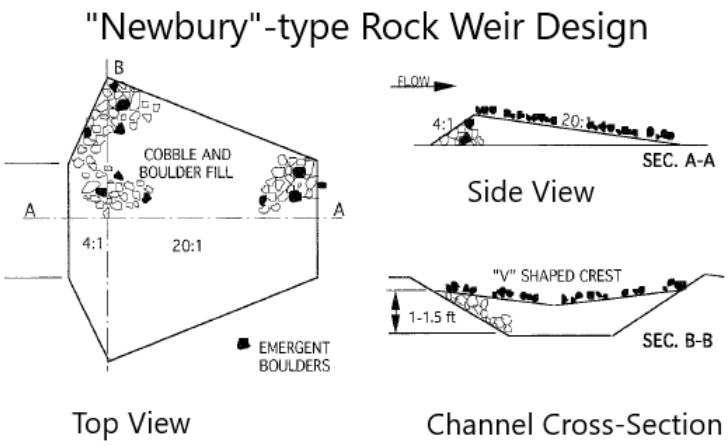

Figure 8. Rock Weir Design (Adapted from Newbury and Gaboury 1993).

Figure 9. Construction and Post-Construction Photos of Bank Stabilization in Former Impoundment of Bruemmerville Dam, Algoma WI
(Courtesy of Cardno Inc. and Kewaunee County)

measures taken and the results of bank stabilization in the former impoundment of a removed dam in Kewaunee County. The assumed measures for this alternative are similar to those shown in Figure 9: placement of rock along the edge of the restored stream bottom grading of overbank areas, placement of erosion control fabric extending 10 feet on each side of the stream centerline, and construction of three 1-foot high rock weirs (Figure 8) to prevent channel downcutting.

If deep "holes" can be identified from bathymetric survey of the pond, these areas may be incorporated into the stream design to allow additional pockets of fish habitat. Fish habitat can also be augmented by structures that create scour holes or overhanging cover into the restoration design. Access to fishing along the creek can be provided by leaving the haul road in place and using it for pedestrian access.

Costs

The planning-level estimate of the project costs to partially remove the dam embankment and restore the creek channel is $158,000 (Table 4). As discussed previously, these should be appropriate for planning- or budgeting-level but are subject to change as more information becomes evident through the planning and design process. One of the key cost assumptions is that once dewatered the pond sediments will allow construction equipment access. If this is not the case, the cost of stream restoration will likely increase.

Permits

Table 5 is a list of permits likely to be required to implement Alternative 2; additional permit requirements may be identified over the course of design.

Potential Funding

The City has access to a $50,000 grant from the State to apply to the costs of dam removal and some restoration. This grant does not require matching funds from the City.

In the past the Southeastern Wisconsin Fox River Commission has provided cost-share for some dam removal projects that were shown to directly benefit the Fox River. As a tributary to the Fox River, this project would be eligible for consideration.

Table 4. Planning-Level Cost Estimate to Remove the Dam and Restore the Creek Channel.

Probable Costs					
Remove Dam and Restore Stream					
ITEM NO.	**ITEM DESCRIPTION**	**ESTIMATED QUANTITY**	**UNIT**	**UNIT PRICE**	**TOTAL**
1	Mobilization (10% of total)	1	LS	$ 7,700.00	$7,700
2	Clearing and Grubbing	0.5	AC	$ 6,000.00	$3,000
3	Site Tracking Pad	1	LS	$ 1,500.00	$1,500
4	Erosion Control	200	LF	$ 4.00	$800
5	Water Diversion	1	LS	$ 10,000.00	$10,000
6	Construct Haul Road	450	SY	$ 15.00	$6,750
7	Remove Concrete Structure	1	LS	$ 3,500.00	$3,500
8	Excavate Berm, Dispose on Site	70	CY	$ 5.00	$350
9	Excavation for Rock Structures	200	CY	$ 6.00	$1,200
10	River Rock for Structures	330	TON	$ 40.00	$13,200
11	Install Turf Reinforcement Mat	70	SY	$ 20.00	$1,400
12	Medium Riprap Along Channel Toe	150	TON	$ 45.00	$6,750
13	Regrade Floodplain	2,250	CY	$ 4.00	$9,000
14	Erosion Control Mat - Class I Type B	1,250	SY	$ 4.00	$5,000
15	Vegetate Floodplain	0.5	AC	$ 10,000.00	$5,000
16	Refit Inlet Structure	1	LS	$ 1,000.00	$1,000
17	Site Restoration - Seed and Mulch	150	SY	$ 1.00	$150
			Subtotal		$77,000
			Contingency (20%)		$16,000
			Total Construction =		$93,000
			Engineering Design -		$35,000
			Permitting		$10,000
			Construction Management -		$20,000
				Total -	**$158,000**

Also, if funded in the next State budget, the Muncipal Dam Grant Program is a potential source of funding for matching funds for dam removal. In the 2015-17 biennial budget these funds could match up to 100% of the cost of removal up to $400,000. As described above, grants would be awarded competitively based on a point system including hazard rating and community financial need.

Table 5. Permits Required for Alternative 2.

Agency	Permit	Notes
U.S. Army Corps of Engineers	Sections 10 and 404	Activities may be covered by Nationwide Permits 13, 27 and/or 53
Wisconsin DNR	Chapter 30	Waterway Permit Bridge Permit (work at inlet structure)
	Chapter 31	Dam Abandonment and Removal
City of Waukesha	Erosion Control/ Storm Water	
	Shoreland	Pond is presumed to be a navigable waterway

Comparison of Alternatives

Alternative 2, dam removal and stream restoration, would be less costly and have more opportunities for grant funding than would Alternative 1, dam repair and dredging. However, the restored stream would generally be shallow (less than one foot deep) and have only limited deeper areas. Because of this, it is likely to have a lower capacity to support the fish stocking that would be possible in the restored pond.

In terms of schedule, it can be expected that construction of dam repairs could commence about 12 months after the start of the project, and that dredging would occur 12 months after the start of the design of that project (Figure 10), probably in the winter for better ground conditions.

Table 6. Comparison of Woodfield Dam Alternative Benefits

Benefits	Alt. 1	Alt 2.	Notes
Construction Cost		✓	Removal and restoration would cost approximately ¼ as much as repair and dredging
Ongoing Costs		✓	Keeping dam would require ongoing maintenance, operation of outlet structure and annual inspections
Access	✓		Path can be constructed along restored stream but removal of outlet structure would limit access to the west from parking lot
Fishing	✓		Restored stream unlikely to support level of fishing expected from stocked pond
Funding Opportunities		✓	May not receive competitive grant for matching repair funds, larger match for removal and restoration
Liability		✓	Small but nonzero risk to safety from release of impounded water from dam failure

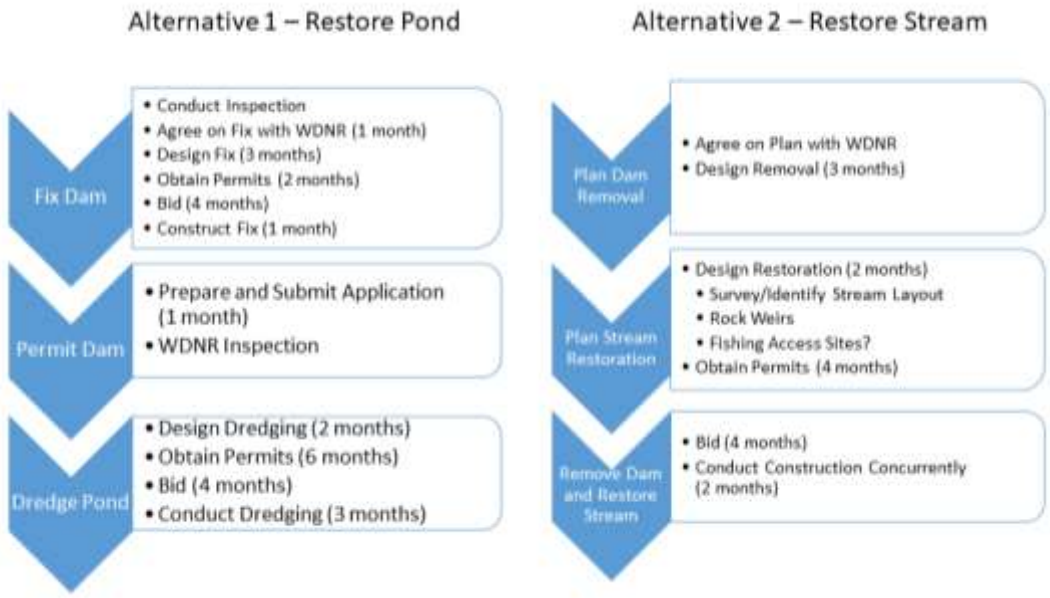

Figure 10. Process and Approximate Timelines for Each Alternative

Summary

The WDNR has informed the City of Waukesha that the Woodfield Dam must either be repaired and brought up to current standards. Since the purpose of the dam is to create a pond for fishing, and that pond has been significantly filled by sediment, in addition to the dam repairs dredging would have to be undertaken to restore the fishing function of the pond. The cost to accomplish this is estimated to be $671,000. Should the City decide to remove the dam and restore the stream, project costs are estimated to be $158,000. This restored stream would be capable of supporting natural biological communities to some degree, but the ability to support recreational fishing would likely be less than that of the restored pond.

Attachments:

Patrick Engineering Study
Chapter NR 335 – Municipal Dam Grant Program