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February 28, 2012

Ohio EPA
Division of Surface Water
Attn: Tom Harcarik
50 West Town Street, Suite 700
P.O. Box 1049
Columbus, Ohio 43216-1049

Subject: Lake Milton Hydropower Project (FERC# P-13953)
Application for Ohio EPA Section 401 Water Quality Certification
U.S. Army Corps of Engineers ID 2009-2067

Dear Mr. Harcarik:

ATC Associates Inc. (ATC) acting on behalf of Mahoning Hydropower, LLC (a.k.a. Hydro Energy Technologies, LLC) is submitting the enclosed Application for Ohio EPA Section 401 Water Quality Certification (WQC). A Provisional Nationwide Permit 17 from the U.S. Army Corps of Engineers (USACE) was issued on June 7, 2010 and is included in the enclosed WQC application.

Should you have any questions, please contact David Sedlick at (614) 367-7840.

Sincerely,

ATC Associates Inc.

David J. Sedlick
Project Manager

Attachments

cc: Mr. Ed Wilk & Mr. Greg Orr, Ohio EPA (Email)
Ms. Nancy Mullen & Mr. Tyler Bintrim, USACE-Pittsburgh District (Email)
Mr. Anthony Marra, III, Mahoning Hydropower, LLC

APPLICATION FOR OHIO EPA
SECTION 401 WATER QUALITY CERTIFICATION

Effective October 1, 1996
Revised August, 1998

This application must be completed whenever a proposed activity requires an individual Clean Water Act Section 401 Water Quality Certification (Section 401 certification) from Ohio EPA. A Section 401 certification from the State is required to obtain a federal Clean Water Act Section 404 permit from the U.S. Army Corps Engineers, or any other federal permits or licenses for projects that will result in a discharge of dredged or fill material to any waters of the State. To determine whether you need to submit this application to Ohio EPA, contact the U.S. Army Corps of Engineers District Office with jurisdiction over your project, or other federal agencies reviewing your application for a federal permit to discharge dredged or fill material to waters of the State, or an Ohio EPA Section 401 Coordinator at (614) 644-2001.

The Ohio EPA Section 401 Water Quality Certification Program is authorized by Section 401 of the Clean Water Act (33 U.S.C. 1251) and the Ohio Revised Code Section 6111.03(P). Ohio Administrative Code (OAC) Chapter 3745-32 outlines the application process and criteria for decision by the Director of Ohio EPA. In order for Ohio EPA to issue a Section 401 certification, the project must comply with Ohio's Water Quality Standards (OAC 3745-1) and not potentially result in an adverse long-term or short-term impact on water quality. Included in the Water Quality Standards is the Antidegradation Rule (OAC Rule 3745-1-05), effective October 1, 1996, revised October, 1997 and May, 1998. The Rule includes additional application requirements and public participation procedures. **Because there is a lowering of water quality associated with every project being reviewed for Section 401 certification, every Section 401 certification applicant must provide the information required in Part 10 (pages 3 and 4) of this application.** In addition, applications for projects that will result in discharges of dredged or fill material to wetlands must include a wetland delineation report approved by the Corps of Engineers, a wetland assessment with a proposed assignment of wetland category (ies), official documentation on evaluation of the wetland for threatened or endangered species, and appropriate avoidance, minimization, and mitigation as prescribed in OAC 3745-1-50 to 3745-1-54. Ohio EPA will evaluate the applicant's proposed wetland category assignment and make the final assignment.

Information provided with the application will be used to evaluate the project for certification and is a matter of public record. If the Director determines that the application lacks information necessary to determine whether the applicant has demonstrated the criteria set forth in OAC Rule 3745-32-05(A) and OAC Chapter 3745-1, Ohio EPA will inform the applicant in writing of the additional information that must be submitted. The application will not be accepted until the application is considered complete by the Section 401 Coordinator. An Ohio EPA Section 401 Coordinator will inform you in writing when your application is determined to be complete.

Please submit the following to "Section 401 Supervisor, Ohio EPA/DSW, P.O. Box 1049, Columbus, Ohio 43216-1049:

- Four (4) sets of the completed application form, including the location of the project (preferably on a USGS quadrangle) and 8-1/2 x 11" scaled plan drawings and sections.
- One (1) set of original scaled plan drawings and cross-sections (or good reproducible copies).

(See Application Primer for detailed instructions)

1. The federal permitting agency has determined this project: (check appropriate box and fill in blanks)

   a.____ requires an individual 404 permit/401 certification- Public Notice # (if known)_____

   b._X_ requires a Section 401 certification to be authorized by Nationwide Permit #17

   c.____ requires a modified 404 permit/401 certification for original Public Notice #_____

   d.____ requires a federal permit under _____ jurisdiction identified by #_____

   e.____ requires a modified federal permit under_____ jurisdiction identified by #_____

Click to clear all entered information (on all 4 pages of this form) CLEAR

2. Application number (to be assigned by Ohio EPA):

3. Name and address of applicant:
Anthony Marra
Mahoning Hydropower, LLC
11365 Normandy Lane
Chagrin Falls, Ohio 44023

Telephone number during business hours:
(216) 361-9977 (Residence)
(440) 804-6627 (Office)

3a. Signature of Applicant: Date:

4. Name, address and title of authorized agent:
David Sedlick
ATC Associates Inc.
950 Taylor Station Road, Suite V
Gahanna, Ohio 43230

Telephone number during business hours:
(614) 226-6796 (Residence)
(614) 367-7840 (Office)

4a. Statement of Authorization: I hereby designate and authorize the above-named agent to act in my behalf in the processing of this permit application, and to furnish, upon request, supplemental information in support of the application.

Signature of Applicant: Date:

5. Location on land where activity exists or is proposed. Indicate coordinates of a fixed reference point at the impact site (if known) and the coordinate system and datum used.

Address:

2541 Grandview Road, Lake Milton, Ohio 44429 - (at the base of the Lake Milton Dam -Lat N 41.1272 Long W 80.9776)
Street, Road, Route, and Coordinates, or other descriptive location

Mahoning River	Mahoning	Milton	N/A	Ohio	44429
Watershed	County	Township	City	State	Zip Code

6. Is any portion of the activity for which authorization is sought complete? _____ Yes __X__ No
If answer is "yes," give reasons, month and year activity was completed. Indicate the existing work on the drawings.

7. List all approvals or certifications and denials received from other federal, interstate, state or local agencies for any structures, construction, discharge or other activities described in this application.

Issuing Agency	Type of Approval	Identification No.	Date of Application	Date of Approval	Date of Denial
USACE	Prov NWP-17	N/A	March 16, 2011	June 7, 2010	N/A

8. DESCRIPTION OF THE ACTIVITY (fill in information in the following four blocks - 8a, 8b, 8c & 9)

8a. Activity: Describe the Overall Activity:
The applicant proposes to construct a 25' x 37' hydroelectric powerhouse over the existing concrete stilling basin/outletworks at the base of the Lake Milton Dam (minimal degradation alternative). The powerhouse will contain one 650 KW Kaplan Turbine. A new 15.5' trashrack will be installed over the existing rack.

8b. Purpose: Describe the purpose, need and intended use of the activity:

The purpose of the project is to convert existing unused water energy at the Lake Milton Dam into renewable energy to supply the local grid.

8c. Discharge of dredged or fill material: Describe type, quantity of dredged material (in cubic yards), and quantity of fill material (in cubic yards). **(OAC 3745-1-05(B)(2)(a))**

No dredging is proposed, an estimated 150 cubic feet of class C concrete fill will be placed below the OHWM to construct the project.

9. Waterbody and location of waterbody or upland where activity exists or is proposed, or location in relation to a stream, lake, wetland, wellhead or water intake (if known). Indicate the distance to, and the name of any receiving stream, if appropriate.

The project will be located at base of the Lake Milton Dam along the Mahoning River within the existing stilling basin.

10. To address the requirements of the Antidegradation Rule, your application must include a report evaluating the:

- Preferred Design (your project) and Mitigative Techniques
- Minimal Degradation Alternative(s) (scaled-down version(s) of your project) and Mitigative Techniques
- Non-Degradation Alternative(s) (project resulting in avoidance of all waters of the state)

At a minimum, item a) below must be completed for the Preferred Design, the Minimal Degradation Alternative(s), and the Non-Degradation Alternative(s), followed by completion of item b) for each alternative, and so on, until all items have been discussed for each alternative (see Primer for specific instructions). (Application and review requirements appear at **OAC 3745-1-05(B)(2), OAC 3745-1-05(C)(6), OAC 3745-1-05(C)(1) and OAC 3745-1-54)**.

10a) Provide a detailed description of any construction work, fill or other structures to occur or to be placed in or near the surface water. Identify all substances to be discharged, including the cubic yardage of dredged or fill material to be discharged to the surface water. **(OAC 3745-1-05(B)(2)(b))**

10b) Describe the magnitude of the proposed lowering of water quality. Include the anticipated impact of the proposed lowering of water quality on aquatic life and wildlife, including threatened and endangered species (include written comments from Ohio Department of Natural Resources and U.S. Fish and Wildlife Service), important commercial or recreational sport fish species, other individual species, and the overall aquatic community structure and function. Include a Corps of Engineers approved wetland delineation. **(OAC 3745-1-05(C)(6)(a, b) and OAC 3745-1-54)**

10c) Include a discussion of the technical feasibility, cost effectiveness, and availability. In addition, the reliability of each alternative shall be addressed (including potential recurring operational and maintenance difficulties that could lead to increased surface water degradation.) **(OAC 3745-1-05(C)(6)(h, j-k) and OAC 3745-1-54)**

10d) For regional sewage collection and treatment facilities, include a discussion of the technical feasibility, cost effectiveness and availability, and long-range plans outlined in state or local water quality management planning documents and applicable facility planning documents. **(OAC 3745-1-05(C)(6)(i))**

10e) To the extent that information is available, list and describe any government and/or privately sponsored conservation projects that exist or may have been formed to specifically target improvement of water quality or enhancement of recreational opportunities on the affected water resource. **(OAC 3745-1-05(B)(2)(g))**

10f) Provide an outline of the costs of water pollution controls associated with the proposed activity. This may include the cost of best management practices to be used during construction and operation of the project. **(OAC 3745-01-05(C)(6)(g))**

10g) Describe any impacts on human health and the overall quality and value of the water resource. **(OAC 3745-1-05(C)(6)(c) and OAC 3745-1-54)**

10h) Describe and provide an estimate of the important social and economic benefits to be realized through this project. Include the number and types of jobs created and tax revenues generated and a brief discussion on the condition of the local economy. **(OAC 3745-1-5(B)(2)(e), and OAC 3745-1-05(C)(6)(i))**

10i) Describe and provide an estimate of the important social and economic benefits that may be lost as a result of this project. Include the effect on commercial and recreational use of the water resource, including effects of lower water quality on recreation, tourism, aesthetics, or other use and enjoyment by humans. **(OAC 3745-1-05(B)(2)(e,f), and OAC 3745-1-05(C)(6)(e))**

10j) Describe environmental benefits, including water quality, lost and gained as a result of this project. Include the effects on the aquatic life, wildlife, threatened or endangered species. **(OAC 3745-1-05 (B)(2)(e,f), OAC 3745-1-05 (C)(6)(b) and OAC 3745-1-54)**

10k) Describe mitigation techniques proposed (except for the Non-Degradation Alternative):

- Describe proposed Wetland Mitigation (see **OAC 3745-1-54** and Primer)
- Describe proposed Stream, Lake, Pond Mitigation (see Primer)

11. Application is hereby made for a Section 401 Water Quality Certification. I certify that I am familiar with the information contained in this application and, to the best of my knowledge and belief, such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities or I am acting as the duly authorized agent of the applicant.

Signature of Applicant	Date	Signature of Agent
	2/28/12	

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in Block 3 has been filled out and signed.

401\401appl.898

FERC Project No. 13953
Lake Milton Hydroelectric Project
Mahoning Hydropower, LLC

10) ALTERNATIVES ANALYSIS FOR THE LAKE MILTON HYDROELECTRIC PROJECT (FERC # 13953)

By:

Mahoning Hydropower, LLC

11365 Normandy Lane,
Chagrin Falls, Ohio 44023
phone: 440-804-6627 fax: 216-361-9981

February 28, 2012

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ALTERNATIVES ANALYSIS

LAKE MILTON HYDROELECTRIC PROJECT (FERC #13953)

10a) DETAILED PROJECT DESCRIPTION

Preferred Alternative

The preferred alternative (PA) is not the alterative that we are currently proposing. It is an "ideal" version of the Minimal Degradation Alterative (MDA) which is actually the alternative we are pursuing.

The Preferred Alternative (PA) would be constructed on the downstream side of the Lake Milton Dam over the existing outlet works. The dam is owned by ODNR and operated by the Lake Milton State Park under the supervision of the Pittsburgh District of the US Army Corps of Engineers (USACE). Dam releases are determined by the USACE.

The preferred alternative (PA) design uses the existing intake and connects a 650 KW Horizontal Kaplan Turbine to the exisiting 60" outlet pipe on gate 2 below the dam. The proposed powerhouse would be constructed over the existing discharge location where the turbine and generator will be housed (Figure 1 & Figure 2). The PA also includes an additional concrete turbine foundation at gate 3 to provide the infrastructure for a second turbine. To clarify, the PA does not include a second turbine, only the foundation for a second turbine. This alternative would place approximately 300 cubic yards of class C concrete below the OHWM within the existing concrete stilling basin. Concrete shall be ordered from the local concrete supplier (i.e. R.W. Sidley). No dredging or material removal is proposed from any wetland or from any area below the OHWM. Details of the construction of the PA are outlined below and are further illustrated in Figure 1 and Figure 2:

1) Construct 280 ft Gravel Access Road (requires some excavation to create more gradual slope but this work is above the OHWM).
2) Install temporary bulkhead/sheeting and dewater existing stilling basin.
3) Construct turbine inlet, powerhouse/turbine foundation/s, and draft tube within the existing concrete stilling basin at gates 2 and 3. Total estimated permanent fill is approximately 300 cubic yards of concrete.
4) Construct the powerhouse (approximately 37' x 37') using steel I-beams and concrete block.
5) Using a crane, lower new pre-fabricated trashrack over existing trashrack.
6) Install Turbine/generator, switchgear, and other controls located in the powerhouse.
7) Construct a new underground 600 VAC transmission line approximately 320 feet

long to a new transformer installed next to the eexisting distribution pole.

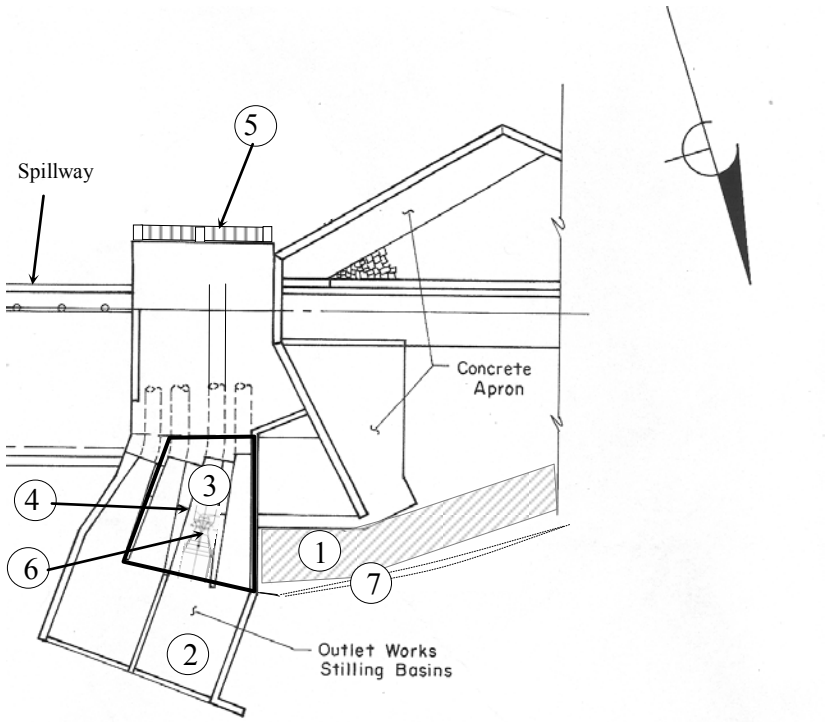


Figure 1 – Project Plan of Construction Activities for PA

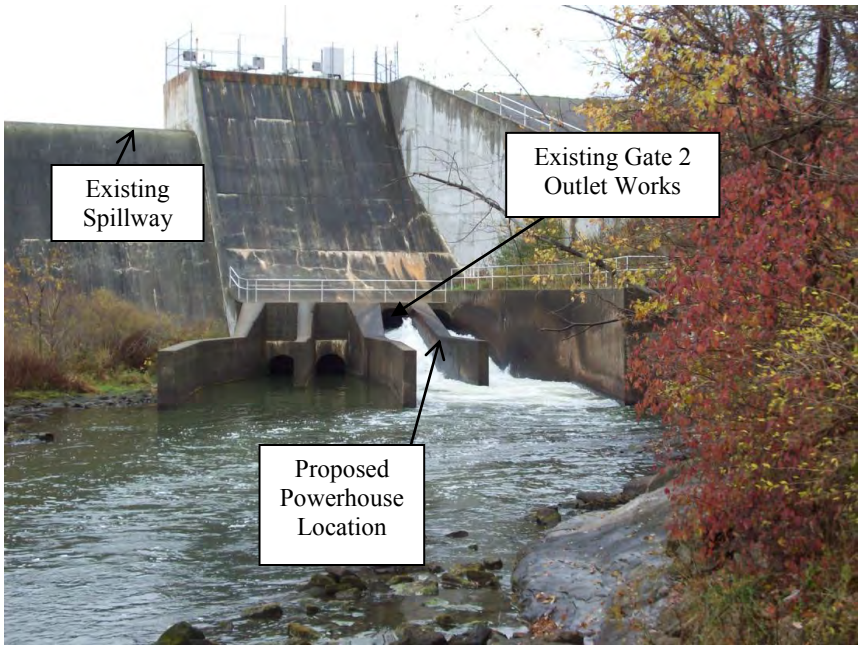


Figure 2- Photo of existing dam and outlet works

For the PA, operation of the proposed hydroelectric facility is "run of the river" meaning no alteration in the existing flow regime is proposed. The turbine will have a hydraulic capacity of 250 cubic feet per second (cfs) and 100% of the flow (as determined by the USACE) will flow through the turbine up to the capacity of 250 cfs. Any flows exceeding 250 cfs will be discharged through one or more of the other 3 gates.

Minimal Degradation Alternative

The Minimal Degradation Alternative (MDA) would also be constructed on the downstream side of the Lake Milton Dam over the existing outlet works. It uses the existing intake and connects a 650 KW Horizontal Kaplan Turbine to the exisiting 60" outlet pipe on gate 2 below the dam. No additional turbine foundation would be constructed with this alternative. The proposed powerhouse would be constructed over the existing discharge location where the turbine and generator will be housed (Figure 1& Figure 2). This alternative would place approximately 150 cubic yards of class C concrete below the OHWM within the existing concrete stilling basin. Concrete shall be ordered from the local concrete supplier (i.e. R.W. Sidley). No dredging or material removal is proposed from any wetland or below the OHWM. Details of the construction of the MDA are outlined below and are further illustrated in Figure 3:

1) Construct 280 ft Gravel Access Road (requires some excavation to create more gradual slope but this work is above the OHWM).
2) Install temporary bulkhead/sheeting and dewater northwest side of existing stilling basin.
3) Construct turbine inlet, powerhouse/turbine foundation, and draft tube within the existing concrete stilling basin at gate. Total estimated permanent fill is approximately 150 cubic yards of concrete.

4) Construct the powerhouse (approximately 25' x 37') using steel I-beams and concrete block.
5) Using a crane, lower new pre-fabricated trashrack over existing trashrack.
6) Install Turbine/generator, switchgear, and other controls located in the powerhouse.
7) Construct a new underground 600 VAC transmission line approximately 320 feet long to a new transformer installed next to the eexisting distribution pole.

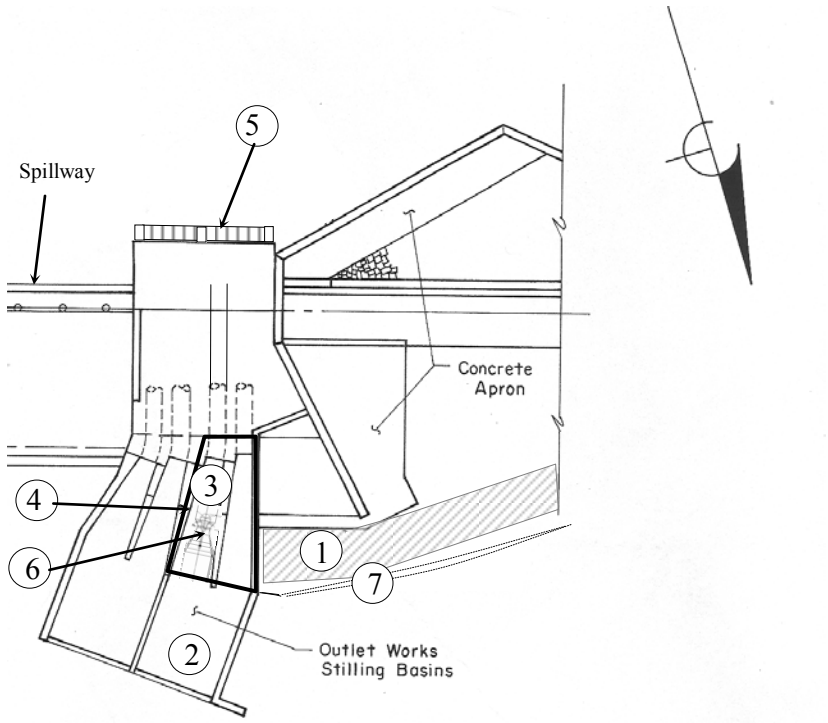


Figure 3 – Project Plan of Construction Activities for MDA

Operationally the MDA is the same as the PA.

Non-Degradation Alternative

Since the proposed project is based on recovering power from the gravity flow of water and producing renewable energy without fossil fuels it is not possible to construct the facility somewhere other than in the river. The project is water and gravity dependent and therefore the Non-Degradation Alternative (NDA) is "No build". Impacts of the NDA for each question would be the same as the existing condition.

10b) BIOLOGICAL AND PHYSICAL IMPACTS

Preferred Alternative

No significant animal habitat or vegetation is likely to be adversely impacted by construction of the proposed hydroelectric plant. The facility will be constructed entirely within the existing manmade concrete stilling basin at the base of the dam. The access road and new transmission line will require some excavation, however, this work is above the OHWM in a previously disturbed area.

Impacts to Animals

Aquatic Species: No threatened or endangered aquatic species were identified by ODNR or USFWS in the project vicinity. In terms of sport fish, Phil Hillman of the ODNR Division of Wildlife expressed concern regarding the impact of the project on fish species (most specifically the Walleye and Muskellunge populations). Other agencies including the US Army Corps of Engineers and US Fish and Wildlife have requested "adequate documentation that fish mortality will be kept to a minimum."

Using desktop and field study methods, Hydro Energy Technologies, LLC (2009) conducted a fish study (Appendix B) to determine impacts of the proposed project on fish species. The study showed that the PA would have the following affects:

> *Qualitatively, with consideration to the proposed characteristics of the Lake Milton Project, the existing fisheries resources, and the abundance of reference information available, fish passage and fish losses due to entrainment and impingement mortality are likely to be low and comparable to the existing conditions. There are several key points of information that support this conclusion.*
>
> - *The proposed project will utilize 1 inch trash racks compared to the 5.3" to 22.5" spacing at the existing trashrack. This change substantially limits the size of fish susceptible to entrainment and represents an element of entrainment protection relative to the current condition (possibility of decompression trauma, exposure to illegal fishing activity below the dam, etc.).*
> - *In general only fish < 8" TL would be susceptible to entrainment. For many species this would represent juveniles or even YOY as compared to adults which would be part of the reproductive cohort. Even moderate to high losses of young fish are not likely to affect most fisheries (Kleinschmidt Associates, 2010).*
> - *Turbine mortality rates for entrained fish would likely be due to blade strike probability associated with the turbines. However, some entrained fish would likely perish due to decompression trauma. While losses due to decompression are not quantifiable they could be substantial. The proposed project would reduce flows through the lower gates reducing risk of decompression trauma.*

- *An excellent recreational fishery for several species exists at Lake Milton as well as below the dam. Because over 90% of fish passage will be maintained, the downstream fishery would be maintained similar to the existing conditions. The fishery above the dam will be improved as larger individuals will have less opportunity to pass through the dam.*

- *Having a hydro operator present below the dam on an almost daily basis would increase monitoring of illegal fishing activity below the dam. (MH) employees will watch for and aggressively report illegal fishing activities. Additionally (MH) is willing to post Ohio fishing laws on the powerhouse visible from the fishing decks. The possibility exists that this additional monitoring will offset impacts of any walleye killed by the turbine. Additionally compensation for the estimated 42 walleye killed by the turbine will be paid by (MH) while poachers often get away scott free.*

- *Walleye fishing would not be significantly affected downstream and would improve in terms of more large individuals remaining upstream of the dam. The most popular time for anglers who fish walleye below the dam is spring. Since spring is spawning season for walleye and walleye that inhabit reservoirs will typically migrate up rivers to spawn (Scott and Crossman 1973), fisherman who make the assumption that the larger mature walleye they are catching are passing through the dam during the spring is erroneous. The reason for their success is because the walleye are generally coming from down stream and congregate at the tailwaters of the dam because they can't go any further. This trend should continue and walleye up to 8" will continue to pass freely through the dam at all times to maintain the fishery downstream. Larger individuals will have opportunities to pass through gates 3 and 4 from November to April 40% of the time. Fishing at the tailwaters of the Berlin Dam will also improve as increased large individuals will make their way upstream in the spring. Due to the fast swim speeds documented for walleye, impingement is not likely to occur. This is supported by the fact that no walleye were impinged during the field study.*

- *The Muskellunge population would not be significantly affected. The size of the fish when they are initially stocked (8"- 12") generally excludes them from entrainment through or impingement on the new rack. Evidence was presented that with the current condition, Muskellunge rarely pass through the dam (ODNR, 2010). If significant passage does occur, the new rack would protect them from the current condition and will improve Muskie*

fishing above the dam as more large individuals would be kept in the Lake. These results were supported by the field study as no muskie were impinged during the impingement field study.

- *Total fish passage will not be significantly restricted. An estimated 90% of current successful fish passage will continue during Hydro Operation. Some restriction of fish passage for fish 8 inches in length or longer will occur. However, passage for larger fish will be available 40% of the time through gates 3 and 4 from November to April.*

- *(MH) would pay approximately $931.59 per year to ODNR in compensation for fish loss due to entrainment in the turbine for the estimated 1320 fish killed by the turbine annually (approximately .78 fish/acre). An additional 28.8 fish (mostly likely slower swimming species like blue gill or sunfish 5 to 8 inches) will be impinged annually costing an additional $29 in compensation per year.*

The methodologies and rates presented in this report for estimating annual fish entrainment and impingement at the Lake Milton Project were more stringent than approaches used in other hydro licensing/relicensing efforts of plants using one inch bar spacing. The Jennings Randolf Project desktop entrainment study, which also used the EPRI database for its source studies and proposes 1" bar spacing, shows an estimated annual mean entrainment of 0.19 fish/mcf (Kleinschmidt Associates, 2010). In comparison the entrainment rate used in this study is 8 times higher at 1.55 fish/mcf estimated entrainment. The Jennings study also did not include a field impingement test. As the results of this study are quite inflated compared to other impingement entrainment studies the information in this report should be used with confidence as a "worst case scenario" in the final assessment of the impacts of the Lake Milton Project on fish species.

After conducting a review of the study ONDR Division of Wildlife submitted the following response in an email dated May 14, 2010:

> Anthony:
>
> Phil has reviewed the Lake Milton fish study report and is satisfied with the results. You can suspend any further studies.
>
> John Navarro
> Program Administrator
> ODNR Division of Wildlife
> 2045 Morse Rd, G-3
> Columbus, Ohio 43229
> 614-265-6346 (Phone)
> 614-262-1143 (Fax)
> john.navarro@dnr.state.oh.us

Bald Eagle: According the ONDR and USFWS the project is within the range of the bald eagle (*Haliaeetus leucocephalus*), a state threatened species. No impacts to this species are expected as currently there are no nests within the construction limits. However, the location of bald eagle activity frequently changes. Therefore, closer to the actual date of construction, the MH will obtain an updated status of bald eagle activity in the area. To obtain any changes in status. If a nest is located within ½ mile of the project site, coordination with the DOW is required.

Indiana Bat: ODNR and USFWS indicate the project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis),* Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (Populus deltoides), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. If no tree removal is proposed, the project is not likely to impact this species. The proposed project will remove one young pine tree during construction of the access road and transmission line. Therefore, no impacts to this species are anticipated.

Other animal species potentially occurring in Mahoning county include:

Table 1: Wildlife Status Report (ODNR, 2009) Animal Species Potentially Occurring in Mahoning County

Species	Status
American Crow	
Beaver	
Cottontail Rabbit	
Mourning Dove	
Osprey	
River Otter	
Swamp Sparrow	
Willow Flycatcher	
Bobolink	
Canada Goose (migrant)	

Canada Goose (resident)	
Field Sparrow	
Gray & Fox Squirrel	
Gray Fox	
Opossum	
Ring-necked Pheasant	
Red Fox	
Skunk	
White-tailed Deer	
Wild Turkey	
Acadian Flycatcher	
American Woodcock	
Barn Owl	
Black Bear	State Endangered
Blue-winged Warbler	
Coyote	
Eastern Meadowlark	
Grasshopper Sparrow	
Henslow's Sparrow	
Northern Bobwhite	
Raccoon	
Scarlet Tanager	
Great Egret	Species of Concern
Bobcat	State Endangered
Peregrine Falcon	State Threatened
Snapping Turtle	
Midland Map Turtle	
Red-Eared SliderQueen Snake	
Common WaterSnake	
Northern Red-Bellied Snake	
Northern Black Racer & Blue Racer	
Eastern Ratsnake	
Eastern Milksnake	
Eastern Gartersnake	
Hellbender	State Endangered
Common Mudpuppy	
Red-Spotted Newt	
Spotted Salamander	
Mountain Dusky Salamander	
Northern Dusky Salamander	
Redback Salamander	
Northern Ravine Salamander	
Northern Slimy Salamander	
Northern Two-Lined Salamander	
Longtail Salamander	

American Toad	
Northern Spring Peeper	
Gray Treefrog	
Western Chorus Frog	
Bullfrog	
Green Frog	
Northern Leopard Frog	
Pickerel Frog	
Wood Frog	

Impacts to Plants

No significant impact to plant species is anticipated. The construction limits do not include any wetlands or riparian zones. The only vegetation affected is a field or prairie like area (open/urban land use) west of the left dam abutment where the access road and new transmission line will be constructed. This vegetation was previously disturbed during the 1988 dam repairs and is located above the OHWM. Any vegetation disturbed during construction will be restored with the appropriate native species. Best management practices will be implemented during construction to prevent sedimentation or other negative impacts. No plant species of concern were identified by ODNR within the construction limits.

A search of the Ohio Natural Heritage Database was conducted to identify any rare, threatened or endangered species potentially occurring in Mahoning County (Table 2).

Table 2: (ODNR, 2010)

Ohio Natural Heritage Database
Rare Plant List for Mahoning County
As of 06/04/2008

Scientific Name	Common Name	Last Observed	State Status	Federal Status
Vascular Plants:				
Callitriche verna	Vernal Water-starwort	1995	T	
Castanea dentata	American Chestnut	1995	P	
Clintonia umbellulata	Speckled Wood-lily	1993	T	
Corallorhiza maculata	Spotted Coral-root	1984	P	
Cuscuta pentagona	Five-angled Dodder	1960	T	
Deschampsia flexuosa	Crinkled Hair Grass	1967	T	
Dryopteris clintoniana	Clinton's Wood Fern	1987	E	
Eleocharis tenuis	Slender Spike-rush	1994	T	
Epilobium strictum	Simple Willow-herb	1960	T	
Equisetum sylvaticum	Woodland Horsetail	1994	P	
Gymnocarpium dryopteris	Common Oak Fern	1997	E	
Juncus platyphyllus	Flat-leaved Rush	1960	E	
Lechea pulchella	Leggett's Pinweed	1971	T	
Luzula bulbosa	Southern Woodrush	1997	T	
Phegopteris connectilis	Long Beech Fern	1985	P	
Plantago cordata	Heart-leaved Plantain	1982	E	
Platanthera psycodes	Small Purple Fringed Orchid	1985	E	
Trollius laxus	Spreading Globeflower	1986	E	

Number of rare plant species for this county: 18

P=Potentially Threatened, T=Threatened, E=Endangered, X=Presumed Extirpated
FT=Federally Threatened, FE=Federally Endangered

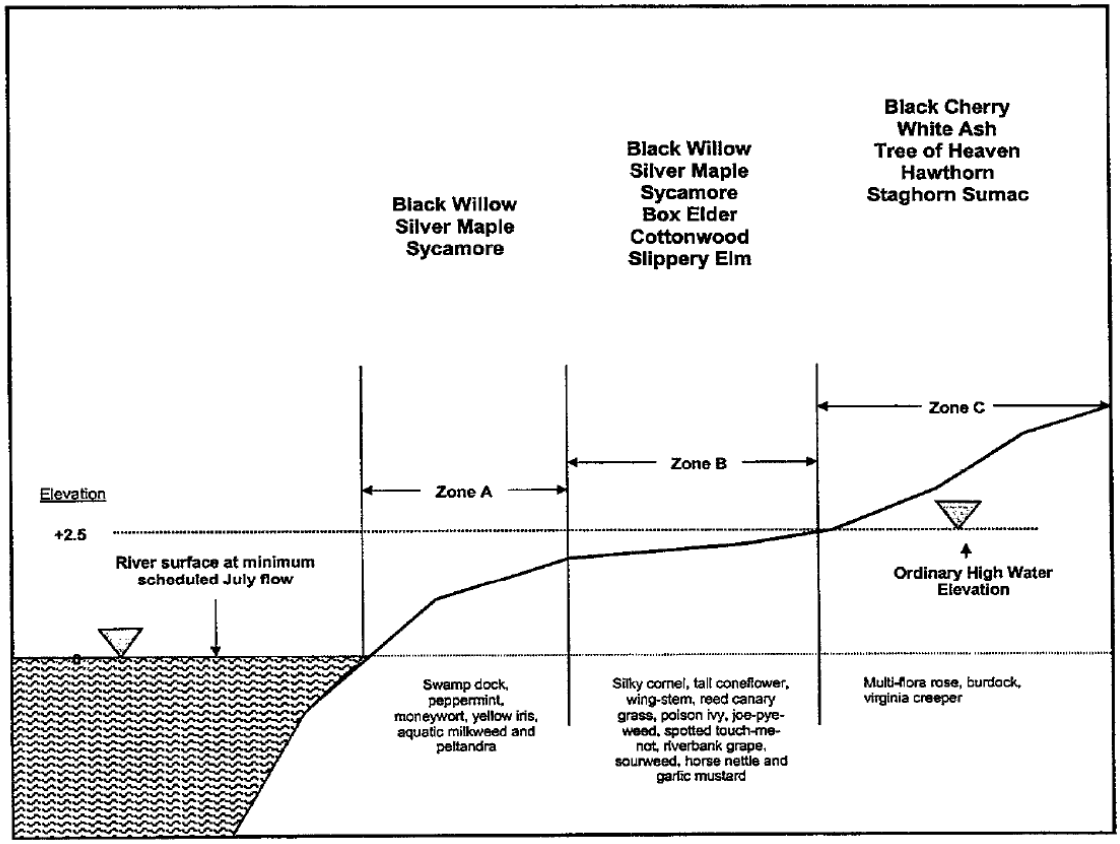


Figure 4 – Typical Vegetation along the Mahoning River (USACE, 1999)

Impacts to Wetlands

The proposed project will be constructed below the OHWM below the Lake Miton Dam along the Mahoning River within the existing concrete stilling basin. No wetlands will be impacted (Figure 5).

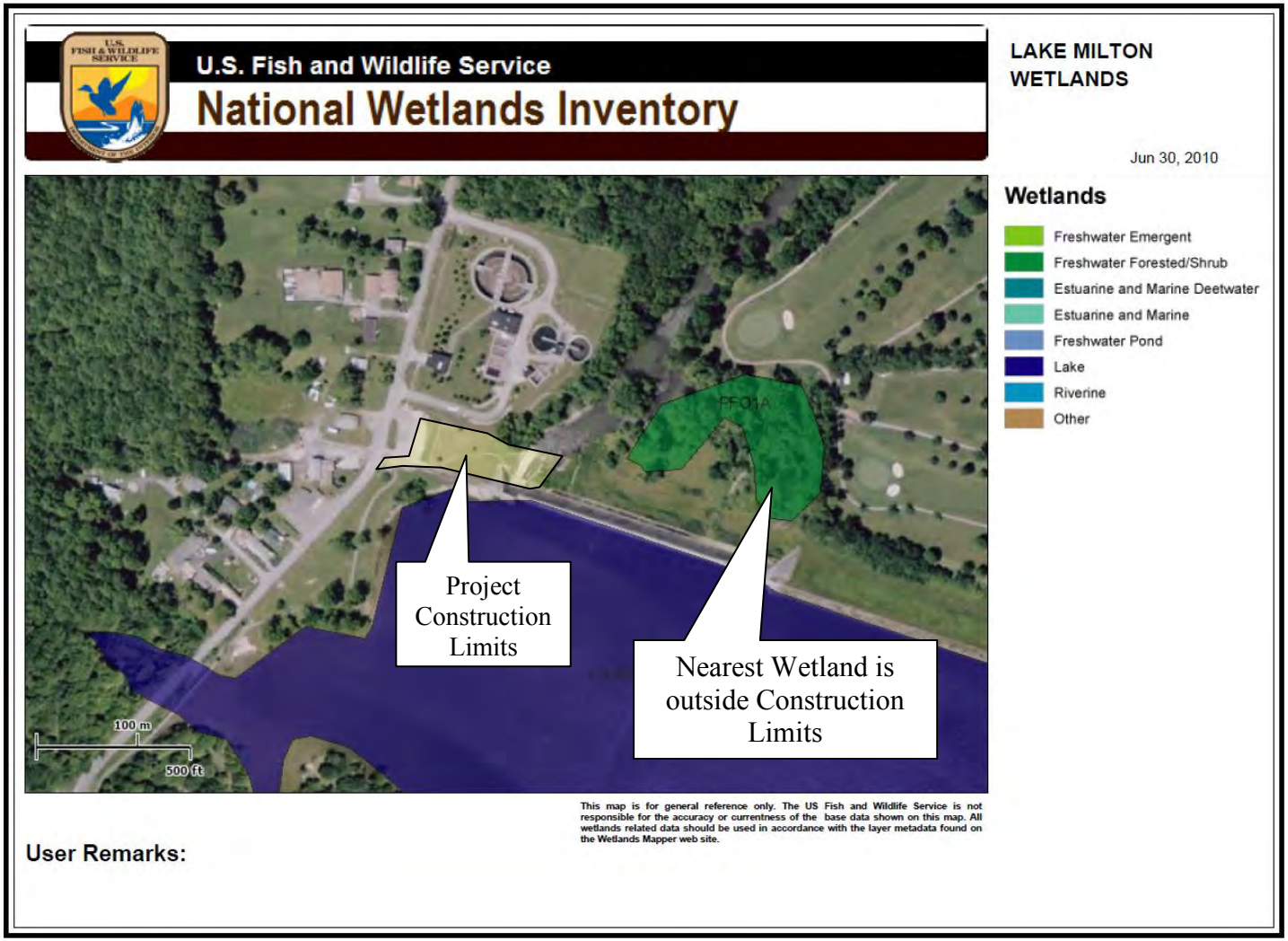


Figure 5 – Wetland Location Map (USFWS, 2011)

Impacts to Streams

No headwater streams were observed (0 ft) within the project construction limits. Approximately 100 ft of the Mahoning River is located within the construction limits, beginning at the upstream side of the of the dam extending to the end of the existing stilling basin. However, only a 30 ft section within the existing Lake Milton Dam footprint will be impacted. The use designation for this segment of the Mahoning River is Warm Water Habitat. The section of the river to be impacted is within the existing concrete stilling basin (Figure 6). This segment of the river is immediately downstream of Lake Milton which is approximately 7 miles downstream from Berlin Lake. There is no vegetation below the OHWM that will be disturbed. The Vegetation to be disturbed above the OHWM can be described as field or prairie.

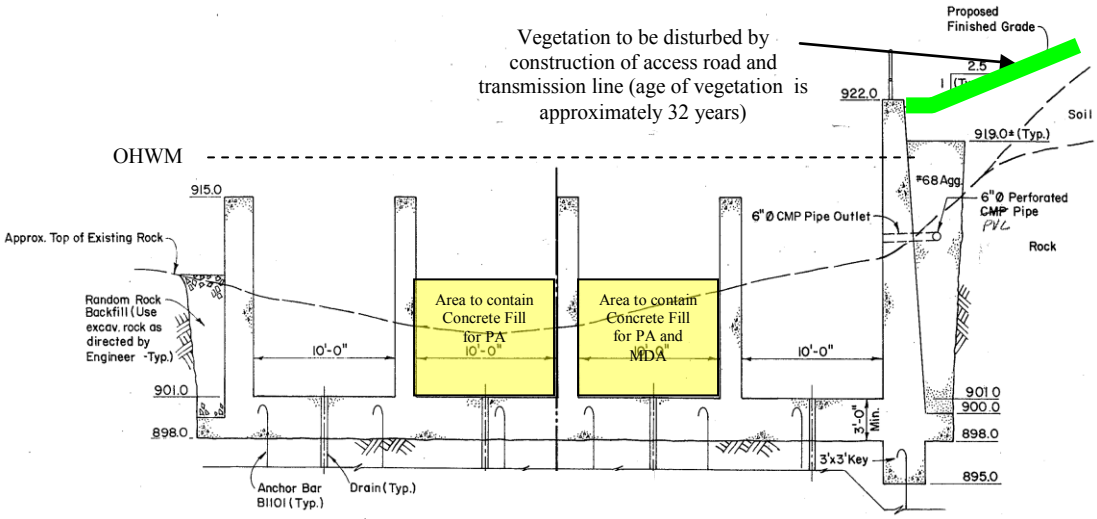


Figure 6 – Cross Section of Mahoning River Impacted by the Proposed Project

No significant impact to aquatic habitat and physical characteristics of the water body or adjacent areas is expected as the project is to be built within a man-made structure. The turbine will discharge within the existing stilling basin which is designed to evenly distribute the flow down stream. Therefore discharge patterns during hydro operations will be very similar to existing outflow patterns. The project will not significantly impact flow patterns of surface water. Drainage in the area occupied by the access road will continue to drain in the same catch basin prior to construction. All surface water within the construction limits currently drains directly into the Mahoning River. This pattern will be unaffected.

Existing Water Quality Data for this segment of the Mahoning River is shown in Table 3.

Table 3: Water Quality Data from EPA Sampling For Mahoning River Upstream and Downstream of Proposed Project (OEPA, 2008).

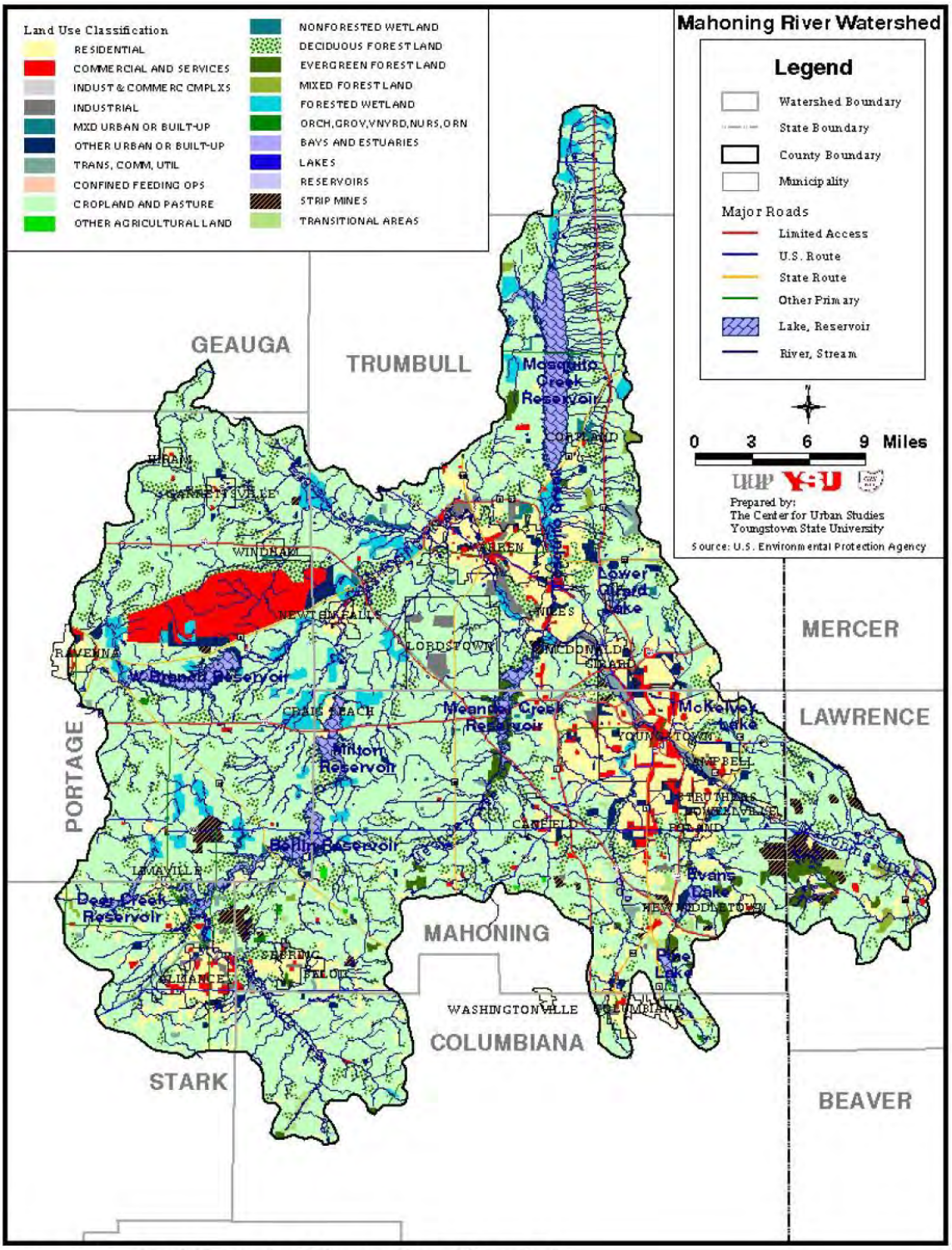
Location	Drainage Area (sq. miles)	Current Aquatic Life Use	Attain-ment Status	IBI	MIWB	QHEI	ICI
Mahoning River UST of Lake Milton (RM 70.7)	248	WWH	Partial	28-30	8.41-9	78.5	30
Mahoning River DST of Lake Milton (RM 62.7)	274	WWH	Partial	26-34	8.14-9.18	80.5	34

Land Uses

The present land uses are in the project area are shown in Table 4 and Figure 7. No changes are proposed for any of the alternatives.

Table 4: Land Use in the Upper Mahoning River Basin (YSU, 2004)

Land Use Categories	Area (mi^2)	% in Upper Mahoning River
Cropland & Pasture	504.193	62.70
Forest Land (Deciduous, Evergreen, Mixed)	111.727	13.89
Residential	70.154	8.72
Commercial & Service (mostly Ravenna Arsenal)	32.563	4.05
Wetlands (Forested, Non-Forested)	26.543	3.30
Natural Lakes & Reservoirs	16.188	2.01
Urban & Built-Up	11.948	1.49
Strip Mines	11.067	1.37
Transportation, Utilities	10.748	1.34
Industrial	4.438	0.55
Transitional Areas	4.530	0.56
Total in Upper Mahoning River basin	804.099	100.0 %



Land Use in the Mahoning River Watershed.

Figure 7 – (YSU, 2004)

Minimal Degradation Alternative

There are no differences in biological impacts between the MDA and the PA.

10c) PROJECT COSTS/COST EFFECTIVENESS

Item	Preferred Alternative	Min. Degradation Alternative	Non-Deg Alternative
Capital Costs			
Engineering	$100,000	$100,000	$0
Electromechanical Equipment	$1,000,000	$1,000,000	$0
Civil Works	$1,300,000	$1,000,000	$0
Interconnection	$200,000	$200,000	$0
Total	**$2,600,000**	**$2,300,000**	**$0**
Annual Ongoing Expenses/Revenues			
Estimated Annual Expenses/Operation & Maitenance	$80,000	$80,000	
Estimated Annual Revenue	$241,000	$241,000	$0
EBITA	**$161,000**	**$161,000**	**$0**

Revenues are similar for both the PA and the MDA, however, capital costs are slightly higher for the PA.

In terms of reliability and availability of technology, the hydroelectric industry is over a century old and many plants today are operating with the original turbines. Hydropower technology has improved since that time and proven technology is readily available for all alternatives. The anticipated life of the project is 50 to 100 years. Significant repairs are not expected during the project life. All alternatives are reliable and dependable.

10d) SEWAGE PROJECT

The proposed project is not a sewage project therefore, this section is not applicable.

10e) OTHER RELATED PROJECTS

There are no known related projects.

10f) WATER POLLUTION CONTROLS

Best Management practices will be used to control sedimentation from construction for all alternatives. Straw Bales or silt fence shall be placed around catch basins and disturbed areas until permanent vegetation in place. Disturbed vegetation shall be replaced with recommended native species. The cost of these measures is included in the budget under civil works.

The facility will produce clean renewable energy from the gravity flow of water, therefore, no fossil fuels are required for operation. Small amounts of lubricants and/or

hydraulic oil will be required for proper operation of the machinery. When possible environmentally safe substances will be used such as vegetable or soy based oils. A small container of gasoline may be kept on site for emergency generation. All codes and laws governing storage and use of hazardous materials shall be followed and no chemicals or hazardous materials shall be discharged into the river at anytime. Any accidental spills from broken hydraulics or other anticipated event would be reported immediately.

10g) HUMAN HEALTH IMPACTS

No significant change in water quality or impact to human health is expected to result from any of the alternatives.

10h) JOBS CREATED AND REVENUES GAINED

Preferred Alternative

According to a study by Navagant Consulting (2010) approximately 18 jobs are created per megawatt of capacity installed for this type of hydroelectric project. These include direct, indirect and induced jobs (Figure 8, Figure 9, & Figure 10). . The proposed Lake Milton Project has a capacity of .65 MW creating an estimated total of 11.7 jobs including 3.5 direct fulltime jobs, 2.3 indirect fulltime jobs and 5.9 induced jobs. MH will likely pay state and local taxes on revenues as well as applicable property taxes annually. ODNR will also receive annual dam use lease payments once the plant is in operation which is still pending ongoing lease nego-tiations. The local economy is below the state average in most categories (Table 5).

No impact to property values is anticipated. In terms of recreational opportunities, the project will not change any of the existing boating conditions or lake levels in Lake Milton and fishing will continue to be permitted below the dam. Access to the fishing area below the dam will be improved due to the new access road to be constructed. Currently the slope leading to the fishing areas below the dam is too steep for the less agile anglers to negotiate. The road will also provide improved access for canoeing and kayaking down stream of the dam as well. It is anticipated that tourism will be increased as MH will be welcoming the community and education groups to tour the hydro facility and learn about renewable energy. Culturally the project is significant as it marks the revival of hydropower on the Mahoning River which historically powered several hydroelectric plants in the early 1900s and mechanical mills before that. Bait shops, restaurants, convenience marts, gas stations and other local business will all benefit from the additional traffic to the area.

Aesthetically the powerhouse will be consistent with the look of the existing dam. The new transmission line will be buried to enhance the aesthetics of the project as well. The noise from the turbine/generator will be a lower decibel level than the water that is currently being discharged from the dam.

Table 5: U.S. Census Data for 2000 and 2008

	Population		Pop. Growth	median household income		Poverty Rate		unemp - loyment		Median Home Value	
	2000	2008		2000	2008	2000	2008	2000	2008	2000	2008
Village of Craig Beach	1254	1159	-7.6%	$38,594	$43,944	13.0%	13.0%	4.9%	7.5%	$75,700	$93,796
Milton Township	4,107	4,078	-0.7%	$39,912	$46,764	10.4%	10.4%	3.9%	una-vail-	$94,500	$138,931
Ohio	11,353,140	11,473,983	1.1%	$40,956	$47,988	10.6%	13.3%	3.2%	4.6%	$103,700	$140,200

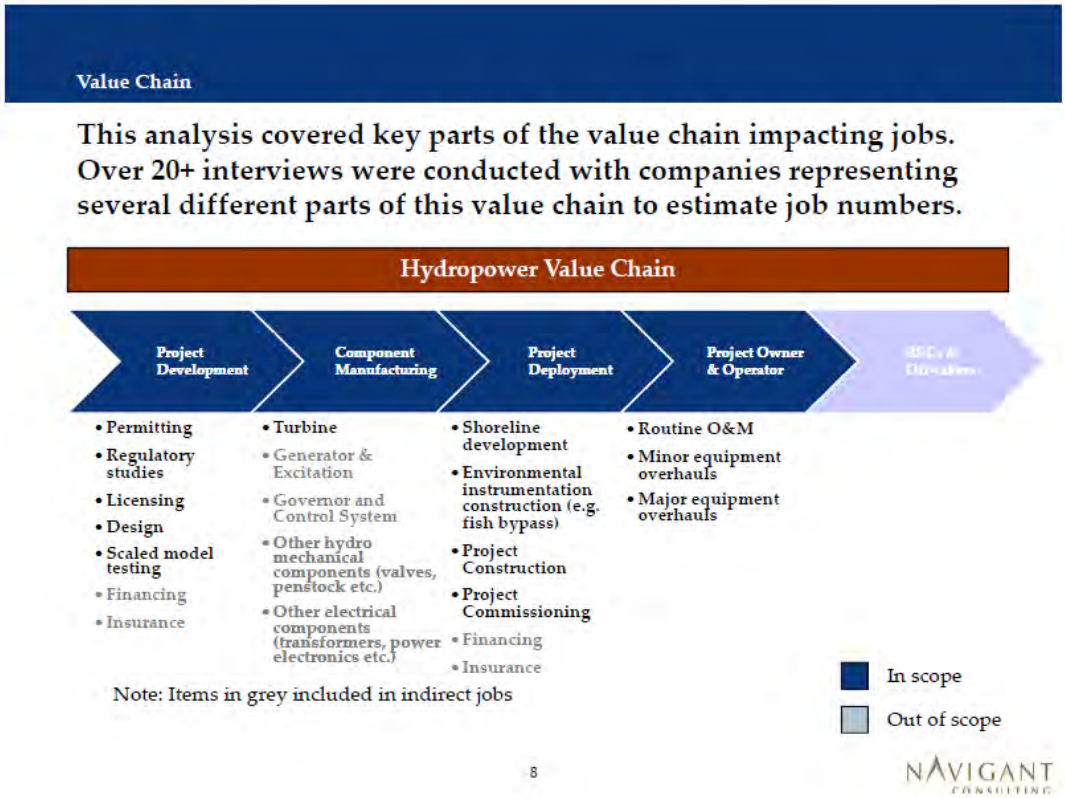


Figure 8

Job Rule of Thumbs

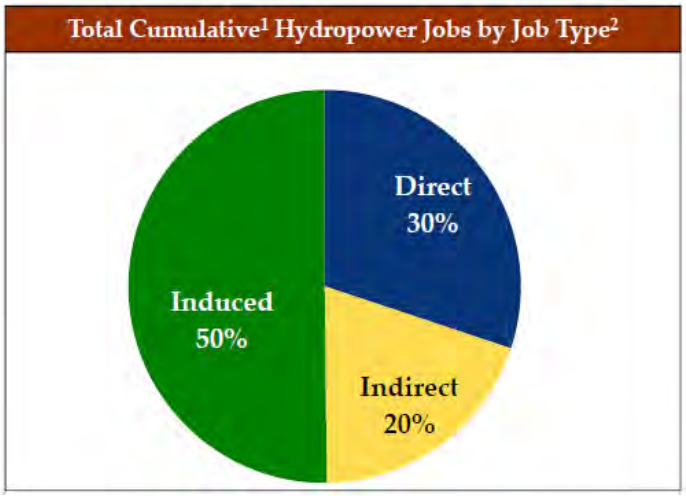
Navigant cross-checked cost basis job estimates with industry interviews. Below are typical full time equivalents (FTEs) per MW.

U.S. Hydropower Market Direct Jobs in FTE (Full Time Equivalents) – 2009		
Technology	Average Project Size	Total FTE/MW (Average)
Inland Hydrokinetic, Micro Hydro (<1 MW)	10 MW	6.00
Efficiency Improvements, New Capacity in existing facilities, modifications	10 MW	6.50
New Facilities in low head/low flow Existing Dams without Hydropower	10 MW	5.30
Green Field Small	50 MW	6.00
New Facilities in higher head / higher flow Existing Dams without Hydropower	50 MW	5.30
Green Field Large	100 MW	6.00
Pumped Storage	500 MW (interviews) 1,000 MW (cost basis)	5.10
Ocean – Wave, Tidal	15 – 200 MW (literature) 50 MW (cost basis)	14.0

Figure 9

Types of Jobs

Induced jobs comprise half of the total cumulative jobs created.



Notes:
1. "A cumulative job is a job-year, which is defined as 1 person working full-time for 12 months
2. Percentages estimated based on direct jobs from MWs installed and indirect and induced jobs based on multipliers described in previous slide

11

NAVIGANT CONSULTING

Figure 10

Minimum Degradation Alternatives 1 & 2

Economic, recreational, cultural, and aesthetic impacts are very similar for the MDA.

10i) JOBS AND REVENUES LOST

Preferred Alternative

Since the turbine will control the majority of the flow through the dam there will be less operation of the gates required by Lake Milton State Park (LMSP) staff. Typically the gates are operated by maintenance staff or park officers. This would not likely mean that the personnel that operate the gates would lose their jobs as operating the gates is only part of the job description for these employees. Because LMSP has limited resources as it is, it is more likely that the park will benefit from less gate operation as these employees will be able to focus more on other responsibilities such as monitoring recreational activities in the Lake and maintaining the safety and other facilities of the park. Additionally ONDR will receive approximately $25,000 - $30,000 per year in lease payments from MH which would possibly be used to create additional work. No other jobs are anticipated to be impacted.

No local businesses will be impacted negatively. Statewide, coal and other fossil fuel generators may be impacted as the power generated by the hydro plant will replace the power generated by fossil fuels. This would perhaps reduce revenues very slightly for these companies as well as the taxes paid by fossil fuel power companies. Those taxes would begin to be paid by MH so no net loss in taxes would occur.

As mentioned previously property values will not be negatively impacted by the project. The plant will produce 100% clean renewable power compared to other forms of generation which pollute. Aesthetically negative impacts will be minimal/debatable. The amount of concrete structure will be increased at the dam but it will only be visible to those looking down into the valley below the dam and the powerhouse will not extend beyond the existing footprint of the dam. There may be a slight hum produced by the generator audible to those standing by the powerhouse but this sound will be a lower decibel level than the existing sound of the water discharging from the dam. The water discharge noise will be reduced as the turbine will capture the energy from the water and release it more gently as opposed to discharging it violently as is currently done.

Minimum Degradation Alternatives

The MDA will have similar impacts.

10j) ENVIRONMENTAL BENEFITS LOST OR GAINED

Preferred Alternative

Benefits Lost

The project will not modify any existing slope, flow velocities, or quantities downstream of the dam. Therefore sediment moving capabilities of the river will be unaffected. The turbine will discharge water from the existing stilling basin to continue distributing water evenly down stream. No wetlands will be impacted by the project. The existing dam intake will be used to supply the turbine so temperature and other water quality conditions will not be impacted. The USACE did express concern regarding two potential water quality impacts.

1) Werner Loehlein, Chief of the Water Management Branch of the USACE Pittsburg District indicated year round operation from the existing gate 2 intake elevation may impact water quality in Lake Milton. This is due to the current practice of switching from gates 1 & 2 (higher intake elevation) to gates 3 & 4 (lower intake elevation) during the winter. Mr. Loehlein explained that this is done to improve water quality in the lake by flushing out the low quality water that settles at the lower elevation each year. Since the turbine will be installed on gate 2 (higher elevation), operating the turbine November to March may impact water quality in the Lake as it changes the intake elevation used during that time. In order to mitigate potential water quality impacts during the winter MH agreed to shut down hydro operation in the winter until MH can show evidence that water quality would not be impacted during the winter during hydro operation.

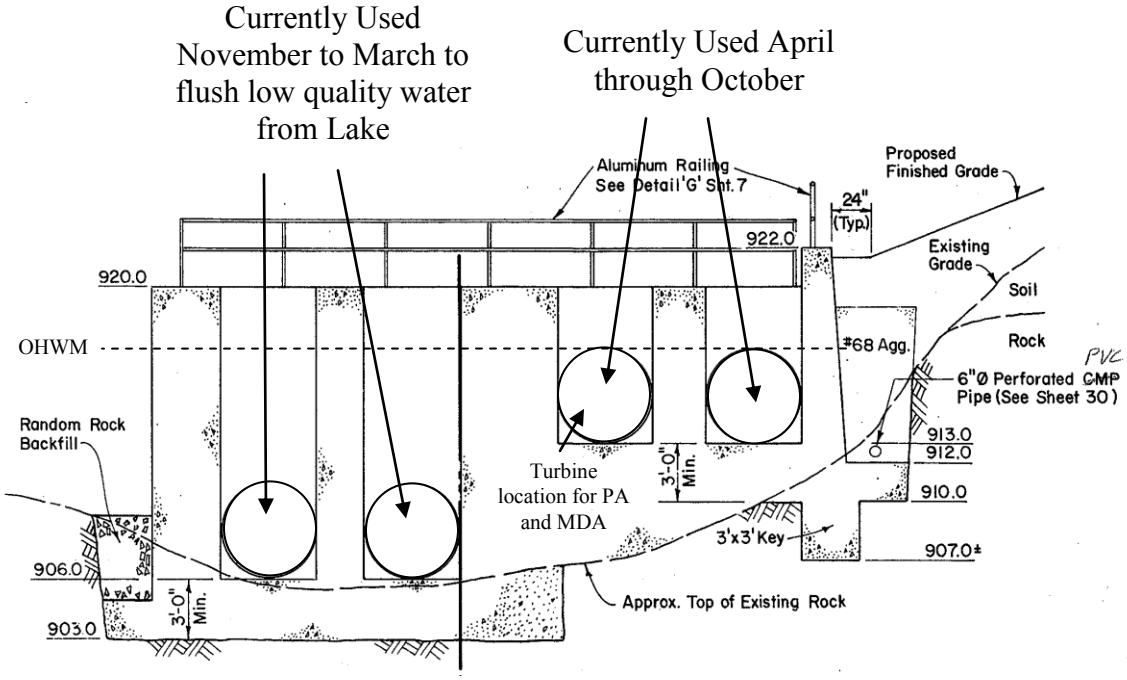


Figure 11 – Cross Section of Existing Dam Outlet Works

2) USACE biologist Rose Reilly expressed concern that dissolved oxygen (DO) levels down stream of the dam may also be impacted by the turbine particularly from August to October. Therefore condition 3 of the provisional Nationwide 17

permit issued by the USACE on June 7, 2010 (Appendix F) requires MH to perform pre-hydro DO testing August to October to establish pre-hydro range of DO levels below the dam to be maintained during hydro operation. If DO levels drop below the pre-hydro range, bypass flows will be used through an alternate gate (existing condition) to mitigate the problem.

Benefits Gained

The Project will provide clean, renewable, environmentally sound energy to the Mahoning Valley area thus reducing acid rain, greenhouse gases and reliance on fossil fuels. It is estimated that the project will produce approximately 3,712.19 MWh/year of clean, renewable power resulting in an estimated reduction in coal related emissions of 2,992,025 Kg CO2/year.

Environmental impacts will be minimal as the project will be constructed on an existing dam. The project is part of an effort to create much needed jobs in Northeast Ohio.

Minimal Degradation Alternative

Environmental impacts are the same with the MDA as the PA.

10k) MITIGATION TECHNIQUES

Wetland Mitigation:

No wetland mitigation is required.

Stream, Lake, Pond Mitigation:

Mahoning Hydropower, LLC proposes to purchase 60 linear feet of stream preservation (2:1 ratio), including 50 feet of forested wetland riparian area surrounding both sides of the stream, from a consolidated wetlands and stream mitigation site for the 30 linear feet of proposed stream impacts. The proposed mitigation site is located off the west side of Warner Road in Fowler Township, Trumbull County, Ohio. The mitigation site is known as the Yankee Creek 1 Consolidated Wetlands Mitigation Project and contains 592 linear feet of available stream preservation surrounded by a riparian area consisting of Category 3 forested wetlands and is located within the Shenango River Watershed (HUC 05030102). The mitigation site is protected by a Conservation Easement held by the Cleveland Museum of Natural History. The proposed impacts are located in the Mahoning River Watershed (HUC 05030103), which like the Shenango River, is a tributary of the Beaver River (HUC 05030104). A USGS topographic map and an abridged copy of the Year Five Monitoring and Management Report for the mitigation site, containing a detailed site plan and site location map, is attached as Appendix C.

REFERENCES

Electric Power Research Institute (EPRI). 1990. Assessment and Guide for Meeting Dissolved Oxygen Water Quality Standards for Hydroelectric Plant Discharges. GS-7001

Kleinschmidt Associates. 2010. Jennings Randolph Hydroelectric Project Desktop Fish Entrainment and Turbine Mortality Analysis. Prepared for Fairlawn Hydroelectric Company, LLC.

Environmental Protection Agency (OEPA), (2008). Biological and Water Quality Study of the upper Mahoning River and Selected Tributaries 2006. OEPA Technical Report EAS/2008-10-8, Columbus, Oh.

Hydro Energy Technologies, LLC (HET). 2010. Fish Impingement, Entrainment And Turbine Mortality Analysis. Lake Milton Hydroelectric Project P-13402.

Navagant Consulting, 2010. Job Creation Opportunities in Hydropower. Presented to National Hydropower Association Annual Conference on April 26, 2010.

Ohio Department of Natural Resources (ODNR), 2010. Lake Milton State Park http://www.dnr.state.oh.us/parks/lakemilton/tabid/759/Default.aspx Accessed November 27, 2010.

Ohio Department of Natural Resources (ODNR), 2010. A to Z Species Guide http://www.dnr.state.oh.us/Home/species_a_to_z. Accessed May 4, 2010.

Ohio Department of Natural Resources (ODNR), 2010. Hunting and Fishing Regulations http://www.ohiodnr.com/wildlife/dow/regulations/fishing_general.aspx. May 4, 2010.

Ohio Department of Natural Resources (ODNR), 2010. Muskie Angler Log http://www.dnr.state.oh.us/muskielog/sumall.aspx. Accessed May 4, 2010.

Ohio Department of Natural Resources (ODNR), 2004. Suspected Fish Poachers Netted During Undercover Wildlife Investigation., http://www.ohiodnr.com/news/jun04/0601poachers/tabid/13461/Default.aspx. Accessed May 4, 2010.

Ohio Department of Natural Resources Division of Water (ODNR Division of Water), 2008. Dam safety Inspection Report – Lake Milton Dam. Columbus, Ohio.

Ohio Environmental Protection Agency (OEPA), (2008). Appendices to the Biological and Water Quality Study of the upper Mahoning River and Selected Tributaries 2006. OEPA Technical Report EAS/2008-10-8, Columbus, Oh.

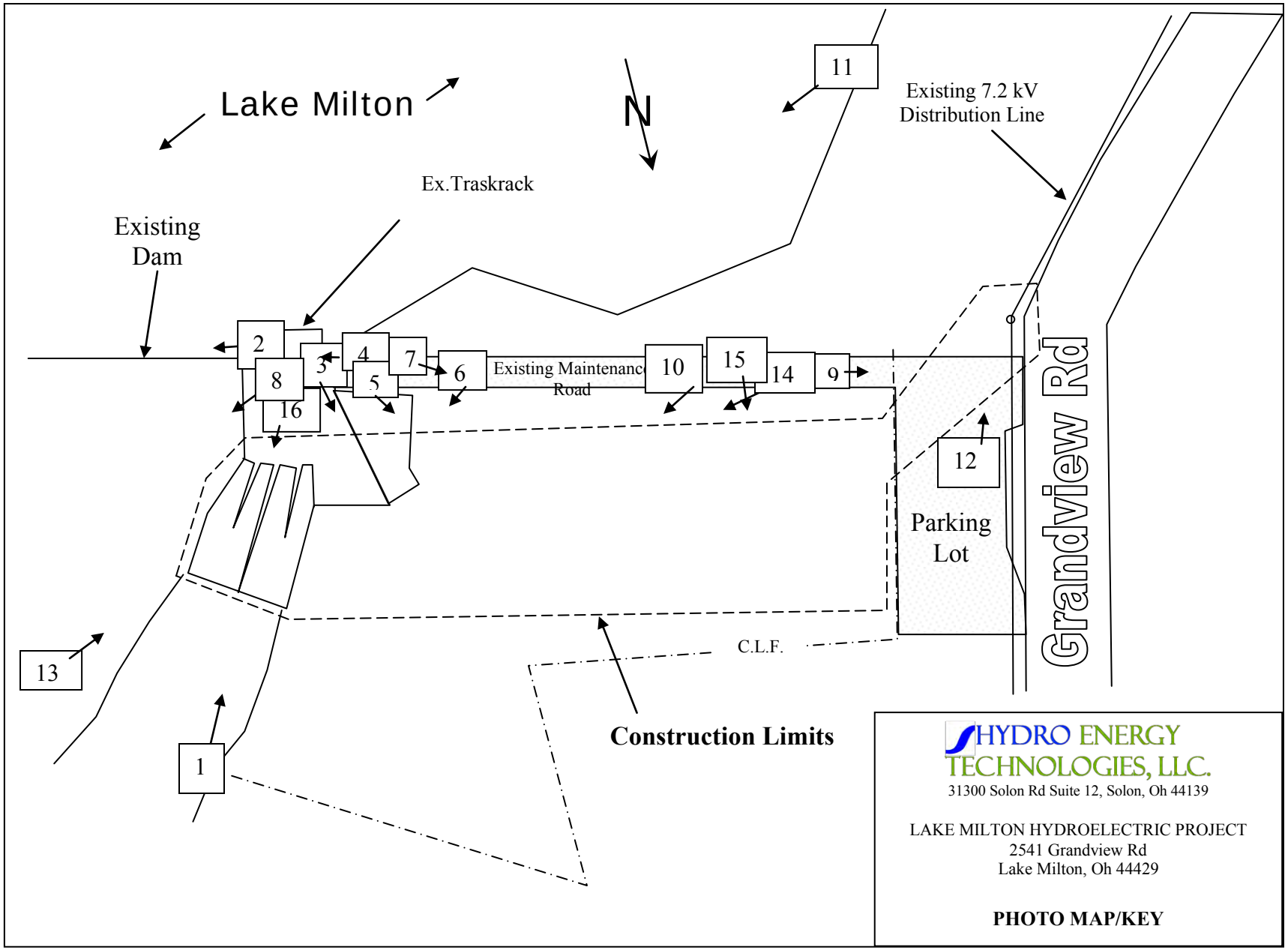
United States Department of Agriculture, 1971. Soil Survey Mahoning County Ohio. Washington, D.C.

U.S. Army Corps of Engineers Pittsburgh District, 1999. Mahoning River Environmental Dredging Reconnaissance Study, Trumbull and Mahoning Counties, Ohio, May 1999 http://www.lrp.usace.army.mil/pm/mahonoh/ohrpt.htm Accessed November 29, 2010.

US Fish and Wildlife Service, 2011. Wetlands Mapper. http://107.20.228.18/Wetlands/WetlandsMapper.html accessed December, 5, 2011.

Youngstown State University, 2004. Mahoning River Watershed Action Plan. Youngstown, Oh.

APPENDIX A: Photographs and Reference Map


Lake Milton
N
11
Existing 7.2 kV
Distribution Line
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Dam
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Parking
Lot
Grandview Rd
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C.L.F.
Construction Limits
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HYDRO ENERGY
TECHNOLOGIES, LLC.
31300 Solon Rd Suite 12, Solon, Oh 44139
LAKE MILTON HYDROELECTRIC PROJECT
2541 Grandview Rd
Lake Milton, Oh 44429
PHOTO MAP/KEY

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

Photo 13

Photo 14

Photo 15

Photo 16

APPENDIX B: Draft Fish Study Report (Attached)

FERC Project No. 13402
Lake Milton Hydroelectric Project
Hydro Energy Technologies, LLC

FISH IMPINGEMENT, ENTRAINMENT AND TURBINE MORTALITY ANALYSIS

By:
HYDRO ENERGY TECHNOLOGIES, LLC
31300 Solon Rd Suite 12
Solon, Oh 44139

May 8, 2010

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FISH IMPINGEMENT, ENTRAINMENT AND TURBINE MORTALITY ANALYSIS

LAKE MILTON HYDROELECTRIC PROJECT (FERC #13402)

1 PROJECT BACKGROUND

Pursuant to section 4.38(b) of the Code of Federal Regulations Hydro Energy Technologies, LLC (HET) has completed the first stage consultation requirements for the Lake Milton Hydroelectric project (FERC # 13402).

During the consultation process for the proposed Lake Milton Hydroelectric Project (FERC # P-13402) Phil Hillman of the ODNR Division of Wildlife expressed concern regarding the impact of the project on fish species (most specifically the Walleye and Muskellunge populations). He recommended the installation of a new trashrack with 1" bar spacing to prevent entrainment of fish species. He indicated, however, that although the rack would reduce entrainment, it would increase risk of impingement.

In addition to installing a new trashrack, HET agreed to pay compensation for fish losses due to impingement on the new rack as well as any fish downstream lacerated by the turbine. HET also offered to field test the proposed trashrack to determine how many fish would be impinged on the new rack.

Other agencies including the US Army Corps of Engineers and US Fish and Wildlife have requested "adequate documentation that fish mortality will be kept to a minimum."

1.1 Study Objectives

The goals of this study were to develop a qualitative and quantitative estimate of fish mortality due to impingement and entrainment for the Lake Milton Hydroelectric Project. This analysis was completed in order to document that fish mortality will be kept to a minimum and to address compensation for fish losses. Study objectives include:

a. Estimate the composition of fish species in the Mahoning River in the project vicinity from the 2006-2007 OEPA samplings.
b. Define the entrainment database that could be applied to the Lake Milton Project;
c. Estimate total entrainment rates at the proposed project using data from similar sites from the entrainment database.

d. Calculate potential fish entrainment by size and month using data from other plants with 1" bar spacing from the entrainment database.
e. Characterize the species composition of potential fish entrainment
f. Analyze individual species and guilds/groups for factors that may influence their vulnerability to entrainment and mortality;
g. Estimate potential turbine mortality for fish entrainment based on turbine mortality estimates from similar project studies; and
h. Assess potential fish impingement for the Lake Milton Project using data from a field study at Lake Milton as well as desk top analysis methods.

2 PROJECT DESCRIPTION AND PROPOSED OPERATIONS

2.1 Description of Existing Dam, River and Impoundment

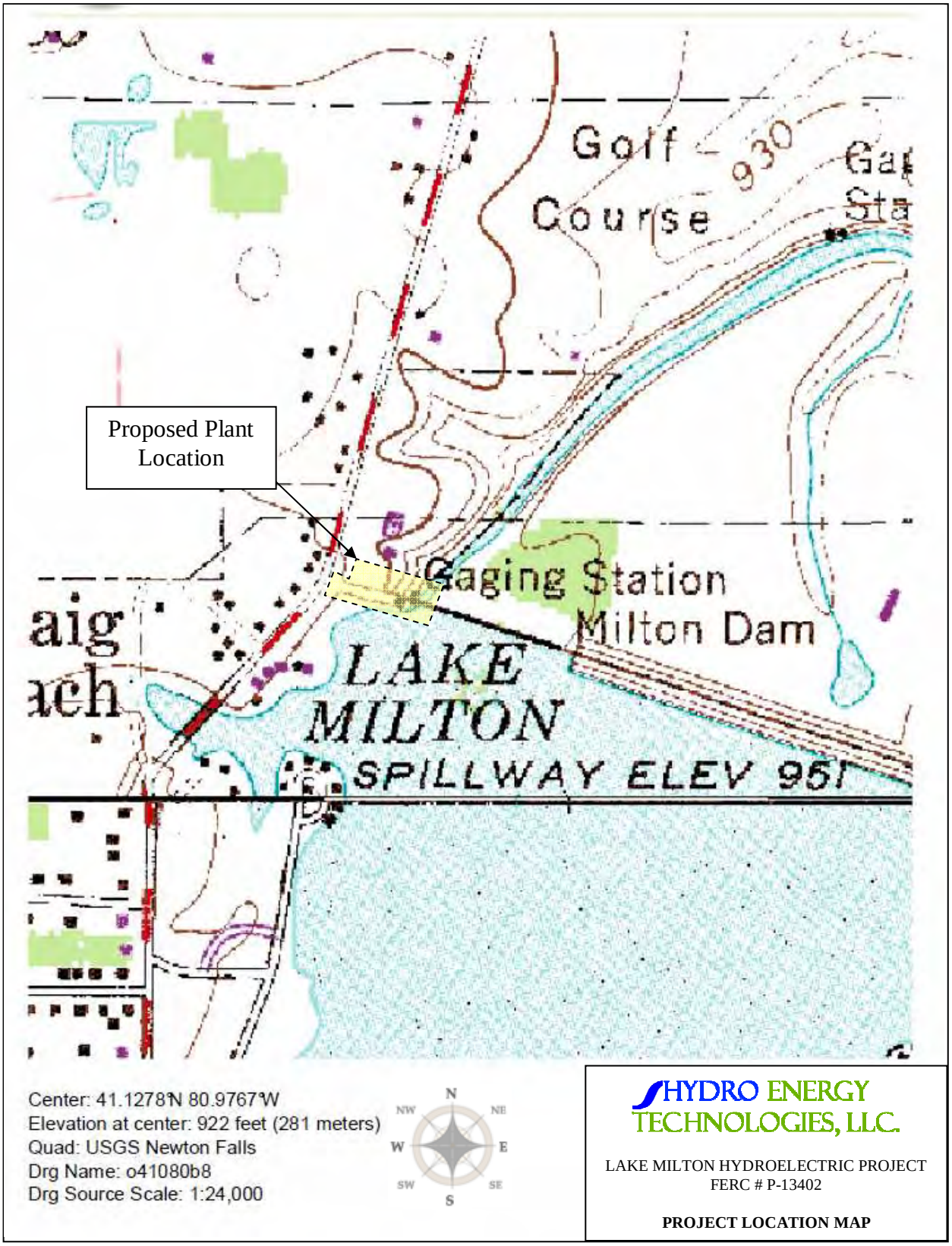
The original dam located along the Mahoning River was constructed in 1913 by the City of Youngstown for the purposes of flood protection and water supply to the steel mills located in the city of Youngstown, Ohio. In 1970 seepage and evidence of instability on the downstream west abutment was noted. Youngstown relinquished control of the dam to the Ohio Department of Natural Resources and ODNR began rehabilitation of the dam which it completed in 1988. Although the dam no longer supplies water to the steel mills in Youngstown, it continues to provide flood protection to the Mahoning Valley as well as an important recreational resource to the area. The dam is operated by the Lake Milton State Park under the supervision of the Pittsburgh District of the US Army Corps of Engineers (USACE). The nominal surface area of the existing impoundment created by the existing dam is 1,685 acres.

Center: 41.1278°N 80.9767°W
Elevation at center: 922 feet (281 meters)
Quad: Newton Falls
Drg Name: o41080b8
Drg Source Scale: 1:24,000

HYDRO ENERGY TECHNOLOGIES, LLC.

LAKE MILTON HYDROELECTRIC PROJECT
FERC # P-13402

STREET LEVEL MAP


Golf
Course
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Proposed Plant Location
Gaging Station
Milton Dam
LAKE
MILTON
SPILLWAY ELEV 951
Center: 41.1278°N 80.9767°W
Elevation at center: 922 feet (281 meters)
Quad: USGS Newton Falls
Drg Name: o41080b8
Drg Source Scale: 1:24,000
N
NW
NE
W
E
SW
SE
S
HYDRO ENERGY TECHNOLOGIES, LLC.
LAKE MILTON HYDROELECTRIC PROJECT
FERC # P-13402
PROJECT LOCATION MAP

The proposed hydro plant shown in Figure 2-1 is located on the Mahoning River and is fed by a total drainage area of approximately 273 square miles. Flow levels at the proposed site were determined using the data from the USGS gaging station 03091500 on the Mahoning River located .3 miles downstream of the Milton Dam near Pricetown.

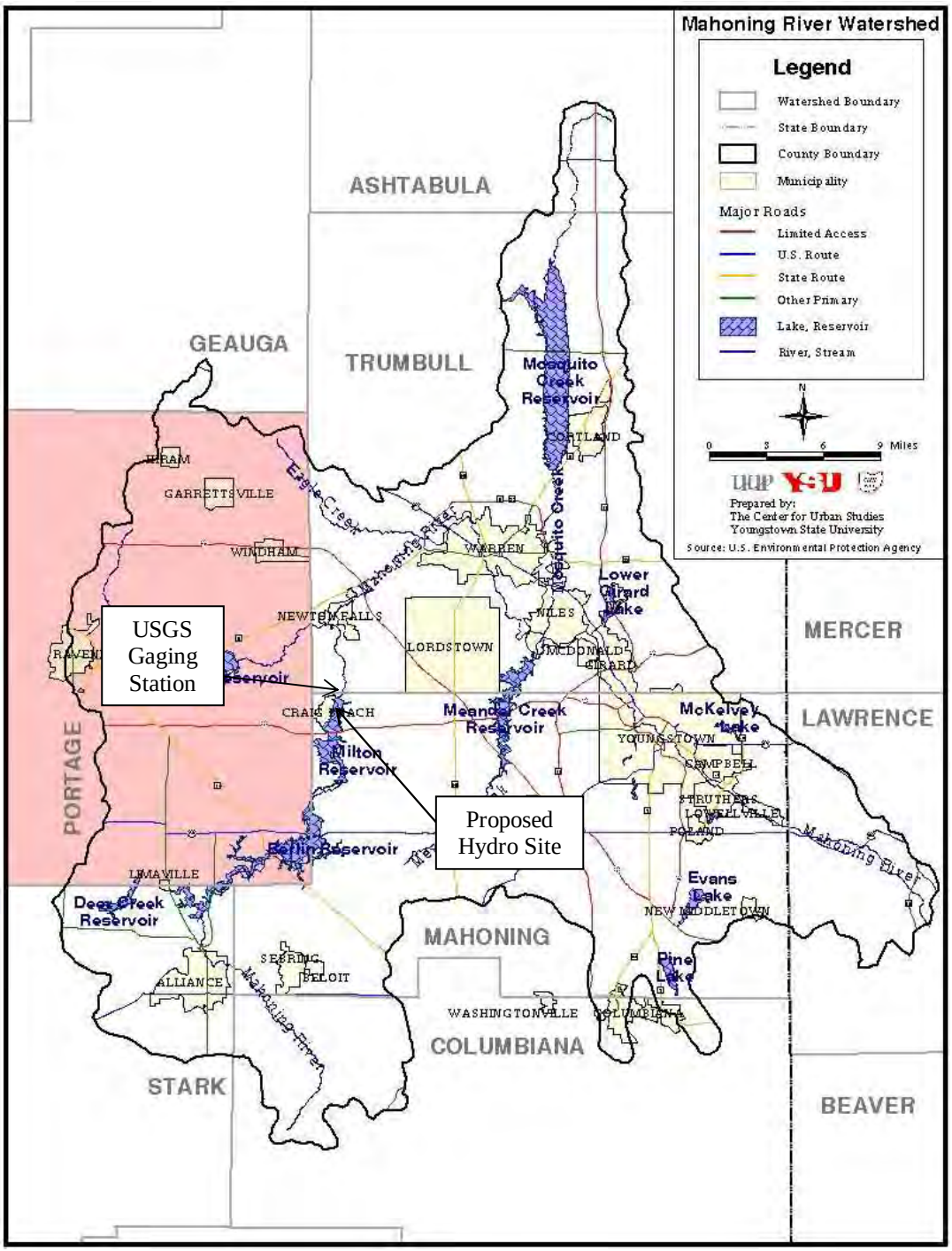


Figure 2-1 – Mahoning River Watershed

Figure 2-2 and Table 2-1 represent the daily mean flows from August 1979 to August 2009 for the Mahoning River at the Pricetown gaging station:

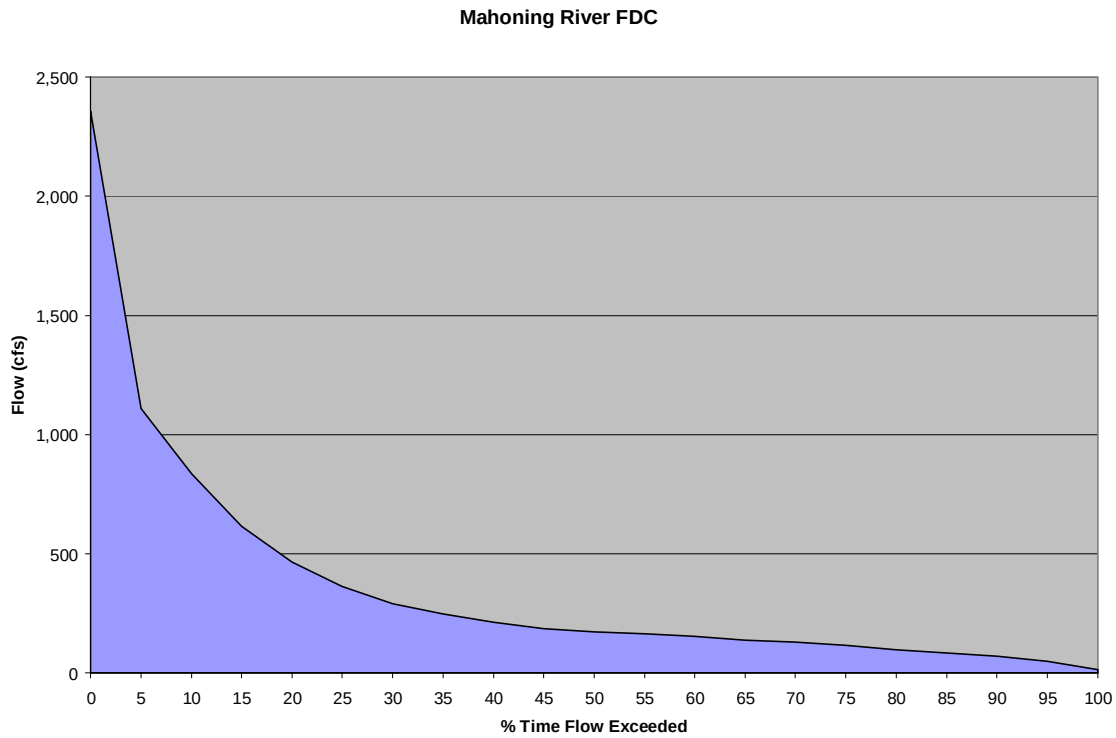


Figure 2-2

% Time Flow Exceeded	Q (cfs)
0	2,430
5	1,110
10	835
15	615
20	466
25	362
30	289
35	247
40	213
45	186
50	172
55	162
60	152
65	138
70	129
75	115
80	97
85	85
90	70
95	47
100	13

Table 2-1

Monthly mean data from the USGS Station from years 1979 to 2009 was used to create the hydrograph and data table for the Mahoning River labeled Figure 2-3 and Table 2-2 respectively.

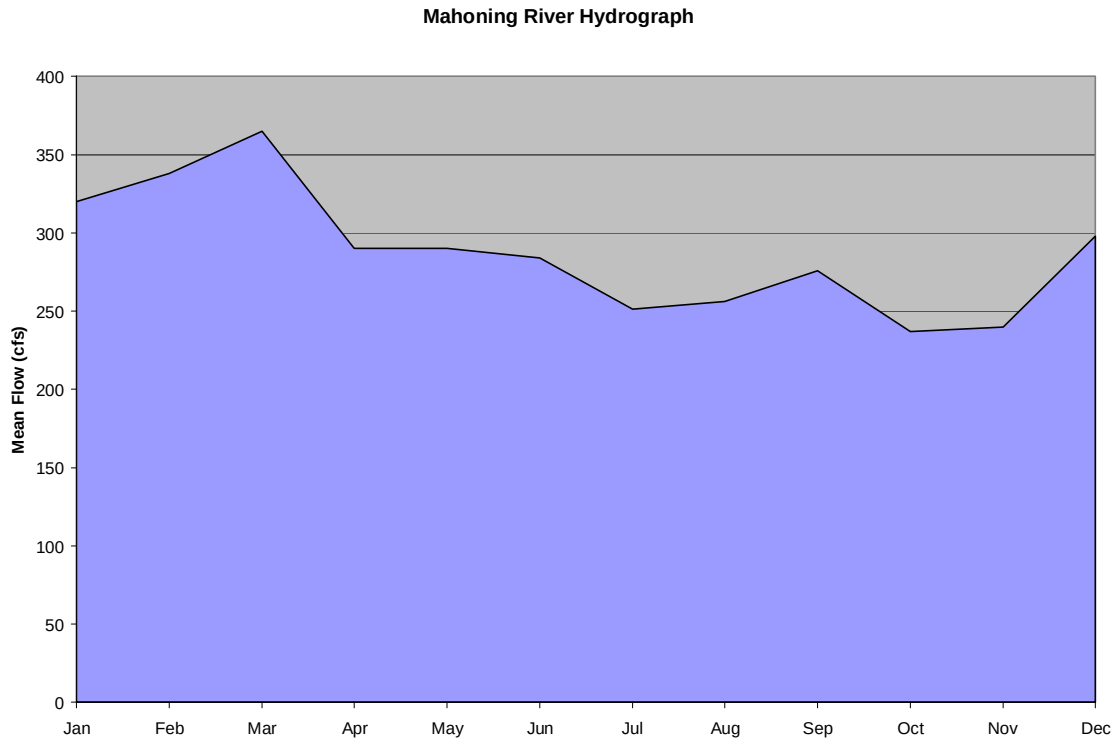


Figure 2-3

Month	Mean Flow (cfs)
Jan	320
Feb	338
Mar	365
Apr	290
May	290
Jun	284
Jul	251
Aug	256
Sep	276
Oct	237
Nov	240
Dec	298
Mean	**287.1**

Table 2-2

2.2 Description of Proposed Project and Operations

The current design (Figure 2-4) uses the existing intake and connects a 800 mm diameter 650 KW S-Type Kaplan Turbine to the exisiting 60" outlet pipe on gate 2 below the dam. The proposed powerhouse would be constructed over the existing discharge location where the turbine and generator will be housed. The proposed location of the turbine and powerhouse are shown in Figure 2-5 & Figure 2-6.

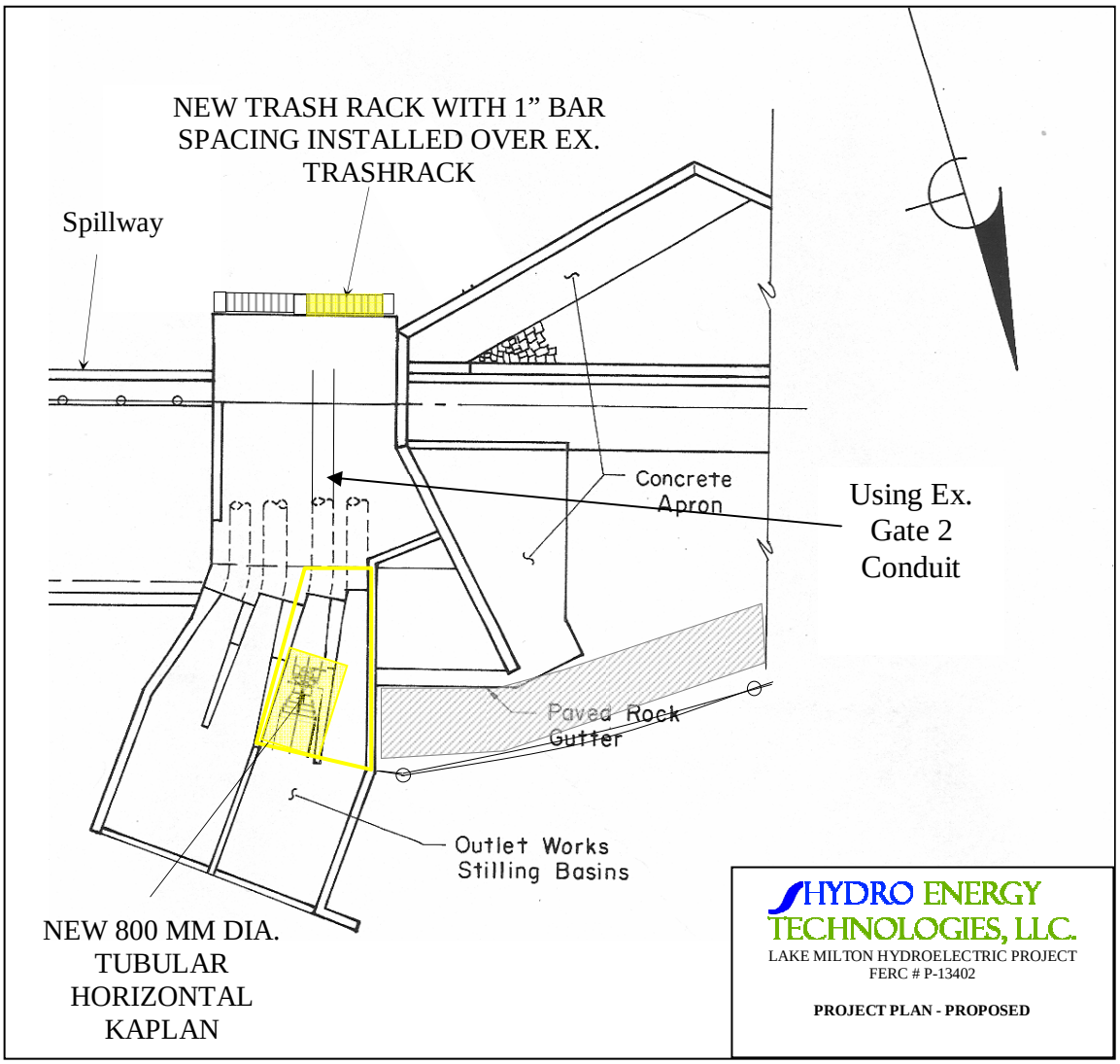


Figure 2-4

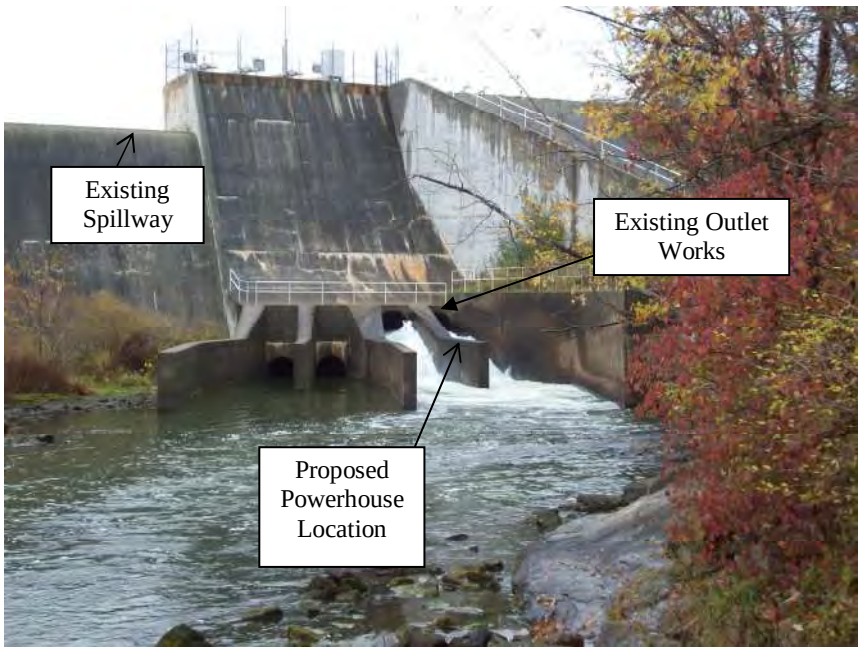


Figure 2-5 - Photo of existing dam and outlet works

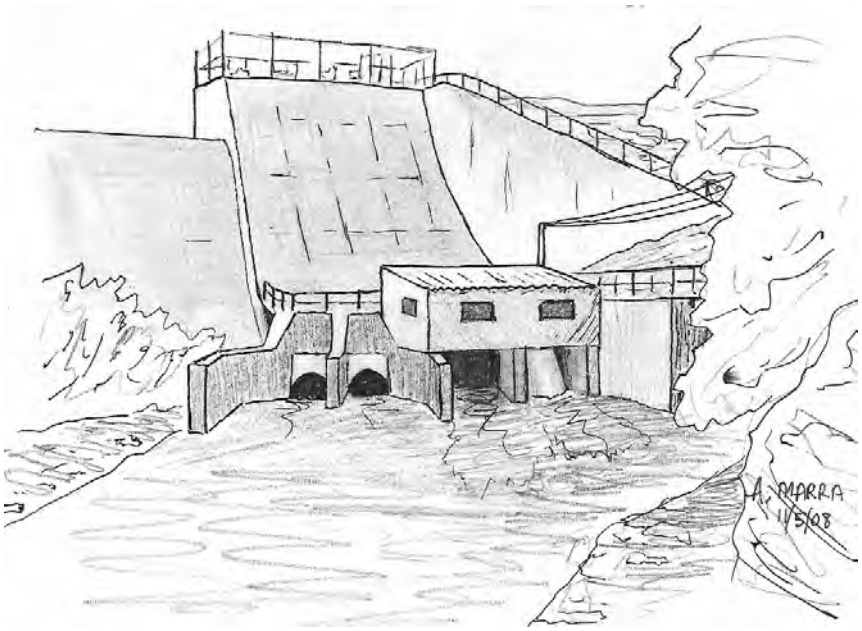
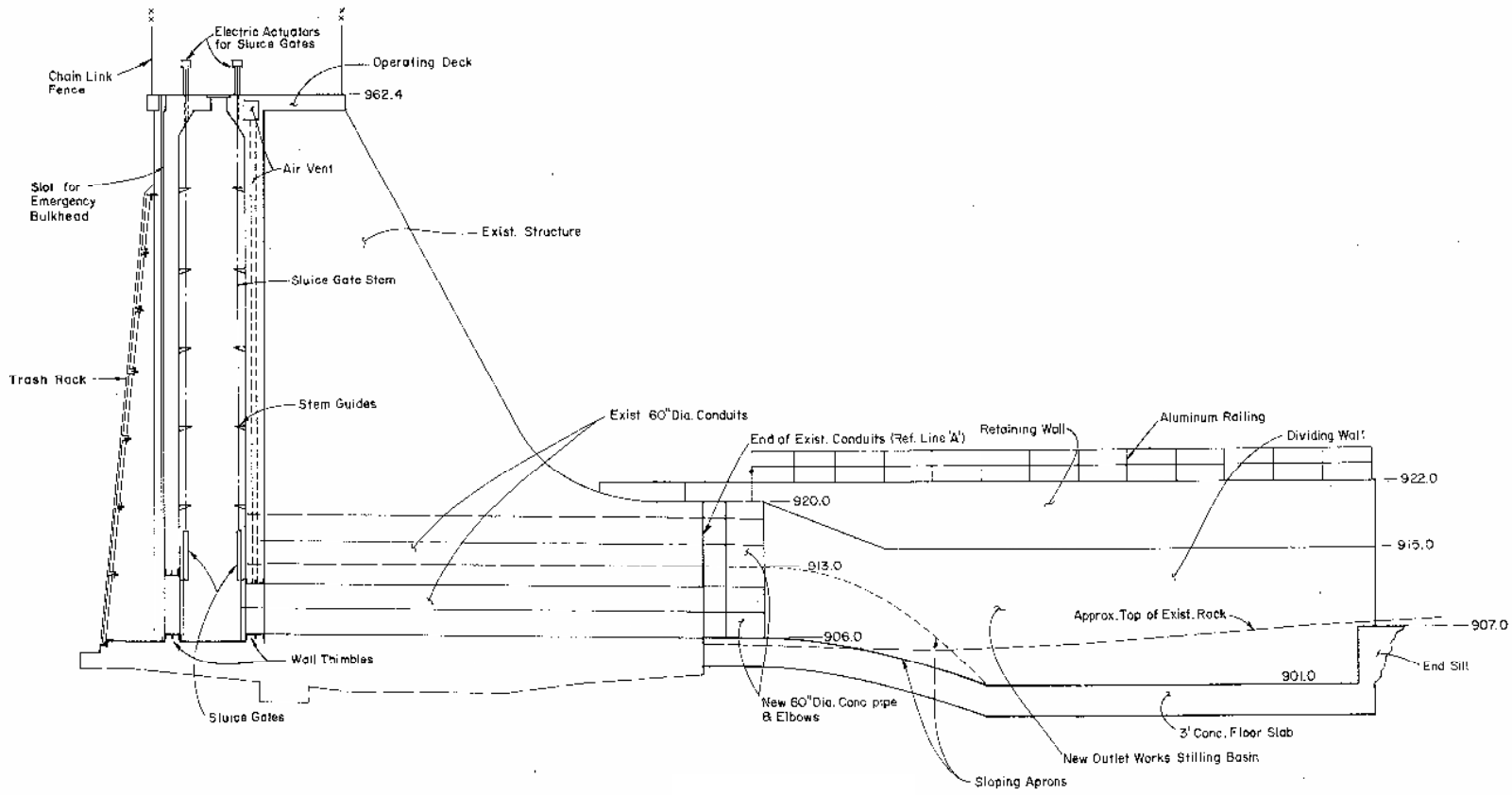
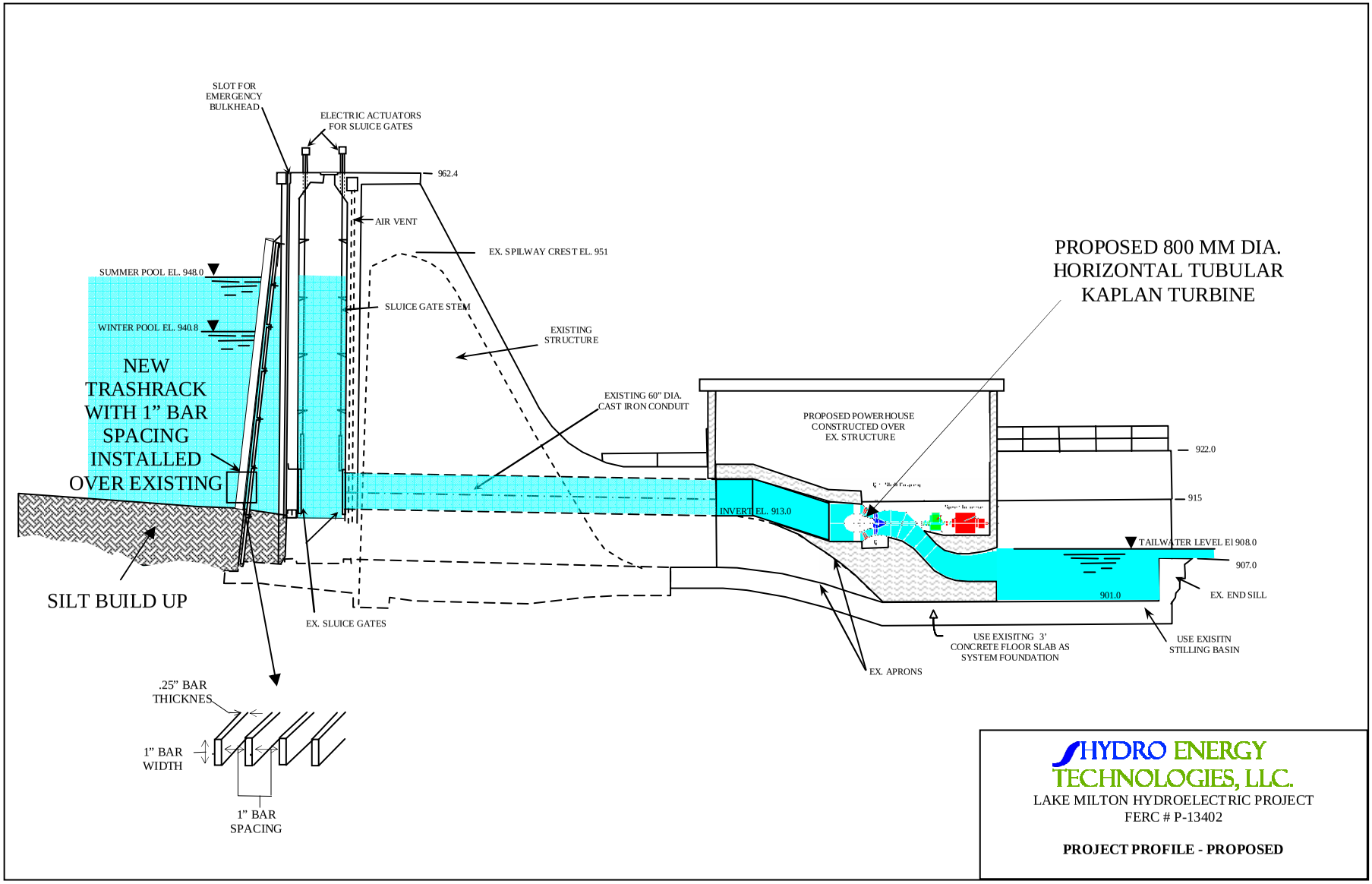


Figure 2-6 – Conceptual Sketch of Dam and Proposed Powerhouse



HYDRO ENERGY TECHNOLOGIES, LLC.
LAKE MILTON HYDROELECTRIC PROJECT
FERC # P-13402

PROFILE – EXISTING CONDITIONS


SLOT FOR EMERGENCY BULKHEAD
ELECTRIC ACTUATORS FOR SLUICE GATES
962.4
AIR VENT
EX. SPILWAY CREST EL. 951
SUMMER POOL EL. 948.0
SLUICE GATE STEM
WINTER POOL EL. 940.8
EXISTING STRUCTURE
NEW TRASHRACK WITH 1" BAR SPACING INSTALLED OVER EXISTING
EXISTING 60" DIA. CAST IRON CONDUIT
PROPOSED POWERHOUSE CONSTRUCTED OVER EX. STRUCTURE
PROPOSED 800 MM DIA. HORIZONTAL TUBULAR KAPLAN TURBINE
922.0
915
INVERT EL. 913.0
TAILWATER LEVEL El 908.0
907.0
901.0
EX. END SILL
SILT BUILD UP
EX. SLUICE GATES
USE EXISITNG 3' CONCRETE FLOOR SLAB AS SYSTEM FOUNDATION
USE EXISITN STILLING BASIN
EX. APRONS
.25" BAR THICKNES
1" BAR WIDTH
1" BAR SPACING
HYDRO ENERGY TECHNOLOGIES, LLC.
LAKE MILTON HYDROELECTRIC PROJECT
FERC # P-13402
PROJECT PROFILE - PROPOSED

Current flow operations at Lake Milton Dam were described by Robert Yue of the USACE Pittsburgh district in an email received by HET on January 20, 2010 attached below. Mean historical lake elevations are shown in Figure 2-7:

Anthony,

As you know, there are four 60" gate valves at Lake Milton. Gate Valves #1 & 2 are at invert 915 and Gate Valves #3 & 4 are at invert 908. Thus #1 & 2 have smaller discharge capacity. Lake Milton is operated at 942 or less during Jan-March. The lake starts to fill toward summer pool recreational pool of 948 from late March to 12 April and it remains at 948 through 15 Oct. From 15 October, it being drawdown slowly down to 942 by 20 Dec. On a 3-year trial basis, 2007-2010, the lake is being held at 940 or lower instead of 942. This is to check if the lower lake level helps in minimize the ice problems and if it has any negative impact in filling toward 948. So far this lower level seems to be ok for both aspects.

The discharge capacities for #1 & 2 GV's range from 0 to about 1500 cfs at 60" open. For the various target elevation the capacities (at 60" opening) are as follows:

Elevation	Discharge, cfs
942.0	620
948.0	690
952.0	740

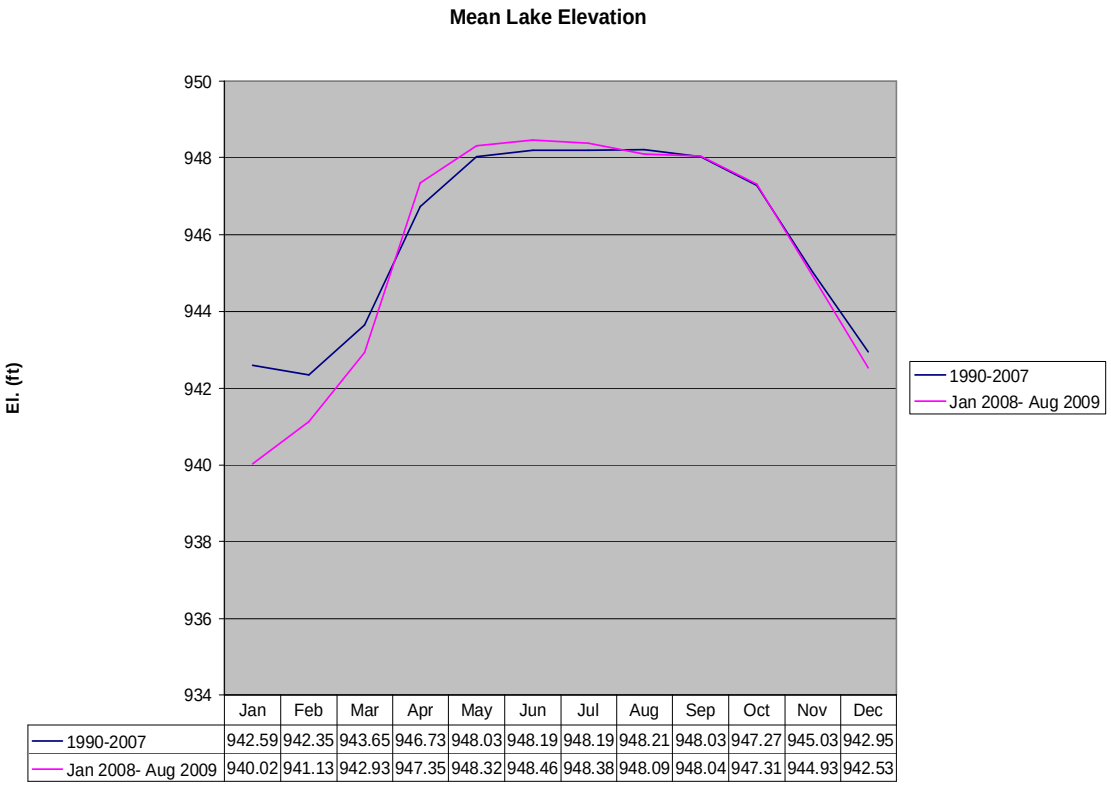
The discharge capacities for #3 & 4 GV's range from 0 to about 1600 cfs at 60" open. For the various target elevation the capacities (at 60" opening) are as follow:

Elevation	Discharge, cfs
942.0	700
948.0	770
952.0	810

The crest elevation is at 951.0

As for the operating schedule, Gate Valves #1 & 2 are used from May thru Oct and Gate Valves from #3 & 4 are from Nov thru April. The dates serve as guidelines.

The minimum flow requirement from Lake Milton is 25 cfs.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1990-2007	942.59	942.35	943.65	946.73	948.03	948.19	948.19	948.21	948.03	947.27	945.03	942.95
Jan 2008- Aug 2009	940.02	941.13	942.93	947.35	948.32	948.46	948.38	948.09	948.04	947.31	944.93	942.53

Figure 2-7 – Mean Historical Lake Elevations obtained from the USACE Pittsburgh District

The proposed flow operations during hydro operation do not modify lake elevations or discharge levels dictated by the USACE. The only modification is the timing of which gates are used (mainly November through April). Since the 250 cfs capacity turbine will be installed on gate 2, all flows up to 250 cfs are proposed to be discharged through gate 2 so that hydro power production can be continuous throughout the year. All flows above 250 cfs would be discharged through gates 3 & 4 from November to April and through gate 1 May through October. Table 2-3, Figure 2-8, and Figure 2-9 show how the proposed gate use schedule would differ from existing operations. The total flow use curve is shown in Table 2-4.

CURRENT DISCHARGE CAPACITY AT LAKE MILTON (CFS)					
Lake E. (ft)	**GV 1**	**GV 2**	**GV 3**	**GV 4**	**Total**
940	600	600	690	0	**1890**
942	620	620	700	0	**1940**
948	690	690	770	0	**2150**
952	740	740	810	0	**2290**

DISCHARGE CAPACITY WITH HYDRO (CFS)					
Lake E. (ft)	**GV 1**	**GV 2**	**GV 3**	**GV 4***	**Total**
940	600	250	690	690	**2230**
942	620	250	700	700	**2270**
948	690	250	770	770	**2480**
952	740	250	810	810	**2610**

Table 2-3 – Gate Discharge Capacity at Lake Milton (Current and with Hydro)
***Gate 4 is currently inoperable and will be repaired by HET if Hydro is approved.**

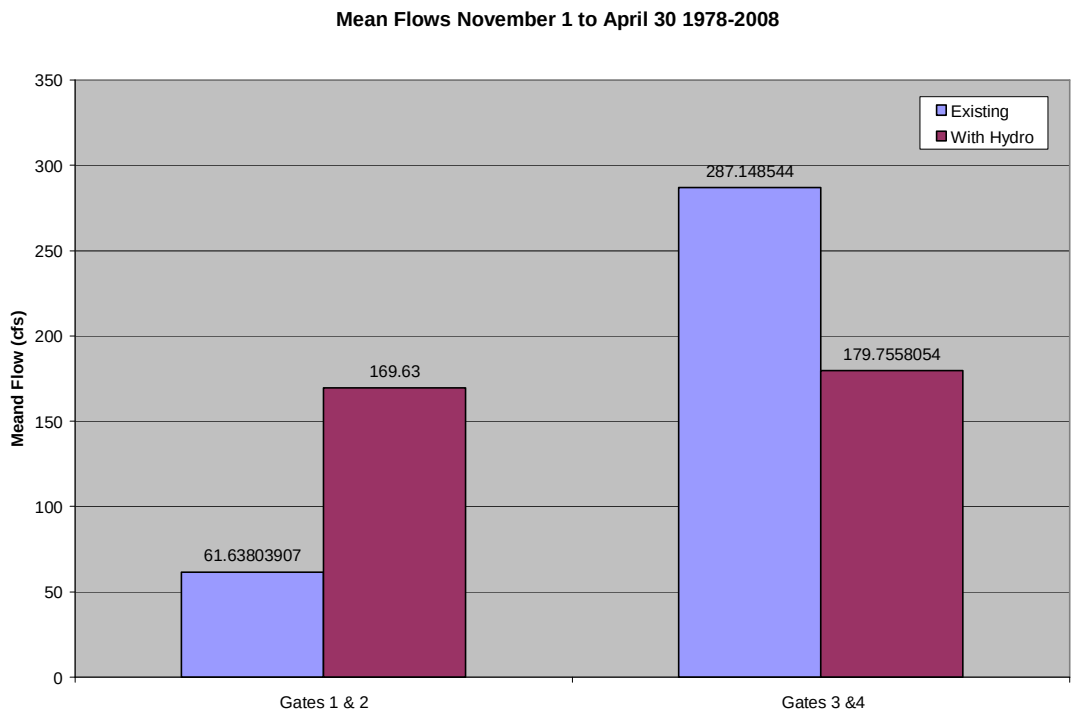


Figure 2-8

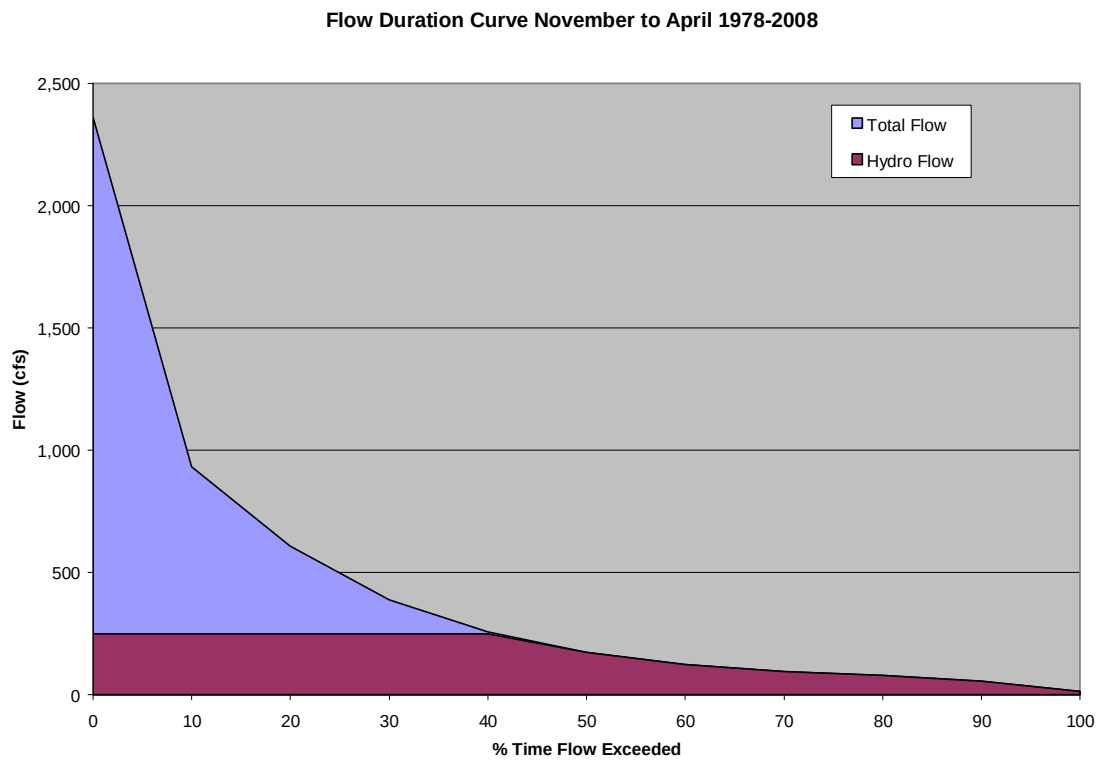


Figure 2-9

% Time Flow Ex.	Total Flow (cfs)	Hydro (cfs)	Other 60" Discharge Pipes (cfs)
0	2,430	250	2218
5	1,110	250	898
10	835	250	623
15	615	250	403
20	466	250	254
25	362	250	150
30	289	250	77
35	247	247	35
40	213	212	1
45	186	186	0
50	172	172	0
55	162	162	0
60	152	152	0
65	138	138	0
70	129	129	0
75	115	115	0
80	97	97	0
85	85	85	0
90	70	70	0
95	47	47	0
100	13	0	13

Table 2-4 – Total Flow Use Curve

3 METHODOLOGY

3.1 Desktop Evaluations of Entrainment and Turbine Mortality

Through the early-1990's, numerous field studies documented fish entrainment and turbine mortality trends at hydropower projects throughout the United States. These data were subsequently compiled into a comprehensive database of fish entrainment information by the Electric Power Research Institute (EPRI 1992). A review of existing entrainment studies and methodologies was also completed by the FERC (FERC 1995). Since the mid 1990's, the transfer of entrainment information from project to project utilizing the EPRI database has been widely accepted by state and federal resource agencies, including the FERC, United States Fish and Wildlife Service and National Marine Fisheries Service, as a means of providing "desktop" estimates of fish entrainment and mortality. In these studies, the estimated turbine-induced mortality rates (based on mortality studies for similar type turbines) were applied to the fish entrainment estimates to determine potential project-related losses to the local fisheries resource (FERC 1995). Well over 100 agency-accepted "desktop" analyses have been conducted since the 1990's. Some recent examples of agency-accepted assessments include: Markland Hydroelectric Project Desktop Fish Entrainment and Turbine Mortality Analysis (Kleinschmidt Associates 2008); Claytor Hydroelectric Project Fish Entrainment and Impingement Desktop Assessment (Normandeau Associates, Inc 2009); and Saluda Hydro Project Desktop Fish Entrainment and Turbine Mortality Report (Kleinschmidt Associates 2007). All entrainment studies, empirical or desktop, provide information that can be used to assess the effects of entrainment. Entrainment estimates however are influenced by multiple factors which are not well understood. Even empirically derived estimates can vary substantially from data collected during various

years and environmental conditions. Therefore, entrainment estimates should be viewed qualitatively in terms of potential effects rather than the emphasis being placed on specific numerical estimates.

The following sections detail the steps taken to calculate the potential annual estimated fish entrainment and potential turbine-induced mortality for the Lake Milton Project.

3.2 Entrainment

Fish entrainment at the Lake Milton Project was assessed through a desktop study, the goal of which was to provide an estimate of potential fish entrainment, using entrainment rates established at similar projects. The primary steps in this analysis include:

- Conduct a literature review to obtain information applicable to Lake Milton;
- Define the subset of empirical studies available to form an applicable database;
- Develop total average potential fish entrainment rates as a function of number of fish/unit flow volume from each of the selected sites from the database.
- Estimate the average annual turbine flows for the Lake Milton Project; and multiply the average flow at Lake Milton by the average entrainment/flow unit at each of the selected sites from the database to obtain annual entrainment estimate at Lake Milton.
- Use the entrainment database to qualitatively characterize entrainment risk by species, size and season based on 1” bar spacing.

3.2.1 Literature Review

A literature review was conducted to identify fish species, relative abundance, and fisheries management objective for the Lake Milton Site. Data was then assembled to characterize the fishery and provide qualitative ratings (%) of abundance. In addition, life history characteristics of the species present were researched to identify traits which could influence a species potential for entrainment. Such traits include habitat preferences and seasonal movement patterns. Existing entrainment studies were also identified in order to develop a database suitable for application to Lake Milton.

3.2.2 Define the Entrainment Database

Over forty (40) site specific entrainment studies that provide estimates of annual resident fish entrainment at hydroelectric sites in the United States have been reported by FERC (1995) (Appendix A). These studies were derived from the 1992 EPRI report entitled *Fish Entrainment and Turbine Mortality Review and Guidelines*. The EPRI Report includes descriptive information gathered from each entrainment study, which includes:

- Project name and FERC project number;
- Location: state and river;
- Project size: discharge capacity and power production;
- Trash rack spacing
- Project operation: e.g., peaking, run-of-river, etc.;
- Biological factors: fish species composition & size; and
- Impoundment characteristics: impoundment size, flow regime.

Specific studies were selected from the database were most applicable to the Lake Milton Project. Ideal criteria used in selecting specific studies were as follows:

- Similar geographical location, with preference given to projects located in the same basin;
- Similar station hydraulic capacity;
- Similar station operation (run-of-river);
- Biological similarities: fish species, assemblage and water quality;
- Similarities in bar spacing on the trash rack; and
- Availability of volume of flow sampled data in order to estimate fish entrained per unit of flow.

3.2.3 Methods used to Estimate Entrainment Quantity

Fish entrainment rates for the Lake Milton Project were estimated in "fish entrained per million cubic feet (mcf)" by calculating the number of fish entrained at each site chosen from the database divided by the total mcf sampled at each site. The calculated entrainment rates for each site were then averaged to create estimated entrainment rate at the Lake Milton site (Table 4-7: Source Studies Chosen to Estimate Quantitative Entrainment Rate). The total flow passing through the turbine during a typical year at Lake Milton was then calculated using the flow duration curve and the total flow use curve for the project (Table 2-4). The **total estimated annual number of fish entrained** for the Lake Milton Project was then calculated by multiplying the average fish entrainment rate (number of fish/mcf) by the annual volume of water estimated to pass through the turbine at the Lake Milton Project (mcf/year). Again the flow data used for these calculations are based on data from the USGS gaging station 03091500 on the Mahoning River located .3 miles downstream of the Milton Dam near Pricetown.

3.2.4 Methods used to Estimate Entrainment by Species, Month, and Size

Species composition in the project area was calculated (Figure 4-1) using the OEPA's 2006 -2007 sampling data. These figures were used to estimate the species composition by percentage of the total estimated fish entrained at Lake Milton. All three of the studies available in the EPRI database with 1" barspacing (Lake Algonquin, Ninth Street Dam, and the Tower Project) were used to create a general length frequency

analysis (Figure 4-9), a length frequency analysis based on species (Figure 4-10), a general entrainment by month analysis (Figure 4-15), and a monthly entrainment by species analysis (Figure 4-13).

3.3 Fish Impingement

Fish impingement potentially occurs however when water velocities trap or pin fish against the intake trash racks. If the fish cannot free itself from the trash racks, then mortality usually ensues. The potential for fish impingement is based on:

- The spacing between the trash rack bars;
- Intake velocities at the trash racks;
- Typical sizes (total length and critical width) of fish subject to impingement; and
- Swim speeds of species and size groups present.

HET proposes to use the existing intake and install a new trash rack screen with 1" bar spacing over the existing rack. The rack will be 15.5' x 36' and will cover the intakes to gates 1 & 2. Therefore flow through the new rack will include gates 1 & 2 and flows through gates 3 & 4 use an existing separate trash rack. The new trash rack will be used to prevent debris from moving into and damaging the turbine. The racks can also exclude those fish which are greater than 1 inch in width from entering the intake.

Several methods were used to assess risk of impingement to fish species. In addition to a desktop analysis, a field study was also conducted using a test rack and simulating hydro operation.

3.3.1 Impingement Field Study Methodology

3.3.1.1 Test Trashrack Design vs. Final Trashrack Design

The 6.5' x 19' test rack (Figure 3-1) is a smaller version of the final rack. It is built to be laid over the existing rack in front of gate 2 as shown in Figure 3-1. The final design is much larger (approximately 15.5 feet wide and 36 feet deep) and overlays the entire existing rack on gates 1 and 2. Both the test rack and the final rack shall have 1" clear bar spacing. Since the test rack covers approximately one third of the submerged portion of the existing rack, it will not represent the total fish impinged but a percentage of the fish that will be impinged with the final rack.

Figure 3-1- Photos of Test Rack and Existing Rack

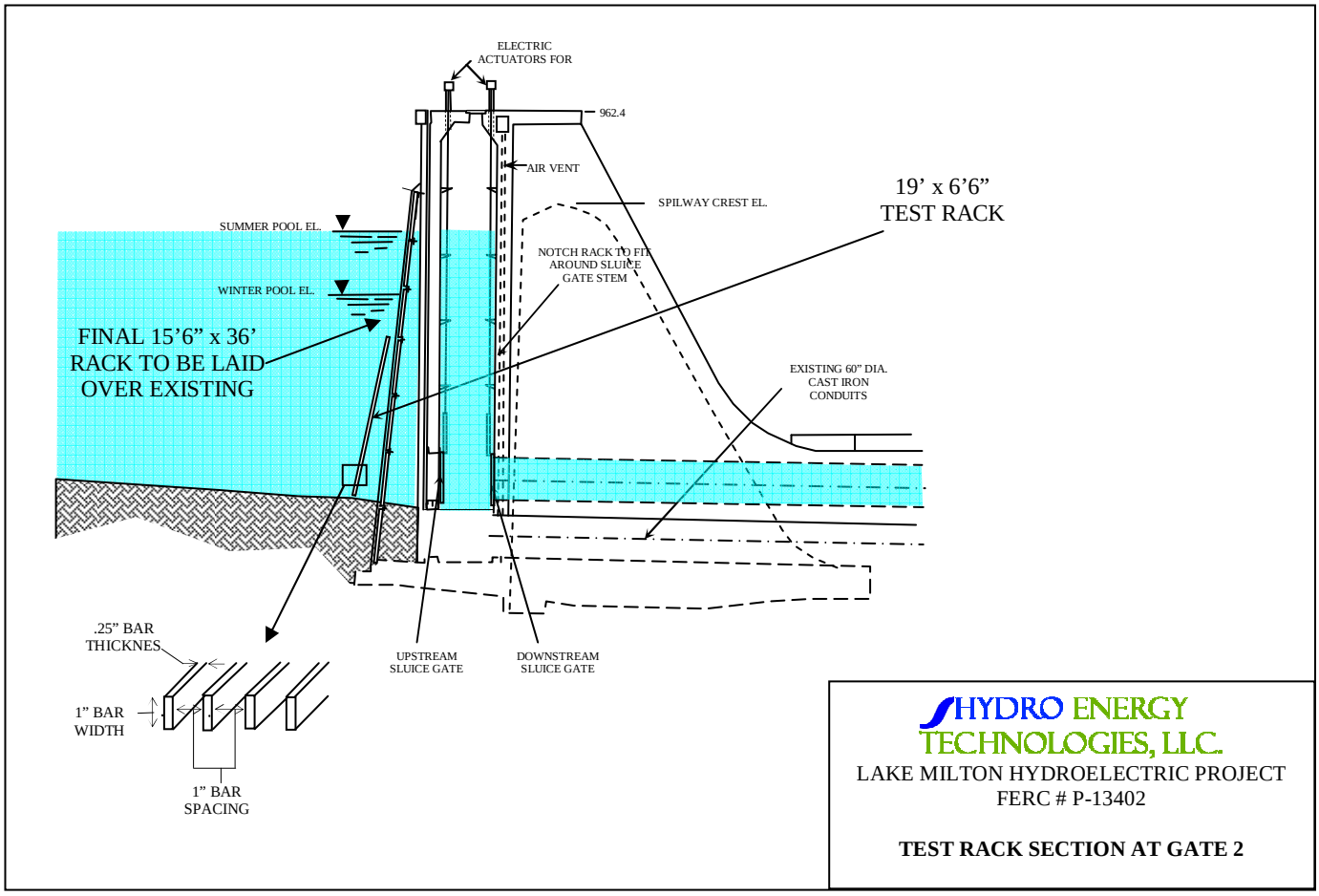


Figure 3-2 – Profile of Dam at Gate 2

3.3.1.2 Impingement Field Study Procedures

1. Drop test rack into place in front of gate 2 sluice using boom truck.
2. Coordinate discharge flows with USACE as proposed for simulated hydro operation:
    - Gate 2 becomes primary gate for all flows up to 250 cfs during fish study. Flows exceeding 250 cfs should be discharged through the 3 remaining gates as determined by the USACE.

3. Three methods will be used to check for impinged fish:
    a. **Float Check** - gates are closed and the dead fish float to the surface and are netted out.
    b. **Video Check** – An under water video inspection of the rack using a weighted "see snake" to visually confirm if impinged fish are present.

c. **Dry Check –** (Figure 3-3) The test rack is pulled up out of the water with a boom truck and checked and inspected directly for any wedged fish.

Figure 3-3: Test rack during a "Float Check" and "Dry Check" on 4/21/10 (no fish were observed to be impinged on the rack during this check – only leaves and debris)

4. Fish Collection: Live fish are released, dead fish are collected and photographed and measured.
5. Detailed Study Schedule:

<u>Spring Test Period - Begin March 17th end May 15th</u>

March 17th – Test Rack installed

March 26 – Float check
March 31 – Float check and video check
April 2 – Float check and video check
April 7 – Float check and video check
April 14 – Float check and video check
April 21 – Float check and Dry Check
April 28 – Float check
May 12 – Final float and dry check and remove rack with boom truck

Summer Test Period – Begin June 2nd End June 25th 1st

Day one
Drop test rack in place with boom truck.
One float check and one video check

Rest of Week 1
Two float checks and two video checks

Weeks 2 – 4
Modify fish check frequency based on previous results with approval from Mr. Hillman.

End of Week 4
Remove rack with Boom Truck.

Fall Test Period – Begin Sept 15 End Oct 15

Day one
Drop test rack in place with boom truck.
One float check

Rest of Week 1
Two Float checks and two video checks

Weeks 2 – 4
Modify fish check frequency based on previous results with approval from Mr. Hillman.

End of Week 4
Remove rack with Boom Truck.

3.3.1.3 Impingement Field Study Responsibilities

USACE (Pittsburgh District)

1. Simulate Hydro operation by using gate 2 for all flows up to 250 cfs during scheduled test periods

2. Notify HET of each flow modification during the scheduled test periods.

Lake Milton State Park

1. Provide HET with access to dam per the above schedule and witness of collection of impinged fish.

ODNR Div of Wildlife

1. Supervision of Fish study

HET

1. Conduct study as described above
2. Collect, maintain and distribute data from the study.

3.3.2 Impingement Desktop Methodology

It is likely that smaller fish which are not physically excluded by the trash racks can pass freely through a trash rack spacing of 1 inch (25 mm) at the Lake Milton Project. A study conducted at a hydro plant in North Carolina, which also is equipped with 1" bar spaced trash racks, found that a wide range of species 4" (100 mm) or less in length avoided impingement under a range of flow conditions (Tomljanovich, 1989).

Avoidance of fish entrainment and impingement problems at water intakes is related to fish size and swimming performance (Castro-Santos and Haro 2005). If fish are unable to negotiate the velocities experienced at the intakes, they can potentially become impinged and experience injuries or mortality. To determine this potential, a comparison between swim speed and intake velocities is required (Kleinschmidt Associates. 2008).

Mean water velocities (feet/second) through the trash rack were calculated by dividing the total flow through the rack (cubic feet/second) by the total area of the submerged[1] surface area of the trash rack (square feet). The flow duration curve, lake elevation curve, and the proposed gate use schedule were all taken into account for these calculations. The trash rack velocities were then compared with documented fish swim velocities to show the ability of different fish species to escape impingement. In general if swim speeds are above the trash rack velocity it is assumed the fish is able to escape impingement.

Additionally the USFWS (1989) developed a general formula for addressing entrainment and impingement at hydropower plants. The formula is as follows:

Critical Fish Length (ft) = Water Velocity (ft/sec)
Minimum sustained speed (3 to 7 Body lengths/sec)

[1] Note that the lake elevation affects the surface area of the submerged portion of the trashrack. The higher the lake elevation the lower the mean water velocity through the rack given the same flow.

Essentially this formula estimates the size at which fish would be expected to avoid the intake velocity. An analysis using this formula was also conducted to assess impingement risk at Lake Milton.

3.4 Turbine Mortality Rate Estimate

Proposed turbine characteristics of the Lake Milton Project were compared to those of potential source studies to identify appropriate turbine mortality rates. The Lake Milton Project will be equipped with a tubular horizontal or S-Type Kaplan-type turbine. Studies were chosen from the Turbine Mortality Database that have similar type, size, hydraulic capacity, and/or power capacity to the Lake Milton Project. The study information contained in Table 4-11 includes (where available): species, size class/range, number of fish (test and control), and survival results.

Turbine passage mortality rate estimates can be quite variable, but some trends have been recognized. For example, the size of a fish relative to the water passage-way within a turbine is important. In general, fish size rather than species is the critical factor influencing turbine mortality for a given turbine. Simply stated, fish that are small, relative to the passage-way tend to survive at higher rates than large fish. Between different turbines, a number of factors play a role such as the number of turbine blades, turbine speed, and turbine diameter (Heisey et al 1996).

3.4.1 Calculation of Turbine Mortality Estimate

For purposes of this report, turbine mortality is defined as turbine interaction with a fish that results in fish mortality. Turbine mortality rates selected for the target Project were sorted by site and fish size. Species tested is also identified for each study.

Turbine mortality was estimated based on fish size by plotting the results for each study on a graph to create an estimated turbine mortality curve at Lake Milton. Using this curve as well as the entrainment data (estimated entrainment quantity, species composition, and size composition estimated to be entrained for each species) total annual turbine mortality was calculated for each size and species.

For example: *total fish entrained * percent of a particular species entrained * percent of a particular size entrained for that particular species * estimated turbine mortality for fish of that particular size = total number of fish killed for that particular size and species*

3.5 Fish Compensation Estimate

The total compensation to be paid for fish mortality was calculated using the chart provided by ODNR Division of Wildlife titled “Wild Animal Prices” (Table 3-1). The

estimated number of fish killed by the turbine for each species and size was multiplied by the appropriate rate shown in the ODNR Wild Animal Price List.

Compensation for fish mortality due to impingement was not calculated as this will be paid per documented occurrence. Impingement is easier to account for during operation as impinged fish remain on the rack and can be recovered, measured and documented whereas fish killed by the turbine float downstream and are lost and unlikely to be reported. Entrainment/turbine mortality compensation could therefore be paid according to the estimate in this study on a yearly basis to the ODNR DOW.

Table 3-1 ODNR DOW fish compensation rates used for this study

DEC-17-2009 12:41 FROM-DIV.OF WILDLIFE #3 +330-644-8403 T-153 P.002/002 F-342

Ohio Department of Natural Resources, Division of Wildlife

Inservice Document 22 (R304)

WILD ANIMAL PRICES

Size Up to (inches):	Bullheads	Channel & Flathead Catfish	Muskie/ Pike	Gar/ Bowfin	Carp/ Quillback	Sucker	Buffalo	Pickerel	Rainbow/ Steelhead Trout	Brown/ Brook Trout	Walleye/ Saugeye/ Sauger	Drum	White Bass	Black Bass	Shad	Crappie	Sunfish	Yellow Perch/ Darters
2	0.25	0.28	2.00	0.95	0.09	0.41	0.15	0.52	0.25	0.13	0.15	0.13	0.36	0.46	0.12	0.39	0.35	0.33
3	0.50	0.28	3.00	0.95	0.09	0.95	0.15	0.52	0.46	0.30	0.35	0.13	0.58	0.79	0.12	0.53	0.44	0.49
4	0.61	0.42	4.00	0.95	0.09	0.95	0.15	0.90	0.56	0.32	0.74	0.21	0.71	0.92	0.12	0.72	0.62	0.64
5	0.76	0.48	5.00	1.19	0.09	0.95	0.27	1.00	0.76	0.60	0.87	0.21	0.89	1.03	0.12	0.80	0.78	0.76
6	0.83	0.58	6.00	1.19	0.09	1.19	0.27	1.43	0.83	0.62	1.18	0.21	1.07	1.76	0.12	1.03	1.09	0.94
7	1.63	0.63	7.00	1.19	0.18	2.37	0.36	1.94	1.06	1.03	1.62	0.32	1.24	2.16	0.12	1.58	1.54	1.36
8	1.80	0.64	8.00	1.66	0.18	2.37	0.36	2.11	1.11	1.14	1.79	0.32	1.42	2.61	0.12	1.58	2.43	2.33
9	2.30	0.84	9.78	1.66	0.21	2.37	0.36	2.29	1.33	1.15	1.97	0.45	1.60	3.10	0.12	2.79	2.43	3.16
10	3.00	0.84	11.55	2.37	0.27	2.37	0.49	2.37	1.56	1.28	2.95	0.45	1.78	3.39	0.12	3.25	3.06	3.27
11	3.45	0.88	13.33	2.37	0.32	2.37	0.57	6.75	2.06	2.18	4.83	0.53	1.96	4.75	0.12	4.75	4.20	4.35
12	4.52	0.88	24.00	2.37	0.35	2.37	0.70	8.13	2.27	2.56	6.25	0.62	2.13	4.75	0.12	4.84	5.60	5.77
13	5.79	1.07	24.00	2.37	0.45	3.56	0.91	8.13	2.69	2.70	6.25	0.81	2.72	5.88	0.12	6.32	7.30	7.47
14	7.29	1.25	24.00	3.56	0.55	4.55	1.15	8.13	3.12	3.21	7.89	1.02	3.42	7.45	0.12	8.09		9.48
15	9.04	1.43	24.00	4.40	0.68	5.57	1.42	8.13	3.31	3.73	9.82	1.28	4.23	9.29	0.12	10.18		11.85
16	11.04	1.77	24.00	4.93	0.82	6.73	1.74	8.13	3.42	3.73	12.06	1.57	5.16	11.41	0.12	12.62		14.60
17	13.33	2.16	24.00	6.08	0.98	8.05	2.10	16.00	3.42	3.73	14.62	1.91	6.22	13.85	0.12	15.44		17.76
18	15.92	2.60	24.50	7.40	1.15	9.52	2.51	36.00	3.42	3.73	17.54	2.29	7.42	16.62	0.12	18.68		21.36
19	18.83	3.11	24.50	8.92	1.35	11.16	2.97	48.00	17.74	3.73	20.83	2.73	8.76	19.75	0.12			
20	22.08	3.68	24.50	10.64	1.57	12.98	3.49	64.00	20.71	21.71	24.52	3.21	10.26	23.26	0.12			
21		4.32	25.00	12.59	1.81	14.98	4.06		24.00	25.08	28.63	3.76	11.92	27.18				
22		5.04	25.00	14.79	2.07	17.18	4.70		27.63	28.79	33.20	4.36	13.76	31.53				
23		5.84	25.00	17.24	2.36	19.57	5.40		31.60	32.83	38.24	5.03	15.78	36.34				
24		6.71	25.00	19.96	2.67	22.18	6.16		35.95	37.24	43.78	5.56	17.99	41.63				
25		7.68	25.00	22.98	3.01	25.01	7.00		40.67	42.02	49.85	6.57	20.40	47.42				
26		8.74	25.00	26.31	3.38	28.07	7.91		45.79	47.20	56.47	7.45						
27		9.90	51.47	29.97	3.77	31.36	8.90		51.33	52.78	63.67	8.40						
28		11.16	58.08	33.97	4.19	34.90	9.96		57.29	58.77	71.48	9.44						
29		12.52	65.27	38.34	4.64	38.69	11.12		63.71	65.21	79.92	10.56						
30		14.00	73.06	43.10	5.13	42.75	12.36		70.58	72.09	89.01	11.78						
31		15.60	81.47	48.26	5.64		13.69		77.94		98.80							
32		17.32	90.55	53.84	6.19		15.11		85.79		109.29							
33		19.17	100.30	59.87	6.77		16.63		94.16		120.53							
34		21.15	110.77	66.36	7.39		18.25		103.06									
35		23.26	121.98	73.34	8.04		19.98		112.50									
36		25.53	133.95	80.82	8.73		21.81											
37		27.94	146.73	88.83	9.46		23.76											
38		30.50	160.33	97.39	10.22		25.82											
39		33.23	174.80	106.52	11.03		28.00											
40		36.12	190.15	116.24	11.87		30.30											
41		39.18	206.42		12.76		32.72											
42		42.21	223.64		13.69		35.28											
43		45.83	241.84		14.67		37.96											
44		49.44	261.05		15.68		40.78											
45		53.24	281.31		16.75		43.74											
46		57.23	302.63		17.86		46.85											
47		61.44	325.07		19.02		50.10											
48		65.85	348.64		20.22		53.50											
49		70.48	373.38		21.48		57.05											
50		75.33	399.32		22.78		60.76											

Species	Price per Animal
Minnow	0.07
Crayfish	0.35
Adult Frog	3.10
Tadpole	0.27
Asian Clam	0.05
Freshwater Mussel	Price by species per A.F.S.
Snail	0.25
Salamander or Newt	2.10
Leech	0.17
Turtle	Price by species Current Market Value
Hellgrammite	0.25
Freshwater Eel	2.37
Endangered/Threatened Wild Animal	1000.00

3.6 Project Fishery Resource and Estimated Species Composition

Species composition was estimated using the OEPA 2006-2007 collected fish samples from the Mahoning River from river mile 70.7 to 58.1 (figure 3-5). The proposed project is located at RM 63. This data was used to create a pie chart of species composition in the project area (Figure 4-1). These general species composition figures were used to create species compositions of entrainment, impingement and fish passage.

Proximity of Mahoning River sampling locations to Berlin Lake and Lake Milton.

Figure 3-4

3.7 Fish Passage Analysis

Fish passage was estimated by subtracting the estimated number of fish killed by the proposed turbine from the total number of fish entrained for each species and size. However this does not represent the total fish passage as opportunities will exist 35 - 40% of the time for fish to pass through one of the three remaining gates without a turbine (Figure 2-9). To account for this additional fish passage the estimated fish entrained/mcf at Lake Milton was multiplied by the mean annual flow in mcf through the remaining three gates. The two figures were then added to represent the total estimated annual fish passage. This figure is then compared to the estimated passage without the turbine installed on gate 2 which was calculated without subtracting the estimated number of fish killed by the proposed turbine.

Fish unable to pass through the new trash rack covering gates 1 and 2 with 1" bar spacing will be able to pass through gates 3 or 4 which have 5.3" bar spacing on upper portion of rack and 22.5" bar spacing on the lower portion of the rack. Gates 3 or 4 will be available for fish passage[2] approximately 40% of the time from November to April. The end result is approximately 60-65% less opportunity for large fish to pass downsteam. It should be noted that in the joint meeting held December 16, 2009 Phil Hillman of the ODNR DOW indicated he was not opposed to less of the larger fish being passed down stream. No evidence was found that fish passage occurs upstream through the dam.

4 RESULTS AND DISCUSSION

4.1 Project Fishery Resource and Estimated Species Composition

Lake Milton has good populations of walleye, largemouth bass, bluegill, crappies, and channel catfish, plus fair populations of smallmouth bass, brown bullhead, yellow perch, white bass, suckers, and muskellunge. Walleye and surplus muskellunge are stocked by the Division of Wildlife of the Ohio Department of Natural Resources. Fishing in April, May, and June produces good to excellent catches of largemouth bass, walleye, and crappies (ODNR, 2010).

[2] Gates 3 and 4 are currently inoperable but would be repaired by HET if hydro is approved.

Composition of Fish Species in the Mahoning River from RM 70.7 to 58.1 from EPA 2006-2007 Sampling

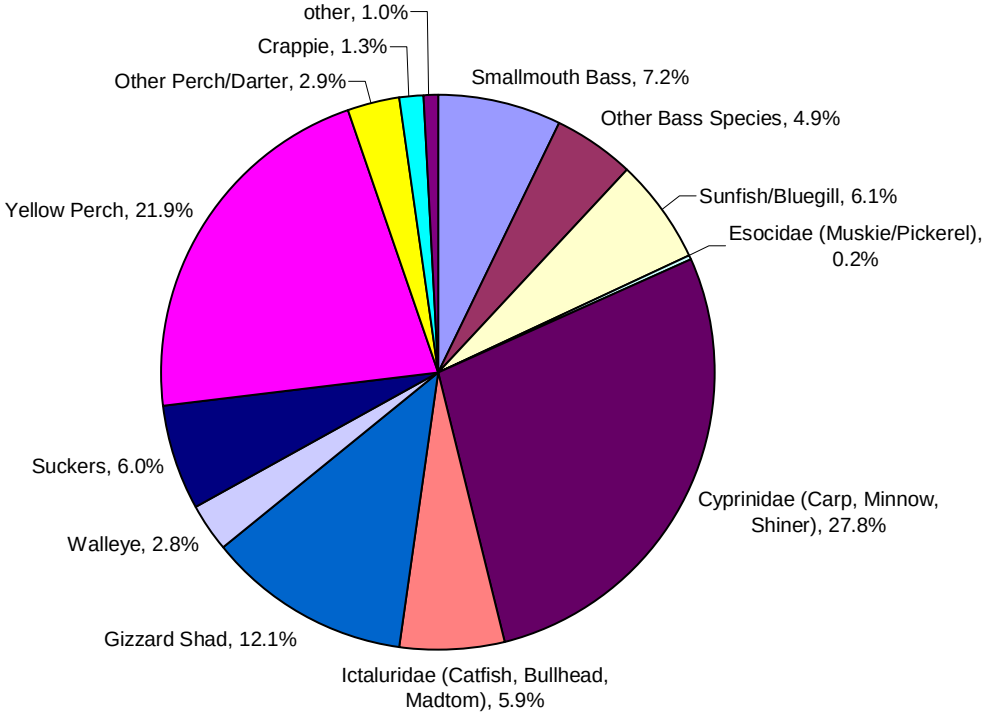


Figure 4-1

Channel Catfish generally occur over a broad range of environmental conditions, but prefer warm water temperatures with high productivity and abundant cover. Overwintering habitat consist of deeper water with boulder and debris. In a lacustrine habitat, adults favor reefs and deep, protected areas with rocky substrates. Feeding usually occurs at night along the shoreline or in tributaries to the reservoir. Channel catfish spawn in late spring and early summer once water temperatures reach 21°C in areas of abundant cover. Strong orientation to cover and preference for shallower habitats limits the channel catfish exposure to entrainment (McMahon 1982).

Smallmouth Bass typically spawn in the spring from April through June when water temperatures range from 58 to 70°F. Generally, males construct nests near the shore in a depth of 30-60 cm, on firm bottoms and often adjacent to cover. After hatching, young bass remain in shallow habitats following termination of parental care. Fry and juveniles inhabit areas of calm shallow, fringe areas with rocks and vegetation. After spawning, adult smallmouth bass are often found in littoral areas in the summer and fall and move into deeper waters in the winter that are away from vegetation (Scott and Crossman 1973). When water temperatures drop to 20°C, adults will seek deep dark areas (McMahon 1982). Adult smallmouth bass may be susceptible to entrainment because of their preferences to deep waters throughout the winter. During warm weather month, they would

likely inhabit the littoral zone and young of the year (YOY) would be found in near shore areas associated with object cover.

Largemouth Bass (*Micropterus salmoides*) prefer lacustrine environments with soft bottoms that can grow submerged aquatic vegetation (Scott and Crossman 1973). Largemouth bass will spawn in the spring when water temperatures typically reach 16 to 22°C, over gravel substrate in shallow areas. Entrainment of largemouth bass in the spring at Lake Milton may be limited due to their preferences of shallower habitats; however entrainment potential may increase in the winter months due to warm water preferences in deeper waters of the lake. During warmer months, largemouth bass would be found in the littoral zone near object cover. The YOY would be associated with near-shore shallows and object cover.

Rock Bass prefer clear, cool and warm waters; they inhabit pools and backwaters of creeks streams, rivers and reservoirs. The habitat preferences of rock bass are very similar to smallmouth bass, but tend to prefer slower moving waters. Rock bass typically do well in both vegetated and unvegetated lakes. Spawning typically occurs between April and July when water temperatures range from 15.6 to 26°C. Males build nests in shallow areas with course sand to large gravel substrate. It is likely that juvenile and adult rock bass abundance would be highest in coves where habitat is less than 5 meters deep (Scott and Crossman 1973).

Gizzard shad are primarily residents of shallow, littoral habitats. Spawning typically occurs in the spring, beginning in mid-May (Ney et al. 1988). Gizzard shad primarily spawn in littoral areas favoring coves over main channel sites. Gizzard shad will succumb or become moribund at prolonged water temperatures below about 3°C (37°F) (Williamson and Nelson 1985). Young gizzard shad typically pass out of temperate reservoirs during fall and early winter as their lower temperature threshold is approached and swimming ability is reduced or lost. The loss of swimming ability creates their susceptibility to entrainment, and as a result fall/winter gizzard shad entrainment peaks are typical in reservoirs where they are abundant (FERC 1995). One behavioral factor of note is that shad are a schooling species. Because of this behavior, gizzard shad when entrained, may be entrained in large numbers.

Figure 4-2 – Gizzard Shad floating below the Lake Milton Dam December 16, 2009

Walleye prefer clear to slightly turbid waters of large lakes and rivers. They usually occur in greatest abundance over reefs, shoals of gravel, bedrock, and other firm bottoms. Although walleye can naturally reproduce in Ohio reservoirs, natural reproduction is not sufficient to maintain the fishery; therefore, each year the Division of Wildlife stocks Lake Milton with Walleye fry and fingerlings to maintain high-quality fishing. Walleye produced naturally are typically considered a "bonus" in these waters (ODNR 2010).

Walleye spawning occurs in the spring between water temperatures 6 to 11°C in shallow shoreline areas with rocky substrate and water circulation from wave action or currents. Walleye that inhabit reservoirs will typically migrate up rivers to spawn. Demersal fry, juveniles and adults are photosensitive and will inhabit deep or turbid water or may find shelter under boulders, log piles, brush or dense beds of submerged vegetation during the day and will move inshore at night. Adult and juvenile walleye may be susceptible to entrainment as they inhabit deeper waters during the day due to photosensitivity. During the winter walleye will seek out deeper areas where forage fish congregate in search of warmer water (Scott and Crossman, 1973).

Muskellunge, typically referred to as "muskie", are stocked in Lake Milton by the Ohio Division of Wildlife. On average nearly 1650 fingerlings (approximately 1 fish per acre per year) are stocked in Lake Milton each September ranging in size from 8 to 10 inches. Muskie are native to Ohio and naturally reproduce in a limited number of streams along Lake Erie and the Ohio River. Prime Muskellunge habitat is found in heavily vegetated lakes with lots of tree stumps and bays. Prime stream muskellunge habitat is generally considered to be long pools (at least 0.2 miles in length) with a minimum depth of at least three to four feet and an abundance of submerged woody structure. Muskellunge usually spawn in April and early May when water temperatures are in the low to mid-50s. Females will lay as many as 200,000 eggs on soft shallow substrate where they adhere to vegetation and other objects. After hatching, young muskellunge feed on microscopic animals until they are large enough to switch over to feeding on fish. Limited natural reproduction occurs in Lake Milton. Muskellunge is listed as Ohio Status: Sport fish and species of concern (ODNR, 2010).

As indicated by the reported catch of Muskellunge in Lake Milton compared to the rest of the Mahoning River down stream of the dam (Figure 4-1), passage of muskellunge through the Lake Milton Dam is rare. This may be in part due to the deep intake elevation and the Muskie's preference for vegetative cover, as well as its size, strength and swimming ability. Due to the size of this species entrainment is not likely through 1" inch bar spacing (Figure 4-9).

Table 4-1 - Reported Muskie Catch (ODNR, 2010)

Year	Caught In Lake Milton	Caught in Mahoning River
1999	34	0
2000	27	0
2001	71	0
2002	44	0
2003	135	0
2004	84	0
2005	133	0
2006	239	0
2007	175	0
2008	176	0
2009	109	12
Total	**1227**	**12**
1988 to Present	**2311**	**12**
>30" in Length	**86%**	**91%**

Yellow Perch is found primarily in lakes, reservoirs, and occasionally in slow moving streams. They are most common in Lake Erie and in some of Ohio's larger reservoirs. They prefer relatively clear water and are often associated with rooted aquatic vegetation. Yellow perch spawn from mid-April to early May by depositing their eggs over vegetation or submerged brush and give no parental care (ODNR, 2010).

Black Crappie prefer clearer water and more aquatic vegetation than white crappie. They are also less tolerant of silt and turbidity than are white crappie. Crappie spawn during May and June in Ohio. Males construct a nest by fanning out small depressions on the bottom in and around brush, rocks, or vegetation in water between one and five feet deep (ODNR, 2010).

White Suckers show little preference for a particular habitat and can be found in nearly every lake, reservoir, river and stream in Ohio. White suckers also are very tolerant of pollution, turbidity (muddy water), and low oxygen levels. White suckers spawn from April to early May when they run upstream, usually starting at night. They seek areas with swift water and a gravel substrate to randomly spread their eggs. The young hatch and remain in the gravel for one to two weeks before migrating downstream at night (ODNR, 2010). Suckers may be susceptible to entrainment at Lake Milton due to their bottom feeding behavior and high tolerance of low oxygen levels.

Bluegill/Sunfish are most abundant in clear lakes and ponds that have some rooted aquatic vegetation. They are usually not the dominant sunfish species in most streams but do make up a portion of the over all sunfish population in nearly every stream. Both bluegill and green sunfish readily hybridize with other species of sunfish, most often each other. Hybrids between two other sunfish species are relatively rare. Bluegill sunfish typically build nests in large groups, or colonies. They spawn multiple times between May and August. Peak spawning, in Ohio, usually occurs in June. Males select an area in one to four feet of water and sweep out a saucer shaped nest with their tails (ODNR, 2010).

4.2 Fish Impingement Results

4.2.1 Desktop Study Results and Analysis

The estimated trash rack velocities are shown in Figure 4-3 and Figure 4-4 below. Documented Swim speeds (Table 4-2) for several species, including largemouth bass, smallmouth bass, bluegill and walleye were obtained. Documented swim speeds of other relevant species were not found and were assessed using the USFWS formula described in the desktop impingement analysis methods (Table 4-3).

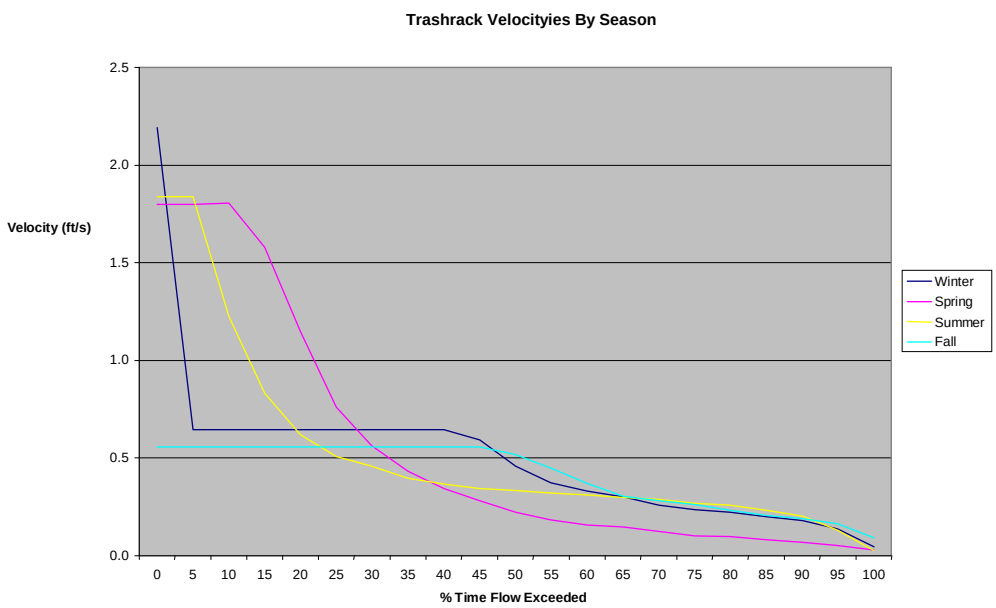


Figure 4-3

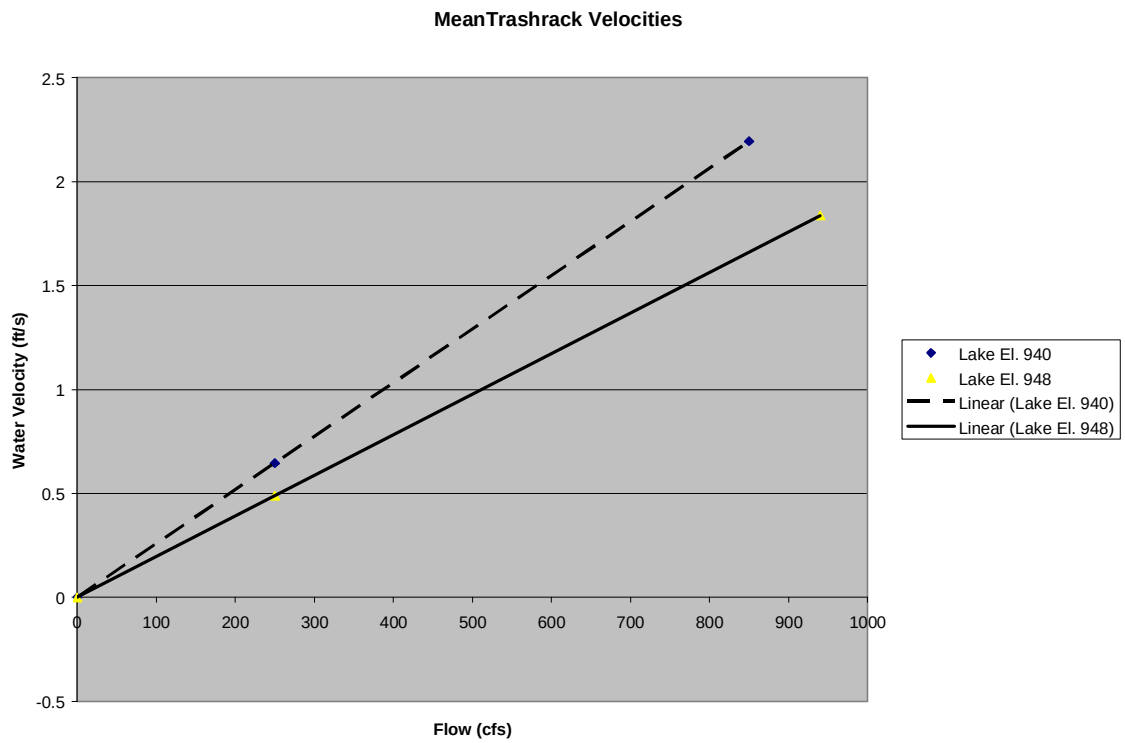


Figure 4-4

Table 4-2 Documented Swim Speeds for Select Species

Species	Life Stage	Fish Size	Swim Speed (ft/s) Max Sustained	Prolonged or Critical	Burst or Startle	Literature Souce - comments - clarification
Largemouth	Large Juv	5.9 to 10.6		1.8 to 2.17		Beamish 1970 (cited in Beamish 1978); prolonged at 10 to 30 C.
Smallmouth	Adult	10.3 to 14.9 in TL		1.6 to 3.9		Critical swim speed, U-crit-10 min @ 15 to 20 C; Bunt et al. 1999.
Walleye	Large Juv	12.5 in FL			11	Haro et al. 2004; @ 10.3 C; able to enter fishway at this velocity,
	Adult	15 in FL		2.74		Jones et al. 1974; critical swim speed @ 18 to 20 C for 10 min
	Juv	6.3 in FL			6.02	Fast-start or startle speed; calc. from formula in Peake et al. 2000.
	Adult	13.8 in FL			7.2	Fast-start or startle speed; calc. from formula in Peake et al. 2000.
	Adult	22.2 in FL			8.57	Fast-start or startle speed; calc. from formula in Peake et al. 2000.
Bluegill	Adult	8 in	1			Deng et al. 2004
	Adult	4 to 6 in		1.22		Critical swim speed for 10-min; Gardner et al. 2006

In regards to the USFWS formula, a minimum sustained swimming speed of 3 to 5 body length/sec is considered to be conservative and 6 to 7 body lengths/sec is more liberal (i.e., closer to burst swimming speed). Using this formula, at 3 body length/sec, a 300 mm fish would be capable of sustaining a swimming speed of 3 ft/sec. Using a higher burst speed of 6 body lengths/sec with a fish length of 300 would yield a swimming speed of 6 ft/sec. Table 4-3 describes the swimming performance for both sustained swimming speeds (3 to 5 body lengths) and burst swimming speeds (6 to 7 body lengths) for each length frequency group using this equation.

Table 4-3: Swimming Speeds of Fish for Each Length Frequency Group (shaded areas indicate susceptibility to impingement at peak intake velocity but not during average intake velocity). Fish 4 inches or less are not shaded as they are not likely to be impinged regardless of velocity (Tomljanovich, 1989).

Swim Speed (body lengths)	FISH LENGTH (inches)														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Sustained Swim Speeds	**SWIMMING SPEEDS (FT/S)**														
3	0.24	0.5	0.8	0.99	1.26	1.5	1.8	2.1	2.25	2.5	2.76	3	3.3	3.27	3.75
4	0.32	0.6	1	1.32	1.68	2	2.4	2.8	3	3.3	3.68	4	4.4	4.36	5
5	0.4	0.8	1.3	1.65	2.1	2.5	3	3.5	3.75	4.2	4.6	5	5.5	5.45	6.25
Burst Swim Speeds	**SWIMMING SPEEDS (FT/S)**														
6	0.48	1	1.5	1.98	2.52	3	3.6	4.2	4.5	5	5.52	6	6.6	6.54	7.5
7	0.56	1.1	1.8	2.31	2.94	3.5	4.2	4.9	5.25	5.8	6.44	7	7.7	7.63	8.75
Peak Intake Velocity = 1.8 ft/s @ Lake EL. 948 and 2.2 ft/s @ EL. 940 Average Intake Velocity = 0.5 ft/s															

According to the USFWS formula slower species of fish such as bluegill/sunfish 5 to 8 inches in length are most susceptible to impingement during peak intake velocities. Fish smaller than 4 inches are not likely to be impinged regardless of velocity or swim speed (Tomljanovich, 1989). The 8 to 10 inch muskie that are stocked each year are not at significant risk of impingement according to the USFWS formula. With each inch the muskie fingerlings grow, the risk of impingement is reduced even further.

4.2.2 Field Study Results and Analysis

The results of the impingement field study (Table 4-4) were consistent with the results of the desktop study as the only fish impinged was an 8" sunfish (the identified size and species at risk). The sunfish (Figure 4-7) was noted to be impinged with the video camera and did float to the surface during the float check to be collected. Although injured, the fish was still breathing and was released back into the lake after measurement. Figure 4-5 and Figure 4-6 graph the flow through the trash rack as well as the mean velocity at the rack during the study. The 8" sunfish is the only fish that has been impinged during the study[3] as of May 6, 2010. A total annual impingement was estimated (Table 4-5) by multiplying the total fish impinged per mcf during the field study times the total mcf expected to pass through gates 1 and 2 during a year. The smaller size of the test rack was accounted for by multiplying the fish impinged/mcf by 4.17 since the test rack covered approximately 24% of the area the proposed trash rack would have covered during the study.

Table 4-4: Results of Lake Milton Impingement Field Study

Date	Check type (float-f, video-v, dry-d)	Apprx. Lake EL. (ft MSL)	Flow though gate 1 (cfs)	flow through gate 2 (cfs)	combined flow gates 1 and 2 (cfs)	fish impinged	Park/ODNR employee Present
3/17/2010	Test Rack Installed	944	76	0	76	n/a	Yes
3/26/2010	f	948	630	630	1260	0	Yes
3/31/2010	f,v	948	284	284	568	0	Yes
4/2/2010	f,v	948	131	0	131	1	Yes
4/7/2010	f,v	948	123	0	123	0	Yes
4/14/2010	f,v	948	96	0	96	0	Yes
4/21/2010	f,d	948	106	0	106	0	Yes
4/28/2010	f	948.8	297	297	594	0	Yes
Total						**1**	

[3] It should be noted that an uncounted quantity of 4" Gizzard Shad were floating prior to shutting gates at the intake during the March 26th and March 31th float checks, but were not included in the results as the cause of death for Gizzard Shad this size floating prior to shutting gates was not likely to be impingement (Tomljanovich, 1989)

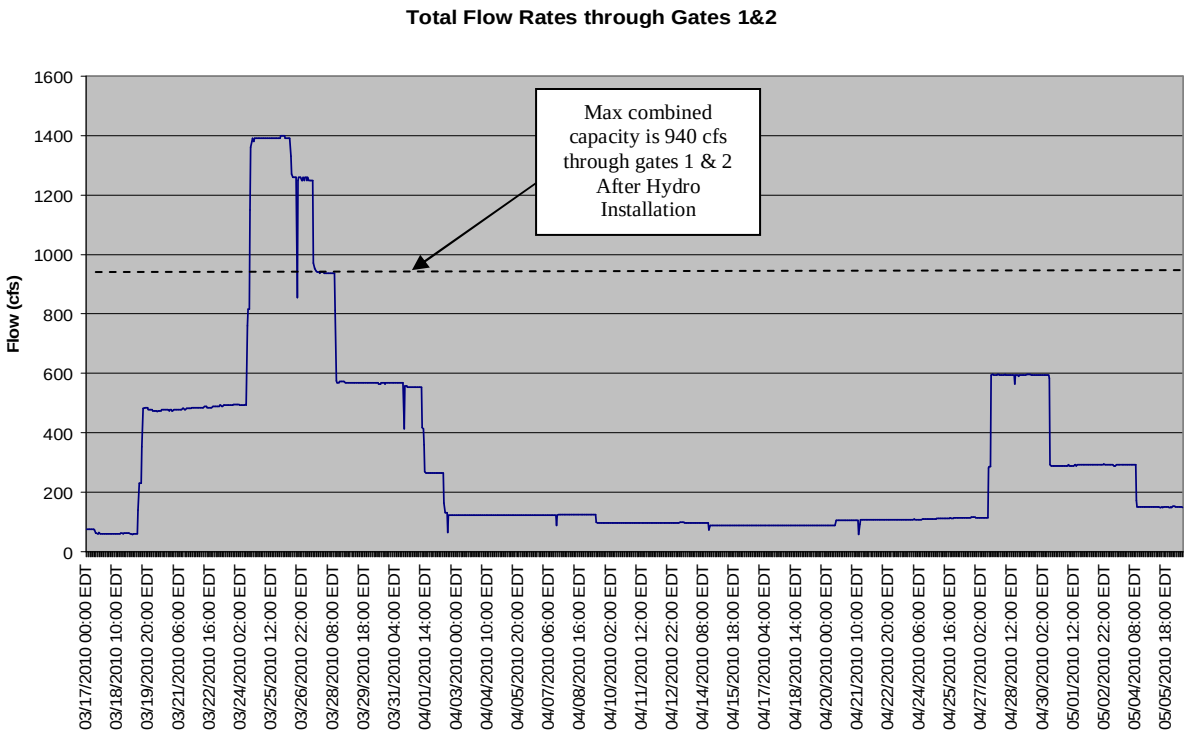


Figure 4-5

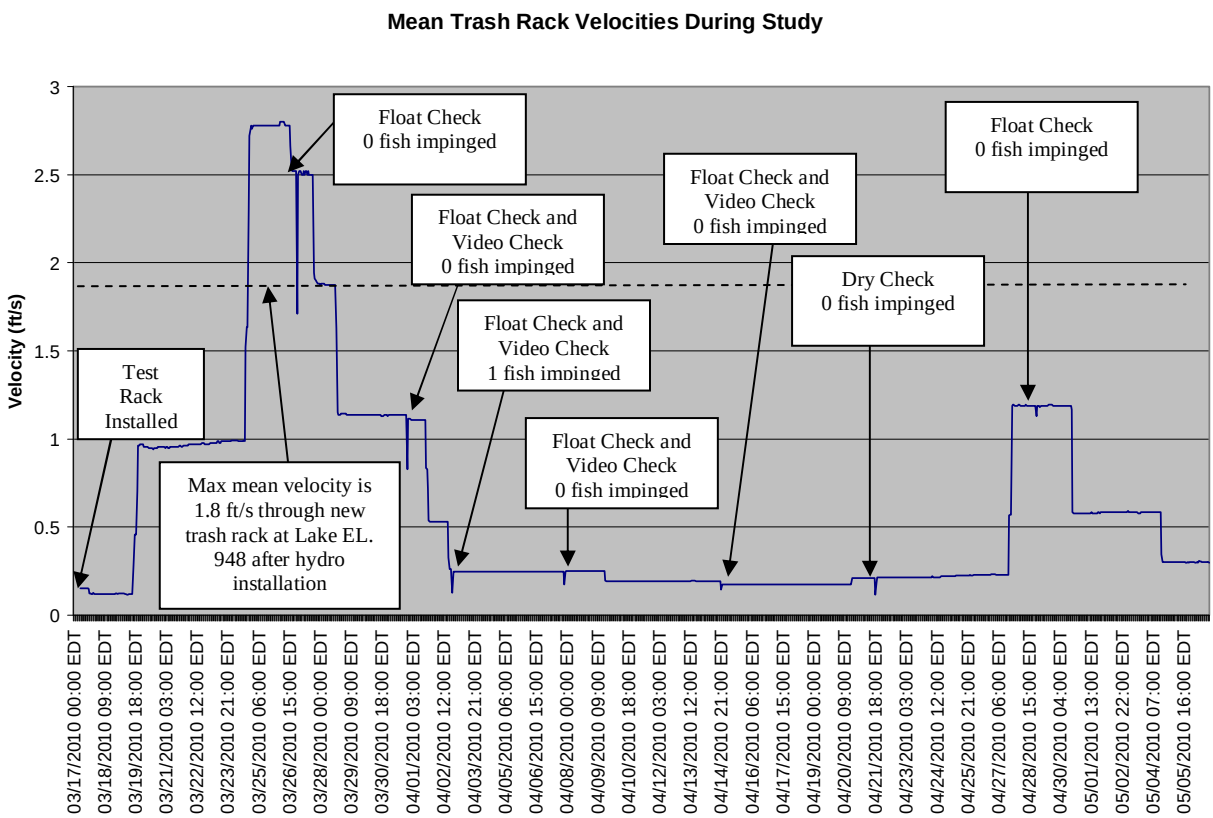


Figure 4-6

Figure 4-7: Only fish impinged during field study as of May 6, 2010. The fish was still breathing when recovered during the April 2, 2010 fish check

Table 4-5 Estimation of Annual Impingement at Lake Milton Project Based on Results of Field Impingement Study

Fish impinged during study	1
Mean Test Rack Coverage of Existing Rack During Study	24%
Fish Estimated to have been Impinged on larger Final Rack during hydro operation	4.17
Mean flow During Study (cfs)	312.7
Total flow (mcf) During Study up to last fish check on 4/28/10	1152.7
Estimated Fish Impinged/mcf	0.0036
Total Estimated Annual Flow (mcf) through the final rack (gates 1 & 2) during hydro operation	7413.48
Total Estimated Annual Fish Impingement During Hydro Operation	**26.80**

4.3 Fish Entrainment Rate

4.3.1 Quantitative Analysis

Table 4-6 depicts the projects initially considered for entrainment rate analyses at the Lake Milton Project. No projects from the database were located in Ohio and none were as small as the Lake Milton Project, however, several project similarities did exist in the database. Similarities included trash rack bar spacing, mode of operation, and similarities in fish assemblages. These parameters justified the initial selection of the projects listed below.

Table 4-6: Summary of Candidate Source-Study Projects Considered for Entrainment Rata Data Transfer for the Jennings Randolph Project

Project Name	ST	River	Trashrack Bar Spacing (inches)	Capacity (cfs)	Capacity Tested (cfs)	Mode of Operation	Flow Volume Recorded During Study
Lake Milton	**OH**	**Mahoning**	**1**	**250**	**N/A**	**Run of River**	**N/A**
Colton Project	NY	Middle Raquette	2	1503	450	Peaking	Yes
Grand Rapids	MI/WI	Menominee	1.75	3870	2216	Run of River	Yes
Herrings Project	NY	Black	4.125	3610	1203	Run of River	Yes
High Falls	NY	Beaver	1.81	900	300	Peaking	Yes
Lake Algonquin	NY	Sacandaga	1	750	750	Not Indicated	No
Moshier Project	NY	Beaver	1.5	660	330	Peaking	yes
Ninth Street Dam	MI	Thunder Bay	1	1650	550	Run of River	No
Potato Rapids	WI	Peshtigo	1.75	1380	500	Run of River	Yes
Tower Project	MI	Black	1	404	202	Run of River	No
Townsend Dam	PA	Beaver	5.5	4400	2200	Run of River	Yes
Twin Branch	IA	St. Joseph	3	3200	1200	Run of River	Yes
Youghiogheny	PA	Youghiogheny	10	1600	1600	Run of River	Yes

Upon further screening, studies were excluded from the qualitative analysis if: (1) the volume of flow during study was not recorded[4], (2) the site had an excessive volume of non-critical or irrelevant[5] species. Using these selection criteria, the candidate studies

[4] Since no projects were the same size as the Lake Milton Project, flow volume records are required to calculate a fish/mcf for the project which can then be used to estimate the relative entrainment rate at Lake Milton. This excluded Lake Algonquin, Ninth Street, and Tower projects for the quantitative analysis.

[5] Over 99% of the total fish entrained at Youghiogheny were Alewife, Over 99% of the total fish entrained at Townsend were Gizzard Shad, and Over 89% of the total fish entrained at Mosier were Rainbow Smelt. Aside from Gizzard Shad none of these species were found in the 2006-2007 EPA samplings in the project area, however, the overrepresented gizzard shad skew the entrainment rate.

were further examined and refined to six source studies for the Lake Milton Project The fish entrainment rate for each of the six projects was calculated (Table 4-7). Entrainment by species was also estimated (Figure 4-8) using the results from the 2006-2007 EPA fish samplings. Please note that entrainment does not equal fish mortality (see Turbine Mortality Calculations in section 4.5)

Table 4-7: Source Studies Chosen to Estimate Quantitative Entrainment Rate for the Lake Milton Project

Project Name	ST	River	Trashrack Bar Spacing (inches)	Mode of Operation	Total Flow Volume Tested (mcf)	Total Fish Entrained	Project Entrainment Rate (fish/mcf)
Colton Project	NY	Middle Raquette	2	Peaking	1717.3	584	0.34
Grand Rapids	MI/WI	Menominee	1.75	Run of River	10221.5	15909	1.56
Herrings Project	NY	Black	4.125	Run of River	2777.8	762	0.27
High Falls	NY	Beaver	1.81	Peaking	1286	1141	0.89
Potato Rapids	WI	Peshtigo	1.75	Run of River	4772.7	24074	5.04
Twin Branch	IA	St. Joseph	3	Run of River	5309	6263	1.18
Meand Total Estimated Entrainment Rate @ Lake Milton (fish/mcf)							**1.55**
Mean Flow @ Milton Through Turbine							**169.60**
Estimated Annual Flow Through Turbine @ Milton (mcf)							**5348.51**
Estimated Fish Entrained/mcf per Year @ Milton							**8290.19**

Table 4-8 Estimated Annual Fish Entrainment by Species

Species	# from 2007 EPA Sampling	% from 2007 EPA Sampling	Estimation of Entrainment/ Year @ Milton
Smallmouth Bass	96	7.2%	594.8
Other Bass Species	65	4.9%	402.7
Sunfish/Bluegill	82	6.1%	508.1
Esocidae (Muskie/Pikerel)	3	0.2%	18.6
Cyprinidae (Carp, Minnow, Shiner)	372	27.8%	2304.9
Ictaluridae (Catfish, Bullhead, Madtom)	79	5.9%	489.5
Gizzard Shad	162	12.1%	1003.7
Walleye	37	2.8%	229.3
Suckers	80	6.0%	495.7
Yellow Perch	293	21.9%	1815.4
Other Perch/Darter	39	2.9%	241.6
Crappie	17	1.3%	105.3
Other	13	1.0%	80.5
Total	**1338**	**100.0%**	**8290.2**

4.3.2 Qualitative Analysis

Since a qualitative (size, species, and monthly) entrainment analysis can be calculated by percentage, flow volume data is not required as it was for a quantitative analysis. Consequently the three projects with the exact bar spacing as will be used at Lake Milton can be used to estimate entrainment rates by size, species and month at Lake

Milton. These projects are shown in Table 4-9. Entrainment rates (%) were calculated for the three projects by size (Figure 4-8, Figure 4-9, and Figure 4-10), species (Figure 4-10, Figure 4-11, and Figure 4-13) and month (Figure 4-13, Figure 4-14, and Figure 4-15). The rates were averaged to estimate qualitative entrainment rates (%) for the Lake Milton Project.

Table 4-9: Projects Used to Estimate Entrainment Rates by Size, Species and Month for the Lake Milton Project.

Project Name	ST	River	Trashrack Bar Spacing (inches)	Capacity (cfs)	Capacity Tested (cfs)	Mode of Operation	Flow Volume Recorded During Study
Lake Milton	**OH**	**Mahoning**	**1**	**250**	**N/A**	**Run of River**	**N/A**
Lake Algonquin	NY	Sacandaga	1	750	750	Not Indicated	No
Ninth Street Dam	MI	Thunder Bay	1	1650	550	Run of River	No
Tower Project	MI	Black	1	404	202	Run of River	No

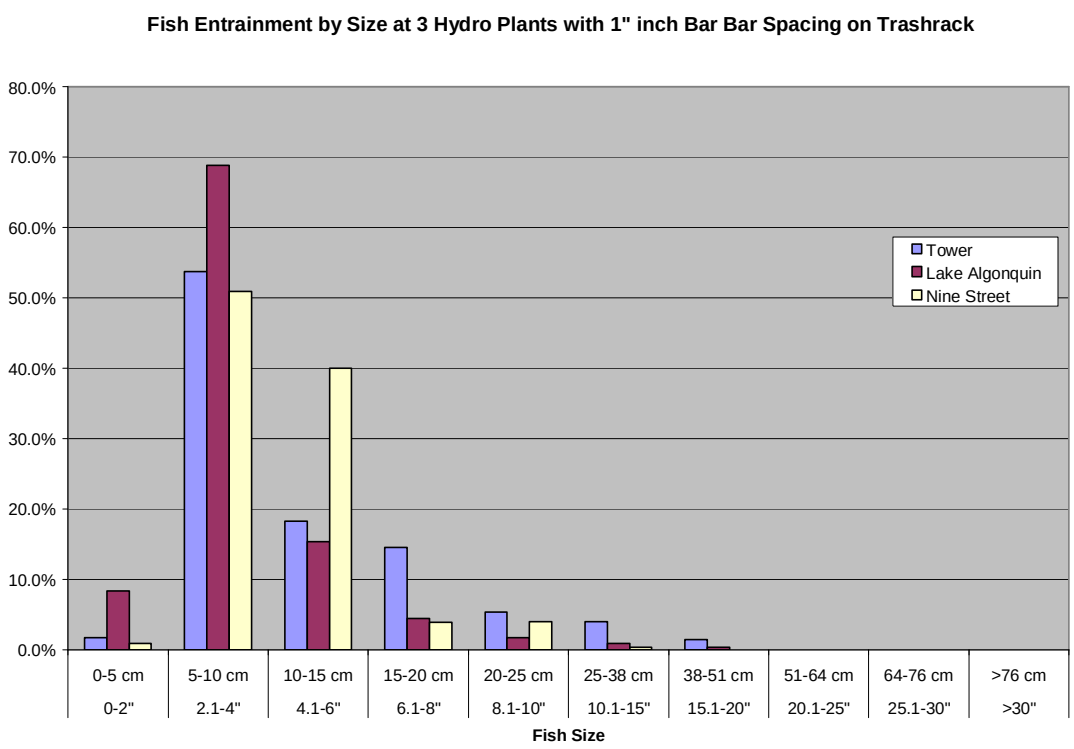


Figure 4-8

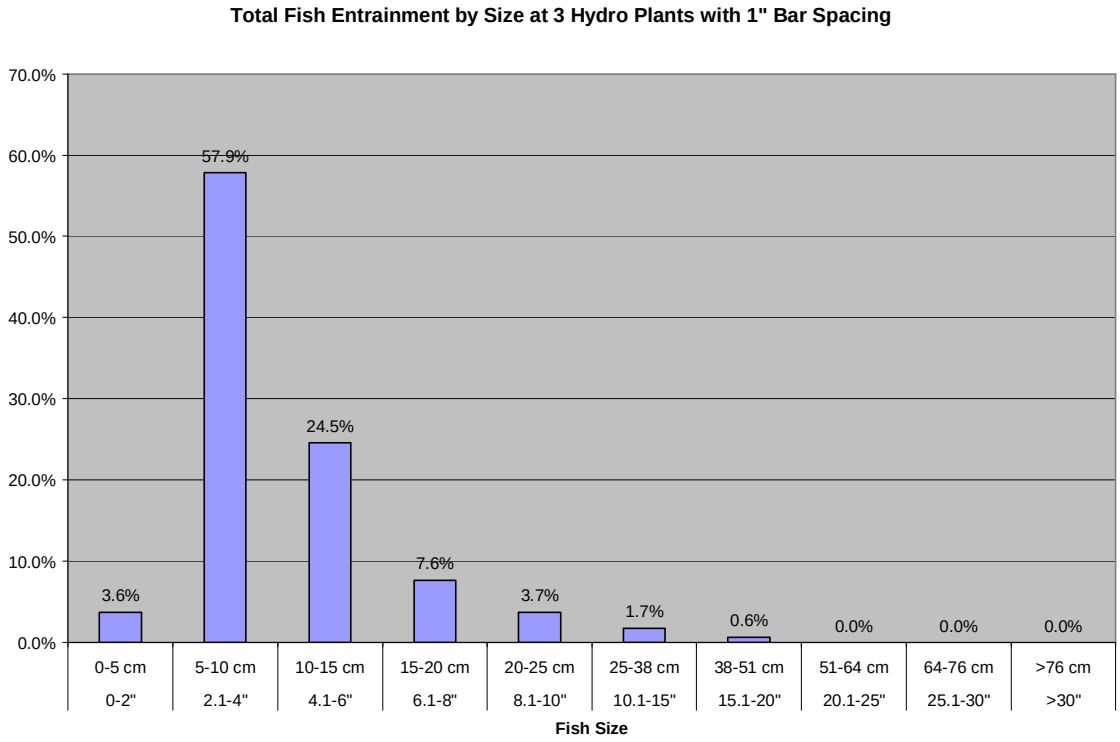


Figure 4-9

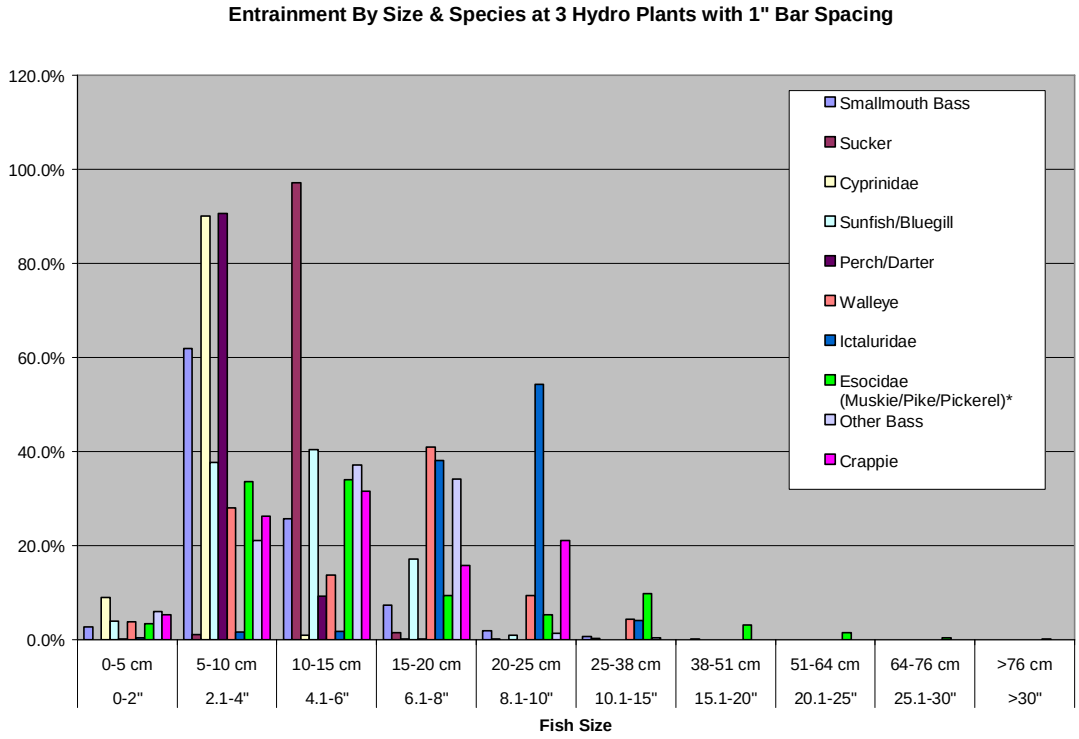


Figure 4-10

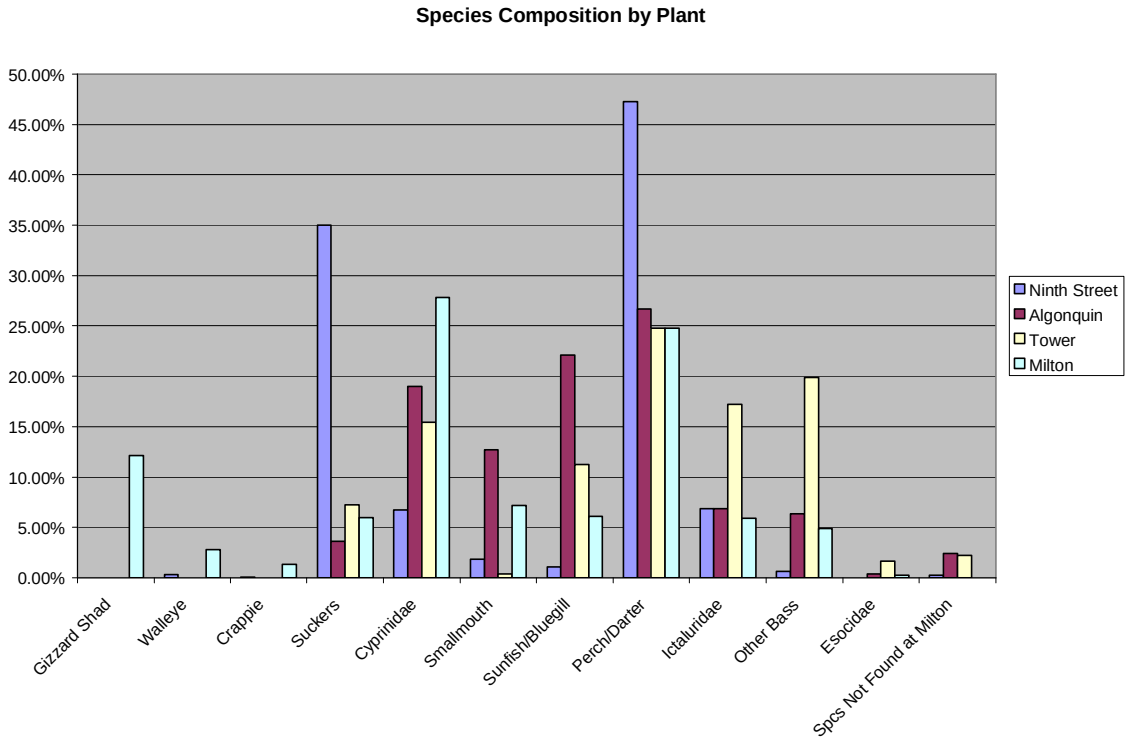


Figure 4-11 – Figures represent entrainment composition rather than fishery composition (except for Milton)

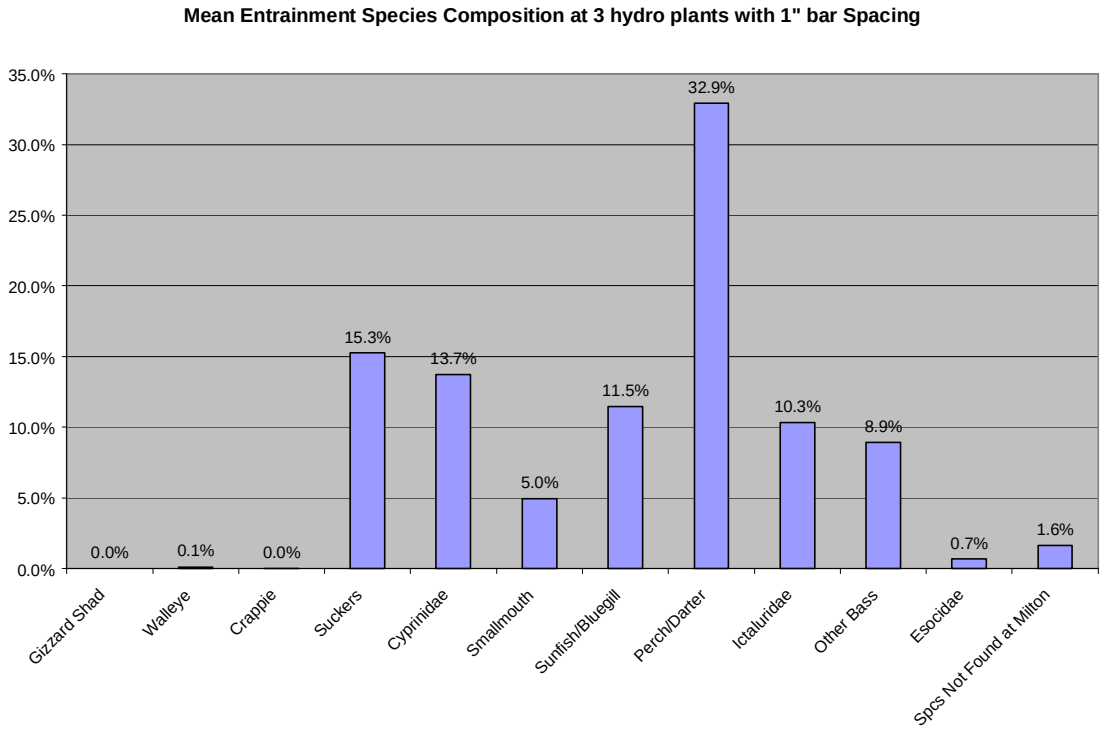


Figure 4-12 Figures show species entrainment composition/susceptibility trend with 1" bar spacing (note: no muskellunge were entrained at any of the three plants with one 1" bar spacing – Esocidae entrainment included only Northern Pike and Chain Pickerel)

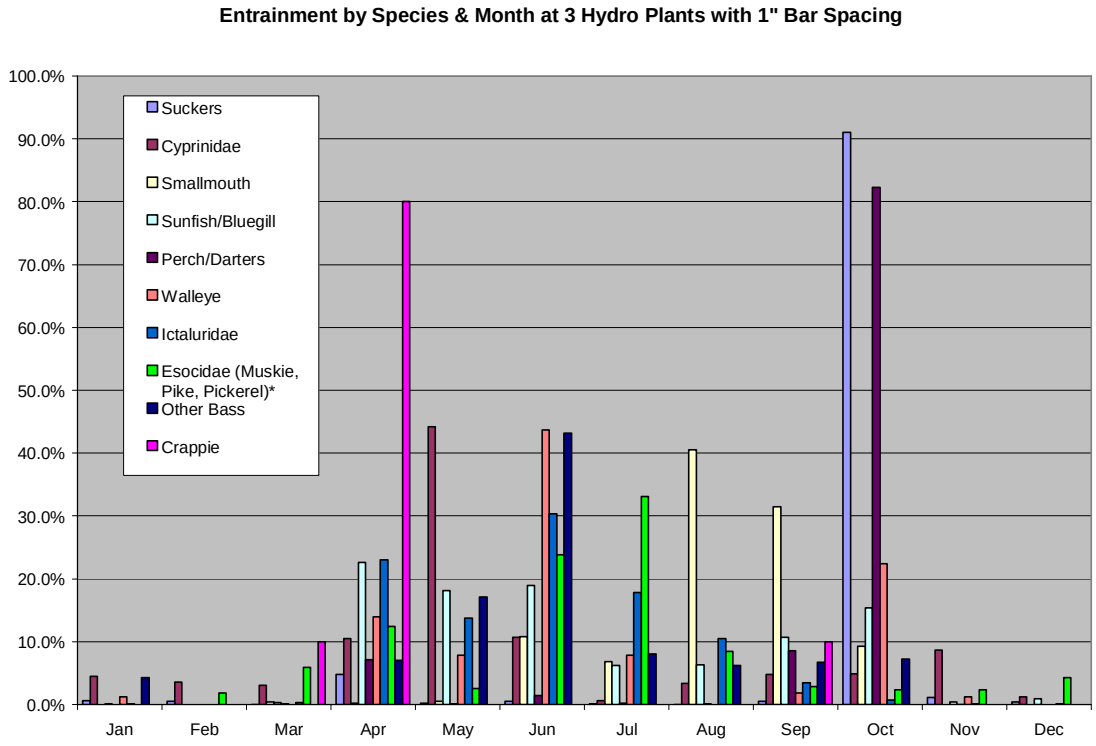


Figure 4-13: Percentages represent the monthly entrainment patters for each species

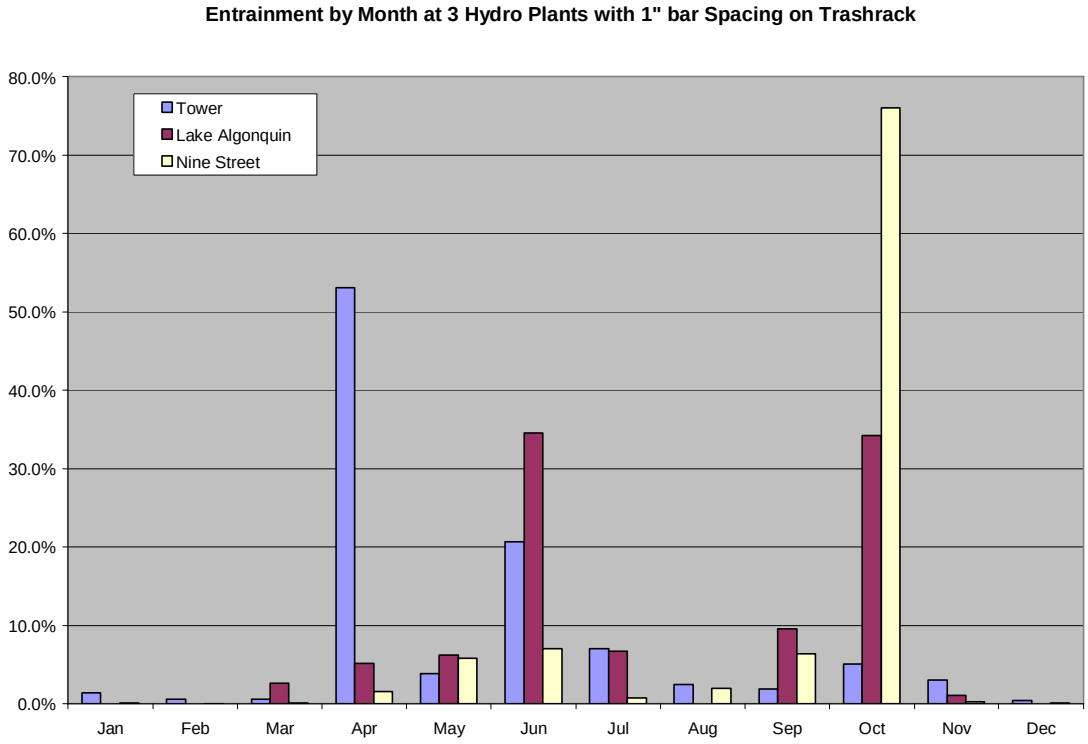


Figure 4-14

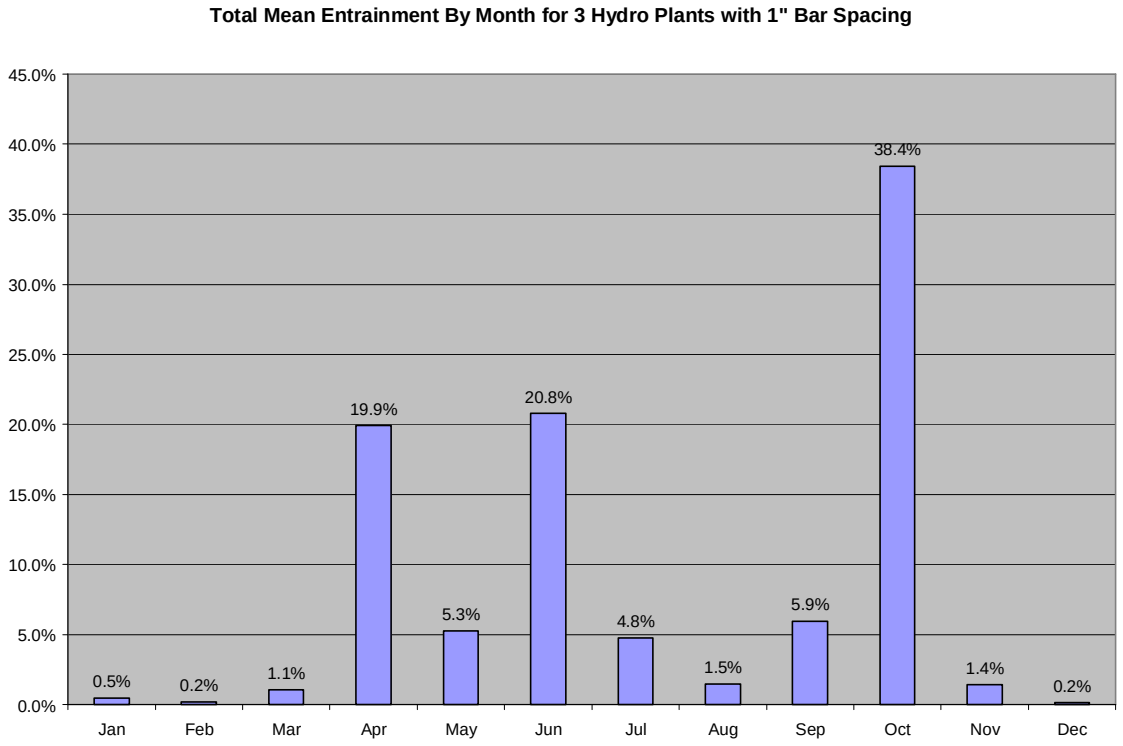

Total Mean Entrainment By Month for 3 Hydro Plants with 1" Bar Spacing
45.0%
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
0.5%
0.2%
1.1%
19.9%
5.3%
20.8%
4.8%
1.5%
5.9%
38.4%
1.4%
0.2%
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Figure 4-15

4.4 Turbine Characteristics and Fish Mortality

The turbine mortality database includes studies using both Francis and propeller turbines. The S-type Kaplan turbine proposed at Lake Milton is one variation of propeller or axial flow turbines (Figure 4-16). Kaplan turbines are a specialized type of propeller turbine that has adjustable runners and wicket gates to adjust to varying flows. The Francis turbines (Figure 4-17) in comparison have an increased number of blades and are consequently more lethal than propeller turbines given the same diameter, flow, rpm and fish size (Winchell, 2000).

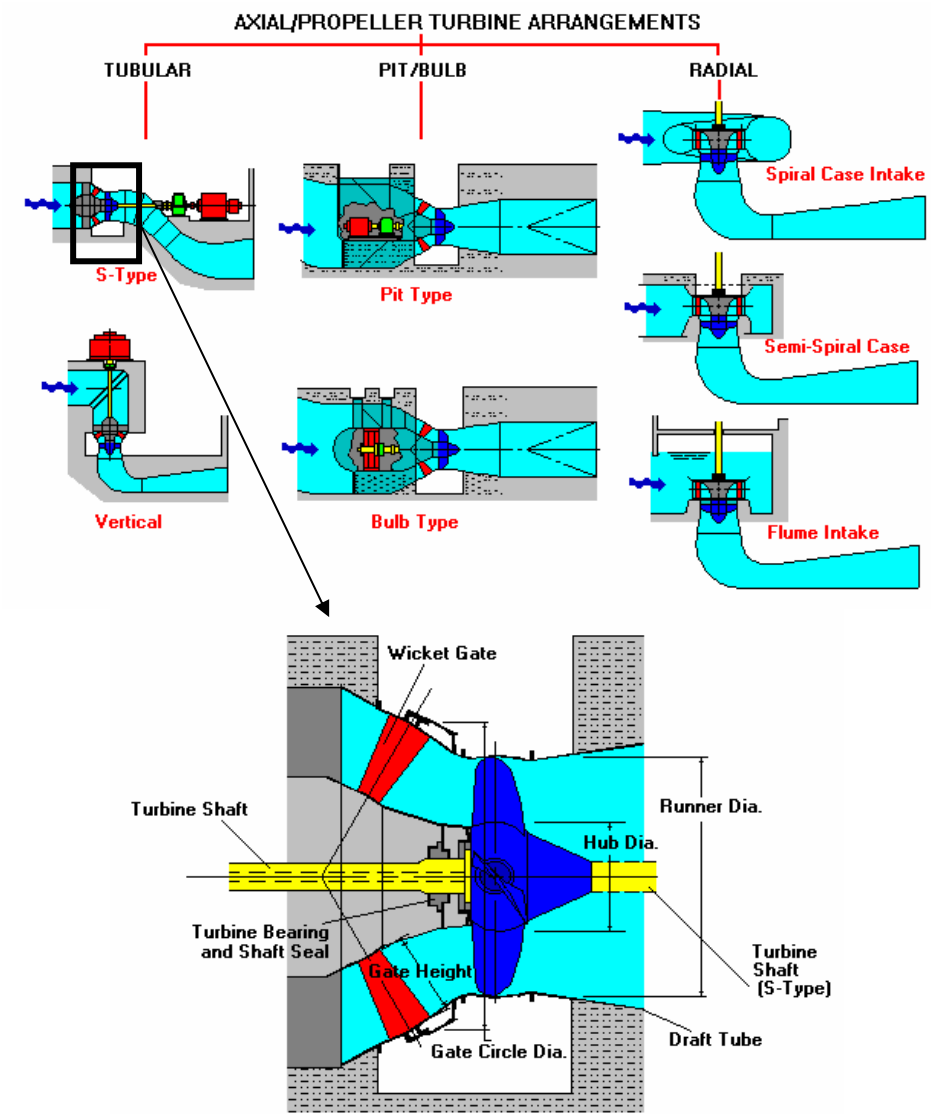


Figure 4-16 An S-type Kaplan Turbine is proposed at Lake Milton

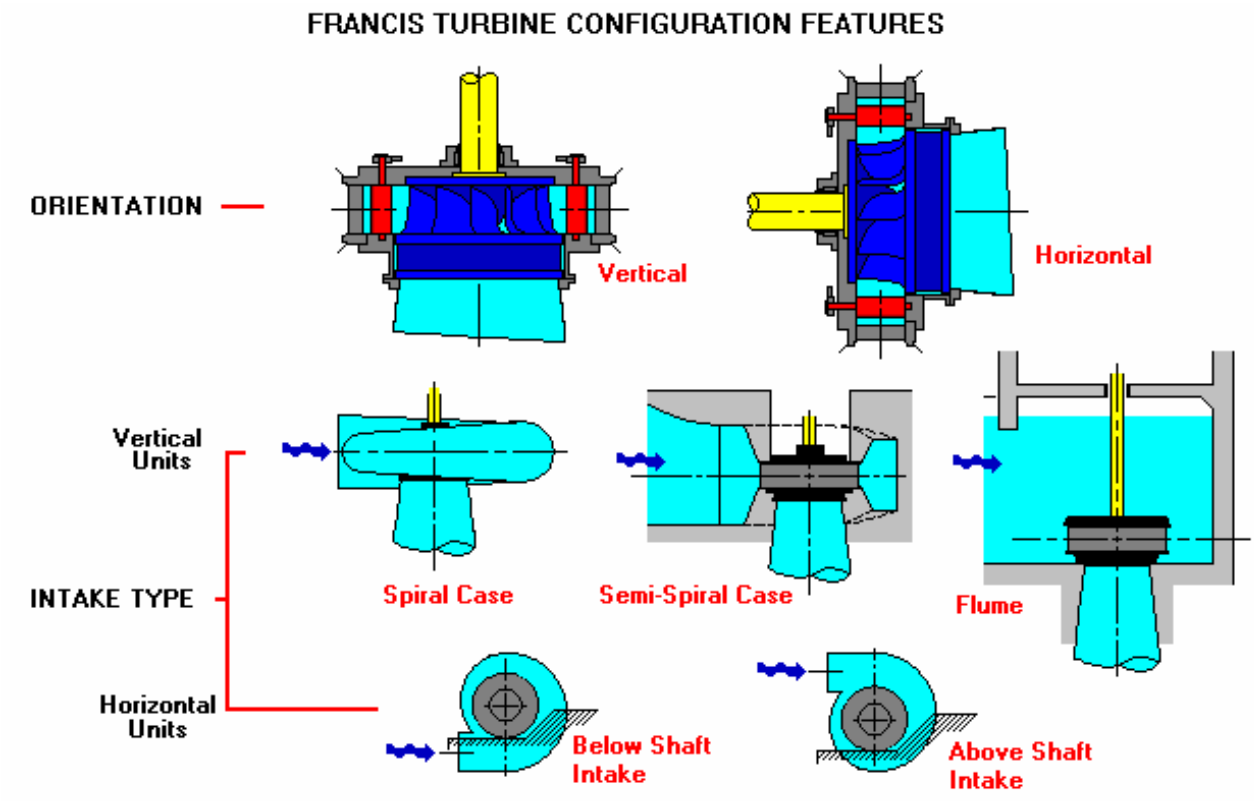


Figure 4-17 The more lethal Francis Turbine Types and Configurations

4.5 Turbine Mortality Calculations

Although no study from the database matched exactly the size and type of turbine proposed at Lake Milton, the studies chosen (Table 4-10) resembled the Lake Milton turbine in one or more characteristics including type, size, rated power, and rated flow. The results from the study (Table 4-10) were used to create a turbine mortality curve (Figure 4-18). The most lethal turbine (High Falls - which was most similar in size to the Lake Milton turbine, but is a Francis style instead of propeller) was used exclusively in the creation of the curve in order to create "a worst case scenario".

Table 4-10 Turbine Mortality Studies Selected form the Database with similarities to the Proposed Lake Milton Turbine

Site Name	Turbine Type	Rated Head		Rated Power	Rated Power	Rated Flow		Runner Diameter	
		(ft)	(m)	(HP)	(MW)	(cfs)	(cms)	(in)	(cm)
Lake Milton	**Kaplan (horiz, S-type)**	**35**	**12.2**	**871**	**0.65**	**250**	**7.1**	**32**	**80**
Fourth Lake	Tube (S-type)	75.5	23.0	4000	3.1	530	15.0	65	165
Twin Branch	Kaplan (horiz, pit/bulb)	21.1	6.4	871	0.65	400	11.3	60	152
High Falls	Francis (horiz)	83	25.3	**1876**	1.4	275	7.8	39	99

Table 4-11 Results of Turbine Mortality Studies for the Selected Project from the Database

Site	Size	Species	Group	Released	Recovered	Immediate Live	48 Hr Live	Imeditate Survival Rate	48 Hr Survival Rate	Adjusted ImediateSurvival Rate	Adjusted 48 hour survival Rate
Twin Branch	81-171 mm	Bulegill	Test	300	219	213	202	97.3%	92.2%	97.3%	95.0%
			Control	300	173	173	168	100.0%	97.1%		
Twin Branch	81-161 mm	Chinook, Channel Catfish	Test	900	804	794	706	98.8%	87.8%	98.8%	92.9%
			Control	900	620	620	586	100.0%	94.5%		
Twin Branch	141-231 mm	Steelhead, Channel Catfish	Test	300	195	168	149	86.2%	76.4%	86.2%	80.4%
			Control	300	239	239	227	100.0%	95.0%		
Fourth Lake	Avg. 96.3 mm	Alewife	Test	675	478	338	N/A	70.7%	N/A	83.3%	N/A
			Control	627	521	442	N/A	84.8%	N/A		
Fourth Lake	Avg. 169.3 mm	Atlantic Salmon	Test	1090	908	665	N/A	73.2%	N/A	80.5%	N/A
			Control	1056	910	828	N/A	91.0%	N/A		
High Falls	50-100 mm	bluegill, gluegill x green sunfish hybrid	Test	154	140	117	110	83.6%	78.6%	88.3%	85.5%
			Control	88	74	70	68	94.6%	91.9%		
High Falls	50-100 mm	Flathead minnow, creek chub, white sucker, golden/ shorthead	Test	146	140	117	110	83.6%	78.6%	88.3%	85.5%
			Control	95	74	70	68	94.6%	91.9%		
High Falls	100-150 mm	bluegill, gluegill x green sunfish hybrid	Test	90	81	63	60	77.8%	74.1%	77.8%	78.1%
			Control	40	39	39	37	100.0%	94.9%		
High Falls	100-150 mm	Flathead minnow, creek chub, white sucker, golden/ shorthead	Test	307	278	195	183	70.1%	65.8%	74.0%	75.2%
			Control	164	153	145	134	94.8%	87.6%		
High Falls	150-200 mm	bluegill, gluegill x green sunfish hybrid	Test	159	151	93	89	61.6%	58.9%	61.6%	58.9%
			Control	159	84	84	84	100.0%	100.0%		
High Falls	150-200 mm	Flathead minnow, creek chub, white sucker, golden/ shorthead	Test	188	173	87	80	50.3%	46.2%	50.7%	48.4%
			Control	119	112	111	107	99.1%	95.5%		
High Falls	200-250 mm	Flathead minnow, creek chub, white sucker, golden/ shorthead	Test	146	129	59	57	45.7%	44.2%	46.3%	46.2%
			Control	95	90	89	86	98.9%	95.6%		
High Falls	250-325 mm	Flathead minnow, creek chub, white sucker, golden/ shorthead	Test	160	160	34	31	21.3%	19.4%	21.5%	20.1%
			Control	94	88	87	85	98.9%	96.6%		
High Falls	325 mm	Flathead minnow, creek chub, white sucker, golden/ shorthead	Test	105	104	3	3	2.9%	2.9%	2.9%	2.9%
			Control	59	37	37	37	100.0%	100.0%		

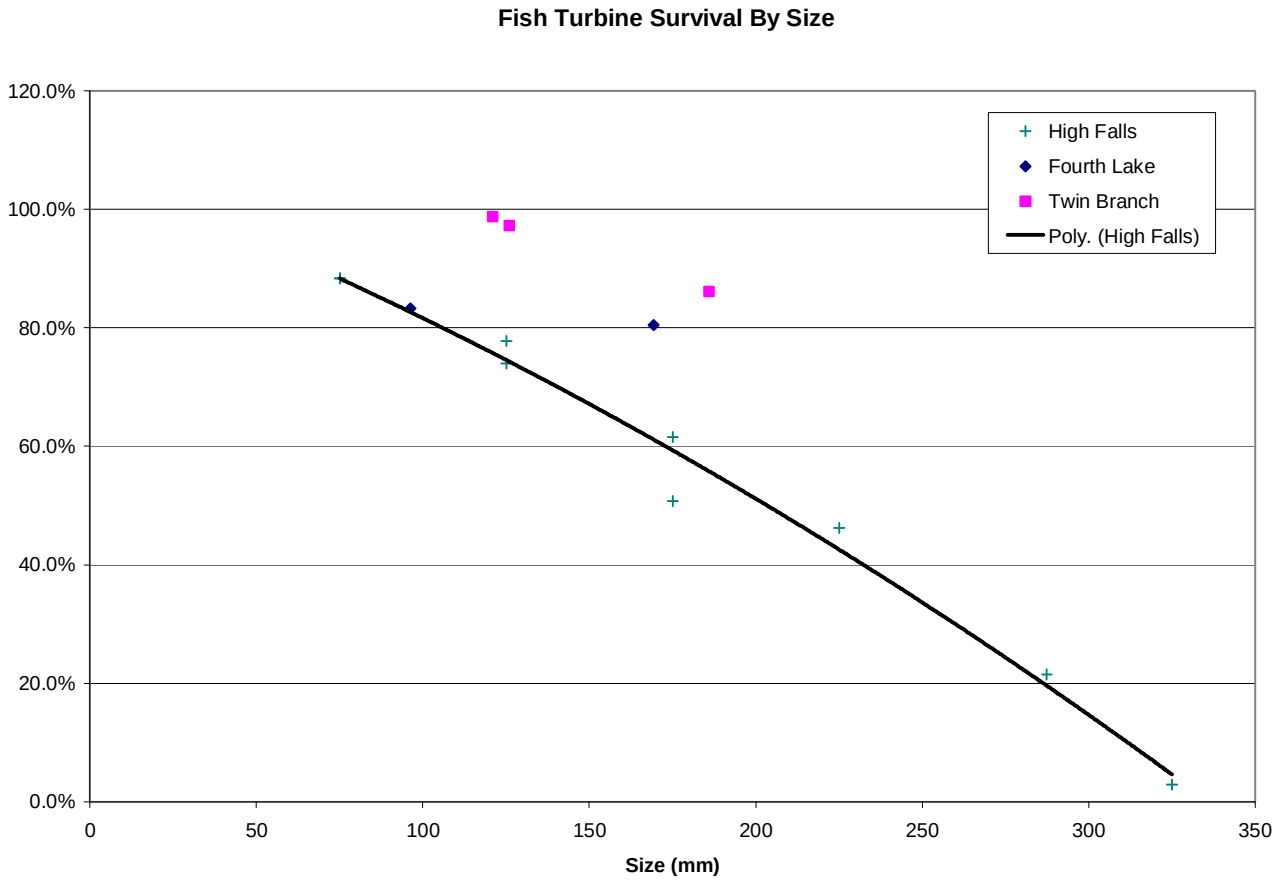


Figure 4-18 Turbine Mortality Curve

4.6 Estimation of Annual Fish Turbine Mortality and Compensation to be Paid

Using the entrainment results, the turbine mortality curve, and the Wildlife Price List, the total annual mortality and compensation rates for each species was calculated (Table 4-12). An estimated 3.7 Muskellunge and 41.9 Walleye would be lost due to entrainment in the turbine costing HET $52.54 and $75.91 in compensation respectively.

Table 4-12 Estimated Annual Fish Turbine Mortality and Compensation by Species

Smallmouth	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	2.6%	15.5	90%	13.9	1.5	$0.46	$0.71
	5-10 cm	61.9%	368.2	88%	324.0	44.2	$0.92	$40.65
	10-15 cm	25.7%	152.9	80%	122.3	30.6	$1.03	$31.49
	15-20 cm	7.2%	42.8	70%	30.0	12.8	$2.16	$27.75
	20-25 cm	1.9%	11.3	50%	5.7	5.7	$3.10	$17.52
	25-38 cm	0.6%	3.6	20%	0.7	2.9	$5.88	$16.79
	38-51 cm	0.0%	0.0	0%	0.0	0.0	$16.62	$0.00
	Total		**594.2**		**496.6**	**97.7**		**$134.91**
Other Bass Specie	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	2.6%	10.5	90%	9.4	1.0	$0.46	$0.48
	5-10 cm	61.9%	249.3	88%	219.4	29.9	$0.92	$27.52
	10-15 cm	25.7%	103.5	80%	82.8	20.7	$1.03	$21.32
	15-20 cm	7.2%	29.0	70%	20.3	8.7	$2.16	$18.79
	20-25 cm	1.9%	7.7	50%	3.8	3.8	$3.10	$11.86
	25-38 cm	0.6%	2.4	20%	0.5	1.9	$5.88	$11.37
	38-51 cm	0.0%	0.0	0%	0.0	0.0	$16.62	$0.00
	Total		**402.3**		**336.2**	**66.1**		**$91.34**
Sunfish/bluegill	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	3.9%	19.8	90%	17.8	2.0	$0.35	$0.69
	5-10 cm	37.6%	191.0	88%	168.1	22.9	$0.44	$10.09
	10-15 cm	40.4%	205.3	80%	164.2	41.1	$1.09	$44.75
	15-20 cm	17.1%	86.9	70%	60.8	26.1	$1.54	$40.14
	20-25 cm	0.9%	4.6	50%	2.3	2.3	$2.43	$5.56
	25-38 cm	0.0%	0.0	20%	0.0	0.0	$7.30	$0.00
	38-51 cm	0.0%	0.0	0%	0.0	0.0	$0.00	$0.00
	Total		**507.6**		**413.3**	**94.3**		**$101.22**
Muskellunge	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	3.3%	0.4	90%	0.4	0.0	$2.00	$0.08
	5-10 cm	33.5%	4.2	88%	3.7	0.5	$3.00	$1.49
	10-15 cm	34.0%	4.2	80%	3.4	0.8	$5.00	$4.21
	15-20 cm	9.3%	1.2	70%	0.8	0.3	$7.00	$2.42
	20-25 cm	5.2%	0.6	50%	0.3	0.3	$9.78	$3.15
	25-38 cm	9.8%	1.2	20%	0.2	1.0	$24.00	$24.00
	38-51 cm	3.2%	0.4	0%	0.0	0.4	$24.50	$9.72
	51-64 cm	1.5%	0.2	0%	0.0	0.2	$25.00	$4.65
	64-76 cm	0.3%	0.0	0%	0.0	0.0	$51.47	$1.91
	>76 cm	0.1%	0.0	0%	0.0	0.0	$73.00	$0.90
	Total		**12.4**		**8.8**	**3.7**		**$52.54**

Cyprinidae (C	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	8.9%	205.1	90%	184.6	20.5	$0.09	$1.85
	5-10 cm	90.1%	2076.7	88%	1827.5	249.2	$0.09	$22.43
	10-15 cm	0.8%	18.4	80%	14.8	3.7	$0.09	$0.33
	15-20 cm	0.1%	2.3	70%	1.6	0.7	$0.18	$0.12
	20-25 cm	0.0%	0.0	50%	0.0	0.0	$0.21	$0.00
	25-38 cm	0.0%	0.0	20%	0.0	0.0	$0.45	$0.00
	38-51 cm	0.0%	0.0	0%	0.0	0.0	$1.15	$0.00
	Total		**2302.6**		**2028.5**	**274.1**		**$24.73**

Ictaluridae (C	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	0.3%	1.5	90%	1.3	0.1	$0.28	$0.04
	5-10 cm	1.6%	7.8	88%	6.9	0.9	$0.28	$0.26
	10-15 cm	1.7%	8.3	80%	6.7	1.7	$0.48	$0.80
	15-20 cm	38.1%	186.5	70%	130.5	55.9	$0.63	$35.25
	20-25 cm	54.2%	265.3	50%	132.6	132.6	$0.84	$111.43
	25-38 cm	4.1%	20.1	20%	4.0	16.1	$1.07	$17.18
	38-51 cm	0.0%	0.0	0%	0.0	0.0	$2.60	$0.00
	Total		**489.5**		**282.1**	**207.4**		**$164.95**

Gizzard Shad	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	3.6%	36.1	90%	32.5	3.6	$0.12	$0.43
	5-10 cm	57.9%	581.2	88%	511.4	69.7	$0.12	$8.37
	10-15 cm	24.5%	245.9	80%	196.7	49.2	$0.12	$5.90
	15-20 cm	7.6%	76.3	70%	53.4	22.9	$0.12	$2.75
	20-25 cm	3.7%	37.1	50%	18.6	18.6	$0.12	$2.23
	25-38 cm	1.7%	17.1	20%	3.4	13.7	$0.12	$1.64
	38-51 cm	0.6%	6.0	0%	0.0	6.0	$0.12	$0.72
	Total		**999.7**		**816.1**	**183.7**		**$22.04**

Walleye	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	3.6%	8.3	90%	7.4	0.8	$0.15	$0.12
	5-10 cm	57.9%	132.7	88%	116.8	15.9	$0.35	$5.57
	10-15 cm	24.5%	56.2	80%	44.9	11.2	$0.87	$9.77
	15-20 cm	7.6%	17.4	70%	12.2	5.2	$1.62	$8.47
	20-25 cm	3.7%	8.5	50%	4.2	4.2	$1.97	$8.36
	25-38 cm	1.7%	3.9	20%	0.8	3.1	$6.25	$19.49
	38-51 cm	0.6%	1.4	0%	0.0	1.4	$17.54	$24.13
	Total		**228.3**		**186.4**	**41.9**		**$75.91**

Suckers	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	0.0%	0.0	90%	0.0	0.0	$0.41	$0.00
	5-10 cm	1.1%	5.5	88%	4.8	0.7	$0.95	$0.62
	10-15 cm	97.1%	481.3	80%	385.0	96.3	$0.95	$91.45
	15-20 cm	1.4%	6.9	70%	4.9	2.1	$2.37	$4.93
	20-25 cm	0.1%	0.5	50%	0.2	0.2	$2.37	$0.59
	25-38 cm	0.2%	1.0	20%	0.2	0.8	$3.56	$2.82
	38-51 cm	0.1%	0.5	0%	0.0	0.5	$9.52	$4.72
	Total		**495.7**		**395.1**	**100.5**		**$105.13**

Perch/Dater	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	0.1%	1.8	90%	1.6	0.2	$0.33	$0.06
	5-10 cm	90.6%	1644.8	88%	1447.4	197.4	$0.49	$96.71
	10-15 cm	9.2%	167.0	80%	133.6	33.4	$0.76	$25.39
	15-20 cm	0.0%	0.0	70%	0.0	0.0	$1.36	$0.00
	20-25 cm	0.0%	0.0	50%	0.0	0.0	$3.16	$0.00
	25-38 cm	0.0%	0.0	20%	0.0	0.0	$7.47	$0.00
	38-51 cm	0.0%	0.0	0%	0.0	0.0	$21.36	$0.00
	Total		**1813.6**		**1582.6**	**231.0**		**$122.16**
Crappie	Size	% Entrained	Number Entrained	Survival Rate	live	dead	cost/fish	total cost
	0-5 cm	3.6%	3.8	90%	3.4	0.4	$0.39	$0.15
	5-10 cm	57.9%	61.0	88%	53.7	7.3	$0.53	$3.88
	10-15 cm	24.5%	25.8	80%	20.6	5.2	$0.80	$4.13
	15-20 cm	7.6%	8.0	70%	5.6	2.4	$1.58	$3.79
	20-25 cm	3.7%	3.9	50%	1.9	1.9	$2.79	$5.44
	25-38 cm	1.7%	1.8	20%	0.4	1.4	$6.32	$9.05
	38-51 cm	0.6%	0.6	0%	0.0	0.6	$18.68	$11.81
	Total		**104.9**		**85.6**	**19.3**		**$38.25**
Total Entrainment Compensation/year			**7,950.8**		**6,631.2**	**1,319.6**		**$931.59**

4.7 Fish Passage Rates

The results of the fish passage analysis (Table 4-13) show that 90.6% of fish passage will be maintained during hydro operation. Larger fish unable to pass through the new trash rack will have opportunities to pass through gates 3 or 4 November to April 40% of the time (Figure 4-19).

Table 4-13 Estimated Annual Fish Passage

Annual Mean flow at Lake Milton (cfs)	287.10
Total Annual Flow (mcf) through Lake Milton Dam	9,053.99
Estimated fish entrained per mcf	1.55
*Total Annual Estimated Current Fish Passage	14,033.68
Estimated Annual Fish Turbine Moratility	1,319.60
Total Estimated Annual Fish passage during hydro operation	**12,714.08**
Percent fish passage maintained	**90.6%**

*Assumes no fish are killed due to entrainment with the current condition since no such estimate currently exists

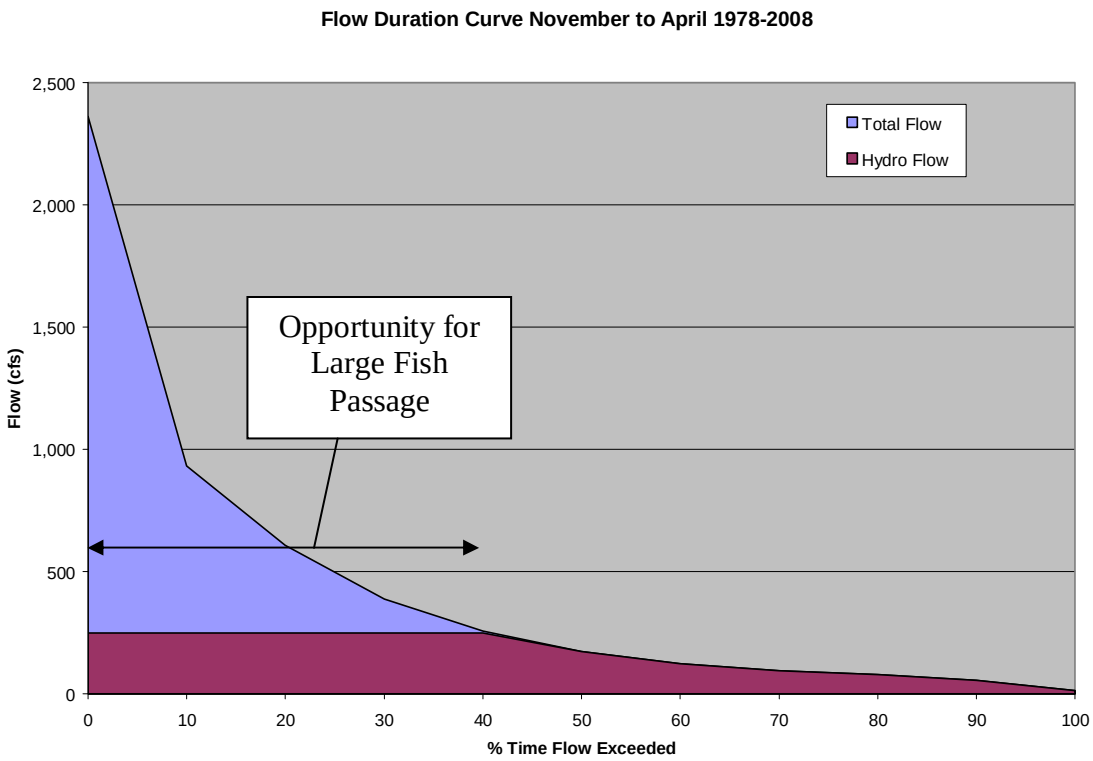


Figure 4-19 Fish not able to pass through the new trash rack will have opportunity to pass through gates three or four 40% of the time November to April

4.8 Existing Sources of Fish Mortality and Injury at Lake Milton Dam

The effects of the current condition in terms of fish safety are unknown. It is possible that installing the new trash rack and reducing flow through the lower gates will provide a level of protection from the current condition. Existing risks may include fish being violently jetted from the outlet pipe, illegal fishing practices below the dam, and decompression trauma.

4.8.1 Illegal Fishing Practices

Illegal practices such as poaching, snagging, using more than two lines or failing to release fish not of legal size account for an unknown amount of fish loss below the Lake Milton Dam. One group of poachers in Freemont, Ohio were accused selling thousands of fish most of which were caught by snagging (ODNR, 2004). Freement, Ohio below the Ballville Dam offers similar fishing conditions to Lake Milton as many walleye congregate below both dams each spring. ODNR does not have the resources to monitor all fishing areas at Lake Milton at all times and many of these activities go unreported. Several laws regarding illegal fishing practices are listed below:

Snagging with a hook to pierce and hook a fish in a part of the body other than the inside of the mouth is illegal for all fish except forage fish. . . Hooks may not be larger than five-eighths inch from shank to point (ODNR, 2010).

Minnow or Bait Fish Traps- It is illegal for anglers to possess or use a minnow or bait fish trap larger than 24 inches in length and 12 inches in width. Additionally, possessing or using a minnow or bait fish trap with an opening larger than one inch is illegal (ODNR, 2010).

Cast Nets- Forage fish may be taken with cast nets only in the Inland Fishing District. It is unlawful to use a cast net with a square mesh less than 1/4 inch or larger than 1 inch on a side, or with a diameter of greater than 10 feet. It is illegal to use a cast net within a distance of 1000 feet downstream from any dam posted with Division of Wildlife signs indicating cast net use is prohibited (ODNR, 2010).

Fishing Lines- Anglers may not use more than two fishing lines, whether fastened to a pole, a rod and reel, or hand held. Anglers may use up to three hooks on each line, except as provided in the Ohio Administrative Code (ODNR, 2010).

Live Release of Fish- Any fish not of legal size or not legally caught must be released immediately. Handle it carefully with a wet hand or a wet towel so it can be freed unharmed. If the fish is hooked deeply and the hook can't easily be removed, cut the line to release the fish. Tearing a hook out can harm a fish so badly that it may not live(ODNR, 2010).

4.8.2 Decompression Trauma

Another existing potential source of fish passage mortality that can occur at high head dams is decompression trauma. Fish within a water column become acclimated to the hydrostatic pressure at a given depth. Once acclimated (i.e. internal gas levels adjust to the appropriate pressure), fish can sound without harmful effects because the increased pressure will not cause injuries. However, if fish ascend too quickly within the water column (i.e. reduce pressure), gases will expand and cause injury or death. This type of injury is frequently observed by anglers who catch fish in deep water and quickly retrieve them to the surface (Kleinschmidt Associates, 2010). It has also been documented at high head hydroelectric projects such as Bond Falls and the Youghiogheny Project (RMC 1992, 1995).

Figure 4-20 Species, Unknown cause of Death Photographed below Lake Milton Dam December 16, 2009

If fish are acclimated to several atmospheres of pressure as would be the

case with deep intakes and then rapidly pass through a dam where they are then instantly exposed to a single atmosphere of pressure, decompression trauma is likely to occur. While mortality may not be instantaneous, it is likely to occur. Visible signs of decompression trauma include exophthalmia and/or prolapsed esophagus or anus (Kleinschmidt Associates, 2010).

In general the lower the intake elevation, the higher the risk of decompression trauma. The proposed hydro plant would decrease flow through the lower gates thus decreasing risk of decompression trauma to fish species.

5 CONCLUSIONS

Qualitatively, with consideration to the proposed characteristics of the Lake Milton Project, the existing fisheries resources, and the abundance of reference information available, fish passage and fish losses due to entrainment and impingement mortality are likely to be low and comparable to the existing conditions. There are several key points of information that support this conclusion.

- The proposed project will utilize 1 inch trash racks compared to the 5.3” to 22.5” spacing at the existing trashrack. This change substantially limits the size of fish susceptible to entrainment and represents an element of entrainment protection relative to the current condition (possibility of decompression trauma, exposure to illegal fishing activity below the dam, etc.).

- In general only fish < 8” TL would be susceptible to entrainment. For many species this would represent juveniles or even YOY as compared to adults which would be part of the reproductive cohort. Even moderate to high losses of young fish are not likely to affect most fisheries (Kleinschmidt Associates, 2010).

- Turbine mortality rates for entrained fish would likely be due to blade strike probability associated with the turbines. However, some entrained fish would likely perish due to decompression trauma. While losses due to decompression are not quantifiable they could be substantial. The proposed project would reduce flows through the lower gates reducing risk of decompression trauma.

- An excellent recreational fishery for several species exists at Lake Milton as well as below the dam. Because over 90% of fish passage will be maintained, the downstream fishery would be maintained similar to the existing conditions. The fishery above the dam will be improved as larger individuals will have less opportunity to pass through the dam.

- Having a hydro operator present below the dam on an almost daily basis would increase monitoring of illegal fishing activity below the dam. HET employees will watch for and aggressively report illegal fishing activities. Additionally HET is willing to post Ohio fishing laws on the powerhouse visible from the fishing decks. The possibility exists that this additional monitoring will offset impacts of any walleye killed by the turbine. Additionally compensation for the estimated 42 walleye killed by the turbine will be paid by HET while poachers often get away scott free.

- Walleye fishing would not be significantly affected downstream and would improve in terms of more large individuals remaining upstream of the dam. The most popular time for anglers who fish walleye below the dam is spring. Since spring is spawning season for walleye and walleye that inhabit reservoirs will typically migrate up rivers to spawn (Scott and Crossman 1973), fisherman who make the assumption that the larger mature walleye they are catching are passing through the dam during the spring is erroneous. The reason for their success is because the walleye are generally coming from down stream and congregate at the tailwaters of the dam because they can't go any further. This trend should continue and walleye up to 8" will continue to pass freely through the dam at all times to maintain the fishery downstream. Larger individuals will have opportunities to pass through gates 3 and 4 from November to April 40% of the time. Fishing at the tailwaters of the Berlin Dam will also improve as increased large individuals will make their way upstream in the spring. Due to the fast swim speeds documented for walleye, impingement is not likely to occur. This is supported by the fact that no walleye were impinged during the field study.

- The Muskellunge population would not be significantly affected. The size of the fish when they are initially stocked (8"- 12") generally excludes them from entrainment through or impingement on the new rack. Evidence was presented that with the current condition, Muskellunge rarely pass through the dam (ODNR, 2010). If significant passage does occur, the new rack would protect them from the current condition and will improve Muskie fishing above the dam as more large individuals would be kept in the Lake. These results were supported by the field study as no muskie were impinged during the impingement field study.

- Total fish passage will not be significantly restricted. An estimated 90% of current successful fish passage will continue during Hydro Operation. Some restriction of fish passage for fish 8 inches in length or longer will occur. However, passage for larger fish will be available 40% of the time through gates 3 and 4 from November to April.

- HET would pay approximately $931.59 per year to ODNR in compensation for fish loss due to entrainment in the turbine for the

estimated 1320 fish killed by the turbine annually (approximately .78 fish/acre). An additional 28.8 fish (mostly likely slower swimming species like blue gill or sunfish 5 to 8 inches) will be impinged annually costing an additional $29 in compensation per year.

The methodologies and rates presented in this report for estimating annual fish entrainment and impingement at the Lake Milton Project were more stringent than approaches used in other hydro licensing/relicensing efforts of plants using one inch bar spacing. The Jennings Randolf Project desktop entrainment study, which also used the EPRI database for its source studies and proposes 1" bar spacing, shows an estimated annual mean entrainment of 0.19 fish/mcf (Kleinschmidt Associates, 2010). In comparison the entrainment rate used in this study is 8 times higher at 1.55 fish/mcf estimated entrainment. The Jennings study also did not include a field impingement test. As the results of this study are quite inflated compared to other impingement entrainment studies the information in this report should be used with confidence as a "worst case scenario" in the final assessment of the impacts of the Lake Milton Project on fish species.

6 REFERENCES

Beamish, F.W.H. 1970. Oxygen consumption of largemouth bass, *Micropterus salmoides*, in relation to swimming speed and temperature. Canadian J. Zoology 48:1221-1228.

Beamish, F.W.H. 1978. Swimming capacity. In: Hoar, W.S. and D.J. Randall, eds. Fish Physiology, Volume 7, Locomotion. Academic Press, NY. 576 pp.

Bunt, C.M., C. Katapodis, and R.S. McKinley. 1999. Attraction and passage efficiency of white suckers and smallmouth bass by two Denil fishways. N Am. J. Fish. Mgt. 19:793-803.

Cada, G.F. 1990. A review of studies relating to the effects of propeller-type turbine passage on fish early life stages. North American Journal of Fisheries Management 10:418-426.

Castro-Santos, T and A. Haro. 2005. Biomechanics and fisheries conservation. Chapter 12 in Fish Physiology: Fish Biomechanics, Volume 23. Elsevier, Inc.

EPRI. 1992. Final Report. Fish Entrainment and Turbine Mortality Review and Guidelines. Project 2694-01. Prepared for Stone & Webster Environmental Services, Boston, MA.

EPRI. 1997. Unpublished Excel Fish Mortality Database.

Federal Energy Regulatory Commission (FERC). 1995. Preliminary Assessment of Fish Entrainment at Hydropower Projects – Volume 1 (Paper No. DPR-10). Office of Hydropower Licensing, FERC, Washington, DC.

Fuller, Pam. 2008. Salvelinus namaycush. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=942. Accessed January 9, 2008.

Haro, A., T. Castro-Santos, J. Norieka, and M. Odeh. 2004. Swimming performance of upstream migrant fishes in open-channel flow: a new approach to predicting passage through velocity barriers. Can. J. Fish. Aquat. Sci. 61:1590-1601.

Heisey, P. G., D. Mathur, E. T. Euston. 1996. Passing fish safely: A closer look at turbine vs. spillway survival. Hydro Review 15(4): 2-6.

Jones, D.R., Kiceniuk, J.W., and O.S. Bamford. 1974. evaluation of the swimming performance of several fish species from MacKenzie River. Journal of Fisheries Research Board of Canada. 31:1641-1647.

Kleinschmidt Associates. 2007. Final Report: Saluda Hydro Project Desktop Fish Entrainment and Turbine Mortality Analysis. Prepared for South Carolina Electric & Gas Company, Columbia, SC.

Kleinschmidt Associates. 2008. Final Report: Markland Hydroelectric Project Desktop Fish Entrainment and Turbine Mortality Analysis. Prepared for Duke Energy. Indiana.

Kleinschmidt Associates. 2010. Jennings Randolph Hydroelectric Project Desktop Fish Entrainment and Turbine Mortality Analysis. Prepared for Fairlawn Hydroelectric Company, LLC.

McMahon, T. E., and J. W. Terrell. 1982. Habitat suitability index models: Channel catfish. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.2.

Normandeau Associates, Inc. 2009. Final Report: Claytor Hydroelectric Project Desktop Fish Entrainment and Impingement Analysis. Prepared for Appalachian Power Company. Roanoke, VA.

Ohio Department of Natural Resources (ODNR), 2010, A to Z Species Guide http://www.dnr.state.oh.us/Home/species_a_to_z. Accessed May 4, 2010.

Ohio Department of Natural Resources (ODNR), 2010, Hunting and Fishing Regulations http://www.ohiodnr.com/wildlife/dow/regulations/fishing_general.aspx. May 4, 2010.

Ohio Department of Natural Resources (ODNR), 2010, Muskie Angler Log http://www.dnr.state.oh.us/muskielog/sumall.aspx. Accessed May 4, 2010.

Ohio Department of Natural Resources (ODNR), 2004, Suspected Fish Poachers Netted During Undercover Wildlife Investigation., http://www.ohiodnr.com/news/jun04/0601poachers/tabid/13461/Default.aspx. Accessed May 4, 2010.

Ohio Environmental Protection Agency (OEPA), (2008). Biological and Water Quality Study of the upper Mahoning River and Selected Tributaries 2006. OEPA Technical Report EAS/2008-10-8, Columbus, Oh.

Ohio Environmental Protection Agency (OEPA), (2008). Appendices to the Biological and Water Quality Study of the upper Mahoning River and Selected Tributaries 2006. OEPA Technical Report EAS/2008-10-8, Columbus, Oh.

Raleigh, R. F., T. Hickman, R. C. Solomon, and P. C. Nelson. 1984. Habitat suitability information: Rainbow trout. U.S. Fish and Wildlife Service. FWS/OBS-82/10.60. 64pp.

RMC. 1992. Final report on study plan to assess the impact of power plant operations on fishresources, Youghiogheny Hydroelectric Project. Report prepared for D/R Hydro Co.,

Monroeville, PA.

Ruggles, C.P. and T.H. Palmeter. 1989. Fish passage mortality in a tube turbine. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1664.

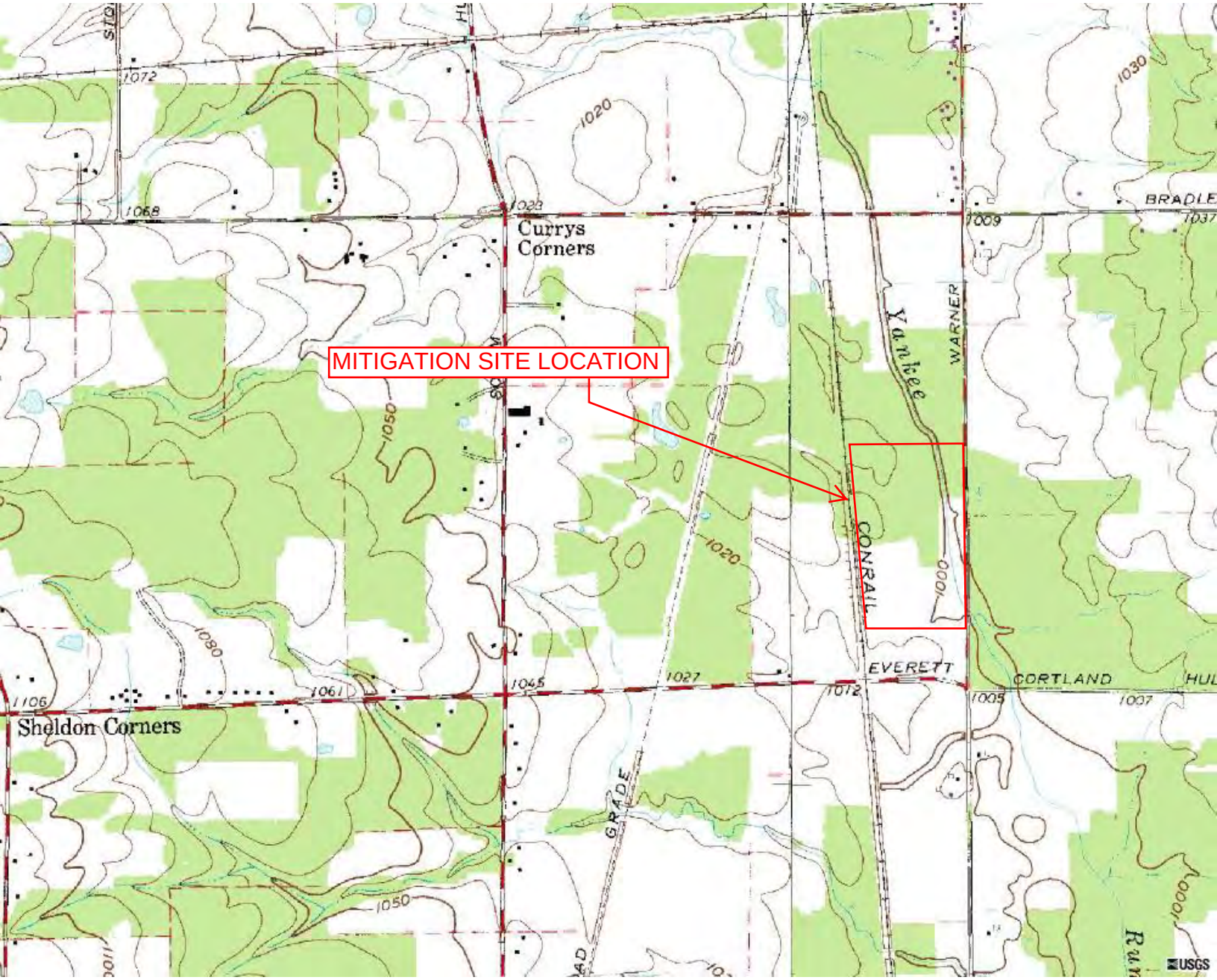
Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada. Ottawa, Canada. Pp.966.

Semple, J.R. 1979. Downstream migration facilities and turbine mortality evaluation, Atlantic salmon smolts at Malay Falls, Nova Scotia. Fisheries and Marine Services manuscript Report No. 1541. Fisheries and Environmental Canada, Halifax, Nova Scotia.

Tomljanovich, D.A. 1989. An investigation to evaluate the effect of intake velocity on entrainment and impingement of fish at a lowhead hydroelectric plant. Final Report. Tennessee Valley Authority.

Winchell, F., S. Amaral and D. Dixon. 2000. Hydroelectric turbine entrainment and survival database: an alternative to field studies. Hydro Vision Conference, Charlotte, NC. August 2000.

APPENDIX C: Mitigation Proposal



USGS 7.5 Topographic Map
Orangeville, Ohio (1995)

Mitigation Site Location
Yankee Creek 1 Consolidated Wetlands

Year Five
Monitoring and Management Report

Yankee Creek 1 Consolidated Wetlands Mitigation Project
Fowler Township, Trumbull County, Ohio

November, 2010

DAVEY RESOURCE GROUP
A Division of The Davey Tree Expert Company

Year Five
Monitoring and Management Report

Yankee Creek 1 Consolidated Wetlands Mitigation Project
Fowler Township, Trumbull County, Ohio

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Introduction

Davey Resource Group has been retained by Ohio Wetlands Foundation to perform monitoring and to prepare a *Year Five Monitoring and Management Report* for the Yankee Creek 1 Consolidated Wetlands Mitigation Project located in Fowler Township, Trumbull County, Ohio (Appendix A). The purpose of this project is to restore and preserve a wetlands system within the Yankee Creek watershed.

This project provides wetland and stream mitigation for multiple construction projects. Appendix B contains a summary table of permits issued by U.S. Army Corps of Engineers (USACE) and Ohio Environmental Protection Agency (EPA) for each of the projects that are using this site as mitigation.

The Yankee Creek 1 Consolidated Wetlands Mitigation Project protects approximately 50 acres by a permanent conservation easement held by the Cleveland Museum of Natural History. The *Yankee Creek 1 Consolidated Wetlands Mitigation Project Conceptual Plan* is included in Appendix C. According to the Conceptual Plan, up to 10.5 acres of wetlands may be restored on site. The consolidated mitigation project also includes on-site preservation of 20.4 acres of Category 3 forested wetlands, 1,672 linear feet of Yankee Creek, and approximately 18 acres of non-wetland buffers and stream corridors.

The preservation area is located along Yankee Creek and its riparian corridor. This forested area contains a mosaic of high-quality wetlands and uplands and has been documented to be inhabited by wood turtles, river otter, and Massasauga rattlesnakes. This project site, including several hundred additional acres of the Yankee Creek riparian area, is owned by Mr. Charles Matthews. Efforts are underway to work with Mr. Matthews to protect and restore additional portions of his property.

USACE and Ohio EPA require monitoring of the mitigation site for five years. This report provides a description of the site characteristics, including vegetation, soils, and hydrology, to provide data to evaluate the success of this site five years following construction. In addition, an overview of project design, restored wetland goals, and monitoring methods are discussed.

Project Site Description

Site Location

The Yankee Creek 1 Consolidated Wetlands Mitigation Project is located north of Everett Cortland Hull Road and west of Warner Road in Fowler Township, Trumbull County, Ohio. Yankee Creek flows through the site. Yankee Creek flows into the Shenango River in Pennsylvania (HUC code 05030102).

The mitigation site is part of the Massasauga Rattlesnake Ranch owned by Mr. Charles Matthews and is held in a conservation easement by the Cleveland Museum of Natural History.

Preconstruction Habitat

The wetlands restoration portion of the site was an old farm field before construction. The preservation portion was, and still is, wooded. Canadice and Sebring soils, which are poorly drained and hydric, make up most of the wetlands restoration area. Rittman and Wadsworth soils are also found over part of the area (Williams, 1992). These soils are non-hydric, but can have hydric inclusions.

Description of the Mitigation Wetlands

Restoration earthwork occurred in late Fall, 2004, and the restored wetland areas were planted in Spring, 2005. Construction was based on the May, 2003, *Yankee Creek 1 Consolidated Wetlands Mitigation Project Conceptual Plan* prepared by Davey Resource Group (Appendix C). According to the Conceptual Plan, it was anticipated that this project would result in up to 10.5 acres of restored wetlands. As of 2009, approximately 7.9 acres of wetlands have been restored on site, of which 7.48 acres are required to fulfill current permit obligations (Appendix B).

In-field adjustments required minor plan modifications, but the overall mitigation site is designed to meet the summarized mitigation criteria. Specific mitigation requirements vary between each project; therefore, most stringent goals will be applied across the entire mitigation site.

To improve site hydrology, a broad, shallow berm was created along the eastern edge of the property across a small east-west intermittent ditch. With no water level control structures installed, the berm was designed to have water sheet-flow over the top and into the preserved wetland areas. The hydrology regime is designed to impound water in just a few deeper areas to a maximum depth of 48 inches; this is where the existing ditch intersects the berm. The majority of the inundated areas will have a seasonal water depth of between 1 to18 inches. Non-inundated portions of the restored wetland communities are designed to support more terrestrial scrub/shrub and forested wetland components. It is also expected that water depths will fluctuate naturally as influenced by climatic conditions, precipitation, and storm events. An as-built map is included in Appendix D.

Photograph 1 (April 12, 2005). *Construction methods used on the site created valuable microtopography. The hummocks and deeper pockets seen in this photograph allowed each species to be planted in its most advantageous location.*

Originally, the site was to develop naturally without planting. However, to meet the project vegetation requirements within five years, intensive planting was initiated in Spring, 2005, following the completion of earthwork (Photograph 1). The plantings, described below, should quickly enrich wetlands species diversity and make monitoring goals attainable within the next five years.

April 12, 2005: 1,600 bare-root shrub and tree seedlings were installed. Appendix E contains a list of planted species.

May 27, 2005: 169 plugs were installed including 6 *Hibiscus laevis* (halberd-leaved-rose mallow, OBL[1]); 11 *Rosa palustris* (swamp rose, OBL); 76 *Saururus cernuus* (lizard's-tail, OBL); and 76 *Spartina pectinata* (prairie cord grass, OBL).

June 16, 2005: Over 180 emergents were installed within the inundated portions of the restored wetlands, including more than 60 *Brasenia schreberi* (water-shield, OBL); 50 *Nuphar advena* (spatterdock, OBL); 50 *Nymphaea odorata* (fragrant water-lily, OBL); and 20 *Pontederia cordata* (pickerel-weed, OBL).

[1] Please refer to Appendix F for a description of wetlands vegetation indicator status symbols.

Late Summer, 2005: Jim Bissell orchestrated the installation of several buckets of *Sparganium americanum* (American burreed, OBL) using volunteers from the Cleveland Museum of Natural History.

October 14, 2005: 136 plantings were installed including 20 S*alix discolor* (pussy willow, FACW); 20 *S. exigua* (sandbar willow, OBL); and 96 *Schoenoplectus acutus* (hard-stemmed bulrush, OBL).

Review of Mitigation Goals

The restored wetlands five-year performance goals include:

- Restore a minimum of 7.48 acres of jurisdictional Category 2 and or 3 wetlands. The required acreage of restored wetlands is based on the permits issued to date (Appendix B).
- Obtain a Vegetation Index of Biotic Integrity (VIBI) (Mack, 2004) score between 45 and 66 by Year Five.
- Maintain less than 5 percent invasive species cover within the restored wetlands (species specific as per permits).
- Achieve less than 10 percent unvegetated open water by Year Five.

Hydrology

The hydrologic goal is to achieve a mixture of areas which have seasonally to regularly inundated or saturated hydrologic regimes (Environmental Laboratory, 1987). Water depths will range from saturated soils to up to 4 feet where the broad berm crosses the east-west drainage ditch. Average depths of the deeper areas in the restored wetlands are expected to be 12 to18 inches.

Vegetation

The wetland design establishes wet meadow and emergent marsh habitats to provide a diversity of vegetative layers. Extensive plantings of hydrophytic species occurred in 2005 to help meet wetland vegetation goals (Photograph 2). At the end of the five-year monitoring period, a VIBI score between 45 and 66 is required for the wetlands.

Photograph 2 (April 27, 2005). *Wetland shrubs are expected to colonize the fringe areas between the uplands and the regularly inundated areas. To help this happen in the five-year monitoring timeframe, plugs such as this* Rosa palustris *(swamp rose, OBL) were installed.*

Soils

The wetland area is expected to contain hydric soils chromas. Any soils that do not contain hydric soil indicators are expected to convert to hydric chromas or demonstrate characteristics of developing hydric indicators by the end of the monitoring period.

Wetlands Monitoring Methodology

The objective of the annual wetlands monitoring is to determine if the goals established in the permit have been met or are anticipated to be achieved within the five-year period. The monitoring is specifically designed to evaluate plant composition and cover and soil inundation and saturation.

After construction and planting of the wetlands, six monitoring quadrats were established in late 2005. Post-construction fluctuations in hydrology required the addition of two more quadrats to adequately monitor the restoration site. These eight quadrats were positioned within different projected depth zones of the new wetlands in different existing and proposed habitat types. The one-meter by one-meter quadrats are designed to evaluate herbaceous vegetation within the individual quadrat. A five-meter by five-meter quadrat centered on the individual quadrat will be used to document shrubs and trees within this area. These quadrats were permanently marked for future monitoring purposes by staking the center of the plot with ultraviolet (UV), light-resistant polyvinyl chloride (PVC) stakes. Each monitoring quadrat was also surveyed using a global positioning system (GPS) unit with navigational capability so that the quadrats can be relocated if the stakes are lost during the course of the five-year monitoring. The location of these quadrats is shown on the maps in Appendix D.

Photographs of all monitoring quadrats were taken from fixed positions for yearly comparisons. The photographs and yearly quadrat wetland condition summaries are located in Appendix G. Data sheets summarizing soils, hydrology, and vegetation information for 2010 are located in Appendix I.

A wetlands delineation was performed in Year Five (2010) to determine the total acreage of restored wetlands. Wetlands delineation methodology followed the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region.*

Hydrology

Hydrology monitoring in spring and late summer or early fall of each year includes quantitative hydrologic measurements of surface water inundation or depth to soil saturation at the center of each sampling plot. Measurements are expressed in inches above or below the soil surface. The depth to saturation in the soil column is determined using a one-inch diameter soil probe. The depth of the groundwater table was noted, when possible, by measuring the depth to standing water in the pit made by the soil probe.

Vegetation

Information regarding plant species composition and percent cover within the monitoring quadrats was collected during the spring and late summer or early fall site visits. Plant identification resources used included Braun (1967, 1989), Newcomb (1977), and Weishaupt (1971). Reed, 1988 was consulted to assign wetlands indicator statuses to plant species.

The restored wetlands must attain a minimum VIBI score between 45 and 66 by Year Five. This intensive vegetation sampling necessary to calculate this score occurred in Years Three and Five.

The restored wetlands may not contain more than 5 percent areal cover of invasive plant species. To determine if this goal has been reached, invasive species cover will be determined each year over the restoration area through a combination GPS mapping and visual observations.

The restored wetlands may not contain more than 10 percent unvegetated open water. This value will be determined yearly by a combination of GPS mapping and visual observation.

Soils

Routine monitoring data collected in spring of each year includes the determination of soil characteristics within each quadrat. Soil samples were taken at a depth of approximately 10 inches for each monitoring quadrat using a 1-inch diameter soil probe. Collection methods adhere to those outlined in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987) and soil chromas were determined with a Munsell Color Chart (Munsell Color, 1994).

Monitoring Data—Year Five Results

The objective of the *Year Five Monitoring and Management Report* is to document conditions after construction activities have been completed in order to evaluate the progression and success of wetlands conversion. Todd Crandall visited the site on May 10 and July 13, 2010. Photographs of each quadrat and vegetation, water depth, and soils data collected at each quadrat are found in Appendix G. Vegetation, hydrology, and soils data sheets from the May, 2010, wetland delineation and a summary table of the data are in Appendix I.

Table 1 summarizes the mitigation project's five-year goals and provides a concise look at the fifth year's progress.

Table 1. Summary of Goal Attainment

Monitoring Goals	Goals	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
Number of the 8 monitoring quadrats meeting jurisdictional wetlands criteria	8	8	8	8	8	8
Acreage of wetlands restored	7.18	5.8	6.9	7.3	7.9	8.2
Invasive species cover	<5%	0%	<1%	<1%	2%	2%
Percent of unvegetated open water	<10%	<5%	<5%	<5%	<5%	<2%
VIBI score at Year Five[1]	42–66	–	–	64	–	71

[1] VIBI scores were calculated only in Years Three and Five.

Hydrology Conditions

Hydrologic measurements were taken at the center of the permanent monitoring quadrats in the spring and fall. A range of hydrological indicators was observed at all quadrats. Surface water was observed at six sampling stations, with soils saturated to the surface and water to the surface at the remaining two quadrats. The deepest water depth of 15 inches was observed at Quadrat 2. Table 2 provides a summary of spring and fall water depths recorded at each monitoring quadrat.

Table 2. Summary of Hydrology Monitoring

Quadrat	Year 1 (2006)		Year 2 (2007)		Year 3 (2008)		Year 4 (2009)		Year 5 (2010)	
#	*Jul-12*	*Oct-4*	*May-31*	*Aug-14*	*May-13*	*Sept-4*	*May-7*	*Aug-4*	*May-10*	*July-13*
1	12”	9”	3”	1”	7”	Saturated to surface	5”	2”	6”	1”
2	23”	17”	13”	9”	16”	10”	17”	14”	15”	13”
3	12”	10”	6”	1”	8”	1”	9”	4”	6”	4”
4	16”	12”	7”	2.5”	7”	2”	8”	5”	10”	4”
5	1”	water to surface	hummocking	saturated to surface, hummocking	water to surface, hummocking	saturated to surface	water to surface	saturated at 3”, hummocking	water to surface	saturated at 6”
6	15”	10”	7”	2”	7”	water to surface	9”	2”	7”	4”
7	5”	4”	saturated to surface	saturated to surface	1”	saturated to surface	1”	saturated to surface; watermarks	1”	saturated to surface
8	4”	3”	saturated to surface	saturated to surface	0.5”	saturated at 10”	water to surface	water to surface	water to surface	saturated to surface

Vegetation

A variety of vegetation communities exist within the wetlands mitigation area—deep emergent marsh, shallow emergent marsh, and wet meadow. The deep emergent marsh contains species such as *Nuphar advena* (spatterdock, OBL), *Nymphaea odorata* (fragrant water-lily, OBL), *Pontederia cordata* (pickerel-weed, OBL), and *Utricularia* spp. (bladderworts, OBL).

Photograph 3 (7-13-10). Pontederia cordata *(pickerel weed, OBL) is found within deep emergent marsh areas.*

There is very little open water remaining. The deepest areas are near the outlet and berm in the eastern portion of the wetland, near Quadrat 2, where areas of open water are intermixed with vegetation, primarily floating-leaved species. Because of the complexity of vegetation in these areas, it is not possible to accurately map the areas of open water. The total amount of open water on the site is approximately less than 2 percent and remains relatively unchanged from last year.

The shallow emergent marshes contain *Juncus effusus* (soft rush, FACW+), *Polygonum* spp. (smartweeds, WIS), *Sparganium americanum* (American bur-reed, OBL), and *Typha latifolia* (broad-leaved cat-tail, OBL). These areas are well vegetated with a diversity of native plants.

The wet meadows are the most diverse portion of the mitigation wetlands. These areas contain a wide variety of emergent species such as *Carex lurida* (bottlebrush sedge, OBL), *Carex scoparia* (pointed broom sedge, FACW), *Juncus effusus* (soft rush, FACW+), *Scirpus cyperinus* (wool-grass, FACW+), and *Verbena hastata* (blue vervain, FACW+).

The wet meadows also have a good diversity of small trees and shrubs, which are increasing yearly in both size and dominance. The wet meadow areas will eventually become a mosaic of lowland woods and scrub/shrub wetlands.

Photograph 4 (7-13-10). *The wet meadows contain a diverse assemblage of grasses, sedges, and rushes.*

All 8 monitoring quadrats exhibited a dominance of hydrophytic vegetation, and 7 of the 8 quadrats contained 100 percent cover of native perennial hydrophytes. Only Quadrat 2, located within the deep emergent marsh area, did not contain a predominance of native perennial hydrophytes. This was due to the presence of annual hydrophytes as well as the non-native, invasive *Myriophyllum spicatum* (European water-milfoil, OBL). Appendix G contains photographs and vegetation species data collected at each monitoring quadrat.

Two state-listed species occur in the wetland, both within the wet meadow habitat. *Epilobium strictum* (simple willow-herb, OBL) is an Ohio threatened species and *Poa languida* (weak spear grass, UPL) is an Ohio potentially threatened species.

A comprehensive list of plant species found within the project boundaries during the 2010 monitoring visits was compiled. This list, which includes 147 species, is contained in Appendix J. Table 3 summarizes the quality and composition of the vegetation in 2010. A total of 4 new plant species were found this year. The percent cover of native perennial hydrophytes has increased, with 94 percent cover this year, compared with 83 percent cover in 2009.

Table 3. Summary of Vegetation Monitoring

	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
Total Plant Species	83	115	130	143	147
FAC—OBL[1] species	61	85	95	106	112
UPL—FACU species	22	29	34	36	34
Perennial Species	66	95	107	118	121
Annual and Biennial Species	17	20	23	25	26
Native Perennial Hydrophyte Species	45	66	90	96	94
Percent Cover Native Perennial Hydrophytes[2]	58%	77%	84%	83%	94%
Invasive Plant Species[3]	0	4	4	5	5
Percent Areal Cover of Invasive Plant Species[3]	0%	<1%	<1%	2%	2%

[1] See Appendix F for an explanation of Wetlands Vegetation Indicator Status.
[2] Percentages are extrapolated for the entire wetland community from percent cover data collected at the eight monitoring quadrats.
[3] Invasive/exotic plant species as named in Table 1 of Ohio Rapid Assessment Method for Wetlands (ORAM) v. 5.0 Scoring Forms (Mack, 2001).

Soils

Even though the silty clay loam soils have been manipulated and disturbed, all 8 quadrats had hydric soil chromas. This is likely due to the anaerobic, inundated soil conditions present since the completion of construction.

VIBI

VIBI data were collected for the focus plot on July 13, 2010. The location of the VIBI plot is shown in Appendix D-6, and the VIBI calculations can be found in Appendix H. The VIBI plot generated a score of 64 in 2008 and 71 in 2010, which is well above our goal of a VIBI score in the range of 45–66. Thus, the VIBI goal for the site has been met.

Discussion and Management Recommendations

The map in Appendix D-6 shows the extent of wetlands in Year Five. The wetlands have adequate hydrology. Water levels were similar to last year and rainfall has been generally slightly below average this year. Five years after construction, the water levels have stabilized. Several distinct plant communities including deep emergent marsh, shallow emergent marsh, and wet meadows have formed in response to varying water levels over the site. Each of these plant communities has continued to increase in species diversity over the five-year monitoring period.

The wetlands have increased in size by 0.3 acre since last year, a smaller increase than in previous monitoring years. This indicates that the site is becoming more stable and has nearly made a full recovery since construction. The wetland size may fluctuate in future years in response to yearly precipitation but overall should remain relatively constant.

Invasive Species

A small area in the deepest part of the wetland has become dominated by *Myriophyllum spicatum* (European water-milfoil, OBL), an invasive species. The area covered by this species is similar to that observed in 2009 and is approximately 2 percent of the total mitigation area. This species does not present a problem. Native emergent and floating-leaved species, such as *Nymphaea odorata* (fragrant water-lily, OBL) and *Typha latifolia* (broad-leaved cat-tail, OBL), are expected to grow in areas dominated by this species. This species is limited from spreading by the lack of deep water over the site.

Other invasive species are not a problem over the site. Adjacent populations of *Phalaris arundinacea* (reed canary grass, FACW) and *Phragmites australis* (giant reed, FACW) have been treated with herbicide in previous years. Although a few individuals of *Phalaris arundinacea* (reed canary grass, FACW+) occur in the mitigation area, this species is not a threat to the wetland due to the amount of well-established native perennial hydrophytes throughout the wetland. Several *Alnus glutinosa* (black alder) were found in the mitigation area. These have been removed.

The mitigation wetland has become well developed through the course of the five-year monitoring period. The data presented in this report indicate a well-developed, stable wetland system. All performance goals have been met and no further monitoring of this site is planned.

Summary

Davey Resource Group was retained by Ohio Wetlands Foundation to perform monitoring and to prepare a *Year Five Monitoring and Management Report* for the Yankee Creek 1 Consolidated Wetlands Mitigation Project located in Fowler Township, Trumbull County, Ohio. The site was established as a consolidated mitigation site for 17 individual projects that require a total of 7.48 acres of wetlands restoration, 13.6 acres of wetlands preservation, and 1,080 linear feet of stream preservation.

The Yankee Creek 1 Consolidated Wetlands Mitigation Project protects approximately 50 acres by a permanent conservation easement held by the Cleveland Museum of Natural History. The Conceptual Plan proposed for the restoration of up to 10.5 acres of wetlands. The mitigation project also includes on-site preservation of a total of 20.4 acres of Category 3 forested wetlands, 1,672 linear feet of Yankee Creek, and approximately 18 acres of non-wetland buffers and stream corridors all protected under a permanent conservation easement.

As of 2010, 8.2 acres of wetlands have been restored based on a wetland delineation conducted in May, 2010, well above the goal of 7.48 acres. Based on the current permits listed in Appendix B, there is 0.72 acre of wetlands restoration, 6.8 acres of wetlands preservation, and 592 linear feet of stream preservation available for use by other perspective permit holders, as approved by USACE and/or Ohio EPA.

Ohio EPA visited the site in September, 2010. Several *Alnus glutinosa* (black alder) were identified in the mitigation area. These have been removed.

This report addresses data collected in 2010. The site was visited on May 10 and July 13, 2010, to collect data for the *Year Five Monitoring and Management Report*. Of the eight monitoring quadrats established, all contain the required jurisdictional wetland criteria. All quadrats had 100 percent wetlands vegetation, hydric soil chromas, and hydrologic indicators.

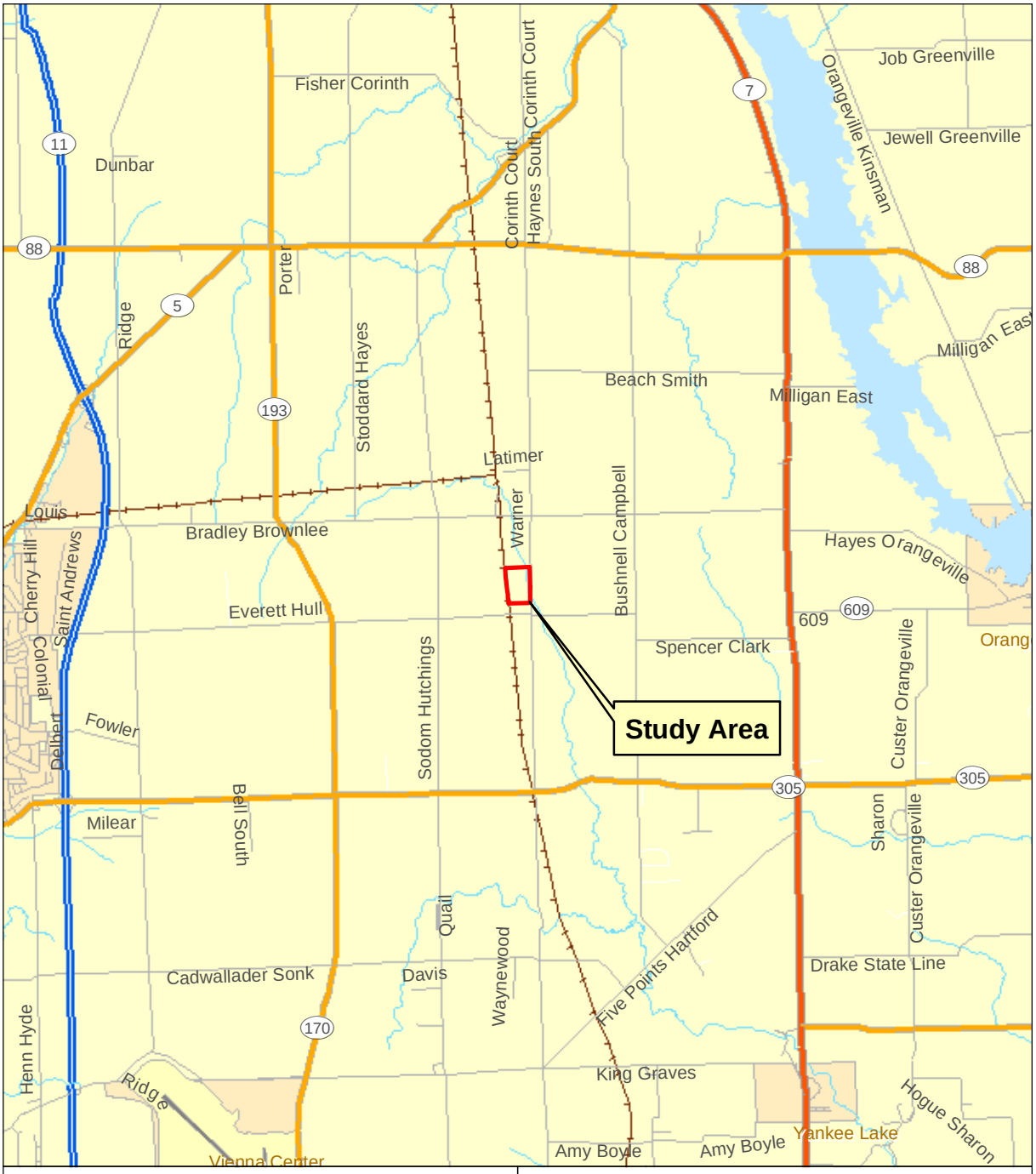
There is less than 5 percent open water, which also is less than the five-year monitoring goal of less than 10 percent open water. A small area of *Myriophyllum spicatum* (European water-milfoil, OBL) was found in the deepest part of the wetland and remains relatively unchanged from last year. This species currently comprises about 2 percent of the mitigation area, well below the goal of 5 percent invasive species.

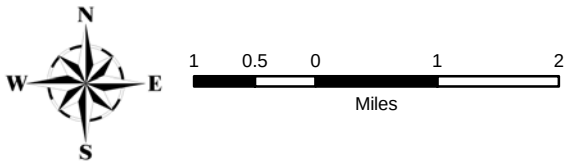
As expected, vegetation diversity is increasing on the site, with 147 plant species recorded this year, of which 112 are wetlands species. The data collected throughout the five-year monitoring period indicate that the wetland is becoming more stable. Although vegetation diversity, water levels, and wetland area will continue to fluctuate over time in response to environmental conditions, the wetland is now a relatively stable system. Because all performance goals have been met, no further monitoring of the site is planned.

References and Professional Staff

Please see Appendix K for a list of references consulted while conducting the field study and preparing this report. Please see Appendix L for a list of Davey Resource Group professionals involved in this study.

Appendix A
Location of Study Area on Highway Map





Site Location: 49.5 Acres, Yankee Creek 1
Consolidated Wetlands Mitigation Project
Fowler Township, Trumbull County, Ohio
Source: ESRI
Redlands, California

Appendix B
Yankee Creek 1 Consolidated Wetlands Mitigation Project Applicant Summary Table

Applicant	Ohio EPA ID #	USACE Permit Number	Project Name	Consultant Name	Acres Impacted	Streams Impacted	Restoration Mitigation Purchased	Preservation Mitigation Purchased
Angellili Builders (d.b.a. Garden Ridge Development)	032635		Garden Ridge Estates Mahoning	Pancher & Wallace	0.990	—	2.48 acres of restored wetlands	—
Charter Oaks Development			Hunt Club Residential Subdivision Lot 32	Mike Hreno	0.380	—	1.2 acres of restored wetlands	—
Cocca Properties, LLC	073262		Roseland Subdivsion		0.18			0.80 acre of preserved wetlands
Dawda, Mann, Malcahy & Sadler for Home Deport USA, Inc.	042029		Home Depot Salem, Ohio	Burgess & Niple	—	900 linear feet of stream	—	2.1 acres of preserved riparian wetlands (50 feet each side of 900 LF of stream)
E & K Land Co.			South Commons	Pancher & Wallace	0.5	—	0.5 acre of restored wetlands	—
Fogg Building Methods, Inc			USF Truck Terminal Project	Chagrin Valley Engineering, Ltd	0.043	—	0.1 acre of restored wetlands	—
Hunter's Glenn Subdivision			Hunt Club Residential Subdivision Lot 35	Rex and Mary King	0.420	—	1.3 acres of restored wetlands	—
Jefferson County Sanitary Engineer	103627		Crestview-Belvedere Sanitary Sewer Project	Flickinger Wetland Service Group	0.1	—	0.1 acre of restored wetlands	—
LaBrae Local School District	033324		LaBrae Local Schools Trumbull	Flickinger Wetland Services Group	1.734	—	—	1.8 acres of preserved wetlands
NRP Group (d.b.a. Youngstown Choice Homes IV, LLC)		2002-1719	Youngstown Jubilee Homes IV	Davey Resource Group	0.500	—	0.5 acre of restored wetlands	1.0 acre of preserved wetlands
PCI Design Group			Meridian Green II, LLC	ATC Assoc., Inc.	0.09	—	—	0.4 acre of preserved wetlands
Peterman Associates, Inc.		2006-1243	Love's Country Stores	Davey Resource Group	0.078	—	0.1 acre of restored wetlands	0.2 acre of preserved wetlands
Stark County Park District			Mahoning Valley Trail	ms Consultants, Inc.	0.36		0.4 acre of restored wetlands	0.9 acre of preserved wetlands
TG Investments, LLC			Greenwood Chevrolet	Triad Consultants	0.351	—	0.5 acre of restored wetlands	—
Trumbull County Metropolitan Housing Authority	103652		Warren Plaza	MS Consultants	0.057	—	0.2 acre of restored wetlands	—
Variety Contractor		2007-1265	Infocision Expansion	Flickinger Wetland Services Group	0.36			6 acres of preserved wetlands
WCI Steel, Inc.	033814		WCI Steel Residual Water Landfill Facility	Burgess & Niple	0.010	180 linear feet of stream	0.1 acre of restored wetlands	0.4 acre of preserved riparian wetlands (50 feet each side of 180 LF of stream)
Total					**6.153 Acres of Impact**	**1,080 Linear Feet of Stream Impacted**	**7.48 Acres of Restored Wetlands**	**13.6 Acres of Preserved CAT 3 Forested Wetlands Including 1,080 LF of Stream Preservation**

Appendix C
Yankee Creek 1 Consolidated Wetlands Mitigation Project Conceptual Plan

Appendix D
Yankee Creek 1 Consolidated Wetlands Mitigation Project Maps

D-1: As-Built Map

D-2: Year One Map

D-3: Year Two Map

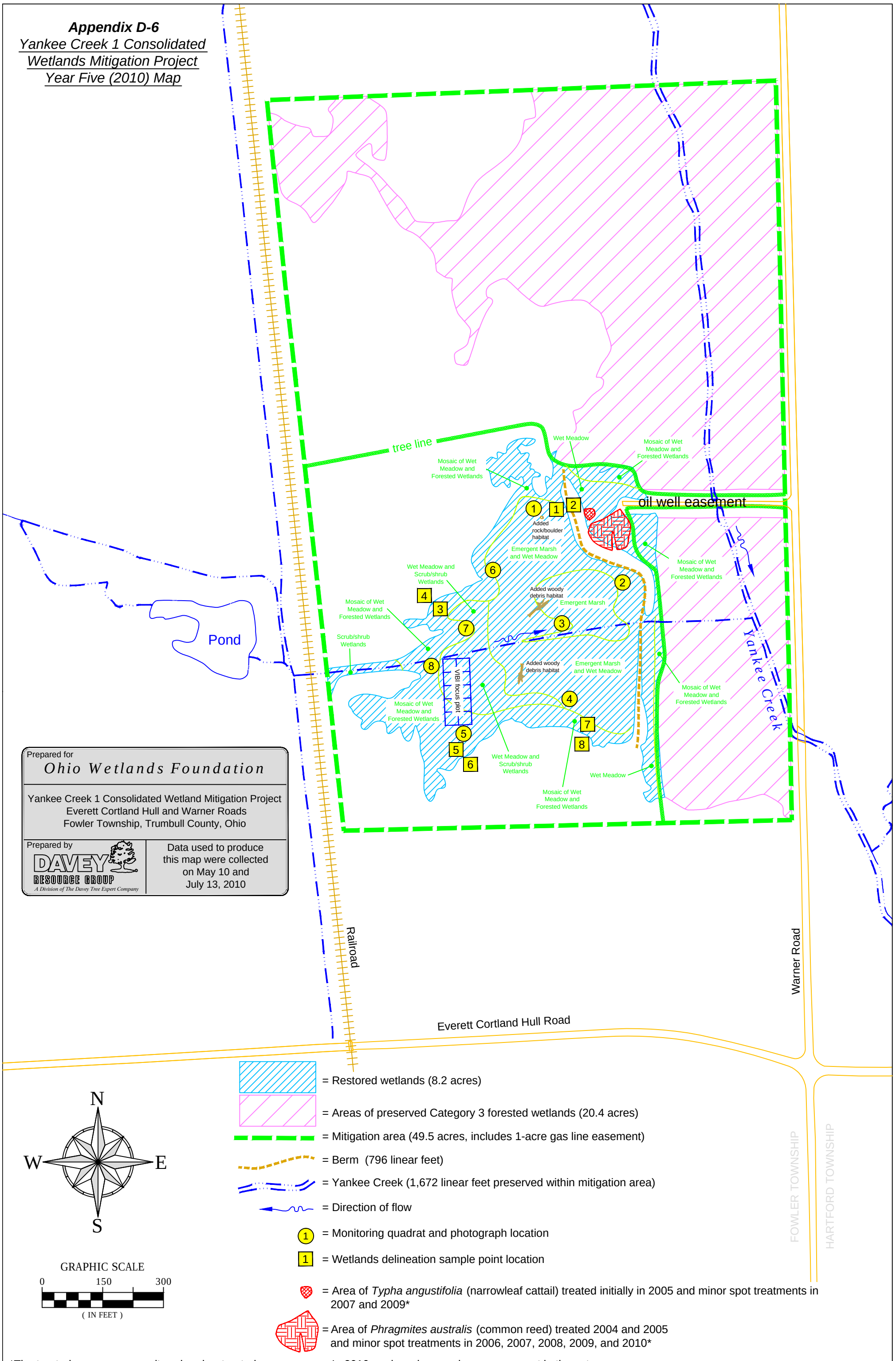
D-4: Year Three Map

D-5: Year Four Map

D-6: Year Five Map

Appendix D-6

Yankee Creek 1 Consolidated Wetlands Mitigation Project Year Five (2010) Map



*The treated areas were monitored and re-treated as necessary. In 2010, no invasive species were present in these two areas.

Appendix E
List of Bare-Root Species Planted on April 12, 2005

Scientific Name[1]	Common Name[1]	Indicator Status[1]	Coefficient of Conservatism[1]	Quantity
Amelanchier laevis	smooth serviceberry	FAC	5	100
Aronia arbutifolia	red chokeberry	FACW	9	100
Betula alleghaniensis	yellow birch	FAC	7	100
Carya laciniosa	shellbark hickory	FAC	7	100
Cephalanthus occidentalis	buttonbush	OBL	6	100
Hamamelis virginiana	witch-hazel	FAC-	5	100
Hibiscus laevis	halberd-leaved rose-mallow	OBL	7	100
Ilex verticillata	winterberry	FACW+	6	100
Nyssa sylvatica	black-gum	FAC	7	100
Platanus occidentalis	sycamore	FACW-	7	100
Quercus bicolor	swamp white oak	FACW+	7	100
Quercus macrocarpa	bur oak	FAC-	6	100
Quercus palustris	pin oak	FACW	5	100
Sambucus canadensis	common elderberry	FACW-	3	100
Viburnum opulus var. *americana*	highbush-cranberry	FACW	8	100
Viburnum prunifolium	black-haw	FACU	4	100
			Total	**1,600**

Appendix F
Definition of Wetlands Vegetation Indicator Status
(from Reed, 1988)

Obligate Wetlands (OBL). Occur almost always (estimated probability is greater than 99%) under natural conditions in wetlands.

Facultative Wetlands (FACW). Usually occur in wetlands (estimated probability 67–99%) but occasionally found in non-wetlands.

Facultative (FAC). Equally likely to occur in wetlands or non-wetlands (estimated probability 34–66%).

Facultative Upland (FACU). Usually occur in non-wetlands (estimated probability 67–99%) but occasionally found in wetlands (estimated probability 1–33%).

Obligate Upland (UPL). Occur in wetlands in another region, but occur almost always (estimated probability >99%) under natural conditions in non-wetlands in the region specified. If a species does not occur in wetlands in any region, it is not on the *National List*.

Species for which little or no information was available to base an indicator status were assigned a no indicator (NI) status. An asterisk (*) after the indicator status indicates that the indicator status was based on limited ecological information.

The wetlands indicator categories should not be equated to degrees of wetness. Many obligate wetlands species occur in permanently or semipermanently flooded wetlands, but a number of obligates also occur and some are restricted to wetlands that are only temporarily or seasonally flooded. The facultative upland species include a diverse collection of plants that range from weedy species adapted to exist in a number of environmentally stressful or disturbed sites (including wetlands) to species in which a portion of the gene pool (an ecotype) always occurs in wetlands. Both the weedy and ecotype representatives of the facultative upland category occur in seasonally and semipermanently flooded wetlands.

Davey Resource Group has added two additional indicators for situations when plants can only be identified to genus. A Wetlands Indicator Species (WIS) is a plant that is most likely obligate wetlands, facultative wetlands, or facultative. An Upland Indicator Species (UIS) is a plant that is most likely indicative of upland or facultative upland conditions. These additional indicators are used when species identification is not possible. A variety of factors are part of the UIS and WIS assignments. Indicator statuses of all locally occurring members of the genus in question are considered, as are the health and size of the population and the indicator status of nearby plants.

Appendix G
Photographs and Data Collected at Each Monitoring Point

Appendix H
VIBI Information

Appendix I
Vegetation, Soils, and Hydrology Data Sheets for Wetland Delineation

Data Sheets Summary Table

Quadrat	Hydric Soil	Wetlands Hydrology	Percent Wetlands Vegetation	Jurisdictional Wetlands	Comments
1	Yes	Yes	100	Yes	Wet meadow
2	No	No	0	No	Upland old field
3	Yes	Yes	100	Yes	Wet meadow
4	Yes	No	0	No	Upland old field
5	Yes	Yes	100	Yes	Wet meadow
6	Yes	No	0	No	Upland old field
7	Yes	Yes	100	Yes	Wet meadow
8	No	No	0	No	Upland old field

Appendix J
Plant Species Found at the Yankee Creek 1 Consolidated Wetlands Mitigation Project

Scientific Name[1]	Common Name[1]	Indicator Status[1]	Habit[1]	Coefficient of Conservatism[1]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
Acalypha rhomboidea	rhombic three-seeded mercury	FACU-	annual	0	X	X	X	X	X
Acer rubrum	red maple	FAC	perennial	2		X	X	X	X
Acer saccharinum	silver maple	FAC	perennial	3		X	X	X	X
Agrimonia parviflora	small-flowered agrimony	FAC	perennial	2	X	X	X	X	X
Agrostis gigantea	redtop	FACW	perennial	*	X	X	X	X	X
Alisma subcordatum	southern water-plantain	OBL	perennial	2	X	X	X	X	X
Allium canadense	wild garlic	FACU	perennial	2	X	X	X	X	X
Alnus glutinosa	black alder	FACW-	perennial	*					X
Alnus incana	speckled alder	FACW+	perennial	6		X			
Ambrosia artemisiifolia	annual ragweed	FACU	annual	0	X	X	X	X	X
Anthoxanthum odoratum	sweet vernal grass	FACU	perennial	*				X	X
Apocynum cannabinum	Indian hemp	FACU	perennial	1	X	X	X	X	X
Asclepias incarnata	swamp milkweed	OBL	perennial	4	X	X	X	X	X
Asclepias syriaca	common milkweed	FACU-	perennial	1	X	X	X	X	X
Aster lanceolatus	eastern lined aster	FACW	perennial	3			X	X	X
Aster lateriflorus	calico aster	FACW-	perennial	2				X	X
Aster novae-angliae	New England aster	FACW-	perennial	2	X	X	X	X	X
Aster praealtus	veiny lined aster	FACW	perennial	6			X	X	X
Aster racemosus	small-headed aster	FACW	perennial	2	X	X	X	X	X
Bidens cernua	nodding beggar's-tick	OBL	annual	3				X	X

Scientific Name[1]	Common Name[1]	Indicator Status[1]	Habit[1]	Coefficient of Conservatism[1]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
Bidens connata	purple-stemmed beggar's tick	FACW+	annual	3	X	X	X	X	X
Bidens frondosa	devil's beggar's-tick	FACW	annual	2	X	X	X	X	X
Carex comosa	bearded sedge	OBL	perennial	2		X	X	X	X
Carex crinita	tasseled sedge	OBL	perennial	3	X	X	X	X	X
Carex hystericina	porcupine sedge	OBL	perennial	5					X
Carex lupulina	hop sedge	OBL	perennial	3	X	X	X	X	X
Carex lurida	bottlebrush sedge	OBL	perennial	3		X	X	X	X
Carex scoparia	pointed broom sedge	FACW	perennial	3	X	X	X	X	X
Carex stipata	crowded sedge	OBL	perennial	2				X	X
Carex tribuloides	blunt broom sedge	FACW+	perennial	4				X	X
Carex vulpinoidea	fox sedge	OBL	perennial	1	X	X	X	X	X
Cephalanthus occidentalis	buttonbush	OBL	perennial	6	X	X	X	X	X
Chrysanthemum leucanthemum	ox-eye daisy	UPL	perennial	*		X	X	X	X
Cirsium arvense	Canada thistle	FACU	perennial	*	X	X	X	X	X
Cornus amomum	silky dogwood	FACW	perennial	2	X	X	X	X	X
Cyperus strigosus	straw-colored umbrella- sedge	FACW	perennial	1			X	X	X
Daucus carota	Queen-Anne's-lace	UPL	biennial	*	X	X	X	X	X
Dipsacus fullonum	wild teasel	FACU-	biennial	*	X	X	X	X	X
Echinchloa muricata	rough barnyard grass	FACW+	annual	3	X	X	X	X	X
Eleocharis obtusa	blunt spike-rush	OBL	annual	1	X	X	X	X	X
Elytrigia repens	quackgrass	FACU-	perennial	*	X	X	X	X	X
Epilobium coloratum	purple-leaved willow-herb	OBL	perennial	1	X	X	X	X	X

Scientific Name[1]	Common Name[1]	Indicator Status[1]	Habit[1]	Coefficient of Conservatism[1]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
Epilobium strictum[3]	simple willow-herb	OBL	perennial	9			X	X	X
Equisteum arvense	field horsetail	FAC	perennial	0			X	X	X
Erechities hieraciifolia	pilewort	FACU	annual	2			X	X	X
Erigeron annuus	daisy fleabane	FACU	annual	0		X	X	X	X
Eupatorium perfoliatum	common boneset	FACW+	perennial	3	X	X	X	X	X
Euthamia graminifolia	flat-topped goldenrod	FAC	perennial	2	X	X	X	X	X
Fragaria virginiana	wild strawberry	FACU	perennial	1	X	X	X	X	X
Fraxinus pennsylvanica	green ash	FACW	perennial	3	X	X	X	X	X
Galium tinctorium	small three-lobed bedstraw	OBL	perennial	4	X	X	X	X	X
Geum laciniatum	rough avens	FAC+	perennial	2	X	X	X	X	X
Helenium autumnale	common sneezeweed	FACW+	perennial	4					X
Hibiscus laevis	halberd-leaved rose-mallow	OBL	perennial	7		X	X	X	X
Holcus lanatus	velvet grass	FACU	perennial	*		X	X	X	X
Hypericum mutilum	slender St.-John's-wort	FACW	annual	3			X	X	X
Impatiens capensis	spotted touch-me-not	FACW	annual	2	X	X	X	X	X
Juncus acuminatus	sharp-fruited rush	OBL	perennial	4		X	X	X	X
Juncus effusus	soft rush	FACW+	perennial	1	X	X	X	X	X
Juncus tenuis	path rush	FAC-	perennial	1	X	X	X	X	X
Juncus torreyi	Torrey's rush	FACW	perennial	3	X	X	X	X	X
Leersia oryzoides	rice cut grass	OBL	perennial	1	X	X	X	X	X
Lemna minor	common duckweed	OBL	annual	3	X	X	X	X	X
Lindernia dubia	false pimpernel	OBL	annual	2	X	X	X	X	X
Lobelia cardinalis	cardinal-flower	FACW+	perennial	5				X	X
Lobelia inflata	Indian-tobacco	FACU	annual	1				X	X

Scientific Name[1]	Common Name[1]	Indicator Status[1]	Habit[1]	Coefficient of Conservatism[1]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
Lobelia siphilitica	great blue lobelia	FACW+	perennial	3			X	X	X
Lolium perenne	perennial ryegrass	FACU-	perennial	*			X	X	X
Ludwigia alternifolia	seedbox	FACW+	perennial	3		X	X	X	X
Ludwigia palustris	water-purslane	OBL	annual	3	X	X	X	X	X
Lycopus virginicus	Virginia bugle-weed	OBL	perennial	3	X	X	X	X	X
Lysimachia nummularia	moneywort	OBL	perennial	*	X	X	X	X	X
Mentha spicata	spearmint	FACW+	perennial	*		X	X	X	X
Mimulus ringens	common monkey-flower	OBL	perennial	4	X	X	X	X	X
Myriophyllum spicatum	European water-milfoil	OBL	perennial	*				X	X
Najas minor	Eurasian water-nymph	OBL	annual	*		X	X	X	X
Nuphar advena	spatterdock	OBL	perennial	4		X	X	X	X
Nymphaea odorata	fragrant water-lily	OBL	perennial	6	X	X	X	X	X
Oenothera biennis	common evening-primrose	FACU-	biennial	1	X	X	X	X	X
Onoclea sensibilis	sensitive fern	FACW	perennial	2	X	X	X	X	X
Oxalis stricta	common yellow wood-sorrel	UPL	perennial	0	X	X	X	X	X
Panicum rigidulum	rigid panic grass	FACW+	perennial	5				X	X
Panicum virgatum	switch grass	FAC	perennial	4	X	X	X	X	X
Penthorum sedoides	ditch-stonecrop	OBL	perennial	2	X	X	X	X	X
Phalaris arundinacea	reed canary grass	FACW+	perennial	0		X	X	X	X
Phleum pratense	timothy	FACU	perennial	*	X	X	X	X	X
Phragmites australis[2]	giant reed	FACW	perennial	0	X	X	X	X	X
Plantago major	common plantain	FACU	perennial	*	X	X	X	X	X
Platanus occidentalis	sycamore	FACW-	perennial	7	X	X	X	X	X

Scientific Name[1]	Common Name[1]	Indicator Status[1]	Habit[1]	Coefficient of Conservatism[1]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
Poa languida[3]	weak spear grass	UPL	perennial	6		X	X	X	X
Polygonum hydropiper	water-pepper	OBL	annual	1			X	X	X
Polygonum hydropiperoides	mild water-pepper	OBL	perennial	6	X	X	X	X	X
Polygonum pensylvanicum	pinkweed	FACW	annual	0	X	X	X	X	X
Polygonum sagittatum	arrow-leaved tearthumb	OBL	annual	2	X	X	X	X	X
Populus deltoids	eastern cottonwood	FAC	perennial	3	X	X	X	X	X
Potamogeton nodosus	long-leaved pondweed	OBL	perennial	3			X	X	X
Potentilla norvegica	strawberry-weed	FACU	annual	1					X
Potentilla recta	rough-fruited cinquefoil	UPL	perennial	*			X	X	X
Potentilla simplex	old field cinquefoil	FACU-	perennial	1	X	X	X	X	X
Prunella vulgaris	self-heal	FACU+	perennial	0		X	X	X	X
Pycnanthemum tenuifolium	narrow-leaved mountain-mint	FACW	perennial	4	X	X	X	X	X
Quercus bicolor	swamp white oak	FACW+	perennial	7		X	X	X	X
Quercus macrocarpa	bur oak	FAC-	perennial	6			X	X	X
Quercus palustris	pin oak	FACW	perennial	5	X	X	X	X	X
Ranunculus abortivus	kidney-leaved buttercup	FACW-	perennial	1		X	X	X	X
Ranunculus acris	tall buttercup	FAC+	perennial	*		X	X	X	X
Ranunculus pensylvanicus	bristly crowfoot	OBL	perennial	4			X	X	X
Ribes americanum	wild black currant	FACW	perennial	4				X	X
Rorippa palustris	yellow cress	OBL	annual	2	X	X	X	X	X
Rosa palustris	swamp rose	OBL	perennial	5		X	X	X	X
Rudbeckia hirta	black-eyed Susan	FACU-	perennial	1		X	X	X	X
Rumex crispus	curly dock	FACU	perennial	*	X	X	X	X	X

Scientific Name[1]	Common Name[1]	Indicator Status[1]	Habit[1]	Coefficient of Conservatism[1]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
Rumex verticillatus	swamp dock	OBL	perennial	6	X	X	X	X	X
Salix amygdaloides	peach-leaved willow	FACW	perennial	3		X	X	X	X
Salix discolor	pussy willow	FACW	perennial	3		X	X	X	X
Salix exigua	sandbar willow	OBL	perennial	1				X	X
Salix sp.	willow	n/a	perennial	n/a	X	X	X	X	X
Sambucus canadensis	common elderberry	FACW-	perennial	3				X	X
Schoenoplectus tabernaemontani	soft-stemmed bulrush	OBL	perennial	2	X	X	X	X	X
Scirpus atrovirens	green bulrush	OBL	perennial	1	X	X	X	X	X
Scirpus cyperinus	wool-grass	FACW+	perennial	1	X	X	X	X	X
Scirpus polyphyllus	leafy bulrush	OBL	perennial	6	X	X	X	X	X
Setaria glauca	yellow foxtail grass	FAC	annual	*	X	X	X	X	X
Sisyrinchium angustifolium	stout blue-eyed-grass	FACW-	perennial	2		X	X	X	X
Sium suave	water-parsnip	OBL	perennial	6			X	X	X
Solanum dulcamara	bittersweet nightshade	FAC-	perennial	*			X	X	X
Solidago canadensis	Canada goldenrod	FACU	perennial	1	X	X	X	X	X
Solidago juncea	plume goldenrod	UPL	perennial	2		X	X	X	X
Solidago rugosa	rough goldenrod	FAC	perennial	2	X	X	X	X	X
Sparganium americanum	American bur-reed	OBL	perennial	6	X	X	X	X	X
Spartina pectinata	prairie cord grass	OBL	perennial	5		X	X	X	X
Spiraea alba	meadow-sweet	FACW+	perennial	3		X	X	X	X
Stuckenia pectinata	sago pondweed	OBL	perennial	2				X	X
Taraxacum officinale	common dandelion	FACU-	perennial	*	X	X	X	X	X
Trifolium hybridum	alsike clover	FACU-	perennial	*	X	X	X	X	X
Trifolium pratense	red clover	FACU-	perennial	*	X	X	X	X	X
Trifolium repens	white clover	FACU-	perennial	*		X	X	X	X

Scientific Name[1]	Common Name[1]	Indicator Status[1]	Habit[1]	Coefficient of Conservatism[1]	Year 1 (2006)	Year 2 (2007)	Year 3 (2008)	Year 4 (2009)	Year 5 (2010)
Typha angustifolia[2]	narrow-leaved cat-tail	OBL	perennial	*	X	X	X	X	X
Typha latifolia	broad-leaved cat-tail	OBL	perennial	1	X	X	X	X	X
Ulmus americana	American elm	FACW-	perennial	2	X	X	X	X	X
Utricularia gibba	humped bladderwort	OBL	perennial	8	X	X	X	X	X
Utricularia vulgaris	common bladderwort	OBL	perennial	6	X	X	X	X	X
Verbena hastata	blue vervain	FACW+	perennial	4	X	X	X	X	X
Vernonia gigantea	tall ironweed	FAC	perennial	2	X	X	X	X	X
Viburnum lentago	nannyberry	FAC	perennial	5		X	X	X	X
Viburnum opulus var. *americana*	highbush-cranberry	FACW	perennial	8	X	X	X	X	X
Viburnum recognitum	northern arrow-wood	FACW-	perennial	2		X	X	X	X
Wolffia columbiana	common water-meal	OBL	annual	3		X	X	X	X

[1] C of C scores as well as scientific and common plant names are obtained from *Andreas,* et. al. (2004). Non-native species are denoted with an asterisk in the Coefficient of Conservatism (C of C) column and have no score.

[2] These species were identified in an area adjacent to, but not within, the active wetland restoration area. They are included because management actions occurred to control their spread into the active restoration areas.

[3] Ohio potentially threatened species.

Appendix K
References Cited

Andreas, Barbara K., John J. Mack, and James S. McCormac. 2004. *Floristic Quality Assessment Index (FQAI) for vascular plants and mosses for the State of Ohio*. Ohio Environmental Protection Agency, Division of Surface Water, Wetland Ecology Group, Columbus, Ohio. 219 pp.

Braun, E. Lucy. 1967. *The Monocotyledoneae: Cat-tails to Orchids.* The Ohio State University Press, Columbus, Ohio. 464 pp.

Braun, E. Lucy. 1989. *The Woody Plants of Ohio.* The Ohio State University Press, Columbus, Ohio. 362 pp.

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1*. United States Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Mack, John J. 2004. *Integrated Wetland Assessment Program. Part 4: Vegetation Index of Biotic Integrity (VIBI) and Tiered Aquatic Life Uses (TALUs) for Ohio Wetlands*. Ohio EPA Technical Report WET/2004-4. Ohio Environmental Protection Agency, Wetland Ecology Group, Division of Surface Water, Columbus, Ohio.

Munsell Color. 1994. *Munsell® Soil Color Charts*, revised edition. GretagMacbeth. New Windsor, New York.

Newcomb, Lawrence. 1977. *Newcomb's Wildflower Guide*. Little, Brown, and Co., Boston. 490 pp.

Reed, P.B., Jr. 1988. *National List of Plant Species that Occur in Wetlands: National Summary*. U.S. Fish and Wildlife Service Biological Report 88 (24). Available from the Superintendent of Documents, U.S.G.P.O., Washington, D.C. 20402. 244 pp.

U.S. Army Corps of Engineers. 2009. *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region*, ERDC/EL-TR-09-19. Vicksburg, MS; U.S. Army Engineer Research and Development Center.

Weishaupt, Clara G. 1971. *Vascular Plants of Ohio.* Kendall/Hunt Publishing Co., Dubuque, Iowa. 293 pp.

Williams, Norris L. 1992. *Soil Survey of Trumbull County, Ohio.* United States Department of Agriculture, Soil Conservation Service, Washington, D.C.

APPENDIX D: Wildlife Coordination Letters

ODNR COMMENTS TO:
Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Room 1A
Washington, D.C. 20426

Location: The project is located on the Lake Milton Dam, in the City of Lake Milton, Mahoning County, Ohio.

Project No.13402-000, Lake Milton Hydroelectric Project. The project involves the construction of a new powerhouse at the base of the existing dam over the existing outlet works. The project will consists of one or more turbine/generator units with a combined nominal capacity of up to 1.2 MW.

The Ohio Department of Natural Resources (ODNR) has completed a review of the above referenced project. These comments were generated by an inter-disciplinary review within the Department. These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the National Environmental Policy Act, the Coastal Zone Management Act, Ohio Revised Code and other applicable laws and regulations. These comments are also based on ODNR's experience as the state natural resource management agency and do not supersede or replace the regulatory authority of any local, state or federal agency nor relieve the applicant of the obligation to comply with any local, state or federal laws or regulations.

Rare and Endangered Species: The ODNR, Division of Natural Areas and Preserves, Natural Heritage Database contains no records of rare species or unique natural features within the proposed projects and there are no state nature preserves, wildlife areas, or scenic rivers in the vicinity of the sites.

Our inventory program has not completely surveyed Ohio and relies on information supplied by many individuals and organizations. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area.

Fish and Wildlife: The ODNR, Division of Wildlife (DOW) has the following comments.

The DOW is concerned with the impacts this project will have on the aquatic resources provided by Lake Milton and the Mahoning River as well as the fishery resource the Mahoning River provides. The proposed project creates a potential threat to this fishery resource and habitat. The applicant should take adequate measures to reduce impacts from potential fluctuations in dissolved oxygen levels, fluctuations in water discharge and velocities, water level fluctuations, reduction in base flow and water temperatures, restriction of movement of aquatic organisms upstream or downstream, and fish impingement and entrainment. We recommend the applicant address how these concerns will be avoided or mitigated.

The DOW is also concerned with restrictions the project will have on current fishing access facilities. The applicant should address how this concern will be avoided or mitigated. We recommend the applicant consider efforts to enhance fishing opportunities in the project area.

It is recommended intake/discharge structures be constructed in a way to avoid sedimentation that will impact aquatic species at the site and downstream. Additionally, project design must be carried through in such a way that equipment and water flow necessary for operation does not cause entrainment or impingement of fish species. The DOW recommends that the applicant provide adequate documentation that fish mortality will be kept to a minimum and compensation for fish losses will be addressed.

The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis),* Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (Populus deltoides), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. If no tree removal is proposed, the project is not likely to impact this species.

The project is within the range of the bald eagle (*Haliaeetus leucocephalus*), a state threatened species. The location of bald eagle activity frequently changes. Therefore, closer to the actual date of construction, the applicant must obtain an updated status of bald eagle activity in the area. To obtain any changes in status, contact Andrea Tibbels or Dave Sherman at the Ohio Department of Natural Resources, Division of Wildlife, Crane Creek Wildlife Research Station, for current information on the presence of bald eagles in the area. Andrea can be reached at (419) 898-0960 extension 25 and Dave at extension 24. If a nest is located within ½ mile of the project site, coordination with the DOW is required.

Parks and Recreation: The ODNR, Division of Parks and Recreation offers the following comments regarding the Lake Milton Hydroelectric proposed project.

The Lake Milton Dam is owned, operated and maintained by the Ohio Department of Natural Resources; the Division of Parks and Recreation oversees the dam. Lake Milton receives its water from Berlin Lake, which is fed by the Mahoning River. The Lake Milton Reservoir was constructed to be used as water supply for the local mills and flood protection. Once the mills closed, the main use of the reservoir became recreational purposes and it still functions as a flood control reservoir.

In the information provided, there is no mentioning of the amount of water release needed for the proposed hydroelectric project. The US Army Corp of Engineers maintains the lakes summer pool elevation of 948 feet and also maintains a certain level of the Mahoning River. It is the Division's concern, depending on the amount of water release needed, that this project could adversely affect the reservoir's recreational pool elevation for water dependent recreation activities such as boating, fishing, swimming and other such activities. Also, dependent upon the nature of the generation system the integrity of the dam could be jeopardized. The Division is working on improving the dam; improvements occur when funding is available.

If any work or construction will take place on the Division's lands and/or waters a real estate agreement must be completed prior to the start of any work on the Division's managed lands and/or waters. The agreement process should be started at least 4 months prior to the project's start date. The Division's Real Estate Manager is Mr. Kim Caris. Mr. Caris can be reached at 614-265-6514. The Division's specific comments and requests, including land use requirements, will be incorporated in the real estate agreement.

Boating and Navigation: The ODNR, Division of Watercraft has concerns that this project could negatively affect recreational boating and navigation in this immediate area. The applicant has provided no comments regarding coordination or any consideration of recreational boating and navigation. We would like the applicant to provide additional information that would show how and why this project would not negatively affect recreational boating and navigation both during and after construction.

Water Resources: The ODNR, Division of Water has the following comments.
The applicant and the dam owner should be aware that if this project proceeds, the dam, the powerplant, and the reservoir would all fall within FERC jurisdiction. The dam must meet FERC structural standards and may be subject to five-year independent inspection and annual FERC inspection. FERC safety and security requirements must also be met. In addition, the Ohio Department of Natural Resources, Division of Water, Dam Safety Program has expressed its concerns regarding the internal drainage system of the dam. If the applicant or the owner has questions regarding these comments or the dam, they should contact the Dam Safety Program.

ODNR appreciates the opportunity to provide these comments. Please contact Brian Mitch at (614) 265-6378 if you have questions about these comments or need additional information.

Brian Mitch, Environmental Review Manager
Ohio Department of Natural Resources
Environmental Services Section
2045 Morse Road, Building D-3
Columbus, Ohio 43229-6693
Office: (614) 265-6378
FAX: (614) 267-4764
brian.mitch@dnr.state.oh.us

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614) 416-8993 / FAX (614) 416-8994

December 28, 2009

Anthony J. Marra III
Hydro Energy Technologies, LLC
31300 Solon Road, Suite 12
Solon, Ohio 44139

TAILS# 31420-2009-FA-0305

Dear Mr. Marra:

This is in response to your November 10, 2009 initial consultation document regarding the Lake Milton Hydroelectric Project (FERC project number 13402) and your request for information we may have regarding the occurrence or possible occurrence of federally listed threatened or endangered species within the vicinity of the proposed project site. According to your information, the project is located on the Lake Milton Dam, along the Mahoning River, in Mahoning County. The applicant proposes to install a small hydroelectric facility over the existing outlet of the dam (including one Kaplan turbine, either axial or tubular, with a capacity of approximately 625 KW, a 480-VAC generator, hydraulic power unit, and a switchgear/control package to parallel the generation with the local utility grid and automatically adjust the turbines to varying flow rates). A new 320-foot transmission line will also be constructed leading to the transformer. As the applicant noted, the proposed project will not modify the existing flow discharge or reservoir elevation schedule at the dam and lake levels will not be modified as a result of the project. No significant changes in temperature or dissolved oxygen levels are anticipated given that the existing intake will be used. However, as we understand from the applicant letter, there are two potential maintenance-related actions including 1) an investigation of the embankment drainage system and repair if necessary and 2) repair of downtown sluice gate number four (gate on the far right in the photograph provided).

No Federal wilderness areas, wildlife refuges or designated critical habitat exist within proximity to the site. The project site is located within 100 feet of Lake Milton State Park. Therefore, we recommend coordinating with the Ohio Department of Natural Resources if this area will be impacted from the proposed project.

The U.S. Fish and Wildlife Service recommends that proposed activities minimize water quality impacts and impacts to quality fish and wildlife habitat. Riparian zone habitat should be preserved wherever possible. Vegetated areas along streams and rivers stabilize the banks, provide fish and wildlife habitat, filter pollutants and excess nutrients, store excess water during storm events, and minimize sedimentation. Best Management Practices (BMP's) should be utilized to minimize sedimentation and erosion. All disturbed areas should be mulched and revegetated with native woody and herbaceous species.

The Service is also concerned with impacts of this project specifically to fishery resources and habitat. The applicant noted that fish losses would be comparable to existing fish losses at the intake. We recommend that the applicant provide adequate documentation that fish mortality will be kept to a minimum and compensation for fish losses will be addressed. Project design should be carried through in such a way that equipment and water flow do not cause entrainment or impingement of fish species. The applicant noted

that modifications to the trash rack can be made to further reduce risk of entrainment and impingement of fish species—we request that these modifications be implemented. A fish passageway is a frequently-used method for reducing impingement of fish species—fish passage should be considered if it would measurably reduce entrainment and impingement.

ENDANGERED SPECIES COMMENTS: The proposed project lies within the range of the **Indiana bat** capture, a Federally-listed endangered species. Since first listed as endangered in 1967, the Indiana bat population has declined by nearly 60%. Several factors have contributed to the decline of the Indiana bat including the loss and degradation of suitable hibernacula, human disturbance during hibernation, pesticides, and the loss and degradation of forested habitat, particularly stands of large, mature trees. Fragmentation of forest habitat may also contribute to declines. During winter, Indiana bats hibernate in caves and abandoned mines with relatively stable temperatures ranging from above freezing to 10 degrees Celsius. Summer habitat requirements for the species are not well defined but the following are considered important:

1. Dead or live trees and snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities, which may be used as maternity roost areas.
2. Live trees (such as shagbark hickory and oaks) which have exfoliating bark.
3. Stream corridors, riparian areas, and upland woodlots which provide forage sites.

The applicant noted that no trees exist within the proposed project boundary and therefore, that no tree removal is necessary. As a result, no impacts to the Indiana bat are expected.

BALD EAGLE COMMENTS: The project lies within the range of the **bald eagle**, a species protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Two bald eagle nests exist in proximity to Lake Milton, however they are not located within 660 feet of the dam or appurtenant facilities; therefore no impact to this species is expected. Relative to these particular bald eagle nests, this precludes the need for further action on this project as required by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. However, due to the growing population of bald eagles and frequent changes in activity, the Service recommends continued coordination with the ODNR regarding the location of bald eagle nests as the proposed project progresses.

These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Endangered Species Act of 1973 (ESA), as amended, and are consistent with the intent of the National Environmental Policy Act of 1969 and the U. S. Fish and Wildlife Service's Mitigation Policy. This letter provides technical assistance only and does not serve as a completed section 7 consultation document.

We appreciate the opportunity to provide the above comments. If you have questions, or if we may be of further assistance in this matter, please contact Megan Seymour at extension 16 in this office.

Sincerely,

for
Mary Knapp, Ph.D.
Supervisor

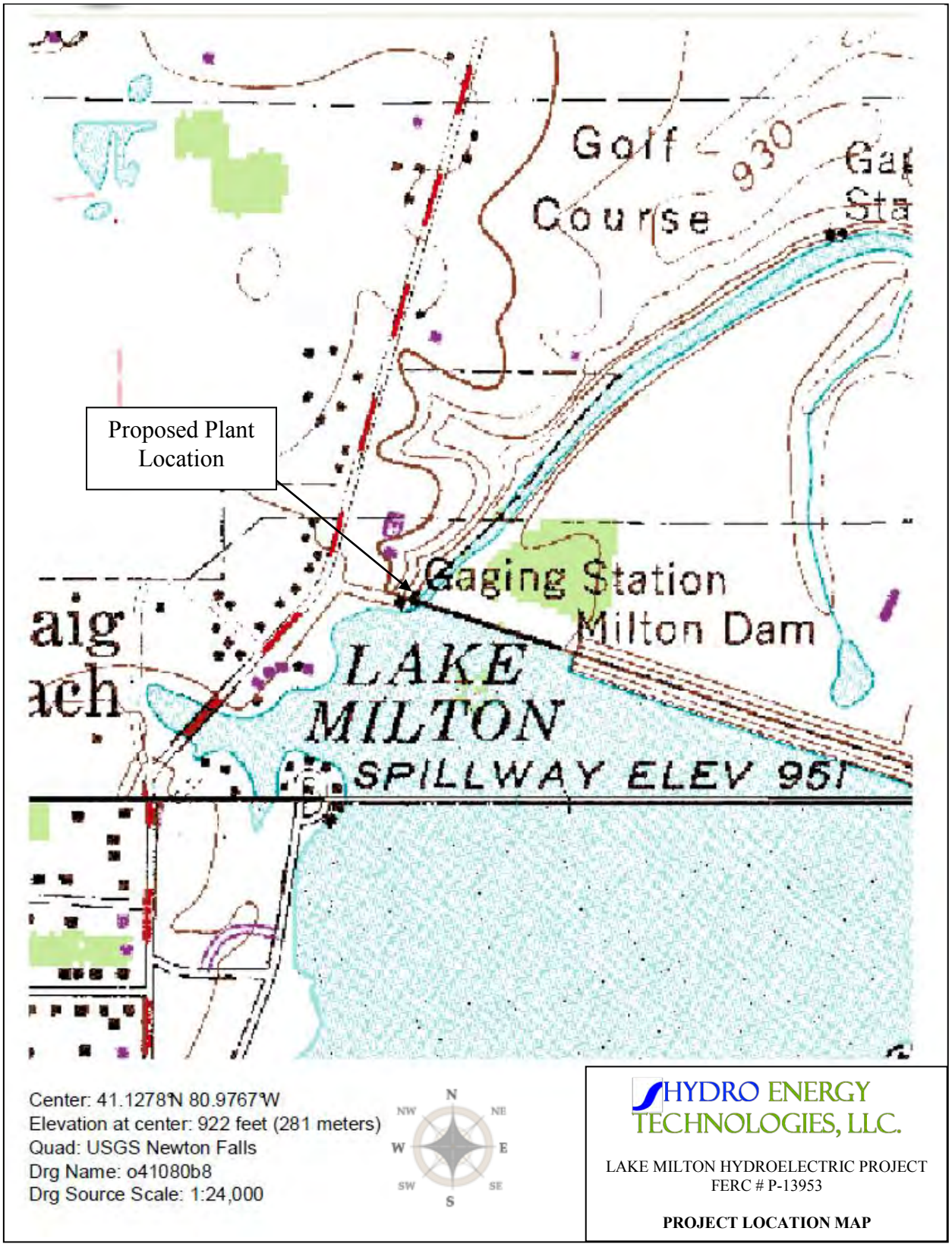
APPENDIX E: Drawings and Maps

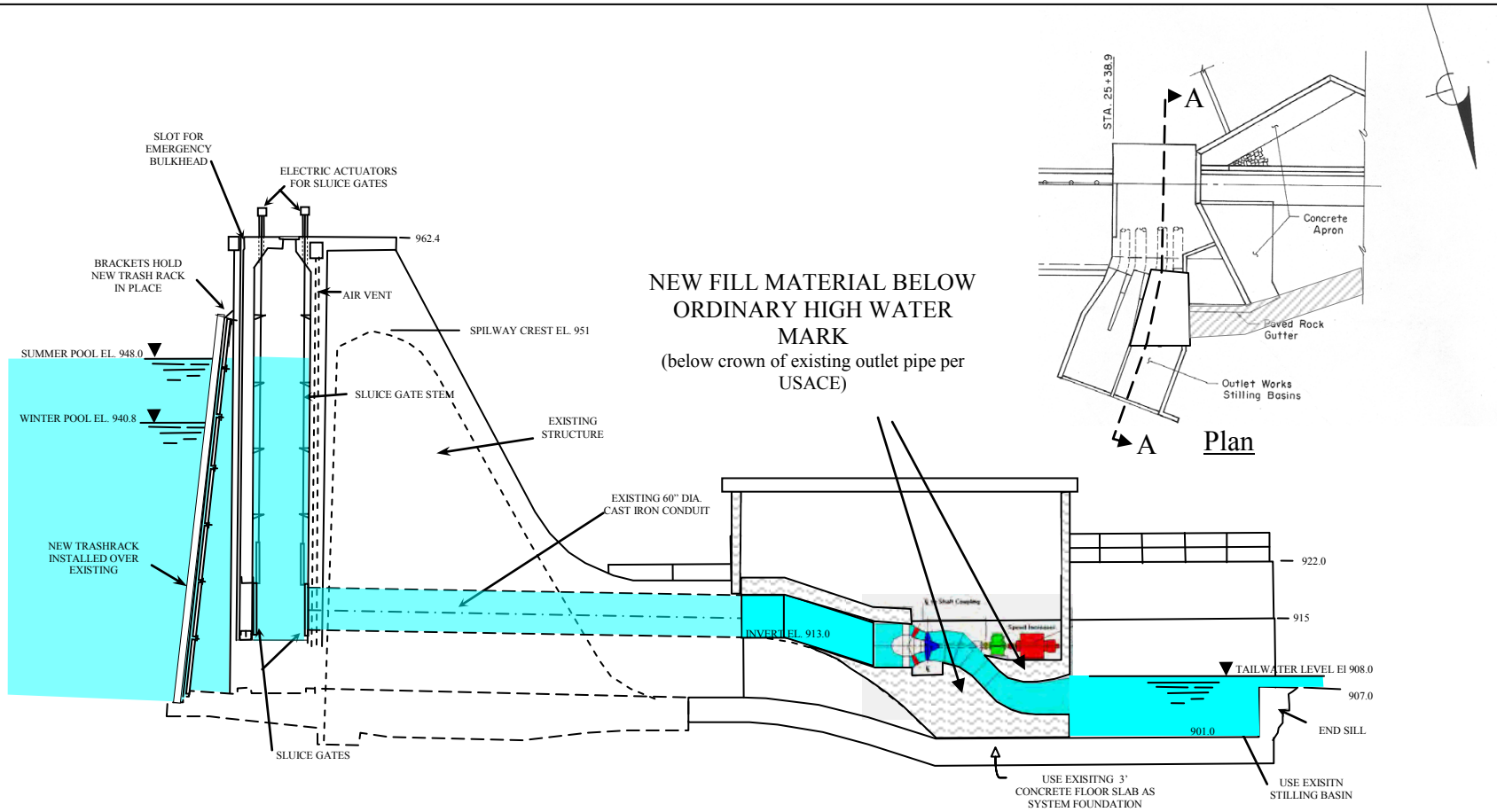
Center: 41.1278°N 80.9767°W
Elevation at center: 922 feet (281 meters)
Quad: Newton Falls
Drg Name: o41080b8
Drg Source Scale: 1:24,000

HYDRO ENERGY TECHNOLOGIES, LLC.

LAKE MILTON HYDROELECTRIC PROJECT
FERC # P-13953

STREET LEVEL MAP


Golf
Course
930
Proposed Plant Location
Gaging Station
Milton Dam
LAKE
MILTON
SPILLWAY ELEV 951
Center: 41.1278°N 80.9767°W
Elevation at center: 922 feet (281 meters)
Quad: USGS Newton Falls
Drg Name: o41080b8
Drg Source Scale: 1:24,000
N
NW
NE
W
E
SW
SE
S
HYDRO ENERGY TECHNOLOGIES, LLC.
LAKE MILTON HYDROELECTRIC PROJECT
FERC # P-13953
PROJECT LOCATION MAP



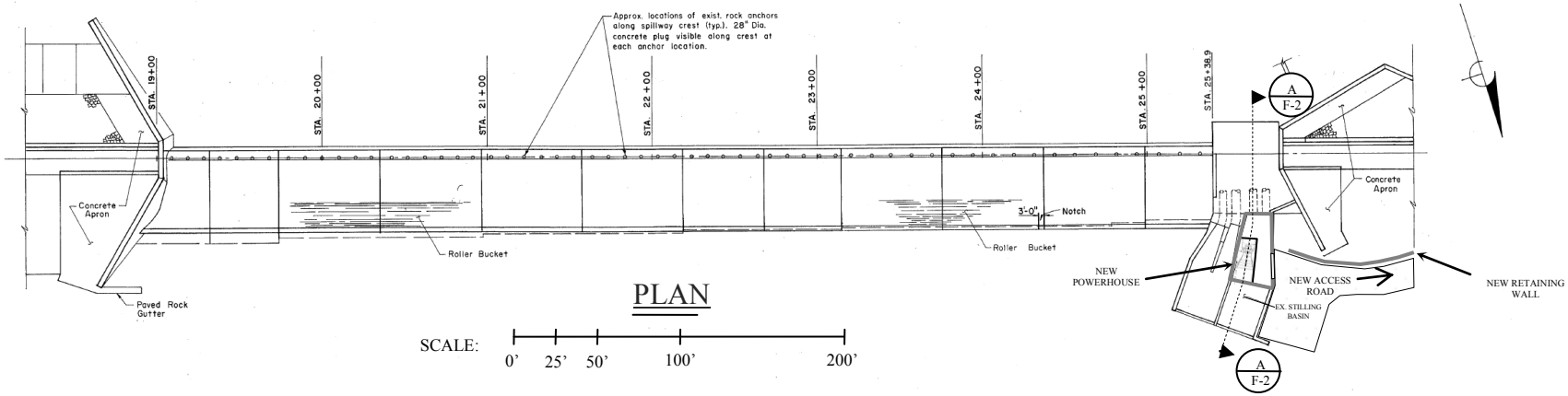
HYDRO ENERGY TECHNOLOGIES, LLC.
LAKE MILTON HYDROELECTRIC PROJECT
FERC # P-13953

PROJECT CROSS SECTION

Exhibit F – Drawings of Project Works

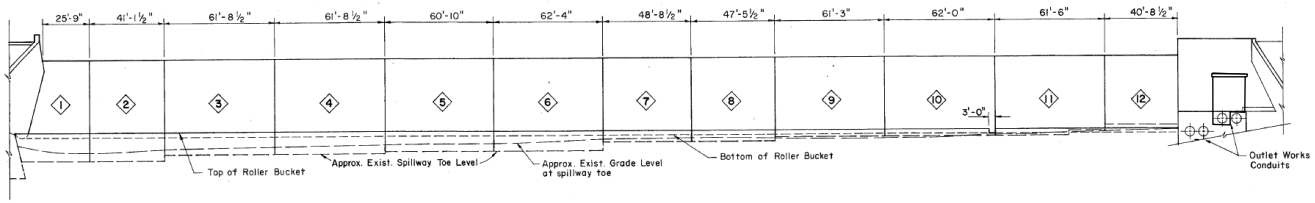
List of Drawings

Sheet No.	Title
F-1	Project Plan, Elevation, & Typical Dam Section
F- 2	Project Profile and Sections
F- 3	Turbine Detail



PLAN

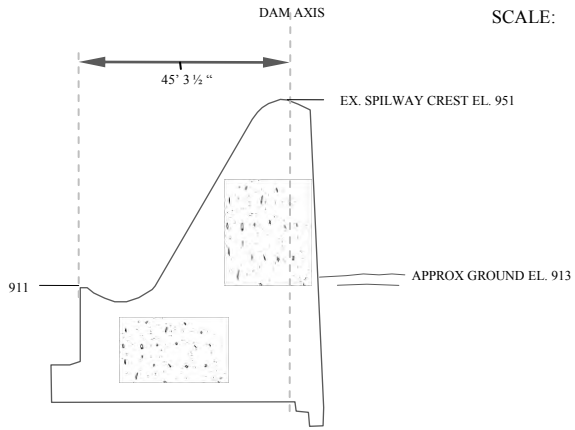
SCALE: 0' 25' 50' 100' 200'



FRONT ELEVATION

2 - Denotes Monolith No.

SCALE: 0' 25' 50' 100' 200'



TYPICAL DAM SECTION

SCALE: 0' 10' 20' 40'

2 WORKING DAYS BEFORE YOU DIG
CALL TOLL FREE 800-362-2764
OHIO UTILITIES PROTECTION SERVICE

Mahoning Hydropower, LLC

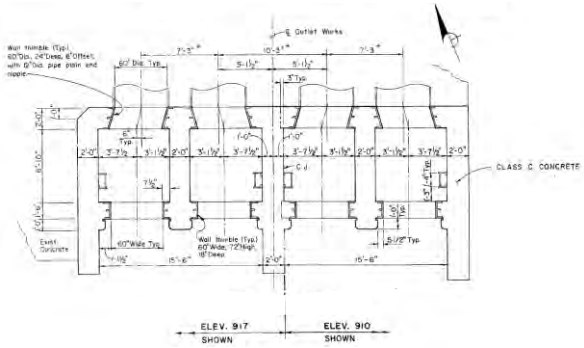
LAKE MILTON HYDROELECTRIC PROJECT
FERC # P-13402

MAHONING COUNTY, OHIO

PLAN, ELEVATION & DAM SECTION
SHEET F-1

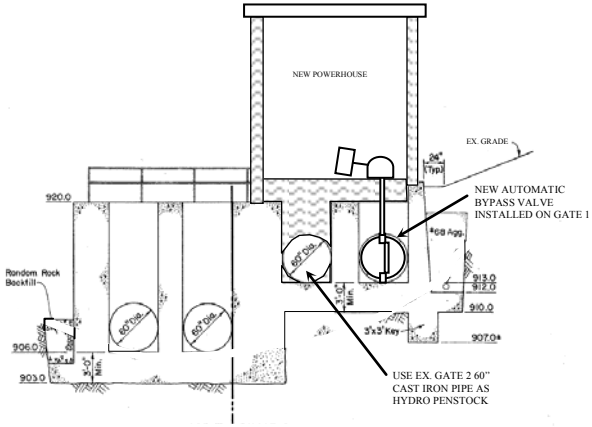
PERMIT LEVEL DRAWING NOT FOR CONSTRUCTION

2 WORKING DAYS
BEFORE YOU DIG
CALL TOLL FREE 800-362-2764
OHIO UTILITIES PROTECTION SERVICE



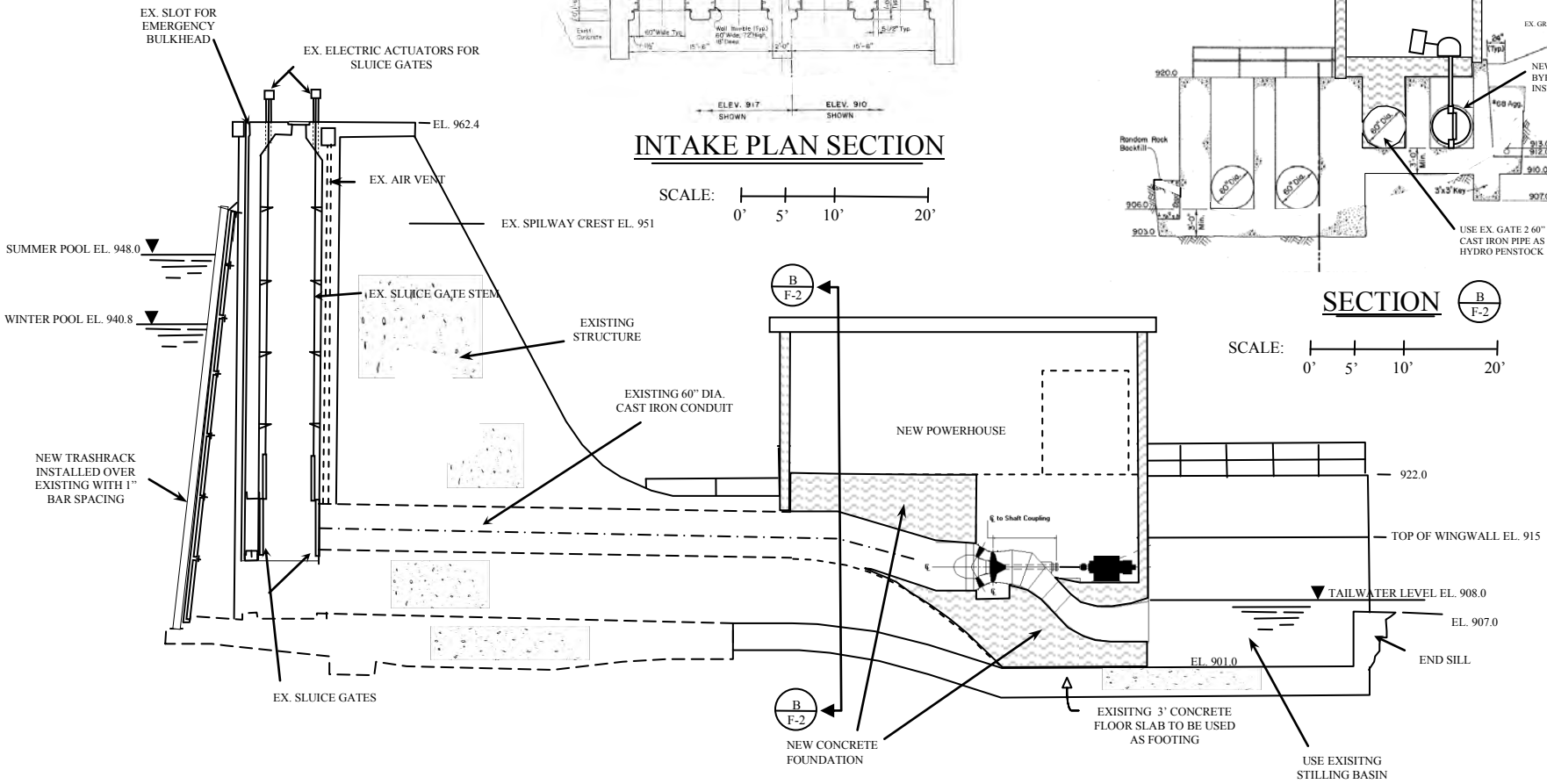
INTAKE PLAN SECTION

SCALE: 0' 5' 10' 20'



SECTION B/F-2

SCALE: 0' 5' 10' 20'



PROJECT PROFILE - SECTION A/F-2

SCALE: 0' 5' 10' 20'

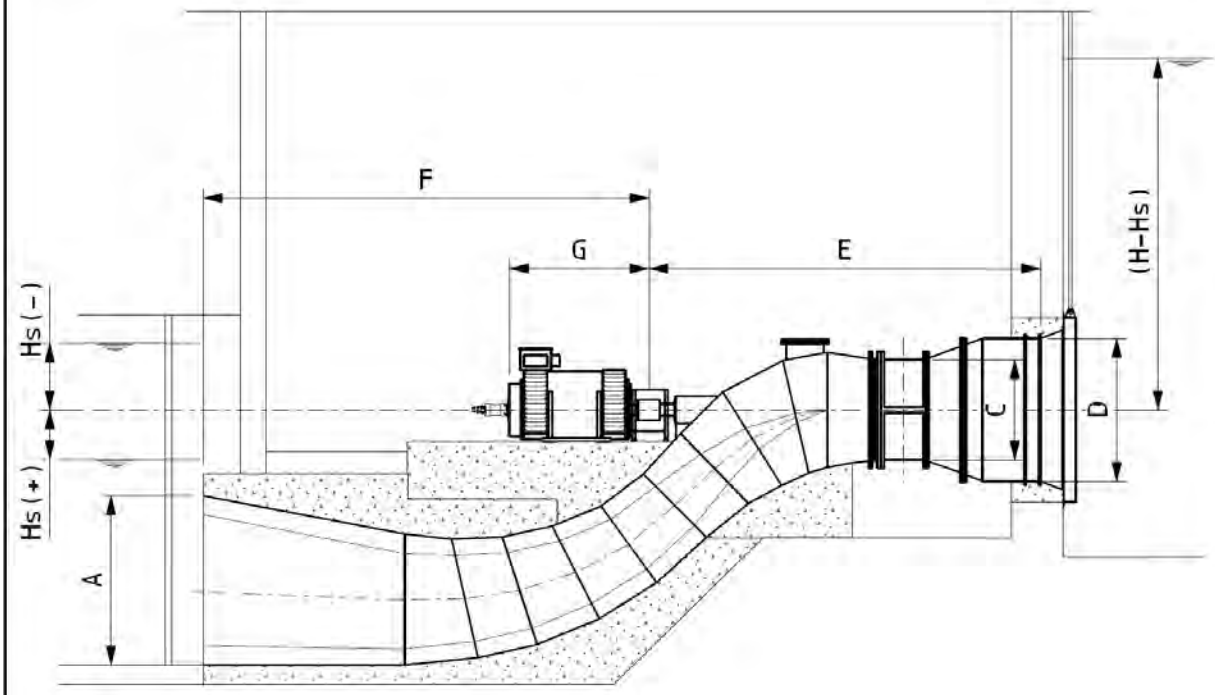
PERMIT LEVEL DRAWING, NOT FOR CONSTRUCTION

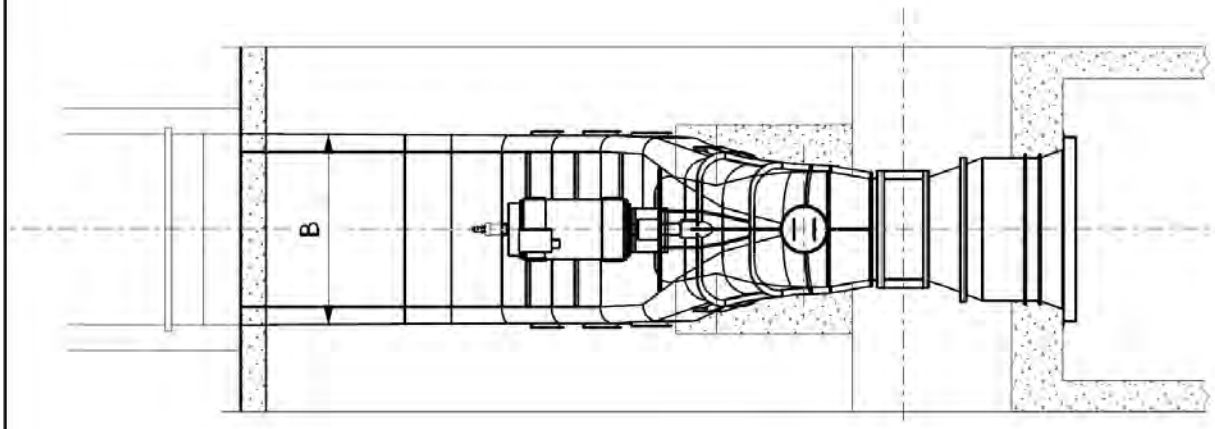
Mahoning Hydropower, LLC

LAKE MILTON HYDROELECTRIC PROJECT
FERC # P-13402

MAHONING COUNTY, OHIO

PROJECT PROFILE & SECTIONS
SHEET F-2





LAKE MILTON
HYDROELECTRIC PROJECT
FERC # P-13953
Mahoning County Ohio

Mahoning Hydropower, LLC

SHEET F-3

Rev.	Data/Date	Emitted	Approved
	2002		

The dimensions are indicated in the offer

Note

Joint type: RIGID

Bearings: NO

Gear Box: NO

mail@orengine.com

http//www.orengine.com

Scala/Scale: NO Sc.

Cliente/Client: OFFER

Titolo/Title: STANDARD KAPLAN TURBINE GENERAL DIMENSIONS

Axis Type: HOR

N tavola/Table n.: KAP002.sht

SINCERT

Certificate n°123

ISO 9001 Certificate

APPENDIX F: Letter from USACE Issuing Provisional NWP 17

DEPARTMENT OF THE ARMY
PITTSBURGH DISTRICT, CORPS OF ENGINEERS
WILLIAM S. MOORHEAD FEDERAL BUILDING
1000 LIBERTY AVENUE
PITTSBURGH, PA 15222-4186

REPLY TO
ATTENTION OF

June 7, 2010

Operations Division
Regulatory Branch
2009-2067

Anthony Marra III
Hydro Energy Technologies, LLC
31300 Solon Road, Suite 12
Solon, Ohio 44139

Dear Mr. Marra:

I refer to your Department of Army Application, received in this office March 16, 2010, regarding your proposal to construct a 25' by 37' hydroelectric powerhouse over the existing concrete stilling basin as the base of Lake Milton Dam. The powerhouse will contain one 650 KW Kaplan Turbine placed on top of 150 cubic yards of concrete. Also installed on the lake side of the Lake Milton Dam will be a 15.5' by 45' trashrack over the existing rack. This hydroelectric project is located in Craig Beach, Mahoning County, Ohio.

Activities associated with projects of this type are authorized by Nationwide Permit No. 17 (see enclosure), previously issued by the Corps of Engineers, for purposes of Section 404 of the Clean Water Act as published in the March 12, 2007 issue of the Federal Register.

Enclosed is a list of conditions which must be followed for the Nationwide Permit to be valid in addition to the following special conditions.

1. This permit will not be valid until the project is licensed by the Federal Energy Regulatory Commission (FERC) under the Federal Power Act of 1920, as amended or a licensing exemption is granted by the FERC pursuant to Section 408 of the Energy Security Act of 1980 and Section 30 of the Federal Power Act, as amended. Per this special condition and Nationwide Permit No. 17, this FERC license or exemption must be received by this office to make this a valid Nationwide Permit authorization.

2. Being as Ohio State Certification for this Nationwide Permit has been denied in association with this Nationwide Permit, an Individual Water Quality Certification from the state is required. Therefore this Nationwide Permit is not valid until a copy of the Individual Water Quality Certification is received by this office.

-2-

3. Dissolved oxygen monitoring from August to October is to be conducted to determine the existing condition of the Mahoning River directly downstream of the dam. This data will be utilized in mitigating dissolved oxygen levels if necessary.

4. If any tree cutting is necessary it should only be conducted between September 30 and April 1.

Adherence to the conditions in the Nationwide Permit, and special conditions above, will permit you to proceed with the proposed project. **Please Note**, the attached Compliance Certification Form must be signed and returned to this office upon completion of the proposed work.

This verification is valid until the Nationwide Permit is modified, reissued, or revoked. All of the existing Nationwide Permits are scheduled to be modified, reissued, or revoked prior to March 18, 2012. It is incumbent upon you to remain informed of changes to the Nationwide Permits. We will issue a public notice when the Nationwide Permits are reissued. Furthermore, if you commence or are under contract to commence this activity before the date that the relevant nationwide permit is modified or revoked, you will have twelve (12) months from the date of the modification or revocation of the Nationwide Permit to complete the activity under the present terms and conditions of this nationwide permit.

The issuance of this Nationwide Permit will not relieve you of the responsibility to obtain any other required state, local, or Federal authorizations.

If you have any questions, please contact Tyler Bintrim at 412-395-7115 or email at tyler.j.bintrim@usace.army.mil.

Sincerely,

Nancy Mullen
Chief, Northern Section
Regulatory Branch

Enclosures