Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

1 – Ohio Department of Natural Resources, Tucker Dam Field Activities 2013

MEMORANDUM

Division of Wildlife

Lake Erie Fisheries Unit

To: Brian Elkington, USFWS, Deputy Program Supervisor - Fisheries

cc:

From: Jeff Tyson, ODNR, Division of Wildlife, Lake Erie Program Administrator

Date: August 15, 2013

Subject: Ballville Reservoir sidescan sonar survey, 2013

On July 1st, 2013, staff at the Ohio DNR Division of Wildlife's Lake Erie Fisheries Unit conducted a reconnaissance sidescan survey in the Ballville Reservoir of the Sandusky River near Fremont, Ohio. The purpose of this survey was to locate any remnants of the Tucker Dam, a small wooden structure that pre-dates the Ballville Dam.

The survey was conducted aboard a small (12-14') Crestliner aluminum modified v-hull boat with a 15 horsepower 2-stroke Mercury outboard motor. The boat was fitted with a portable sidescan unit consisting of a Lowrance HDS-5 Gen 1 chartplotter/depth sounder with a LSS-1 Structure Scan Imaging Module and transducer, broadband sounder, and internal GPS receiver. The sounder and LSS-1 transducers were mounted on a removable plate that was adapted to fit on the transom of the Crestliner boat. A group 31 deep cycle battery was used to power the HDS-5 and the LSS-1 module.

Data were recorded on a SD card in the HDS-5. Sounder depth was recorded at 200-kHz, while sidescan and downscan data from the LSS-1 transducer were recorded at 800-kHz. Data were collected at 3.2-4.8 km/h [2-3 mph]. The area upstream and downstream of some Tucker Dam reference points provided by the engineering firm Stantec was surveyed. Transects were not established before the survey, but we intended to make multiple passes parallel to shore to cover the width of the reservoir, then make overlapping passes perpendicular to shore to overlay additional data. Sidescan data were collected at a range of 18.3 m (60') per side. At this range, it was determined that five parallel passes would have provided sufficient coverage.

The survey was cut short after 3.75 passes due to encroaching thunderstorms (Figure 1). Despite this, more than 50,000 soundings were recorded (ping speed set to max in HDS-5) in the 298 MB .sl2 file during the survey. The survey encompassed an area of the reservoir that was approximately 700-m x 150-m, and the survey track was 2.5-km long. No underwater features were evident during data collection.

The raw sonar log (.sl2) was viewed in Sonar Viewer 2.1.2 upon return to the office, and an object near the suggested location of the Tucker Dam was identified. The file was then examined using two sidescan imagery software packages. DrDepth was used to view the sidescan imagery, generate bathymetry lines (Figure 2), and export images to Google Earth. The river channel in this reach of the reservoir runs along the northern bank, with bathymetry getting shallower as you head to the southern bank. This is likely a result of siltation along the inside bend of the river channel, and suggests that any remnants of the Tucker Dam will most likely be visible along the northern bank.

SonarTRX was used to view and smooth the sidescan imagery, isolate the area of interest (250-m x 150-m), measure object size, and export the imagery to Google Earth. The object appears to be man-made, and is located at N41.329173 W83.146646 (decimal degrees). This is near the Tucker Dam reference point provided by Stantec directly off of 2317 Buckland Avenue, 15-m from the northern bank of the reservoir, and 1-km upstream of the Ballville Dam. The object is somewhat ‘U’ shaped, approximately 6.5-m long and 1- to 3-m thick (Figure 3). The object clearly rises above the bottom of the reservoir, but its height cannot be measured with the available software.

Despite finding this unidentified object, the only other objects found during this survey were exposed bedrock and debris (sunken logs and car tires). No other feature was identified that suggested the continued existence of the Tucker Dam in this location.

Figure 1. Google Earth image of Ballville Reservoir sidescan survey track (grey line). Tucker Dam reference points and location of unidentified object are indicated.

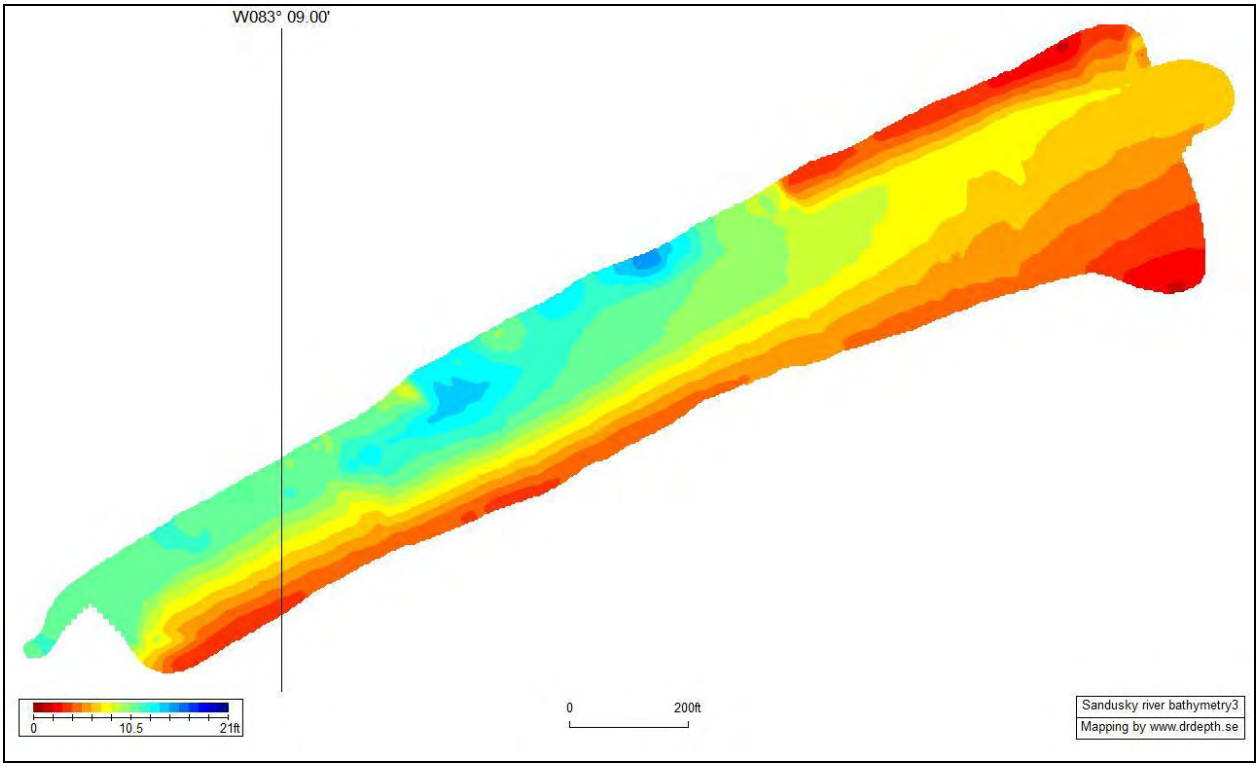

Figure 2. Bathymetry of the surveyed portion of the Ballville Reservoir as generated in DrDepth. Bathymetry indicates that deeper water (blue) is located along the northern bank, with shallower water (red) towards the southern bank.

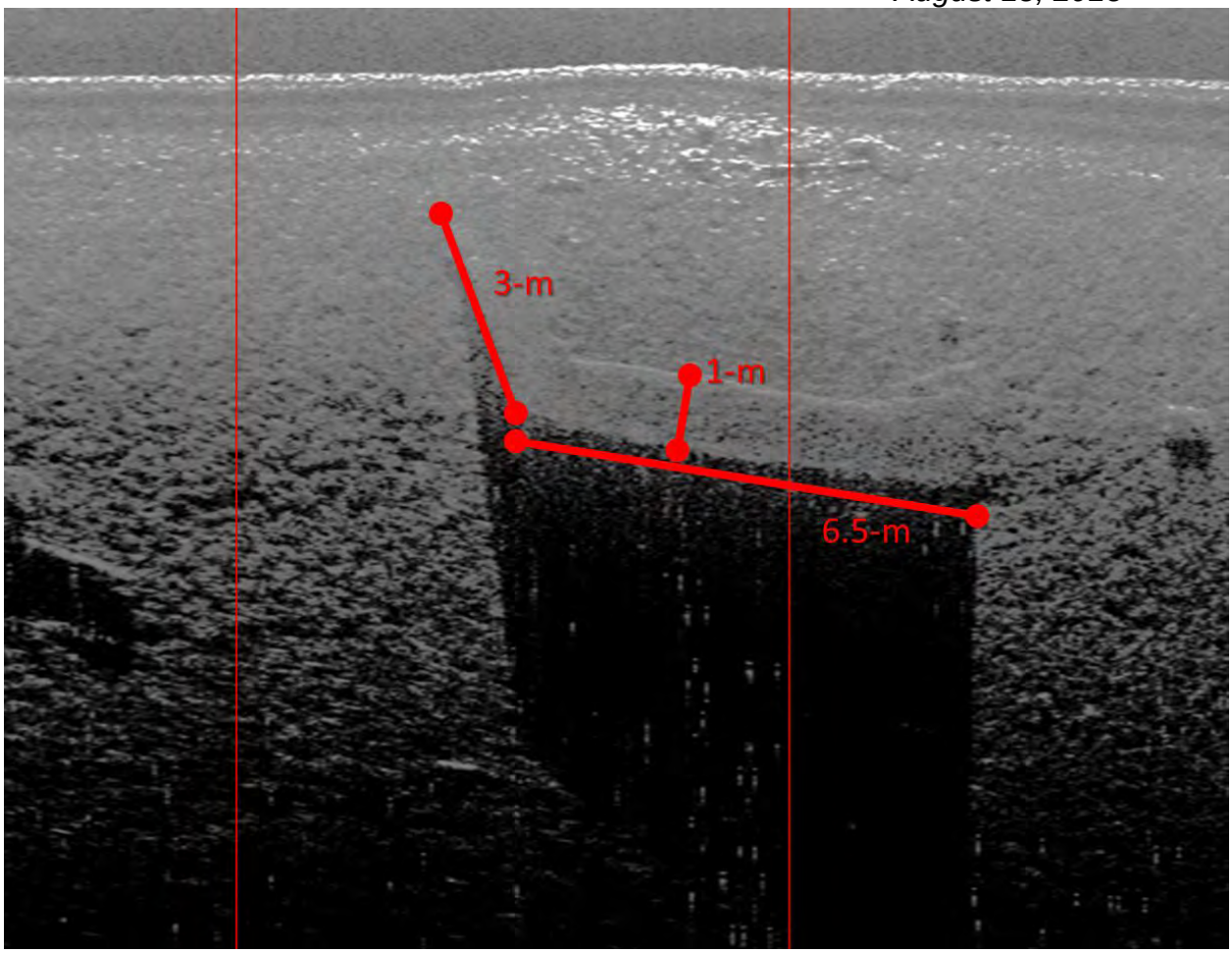

Figure 3. Sidescan imagery of the object at the bottom of the Ballville Reservoir, located near the reported location of the Tucker Dam, Fremont, Ohio.

Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

2 – Opinion and Probable Cost for Dredging the Ballville Dam Impoundment

Memo

Stantec

To:	Brian Elkington Fisheries Coordinator U.S. Fish and Wildlife Service	From:	Tim Taylor, P.E. Scott Peyton, P.E. T.C. Dinkins, E.I.T. Deb Gray, Toxicologist Hallie Serazin, Risk Assessor Stantec Consulting Services Inc.
File:	175631016	Date:	May 2, 2014

Reference: Opinion of probable cost for dredging the Ballville Dam impoundment

PURPOSE OF THIS MEMO

The goal of this memo is to assess the option of dredging the impoundment behind Ballville Dam. The objectives include:

- Provide a background and description of the dam and impoundment
- Describe the physical setting
- Provide an opinion of probable costs for dredging and disposal of sediment.

BACKGROUND

The Ballville Dam was built on the Sandusky River between 1911 and 1913. It is located in the Township of Ballville, upstream of the City. The dam is approximately 18 river miles upstream of Lake Erie. The Dam is classified by the Ohio Department of Natural Resources (ODNR) as a Class I structure; the highest hazard rating due to the probable loss of life if the dam were to fail during a flood event.

The dam was originally built by the Fremont Power and Light Company, which later became the Ohio Power Company. The dam was abandoned as a hydroelectric facility in the early 1900's because the seasonal flow of the river was insufficient to meet the power generating requirements of the plant. The company built a steam power plant to supplement the output of the hydroelectric plant in 1916. The steam power plant closed in 1929 but was reactivated briefly during World War II to supplement the region's power supply. The steam power plant was demolished in 1954. The City of Fremont (City) bought the land and facilities in 1959 and sealed and removed the penstock to re-purpose the dam as a raw water source for the City (Terpstra et al. 2011).

The Ballville Dam is approximately 407 feet long and 34.4 feet high. It is composed of left and right spillways on either side of a non-overflow section. The right spillway, facing downstream,

is 228 feet in length and has a crest elevation of 623.82 feet above mean sea level; the left spillway is 86.5 feet long and has a crest elevation of 624.24 feet above mean sea level; and the

non-overflow section is 92.5 feet long with a crest elevation of 633.82 feet above mean sea level.

The non-overflow section has a penstock[1], six sluice gates[2], and a water intake. The penstock opening and four of the six sluice gates have been permanently sealed, and the operability of the remaining two sluice gates is unknown. The water intake consists of two 48-inch pipes, with another 48-inch concrete pipe connecting the intake to the carbon feed building on the left abutment. The left abutment has another intake and sealed penstock. Water is carried to the treatment plant via a 42-inch pre-stressed concrete pipe. A concrete sea wall, with a top width of 1.5 feet and top elevation of 636.7 feet above mean sea level, extends approximately 702 feet upstream from the left abutment.

The impounded length of the Sandusky River extends upstream from the Ballville Dam approximately 2.1 miles (3.4 km). The U.S. Army Corps of Engineers (USACE) have estimated the surface area of the impoundment to be approximately 89.3 acres at low flow. There are a number of residential properties along the banks of the Sandusky River with views of the impoundment.

The impoundment has been accumulating and storing sediment since its completion in 1913. It appears that the dam is approaching or has reached an equilibrium state where a very little volume of new material is stored despite the high volumes of sediment delivered from the watershed. Evans et al. (2002) estimated that the storage capacity of the impoundment has decreased 78 percent due to sedimentation. The trapping efficiency of the dam is estimated to be less than four percent based on survey data from the previous decade (Evans et al. 2002). Estimates of sediment depths range from 11 feet near the water intake at the dam to over 20 feet near some outer margins. Photos and multiple bathymetric surveys indicate that a partially defined channel has remained within the impoundment sediment. An island within the impoundment has formed over the last 30 years as sediment has continued to accumulate along the inner portion of the river bend upstream of the dam. The formation of the island has promoted further deposition on the south shore downstream of the island.

Only one documented drawdown has occurred since the dam's use was converted from electric generation to water supply. The drawdown occurred in 1969 to allow for repairs and modifications to the dam, intake, and sluice systems.

PHYSICAL SETTING

The United States Geological Survey (USGS) operates a gage (04198000) located approximately 2.2 miles upstream from the dam. The contributing drainage area at the gage is reported as 1,251 square miles. Discharge records, reported in cubic feet per second (cfs), span the period from water year 1924 to the present, except for 1936-1938. Suspended

[1] An enclosed pipe that delivers water to hydraulic turbines.
[2] A gate located at or near the stream bed that allows water and sediment to pass from upstream of the dam to downstream. The structures are common features of dams and are typically used to draw the pool down for maintenance

sediment records, reported as milligrams per liter (mg/l) and tons per day (tn/dy), span the period of water years 1951-1956 and 1979-2002 (Stantec 2011).

Sedimentology. Fluvial sediment data from the USGS gage used in the Feasibility Study (in Stantec 2011) analysis was taken from the 1979-2002 period in order to capture the most recent land use and watershed characteristics. Data indicate that suspended sediment concentrations and loading were seasonally variable. Concentrations are highest during peak spring flow and agricultural activity months of April, May, and June. Monthly means for daily concentrations were higher than 50 mg/l in every month but September, October, and November. Peaks of the daily concentrations were greater than 500 mg/l in every month but October and the highest observed concentration was 2,420 mg/l. The monthly means were substantially higher than monthly medians, an indication that a small number of very high concentrations (i.e., storm generated events) influence the mean. For frame of reference, the suspended solid concentration limit on the effluent from the City's wastewater treatment plant is 12 mg/l. Daily sediment loads followed a similar seasonal pattern. Loading is highest during the wet season from February to May and the maximum observed load was 124,000 tons in a single day. Samples taken by the USGS at this location indicate that approximately 97 percent of the suspended sediment is composed of silt or clay sized particles (less than 0.0625mm), regardless of discharge. Table 1 presents some descriptive statistics on suspended sediment load from the Sandusky River Watershed. The maximum sediment load from a single year was 867,000 CY in 1984.

Table 1. Annual Suspended Sediment Loading at USGS Gage 04198000

	1951-1956		1979-2002	
	Tons*	**Cubic Yards***	**Tons***	**Cubic Yards***
Average	227,000	258,000	323,000	368,000
Median	253,000	289,000	309,000	352,000
Minimum	76,000	87,000	75,000	85,000
Maximum	355,000	404,000	761,000	867,000
Total	1,359,000	1,549,000	7,747,000	8,828,000

*Assumes 65 lbs/ft^3 unit weight of sediment.

Sediment Quantity. Investigations of the sediment of the impoundment indicate predominantly fine material throughout, with a slight coarsening towards the upstream end of the dam impacts (Evans et al. 2002; Evans et al. 2007; AECOM 2010). Gradation analyses on bulk samples of seven (7) vibracores taken from the dam to the west edge of the island in 2010 showed no gravel composition and, on average, over 90 percent silt and clay (AECOM 2010). Evans et al. (2002) classified sediment texture as 5:10:85 ratio of gravel:sand:silt near the dam and 20:20:60 at the upstream end of the impoundment.

Estimates for the total volume stored behind the dam remain a matter of interpretation. Evans et al. (2002) estimated a sediment volume of 1,240,000 cubic yards (CY) of sediment based on a comparison of pre-dam topography (USGS 1903) and 1993 bathymetry. Sediment cores were used to date, map, and characterize sediment horizons. While noting sedimentation rates are cyclical, the authors estimated sedimentation rates of less than 1 inch/year from 1960 to

1990 with an overall general decline in rate likely due to lower trapping efficiency as the impoundment approaches maximum sediment storage capacity.

In June 2011, Stantec performed a bathymetric survey of the impoundment using an acoustic echosounder, global positioning system (GPS) and rugged field laptop. Data were collected at 13-15 readings/sec in cross sections which ranged in spacing from 50 to 300 feet, with intensity decreasing with distance from the dam. A grade-rod was used to manually check the echosounder readings throughout the impoundment. A comparison was made between the bathymetry from this survey and estimated pre-dam topography based on the USGS 1903 topography. The volumetric calculations included the area within the current active channel between the dam and just upstream of the raw water reservoir intake and showed a sediment quantity of approximately 840,000 CY.

The actual amount of sediment impounded due to the dam may be higher than this number when taking the land above normal pool water surface (i.e. the new island) into account. Historic maps show impounded water surface areas larger than current extents. It is important to note that much of the depositional area above normal pool is now covered with mature vegetation and is unlikely to mobilize even when the dam is removed. Therefore, the estimate of 840,000 CY of sediment is appropriate when considering potentially mobile sediment.

The difference in estimated sediment volume could be due to the following items:

- Different survey methods;
- Different comparison area;
- New bathymetric survey data;
- Sediment addition/loss due to hydrology (i.e. big flow events in the spring of 2010);
- Interpretation of the pre-dam topography (10-foot contour intervals).

The maximum single year suspended solids load recorded at the USGS gage was 867,000 CY, approximately equal to the volume stored behind Ballville Dam. Further, the stored volume was approximately 2.3 times the average annual load at the gage (368,000 CY) (Table 2) and 5.9 times the maximum single day load (143,000 CY). Even though the total stored volume is 840,000 CY, it will be possible to release less than this volume to downstream reaches with appropriate management techniques. Control strategies will be discussed in greater detail in Section 4.0 Conclusions and Recommendations.

Sediment Quality. The presence of contaminated sediment in the Ballville Reservoir would be a major impediment to dam removal. However, a wide variety of organic compounds and metals are continuously discharged into rivers from industrial, agricultural, and urban sources. Contaminants carried in runoff are adsorbed onto suspended particles and eventually settle to the sediments. Currently, there are no standard criteria or screening levels that can reliably predict when contaminants in sediment might exert toxic effects on the benthic community that lives in the sediments, or, indirectly affect human health. Sediment quality guidelines such as Threshold Effects Levels (TELs) and Probable Effect Levels (PELs) are used to predict when the chemical concentrations found in sediment may be acceptable but both TELs and PELs are based on short-term, laboratory run, toxicity tests, primarily conducted with sediment dwelling organisms (e.g. amphipods and midges) using field-collected sediments that typically contain

complex mixtures of contaminants. TELs and PELs are predictive values, but are not directly associated in-stream toxicity.
To improve the ability of sediment quality guidelines to actually predict toxicity in field-collected sediments, consensus-based Probable Effect Concentrations (PECs) were developed by MacDonald et al. (2000). Consensus-based PECs were developed using a database from across North America and have been used to reliably predict toxicity of sediments on a regional basis, including the Great Lakes basin (MacDonald et al. 2000).

Ohio-specific Sediment Reference Values (SRVs) were developed to identify representative background sediment concentrations for lotic (flowing) water bodies. SRVs were developed using a regional reference site approach that accounts for differences between Ohio's five ecoregions. The SRVs presented in the following table are for the Huron-Erie Lake Plateau ecoregion, where Ballville dam is located (Ohio EPA 2008).

Sediment analysis conducted on Ballville Reservoir sediment included analysis for metals, pesticides, polychlorinated biphenyls (PCBs), and semi-volatile organic compounds, including polycyclic aromatic hydrocarbons (PAHs). No PAHs were detected. The following table presents a comparison of the concentrations of metals and DDT breakdown products (e. g. 4,4-DDD and 4,4-DDE) detected in Ballville Reservoir sediment to several sediment quality guidelines.

Parameter	Minimum Detected Conc. (mg/kg)	Maximum Detected Conc. (mg/kg)	Average Sediment Conc. (mg/kg)	Threshold Effects Level (mg/kg)	Probable Effects Level (mg/kg)	Consensus Based Probable Effects Conc. (mg/kg)	Huron-Erie Lake Plateau Sediment Reference Value (mg/kg)
Aluminum	46,600	51,900	48,933.33	26,000	60,000		42,000
Arsenic	12.60	14.20	13.43	5.90	17	33*	11
Chromium	44	52	47	37.30	90	111*	51
Iron	31,000	34,000	32766.67	19,000	25,000		44,000
Lead	35	35	35	35	91.30	128*	47[3]
Nickel	32	33	32.67	15.90	42.80	48.6*	36
Zinc	124	135	130.67	123	315	459*	190
4,4-DDD	7.70	10.80	9.67	3.54	8.511	28	
4,4-DDE	7.30	7.30	7.30	1.42	6.752	31.1*	

Threshold Effect Levels (TELs) are sediment concentrations below which adverse effects are expected to occur only rarely (Smith et al. 1996).

Probable Effect Levels (PELs) are sediment concentrations above which adverse effects in sediments are expected to frequently occur (USGS 2000).

Probable Effect Concentrations (PECs) are consensus-based sediment concentrations above which harmful effects are likely to be observed; MacDonald et al. 2000a. An "*" designates a reliable PEC (>20 samples and >75% correct classification as toxic

Sediment Reference Values (SRVs) identify representative background sediment concentrations for lotic (flowing) water bodies in Ohio (Ohio EPA 2008).

1 – Value for sum of p,p'-DDD and o,p'-DDD.
2 – Value for sum of p,p'-DDE and o,p'-DDE.
3 – State-wide Sediment Reference Value.

None of the maximum detected concentrations of metals or DDT breakdown products exceed consensus-based PECs and iron, lead, nickel and zinc are all below the appropriate SRV. The maximum detected concentration of chromium also approximates background reference conditions as represented by the SRV. A consensus-based PEC is not available for aluminum and the maximum detected concentration of aluminum exceeds the Ohio-specific SRVs. Aluminum silicates are abundant in the fine-grained clay soils surrounding Ballville Reservoir and further discussion of the availability of aluminum is provided in the following comment response.

A comparison of the metal concentrations in Ballville sediments, normalized for aluminum, to those in recent Lake Erie sediments indicate metal concentrations in the Ballville Reservoir sediments are appreciably lower than the concentrations reported from Lake Erie sediments (Evans & Gottgens 2007). Following removal of the Ballville Dam, sediment will be resuspended and transported downstream. However, the potential adverse effects on the aquatic life are predicted to be minimum and short-term.

Because benthic organisms spend their entire lives in direct contact with sediment, they are typically far more sensitive to sediment contamination than human receptors that are only intermittently exposed while swimming. Although sediment quality guidelines do not address bioaccumulation and exposure to humans via fish consumption, Ohio EPA's water quality standards do take fish consumption exposures into account.

Several factors strongly influence the distribution and potential for toxic effects for sediment-borne contamination. Fine-grained clay particles, like those present in the Ballville Reservoir watershed, are more likely to be transported in runoff but are also more capable of adsorbing sediment-borne pollutants. Clay soils are typically high in aluminum silicates, however, the presence of aluminum, phosphorus, heavy metals or DDT breakdown products in sediment, does not mean that these compounds will be chemically available to downstream ecosystems.

The Sandusky River watershed is about 90% agricultural and the application of lime to agricultural soil is a standard practice in the area (USDA 1987). The use of lime as a soil amendment reduces soil acidity (increases soil pH) which greatly influences the concentration and chemical availability of many dissolved metal ions. Higher soil pH makes a variety of plant nutrients, including phosphorus, more available but simultaneously decreases the concentration of chemically active aluminum (Al^{3+}). This balance suggests that the release of Ballville Dam sediments should have minimal effect on downstream ecosystems.

PARTIAL AND FULL DREDGING APPROACHES

Due to the volume of sediment stored behind the Ballville Dam two dredging options were considered for assessment: partial and complete. Partial dredging considers removal of approximately 200,000 CY of sediment found between the dam and approximately 2,000 feet upstream. Full dredging consists of removal of up to 800,000 CY throughout the impoundment but primarily directly upstream of the dam. The following sections assess dredging, dewatering, loading/hauling, and disposal.

Dredging. Dredging would occur by use of a hydraulic dredge. The dredge would be staged on a floating barge and the slurry pumped to a dewatering site. In general, hydraulic dredges have a distance limit for pumping slurry of approximately 1,000 feet. However, due to access issues, limited staging area size, and length of reservoir this analysis considers the use of a specialty dredge or the use of booster pumps that can pump up to 2,000 feet.

Costs for hydraulic dredging were based on another dam removal project currently under construction in Michigan. Assumptions included:

- Cost of $80 per CY.

Dewatering. The principal constraint encountered with dredging is the requirement to dewater the dredged slurry prior to disposal. The proposed dredging quantities for both the partial and full dredge would require a substantial acreage to stage the dewatering process. The impoundment is bordered on both banks by private property, and/or jurisdictional wetlands. An area of backwater slew and side channel in the southern portion of the impoundment near the created island was considered as a disposal location; however, it is only six acres. This area could only store approximately 48,000 CY of material if filled to a level of consistent contour (approximately five feet).

Geotextile “Geotubes” are commonly used as a dewatering technique when a limited amount of space is available. The dredged slurry is pumped directly into the tubes, which captures the sediment, allowing the water to seep through the geotextile margins. Even though the tubes efficiently dewater dredge slurry in confined areas, the quantity of sediment to be dredged for both dredging scenarios would require a substantial staging area. For example, if the largest Geotube available was used (approximately 1,200 CY), then the quantity of sediment proposed for the partially dredged, 200,000 CY, would require 34 acres. Due to the lack of accessible area to stage this amount of slurry, dredging would need to occur in phases in order to allow for dewatering. It is possible, however, that the City Fremont could lease some of the agricultural land south and east of the impoundment near TWP Rd 954 and CR 221. The lease costs associated with these properties is unknown, but is likely to cost thousands of dollars per acre. Assumptions for dewatering include:

- No water treatment required for dewatering effluent
- Geotube
    - Size – 45’ circumference, 200 feet long
    - Cost $20/cubic yard

- Staging options
  - Clear approximately 10 acres on right bank near possible construction access
  - Close Cemetery Road temporarily to stage tubes
  - Rotate series of barges to transport/store tubes
  - Use agricultural land south of the impoundment

Loading/Hauling. Once the slurry is dewatered in the Geotubes, it would be hauled to a landfill for disposal (see below for disposal). This would require numerous large dump trucks to load and haul away the sediment. Below are assumptions related loading and hauling of the sediment.

- Travel cycle 24 miles
- Loading
  - Dredged sediment classified as "Common Earth"
  - Front end loader track mount
  - 1.5 CY bucket
  - Cost - $1.57 per CY
- Hauling
  - 20 CY Truck
  - 15 minute wait/Load/Unload
  - 30 mph avg.
  - 20 mile cycle
  - Cost – $6.70CY

Disposal. Dredged materials will need to be disposed of off-site as there are no areas that can store or utilize the sediment. When considering the volume of sediment for either partial or full dredging it is not likely that an existing landfill will accept 200,000 to 800,000 CY of common earth. In order to capture the most accurate estimate, construction of a new landfill was considered. The cost to design and build a landfill with the specific purpose of disposing of the dredged quantity was based on landfill design for fly ash from a coal power plant. The detailed cost estimate for each alternative is presented below. One limiting factor of the disposal process is the amount of time required to obtain the necessary permits. It was estimated that the permitting process could take more than a year. Assumptions for design, construction, operation, and closure of landfill include:

- The landfill will be sized to only hold the quantity of sediment dredged
- The landfill will not need a cap, other than seeding and mulching.
- Partial Dredge Cost
  - $6,000,000/200,000 CY - $30 per CY
- Full Dredge Cost
  - $8,000,000/800,000 CY - $9.5 Per CY

OPINION OF ESTIMATE FOR DREDGING

Considering the approaches developed in this memo, a summary opinion of costs were developed based on techniques and volumes for dredging, dewatering, loading/hauling, and disposal (see Table 2 and 3).

Reference: Opinion of probable cost for dredging the Ballville Dam impoundment

Table 2. Summary of Opinion of Estimated Cost for Partial Dredge[3]

Item	Unit	Quantity	Unit Price	Totals
Hydraulic Dredge	$/CY	200,000	$80.00	$16,000,000.00
Dewatering with Geotextile Tube	$/CY	200,000	$20.00	$4,000,000.00
Loading	$/CY	200,000	$1.57	$314,000.00
Hauling	$/CY	200,000	$6.70	$1,340,000.00
Disposal	LS	1	$4,499,895.00	$4,499,895.00
			Total	$26,153,895.00
			Cost per CY	$130.77

Table 3. Summary of Opinion of Estimated Cost for Full Dredge

Item	Unit	Quantity	Unit Price	Totals
Hydraulic Dredge	$/CY	800,000	$80.00	$64,000,000.00
Dewatering with Geotextile Tube	$/CY	800,000	$20.00	$16,000,000.00
Loading	$/CY	800,000	$1.57	$1,256,000.00
Hauling	$/CY	800,000	$6.70	$5,360,000.00
Disposal	LS	1	$6,810,236.00	$6,810,236.00
			Total	$93,426,236.00
			Cost per CY	$116.78

[3] Unit Prices used for cost of various phases based on RS Means Heavey Construction Cost Data 2010 Handbook, unless otherwise noted.

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Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

3 – Ballville Dam Flood Storage Capacity Memorandum

Memo

Stantec

To:	Brian Elkington Fisheries Coordinator U.S. Fish and Wildlife Service	From:	Scott Peyton Senior Principal Stantec Consulting Services Inc.
File:	175631016	Date:	July 24, 2012

Reference: Ballville Dam Flood Storage Capacity

Goal: To assess the use of the Ballville Dam and associated impoundment for flood storage.

Objectives:

- Provide a background and description of the dam and impoundment
- Describe the design function of the dam and impoundment
- Describe physical setting including hydrology, flooding, and geomorphology
- Describe the current hydrology (inflow/outflow) of the Ballville Impoundment
- Conclude whether the Ballville Dam and impoundment can be considered for flood control

Background

The dam was originally built by the Fremont Power and Light Company, which later became the Ohio Power Company. The dam was abandoned as a hydroelectric facility in the early 1900's because the seasonal flow of the river was insufficient to meet the power generating requirements of the plant. The company built a steam power plant to supplement the output of the hydroelectric plant in 1916. The steam power plant closed in 1929 but was reactivated briefly during World War II to supplement the region's power supply. The steam power plant was demolished in 1954. The City of Fremont (City) bought the land and facilities in 1959 and sealed and removed the penstock to re-purpose the dam as a raw water source for the City (Terpstra et al. 2011).

The Ballville Dam was built on the Sandusky River between 1911 and 1913. It is located in the Township of Ballville, upstream of the City. The dam is approximately 18 river miles upstream of Lake Erie. The Dam is classified by the Ohio Department of Natural Resources (ODNR) as a Class I structure; the highest hazard rating due to the probable loss of life if the dam were to fail during a flood event.

The Ballville Dam is approximately 407 feet long and 34.4 feet high. It is composed of left and right spillways on either side of a non-overflow section. The right spillway, facing downstream, is 228 feet in length and has a crest elevation of 623.82 feet above mean sea level; the left spillway is 86.5 feet long and has a crest elevation of 624.24 feet above mean sea level; and the

non-overflow section is 92.5 feet long with a crest elevation of 633.82 feet above mean sea level.

The non-overflow section has a penstock[1], six sluice gates[2], and a water intake. The penstock opening and four of the six sluice gates have been permanently sealed, and the operability of the remaining two sluice gates is unknown. The water intake consists of two 48-inch pipes, with another 48-inch concrete pipe connecting the intake to the carbon feed building on the left abutment. The left abutment has another intake and sealed penstock. Water is carried to the treatment plant via a 42-inch pre-stressed concrete pipe. A concrete sea wall, with a top width of 1.5 feet and top elevation of 636.7 feet above mean sea level, extends approximately 702 feet upstream from the left abutment.

The impounded length of the Sandusky River extends upstream from the Ballville Dam approximately 2.1 miles (3.4 km). The U.S. Army Corps of Engineers (USACE) have estimated the surface area of the impoundment to be approximately 89.3 acres at low flow. There are a number of residential properties along the banks of the Sandusky River with views of the impoundment.

The impoundment has been accumulating and storing sediment since its completion in 1913. It appears that the dam is approaching or has reached an equilibrium state where a very little volume of new material is stored despite the high volumes of sediment delivered from the watershed. Evans et al. (2002) estimated that the storage capacity of the impoundment has decreased 78 percent due to sedimentation. The trapping efficiency of the dam is estimated to be approximately four percent based on survey data from the previous decade (Evans et al. 2002). Estimates of sediment depths range from 11 feet near the water intake at the dam to over 20 feet near some outer margins. Photos and multiple bathymetric surveys indicate that a partially defined channel has remained within the impoundment sediment. An island within the impoundment has formed over the last 30 years as sediment has continued to accumulate along the inner portion of the river bend upstream of the dam. The formation of the island has promoted further deposition on the south shore downstream of the island.

Only one documented drawdown has occurred since the dam's use was converted from electric generation to water supply. The drawdown occurred in 1969 to allow for repairs and modifications to the dam, intake, and sluice systems.

Dam Functionality

The Ballville Dam was constructed as a run-of-river hydro-electric facility. Operational functions of dams, in general, can be divided into two groups: storage and run-of-river. A storage dam typically has a large amount of hydraulic pressure, large available storage volume capacity, long hydraulic residence time (amount of time water stays in impoundment), and control over the rate at which water is released from the impoundment. In contrast, a run-of-river dam generally has a small amount of hydraulic pressure, small amount of storage capacity, short hydraulic residence time, and little or no control over the rate at which water is released from the impoundment (Poff and Hart 2002). In short, run-of-river outflow nearly equals the amount of

[1] An enclosed pipe that delivers water to hydraulic turbines.
[2] A gate located at or near the stream bed that allows water and sediment to pass from upstream of the dam to downstream. The structures are common features of dams and are typically used to draw the pool down for maintenance

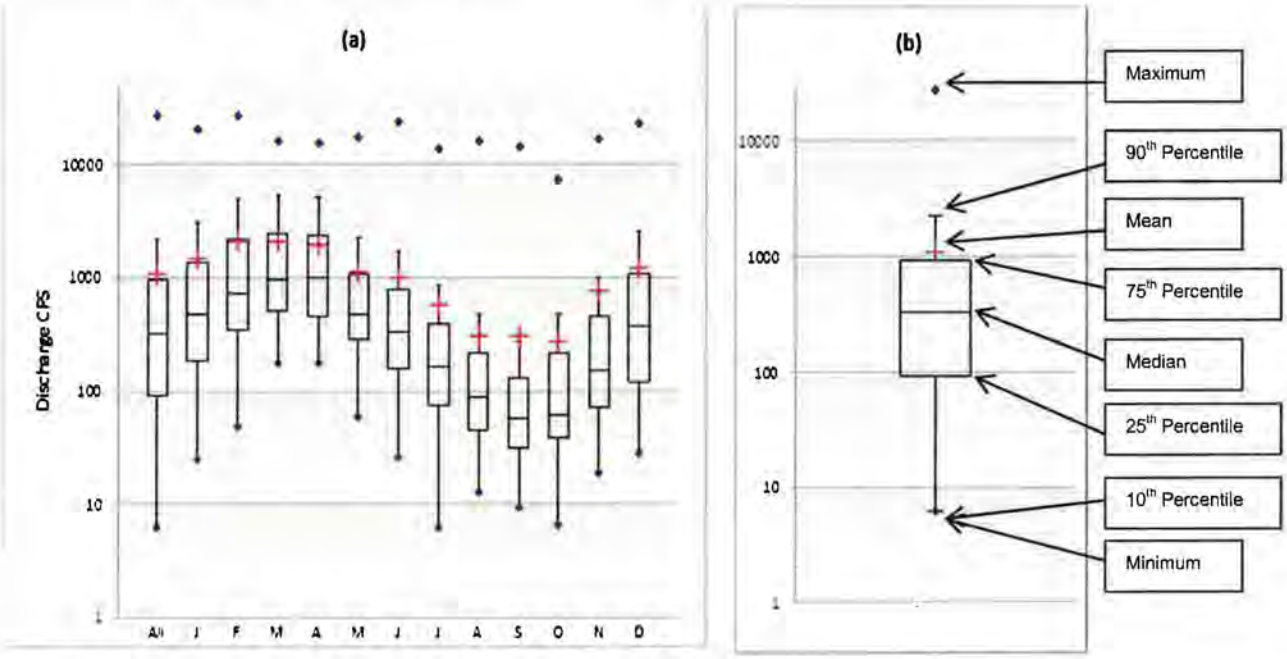
inflow. While impoundment levels may vary by a few feet during normal operations to provide a pool for water withdrawal, they typically are not designed for water storage[3].

Physical Setting

The United States Geological Survey (USGS) operates a gage (04198000) located approximately 2.2 miles upstream from the dam. The contributing drainage area at the gage is reported as 1,251 square miles. Discharge records, reported in cubic feet per second (cfs), span the period from water year 1924 to the present, except for 1936-1938. Suspended sediment records, reported as milligrams per liter (mg/l) and tons per day (tn/dy), span the period of water years 1951-1956 and 1979-2002 (Stantec 2011).

Hydrology. Precipitation in Sandusky County averages 34 inches per year (1960-1990). The average mean annual discharge over the period of record is 1,064 cfs, with a maximum and minimum mean annual discharge of 2,167 cfs in 1984 and 275 cfs in 1934, respectively. The highest mean daily discharge is 36,000 cfs (1978) and the lowest is 5 cfs (1963). Typically, the highest flows are observed in February, March, and April and the lowest in August, September, and October (see Figure 1). Flows of 10,000 cfs or more may occur in any month of the year although 90 percent of the flows in the summer months are less than 1,000 cfs (Figure 1; see Stantec 2011).

Figure 1. (a) Maximum, minimum, and average values of mean monthly discharge, (b) legend for this box plot



[3]Source: http://www.usbr.gov/pn/about/dams/index.html

Flooding. Floods in Sandusky County are historically common. According to available records, flood events were recorded in 1821, 1847, 1860, 1863, 1879, 1883, 1884, 1904, 1910, 1912, 1937, 1959, and 1963 (see Stantec 2011), and many of these caused noteworthy damage within the City. The flood of record occurred in 1913 with an estimated peak discharge of 63,500 cfs. Floodwalls constructed by the USACE in 1972 have limited flood impacts to the City in subsequent years and are designed to contain discharges exceeding 50,000 cfs, with limited freeboard. Table 1 presents peak flood discharges for selected recurrence intervals determined from an analysis of available USGS data.

Table 1. Flood Frequency Analysis*

Recurrence Interval (years)	Peak Discharge (cfs)
1.01	6,170
1.5	12,710
2	15,520
5	20,990
10	24,380
50	31,410
100	34,200

Based on annual peak discharge as reported by USGS

It should be noted that many historical flood events were due to ice jams in the river downstream of Fremont. Although storm flooding has been documented, it is the combined influence of storms and ice floes[4] that have the greatest potential for flood damage. A full account of ice jam and related flooding research in Fremont was performed by the Cold Regions Research and Engineering Laboratory (CRREL) of the US Army Engineer Research and Development Center and published in two reports:

- Impact of the Ballville Dam on Ice Jams in Fremont, Ohio (2008); and
- Removal of the Ballville Dam on the Sandusky River at Fremont, Ohio: Ice-Hydraulic Analysis (2011).

Fremont is located near the boundary of lake level influence on the Sandusky River. The low gradient, low energy section of the river from the City to the Sandusky Bay facilitates the accumulation of ice and formation of ice jams. Surface ice, typically formed in flat sections of the river, and frazil ice, typically formed in steep sections of the river, originate upstream and become trapped as the river transitions into the low-gradient lake influenced areas. As ice accumulates, upstream water levels may be elevated, increasing the chance of flood damage.

These same processes at work in the lower river are present in the Ballville Dam Impoundment, although on a smaller scale. The surface of the impoundment freezes due to the slow moving water and creates a barrier to the downstream floe of ice. The jam point is located approximately 1.7 miles upstream from the dam approximately where River Road (CR 132) begins to run parallel to the river.

[4] A mass or sheet of floating ice.

Six major ice jam related flood events have caused damage to the City. Four events, in 1833, 1843, 1883, and 1904, occurred before the Ballville Dam was completed in 1913. Two events, in 1959 and 1963, occurred after the dam was built but before the flood walls were constructed in 1972. No ice related flood events have caused damage in Fremont since the flood walls were built. Two large floods in 1978 (36,000 cfs) and 2007 (22,300 cfs) occurred when there was potential for ice jams and ice jamming was recorded upstream of Ballville Dam without reported flood damage in Fremont (USACE - CRREL 2008 and 2011). Review of the Ballville Dam as it relates to ice floes is outside the scope of this document.

Geomorphology

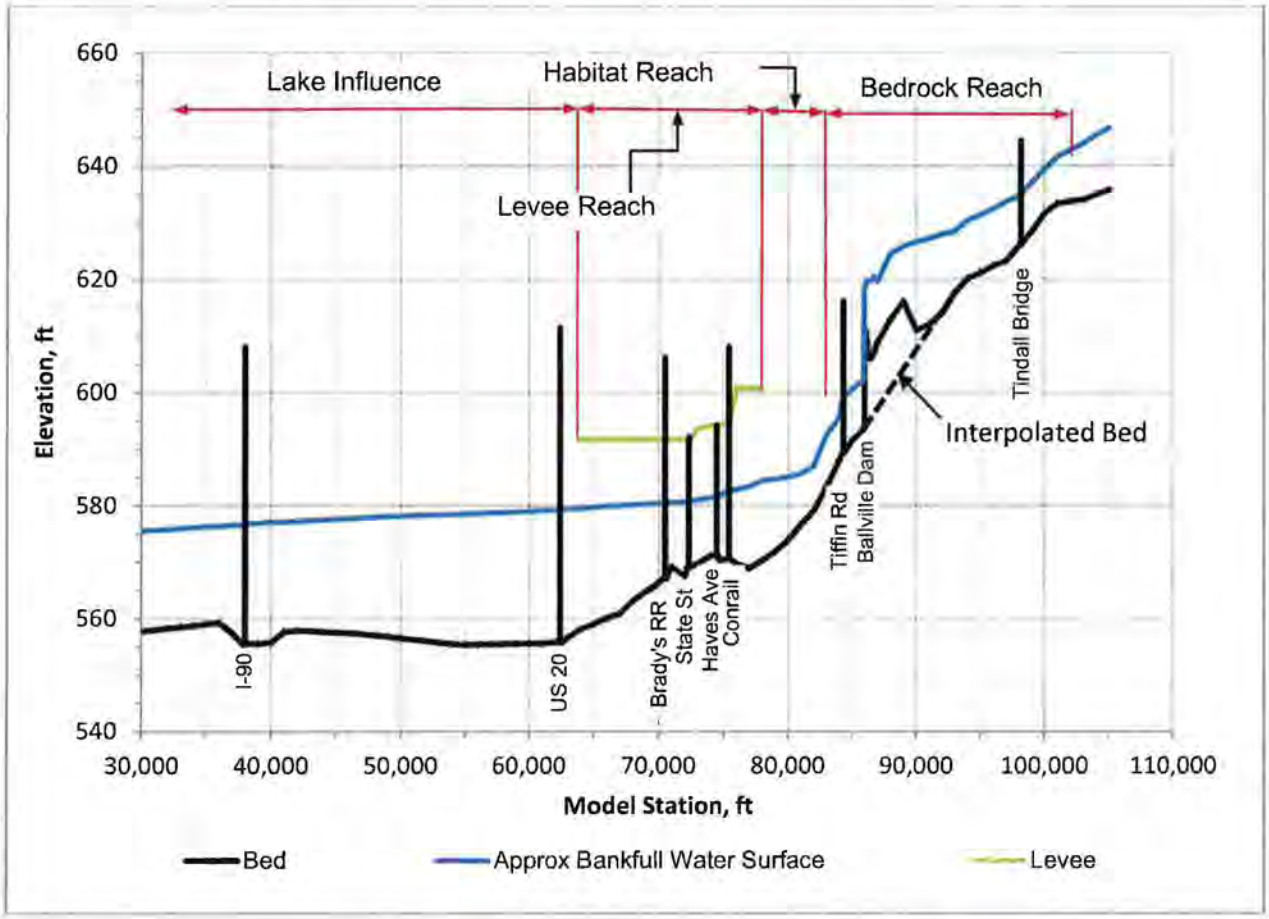
The Sandusky River begins near the edge of the Glaciated Allegheny Plateaus physiographic region in Crawford County, Ohio and passes through the Till and Lake Plains regions on its way to Sandusky Bay and Lake Erie. Changes in river characteristics can be seen as it passes numerous historic lake and glacial boundaries. River meanders are typically a function of till plain irregularities acting as migration boundaries south of Tiffin, which lies on the border of the Till and Lake Plains. As the river enters the Lake Plains region, meanders become larger as the floodplains begin to widen. The river is only slightly to moderately entrenched, as bed incision has been impeded by substantial areas of limestone and dolomite bedrock. Downstream of the City, meanders become more pronounced and irregular as the newer floodplains expand greatly near the bay (Stantec 2011).

Within the vicinity of the Ballville Dam and Impoundment, channel characteristics and slopes vary (Figure 2). Upstream of the impoundment, the channel is dominated by bedrock substrate with some interstitial gravel and cobble. The bedrock has limited channel incision, creating wide cross sections with width to depth ratios (W/D) between 50 and 60. The channel is only slightly entrenched and floodplain access is generally good. Slopes are relatively steep (0.002 ft/ft) in the bedrock sections which yield high velocities. The same characteristics exist immediately below the dam; however, at this point the channel is more entrenched. This condition changes as the stream gains distance past the Tiffin Road Bridge constriction and becomes less laterally confined.

As the river passes the Tiffin Road Bridge, gravel and cobble material become more prevalent in the substrate. Frequent side and mid-channel bars composed of these materials are observed from just past the bridge down to the large left-hand bend adjacent to the River Cliff Golf Course. Bedrock still dominates as grade control through this reach, but increased water depths are seen locally, such as near the old hydroelectric facility. Field survey indicated a hydraulic slope of 0.003 ft/ft. Just downstream of the decommissioned hydroelectric generating facility, the valley expands considerably. The main channel of the river narrows to approximately half of the width observed upstream of the dam impoundment, as flow is diverted to side channels in forested areas on both banks. The inside of the left-hand bend is also comprised of frequent divergent channels. These channels are less stable and are formed and altered due to the presence of massive amounts of driftwood and debris dropped here during flood events.

Immediately past the left-hand bend near the golf course, the river changes characteristics substantially. This geomorphic reach extends from near the golf course to the north side of Fremont. Its most prominent feature is the levee and flood wall system finished in 1972, which laterally confines the river and forms an entrenched channel. Except for a narrow section adjacent to Roger Young Park, the base-flow channel width is generally 350 to 400 feet. Depth ranges throughout the reach, with the deepest portion at the narrow levee constriction. The flood walls in this reach eliminate floodplain access and are designed to protect against a 50,000 cfs flood event with some freeboard. While the river bed slope is relatively high, bankfull water surface slope (0.0008 ft/ft) is greatly reduced due to backwater effects from the lake-level impacts downstream. Substrates range from bedrock to clay size particles, with a predominance of sand and fine gravel.

Figure 2. Profile of Sandusky River (taken from Stantec 2011)



The remainder of the river downstream to the Bay is flat (0.0002 ft/ft). Channel width increases in the direction of the bay, with distances between the banks frequently reaching greater than 1,000 feet near the mouth. There is floodplain connectivity in the majority of the reach except where dikes have been built. As the river nears the transition to Muddy Creek Bay, it begins to resemble a marsh ecosystem. The heavy suspended sediment load from the watershed begins to settle out of the water column and deposition of sediment is heavy in this area. There is less channel definition in this area with widespread deposition of fine particles creating frequent

islands. Dikes around private lands at the mouth provide some physical definition between marsh and active channel.

Flood Storage Analysis Methodology

The following flood storage analysis was performed to understand the capacity of the Ballville Dam and impoundment. Three key components are necessary to perform this analysis: 1) outflow, 2) inflow, and 3) storage. Impoundments, in general, provide water storage up to a maximum level; the level defined by the elevation where the water crests and spills over the Ballville Dam. The storage volume when divided by the rate of inflow provides an estimated time to reach storage capacity. The following equation is used to estimate the time needed for capacity to be reached.

$$\frac{Storage\ Volume\ (ft^3)}{Inflow\ (\frac{ft^3}{sec})} = Time\ (sec)$$

Outflow. Outflow is the amount of water discharged from the sluice gates. This analysis assumes the six (6) sluice gates are operational and left permanently open. Discharge from the gates is dependent upon the water level behind the dam. As the water level increases, pressure builds up behind the gate, leading to higher discharge. To simplify this analysis, however, the assumption of a constant outflow discharge equal to a value associated with a water level even with the crests of the spillways (i.e. 624.24 ft above mean sea level) is used. Therefore, discharge through the sluice gates is estimated to be approximately 1,950 cfs. This conservative assumption was used in the analysis as a means to slow the rate at which the empty impoundment would fill.

At the point when water crests the dam and flaws over the spillway (i.e. capacity) water inflow roughly equals water outflow (i.e. 1,000 ft^3/sec inflow = 1,000 ft^3/sec inflow). Therefore, consideration of both inflow and outflow is critical for a dam and impoundment to be used as flood storage during various flood events. Storage is estimated by the following equation.

$$inflow\left(\frac{ft^3}{sec}\right) - outflow\left(\frac{ft^3}{sec}\right) = \frac{\Delta\ Storage}{\Delta\ Time}\left(\frac{ft^3}{sec}\right)$$

Inflow. Inflow is the amount of water received by the impoundment. This analysis evaluates flood events at return intervals of 1, 2, 100, and 500 years (approximately 6,000; 15,000; 40,000; and 50,000 cfs peak annual discharges, respectively). For reference, a 1-year event typically does not leave the banks of a river; a 2-year event typically leaves the channel and inundates the adjacent floodplain; a 100-year event is the standard for Federal Emergency Management Agency (FEMA) Flood Insurance Rate Mapping; and a 500-year event was the design flow for the floodwalls in Fremont.

USGS gage data at Tindall Bridge indicate annual peak flow values are very similar to the daily means on those days when the annual peaks were recorded. This suggests the peak (cfs) of flood events can last for 24 hours or greater. Inflow is simplified as a constant rather than a typical storm hydrograph that would be highly variable, but less than the constant assumed. A typical hydrograph would show the impoundment being filled prior to the arrival of peak discharge to the impoundment.

Storage. Storage is the volume of water that can be stored behind the Ballville Dam before cresting the spillways. This analysis assumes an estimated 840,000 cubic yards (CY) of sediment has been dredged from the impoundment. This assumption was intended to provide the maximum amount of storage possible under the current configuration. Water volume is the current, pre-dredged, water volume capable of being stored in the impoundment and is estimated to be approximately 1 million CY. When added together the impoundment has an estimated storage volume of 1,840,000 CY or 49,680,000 cubic feet (ft^3).

Calculation Results

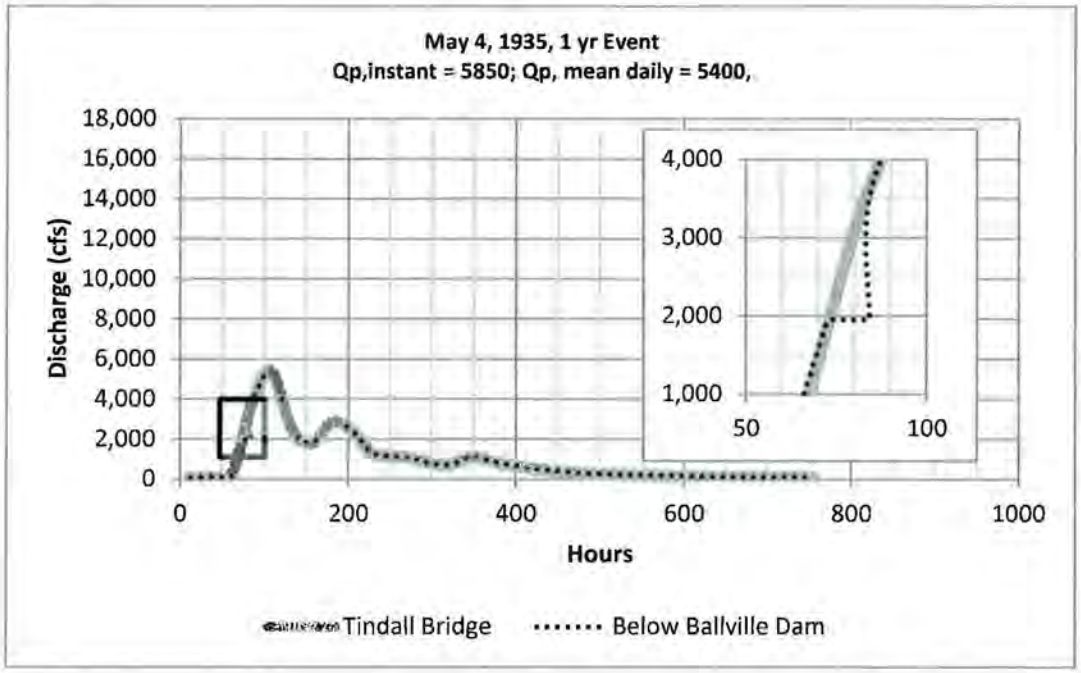
1-Year Event:

During a 1-year flood event, the inflow to the impoundment is expected to be approximately 6,000 ft^3/sec. As mentioned previously, sluice gate outflow is assumed to be 1,950 ft^3/sec, resulting in an inflow rate of excess water equal to 4,050 ft^3/sec. When dividing the storage capacity of the impoundment by the outflow, it is calculated that it would take approximately 3.4 hours to fill the impoundment to the spillway level.

$$\frac{49{,}680{,}000\ (\mathrm{ft}^3)}{4{,}050\ (\frac{ft^3}{sec})} = 12{,}267\ (\mathrm{sec})/3{,}600\left(\frac{sec}{hr}\right) = 3.4\ hours$$

The hydrograph for a typical 1-year event (Figure 3) shows that the peak discharge and time to peak at the USGS gage and at the Ballville Dam are effectively equal due to the dam's run-of-river functionality.

Figure 3. Hydrograph for typical 1-year event for Sandusky River at Ballville Dam project area. The dashed line in the inset box shows the period where the impoundment is storing water.



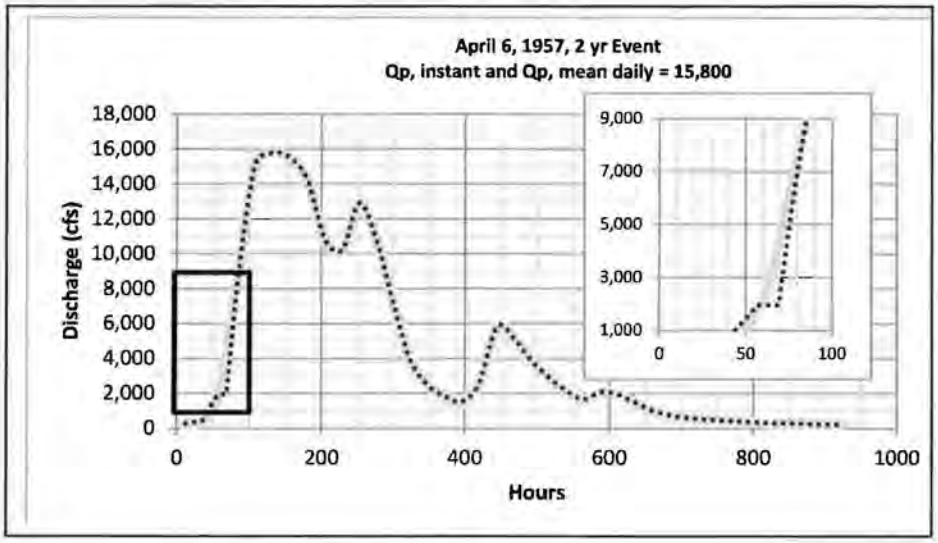
2-Year Event:

During a 2-year flood event, the inflow to the impoundment is expected to be approximately 15,000 ft^3/sec. As mentioned previously, sluice gate outflow is assumed to be 1,950 ft^3/sec, resulting in a flow rate of excess water equal to 13,050 ft^3/sec. When dividing the storage capacity of the impoundment by the outflow rate from the sluice gates, it is calculated that it would take approximately 1.1 hours to fill the impoundment to the spillway level.

$$\frac{49{,}680{,}000\ (ft^3)}{13{,}050\ (\frac{ft^3}{sec})} = 3{,}806\ (sec)/\ 3{,}600(\frac{sec}{hr})\ = 1.1\ hours$$

The hydrograph for a typical 2-year event (Figure 4) shows that the peak discharge and time to peak at the USGS gage and at the Ballville Dam are effectively equal due to the dam's run-of-river functionality. This is true for various fluctuations during the event as well.

Figure 4. Hydrograph for typical 2-year event for Sandusky River at Ballville Dam project area. The dashed line in the inset box shows the period where the impoundment is storing water.



100-Year Event [5]:

During a 100-year flood event, the inflow to the impoundment is expected to be approximately 34,200 ft^3/sec. As mentioned previously, sluice gate outflow is assumed to be 1,950 ft^3/sec, resulting in a flow rate of excess water equal to 32,250 ft^3/sec. When dividing the storage capacity of the impoundment by the outflow rate from the sluice gates, it is calculated that it would take approximately 0.4 hours to fill the impoundment to the spillway level.

$$\frac{49{,}680{,}000\ (ft^3)}{32{,}250\ (\frac{ft^3}{sec})} = 1{,}540(\text{sec})/3{,}600\left(\frac{sec}{hr}\right) = 0.4\ hours$$

500-Year Event:

During a 500-year flood event, the inflow to the impoundment is expected to be approximately 50,000 ft^3/sec. As mentioned previously, sluice gate outflow is assumed to be 1,950 ft^3/sec, resulting in a flow rate of excess water equal to 48,050 ft^3/sec. When dividing the storage capacity of the impoundment by the outflow rate from the sluice gates, it is calculated that it would take approximately 0.3 hours to fill the impoundment to the spillway level.

[5] No hydrograph is included for the 100 and 500 year event as they would also depict a similar hydrograph as the 1- and 2-year events with increased volumes.

$$\frac{49{,}680{,}000\ (ft^3)}{48{,}050\ (\frac{ft^3}{sec})} = 1{,}033(\text{sec})/3{,}600\left(\frac{sec}{hr}\right) = 0.3\ hours$$

Conclusions

The goal of this memo was to assess the flood storage ability of the Ballville Dam and the associated impoundment. The Ballville Dam was operational in 1913 and originally designed to function as a run-of-river hydro-electric generation facility and not as a flood storage impoundment.

The flood levees within the City of Fremont (downstream of the Ballville Dam) are currently designed to convey a 500-year flood event at approximately 50,000 cfs without overtopping. Analysis of available data indicates that the Ballville Dam was not designed to provide flood storage. At a 500-year flood flow rate, a completely empty impoundment (a very conservative assumption) would fill to capacity in approximately 18 minutes. In order for the Ballville Dam to function as a flood storage impoundment, it would need to store flood flows for at least the duration of large storm events, typically 24 to 48 hours. This analysis shows that the Ballville Dam and Impoundment provide insignificant downstream hydrograph attenuation and added flood protection. Therefore, even using very conservative assumptions, the use of Ballville Dam for flood storage is not a viable option.

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/lfb

Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

4 – Proposed Action Alternative Memorandum

To:	Brian Elkington Fisheries Coordinator U.S. Fish and Wildlife Service	From:	Jeff Brown, Sr. Env. Scientist Cody Fleece, Sr. Env. Scientist Stantec Consulting Services Inc.
File:	175631016	Date:	November 21, 2013

REFERENCE: BALLVILLE DAM EIS PROPOSED ACTION

PURPOSE OF THIS MEMO

The purpose of this memo is to provide detail of the proposed action alternative. This information is based on current plans and permit drawings (June 2013; Attachment A). The majority of this information will be provided in the National Environmental Policy Act (NEPA) document; however, this memorandum was developed ahead of the NEPA document to assist in preparation of the environmental consequences chapter for the project. This memorandum describes the three phases making up the proposed action.

BACKGROUND

The U.S. Fish and Wildlife Service (USFWS) is the lead agency for developing a Draft Environmental Impact Statement (DEIS) for the Ballville Dam Removal Project. The USFWS is the lead agency based on the funding commitment of $2 million from the Great Lakes Restoration Initiative (GLRI) through the Great Lakes Fish and Wildlife Restoration Act (Act)(16 U.S.C. 941 §4321 et seq.). The Act authorizes the USFWS to work in partnership with States, Tribes, and other Federal agencies for the restoration of fish and wildlife resources in the Great Lakes Basin.

Issuance of funding under the Act constitutes a discretionary federal action by the USFWS and is thus subject to the NEPA. As the lead agency, the USFWS has determined that an Environmental Impact Statement is appropriate for meeting compliance with the NEPA. The NEPA process requires that federal agencies integrate an interdisciplinary environmental review process that evaluates a range of alternatives, including the No Action Alternative, as part of the decision-making process.

DESCRIPTION

Four alternatives, including the No Action Alternative, are being evaluated in the NEPA DEIS. The proposed action is incremental dam removal with ice control structures. This memorandum describes that alternative.

The proposed alternative is divided into three phases with each phase having multiple objectives for meeting dam removal goals. In summary, the phases are 1.) initial notching of dam; 2.) sediment stabilization, dam removal, and ice control structure construction; and 3.) sea

wall modification and restoration of project area. These phases are discussed further in the following sections. All phases are depicted in the June 2013 permit plan set (Attachment A).

PHASE I – INITIAL NOTCHING OF DAM

Phase 1A – Construct access to south abutment (September 2014)

The first action will be development of a temporary access road to the south dam abutment. Access will be from Yingling Road at its intersection with Laird Drive. From this intersection an existing gravel drive to an Ohio Power Company substation will be used for part of the access and as an equipment staging location. No trespassing signage and appropriate gating, if necessary, will be used to control access to the project area. The remainder of the access to the dam, will track northeastward from the existing gravel drive to the eastern edge of a field adjacent to the substation. At the east property line of this field, access will continue northward along the line until reaching the southern dam abutment. Equipment, such as a trackhoe and work truck will be used on the temporary access road.

The access road will be the width of a track hoe and approximately 850 feet in length. No improvements such as spread gravel or grading are anticipated. As necessary, a limited number of trees will be removed at the property line crossing and at the dam abutment work pad location (approximately 0.5 acre).

The work pad at the south abutment is approximately 0.5 acre in size. Approximately half of the work pad is wooded and will require tree removal. Limited onsite grading will be required to ensure a level work pad to safely use the trackhoe for Phase 1B. Soil erosion measures such as silt fencing will be put into place to prevent any erosion and sediment entry into the Sandusky River due to clearing and grading work at the work pad. Similarly, soil and erosion prevention measures will be installed along the access road, if needed to prevent unnecessary erosion from occurring.

The access road will be restored to previous condition, less the removal of trees, during Phase 3 of the project. Compacted soil will be loosened and seeded with an approved seed mix.

Phase 1B – Notch spillway and impoundment drawdown (November 2014)

Upon completion of the south abutment work pad, a trackhoe with a mounted impact hammer (or hoe-ram) will likely be used to notch the dam to begin lowering the pool. The notch will be approximately 20 feet wide and result in an immediate drawdown of the impoundment by lowering part of the south spillway elevation from roughly 625 feet to 615 feet. Approximately 96 cubic yards (CY) of concrete from the dam will be removed and directed to fall into a large scour hole below the dam. Completion of the notch will conclude Phase 1.

PHASE 2 – SEDIMENT STABILIZATION, DAM REMOVAL, AND ICE CONTROL STRUCTURE CONSTRUCTION

Phase 2A – Sediment stabilization (March 2015)

As a result of Phase 1, approximately 20 acres of newly exposed sediment previously inundated by the impoundment will be exposed. Stabilization measures will reduce potential mobility of the sediment. An approved mixture of seed will be broadcast across the exposed surface then mulched to prevent sediment erosion and seed desiccation (i.e. drying out). It is anticipated that a motorized spreader will be used. Approximately 1,500 square bales of hay will be necessary to adequately mulch the seeded area. Access to the area will occur via the south access road. A boat may be used to transport bales of hay and bags of seed so that they may be strategically placed in the area. The length and time of the seeding schedule will be dependent upon the access conditions due to weather and water levels.

Phase 2B – Construct access ramp below dam (May-June 2015)

Access for equipment to remove the dam will be from County Road 501 and from the American Electric Power (AEP) storage yard adjacent to the dam. Access to the construction site will be controlled by a lockable double swing gate placed on a temporary fence. Approximately 0.3 ac of wooded riparian habitat will require clearing for development of the access road. The access road will be constructed of clean fill and crushed limestone. Some limited cut and fill will be necessary to meet grade specifications needed for construction traffic. The access road will be constructed to allow for dump trucks, bulldozers, and other construction equipment to access the worksite. No refueling of equipment will occur within the Sandusky River. Refueling will only occur within the project staging area (in the AEP storage yard) in order to prevent fuel spills within the waterway.

Once access to the river is established, a temporary earthen ramp will be constructed to allow access for equipment to reach the top of the south spillway (Elevation 625 feet). The ramp will be approximately 250 feet in length and rise in elevation from 602 feet to 620 feet at the dam. Total volume of the ramp is estimated to be 7,400 CY of soil, rock and concrete rubble. Maintenance of the ramp and access road within the banks of the Sandusky River may be more frequent than at the entry gates due to rise of water elevation during rain events. However, these are expected to be infrequent due to the location and elevation of the modified impoundment pool. Sediment and erosion control measures will apply as appropriate along the length of the access road and ramp.

As demolition of the south spillway and non-overflow portion of the dam occur, the temporary access ramp will be lowered and/or placed in locations to help control grade of the new floodplain bench. The temporary access road to the river will remain in place until the end of Phase 3.

Phase 2C – Construct ice control structures (July-October 2015)

Access for construction of the ice control structures (ICS) will be via the access road of Phase 2B, described above. Construction of the ICS will be located 175 feet downstream of, and parallel to, the dam. The ICS consists of approximately 15 piers spaced 18 feet apart on centers. Overall, the piers would be 25 feet tall and six feet in diameter. In general, piers would

be embedded approximately 15 feet into the bedrock and extend 10 feet above grade. Exposure above grade would vary based on river bed; however, piers would be uniform in top elevation at 610 feet.

Each pier would be constructed in three parts: drilling, reinforcement placement, and concrete placement by tremie method (pumping from the bottom up). Each shaft will be drilled approximately 15 feet into the bedrock. A truck mounted drill rig with a 6-foot diameter toothed core drum will be used to remove 1 to 3 foot-long plugs of bedrock. Each plug would be extracted and drilling continued until the required depth is attained. After drilling, reinforcement is added. Reinforcement will consist of a six foot diameter circular form and a mesh of rebar assembled for structural strengthening. A cylindrical form for the concrete will extend at least 12 feet above grade to elevation 610 feet. Concrete will be tremied into the form, displacing any collected water. Each pier would have a volume of approximately 26 cubic yards of steel reinforced concrete. The entire ICS (15 piers) would result in nearly 390 CY of concrete being poured.

Equipment will be staged in the north staging area and refueled daily at this location. It is estimated that the drilling, reinforcement and concrete placement of one shaft per day could be attained. Concrete placement is likely to occur in groups of five to 10 piers for concrete delivery efficiency. A concrete pump truck and an estimated 40 concrete mixing trucks (roughly three mixer loads per pier) will access the project area via the north access road. After the concrete has set-up the circular forms will be removed exposing the structure.

During the 50 to 75 year service life of the ICS, various maintenance activities will be required to extend each pier's service years. Concrete may experience spalling and abrasion throughout its service life. These areas would be patched with Portland cement grout or epoxy. Routine inspection of the structures will be necessary to ensure that the reinforcement is not exposed and that the concrete is maintained.

Periodic removal of debris that may accumulate on the structure may be necessary. Only the necessary portion of the north shore access road will be kept in place to provide access to the river by equipment such as a track hoe for removing debris.

Phase 2D – Remove dam (September-November 2015)

After completion of Phase 2B an access road will be in place to begin demolition of the remaining dam. However, it is not until near completion of Phase 2C that demolition will begin. Demolition of the dam will stop at the north abutment where the current carbon-feed building is located. Demolition is expected to take approximately three months to complete including removal of the Phase 2B access ramp.

Demolition of the dam will be accomplished by a trackhoe (or hoe ram accessing the top of the dam and enlarging the original notch from the north. The bottom elevation of the notch would be lowered from elevation 615 feet to 610 feet. This will allow for additional impoundment drawdown to occur while the track hoe-ram demolishes the top of the remaining south spillway. As the south spillway is demolished, additional equipment will work to demolish the non-overflow section of the dam and move northward to demolish the north overflow area. Debris from the demolition will be directed to fall into a two large scour holes downstream of the south

spillway and north overflow. These areas will serve as temporary concrete disposal areas until removal of concrete rubble begins. The access ramp constructed in Phase 2B will be removed as the dam is reduced in elevation.

The entire volume of debris from demolition of the dam is estimated to be 15,000 CY. Some of the metal materials in the dam such as the old penstock, sluice gates, and raw water intake apparatus will be removed from the demolition area upon extraction. Approximately 1,900 CY of clean concrete rubble fill from the demolition will remain in the two concrete disposal areas in order to level the river bed and fill the scour pools.

Phase 2E – Channel restoration (November-December 2015)

After demolition of the dam, channel restoration will begin. Restoration of the project area will include approximately 28,000 CY of fill consisting of offsite rock and soil materials as well as some concrete rubble from the demolished dam and leftover access ramp. Any rubble used as fill would be buried with soil. Earth moving equipment such as track hoes, bulldozers, and other equipment will regrade the north bank into a more gradual sloping bank. Stabilization measures will be used to prevent erosion. These measures include seeding and vegetative strategies designed to control invasive plant colonization.

As restoration is being completed, removal of the remaining temporary ramp from Phase 2B will occur. Minimal permanent access to the river for maintenance of the ICS will remain. Access to the river for motorized vehicles will be controlled by a gate. Additionally, the south abutment access road from Phase 1A will also be restored to conditions prior to construction.

PHASE 3 – SEA WALL MODIFICAITON AND RESTORATION OF THE PROJECT AREA

Phase 3A – Bank stabilization/planting/stream work (summer 2016)

As Phase 2D is being completed, monitoring of the City of Fremont's new water reservoir intake, approximately 1.5 river miles upstream of the dam, will occur to ensure that, during the lowering of the impoundment, no sediment blockage occurs due to instability of upstream banks. Similarly, stability of River Road will be monitored (just southwest of the intersection of River Road and Buckland Avenue) to ensure that no impacts to infrastructure occur as a result of the pool drawdown. If stabilization is necessary, appropriate measures would be implemented to safeguard both the intake and roadway.

Phase 3B – Remove any remaining dam material and modify seawall (August-November 2016)

After Phase 3A, any material stockpiled in the staging area or along the access road will be removed from the site. The temporary gating will be removed and permanent gate and appropriate signage installed limiting access to the project restoration area.

The last action of the project is to modify the sea wall. The wall is approximately 702 feet long and 1.5 feet wide with an average height of five feet. The sea wall will be reduced in height, mechanically, to grade while keeping the below-grade portion in place. Approximately 195 CY of concrete will be removed and disposed of appropriately. Any rebar or other reinforcement will be cut flush with the remaining base. A permanent fence will then be placed atop of the remaining wall to prevent falls from the top of the riverbank. Upon modification of the sea wall

and installation of the fencing the project will be completed from a dam removal perspective. Phase 3C will be initiated, if necessary after completion of Phases 1 through 3B.

Phase 3C – Remove Tucker Dam – if necessary (fall 2016)

Removal of Ballville Dam and pool is expected to expose the Tucker Dam, if existent, either whole or in part. The initial notch of the dam in Phase 1B will provide evidence to the extent that the dam may still be in place and potentially create a new barrier for fish passage. If the Tucker Dam is intact and requires some action, then actions specified in an Memorandum of Understanding between the U.S. Fish and Wildlife Service and the Ohio State Historic Preservation Office will be followed. Those actions are yet to be determined.

Attachment A

Ballville Dam Removal - Draft Permitting Drawings (August 2013)

Stantec

CITY OF FREMONT

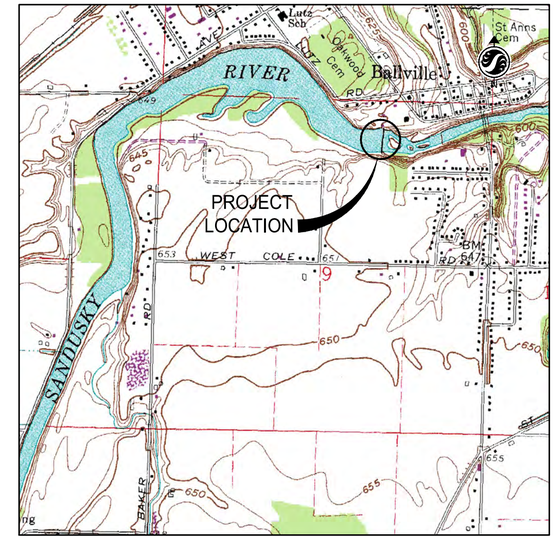
OHIO
FREMONT
Where People Come First

BALLVILLE DAM REMOVAL

DRAFT - PERMIT DRAWINGS

JULY, 2014

Project Number: 175630015



VICINITY MAP
APPROX. SCALE: 1" = 1200' Ñ

INDEX OF SHEETS

SHEET NO.	TITLE
1	COVER SHEET
2	GENERAL NOTES
3	PROJECT OVERVIEW AND SEQUENCE OF CONSTRUCTION
4	PHASE 1A
5	PHASE 1B
6	PHASE 2A
7	PHASE 2B
8	PHASE 2C
9	PHASE 2D
10	PHASE 2E
11	PHASE 3A
12	PLANTING SCHEDULES
13	PHASE 3B
14	PROFILE ALONG THALWEG
15-18	THALWEG CROSS SECTIONS
19	ACCESS ROAD AND TEMPORARY RAMP CROSS SECTIONS
20	DETAILS

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1. Specifications: The latest edition of the City of Fremont construction and material specifications, including all supplements thereto, shall govern all construction items that are part of this plan unless otherwise noted.

   Any modification to the specifications or changes to the work as shown on the drawings must have prior written approval by the owner or owner's representative.

2. Additional Compensation: The Contractor shall furnish all labor, materials, tools, equipment, services, and related accessories for a complete project as shown and described in the plans and specifications. The price for items of work or materials shown on the plans or provided for in the specifications or special provisions for which no separate unit price is given shall be bid as per plans and the costs distributed among the various bid items. Submission of a bid shall be considered evidence that the bidder is satisfied with the plans and conditions as shown. No additional compensation will be paid to the Contractor for compliance with the plans, specifications, or special provisions.

3. Notification: the Contractor shall notify the following parties at least 48 hours in advance of the anticipated start of construction, holidays and weekends excluded. Work shall not commence until a pre–construction conference is held.

Fremont Administration	(419) 334–5900
Fremont Engineering Department	(419) 334–8963
Fremont Fire Department	(419) 332–4131
Fremont Police Department	(419) 332–6464
Fremont Water Treatment	(419) 332–3581
Fremont Water & Sewer Maintenance	(419) 332–3181
Ballville Township	(419) 332–7830
Sandusky County Emergency Mgmt.	(419) 334–8933

   The Contractor shall notify, in writing, all adjacent landowners a minimum of one week in advance of work near their property. The Contractor shall contact the city administration for a suggested format for the notice.

4. Permits: The Contractor shall obtain all necessary permits and licenses needed for construction of this project as required by Ballville Township, the City of Fremont, and Sandusky County.

   The Contractor shall secure a written permit from the Sandusky County Engineer's office, 2500 West State St, Fremont, a minimum of two working days prior to beginning any work within Sandusky County right of way. The Contractor may be required to post a bond with the Sandusky County Engineer prior to issuance of the permit to insure proper restoration of the pavement and right of way. The Contractor shall provide the Sandusky County Engineer's office a 24–hour telephone number to be used in case of an emergency.

5. Track Mounted Vehicles: No track mounted vehicles shall be moved on public streets or roads. The County Engineer may grant exceptions where short distances and special circumstances are involved. Granting of exceptions must be in writing and any resulting damage must be repaired to the satisfaction of the appropriate jurisdiction.

6. Safety: The Contractor shall be solely responsible for complying with all federal, state, and local safety requirements. Together with exercising precautions at all times for the protection of persons (including employees) and property, it is also the sole responsibility of the Contractor to initiate, maintain, and supervise all safety requirements, precautions, and programs in connection with the work.

7. Elevation Datum: Elevations shown on these plans are based on the NAVD88 Datum.

8. Benchmarks: The Contractor shall carefully preserve benchmarks, property corners, reference points, and stakes. Any benchmark, property corner, or survey marker damaged or disturbed by the Contractor shall be reset by an Ohio registered surveyor at the Contractor's expense.

9. Right–of–Way: In addition to the direct requirements of the contract specifications, the Contractor shall observe and conform to the specific requirements of all rights–of–way including easements, court entries, and rights of entry or action filed in court in accordance with the code of the applicable governing agency. The cost of the operations necessary to fulfill such requirements shall be included in the price bid for the various items of the contract unless specific provision is made in the contract specifications for such cost under specific items of the contract.

10. Utilities: The locations of underground utilities shown on the plan are obtained from the owners of the utility as required by section 153.64 ORC. The utility locations indicated are not necessarily complete or correct. The Contractor is responsible for the investigation, location, support, protection and restoration of all existing utilities and appurtenances shown.

11. Grade Changes: Grades and elevations shown on the plans shall not be revised under any circumstances without first obtaining written approval from the Engineer.

12. Fire Prevention Systems: No two (2) adjacent fire hydrants shall be taken out of service concurrently.

    The Contractor shall notify the fire department whenever fire hydrants are taken out of service and placed back in service.

13. Fire Hydrant Permit: The Contractor must obtain permission from water treatment department prior to connection of water supply lines to any fire hydrant. The Contractor shall provide the necessary gate valves, backflow preventers, and flow meter for each hydrant location. All equipment, fittings and valves shall be in accordance with Fremont water and sewer maintenance standards. The Contractor shall pay for water at the current city rates.

14. Stormwater Facilities: Before any work is started on the project and again before final acceptance by the owner, the Engineer and the Contractor shall make an inspection of all existing sewers which are to remain in service and which may be affected by the work. The condition of the existing conduits and their appurtenances shall be determined from field observations. The Engineer shall keep records of the inspection in writing.

    All existing manholes, catch basins, drains, sewers, and appurtenances inspected initially by the above mentioned parties shall be maintained and left in a condition reasonably comparable to that determined by the original inspection. The Contractor shall correct any change in the condition resulting from the Contractor's operations to the satisfaction of the Engineer. The Contractor shall remove debris, silt, etc. From the existing manholes and catch basins that have been affected by construction operations. The Contractor shall maintain service in existing sewers during construction.

15. End Treatment: Immediately after placement of any conduits, the Contractor shall construct the end treatments required by the plans at both the outlet and inlet ends. This shall include headwalls, concrete, riprap, rock channel protection, sodding, etc.

16. Park Property: The Contractor shall contact the appropriate authorities 24 hours prior to any construction in or near city, township, or County park property.

Fremont Parks and Recreation	(419) 334–5906
Ballville Township	(419) 332–7830)
Sandusky County Park District	(419) 334–4495

17. Tree Preservation: All trees, whether shown or not shown on the plans, are to be preserved unless approval to remove is given in writing by the Engineer or their removal has been designated on the plan. Trees removed by either of the two preceding authorities shall be paid for under _____, clearing and grubbing, unless otherwise provided for by unit price bid under item __, tree removed, xx" size. The Contractor shall use special precautions to avoid damage to all other trees. All trees removed shall include stump removal to 6 inches below grade. All wood over 4–inch diameter shall, at the property owner's discretion, be cut into lengths not exceeding 16 inches and stacked on the owner's property adjacent to the permanent easement. The cost for tree, brush, and stump removal shall be included in the price bid for ____, clearing and grubbing. The Contractor is to work with staff from the appropriate parks and recreation departments on all tree removals.

    Pruning: branches or growth that interferes with the free construction of the project may be removed from trees/bushes that are to be saved by the use of pruning tools with prior approval from the Engineer. All pruning tools used and methods employed shall meet the approval of the Engineer. The cost of all work and expenses connected with tree pruning shall be included in the price bid for _____, clearing and grubbing. No extra payment shall be made.

    Trees damaged or destroyed that were not designated for removal or approved by the Engineer for removal shall be replaced at the Contractor's expense. If suitable replacement cannot be determined, compensation by the Contractor for unauthorized tree removal shall include sufficient additional landscaping as determined by recreation and parks officials.

    Protection during construction: public trees will be protected against injury or damage to branches, trunks or roots from construction and excavation.

A. All tree pruning and removal must be done in accordance to ansi a300 and ansi z133.1 standards. The Contractor performing the work must be a professional tree care company with a certified arborist on staff and available to direct the on–site crew.
B. Heavy equipment will not be allowed to compact the soil over the root zone of existing trees. Restricted equipment access routes will be established before work is begun. Temporary paving materials such as plywood, lumber or rubber matting spread over the root zone may be required to prevent compaction.
C. Installation of utilities under the dripline of existing trees must be directionally bored or drilled below the root zone. Top of the bore or tunnel should be no higher than 3 feet deep. Open trenches within the root zone must be avoided.
D. Where grade change is required within the root zone of public trees, a sufficient residual root zone to provide for the good health of the trees should remain undisturbed and protected by either a dry well or retaining wall if the grade is to be raised or lowered.
E. Construction materials, excavation debris, chemicals, fuel, equipment or vehicles are not to be stockpiled, stored, dumped or parked within the dripline of public trees.
F. Fires are not permitted within the dripline of any trees.
G. All existing trees designated for preservation will be protected with a good, substantial fence, frame or box not less than four feet high and as far from the tree as possible. Dripline is preferable, however, actual location will be determined by site limitations.
H. Fencing will be installed before commencing site preparation work. Fence must be maintained during the full construction period.
I. Interfering branches of trees may be removed when acceptable to park officials and shall be pruned in accordance with these standards.
J. Any trees damaged or destroyed due to Contractor negligence will be treated or removed at the Contractor's expense. If damaged beyond repair, the city will require reimbursement for the value of the tree as determined by the current edition of the 'guide for plant appraisal' published by the international society of arboriculture.

18. Dust Control: The Contractor shall be responsible for providing dust control measures in accordance with _____. Dust control operations shall be performed on a periodic basis and/or as directed by the owner to alleviate or prevent the dust nuisance originating with the project work limits. Calcium chloride on areas to be seeded and mulched will not be permitted. The cost for all dust control measures shall be included in the price bid for _____.

19. Temporary Soil Erosion and Sediment Control: The following estimated quantities are to be used as directed by the Engineer for erosion and sedimentation control measures:

    Erosion and sediment control measures are required as a part of this project. The erosion and sedimentation control reflects a schematic diagram of the intended measures for compliance with the required standards. General practice and/or site field conditions may warrant variation in the placement or use of the specified controls.

    The Contractor shall be solely responsible for providing necessary and adequate measures for proper control of erosion and sediment runoff for the site along with proper maintenance and inspection in compliance with the NPDES general permit for storm water discharges associated with construction activity.

    Land–disturbing activities must comply with all provisions of local erosion and sediment control regulations. All land–disturbing activities shall be subject to inspection and site investigation by the City of Fremont and/or the Ohio EPA. Failure to comply with these regulations is subject to legal enforcement action.

    It is the responsibility of the Contractor to notify the City of Fremont and Ballville Township 48 hours prior to commencement of initial site land disturbance on any site of two or more acres. This includes site clearing, grubbing and any earth moving. Primary erosion and sediment control practices are mandated by regulation to be in place from the beginning of the construction activity.

20. Soil Stockpiles: all soil stockpiles shall be protected from erosion by perimeter control devices such as straw bale dikes or silt fences. These perimeter control devices shall be maintained throughout the life of the project. Excavated materials shall not be stored on existing public roadway pavements. This includes excess or unusable excavated soil.

21. Disposal of Excess Excavation: The Contractor shall dispose of all excess excavation. If materials are disposed on property within city limits, the Contractor shall provide a copy of the signed agreement and a copy of the grade and fill permit obtained from the development department.

22. Street Cleaning: The Contractor shall keep streets affected by his construction free of dirt, sediment or mud. The Engineer may direct the Contractor to perform street cleaning periodically or on a regular interval if excessive amounts of dirt and mud are present along the street. This may include removal by sweeping, power cleaning, or manual methods. The cost of this work shall be included in the unit price bid for _____, unless otherwise specified.

23. Non–performance: In the event that it becomes necessary for the city to perform work of an immediate nature (such as the placement of barricades or replacement of signs or other warning or protective devices) required of the Contractor by this contract because of failure or refusal of the Contractor to perform such work, the Contractor shall reimburse the city at the rate of 2.5 times the actual cost of labor, materials, and equipment necessary to perform such work. If the Contractor refuses or fails within a reasonable time to perform or cause the performance of such work, the city shall be reimbursed by the Contractor in the amount provided herein by way of a deduction from the Contractor's net payment under the contract. Reasonable time for all streets involved on this contract is 1 hour from the time of notification by the city.

24. For Ohio Power/American Electric Power (AEP) Transmission: the Contractor shall contact AEP transmission's field representative, Dino Julian, at 740–503–2819 prior to the pre–construction meeting and a minimum of 48 hours prior to any construction activity in the vicinity of AEP's transmission lines.

    The Contractor shall use extreme caution while working in the vicinity of the staging and access areas on or near AEP's property and transmission lines. The Contractor shall also utilize the following construction practices:

A. Keep a low clearance zone in the vicinity of overhead lines where boom or lift mechanisms may not be used.
B. Do not install trees or shrubs within 10 feet on either side of overhead transmission lines.

25. Project Identification Sign: The Contractor shall furnish, install, and maintain four (4) project identification signs at the project site. Place one sign at the Phase 1a South Abutment access entrance near intersection of Yingling and Laird Roads, one sign at the Phase 2b access road near Oakwood Street, one sign at Tucker Dam access road entrance near Laird Road, and one sign at Ice Control Structure (ICS) location B access road near River Road.

Construction

1. Provide 30 in. High x 42 in. Wide signs.
2. Material shall be metal or ¾" exterior grade plywood with trim mitered on all edges.
3. Design signs and supports to withstand 75 mph wind.
4. Paint with exterior gloss enamel white base paint with black lettering, with Type 4 ASTM–approved reflective sheeting.
5. The signs must be professional quality, and in as large a font possible read:

   Ballville Dam Removal Project

   It is the Contractor's responsibility for names and titles to be correct at the time of erection.

Installation and Maintenance

1. The signs shall be installed at least one week before construction begins and removed within one week of completion.
2. The sign shall be placed within the right of way to face traffic as directed by the Engineer.
3. Maintain sign so it is clean, legible, and structurally sound.
4. Repair and repaint all damage to the sign, replace if stolen. Relocate sign as required by the progress of work.

   All costs for project identification signs shall be included in lump sum bid for item mobilization.

Stantec

Stantec Consulting Services Inc.
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Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
General Notes

Project No. 175630015
Scale NONE
Drawing No.
Sheet 2 of 20
Revision 0

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Sequence of Construction:

Phase 1
a. Construct access to south abutment (September, 2014)
b. Notch in Spillway to Elevation 615': resulting in WSE ≈ 618' (November, 2014)

Phase 2
a. Sediment Stabilization (March, 2015)
b. Construct Ramp (May–June, 2015)
c. Construct Ice Control Structure (July–October, 2015)
d. Remove Dam (September–November, 2015)
e. Channel Restoration (November–December, 2015)

Phase 3
a. Bank stabilization/planting/in stream work (Summer, 2016)
b. Remove any remaining Dam designated for removal and modify Seawall (August–November, 2016)

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Legend

- Major Contour
- Minor Contour
- Edge of Water
- Fence
- Overhead Electric Line
- Property Line
- Sign
- Guy Wire
- Power/Light Poles
- River Mile (RM 18.6)

Notes

1. Multiple topographic surveys are represented. Stantec performed bathymetric survey of impoundment in June 2011 and bathymetric survey downstream of the dam January and April 2012. Topographic survey to the North and South of the impoundment was performed by The U.S. Army Corps of Engineers, 2010.
2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).
3. Wetlands delineated by USACE.

Revision	By	Appd.	YY.MM.DD

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File Name: 30015c-003-ovr1.dwg	CW	SDP	JGB	14.07.14
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Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Project Overview And Sequence Of Construction

Project No. 175630015

Scale 1"=400' (0, 200', 400', 800')

Drawing No.

Sheet 3 of 20

Revision 0

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Legend

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Notes

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2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).
3. Wetlands delineated by USACE.

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Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Phase 1a - South Abutment Access

Project No. 175630015

Scale 1"=200' (0, 100', 200', 400')

Drawing No.

Sheet 4 of 20

Revision 0

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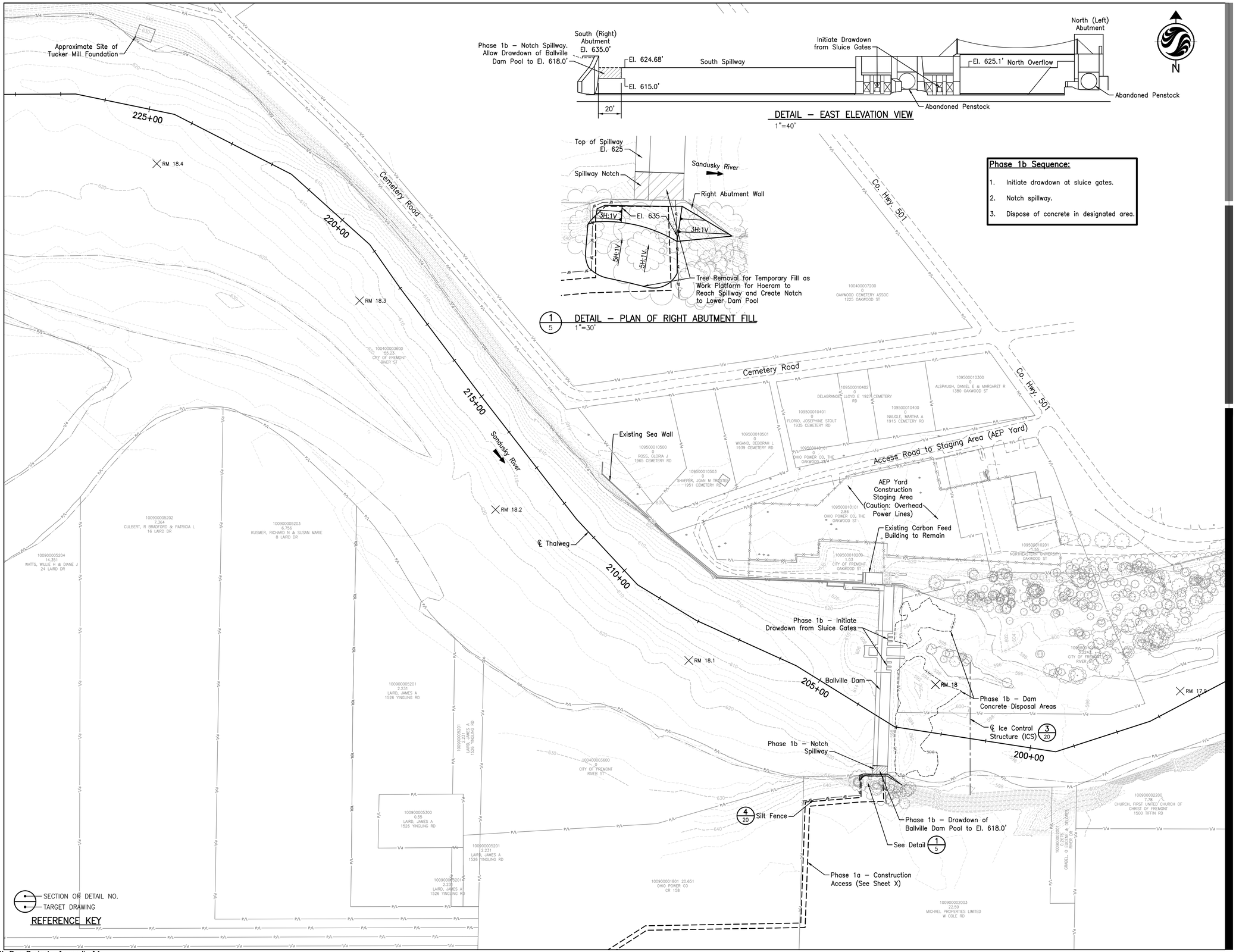

DETAIL – EAST ELEVATION VIEW
1"=40'

1/5 DETAIL – PLAN OF RIGHT ABUTMENT FILL
1"=30'

Phase 1b Sequence:

1. Initiate drawdown at sluice gates.
2. Notch spillway.
3. Dispose of concrete in designated area.

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Legend

- Major Contour
- Minor Contour
- Edge of Water
- Fence
- Overhead Electric Line
- Property Line
- Sign
- Guy Wire
- Power/Light Poles
- RM 18.6 River Mile

Notes

1. Multiple topographic surveys are represented. Stantec performed bathymetric survey of impoundment in June 2011 and bathymetric survey downstream of the dam January and April 2012. Topographic survey to the North and South of the impoundment was performed by The U.S. Army Corps of Engineers, 2010.
2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).

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Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Phase 1b - Notch Spillway And Impoundment Drawdown

Project No. 175630015

Scale 1"=100' (0, 50', 100', 200')

Drawing No.

Sheet 5 of 20

Revision 0

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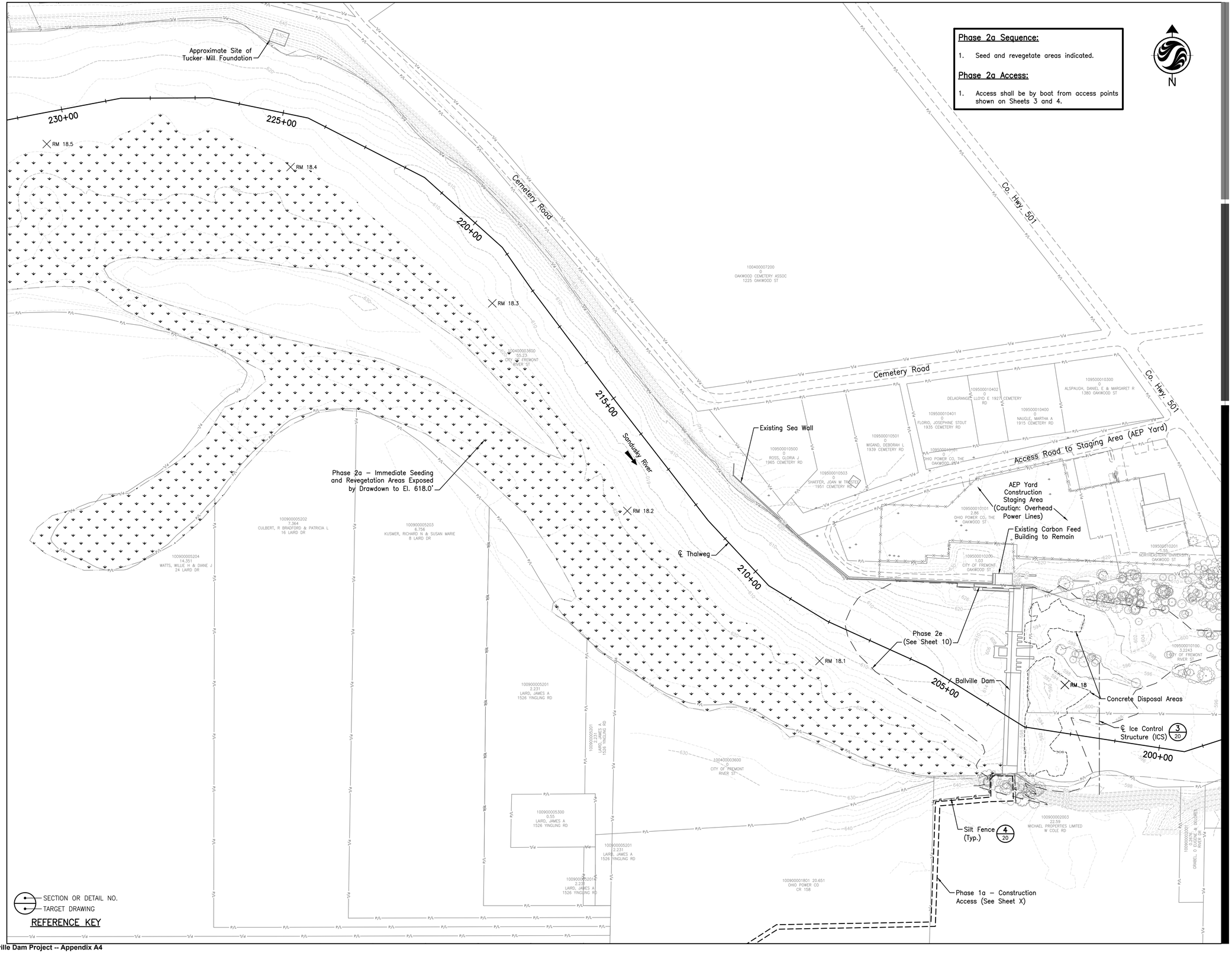

Phase 2a Sequence:

1. Seed and revegetate areas indicated.

Phase 2a Access:

1. Access shall be by boat from access points shown on Sheets 3 and 4.

N

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Legend

- Major Contour
- Minor Contour
- Edge of Water
- Fence
- Overhead Electric Line
- Property Line
- Sign
- Guy Wire
- Power/Light Poles
- RM 18.6 River Mile

Notes

1. Multiple topographic surveys are represented. Stantec performed bathymetric survey of impoundment in June 2011 and bathymetric survey downstream of the dam January and April 2012. Topographic survey to the North and South of the impoundment was performed by The U.S. Army Corps of Engineers, 2010.

2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).

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Issued	By	Appd.	YY.MM.DD

File Name: 30015c-006-ph2a.dwg	CW	SDP	JGB	14.07.14
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project

City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title

Phase 2a - Sediment Stabilization

Project No.	Scale
175630015	1"=100' (0, 50', 100', 200')

Drawing No.	Sheet	Revision
	6 of 20	0

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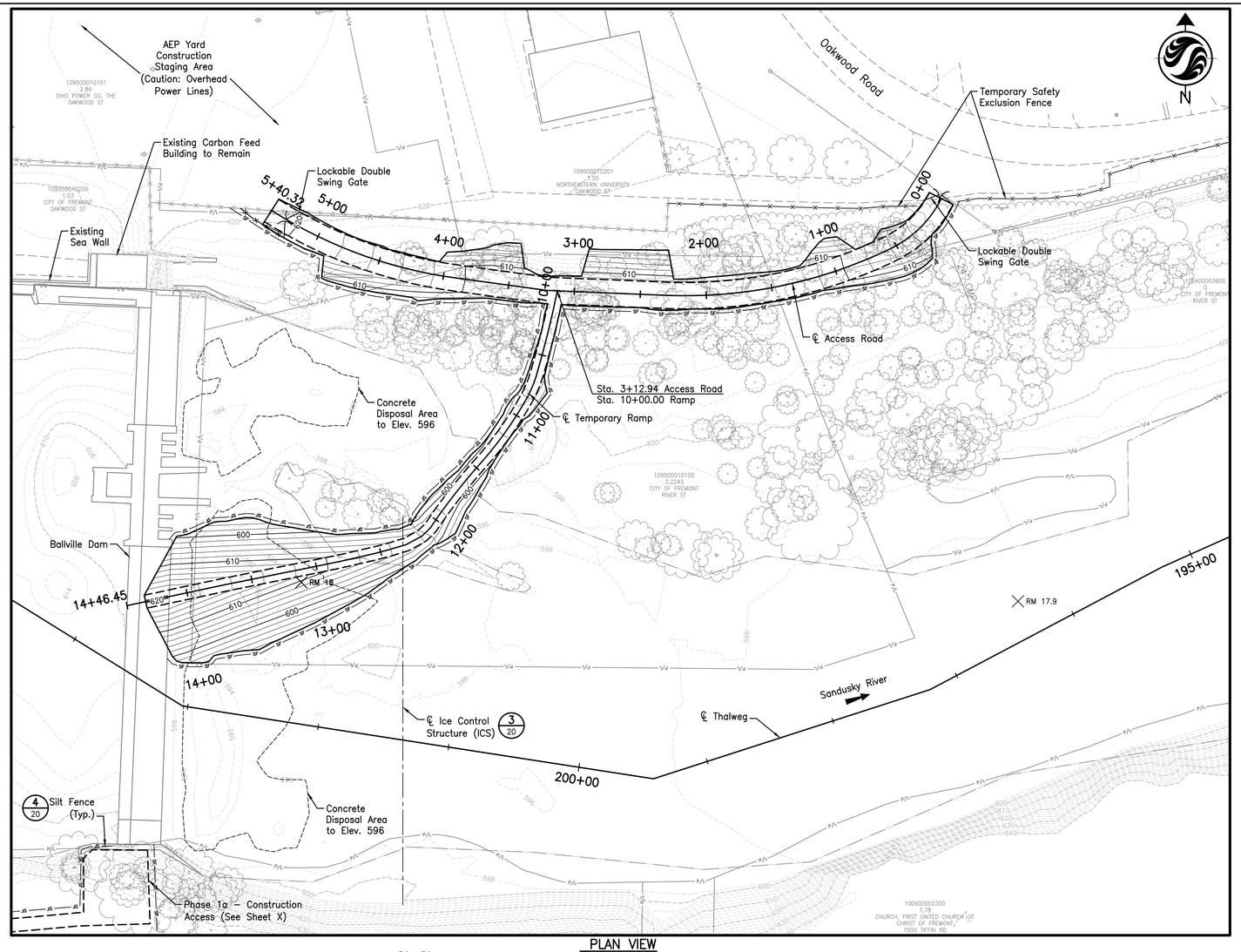
Phase 2b Sequence:

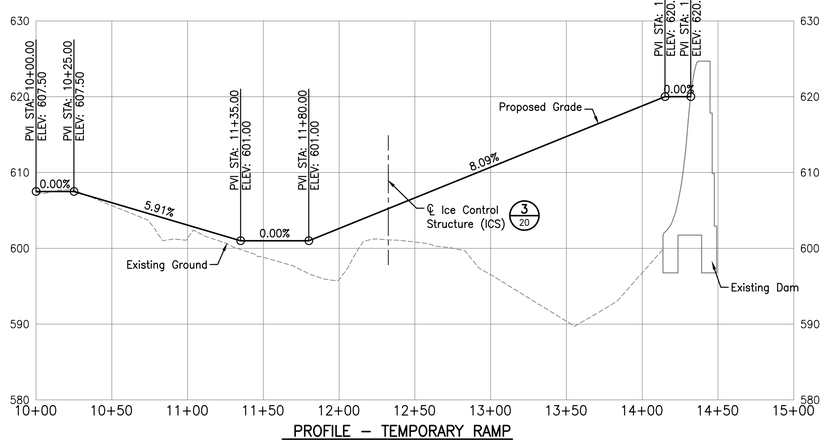
1. Construct access roads and causeways.



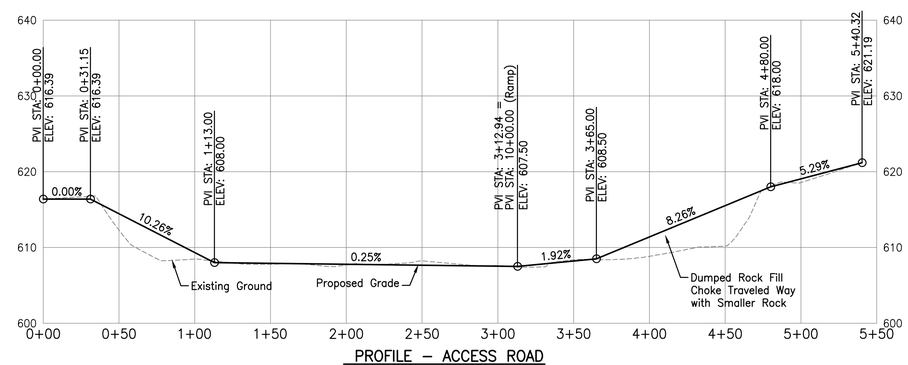
PLAN VIEW
1"=50'

SECTION OR DETAIL NO.
TARGET DRAWING

REFERENCE KEY



PROFILE – TEMPORARY RAMP
1"=50'H, 1"=10'V



PROFILE – ACCESS ROAD
1"=50'H, 1"=10'V

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Legend

- Major Contour
- Minor Contour
- Edge of Water
- Fence
- Overhead Electric Line
- Property Line
- Sign
- Guy Wire
- Power/Light Poles
- River Mile (RM 18.6)

Notes

1. Multiple topographic surveys are represented. Stantec performed bathymetric survey of impoundment in June 2011 and bathymetric survey downstream of the dam January and April 2012. Topographic survey to the North and South of the impoundment was performed by The U.S. Army Corps of Engineers, 2010.
2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).
3. Contractor is not expected to hoe-ram or blast out bedrock. If conditions on site show bedrock above proposed contours, notify Engineer.

Revision	By	Appd.	YY.MM.DD

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File Name: 30015c-007-ph2b.dwg	CW	SDP	JGB	14.07.14
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Phase 2b - Construct Access Road and Temporary Ramp

Project No. 175630015

Scale 1"=50' (0, 25', 50', 100')

Drawing No.

Sheet 7 of 20

Revision 0

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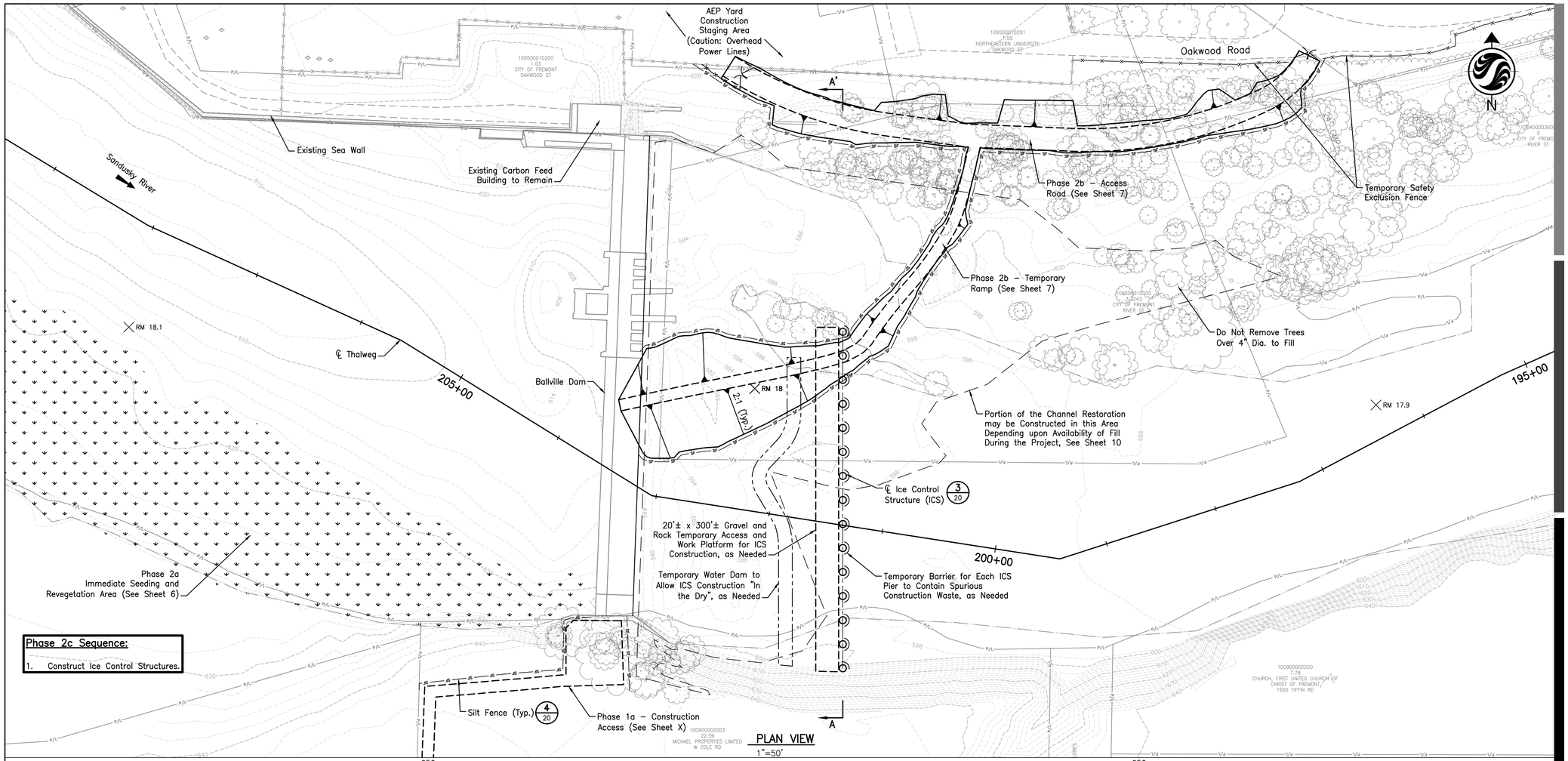
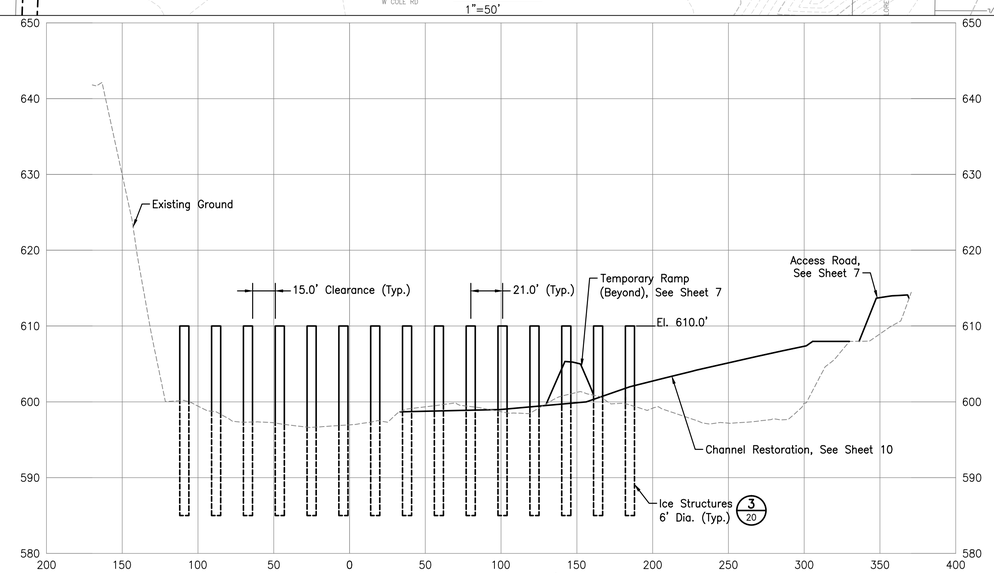


PLAN VIEW
1"=50'



SECTION – A–A'
1"=50'H, 1"=10'V

SECTION OR DETAIL NO.
TARGET DRAWING

REFERENCE KEY

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Legend

- Major Contour
- Minor Contour
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- Fence
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- Property Line
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- Guy Wire
- Power/Light Poles
- River Mile (RM 18.6)

Notes

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2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name: 30015c-008-ph2c.dwg	CW	SDP	JGB	14.07.14
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Phase 2c - Ice Control Structure

Project No. 175630015

Scale 1"=50'H, 1"=10'V (0, 25', 50', 100'; 0, 5', 10', 20')

Drawing No.

Sheet 8 of 20

Revision 0

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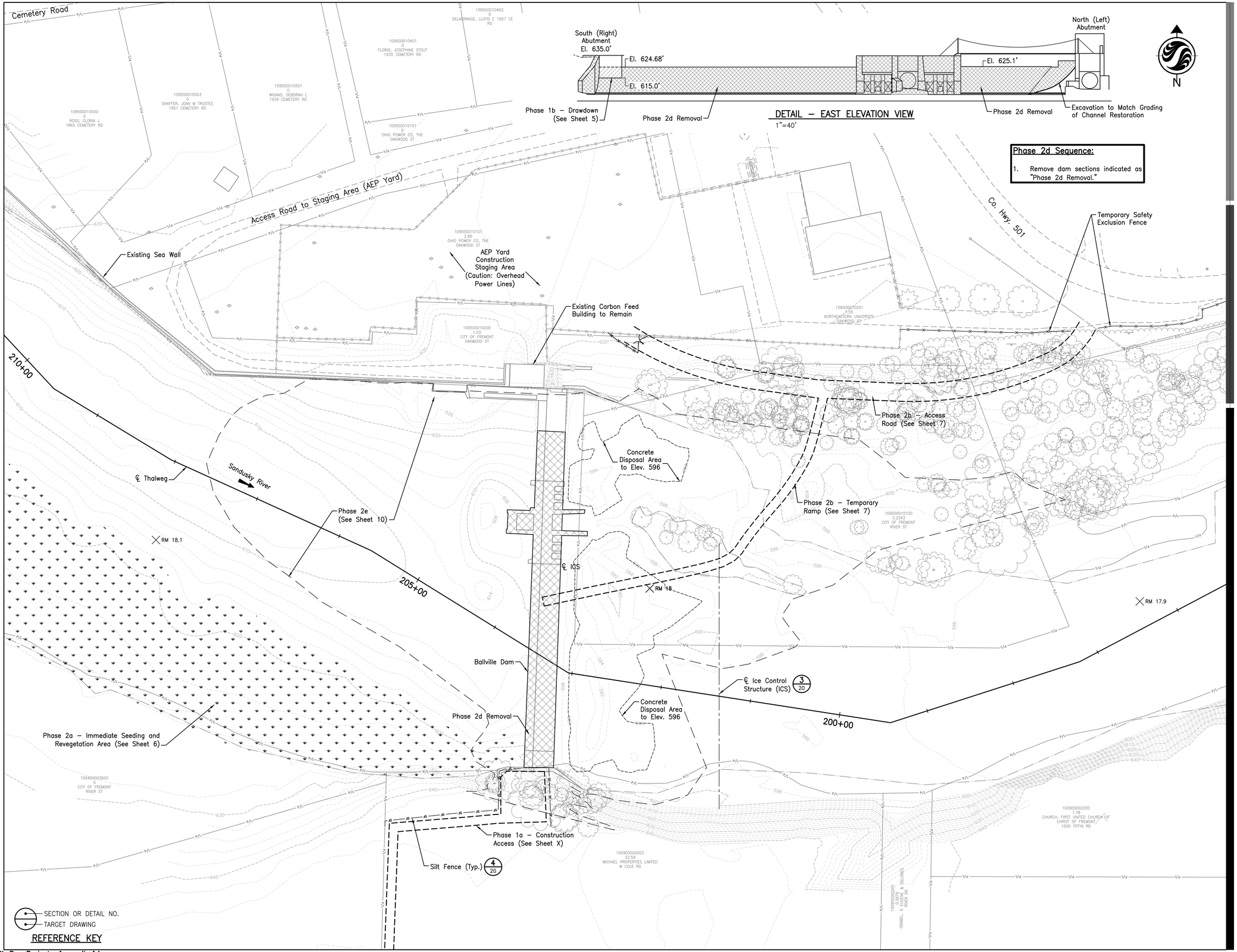

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Legend

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- Fence
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- Property Line
- Sign
- Guy Wire
- Power/Light Poles
- River Mile (RM 18.6)

Notes

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2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).

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Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Phase 2d - Dam Removal

Project No. 175630015

Scale 1"=50' (0, 25', 50', 100')

Drawing No.

Sheet 9 of 20

Revision 0

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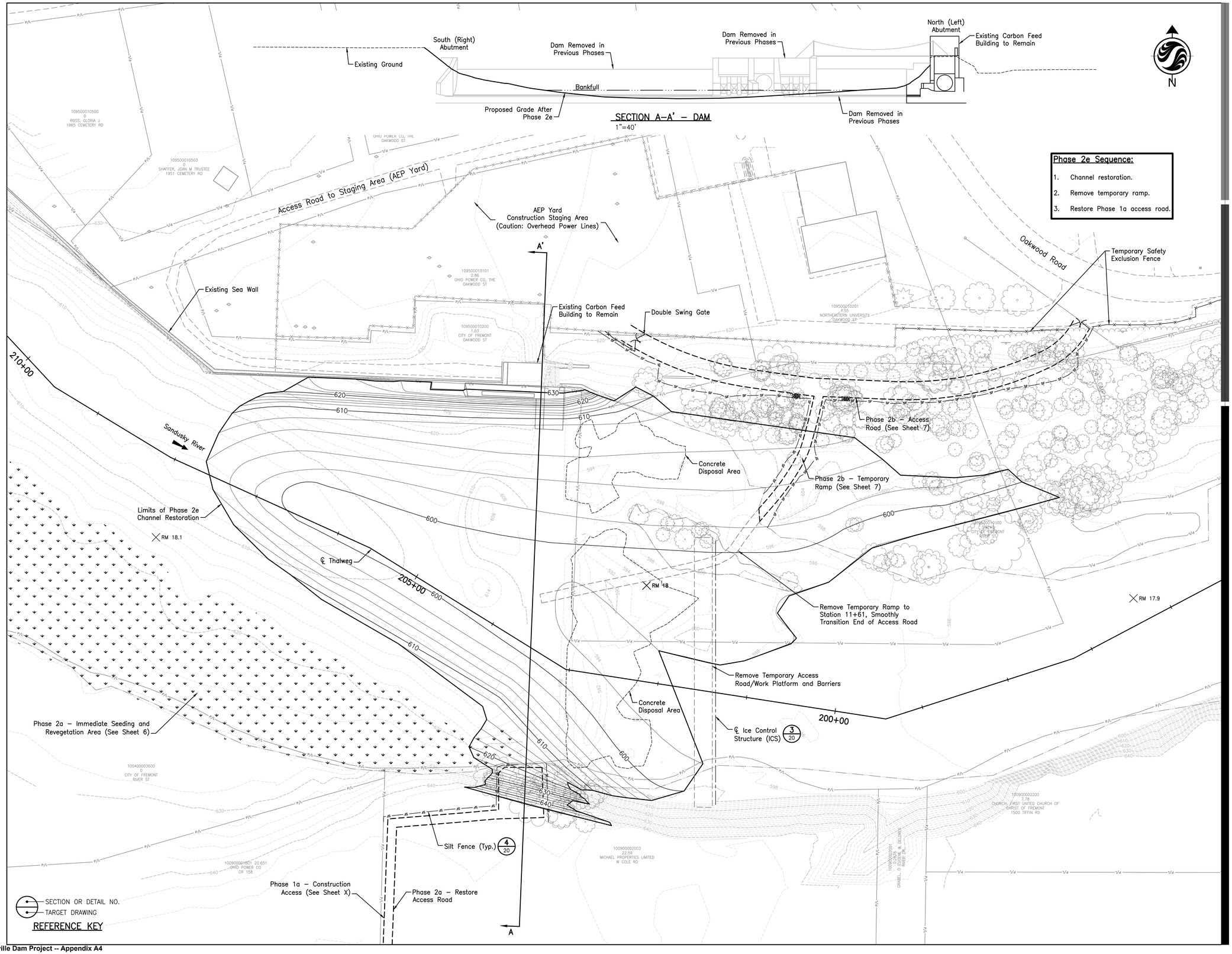

Ballville Dam Project -- Appendix A4

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Legend

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Notes

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2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).
3. Contractor is not expected to hoe-ram or blast out bedrock. If conditions on site show bedrock above proposed contours, notify Engineer.

Revision	By	Appd.	YY.MM.DD

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File Name: 30015c-010-ph2e.dwg	CW	SDP	JGB	14.07.14
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Phase 2e - Channel Restoration

Project No. 175630015
Scale 1"=50' (0, 25', 50', 100')
Drawing No.
Sheet 10 of 20
Revision 0

SaveDate: 2014/07/14 4:06 PM Login: Withers, Cheyenne
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Phase 3a Sequence:

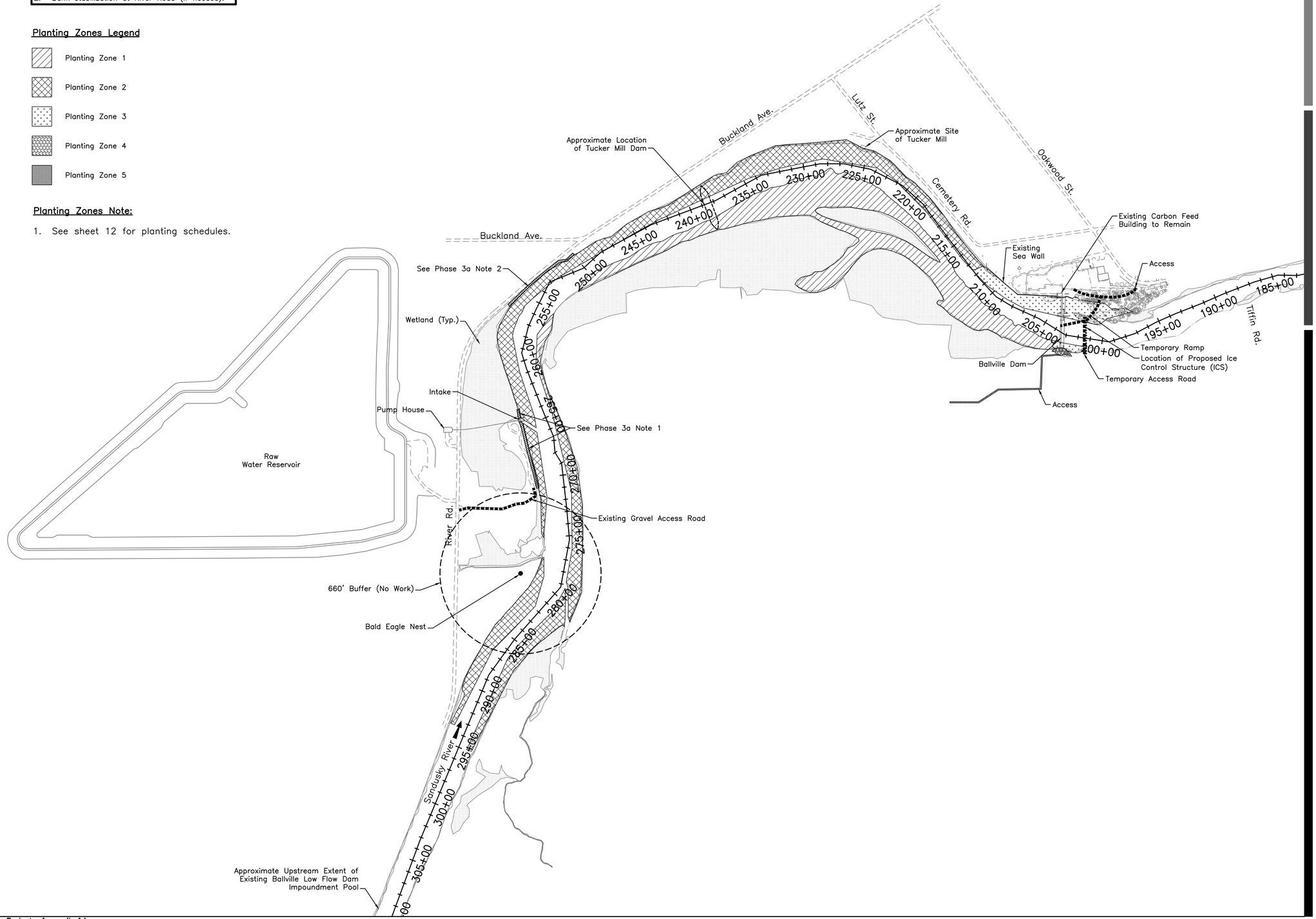
1. Bank stabilization at Intake (if needed).
2. Bank stabilization at River Road (if needed).

Planting Zones Legend

- Planting Zone 1
- Planting Zone 2
- Planting Zone 3
- Planting Zone 4
- Planting Zone 5

Planting Zones Note:

1. See sheet 12 for planting schedules.



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- River Mile (RM 18.6)

Notes

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2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).
3. Wetlands delineated by USACE.

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name: 30015c-011-ph3a.dwg	CW	SDP	JGB	14.07.14
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Client/Project

City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title

Phase 3a - Bank Stabilization, Revegetation and Instream Restoration Work

Project No. 175630015

Scale 1"=400' (0, 200', 400', 800')

Drawing No.

Sheet 11 of 20

Revision 0

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Ballville Dam River Restoration Seeding Schedule

Planting Zone 1-5 (Temporary Cover Crop)

Planting Area: 51.3 acres

Planting Zone	Expected Planting Time	Common Name	Scientific Name	*Wetland Indicator	Pounds (PLS) per Acre	Pounds in Planting Zone
1	Spring	Common Oat	*Avena sativa*	UPL	20	431
2	Spring	Common Oat	*Avena sativa*	UPL	20	507
3	Fall	Winter Rye	*Secale cereale*	NI	40	160
4	Fall	Winter Rye	*Secale cereale*	NI	40	6
5	Fall	Winter Rye	*Secale cereale*	NI	40	11
*Northcentral and Northeast Region			Pure Live Seed (PLS)	**Total**	**160**	**1,115**

Planting Zone 1 (flat to moderate gradient within former reservoir)

Planting Area: 21.573

Custom Blend Herbaceous Seed Mix

Common Name	Scientific Name	Wetland Indicator (NCNE)	Composition (%)	*Pounds (PLS) per Acre	Pounds in Planting Zone
Virginia Wild Rye	*Elymus virginicus*	FACW	34.36	6.18	133.42
Nodding Wild Rye	*Elymus canadensis*	FACU	30.05	5.41	116.69
Partridge Pea	*Chamaecrista fasciculata*	FACU	12.50	2.25	48.54
Swamp Milkweed	*Asclepias incarnata*	OBL	6.25	1.13	24.27
Rice Cut Grass	*Leersia oryzoides*	FACW	3.12	0.56	12.12
Shallow/Lurid Sedge	*Carex lurida*	OBL	3.12	0.56	12.12
Ohio Spiderwort	*Tradescantia ohiensis*	FACU	3.12	0.56	12.12
Tall Ironweed	*Vernonia altissima*	FACW	1.87	0.34	7.26
Gray' sedge	*Carex grayi*	FACW	1.25	0.23	4.85
Fowl Manna Grass	*Glyceria striata*	OBL	0.94	0.17	3.65
Common Tussock Sedge	*Carex stricta*	OBL	0.62	0.11	2.41
New England Aster	*Symphyotrichum novae-angliae*	FACW	0.62	0.11	2.41
Wild Bergamot	*Monarda fistulosa*	FACU	0.62	0.11	2.41
Spotted Joe Pye	*Eupatorium maculatum*	OBL	0.47	0.08	1.83
Blue Vervain	*Verbena hastata*	FACW	0.44	0.08	1.71
Dark Green Bulrush	*Scirpus atrovirens*	OBL	0.31	0.06	1.20
Common Rush	*Juncus effusus*	OBL	0.19	0.03	0.74
Great Lobelia	*Lobelia siphilitica*	FACW	0.06	0.01	0.23
Monkey Flower	*Mimulus ringens*	OBL	0.06	0.01	0.23
*18 PLS Lb/acre drilled or if used 25 PLS Lb/acre broadcast		**Total**	**100**	**18**	**388**

Live Staking Planting Schedule; Along Bankfull; ~5,400 Linear Feet

Common Name	Scientific Name	Wetland Indicator (NCNE)	Spacing	Quantity
Black Willow	*Salix nigra*	OBL	3x3	900
Silky Dogwood	*Cornus amomum*	FACW	3x3	900
Elderberry	*Sambucus canadensis*	FACW	3x3	900
Arrowwood	*Viburnum dentatum*	FAC	3x3	900
			Total	**3,600**

Bare-Root Seedlings

Common Name	Scientific Name	Wetland Indicator (NCNE)	Spacing	Quantity
American Elm	*Ulmus americana*	FACW	10 x 10	1,566
Box Elder	*Acer negundo*	FAC	10 x 10	1,566
Silver Maple	*Acer saccharinum*	FACW	10 x 10	1,566
Pin Oak	*Quercus palustris*	FACW	10 x 10	1,566
Cottonwood	*Populus deltoides*	FAC	10 x 10	1,566
River Birch	*Betula nigra*	FACW	10 x 10	1,566
			Total	**9,396**

Planting Zone 2 (moderate to severe gradient within former reservoir)

Planting Area: 25.345

Custom Blend Herbaceous Seed Mix

Common Name	Scientific Name	Wetland Indicator (NCNE)	Composition (%)	Pounds (PLS) per Acre	Pounds in Planting Zone
Virginia Wild Rye	*Elymus virginicus*	FACW	25.00	5	126.72
Nodding Wild Rye	*Elymus canadensis*	FACU	21.25	4.25	107.71
Indian Grass	*Sorghastrum nutans*	FACU	12.50	2.5	63.36
Partridge Pea	*Chamaecrista fasciculata*	FACU	12.50	2.5	63.36
Little Bluestem	*Schizachyrium scoparium*	FACU	10.63	2.126	53.88
Prairie Cordgrass	*Spartina pectinata*	FACW	9.38	1.876	47.55
Switch Grass	*Panicum virgatum*	FAC	3.12	0.624	15.81
Showy Tick Trefoil	*Desmodium canadense*	FAC	2.50	0.5	12.67
Ohio Spiderwort	*Tradescantia ohiensis*	FACU	1.44	0.288	7.30
Black-eyed Susan	*Rudbeckia hirta*	FACU	0.63	0.126	3.19
Wild Bergamot	*Monarda fistulosa*	FACU	0.31	0.062	1.57
New England Aster	*Symphyotrichum novae-angliae*	FACW	0.31	0.062	1.57
Smooth Aster	*Symphyotrichum laeve*	FACU	0.31	0.062	1.57
Blue Vervain	*Verbena hastata*	FACW	0.06	0.012	0.30
Tall Ironweed	*Vernonia altissima*	FACW	0.06	0.012	0.30
*20 PLS Lb/acre drilled or if used 30 PLS Lb/acre broadcast		**Total**	**100.00**	**20**	**506.89**

Live Staking Planting Schedule: Along bankfull; ~10,900 linear feet

Common Name	Scientific Name	Wetland Indicator (NCNE)	Spacing	Quantity
Black Willow	*Salix nigra*	OBL	3x3	1817
Silky Dogwood	*Cornus amomum*	FACW	3x3	1817
Elderberry	*Sambucus canadensis*	FACW	3x3	1817
Arrowwood	*Viburnum dentatum*	FAC	3x3	1817
			Total	**7,268**

Planting Zone 3 (channel restoration area including seawall)

Planting Area: 3.999 acres

Retention Basin Slope Native Seed Mix produced by the Ohio Prairie Nursery https://ohioprairienursery.com

Common Name	Scientific Name	Wetland Indicator (NCNE)
Grasses requested @ 60% composition		
Big Bluestem	*Andropogon gerardii*	FACU
Switch Grass	*Panicum virgatum*	FAC
Indian Grass	*Sorghastrum nutans*	FACU
Forbs requested @ 40% composition		
Swamp Milkweed	*Asclepias incarnata*	OBL
Partridge Pea	*Chamaecrista fasciculata*	FACU
Lanceleaf Coreopsis	*Coreopsis lanceolata*	FACU
Purple Coneflower	*Echinacea purpurea*	NI
Ox Eye Sunflower	*Heliopsis helianthoides*	FACU
Dense Blazingstar	*Liatris spicata*	FAC
Wild Bergamot	*Monarda fistulosa*	FACU
Foxglove Beardtongue	*Penstemon digitalis*	FACU
Grey-Headed Coneflower	*Ratibida pinnata*	NI
Black-eyed Susan	*Rudbeckia hirta*	FACU
Brown-eyed Susan	*Rudbeckia triloba*	FACU

This specific application seed mix is prescribed to be planted for 1 Acre Drilled @ 10.0 PLS Lbs or 1 Acre Broadcast 15.0 PLS Lbs

Containerized Tree Plantings

Common Name	Scientific Name	Wetland Indicator (NCNE)	Spacing	Quantity
American Elm	*Ulmus americana*	FAC	30x30	25
Cottonwood	*Populus deltoides*	FAC	30x30	25
Red Maple	*Acer rubrum*	FAC	30x30	24
Black Walnut	*Juglans nigra*	FACU	30x30	24
Red Bud	*Cercis canadensis*	FACU	30x30	24
Pin Oak	*Quercus palustris*	FACW	30x30	24
River Birch	*Betula nigra*	FACW	30x30	24
Swamp White Oak	*Quercus bicolor*	FACW	30x30	24
			Total	**194**

Zone 4 (south abutment staging area)

Planting Area: 0.142 acres

Containerized Tree Plantings

Common Name	Scientific Name	Wetland Indicator (NCNE)	Spacing	Quantity
Black Walnut	*Juglans nigra*	FACU	20x20	3
Black Cherry	*Prunus serotina*	FACU	20x20	3
Sugar Maple	*Acer saccharum*	FACU	20x20	3
Common Hackberry	*Celtis occidentalis*	FAC	20x20	3
Red Bud	*Cercis canadensis*	FACU	20x20	3
			Total	**15**

Planting Zone 5 (south access road

Planting Zone: 0.27

Custom Blend Upland Herbaceous Seed Mix

Common Name	Scientific Name	Wetland Indicator (NCNE)	Composition (%)	Pounds per Acre	Pounds in Planting Zone
Grasses					
Little Bluestem	*Schizachyrium scoparium*	FACU	10	3	0.81
Indian Grass	*Sorghastrum nutans*	FACU	10	3	0.81
Nodding Wild Rye	*Elymus canadensis*	FACU	25	7.5	2.03
Switch Grass	*Panicum virgatum*	FAC	10	3	0.81
Big Bluestem	*Andropogon gerardii*	FACU	5	1.5	0.41
		Total	**60**	**18**	**4.86**
Forbs					
Black-eyed Susan	*Rudbeckia hirta*	FACU	7	2.1	0.57
Partridge Pea	*Chamaecrista fasciculata*	FACU	7	2.1	0.57
Common Milkweed	*Asclepias syriaca*	UPL	8	2.4	0.65
Showy Tick Trefoil	*Desmodium canadense*	FAC	1	0.3	0.08
Plains Coreopsis	*Coreopsis tinctoria*	FACU	5	1.5	0.41
Wild Bergamot	*Monarda fistulosa*	FACU	6	1.8	0.49
Beardtongue	*Penstemon digitalis*	FACU	1	0.3	0.08
Evening Primrose	*Oenothera biennis*	FACU	5	1.5	0.41
		Total	**40**	**12**	**3.24**

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File Name: 30015c-012-pltsch.dwg	CW	SDP	JGB	14.07.14
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Phase 3a - Planting Schedules

Project No. 175630015

Scale NONE

Drawing No.

Sheet 12 of 20

Revision 0

SaveDate: 2014/01/23 12:17 PM Login: Withers, Cheyenne
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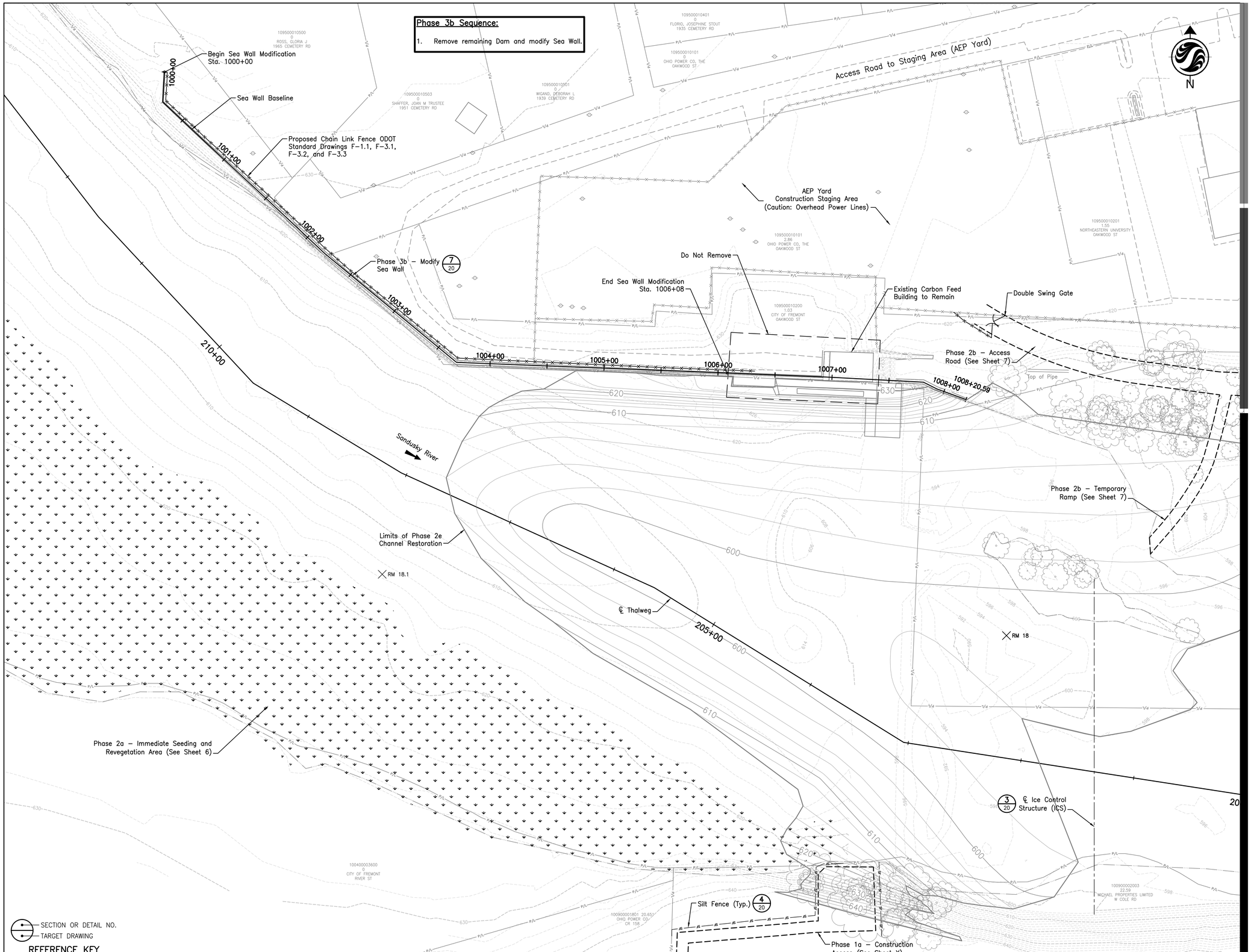

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Legend

- Major Contour
- Minor Contour
- Edge of Water
- Fence
- Overhead Electric Line
- Property Line
- Sign
- Guy Wire
- Power/Light Poles
- River Mile (RM 18.6)

Notes

1. Multiple topographic surveys are represented. Stantec performed bathymetric survey of impoundment in June 2011 and bathymetric survey downstream of the dam January and April 2012. Topographic survey to the North and South of the impoundment was performed by The U.S. Army Corps of Engineers, 2010.
2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name: 30015c-013-ph3b.dwg	CW	SDP	JGB	14.07.14
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Phase 3b - Modify Sea Wall

Project No. 175630015

Scale 1"=40' (0, 20', 40', 80')

Drawing No.

Sheet 13 of 20

Revision 0

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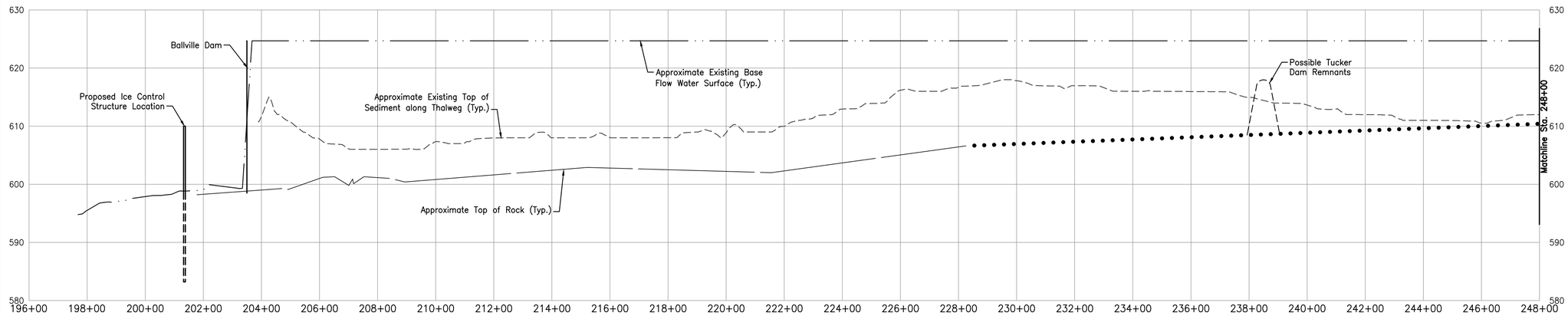

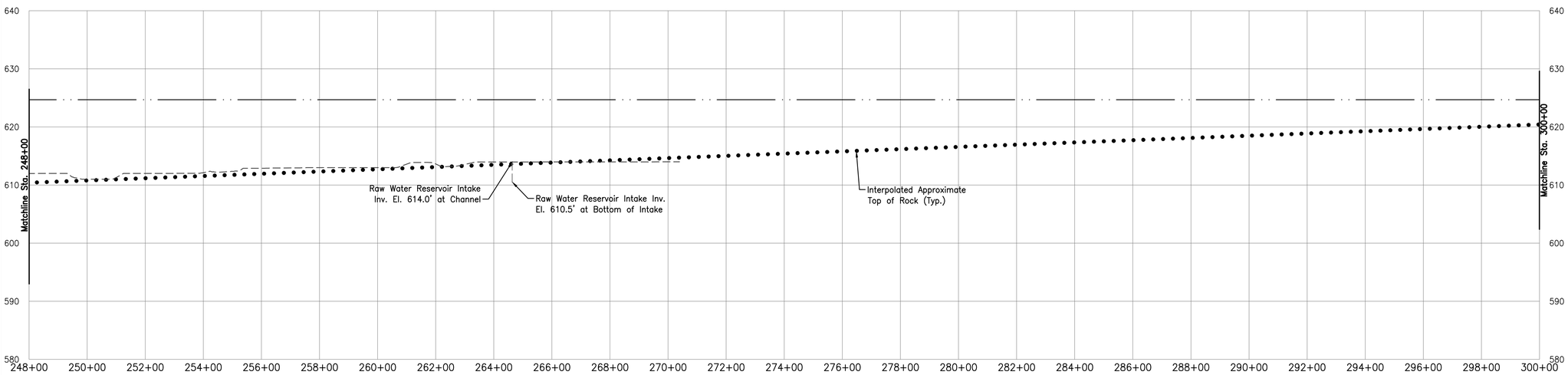

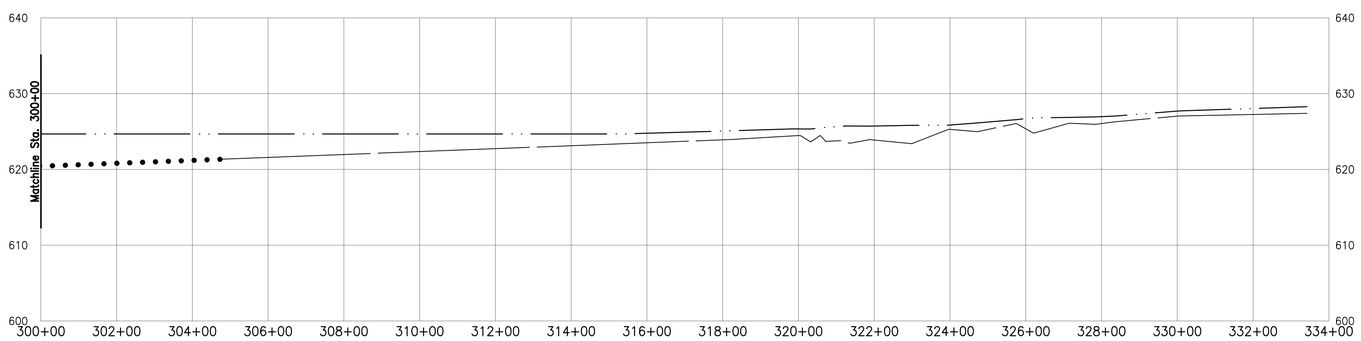

Notes:

1. Top of Rock elevations are taken from field survey (Stantec 2011) and geotechnical explorations (AECOM 2010) and are approximate. Actual rock elevations vary in the riverbed. The elevations shown indicate the lowest elevations noted from existing and collected data.
2. Top of Sediment elevations taken from bathymetric survey along thalweg (Stantec 2011).
3. Interpolated Top of Rock elevations developed as straight line between known top of rock elevations.
4. Tucker Dam location and elevation is based upon historical research. Limited field reconnaissance could not verify the location and elevation of the actual structure.

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Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Profile Along Thalweg

Project No. 175630015

Scale 1"=200'H 1"=10'V (0 100' 200' 400'; 0 5' 10' 20')

Drawing No.

Sheet 14 of 20

Revision 0

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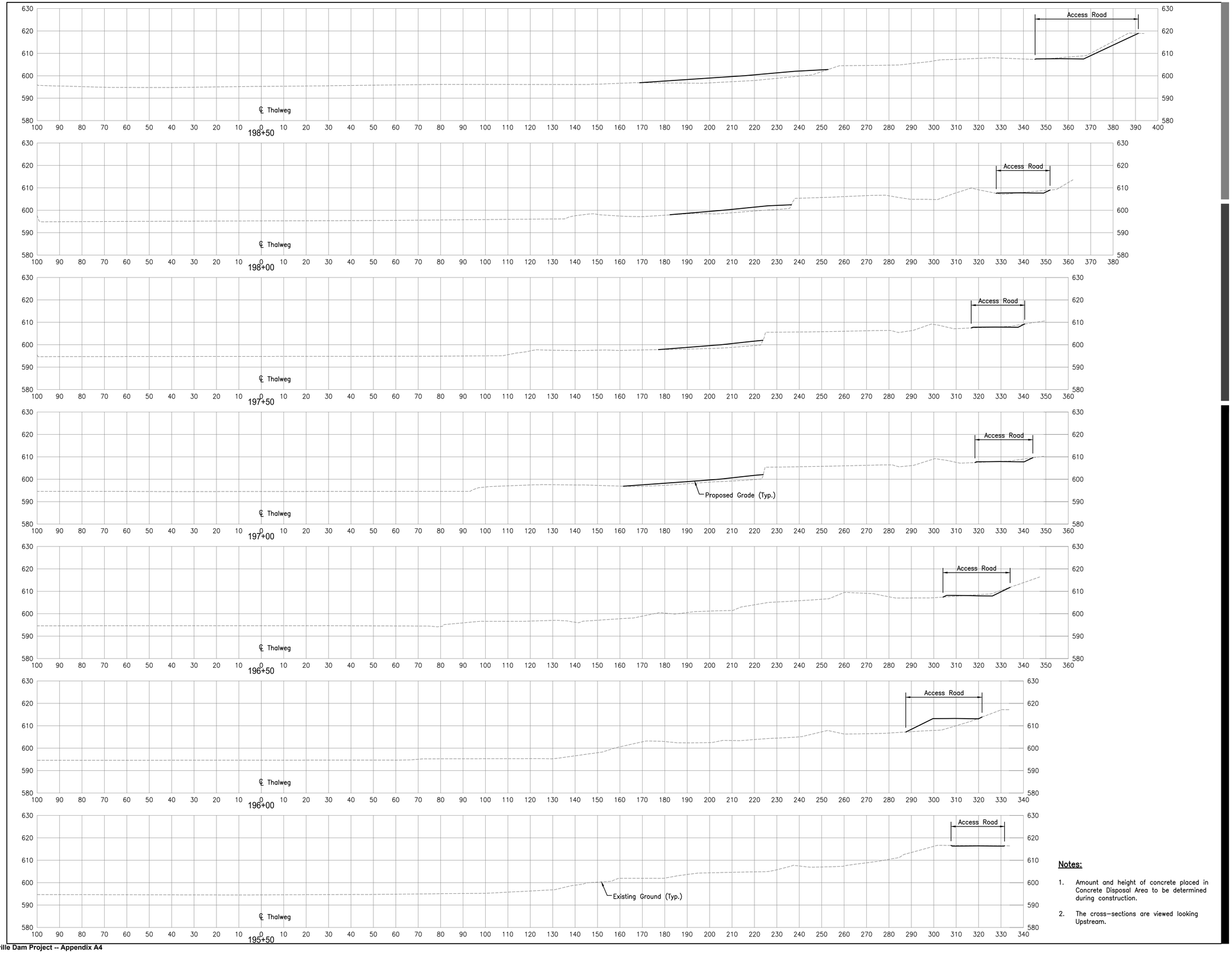

Notes:

1. Amount and height of concrete placed in Concrete Disposal Area to be determined during construction.
2. The cross-sections are viewed looking Upstream.

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File Name: 30015c-015-sec1.dwg	CW	SDP	JGB	14.07.14
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Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Thalweg Cross Sections

Project No. 175630015

Scale 1"=20' (0, 10', 20', 40')

Drawing No.

Sheet 15 of 20

Revision 0

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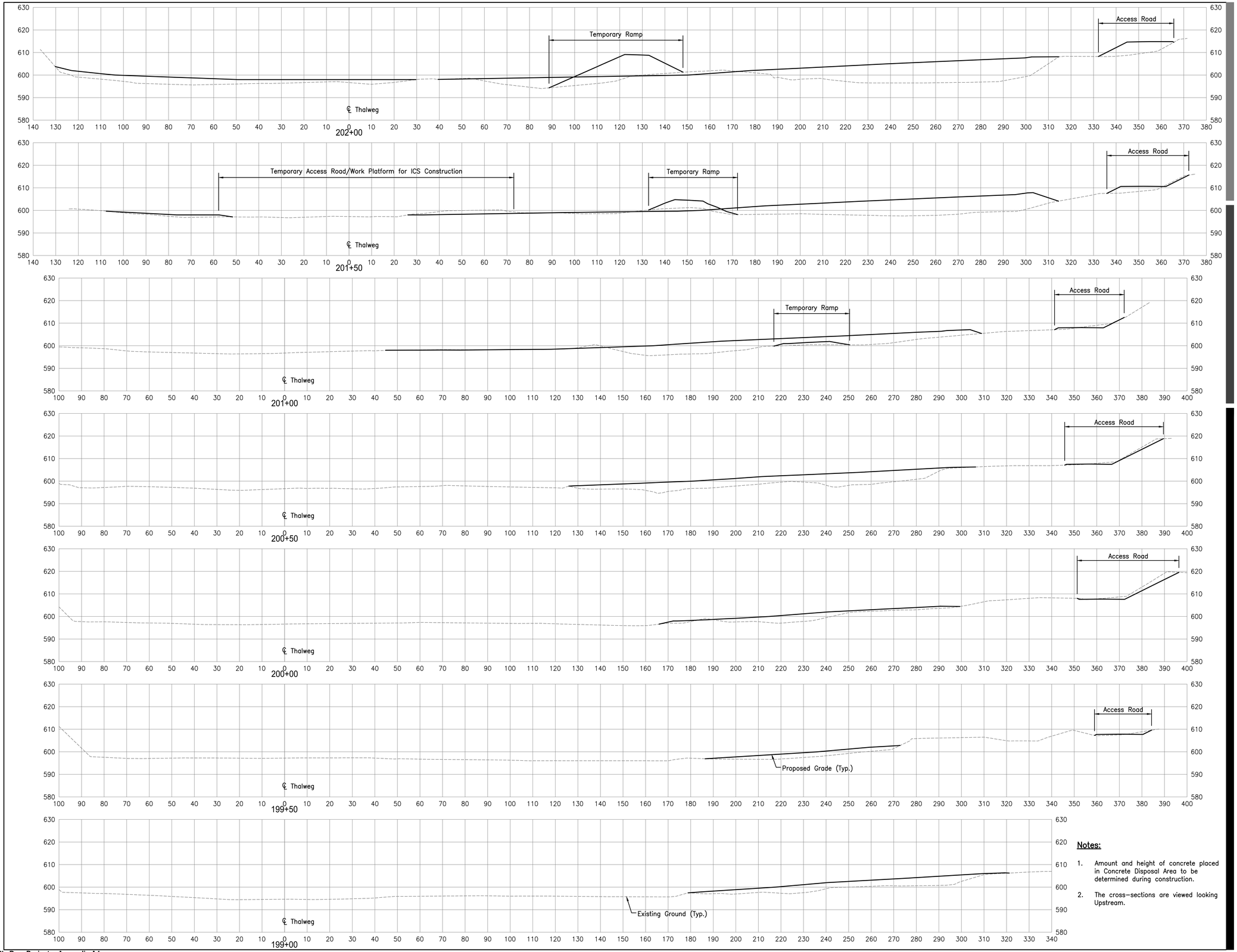

Notes:

1. Amount and height of concrete placed in Concrete Disposal Area to be determined during construction.
2. The cross-sections are viewed looking Upstream.

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Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Thalweg Cross Sections

Project No. 175630015

Scale 1"=20' (0, 10', 20', 40')

Drawing No.

Sheet 16 of 20

Revision 0

SaveDate: 2014/07/14 4:05 PM Login: Withers, Cheyenne
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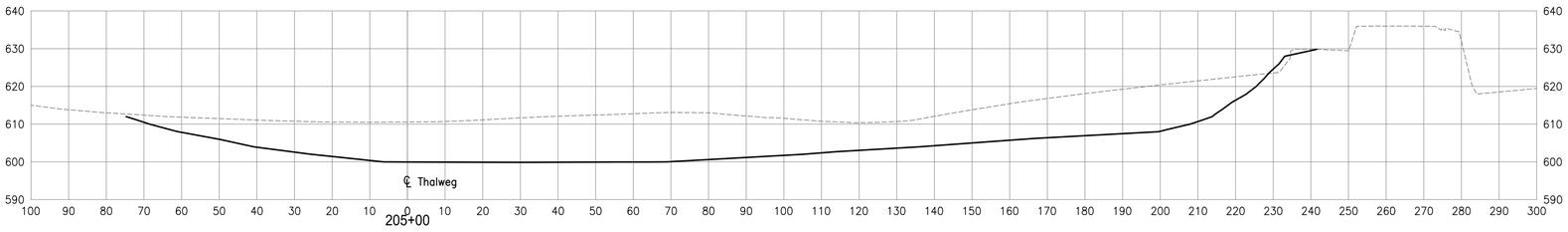
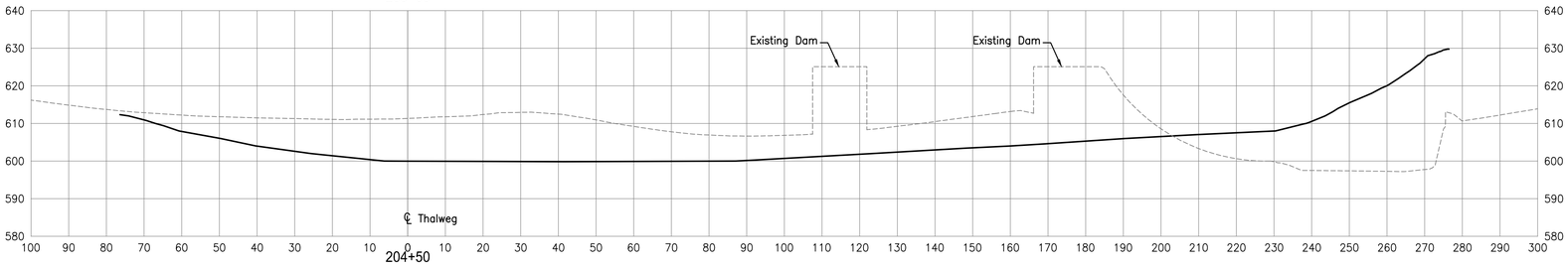
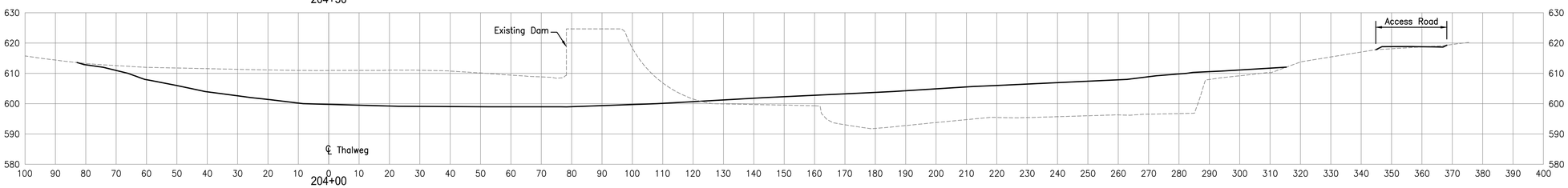
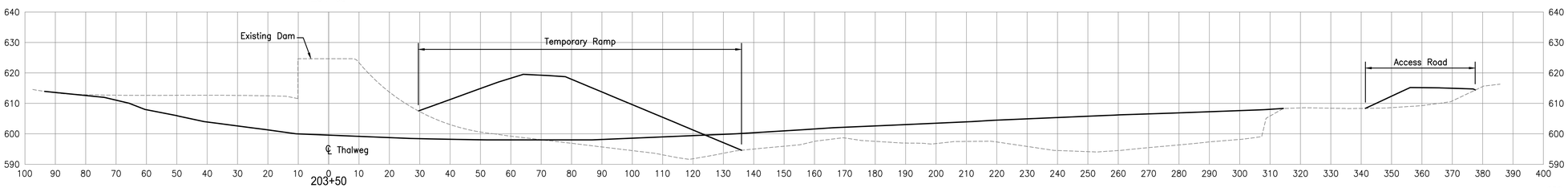
Notes:

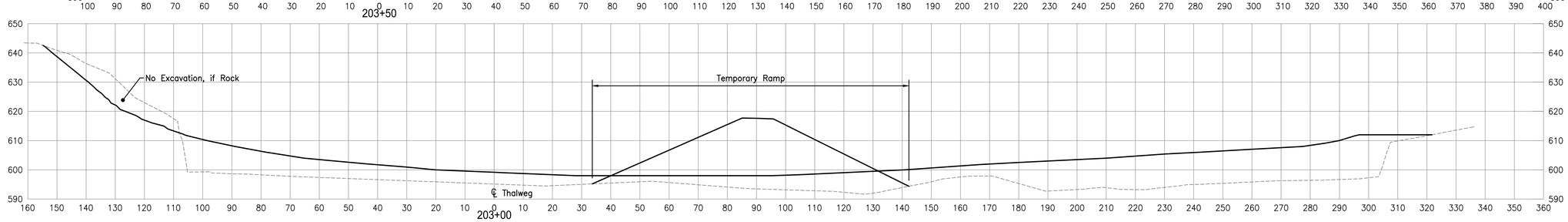
1. Amount and height of concrete placed in Concrete Disposal Area to be determined during construction.
2. The cross-sections are viewed looking Upstream.

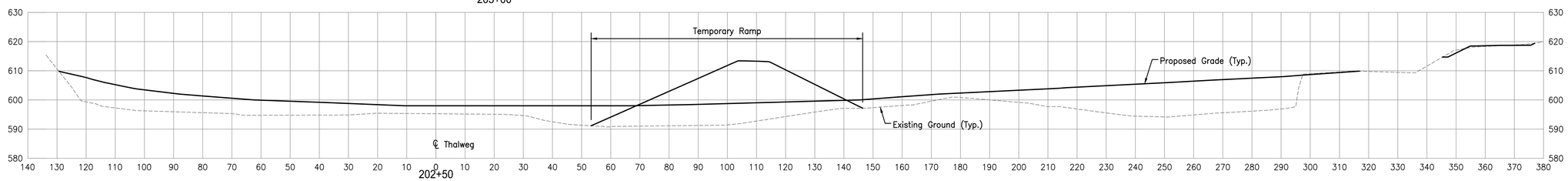












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Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Thalweg Cross Sections

Project No. 175630015

Scale 1"=20' (0, 10', 20', 40')

Drawing No.

Sheet 17 of 20

Revision 0

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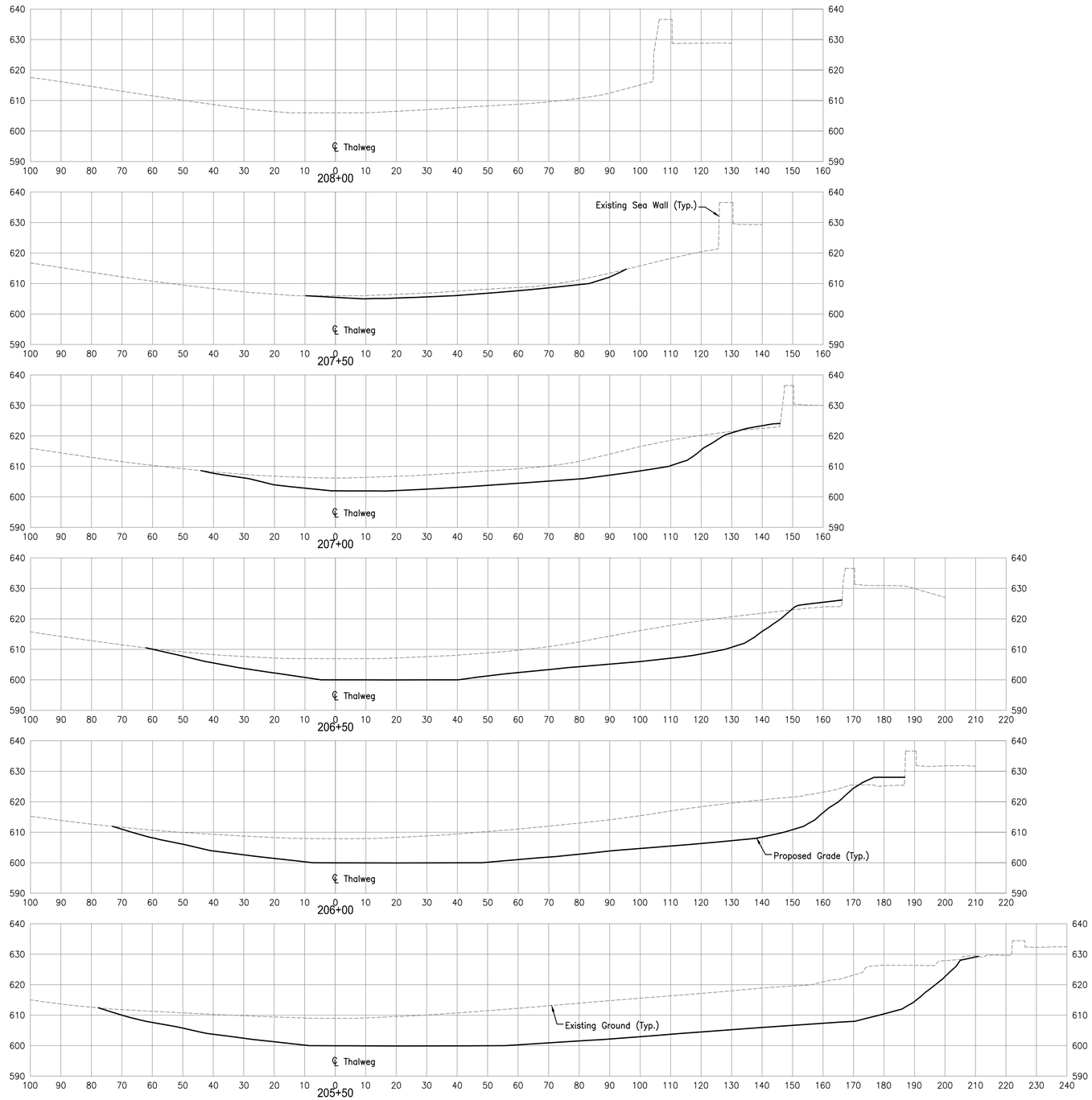

Notes:

1. Amount and height of concrete placed in Concrete Disposal Area to be determined during construction.
2. The cross-sections are viewed looking Upstream.

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Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Thalweg Cross Sections

Project No. 175630015

Scale 1"=20' (0, 10', 20', 40')

Drawing No.

Sheet 18 of 20

Revision 0

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Notes:

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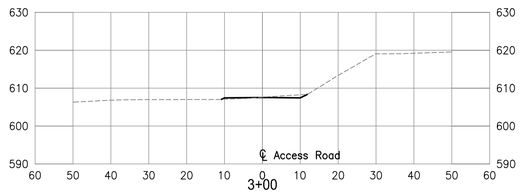
2. The cross-sections are viewed looking Upstream.



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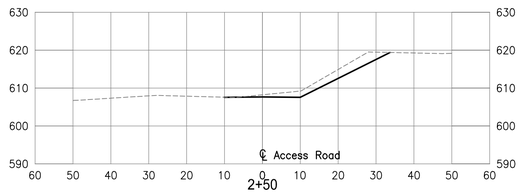

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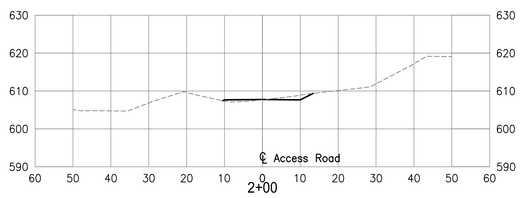

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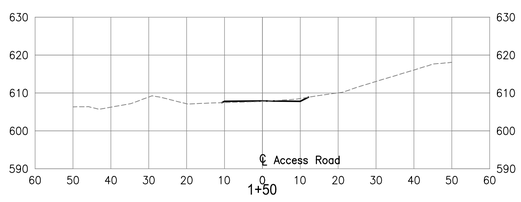

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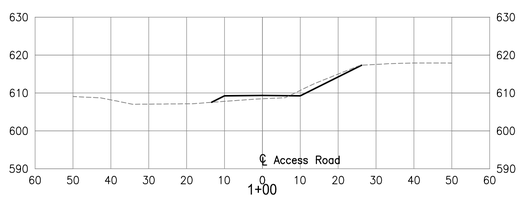

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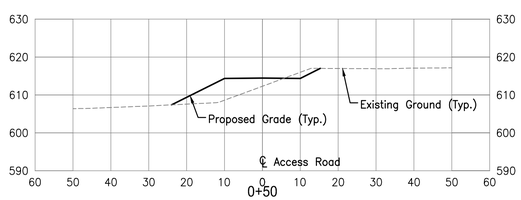

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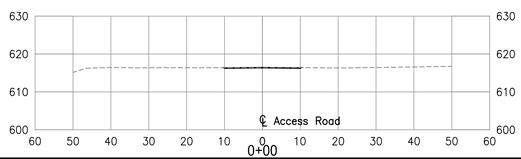

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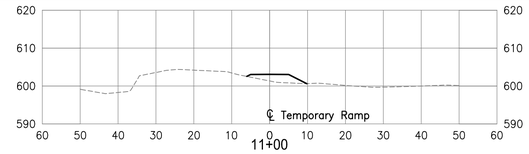

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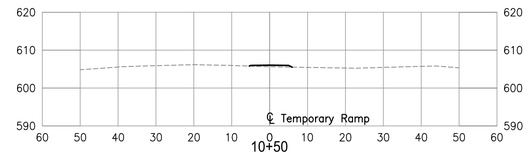

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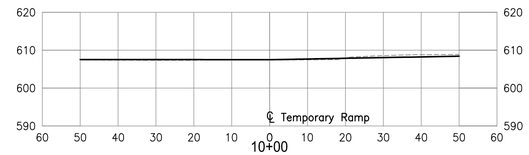

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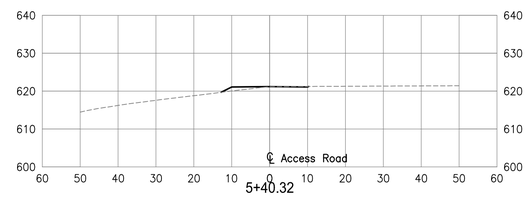

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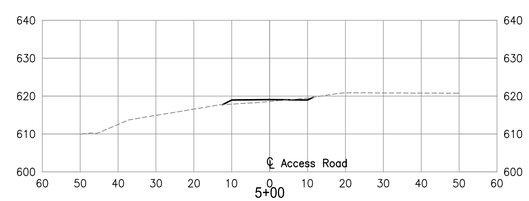

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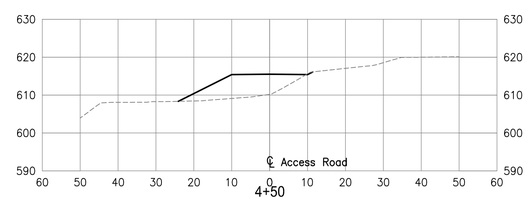

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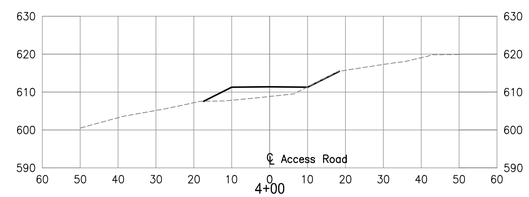

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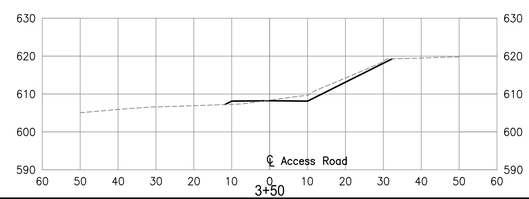

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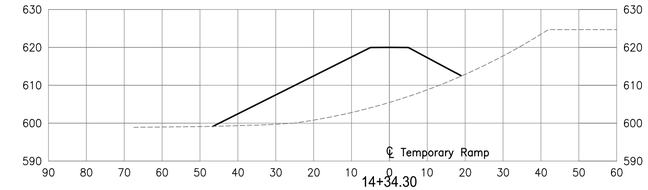

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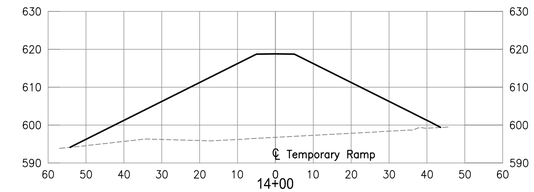

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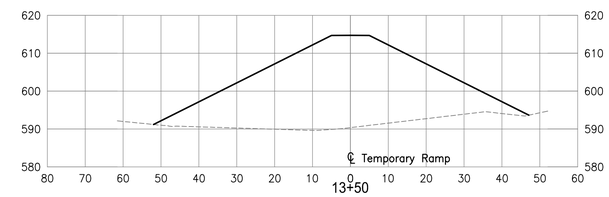

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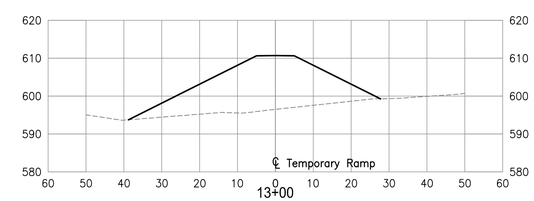

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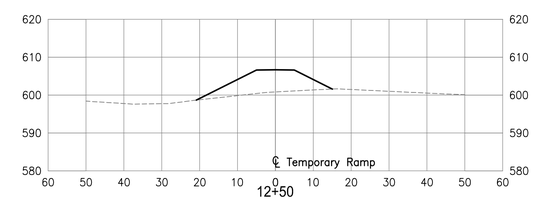

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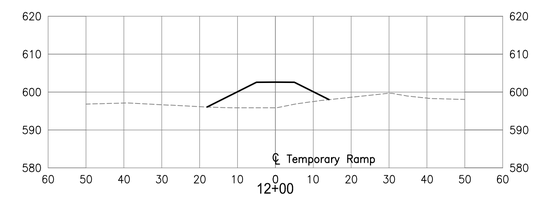

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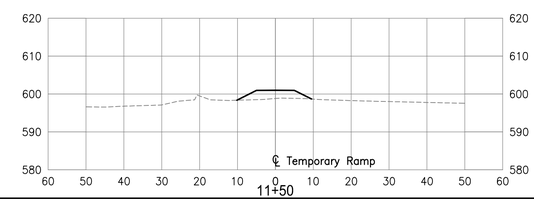

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Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Access Road And Temporary Ramp Cross Sections

Project No. 175630015

Scale 1"=20' (0, 10', 20', 40')

Drawing No.

Sheet 19 of 20

Revision 0

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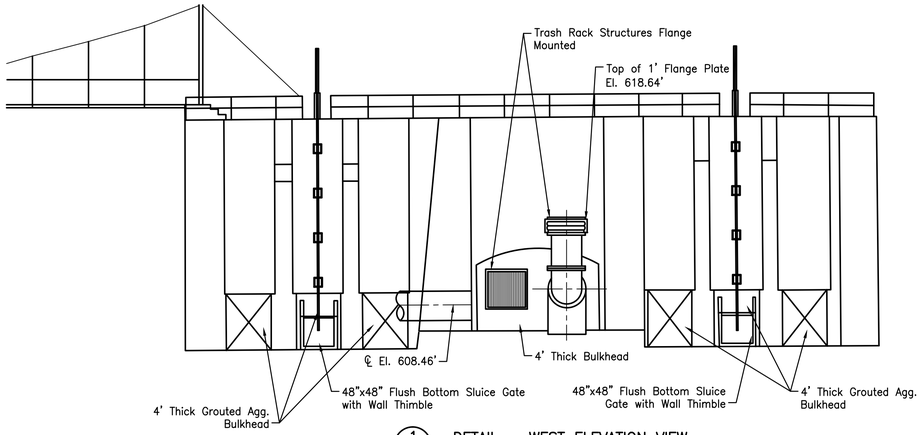

1/20 DETAIL – WEST ELEVATION VIEW
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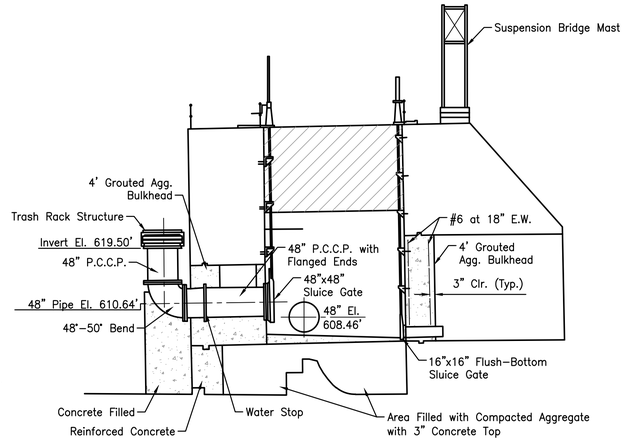

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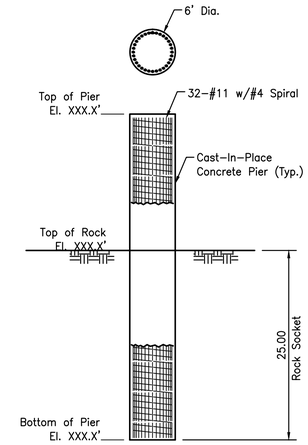
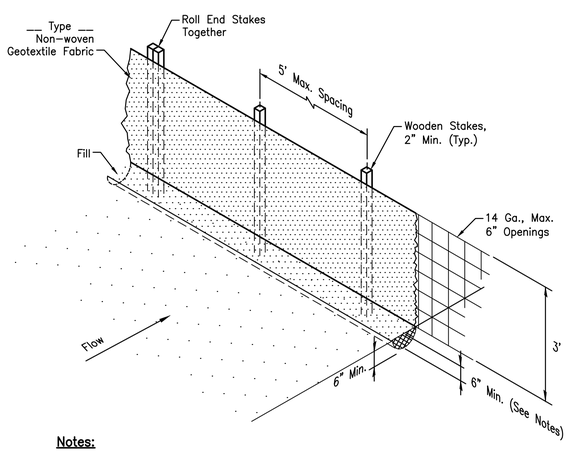


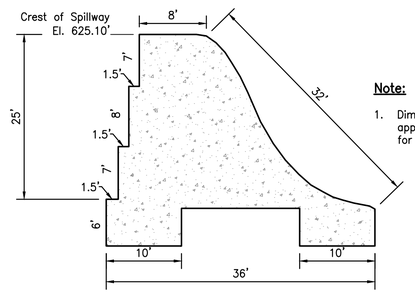
3/20 DETAIL – CONCRETE PIER FOR ICS
1"=10'



Notes:

1. All earthwork activity shall be located uphill of silt fence.
2. Silt fence shall be installed across slopes on the contour line.
3. Attach filter fabric to wooden stakes with staples, hogrings or other materials approved by the engineer.
4. Wooden stakes shall be installed on the downhill side of filter fabric.
5. Bury the bottom 12 inches of filter fabric in a 6"x6" trench (to prevent sediment from escaping under the fence) and back fill with soil.
6. Join silt fence sections by rolling end stakes together to create an unbroken sediment barrier.

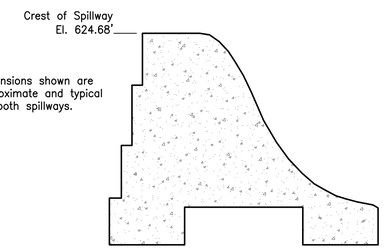
4/20 DETAIL – SILT FENCE
NOT TO SCALE



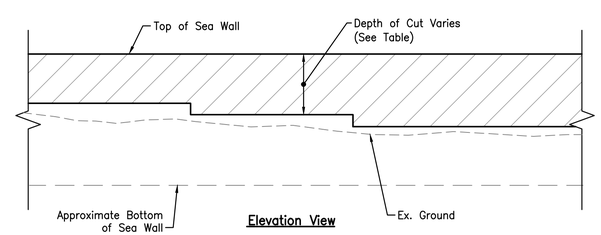
5/## SECTION – NORTH SPILLWAY
1"=10'

Note:

1. Dimensions shown are approximate and typical for both spillways.



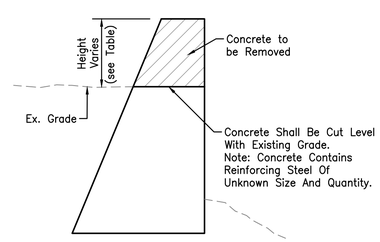
6/## SECTION – SOUTH SPILLWAY
1"=10'



Elevation View

Note:

1. Fence not shown.



Sea Wall Cross Section

Height Of Sea Wall	
Sta.	Height
1000+00–1000+70	3 Ft.
1000+70–1000+90	4 Ft.
1000+90–1001+10	5 Ft.
1001+10–1001+35	6 Ft.
1001+35–1001+60	7 Ft.
1001+60–1003+90	7.5 Ft.
1003+90–1004+25	7 Ft.
1004+25–1004+55	6.5 Ft.
1004+55–1004+85	6 Ft.
1004+85–1005+15	5.5 Ft.
1005+15–1005+55	5 Ft.
1005+55–1006+55	4.5 Ft.

7/20 SEA WALL ALTERATIONS
NOT TO SCALE

SECTION OR DETAIL NO.
TARGET DRAWING
REFERENCE KEY

Stantec
Stantec Consulting Services Inc.
11687 Lebanon Road
Cincinnati, Ohio
45241–2012
Tel. 513.842.8200
Fax. 513.842.8250
www.stantec.com

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Notes

1. Dam details taken from 1969 Construction drawings. The drawing is to scale, but shapes and dimensions are approximate only. This drawing is to provide general information about the work area. All elevations and dimensions should be field verified.
2. Reinforcing steel is known to be present in spillways. Spacing and size is unknown, but historical photographs are available for inspection at the consent of the Engineer. Reinforcing steel is unknown for the non–overflow section, but assumed present.

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Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
DETAILS

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Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

5 – Ice Control Structure (ICS) Design Report

Ice Control Structure
Design Report

Ballville Dam Removal
Sandusky River
Fremont, Ohio

Stantec

August 26, 2013

Sign-off Sheet

This document entitled Ice Control Structure Design Report was prepared by Stantec Consulting Services Inc. for the City of Fremont, Ohio. The material in it reflects Stantec's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Stantec Consulting Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Prepared by* _____
(signature)

Erman Caudill, PE (KY #23451)

Reviewed by _____
(signature)

Scott Peyton, PE (OH #71790)

* - Note structural design elements summarized in Sections 3.3.3-3.3.5 and Appendix C were completed and prepared by John Banton, PE (OH #65018).

Table of Contents

EXECUTIVE SUMMARY ..... **I**

1.0 ICE CONTROL STRUCTURE PROJECT OVERVIEW **1**
1.1 STANTEC'S STUDY OF BALLVILLE DAM AND ICE RELATED FLOOD CONTROL 1
1.2 ICE FLOODING ON THE SANDUSKY RIVER 2
1.3 ICS DESIGN OBJECTIVE 3

2.0 ICS SELECTION **3**
2.1 ICE BOOMS 4
2.2 ICE NET STRUCTURE 5
2.3 THRUST BLOCKS, BOULDERS, AND PIERS 6
2.4 COMBINATION STRUCTURES 7
2.5 RECOMMENDED ICE CONTROL STRUCTURE 8

3.0 ICS LOCATION AND DESIGN GEOMETRY **9**
3.1 HYDRAULIC MODELING 9
3.2 LOCATION SELECTION 10
3.2.1 Upstream Areas 11
3.2.2 Current Dam Location (Downstream) 11
3.2.3 Downstream Areas 12
3.3 ICS GEOMETRIC DESIGN CRITERIA 12
3.3.1 Design Event 12
3.3.2 Pier Spacing 14
3.3.3 Pier Diameter 15
3.3.4 Embedment Depth 15
3.3.5 Pier Strength Analyses 15

4.0 ICS DESIGN SUMMARY **16**
4.1 PRELIMINARY OPINION OF CONSTRUCTION COSTS 16

5.0 REFERENCES **18**

LIST OF TABLES

Table 1 Ice Control Structure Evaluation Summary 9
Table 2 Summary of Results of Structural Analyses of ICS Piers 16
Table 3 Preliminary Opinion of Construction Costs 17

LIST OF FIGURES

Figure 1 Floating Ice Boom 4
Figure 2 Debris Net Structure 5
Figure 3 Ice Pier Structure Cazenovia Creek 7
Figure 4 Ice Pier-Net Structure Laboratory Model 8
Figure 5 ICS Locations Considered 10
Figure 6 Sandusky River Historic Flood Discharges 13
Figure 7 Sandusky River Recorded Ice Thicknesses 14

LIST OF APPENDICES

APPENDIX A HYDRAULIC MODELING RESULTS A.0
A.1 Graphical Flood Profile A.1
A.2 Tabular HYDRAULIC MODEL Results A.2

APPENDIX B STATISTICAL ANALYSES B.0
B.1 STATISTICAL ANALYSES B.1

APPENDIX C STRUCTURAL CALCULATIONS C.0
C.1 STRUCTURAL CALCULATIONS C.1
C.2 LPile COMPUTER Program Output C.2

Executive Summary

This report addresses design considerations for an Ice Control Structure (ICS) to help reduce potential ice jam related flooding damage associated with the accumulation of ice downstream of the City of Fremont, Ohio due to the removal of Ballville Dam.

The Ballville Dam is located on the Sandusky River upstream of the City of Fremont (City). The concrete gravity overflow structure is approximately 410 feet in length and 35 feet in height. The dam, originally constructed in 1911 for hydroelectric power, was purchased by Fremont in 1959. The impoundment was used for the community's raw water supply until 2013.

The dam and its associated structures and gates have deteriorated over the years, and are now considered unsafe. In 2007, the Ohio Department of Natural Resources (ODNR) issued a Notice of Violation to the City requiring the city to repair, correct, or remove the dam. In lieu of costly repairs, the City proposes to remove the dam. This action provides additional benefits by promoting fish passage to fish spawning habitat located in the reach above the dam, as well as improving water quality.

The dam currently provides some level of ice retention for downstream areas, particularly during floods influenced by ice floes. During winter months, sheet ice can form behind the dam and catch other ice floes. Removal of the dam could allow this ice to continue downstream, worsening the impact of ice jams or causing new ice jams to form.

Ice related floods could reduce the effectiveness Fremont's system of flood control levees. Therefore, the USACE Cold Regions Research and Engineering Laboratory (CRREL) has recommended that an Ice Control Structure (ICS) be incorporated into the dam removal project (Vuyovich, 2008) (Carr, Tuthill, & Vuyovich, 2011).

This report addresses issues related to the design of an ICS that will be constructed as a part of the dam removal project. The report includes: an overview of the mechanics of ice control on the Sandusky River; a review of types of ICS structures and a recommendation for the Ballville Dam Removal project; a description of the hydraulic modeling used to assess alternative locations; and geometric design considerations for the ICS.

A preliminary design for a proposed break-up ICS also is presented. The recommended "comb-like" structure allows fish passage and recreational activities and requires less maintenance than some other ICSs. This design would consist of approximately 15 concrete cylindrical piers approximately 6-feet in diameter and spaced approximately 21 feet on center across the river channel. This design allows for passing the 10-percent-annual-chance (10-year) storm event while retaining the captured ice. A conceptual opinion of ICS project costs of $1.56 million is included for planning purposes.

1.0 Ice Control Structure Project Overview

The Ballville Dam is located on the Sandusky River upstream of the City of Fremont (City), Ohio. The concrete gravity overflow structure is approximately 410 feet in length and 35 feet in height. The dam was originally constructed in 1911 for hydroelectric power. Fremont purchased it in 1959 after it was no longer used for generating electricity, and used the impoundment as the community's raw water supply for many years, before completing a separate, off channel raw water reservoir in 2013.

The dam and its associated gates and sea wall have deteriorated over the years, and are now considered unsafe. In 2007, the Ohio Department of Natural Resources (ODNR) issued a Notice of Violation to the City requiring repairs, correction, or removal. In lieu of costly repairs and with support of grants from the U.S. Fish and Wildlife Agency and other Federal and State interests, removal of the dam is being proposed by the City to promote fish passage, improve water quality and aquatic habitat, and provide increased recreational opportunities. Consideration for removing the dam was previously discussed by Stantec in the *Ballville Dam Removal Feasibility Study* in 2011 (Stantec, 2011) (Feasibility Study). The City has engaged Stantec to continue the design and permitting effort for removing Ballville Dam.

An issue discussed in the Feasibility Study is the dam's ability to provide flood control for downstream areas during floods influenced by ice floes and ice jams. This report addresses the design considerations for an Ice Control Structure (ICS) to help reduce potential flooding associated with the accumulation of ice downstream of Fremont due to the removal of Ballville Dam.

1.1 STANTEC'S STUDY OF BALLVILLE DAM AND ICE RELATED FLOOD CONTROL

The Sandusky River is located in north-central Ohio and generally flows in a northeasterly direction to its outlet into Lake Erie. The Feasibility Study focused on a reach of the Sandusky River that extends from its confluence at Muddy Creek Bay and Sandusky Bay, upstream approximately 20 river miles past the City of Fremont (river mile (RM) 15 to 18) and Ballville Dam (RM 18), to a point upstream of West County Road 201 and downstream of the community of Old Fort. The US Army Corps of Engineers (USACE) Buffalo District previously studied flood potential along this reach for the community's Federal Emergency Management Agency (FEMA) Flood Insurance Study by developing a hydraulic simulation model using the USACE HEC-RAS software. Stantec obtained a copy of this model and used it to analyze the hydraulic effects of the dam removal project for non-ice related events as a part of the Feasibility Study.

Stantec's hydraulic analyses completed in 2011 primarily considered flood elevation reductions upstream of the dam and the potential for scouring of the accumulated sediment upstream of the dam. The following fundamental assumptions applied to those analyses:

- Post-dam removal channel geometry in the model consisted of channel bedrock elevations achieved after scour similar to reaches upstream and downstream of the dam
- Hydrologic attenuation of flood peaks was not considered
- Hydrologic storage by Ballville Dam was assumed to provide no appreciable flood reduction benefits
- Sub-critical flow regime was assumed throughout the reach; upstream changes will not cause a decrease in downstream water surface elevations

Stantec concluded that the velocities generated in the river near the dam location after removal would be enough to support scour of the accumulated sediment. Stantec determined that the sediment would not have a long-term adverse flood impact downstream (less than 0.5-foot maximum rise).

The USACE Cold Regions Research and Engineering Laboratory (CRREL) suggests that removing the dam would increase the volume of ice available to lower reaches of the Sandusky River, therefore increasing the potential of ice jams downstream of Fremont. CRREL recommended an ICS be considered as a potential way of mitigating the ice jam flood threat (Vuyovich, 2008; Carr, Tuthill & Vuyovich, 2011).

1.2 ICE FLOODING ON THE SANDUSKY RIVER

The cause for the ice related floods in Fremont is related directly to the mechanics of ice jam formation and “ice cover progression” as described by USACE in EM-1110-2-161, “Engineering Design, Ice Engineering Manual”. (USACE, 2002) (Vuyovich, 2008) The following terms are key to understanding ice jam processes and ICS design as described in this report:

- Sheet ice is formed along slow moving areas of water when freezing temperatures occur for several days. This formation is often described as “thermally grown” sheet ice.
- Frazil ice can be described as floating slush within a very cold, but not yet frozen, water body.
- Floes are masses of floating ice, either frazil or larger solid pieces of sheet ice, which are transported downstream.

The City of Fremont is located near the boundary of lake level influence on the Sandusky River. The low grade, low energy section of the river from the City to the mouth of the river enables the accumulation and formation of thermally grown sheet ice. When frazil ice and breakup ice floes from upstream reaches encounter the thermally grown sheet ice, they can accumulate and form ice jams. When an ice jam is present and a flood occurs, the ice jam becomes an obstruction to flow and may lead to higher upstream or backwater river stages, increasing the chances of flooding in Fremont.

The reach upstream of Fremont near the Ballville Dam is characterized by a steeper grade and faster moving water of the type where frazil ice might form. Instead, the presence of Ballville Dam allows sheet ice to form. Upstream of the dam to downstream of Tiffin, the river bed has a more gradual slope causing sheet ice to form.

The presence of sheet ice upstream of Ballville Dam interrupts the ice cover progression process upstream of Fremont. The dam's sheet ice acts as a partial barrier to upstream floes of frazil and break-up ice. This promotes the formation of ice jams near the upstream end of Ballville Dam's impoundment and reduces the amount of ice available to form jams downstream, thus reducing the risk of ice jam-related flooding. It should be noted that the dam does not prevent all ice from reaching Fremont as Vuyovich documents ice flows over the dam (Vuyovich, 2008).

CRREL, in the investigation of ice hydraulics associated with the removal of Ballville Dam, recommended an ICS be included in the removal project to help mitigate potential negative effects associated with ice that would have otherwise been captured or controlled by the dam. (Carr, Tuthill, & Vuyovich, 2011)

1.3 ICS DESIGN OBJECTIVE

Based on the ice cover progression, jam development, and potential flood scenario described above, Stantec was asked by the City to incorporate an ICS into the design if Ballville Dam is to be removed. The objective of this study is to choose a location and design an ICS that attempts to have a commensurate level of protection to Fremont from ice jam related flooding risk associated with removing the dam. The goal of the ICS selection and design process is to create a structure that will replicate or improve on the ability of the existing Ballville Dam to control ice in this portion of the Sandusky River.

Control of frazil and break-up ice, with comparatively low cost of installation, operation, and maintenance are desirable features of the ICS. During this study, Stantec reviewed several potential types of ICS structures often used and recommends a type for this application, makes use of the hydraulic modeling developed for the Feasibility Study to further explore potential locations and geometric configurations, develops a design geometry based on risk assessment methods, and provides a recommended configuration for the proposed structure based on the data presented.

2.0 ICS Selection

Ice Control Structures generally fall into two classes based on their function: those that form and control sheet ice or those that catch and retain break-up ice floes from upstream areas.

Sheet ice retention structures such as booms, nets, weirs, or dams are frequently used to induce thermally grown ice sheets over larger spans. Sheet ice retention structures typically

require low surface velocities (< 2.3 ft/s), low energy slopes, and low Froude Numbers (< 0.08) (a measure of energy and hydraulic flow conditions). (USACE, 2002)

Breakup ice control structures such as thrust blocks, divided weirs, channel blocks or boulders, and pier structures are generally placed at strategic locations in a stream and are designed to catch breakup ice floes to form a controlled jam that protects downstream areas.

The ICS for the Sandusky River must at a minimum provide breakup ice control in order to prevent increases in size of downstream ice jams from occurring. A breakup ICS would protect bridges by preventing ice jams from occurring at bridge piers. One important benefit for removing the dam is fish passage so it is important that the selected ICS allow fish to move freely along the river.

ICS configurations that may be appropriate for the Sandusky River include: booms; net structures; thrust blocks, boulders and piers; and combination structures. The sections that follow describe how they might be applied to the Ballville Dam Removal Project.

2.1 ICE BOOMS

Ice booms like the one shown in Figure 1 have been primarily used for developing sheet ice cover and inducing freeze up jams. Booms are generally temporary structures that can be installed and removed as needed. They are constructed of floating pontoons attached to a flexible wire or cable system with varying size and spacing. They may be anchored to the stream bed as well; however, caution must be exercised to avoid freezing of the boom to the river bottom, which can cause a blockage.

BMT Fleet Technology

Figure 1 Floating Ice Boom

These structures have little impact on natural river function under no-ice conditions. They require relatively small upfront capital investment to install, but have higher operation and maintenance costs throughout their lifecycle. Regular operation and maintenance would include annual installation of the boom, regular inspection for wear and potential defects, and likely

repairs or replacement after large ice events. Debris removal would also be required as needed.

For a boom to work in the Sandusky River, a suitable location with deeper, slow moving water would need to be identified. The boom would help control sheet ice formation, but would not provide much benefit for frazil or breakup ice, unless the velocity was relatively low. Structurally, the boom would not likely have the required strength to withstand larger ice jams. From the review of potential ICS locations, described in Section 3 of this report, a boom could function as intended if it were placed downstream of Fremont or farther upstream of the Ballville Dam location. Unfortunately, these locations are not ideal to form ice jams that would help protect Fremont from flooding damage. Because of the poor suitability of the location and inability to control frazil and breakup ice, an ice boom is not recommended.

2.2 ICE NET STRUCTURE

In some locations, structures consisting of cables and nets are stretched across smaller channels to help control debris and trap ice. An example designed to control debris is shown in Figure 2. Many of these are improvised structures intended only to catch debris or control access, but they often inadvertently act as ice control structures during winter freeze-up conditions. For those intended to control ice, like ice booms with suspended debris nets, these are generally temporary in nature. Depending on the design, the structures may fill with ice and freeze up to form a weir, or be used in conjunction with a fixed weir to catch ice and provide a delay before failure at some preset design limit. The nets may be a way to catch frazil floes and initiate a jam. The relatively weak structural integrity makes them easily overwhelmed when faced with sufficient forces. Stacking of ice behind a jam formed upstream of the structure, as described in “ice cover progression” scenario previously discussed, would likely produce better results than stacking at the structure itself due to the added structural support of the banks and other in channel features. Stacking at the net could lead to the increased probability of pushing it down and releasing ice over the top. (Morse, Francoeur, Delcourt, & Leclerc, 2006)

Geobrugg

Figure 2 Debris Net Structure

Nets with proper opening sizes would promote fish passage between up- and downstream river segments. Initial investment for net structures would be relatively low, but operation and maintenance costs could be higher with likely frequent maintenance while in use.

A net structure in the Sandusky River would be required to have to span a distance of 200-feet or more and would control a significant volume of ice. Flood discharges would be anticipated to make the river elevations and velocities fluctuate. The forces involved would require the net structure to be substantial to resist failure. Literature indicates some scale modeling studies have been performed to simulate how they might function on larger streams, but there does not appear to be an application of these for a waterbody the size of the Sandusky River. Due to the anticipated loading conditions and the difficulty in operation and maintenance, not to mention the uncertainty on how it would perform on a river the size of the Sandusky, an ice net structure is not recommended.

2.3 THRUST BLOCKS, BOULDERS, AND PIERS

These types of ICSs appear to be the most frequently used and studied. Literature review indicates some documented success in catching and retaining breakup ice floes. The typical configuration consists of a series of permanent obstructions spaced evenly across the width of the river. A variety of configurations have been used in previous designs, including: large boulders placed on the stream bed, concrete thrust blocks anchored into the channel, and round or elongated concrete piers oriented parallel with flow. Geometric dimensions (height, length, and widths) as well as spacing on these structures vary, with many pier structures resembling a “comb-like” arrangement.

The function of this type of ICS is generally to catch large sheets of ice, which then interlock to bridge over the gaps and form an ice jam. The ice jam is typically grounded at the toe of the structure, building vertically and upstream. The structure generally must be capable of maintaining excess flow around or over the ice jam, or be located adjacent to an accessible floodplain for flood flow relief. This prevents further increases in water level that could overtop the structure, compromise the grounded toe, or washout ice through the piers. Pier heights vary based on floodplain elevations, ice storage requirements, and design discharge. Structures placed in river reaches where the formation of sheet ice immediately upstream is possible also benefit from the structural strength of the sheet ice and potential ice jams associated with it. Design loads must be given careful considerations and are often comparable to highway bridge pier specifications.

One example of this type of structure, a series of ice-retaining piers, was constructed by USACE on Cazenovia Creek, located in West Seneca, NY. Figure 3 is a photo of the Cazenovia Creek ice pier structure from USACE. The slope of the channel and post-dam removal average flow velocities (0.004-0.005 ft/ft and ~4-6 ft/s respectively) for that structure appear to be comparable to the typical winter conditions downstream of Ballville Dam on the Sandusky River. At Cazenovia Creek, the 5 ft. diameter cylindrical piers are spaced with 12-ft gaps and protrude 2 feet above the adjacent floodplain elevation, where there is a relief flow channel adjacent to the

structure. (Tuthill & Lever, 2006) The Cazenovia Creek structure was constructed in 2005 and successfully controlled ice during an ice floe in 2007. (Vuyovich, 2008)

USACE

Figure 3 Ice Pier Structure Cazenovia Creek

These structures allow for fish passage, but would be a permanent visual impact on the river. Initial costs for pier structures are relatively high, due to the amount of work and materials needed, but operation and maintenance efforts are lower than temporary structures. No operation is involved with the structures as they are permanent and stand alone. Maintenance may be required for debris removal and less frequently in the form of concrete repair and abutment armor replacement. An ICS structure of the type described, particularly a comb pier structure, has precedence in other locations and appears to be a suitable option for the Sandusky River.

2.4 COMBINATION STRUCTURES

Combinations of the previous structures may also be used for ice protection. A boom-net structure utilizes booms attached to the top of a single-span net across a river section. Pontoons on the boom help catch surface ice and support the net, so that ice is successfully wedged into the net to start a jam and ice does not flow over the top. Structures like the one shown in Figure 4 have been tested in laboratory applications and at small scales; however, little is known about how well they might function on a larger river. Research suggests these structures are more appropriate for smaller rivers (<100 feet width) and greater flow depths. (Morse, Francoeur, Delcourt, & Leclerc, 2006) Greater widths increase forces on the structural elements, thus prohibitively driving up the cost of the structure. Shallow flow depths are not as effective due to potential freeze-up of the net to the channel bottom and strength required to sustain ice piling up on the net. The boom-net structure is not recommended due to the location constraints, anticipated forces on the net structure, and operation and maintenance concerns.

(Morse, Francoeur, Delcourt, & Leclerc, 2006)

Figure 4 Ice Pier-Net Structure Laboratory Model

Pier-net structures combine a comb pier structure with a temporary net anchored to the piers. They are comprised of permanent piers spaced across the channel with the addition of temporary, high tensile steel nets between piers. The nets are anchored to the river bed and the piers. Loading analyses determine the span of the net (or pier spacing). The combination allows for fewer piers and subsequently wider spacing. The nets potentially have higher capture efficiency of smaller frazil floes, which reduces the need for sheet ice upstream of the piers for jam formation at the structure. As previously mentioned, there does not appear to be an application of these for a waterbody the size of the Sandusky River. Due to the anticipated loading conditions and the difficulty in operation and maintenance of the net, and the absence of scale trials of such a structure, a combination pier-net structure is not recommended.

2.5 RECOMMENDED ICE CONTROL STRUCTURE

Table 1 summarizes the desired criterion for an ICS on the Sandusky River and the benefits delivered by each type of ICS considered. Based on this summary, a pier type ICS is recommended. This structure may not be as effective at promoting formation of sheet ice or capturing frazil ice, but it would function to control break-up ice and fit within the geometry of the Sandusky River near the Ballville Dam location.

Table 1 Ice Control Structure Evaluation Summary

	Type of Structure			
	Boom	Net	Piers	Combination Pier-Net
Forms Sheet Ice	✓	✓	✗	✓
Captures Frazil Ice	✗	✓	✗	✓
Captures Breakup Ice	✗	✓	✓	✓
Compatible w/ Flow & Velocity	✗	✗	✓	✗
Compatible w/ Sandusky River Geometry	✓	✓	✓	✓
Visual Impact (Rank)	1	2	3	4
Installation Cost (Rank)	1	2	3	4
Operation and Maintenance Cost	2	3	1	4
Precedence in Other Locations	✓	✗	✓	✗
Perceived Overall Rank	4	3	1	2

Rankings are presented as Best (1) to Worst (4)

3.0 ICS Location and Design Geometry

Key design features of the ICS have been identified in terms of location and physical geometry. Stantec used the anticipated hydraulic operation of the ICS to determine design parameters and geometry.

3.1 HYDRAULIC MODELING

Stantec used the HEC-RAS model developed by the USACE Buffalo District for the ICS design. This was the same base model used for the Feasibility Study. For comparison Stantec obtained a copy of the HEC-RAS model that CRREL used in their 2011 study of potential ice impacts of the removal of Ballville Dam. The CRREL model was based on the same Buffalo District model with no apparent changes to the model geometry. CRREL added ice accumulation behind various cross sections based on ice jam locations and thicknesses determined from reviewing historic records of the Sandusky River.

The average winter flow was used as the base condition for the ICS design. The average winter discharge and ice thickness values were calculated using monthly averages for November through February between the years 1923 and 2011 from US Geological Survey (USGS) Stream Flow Gage # 04198000 located on the Sandusky River at river mile 2.4. The results and comparison of simulations with and without the dam is presented in Appendix A.

Removal of the dam caused increased velocity and decreased water surface elevations at and just upstream of the dam location. Simulations using the average winter flow indicated removal caused an increase in velocity of approximately 5.3 feet/second (ft/s) and a decrease in water

surface elevation of approximately 24.0 feet immediately upstream of the dam location. This combination will likely result in sediment erosion, causing a decrease in channel bed elevation of ten feet or more at the location of the dam. This decrease in minimum channel elevation is apparent on the graphical profile shown in Appendix A.

The resulting HEC-RAS model was then used to evaluate potential locations for an ICS and potential interactions with the City's flood protection system.

3.2 LOCATION SELECTION

Based on the prior CRREL analyses of the Sandusky River ice floes and review of the hydraulic modeling results, the most suitable location for the ice structure would be near the current dam. Based on the design and operation of the ICS on Cazenovia Creek, the site would need to have an area for bypass flow (i.e. an adjacent floodplain) or be capable of maintaining the ice and flood event within the channel. Stantec considered three areas with these criteria in mind: upstream of the dam (two different locations), at the current dam location (actually slightly downstream), and well downstream of the dam. The four locations are shown on Figure 5 and discussed further below.

Figure 5 ICS Locations Considered

3.2.1 Upstream Areas

In the CRREL study from 2011, two possible sites for the ICS location were proposed upstream of the current dam: one around River Mile (RM) 19.1 (XS 92000 in the model) and another close to RM 18.4 (XS 88000). (Carr, Tuthill, & Vuyovich, 2011) River mile (RM) 19.1 is close to the location of the City's new raw water reservoir intake. The anticipated width and depth of the channel after the Ballville Dam is removed would support a pier ICS structure. The higher elevations of the channel banks make it a feasible location for providing floodplain release of bypass flow, though some homes could be at increased risk of flooding in the vicinity. In addition, the distance from the current dam may contribute to excess frazil ice generation downstream of the ICS. Due to risk to homes in the vicinity and distance from the current dam location, this location was omitted from further consideration.

Approximately 1,500 feet upstream of the dam, at RM 18.3-18.4 (XS 87500), the depth of the river (based on model results and assuming scour has occurred) is approximately 4 feet and the velocity is 2.3 ft/s during average winter flow. Based on USACE guidelines this flow regime would be suitable for sheet ice retention and could allow sheet ice to form. (USACE, 2002) There is a secondary channel and a large wetland area on the right side of the Sandusky River that could be modified to allow overflow. This location is close to the dam and operation of an ICS here would provide similar protection as the dam and affect a similar area.

An assumption with this location is that the desired channel configuration would depend on scour, which may take several years to achieve without extensive intervention through construction. Construction would be costly as approximately 10 feet of sediment will need to be removed from the channel bed before the ICS could be placed and natural channel scour processes will need to occur before the ICS reaches its full effectiveness. These activities could be difficult and costly to implement before the pool is drawn down and the dam is removed. At that point, any delays in construction result in exposure of areas downstream to increased risks.

Other features of this location that make it less desirable are that it would be highly visible from the adjacent cemetery and properties to the northeast (a possible negative effect on the current viewshed) and an access road will need to be constructed along the previously undisturbed left embankment (increased direct impact effects).

Although this location is feasible from an operational standpoint, the constructability issues could lead to increased costs and its impacts are not desirable.

3.2.2 Current Dam Location (Downstream)

A location just downstream of the dam near RM 17.9 (XS 85750) was considered based on constructability and geometry. This area is essentially within the discharge zone for Ballville Dam and is characterized by a shallow channel that is founded on bedrock. Model results of typical winter flow conditions indicate that after dam removal the anticipated depth of water would be approximately 2 feet and the velocity would be 6 ft/s. The velocity is fast enough to preclude the use of this location for developing sheet ice cover, but a break up structure could

be used. The channel is wide enough and deep enough such that a storm and ice event can be maintained within the channel, so an overflow channel would not be needed.

The ICS construction could occur largely independent of the dam removal effort with minimal changes to the existing conditions and minimal additional impacts beyond the dam removal effort. Upstream flooding impacts of this structure would also be less than the existing dam.

3.2.3 Downstream Areas

Downstream of the dam at RM 16.6 (XS 78500), the depth of the river is approximately 4 feet and the velocity is 1.43 ft/s, based on model results. On the left side of the river is a golf course that could be configured to allow flood overflows without impacting structures. This area seems to fit the necessary hydraulic criteria with low velocity and an available overflow area. This location is downstream of County Road 53 Bridge. There is a chance for ice to collect upstream of the bridge causing flooding to structures in the vicinity. This is also near the area protected by levees, so flooding here increases the risk of flood impacts to the levee system. Other areas downstream of the Ballville Dam location were reviewed and found to have similar issues. The increased risk of flooding makes these areas ineffective for an ICS and they were eliminated from consideration as potential locations.

3.3 ICS GEOMETRIC DESIGN CRITERIA

The current dam location is recommended for the ICS placement. Depths and velocities during the typical winter condition would be anticipated to be on the order of 2 feet and 6 ft/s respectively. Stantec has based the design on desired operation. The goal is for the piers to capture a designated amount of ice, allow a chosen storm to pass while retaining that captured ice, withstand the forces associated with the combination event, and have a geometry conducive to effective operation. This design results in a pier height, pier spacing, pier diameter, and embedment depth directly related to the hydraulic operation of the ICS and the geologic conditions at the chosen site. Further discussion of the design aspects follows.

3.3.1 Design Event

The design event was calculated using historical records of flood and ice events reported by CRREL and stream flow gage data obtained from USGS Gage #04198000. Each historical event has a corresponding peak flood discharge and estimated ice thickness. Ice thickness and flow were ranked from highest to lowest and subsequently a frequency was calculated for each of these occurrences, using Equation 1.

$$P(x) = \frac{m}{N} \qquad \text{Equation 1.}$$

Where: x = a particular occurrence, P(x) = probability of the occurrence of x, m=the rank of x with all observed occurrences, N = total number of observations.

Ice jam related flooding occurs when these two events, accumulation of ice and occurrence of a large discharge, happen simultaneously. These events are not related and are independent. To relate the relative frequency or risk of the two independent events happening at the same time, the combined probability of the two independent datasets was calculated using Equation 2.

$$P(x,y) = \frac{cd}{(cd+(1-c)(1-d))} \qquad \text{Equation 2.}$$

Where: x or y = a particular occurrence of an independent event, P(x,y) = probability of the occurrence of x and y, c = probability of x from Eq.1, d = probability of y from Eq.1

From equations 1 and 2, the probability of event X can be explained as the probability of a flood peak discharge exceeding a certain value X. The probability of event Y would relate to the probability of ice thickness exceeding a certain value Y. The probability of X and Y would be the probability of ice being thicker Y when a flood with a discharge greater than X occurred. Results from this analysis are included in Appendix B and the datasets are presented graphically in Figures 6 and 7. It can be noted that the two events highlighted in yellow in Figures 6 and 7 (1959 and 1963) had ice jams that caused flooding in Fremont, and occurred while Ballville Dam was in place.

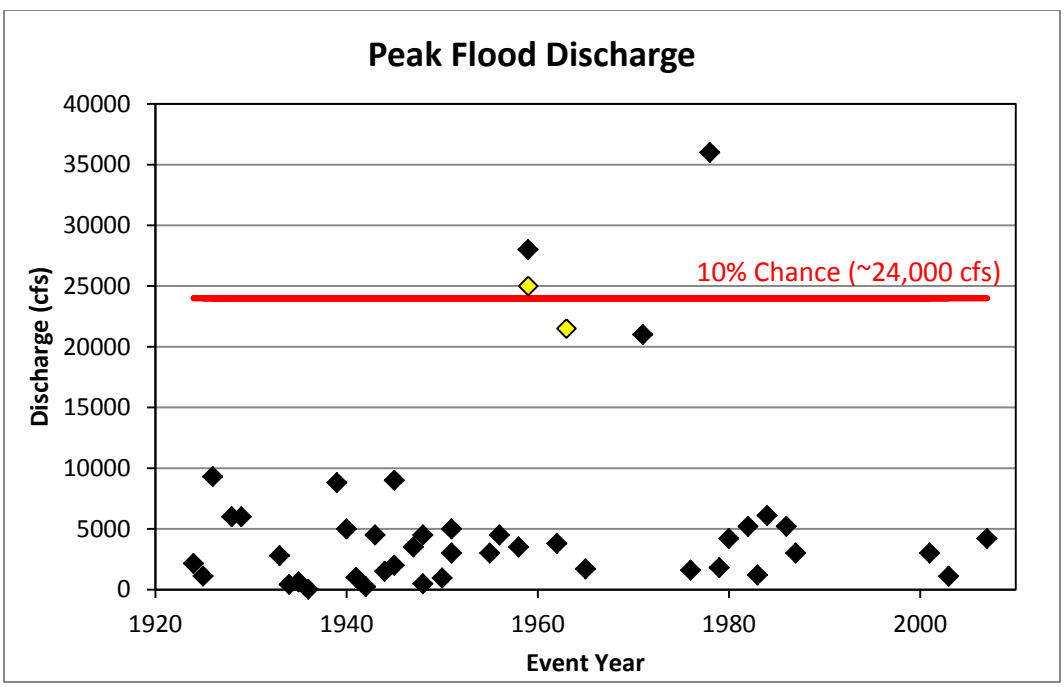

Figure 6 Sandusky River Historic Flood Discharges

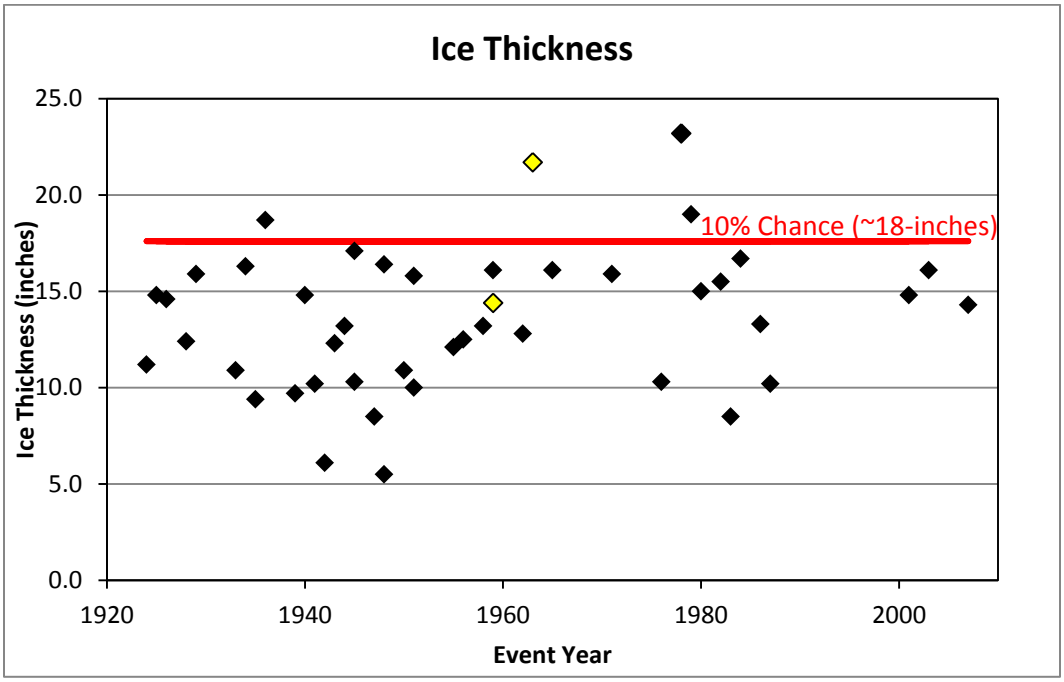

Figure 7 Sandusky River Recorded Ice Thicknesses

The ICS needs to be at least as effective as the current dam. The two combined events which caused flooding (1959 and 1963) occurred when the joint probability had an 11.2-percent or less chance of occurring. To be conservative, the ICS was designed to hold both the ice thickness and discharge of 10-percent or lower chances of occurrence independently. At 10-percent probability of occurrence the ice thickness based on historic records would be about 18 inches thick or greater. At 10-percent probability of occurrence, the USGS gage discharge would be 24,000 cfs or greater. The actual combined probability of these two events would be 1.2-percent, which is much more conservative than the 11.2-percent for the events in 1959 and 1963 that Ballville Dam could not prevent.

As a factor of safety and to account for stacking of ice, the ice thickness allowance was actually set at twice the design value or 3 feet and the ICS was designed to still pass the 10-percent chance flood event without overtopping or flowing around the structure with that amount of ice in place. Based on model geometry at the recommended location, these design parameters translated to an ICS height of approximately 12 feet as predicted by the results of the HEC-RAS model.

3.3.2 Pier Spacing

Spacing of the piers was selected based on capturing and containing the largest free-floating mass of sheet ice that would be of concern downstream. The USACE Cazenovia Creek ICS design reports that “ICS gap width can be set at about 15 times the *minimum* ice thickness that poses an ice jam threat under existing conditions”. (Tuthill & Lever, 2006) From Figure 7, the typical recorded ice thickness is about 12 inches (1.0 foot) and the design thickness is about 18

inches (1.5 feet). Therefore, 15-22.5 feet would be the designed gap width, with the smaller end of that range, which is more conservative, having a better chance of capturing smaller sheets of ice from upstream.

3.3.3 Pier Diameter

The pier diameter was assumed to be 6 feet. It was set in accordance to USACE guidelines for ice control structures in similar conditions. (Tuthill & Lever, 2006) (Stantec, March 2013) For a pier diameter of 6 feet and a desired gap width of 15 feet, the pier spacing would be 21 feet on center.

3.3.4 Embedment Depth

Stantec performed a geotechnical exploration of the proposed site and the results have been submitted separately. (Stantec, March 2013) In general, the channel bottom at the project site was found to consist of dolomitic limestone. The embedment depth for each pier was assumed to be 15 feet based on strength requirements. Additional discussion is included in the Stantec geotechnical exploration report.

3.3.5 Pier Strength Analyses

The loads from ice for the piers were determined using guidelines found in AASHTO “Bridge Design Specifications”. (American Association of State Highway Transporation Officials (AASHTO), 2010) A copy of the calculation spreadsheet containing the method for determining loads using the equations is presented in Appendix C. For reference, the top of the ICS piers was assumed to be elevation 610 feet.

Two loading conditions were analyzed:

- Loading Condition 1 – Ice breakup upstream occurs at melting temperatures resulting in an ice floe 2 feet thick, in addition to the design flood discharge. The top elevation of the ice floe is 610.0 feet. This simulates ice jam during a flood.

- Loading Condition 2 – Ice breakup or major ice movement occurs when the ice temperature is below the melting point (averaged over its depth). The top elevation of the ice floe is 600.5 feet. The ice is assumed 2 feet thick. This simulates ice loading without a flood.

The L-Pile computer program (Version 5.0, Ensoft, Inc.) and the ShortCol program for use in spreadsheets (shareware,Yakpol.net) were used for iterative analyses of the pier. Load Resistance Factor Design (LRFD) resistance factors of 0.9 for bending and 0.75 for compression were used in ShortCol. The results of the strength analyses are presented in Table 2.

Table 2 Summary of Results of Structural Analyses of ICS Piers

Loading Condition	Horizontal Force (kips)	Maximum Moment (kip-ft)	Deflection At Top Of Pier (inches)	Factor of Safety	Steel Reinforcement (No. & Size)
1	157	1912.8	0.20	2.1	24, #10
2	627	1856.3	0.05	2.2	24, #10

The steel reinforcing is circular and is to be tied with nominal spiral shear reinforcing. Computer program output is presented in Appendix C.

4.0 ICS Design Summary

The potential exists for the dam removal to contribute to downstream ice jams, which could cause increased water surface elevations and associated flood damage downstream. An ice control structure would reduce the likelihood of ice continuing downstream from the Ballville Dam location, where it could cause associated flooding risks. Therefore, an ICS is recommended downstream of the current dam location as a part of removing the dam. This location is suitable to capture breakup ice. This section of the river is capable of containing the storm event and ice buildup within the channel. The location is close enough to the dam that it can capture a similar amount of ice breakup from upstream as the existing dam does.

The ICS is recommended to be a pier structure consisting of approximately 15 piers, spaced 21 feet on center. The piers would be approximately 12 feet tall and 6 feet in diameter, embedded approximately 15 feet into rock. A pier structure is being recommended because it has the ability to protect downstream areas from breakup ice floes with minimal operation and maintenance requirements compared to other types of structures. The pier structure allows the passage of fish and recreational activities.

This design was used in the Cazenovia Creek ICS, which has proved successful in its ice jam flood prevention. (Carr, Tuthill, & Vuyovich, 2011) The Sandusky River ICS and the Cazenovia Creek ICS are comparable in structure and channel characteristics. Based on results thus far for the Cazenovia Creek ICS, the Sandusky River ICS would be expected to perform in a similar manner.

4.1 PRELIMINARY OPINION OF CONSTRUCTION COSTS

Stantec developed a preliminary opinion of construction cost for the proposed ICS. The opinion shown in Table 3 is conceptual.

Table 3 Preliminary Opinion of Construction Costs

Item No.	Description	Units	Quantity	Unit Price	Item Cost*
1	ICS Coffer dam for water diversion	Ea.	15	$5,000	$75,000
2	Floodplain protection (rock or wood bollards)	Ea.	6	$2,000	$12,000
3	ICS Dewatering pump/treatment system	Day	60	$1,500	$90,000
4	ICS caissons	V.L.F.	760	$500	$380,000
5	ICS Caisson rock excavation	C.F.	3,534	$100	$354,000
6	ICS Caisson rig mob/demob.	Ea.	4	$15,000	$60,000
7	Steel Reinforcing	TN	67.8	$3,350	$228,000
				ICS Construction Cost:	$1,199,000
				+ Construction Contingency (30%):	$360,000
				=Total Opinion of Cost:	**$1,559,000**

* - Costs are rounded up to the nearest thousand ($1,000)

5.0 References

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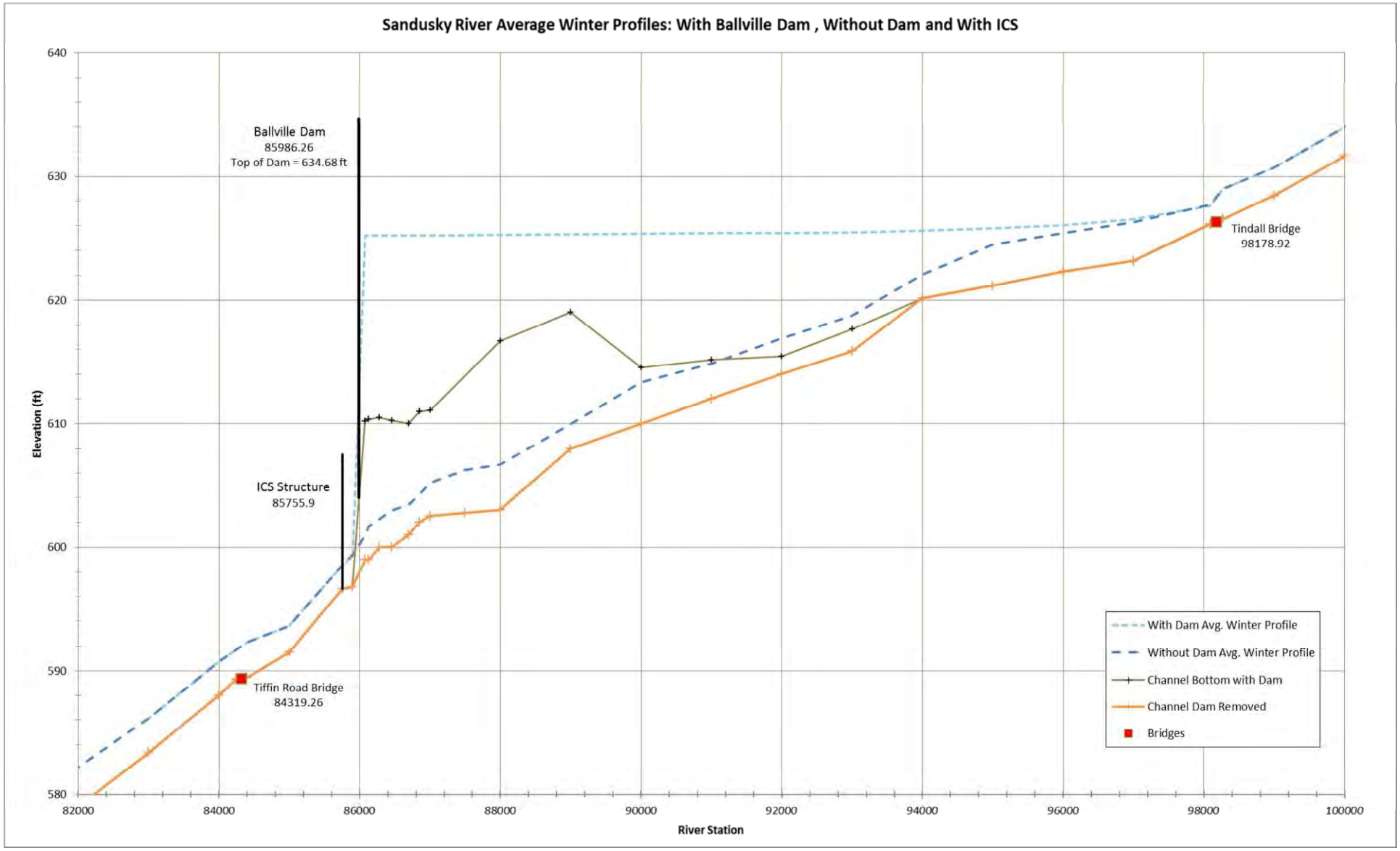
Appendix A Hydraulic Modeling Results

A.1 GRAPHICAL FLOOD PROFILE

APPENDIX A.1 GRAPHICAL FLOOD PROFILE



A.2 TABULAR HYDRAULIC MODEL RESULTS

APPENDIX A.2 TABULAR HYDRAULIC MODEL RESULTS

River Station	WITH DAM				WITHOUT DAM				DIFFERENCE [w/o-with]	
	Min Channel El. With Dam	WSEL With Dam 1%	Depth of Water (ft)	Velocity with Dam (ft/s)	Min Channel El. - Eroded	WSEL Without Dam 1%	Depth of Water (ft)	Velocity without Dam (ft/s)	Velocity (ft/s)	Depth (ft)
105000.00	635.77	639.05	3.28	1.79	635.77	639.05	3.28	1.79	0.00	0.00
104000.00	634.98	638.39	3.41	2.41	634.98	638.39	3.41	2.41	0.00	0.00
103000.00	634.04	637.74	3.70	2.00	634.04	637.74	3.70	2.00	0.00	0.00
102015.90	633.78	637.33	3.55	1.69	633.78	637.33	3.55	1.69	0.00	0.00
101000.00	633.40	636.52	3.12	2.76	633.40	636.52	3.12	2.76	0.00	0.00
100000.00	631.67	633.97	2.30	3.71	631.67	633.97	2.30	3.71	0.00	0.00
99000.00	628.45	630.75	2.30	3.48	628.45	630.75	2.30	3.48	0.00	0.00
98270.85	626.52	628.99	2.47	3.36	626.52	628.99	2.47	3.35	-0.01	0.00
98088.88	626.12	627.59	1.47	5.58	626.12	627.66	1.54	5.26	-0.32	0.07
97000.00	623.17	626.50	3.33	2.06	623.17	626.25	3.08	2.25	0.19	-0.25
96000.00	622.32	626.02	3.70	2.15	622.32	625.38	3.06	2.83	0.68	-0.64
95000.00	621.16	625.77	4.61	1.41	621.16	624.50	3.34	2.18	0.77	-1.27
94000.00	620.16	625.59	5.43	1.28	620.16	622.06	1.90	6.24	4.96	-3.53
93000.00	617.66	625.43	7.77	1.17	615.87	618.75	2.88	2.67	1.50	-4.89
92000.00	615.46	625.40	9.94	0.67	614.00	616.94	2.94	3.17	2.50	-7.00
91000.00	615.13	625.38	10.25	0.64	612.00	614.85	2.85	3.07	2.43	-7.40
90000.00	614.50	625.36	10.86	0.67	610.00	613.31	3.31	2.44	1.77	-7.55
89000.00	619.01	625.32	6.31	0.76	608.00	609.98	1.98	5.75	4.99	-4.33
88000.00	616.71	625.25	8.54	0.80	603.00	606.66	3.66	2.12	1.32	-4.88
87000.00	611.07	625.22	14.15	0.67	602.50	605.18	2.68	3.38	2.71	-11.47
86850.00	611.00	625.22	14.22	0.54	602.00	604.23	2.23	4.61	4.07	-11.99
86700.00	609.99	625.22	15.23	0.49	601.00	603.43	2.43	3.98	3.49	-12.80
86455.00	610.24	625.22	14.98	0.52	600.00	602.96	2.96	2.89	2.37	-12.02
86280.00	610.49	625.22	14.73	0.51	600.00	602.30	2.30	4.38	3.87	-12.43
86130.00	610.34	625.22	14.88	0.45	599.00	601.69	2.69	3.36	2.91	-12.19
86076.27	610.20	625.22	15.02	0.43	599.00	600.98	1.98	5.77	5.34	-13.04
85895.92	593.49	595.12	1.63	2.27	593.49	595.11	1.62	2.29	0.02	-0.65
85755.90	593.18	594.89	1.71	2.34	593.18	594.89	1.71	2.34	0.00	-1.11
85000.00	591.49	593.59	2.10	2.82	591.49	593.59	2.10	2.82	0.00	-1.27
84400.10	589.46	592.31	2.85	3.37	589.46	592.31	2.85	3.37	0.00	2.85

River Station	WITH DAM				WITHOUT DAM				DIFFERENCE [w/o-with]	
	Min Channel El. With Dam	WSEL With Dam 1%	Depth of Water (ft)	Velocity with Dam (ft/s)	Min Channel El. - Eroded	WSEL Without Dam 1%	Depth of Water (ft)	Velocity without Dam (ft/s)	Velocity (ft/s)	Depth (ft)
105000.00	635.77	639.05	3.28	1.79	635.77	639.05	3.28	1.79	0.00	0.00
104000.00	634.98	638.39	3.41	2.41	634.98	638.39	3.41	2.41	0.00	0.00
103000.00	634.04	637.74	3.70	2.00	634.04	637.74	3.70	2.00	0.00	0.00
102015.90	633.78	637.33	3.55	1.69	633.78	637.33	3.55	1.69	0.00	0.00
101000.00	633.40	636.52	3.12	2.76	633.40	636.52	3.12	2.76	0.00	0.00
100000.00	631.67	633.97	2.30	3.71	631.67	633.97	2.30	3.71	0.00	0.00
99000.00	628.45	630.75	2.30	3.48	628.45	630.75	2.30	3.48	0.00	0.00
98270.85	626.52	628.99	2.47	3.36	626.52	628.99	2.47	3.35	-0.01	0.00
98088.88	626.12	627.59	1.47	5.58	626.12	627.66	1.54	5.26	-0.32	0.07
97000.00	623.17	626.50	3.33	2.06	623.17	626.25	3.08	2.25	0.19	-0.25
96000.00	622.32	626.02	3.70	2.15	622.32	625.38	3.06	2.83	0.68	-0.64
95000.00	621.16	625.77	4.61	1.41	621.16	624.50	3.34	2.18	0.77	-1.27
94000.00	620.16	625.59	5.43	1.28	620.16	622.06	1.90	6.24	4.96	-3.53
93000.00	617.66	625.43	7.77	1.17	615.87	618.75	2.88	2.67	1.50	-4.89
92000.00	615.46	625.40	9.94	0.67	614.00	616.94	2.94	3.17	2.50	-7.00
91000.00	615.13	625.38	10.25	0.64	612.00	614.85	2.85	3.07	2.43	-7.40
90000.00	614.50	625.36	10.86	0.67	610.00	613.31	3.31	2.44	1.77	-7.55
89000.00	619.01	625.32	6.31	0.76	608.00	609.98	1.98	5.75	4.99	-4.33
88000.00	616.71	625.25	8.54	0.80	603.00	606.66	3.66	2.12	1.32	-4.88
87000.00	611.07	625.22	14.15	0.67	602.50	605.18	2.68	3.38	2.71	-11.47
86850.00	611.00	625.22	14.22	0.54	602.00	604.23	2.23	4.61	4.07	-11.99
86700.00	609.99	625.22	15.23	0.49	601.00	603.43	2.43	3.98	3.49	-12.80
86455.00	610.24	625.22	14.98	0.52	600.00	602.96	2.96	2.89	2.37	-12.02
86280.00	610.49	625.22	14.73	0.51	600.00	602.30	2.30	4.38	3.87	-12.43
86130.00	610.34	625.22	14.88	0.45	599.00	601.69	2.69	3.36	2.91	-12.19
86076.27	610.20	625.22	15.02	0.43	599.00	600.98	1.98	5.77	5.34	-13.04
85895.92	593.49	595.12	1.63	2.27	593.49	595.11	1.62	2.29	0.02	-0.65
85755.90	593.18	594.89	1.71	2.34	593.18	594.89	1.71	2.34	0.00	-1.11
85000.00	591.49	593.59	2.10	2.82	591.49	593.59	2.10	2.82	0.00	-1.27
84400.10	589.46	592.31	2.85	3.37	589.46	592.31	2.85	3.37	0.00	2.85

Appendix B Statistical Analyses

APPENDIX B STATISTICAL ANALYSES

Rank	Date	Date (year)	Estimated Ice Thickness (in)	Daily Average Discharge (cfs)	Ice Probability (%)	Discharge Probability (%)	Combined Probability (%)
1	15-Mar-78	1978	23.20	36000	1.69	8.43	0.16
2	6-Mar-63	1963	21.70	21500	3.93	6.18	0.27
3	10-Feb-59	1959	16.10	28000	19.66	1.69	0.42
4	23-Feb-45	1945	17.10	9000	10.67	15.17	2.09
5	22-Jan-59	1959	14.40	25000	46.63	3.93	3.45
6	27-Jan-84	1984	16.70	6100	12.92	19.66	3.50
7	23-Feb-71	1971	15.90	21000	26.40	10.67	4.11
8	14-Feb-48	1948	16.40	4500	15.17	35.39	8.92
9	26-Feb-29	1929	15.90	6000	28.65	21.91	10.13
10	26-Feb-26	1926	14.60	9310	44.38	12.92	10.59
11	24-Feb-79	1979	19.00	1800	6.18	69.10	12.84
12	31-Jan-82	1982	15.50	5200	33.15	26.40	15.10
13	20-Feb-40	1940	14.80	5000	37.64	30.90	21.25
14	20-Jan-86	1986	13.30	5200	51.12	28.65	29.58
15	23-Feb-80	1980	15.00	4200	35.39	44.38	30.42
16	13-Feb-51	1951	15.80	3000	30.90	53.37	33.85
17	6-Feb-28	1928	12.40	6000	62.36	24.16	34.54
18	2-Mar-07	2007	14.30	4211	48.88	42.13	41.04
19	26-Feb-65	1965	16.10	1700	21.91	71.35	41.13
20	31-Jan-01	2001	14.80	3000	39.89	55.62	45.40
21	9-Feb-56	1956	12.50	4500	60.11	37.64	47.63
22	24-Feb-58	1958	13.20	3500	53.37	48.88	52.25
23	26-Jan-62	1962	12.80	3800	57.87	46.63	54.54
24	25-Jan-43	1943	12.30	4500	64.61	39.89	54.78
25	3-Feb-39	1939	9.70	8800	87.08	17.42	58.70
26	23-Feb-03	2003	16.10	1100	24.16	82.58	60.17
27	13-Feb-55	1955	12.10	3000	66.85	57.87	73.47
28	30-Dec-51	1951	10.00	5000	84.83	33.15	73.49
29	7-Feb-25	1925	14.80	1110	42.13	80.34	74.84
30	10-Mar-34	1934	16.30	426	17.42	93.82	76.20
31	10-Mar-44	1944	13.20	1500	55.62	75.84	79.73
32	30-Jan-24	1924	11.20	2150	69.10	64.61	80.32
33	1OFeb33	1933	10.90	2800	71.35	62.36	80.49
34	26-Feb-36	1936	18.70	28	8.43	98.31	84.30
35	4-Feb-87	1987	10.20	3000	80.34	60.11	86.03
36	27-Dec-45	1945	10.30	2000	75.84	66.85	86.36
37	15-Jan-76	1976	10.30	1600	78.09	73.60	90.85
38	23-Jan-47	1947	8.50	3500	91.57	51.12	91.91
39	3-Mar-50	1950	10.90	950	73.60	87.08	94.95
40	9-Feb-41	1941	10.20	1000	82.58	84.83	96.37
41	24-Dec-83	1983	8.50	1200	93.82	78.09	98.19
42	24-Jan-35	1935	9.40	630	89.33	89.33	98.59
43	6-Jan-42	1942	6.10	240	96.07	96.07	99.83
44	27-Dec-48	1948	5.50	480	98.31	91.57	99.84

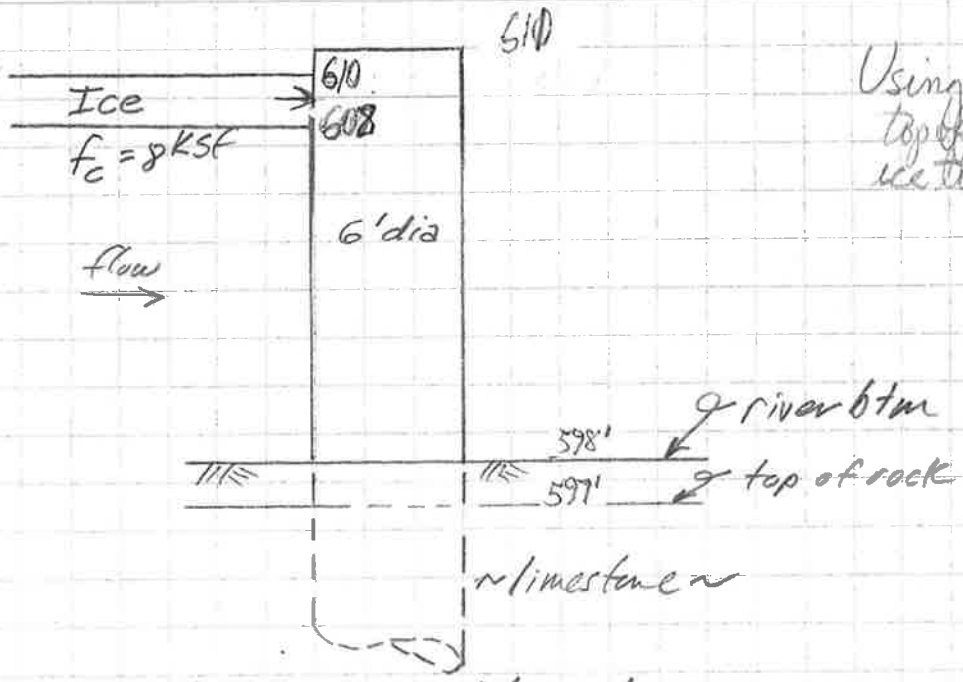
Flooded Freemont with Dam

Appendix C Structural Calculations

C.1 STRUCTURAL CALCULATIONS

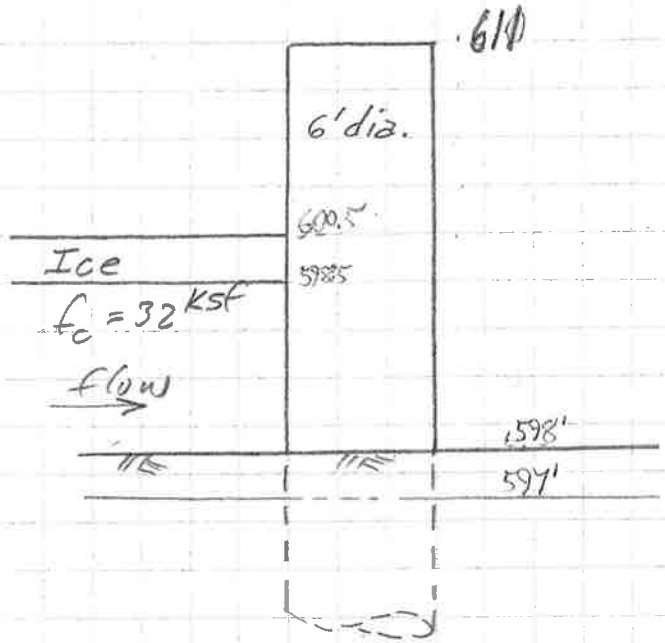
Ballville Dam Removal 175630015 Task 416
Ice Control Structure

Stantec



Using 500yr flood model
top of ice = 610'
ice thickness = 2'

Loading Condition 1



Using flow model from report
- 1.5' of flow
- 2.0' of ice

Loading Condition 2

NTS

Designed by: J Banton PE 1/11/12 Checked by: D. Rogers, PE 5/23/2013

V:\1756\active\175630015\geotech\Bulk\ICS loading\Dynamic and Static Loading.xlsx

175630015: Ballville Dam Removal - Ice Control Structure (ICS)

Following the guidelines found in AASHTO LRFD Bridge Design Specifications, Section 3, 5th Ed. 2010

General Info

Effective Ice Strength	
8.0 ksf	Breakup occurs at melting temperatures; structure is substantially disintegrated
16.0 ksf	Breakup occurs at melting temperatures; structure is somewhat disintegrated
24.0 ksf	Breakup or major ice movement occurs at melting temperatures; ice moves and is internally sound
32.0 ksf	Breakup or major ice movement occurs when the ice temperature is below the melting point (averaged over the its depth)

Equations

$C_a = (5t/w + 1)^{0.5}$

$$Cn = \frac{0.5}{\tan(\alpha - 15)}$$

$F_c = Ca*p*t*w$

$F_b = C_n*p*t^2$

$$Fv = 80.0t^2(0.35 + \frac{0.03R}{t^{0.75}})$$

Variables	
R	Pier radius (ft)
α	Inclination of the nose to the vertical
d	Pier diameter (ft)
w	Pier width at level of ice action (ft)
t	Thickness of ice (ft)
p	Effective ice crushing strength as specified in Article 3.9.2.1 (ksf)
C_a	Coefficient accounting for the effect of the pier width/ice thickness ratio where the floe fails by crushing
C_n	Coefficient accounting for the inclination of the pier nose with respect to a vertical
F_c	Horizontal ice force caused by ice floes that fail by crushing over the full width of the pier (kips)
F_b	Horizontal ice force caused by ice floes that fail by flexure as they ride up the inclined pier nose (kips)
F_v	Vertical force on a bridge pier due to rapid water level fluctuations (kips)

User Defined Values	
d (ft)	6.00
α (degrees)	0.00
w (ft)	6.00
t (ft)	2.00
p (ksf)	8.0
R (ft)	3.00

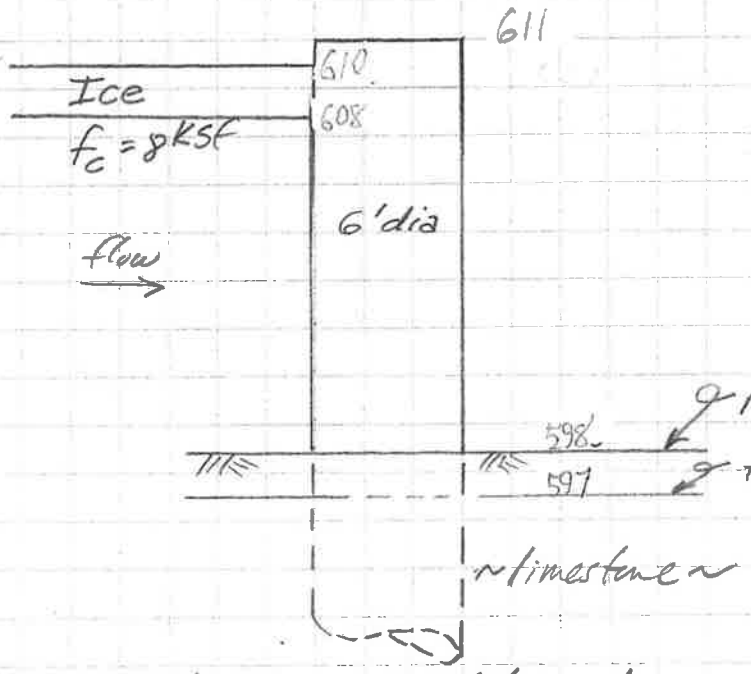
Dynamic Loading			
$w/t \le 6$	✓ 3.00	$w/t > 6$	✗ 3.00
If $w/t \le 6$, F = lesser of either F_c or, when ice failure by flexure is considered applicable, F_b **		If $w/t > 6$, $F = F_c$	
C_a	1.633		
C_n	-1.866		
F_c (kips)	156.7673435		
F_c (Tons)	78		
F_b (kips)**	-59.713		
F_b (Tons)**	-29.856		
Static Loading			
F_v (kips)	129.125		
F_v (Tons)	65		

** When $\alpha \le 15$ degrees, ice failure by flexure shall not be considered to be a possible ice failure mode for the purpose of calculating the horizontal force, F, in which case F shall be taken as F_c

Ballville Dam Removal 175630015 Task 416
Ice Control Structure

Stantec

LPile Input



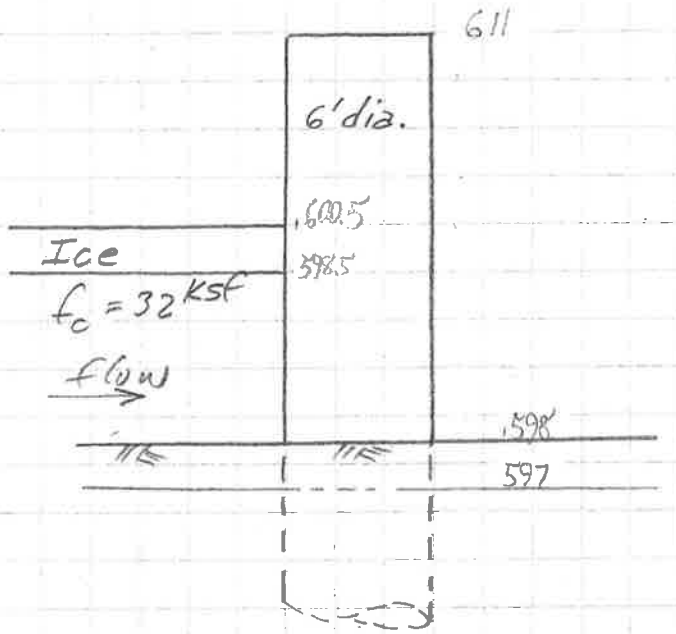
-0" → 157 kip

-144"

Total Length ~ 324"

0.081" 3600 psi

Loading Condition 1



-0" → 627 kip

42"

-30"

Total length 210"

0.081" 3600 psi

Loading Condition 2

NTS

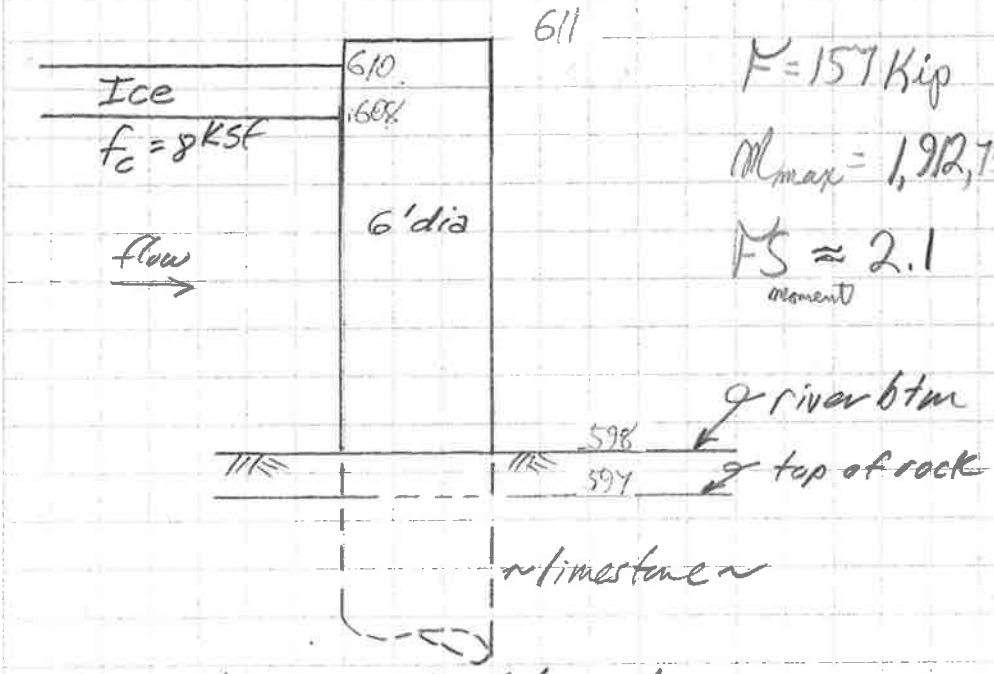
Designed by: JBanton PE 1/11/12 Checked by:

D. Rogers, PE 3/23/2013

Ballville Dam Removal 175630015 Task 416
Ice Control Structure

Stantec

Results

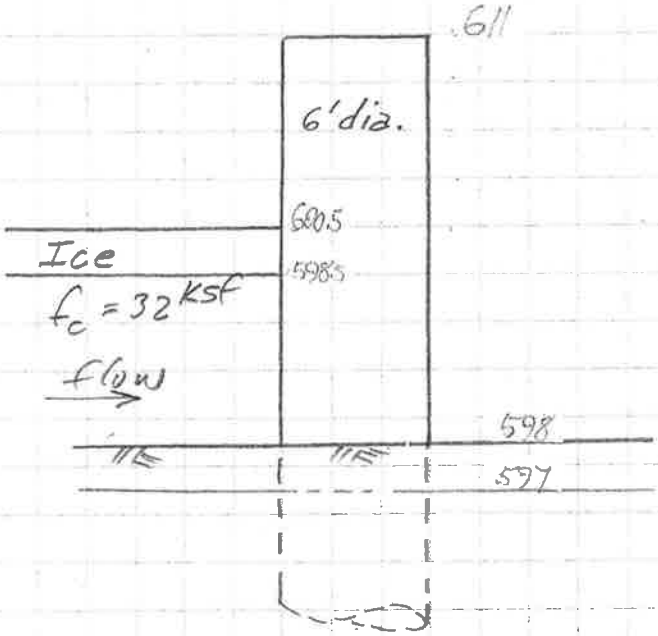


$F = 157$ Kip

$M_{max} = 1,912,750$ ft-lbs

$FS_{moment} \approx 2.1$

Loading Condition 1



$F = 627$ Kip

$M_{max} = 1,856,250$ ft-lbs

$FS_{moment} \approx 2.2$

Loading Condition 2

NTS

Designed by: JBanton PE 1/11/12 Checked by:

D. Rogers, PE 3/23/2013

Z:\Spreadsheets\Templates\Concrete column.xls

Stantec	Project: Ballville Ice Control Structure	Engineer: mrs Date: 23-May-13	Project #
ShortCol Copyright © 2007	Subject: 72" Drilled Shaft	Checker: Date:	Page:

Last modified: 06-May-10

Reinforced concrete column capacity

Materials:

Concrete f'_c = 4.5 ksi γ_c = 145 lb/ft³

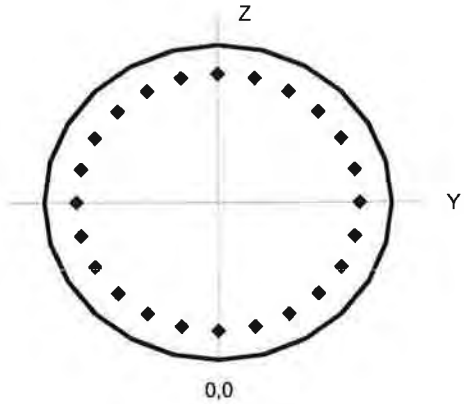
Steel f_y = 60 ksi E_c = 3,865 ksi

Ultimate conc. strain ε_c = -0.003 E_s = 29,000 ksi

Design Code: AASHTO LRFD-static

Resistance Factors ϕ_b = 0.9 ϕ_c = 0.75

Confinement: Spiral



Section Properties:

Diameter = 72 in Width =

A_C = 4071.5 in² A_T = 4269.7 in²

I_C = 1319167 in⁴ I_T = 1404683 in⁴

Y_{bC} = 36 in Y_{bT} = 36.00 in

Reinforcing bars:

Bar Area = 1.27 in²

No.bars = 24 (< 100)

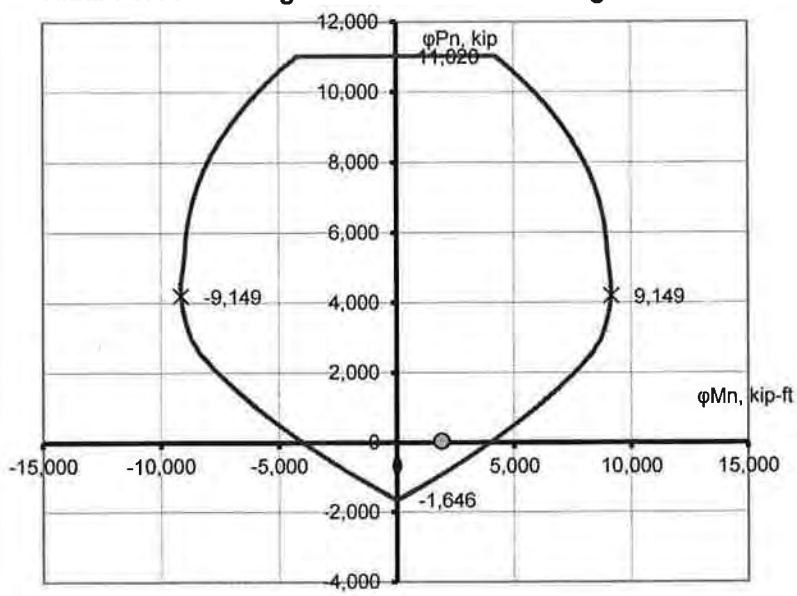
Σ(As) = 30.48 in²

As/Ac = 0.75%

Edge dist. = 6.625 in

Reinforcing Bar No.	Area A_s in²	Coordinates, in Y (from ctr.)	Z (from bot.)
1	1.27	29.38	36.00
2	1.27	28.37	43.60
3	1.27	25.44	50.69
4	1.27	20.77	56.77
5	1.27	14.69	61.44
6	1.27	7.60	64.37
7	1.27	0.00	65.38
8	1.27	-7.60	64.37
9	1.27	-14.69	61.44
10	1.27	-20.77	56.77
11	1.27	-25.44	50.69
12	1.27	-28.37	43.60
13	1.27	-29.38	36.00
14	1.27	-28.37	28.40
15	1.27	-25.44	21.31
16	1.27	-20.77	15.23
17	1.27	-14.69	10.56
18	1.27	-7.60	7.63
19	1.27	0.00	6.63
20	1.27	7.60	7.63
21	1.27	14.69	10.56
22	1.27	20.77	15.23
23	1.27	25.44	21.31

Axial Force/Bending Moment Interaction Diagram

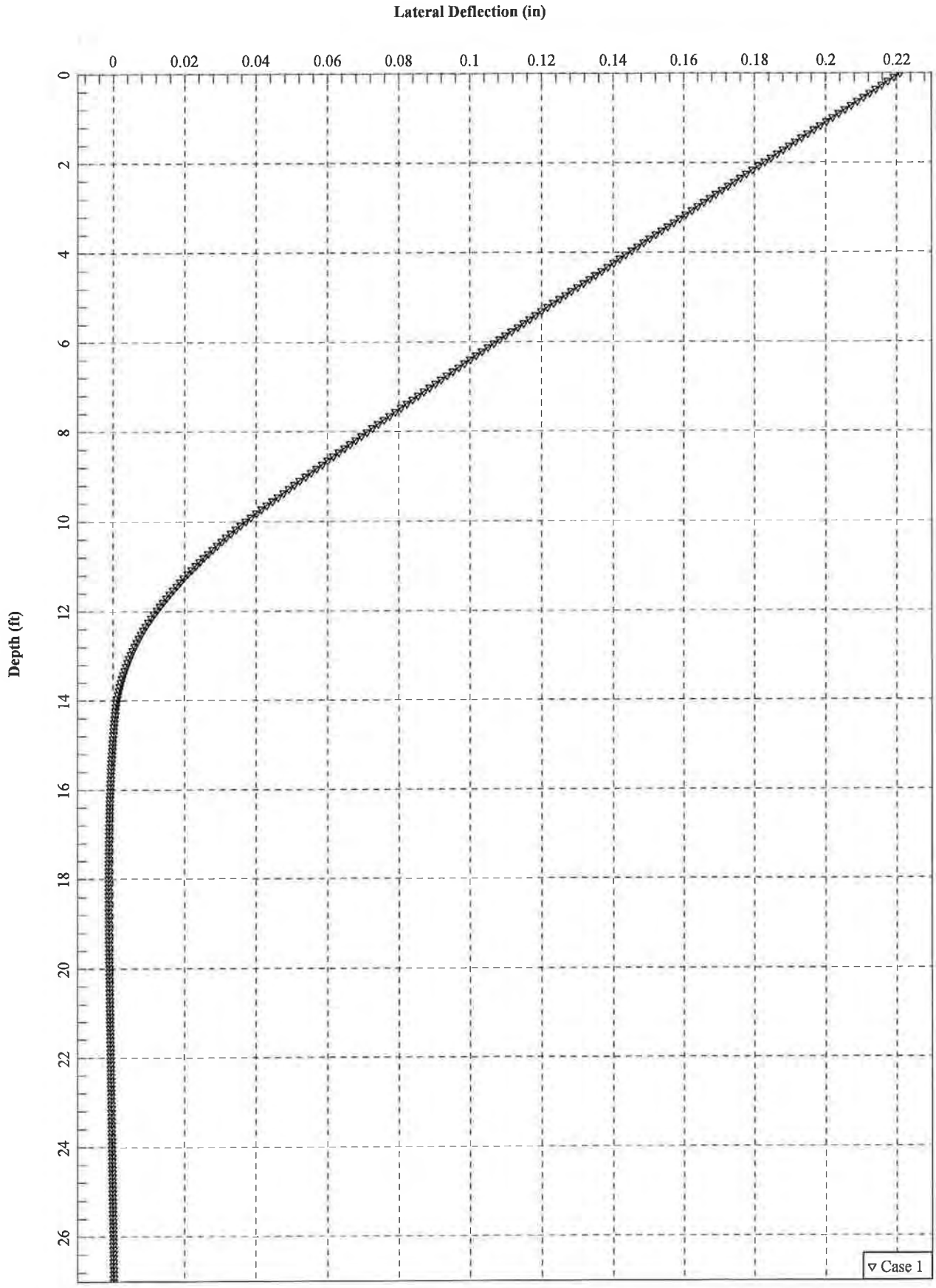


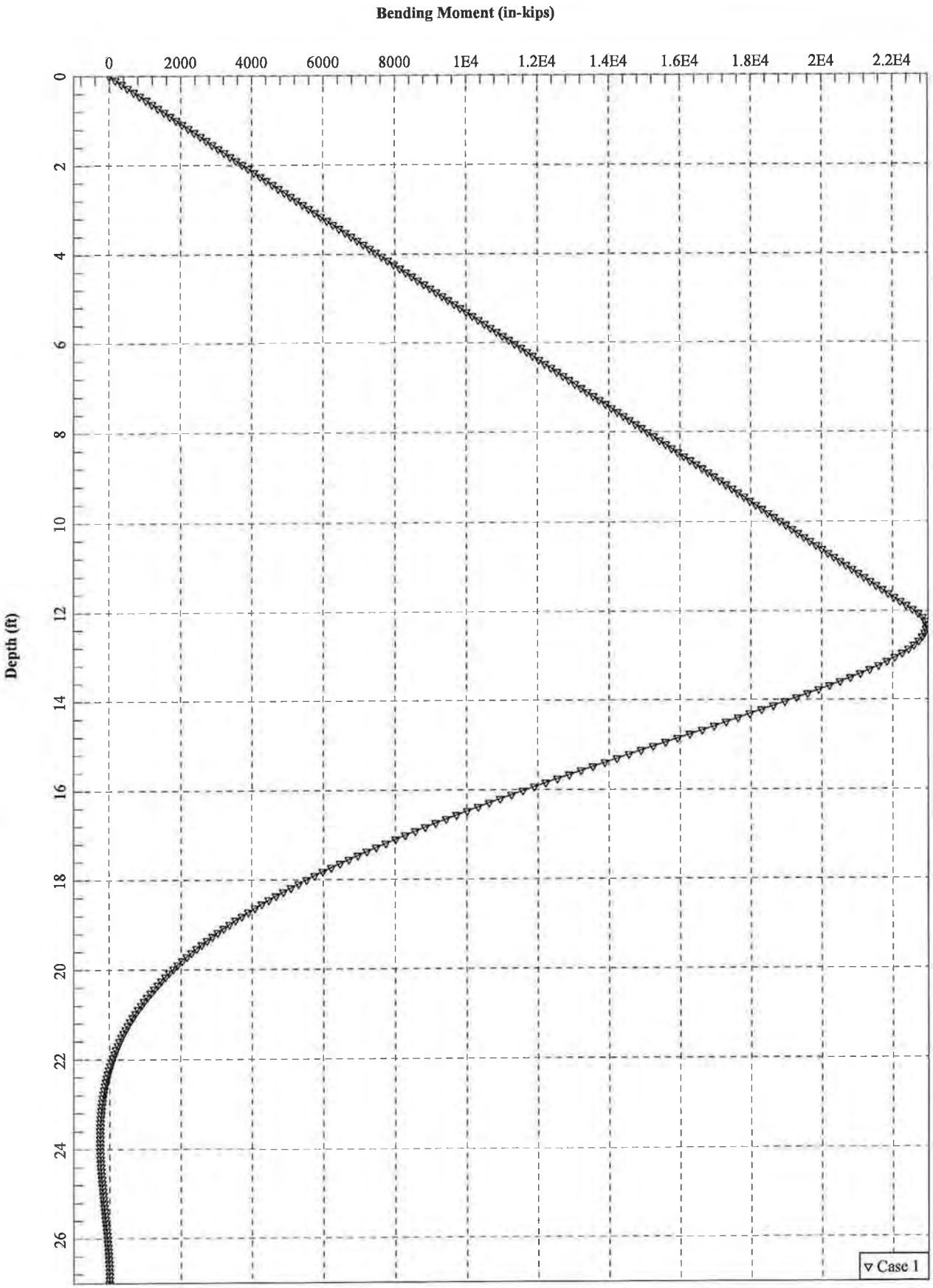
Positive moment corresponds to tension in bottom fibers of the section
Positive axial force is compressive force

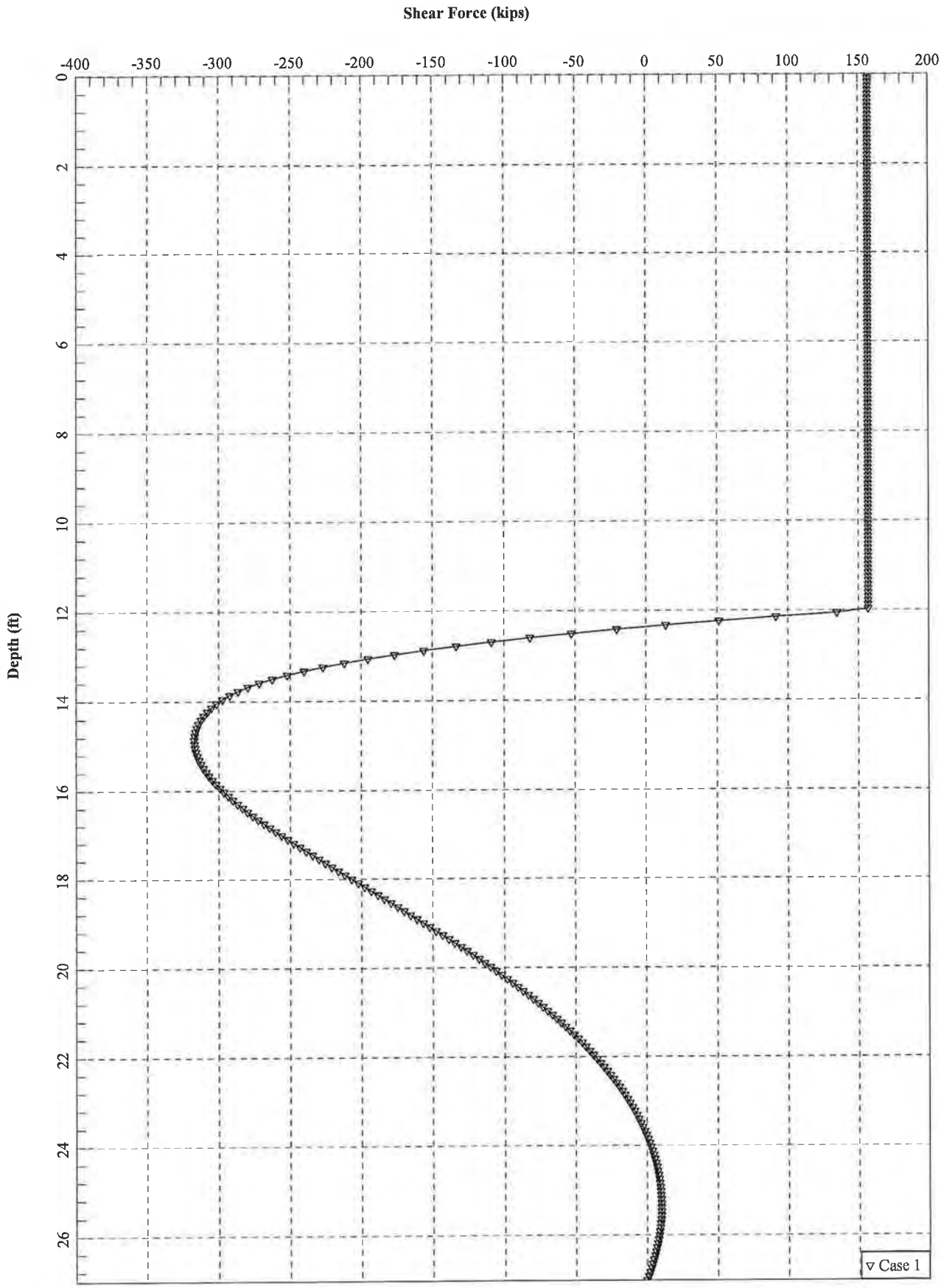
Description	Factored Loads Pu kip	Mu kip-ft	Capacity φMn kip-ft	Demand/ Capacity Ratio
1	31	1918	4058	47%
2	31	1900.8	4058	47%
3				
4				
5				

C.2 LPILE COMPUTER PROGRAM OUTPUT

LPile LC 1


Lateral Deflection (in)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Case 1


Bending Moment (in-kips)
0
2000
4000
6000
8000
1E4
1.2E4
1.4E4
1.6E4
1.8E4
2E4
2.2E4
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Case 1


Shear Force (kips)
-400
-350
-300
-250
-200
-150
-100
-50
0
50
100
150
200
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Case 1

```
================================================================================

                    LPILE Plus for Windows, Version 5.0 (5.0.47)

                  Analysis of Individual Piles and Drilled Shafts
                 Subjected to Lateral Loading Using the p-y Method

                          (c) 1985-2010 by Ensoft, Inc.
                               All Rights Reserved

================================================================================

This program is licensed to:

Daniel Rogers, PE
Stantec Consulting Services Inc

--------------------------------------------------------------------------------
                              Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
V:\1756\active\175630015\geotechnical\analysis\Ballville Dam LPILE\UPDATE 05222013\
Name of input data file:      Ballville Dam_LC_1_Downstream.lpd
Name of output file:          Ballville Dam_LC_1_Downstream.lpo
Name of plot output file:     Ballville Dam_LC_1_Downstream.lpp
Name of runtime file:         Ballville Dam_LC_1_Downstream.lpr


--------------------------------------------------------------------------------
                            Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  May 23, 2013     Time:  11:59:17


--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

Ballville Dam Ice Control Structure-LC_1_Downstream


--------------------------------------------------------------------------------
                                  Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 3:
- Computation of Nonlinear Bending Stiffness and Ultimate Bending Moment
  Capacity with Pile Response Computed Using Nonlinear EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
```

- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 300
- Maximum number of iterations allowed = 300
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 324.00 in

Depth of ground surface below top of pile = 144.00 in

Slope angle of ground surface = 0.00 deg.

Structural properties of pile defined using 2 points

Point No.	Point Depth in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	72.00000000	1319167.	4071.5000	3865000.
2	324.0000	72.00000000	1319167.	4071.5000	3865000.

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of moment of inertia and modulus of are not used for any computations other than total stress due to combined axial loading and bending.

Soil and Rock Layering Information

The soil profile is modelled using 1 layers

Layer 1 is strong rock (vuggy limestone)
Distance from top of pile to top of layer = 144.000 in
Distance from top of pile to bottom of layer = 800.000 in

(Depth of lowest layer extends 476.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 2 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3

1	144.00	0.08100
2	800.00	0.08100

Shear Strength of Soils

Shear strength parameters with depth defined using 2 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	144.000	3600.00000	0.00	------	------
2	800.000	3600.00000	0.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 157000.000 lbs
Bending moment at pile head = 0.000 in-lbs
Axial load at pile head = 0.000 lbs

(Zero moment at pile head for this load indicates a free-head condition)

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Number of sections = 1

Pile Section No. 1

The sectional shape is a circular drilled shaft (bored pile).

Outside Diameter = 72.0000 in

Material Properties:

Compressive Strength of Concrete	=	4.500	kip/in**2
Yield Stress of Reinforcement	=	60.	kip/in**2
Modulus of Elasticity of Reinforcement	=	29000.	kip/in**2
Number of Reinforcing Bars	=	24	
Area of Single Bar	=	1.27000	in**2
Number of Rows of Reinforcing Bars	=	13	
Area of Steel	=	30.480	in**2
Area of Shaft	=	4071.504	in**2
Percentage of Steel Reinforcement	=	0.749	percent
Cover Thickness (edge to bar center)	=	6.625	in

Unfactored Axial Squash Load Capacity = 17285.72 kip

Distribution and Area of Steel Reinforcement

Row Number	Area of Reinforcement in**2	Distance to Centroidal Axis in
1	1.270	29.375
2	2.540	28.374
3	2.540	25.439
4	2.540	20.771
5	2.540	14.687
6	2.540	7.603
7	2.540	0.000
8	2.540	-7.603
9	2.540	-14.687
10	2.540	-20.771
11	2.540	-25.439
12	2.540	-28.374
13	1.270	-29.375

Axial Thrust Force = 0.00 lbs

Bending Moment in-lbs	Bending Stiffness lb-in2	Bending Curvature rad/in	Maximum Strain in/in	Neutral Axis Position inches	Max. Concrete Stress psi	Max. Steel Stress psi
4547209.	5.456651E+12	8.333333E-07	0.00003010	36.11977994	113.32093	712.79052
9050696.	5.430418E+12	0.00000167	0.00006020	36.11953318	224.93635	1425.56910
13510462.	5.404185E+12	0.00000250	0.00009030	36.11928213	334.84627	2138.33545
17926505.	5.377951E+12	0.00000333	0.00012040	36.11903107	443.05079	2851.08967
17926505.	4.302361E+12	0.00000417	0.00006880	16.51232994	251.46414	5904.23930
17926505.	3.585301E+12	0.00000500	0.00008261	16.52262747	300.92168	7083.59402
17926505.	3.073115E+12	0.00000583	0.00009644	16.53297007	350.09865	8262.44340

17926505.	2.688976E+12	0.00000667	0.00011029	16.54336202	398.99421
9440.78334					
17926505.	2.390201E+12	0.00000750	0.00012415	16.55379903	447.60733
10618.61121					
17926505.	2.151181E+12	0.00000833	0.00013804	16.56428325	495.93709
11795.92321					
17926505.	1.955619E+12	0.00000917	0.00015194	16.57481468	543.98253
12972.71593					
17926505.	1.792650E+12	0.00001000	0.00016585	16.58539546	591.74274
14148.98532					
17926505.	1.654754E+12	0.00001083	0.00017979	16.59602559	639.21675
15324.72780					
17926505.	1.536558E+12	0.00001167	0.00019374	16.60670292	686.40347
16499.94051					
17926505.	1.434120E+12	0.00001250	0.00020772	16.61742961	733.30198
17674.61926					
17926505.	1.344488E+12	0.00001333	0.00022171	16.62820780	779.91134
18848.75965					
17926505.	1.265400E+12	0.00001417	0.00023572	16.63903749	826.23054
20022.35793					
17926505.	1.195100E+12	0.00001500	0.00024975	16.64991653	872.25843
21195.41131					
17926505.	1.132200E+12	0.00001583	0.00026380	16.66084707	917.99406
22367.91522					
17926505.	1.075590E+12	0.00001667	0.00027786	16.67182910	963.43635
23539.86593					
17926505.	1.024372E+12	0.00001750	0.00029195	16.68286479	1008.58435
24711.25862					
17926505.	9.778093E+11	0.00001833	0.00030606	16.69395411	1053.43698
25882.08940					
17926505.	9.352959E+11	0.00001917	0.00032018	16.70509493	1097.99299
27052.35557					
18022639.	9.011320E+11	0.00002000	0.00033433	16.71628940	1142.25140
28222.05215					
18763365.	9.006415E+11	0.00002083	0.00034849	16.72753966	1186.21122
29391.17396					
19503234.	9.001492E+11	0.00002167	0.00036267	16.73884571	1229.87130
30559.71695					
20242236.	8.996549E+11	0.00002250	0.00037688	16.75020540	1273.23034
31727.67848					
20980371.	8.991588E+11	0.00002333	0.00039110	16.76162302	1316.28747
32895.05175					
21717631.	8.986606E+11	0.00002417	0.00040535	16.77309644	1359.04136
34061.83408					
22454009.	8.981603E+11	0.00002500	0.00041962	16.78462565	1401.49079
35228.02140					
23189505.	8.976583E+11	0.00002583	0.00043390	16.79621494	1443.63488
36393.60648					
23999380.	8.999768E+11	0.00002667	0.00044800	16.80000007	1484.83975
37564.66661					
24716290.	8.987742E+11	0.00002750	0.00046200	16.80000007	1525.39258
38738.56244					
25431195.	8.975716E+11	0.00002833	0.00047600	16.80000007	1565.59095
39912.45827					
26144096.	8.963690E+11	0.00002917	0.00049000	16.80000007	1605.43488
41086.35411					
26856269.	8.952090E+11	0.00003000	0.00050402	16.80066097	1644.98209
42259.67496					
27586616.	8.947010E+11	0.00003083	0.00051835	16.81149280	1685.08186
43423.86935					
28316055.	8.941912E+11	0.00003167	0.00053271	16.82237613	1724.86565
44587.49292					
29044585.	8.936795E+11	0.00003250	0.00054708	16.83331311	1764.33244

45750.53990					
30498883.	8.926502E+11	0.00003417	0.00057589	16.85534370	1842.30965
48074.89278					
31949465.	8.916130E+11	0.00003583	0.00060478	16.87758887	1919.00381
50396.89307					
33396286.	8.905676E+11	0.00003750	0.00063375	16.90005291	1994.40500
52716.50497					
34839305.	8.895142E+11	0.00003917	0.00066281	16.92274225	2068.50330
55033.68943					
36278469.	8.884523E+11	0.00004083	0.00069195	16.94565904	2141.28812
57348.41125					
37713733.	8.873819E+11	0.00004250	0.00072117	16.96880972	2212.74904
59660.62952					
38934730.	8.815411E+11	0.00004417	0.00074911	16.96100342	2279.49892
60000.00000					
39936015.	8.713312E+11	0.00004583	0.00077568	16.92401898	2341.56454
60000.00000					
40771614.	8.583498E+11	0.00004750	0.00080116	16.86655319	2399.77853
60000.00000					
41506716.	8.442044E+11	0.00004917	0.00082600	16.80000007	2455.35431
60000.00000					
42251988.	8.311866E+11	0.00005083	0.00085368	16.79364216	2516.23614
60000.00000					
42874447.	8.166561E+11	0.00005250	0.00087747	16.71372521	2567.15955
60000.00000					
43377331.	8.008123E+11	0.00005417	0.00090027	16.62040579	2614.92052
60000.00000					
43878754.	7.858881E+11	0.00005583	0.00092312	16.53345931	2661.85230
60000.00000					
44378692.	7.718033E+11	0.00005750	0.00094601	16.45233643	2707.94976
60000.00000					
44877139.	7.584869E+11	0.00005917	0.00096895	16.37655437	2753.20829
60000.00000					
45310123.	7.448239E+11	0.00006083	0.00099126	16.29467404	2796.28390
60000.00000					
45631820.	7.301091E+11	0.00006250	0.00101246	16.19935906	2836.29539
60000.00000					
45952401.	7.161413E+11	0.00006417	0.00103370	16.10956514	2875.58348
60000.00000					
46271862.	7.028637E+11	0.00006583	0.00105497	16.02487814	2914.14453
60000.00000					
46590196.	6.902251E+11	0.00006750	0.00107628	15.94492471	2951.97476
60000.00000					
46907396.	6.781792E+11	0.00006917	0.00109763	15.86936796	2989.07044
60000.00000					
47223451.	6.666840E+11	0.00007083	0.00111902	15.79790103	3025.42754
60000.00000					
47538354.	6.557014E+11	0.00007250	0.00114044	15.73024714	3061.04220
60000.00000					
47844998.	6.451011E+11	0.00007417	0.00116181	15.66488707	3095.75224
60000.00000					
47855180.	6.310573E+11	0.00007583	0.00118300	15.59999907	3129.35587
60000.00000					
48268062.	6.228137E+11	0.00007750	0.00120669	15.57018149	3166.17770
60000.00000					
48452715.	6.120343E+11	0.00007917	0.00122602	15.48656523	3195.19507
60000.00000					
48636571.	6.016895E+11	0.00008083	0.00124538	15.40678561	3223.60699
60000.00000					
48819634.	5.917531E+11	0.00008250	0.00126478	15.33061516	3251.41070
60000.00000					
49001896.	5.822007E+11	0.00008417	0.00128420	15.25784147	3278.60305
60000.00000					

49183338.	5.730098E+11	0.00008583	0.00130366	15.18826711	3305.18063
60000.00000					
49363974.	5.641597E+11	0.00008750	0.00132315	15.12171614	3331.14084
60000.00000					
49543784.	5.556312E+11	0.00008917	0.00134267	15.05801904	3356.48016
60000.00000					
49722772.	5.474067E+11	0.00009083	0.00136223	14.99702346	3381.19562
60000.00000					
49900927.	5.394695E+11	0.00009250	0.00138182	14.93858564	3405.28392
60000.00000					
50078245.	5.318044E+11	0.00009417	0.00140144	14.88257253	3428.74177
60000.00000					
50254714.	5.243970E+11	0.00009583	0.00142110	14.82885969	3451.56576
60000.00000					
50429881.	5.172296E+11	0.00009750	0.00144078	14.77723897	3473.74195
60000.00000					
50529280.	5.095390E+11	0.00009917	0.00145897	14.71230376	3493.54696
60000.00000					
50726176.	4.948895E+11	0.00010250	0.00149543	14.58959806	3531.52388
60000.00000					
50920501.	4.811386E+11	0.00010583	0.00153201	14.47570288	3567.30536
60000.00000					
51270699.	4.696553E+11	0.00010917	0.00157200	14.40000021	3603.93493
60000.00000					
51348584.	4.564319E+11	0.00011250	0.00161389	14.34565008	3639.37371
60000.00000					
51526301.	4.448314E+11	0.00011583	0.00164944	14.23976076	3666.79001
60000.00000					
51701617.	4.338597E+11	0.00011917	0.00168511	14.14078295	3692.10139
60000.00000					
51874506.	4.234654E+11	0.00012250	0.00172090	14.04816949	3715.28607
60000.00000					
52044930.	4.136021E+11	0.00012583	0.00175681	13.96142900	3736.32151
60000.00000					
52212847.	4.042285E+11	0.00012917	0.00179285	13.88012159	3755.18465
60000.00000					
52378233.	3.953074E+11	0.00013250	0.00182901	13.80385458	3771.85200
60000.00000					
52541054.	3.868053E+11	0.00013583	0.00186530	13.73227394	3786.29939
60000.00000					
52701266.	3.786917E+11	0.00013917	0.00190172	13.66505778	3798.50186
60000.00000					
52805551.	3.705653E+11	0.00014250	0.00193632	13.58818781	3807.93352
60000.00000					
52882380.	3.626220E+11	0.00014583	0.00197010	13.50923002	3815.13941
60000.00000					
52957190.	3.550203E+11	0.00014917	0.00200399	13.43454874	3820.39608
60000.00000					
53029953.	3.477374E+11	0.00015250	0.00203799	13.36387360	3823.68289
60000.00000					
53100626.	3.407527E+11	0.00015583	0.00207211	13.29695570	3824.97875
60000.00000					
53164752.	3.340194E+11	0.00015917	0.00210634	13.23356974	3816.30002
60000.00000					
53164752.	3.271677E+11	0.00016250	0.00214500	13.19999921	3808.36442
60000.00000					
53216658.	3.209045E+11	0.00016583	0.00218900	13.19999921	3816.62658
60000.00000					
53396763.	3.156459E+11	0.00016917	0.00222629	13.16033256	3821.32148
60000.00000					
53450681.	3.098590E+11	0.00017250	0.00225960	13.09913099	3823.86305
60000.00000					
53503677.	3.042863E+11	0.00017583	0.00229304	13.04097855	3824.95572

60000.00000					
53554306.	2.989078E+11	0.00017917	0.00232675	12.98652971	3818.38125
60000.00000					
53603812.	2.937195E+11	0.00018250	0.00236062	12.93490684	3809.58024
60000.00000					
53652660.	2.887139E+11	0.00018583	0.00239459	12.88568723	3804.21364
60000.00000					
53700837.	2.838811E+11	0.00018917	0.00242866	12.83875287	3810.49540
60000.00000					
53748353.	2.792122E+11	0.00019250	0.00246284	12.79399860	3815.67037
60000.00000					
53795175.	2.746988E+11	0.00019583	0.00249713	12.75131929	3819.72367
60000.00000					
53841289.	2.703328E+11	0.00019917	0.00253153	12.71062052	3822.64016
60000.00000					
53886706.	2.661072E+11	0.00020250	0.00256604	12.67181861	3824.40435
60000.00000					
53931399.	2.620149E+11	0.00020583	0.00260067	12.63482988	3825.00009
60000.00000					
53973437.	2.580403E+11	0.00020917	0.00263564	12.60068643	3817.15261
60000.00000					
54015027.	2.541884E+11	0.00021250	0.00267070	12.56801713	3809.23816
60000.00000					
54056143.	2.504532E+11	0.00021583	0.00270585	12.53674901	3801.29699
60000.00000					
54096788.	2.468295E+11	0.00021917	0.00274108	12.50682628	3799.25376
60000.00000					
54136957.	2.433122E+11	0.00022250	0.00277640	12.47819531	3805.55837
60000.00000					
54176648.	2.398966E+11	0.00022583	0.00281181	12.45080674	3810.99998
60000.00000					
54215844.	2.365782E+11	0.00022917	0.00284731	12.42461121	3815.56761
60000.00000					
54251803.	2.333411E+11	0.00023250	0.00288264	12.39846933	3819.21195
60000.00000					
54269372.	2.269103E+11	0.00023917	0.00294859	12.32860529	3823.50556
60000.00000					
54285685.	2.208231E+11	0.00024583	0.00301483	12.26373231	3824.99921
60000.00000					
54298122.	2.150421E+11	0.00025250	0.00308184	12.20532238	3812.98369
60000.00000					
54309833.	2.095556E+11	0.00025917	0.00314906	12.15071476	3800.59843
60000.00000					
54320861.	2.043418E+11	0.00026583	0.00321647	12.09958541	3788.15109
60000.00000					
54331185.	1.993805E+11	0.00027250	0.00328409	12.05169404	3796.66224
60000.00000					
54340812.	1.946537E+11	0.00027917	0.00335191	12.00682819	3806.24187
60000.00000					
54576556.	1.909384E+11	0.00028583	0.00343000	12.00000036	3815.88917
60000.00000					
54842916.	1.874971E+11	0.00029250	0.00351000	12.00000036	3822.28965
60000.00000					
55096344.	1.841661E+11	0.00029917	0.00359000	12.00000036	3824.92489
60000.00000					
55323034.	1.808928E+11	0.00030583	0.00367000	12.00000036	3813.88182
60000.00000					
55323034.	1.770337E+11	0.00031250	0.00374595	11.98704636	3801.26425
60000.00000					
55323034.	1.733359E+11	0.00031917	0.00381355	11.94845903	3791.28505
60000.00000					

Unfactored (Nominal) Moment Capacity at Concrete Strain of 0.003 = 54282.03186

in-kip

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (Pile-head Condition Type 1)
Specified shear force at pile head = 157000.000 lbs
Specified moment at pile head = 0.000 in-lbs
Specified axial load at pile head = 0.000 lbs

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Flx. Rig. EI lbs-in**2	Soil Res. p lbs/in	Es*h F/L
0.000	0.220977	0.001169	1.57E+05	-0.001604	3.19E-08	5.46E+12	0.000	0.000
1.080	0.219244	1.70E+05	1.57E+05	-0.001604	4.627	5.46E+12	0.000	0.000
2.160	0.217511	3.39E+05	1.57E+05	-0.001604	9.255	5.46E+12	0.000	0.000
3.240	0.215779	5.09E+05	1.57E+05	-0.001604	13.882	5.46E+12	0.000	0.000
4.320	0.214046	6.78E+05	1.57E+05	-0.001604	18.509	5.46E+12	0.000	0.000
5.400	0.212314	8.48E+05	1.57E+05	-0.001604	23.136	5.46E+12	0.000	0.000
6.480	0.210582	1.02E+06	1.57E+05	-0.001604	27.764	5.46E+12	0.000	0.000
7.560	0.208850	1.19E+06	1.57E+05	-0.001604	32.391	5.46E+12	0.000	0.000
8.640	0.207118	1.36E+06	1.57E+05	-0.001603	37.018	5.46E+12	0.000	0.000
9.720	0.205387	1.53E+06	1.57E+05	-0.001603	41.646	5.46E+12	0.000	0.000
10.800	0.203655	1.70E+06	1.57E+05	-0.001603	46.273	5.46E+12	0.000	0.000
11.880	0.201925	1.87E+06	1.57E+05	-0.001602	50.900	5.46E+12	0.000	0.000
12.960	0.200194	2.03E+06	1.57E+05	-0.001602	55.527	5.46E+12	0.000	0.000
14.040	0.198465	2.20E+06	1.57E+05	-0.001602	60.155	5.46E+12	0.000	0.000
15.120	0.196735	2.37E+06	1.57E+05	-0.001601	64.782	5.46E+12	0.000	0.000
16.200	0.195006	2.54E+06	1.57E+05	-0.001601	69.409	5.46E+12	0.000	0.000
17.280	0.193278	2.71E+06	1.57E+05	-0.001600	74.037	5.46E+12	0.000	0.000
18.360	0.191550	2.88E+06	1.57E+05	-0.001600	78.664	5.46E+12	0.000	0.000
19.440	0.189823	3.05E+06	1.57E+05	-0.001599	83.291	5.46E+12	0.000	0.000
20.520	0.188096	3.22E+06	1.57E+05	-0.001598	87.918	5.46E+12	0.000	0.000
21.600	0.186370	3.39E+06	1.57E+05	-0.001598	92.546	5.46E+12	0.000	

0.000							
22.680	0.184645	3.56E+06	1.57E+05	-0.001597	97.173	5.46E+12	0.000
0.000							
23.760	0.182921	3.73E+06	1.57E+05	-0.001596	101.800	5.46E+12	0.000
0.000							
24.840	0.181197	3.90E+06	1.57E+05	-0.001595	106.428	5.46E+12	0.000
0.000							
25.920	0.179475	4.07E+06	1.57E+05	-0.001595	111.055	5.46E+12	0.000
0.000							
27.000	0.177753	4.24E+06	1.57E+05	-0.001594	115.682	5.46E+12	0.000
0.000							
28.080	0.176032	4.41E+06	1.57E+05	-0.001593	120.309	5.46E+12	0.000
0.000							
29.160	0.174312	4.58E+06	1.57E+05	-0.001592	124.937	5.46E+12	0.000
0.000							
30.240	0.172593	4.75E+06	1.57E+05	-0.001591	129.564	5.45E+12	0.000
0.000							
31.320	0.170875	4.92E+06	1.57E+05	-0.001590	134.191	5.45E+12	0.000
0.000							
32.400	0.169158	5.09E+06	1.57E+05	-0.001589	138.818	5.45E+12	0.000
0.000							
33.480	0.167442	5.26E+06	1.57E+05	-0.001588	143.446	5.45E+12	0.000
0.000							
34.560	0.165727	5.43E+06	1.57E+05	-0.001587	148.073	5.45E+12	0.000
0.000							
35.640	0.164014	5.60E+06	1.57E+05	-0.001586	152.700	5.45E+12	0.000
0.000							
36.720	0.162301	5.77E+06	1.57E+05	-0.001585	157.328	5.45E+12	0.000
0.000							
37.800	0.160590	5.93E+06	1.57E+05	-0.001584	161.955	5.44E+12	0.000
0.000							
38.880	0.158880	6.10E+06	1.57E+05	-0.001583	166.582	5.44E+12	0.000
0.000							
39.960	0.157172	6.27E+06	1.57E+05	-0.001581	171.209	5.44E+12	0.000
0.000							
41.040	0.155465	6.44E+06	1.57E+05	-0.001580	175.837	5.44E+12	0.000
0.000							
42.120	0.153759	6.61E+06	1.57E+05	-0.001579	180.464	5.44E+12	0.000
0.000							
43.200	0.152054	6.78E+06	1.57E+05	-0.001577	185.091	5.44E+12	0.000
0.000							
44.280	0.150351	6.95E+06	1.57E+05	-0.001576	189.719	5.44E+12	0.000
0.000							
45.360	0.148650	7.12E+06	1.57E+05	-0.001575	194.346	5.44E+12	0.000
0.000							
46.440	0.146950	7.29E+06	1.57E+05	-0.001573	198.973	5.44E+12	0.000
0.000							
47.520	0.145251	7.46E+06	1.57E+05	-0.001572	203.600	5.44E+12	0.000
0.000							
48.600	0.143555	7.63E+06	1.57E+05	-0.001570	208.228	5.44E+12	0.000
0.000							
49.680	0.141860	7.80E+06	1.57E+05	-0.001569	212.855	5.43E+12	0.000
0.000							
50.760	0.140166	7.97E+06	1.57E+05	-0.001567	217.482	5.43E+12	0.000
0.000							
51.840	0.138474	8.14E+06	1.57E+05	-0.001566	222.110	5.43E+12	0.000
0.000							
52.920	0.136784	8.31E+06	1.57E+05	-0.001564	226.737	5.43E+12	0.000
0.000							
54.000	0.135096	8.48E+06	1.57E+05	-0.001562	231.364	5.43E+12	0.000
0.000							
55.080	0.133410	8.65E+06	1.57E+05	-0.001561	235.991	5.43E+12	0.000
0.000							

56.160	0.131725	8.82E+06	1.57E+05	-0.001559	240.619	5.43E+12	0.000	0.000
57.240	0.130042	8.99E+06	1.57E+05	-0.001557	245.246	5.43E+12	0.000	0.000
58.320	0.128362	9.16E+06	1.57E+05	-0.001555	249.873	5.43E+12	0.000	0.000
59.400	0.126683	9.33E+06	1.57E+05	-0.001553	254.501	5.43E+12	0.000	0.000
60.480	0.125006	9.50E+06	1.57E+05	-0.001552	259.128	5.43E+12	0.000	0.000
61.560	0.123331	9.66E+06	1.57E+05	-0.001550	263.755	5.43E+12	0.000	0.000
62.640	0.121659	9.83E+06	1.57E+05	-0.001548	268.382	5.42E+12	0.000	0.000
63.720	0.119988	1.00E+07	1.57E+05	-0.001546	273.010	5.42E+12	0.000	0.000
64.800	0.118320	1.02E+07	1.57E+05	-0.001544	277.637	5.42E+12	0.000	0.000
65.880	0.116654	1.03E+07	1.57E+05	-0.001542	282.264	5.42E+12	0.000	0.000
66.960	0.114990	1.05E+07	1.57E+05	-0.001540	286.892	5.42E+12	0.000	0.000
68.040	0.113328	1.07E+07	1.57E+05	-0.001538	291.519	5.42E+12	0.000	0.000
69.120	0.111669	1.09E+07	1.57E+05	-0.001535	296.146	5.42E+12	0.000	0.000
70.200	0.110012	1.10E+07	1.57E+05	-0.001533	300.773	5.42E+12	0.000	0.000
71.280	0.108357	1.12E+07	1.57E+05	-0.001531	305.401	5.42E+12	0.000	0.000
72.360	0.106705	1.14E+07	1.57E+05	-0.001529	310.028	5.41E+12	0.000	0.000
73.440	0.105055	1.15E+07	1.57E+05	-0.001526	314.655	5.41E+12	0.000	0.000
74.520	0.103407	1.17E+07	1.57E+05	-0.001524	319.283	5.41E+12	0.000	0.000
75.600	0.101763	1.19E+07	1.57E+05	-0.001522	323.910	5.41E+12	0.000	0.000
76.680	0.100120	1.20E+07	1.57E+05	-0.001519	328.537	5.41E+12	0.000	0.000
77.760	0.098481	1.22E+07	1.57E+05	-0.001517	333.164	5.41E+12	0.000	0.000
78.840	0.096844	1.24E+07	1.57E+05	-0.001515	337.792	5.41E+12	0.000	0.000
79.920	0.095209	1.25E+07	1.57E+05	-0.001512	342.419	5.41E+12	0.000	0.000
81.000	0.093578	1.27E+07	1.57E+05	-0.001510	347.046	5.41E+12	0.000	0.000
82.080	0.091949	1.29E+07	1.57E+05	-0.001507	351.673	5.41E+12	0.000	0.000
83.160	0.090322	1.31E+07	1.57E+05	-0.001504	356.301	5.41E+12	0.000	0.000
84.240	0.088699	1.32E+07	1.57E+05	-0.001502	360.928	5.41E+12	0.000	0.000
85.320	0.087079	1.34E+07	1.57E+05	-0.001499	365.555	5.40E+12	0.000	0.000
86.400	0.085461	1.36E+07	1.57E+05	-0.001496	370.183	5.40E+12	0.000	0.000
87.480	0.083846	1.37E+07	1.57E+05	-0.001494	374.810	5.40E+12	0.000	0.000
88.560	0.082235	1.39E+07	1.57E+05	-0.001491	379.437	5.40E+12	0.000	0.000
89.640	0.080626	1.41E+07	1.57E+05	-0.001488	384.064	5.40E+12	0.000	

0.000							
90.720	0.079020	1.42E+07	1.57E+05	-0.001485	388.692	5.40E+12	0.000
0.000							
91.800	0.077418	1.44E+07	1.57E+05	-0.001482	393.319	5.40E+12	0.000
0.000							
92.880	0.075818	1.46E+07	1.57E+05	-0.001480	397.946	5.40E+12	0.000
0.000							
93.960	0.074222	1.48E+07	1.57E+05	-0.001477	402.574	5.40E+12	0.000
0.000							
95.040	0.072629	1.49E+07	1.57E+05	-0.001474	407.201	5.39E+12	0.000
0.000							
96.120	0.071039	1.51E+07	1.57E+05	-0.001471	411.828	5.39E+12	0.000
0.000							
97.200	0.069452	1.53E+07	1.57E+05	-0.001468	416.455	5.39E+12	0.000
0.000							
98.280	0.067869	1.54E+07	1.57E+05	-0.001464	421.083	5.39E+12	0.000
0.000							
99.360	0.066289	1.56E+07	1.57E+05	-0.001461	425.710	5.39E+12	0.000
0.000							
100.440	0.064713	1.58E+07	1.57E+05	-0.001458	430.337	5.39E+12	0.000
0.000							
101.520	0.063139	1.59E+07	1.57E+05	-0.001455	434.965	5.39E+12	0.000
0.000							
102.600	0.061570	1.61E+07	1.57E+05	-0.001452	439.592	5.39E+12	0.000
0.000							
103.680	0.060003	1.63E+07	1.57E+05	-0.001449	444.219	5.39E+12	0.000
0.000							
104.760	0.058441	1.64E+07	1.57E+05	-0.001445	448.846	5.39E+12	0.000
0.000							
105.840	0.056881	1.66E+07	1.57E+05	-0.001442	453.474	5.38E+12	0.000
0.000							
106.920	0.055326	1.68E+07	1.57E+05	-0.001439	458.101	5.38E+12	0.000
0.000							
108.000	0.053774	1.70E+07	1.57E+05	-0.001435	462.728	5.38E+12	0.000
0.000							
109.080	0.052226	1.71E+07	1.57E+05	-0.001432	467.356	5.38E+12	0.000
0.000							
110.160	0.050681	1.73E+07	1.57E+05	-0.001428	471.983	5.38E+12	0.000
0.000							
111.240	0.049140	1.75E+07	1.57E+05	-0.001425	476.610	5.38E+12	0.000
0.000							
112.320	0.047603	1.76E+07	1.57E+05	-0.001421	481.237	5.38E+12	0.000
0.000							
113.400	0.046070	1.78E+07	1.57E+05	-0.001418	485.865	5.38E+12	0.000
0.000							
114.480	0.044541	1.80E+07	1.57E+05	-0.001413	490.492	3.63E+12	0.000
0.000							
115.560	0.043017	1.81E+07	1.57E+05	-0.001400	495.119	9.01E+11	0.000
0.000							
116.640	0.041517	1.83E+07	1.57E+05	-0.001378	499.747	9.01E+11	0.000
0.000							
117.720	0.040041	1.85E+07	1.57E+05	-0.001356	504.374	9.01E+11	0.000
0.000							
118.800	0.038588	1.87E+07	1.57E+05	-0.001334	509.001	9.01E+11	0.000
0.000							
119.880	0.037160	1.88E+07	1.57E+05	-0.001311	513.628	9.01E+11	0.000
0.000							
120.960	0.035756	1.90E+07	1.57E+05	-0.001289	518.256	9.00E+11	0.000
0.000							
122.040	0.034377	1.92E+07	1.57E+05	-0.001266	522.883	9.00E+11	0.000
0.000							
123.120	0.033023	1.93E+07	1.57E+05	-0.001243	527.510	9.00E+11	0.000
0.000							

124.200	0.031693	1.95E+07	1.57E+05	-0.001219	532.138	9.00E+11	0.000	0.000
125.280	0.030389	1.97E+07	1.57E+05	-0.001196	536.765	9.00E+11	0.000	0.000
126.360	0.029110	1.98E+07	1.57E+05	-0.001172	541.392	9.00E+11	0.000	0.000
127.440	0.027857	2.00E+07	1.57E+05	-0.001148	546.019	9.00E+11	0.000	0.000
128.520	0.026630	2.02E+07	1.57E+05	-0.001124	550.647	9.00E+11	0.000	0.000
129.600	0.025429	2.03E+07	1.57E+05	-0.001100	555.274	9.00E+11	0.000	0.000
130.680	0.024255	2.05E+07	1.57E+05	-0.001075	559.901	8.99E+11	0.000	0.000
131.760	0.023107	2.07E+07	1.57E+05	-0.001050	564.528	8.99E+11	0.000	0.000
132.840	0.021986	2.09E+07	1.57E+05	-0.001025	569.156	8.99E+11	0.000	0.000
133.920	0.020892	2.10E+07	1.57E+05	-0.001000	573.783	8.99E+11	0.000	0.000
135.000	0.019825	2.12E+07	1.57E+05	-0.000975	578.410	8.99E+11	0.000	0.000
136.080	0.018786	2.14E+07	1.57E+05	-0.000949	583.038	8.99E+11	0.000	0.000
137.160	0.017775	2.15E+07	1.57E+05	-0.000924	587.665	8.99E+11	0.000	0.000
138.240	0.016791	2.17E+07	1.57E+05	-0.000898	592.292	8.99E+11	0.000	0.000
139.320	0.015836	2.19E+07	1.57E+05	-0.000871	596.919	8.99E+11	0.000	0.000
140.400	0.014909	2.20E+07	1.57E+05	-0.000845	601.547	8.98E+11	0.000	0.000
141.480	0.014010	2.22E+07	1.57E+05	-0.000818	606.174	8.98E+11	0.000	0.000
142.560	0.013141	2.24E+07	1.57E+05	-0.000792	610.801	8.98E+11	0.000	0.000
143.640	0.012300	2.26E+07	1.57E+05	-0.000765	615.429	8.98E+11	0.000	0.000
144.720	0.011489	2.27E+07	1.35E+05	-0.000737	620.056	8.98E+11	-41361.	3.89E+06
145.800	0.010708	2.28E+07	91515.	-0.000710	623.367	8.98E+11	-38547.	3.89E+06
146.880	0.009956	2.29E+07	51346.	-0.000683	625.450	8.98E+11	-35840.	3.89E+06
147.960	0.009233	2.30E+07	14043.	-0.000655	626.393	8.98E+11	-33240.	3.89E+06
149.040	0.008541	2.29E+07	-20511.	-0.000627	626.278	8.98E+11	-30747.	3.89E+06
150.120	0.007878	2.29E+07	-52430.	-0.000600	625.184	8.98E+11	-28362.	3.89E+06
151.200	0.007246	2.28E+07	-81830.	-0.000572	623.188	8.98E+11	-26084.	3.89E+06
152.280	0.006642	2.27E+07	-1.09E+05	-0.000545	620.361	8.98E+11	-23913.	3.89E+06
153.360	0.006069	2.26E+07	-1.34E+05	-0.000518	616.773	8.98E+11	-21847.	3.89E+06
154.440	0.005524	2.24E+07	-1.56E+05	-0.000490	612.489	8.98E+11	-19888.	3.89E+06
155.520	0.005009	2.23E+07	-1.77E+05	-0.000464	607.572	8.98E+11	-18034.	3.89E+06
156.600	0.004523	2.21E+07	-1.95E+05	-0.000437	602.082	8.98E+11	-16283.	3.89E+06
157.680	0.004066	2.18E+07	-2.12E+05	-0.000411	596.073	8.99E+11	-14636.	

3.89E+06								
158.760	0.003636	2.16E+07	-2.27E+05	-0.000384	589.598	8.99E+11	-13091.	
3.89E+06								
159.840	0.003235	2.14E+07	-2.40E+05	-0.000359	582.707	8.99E+11	-11647.	
3.89E+06								
160.920	0.002862	2.11E+07	-2.52E+05	-0.000333	575.444	8.99E+11	-10302.	
3.89E+06								
162.000	0.002516	2.08E+07	-2.62E+05	-0.000308	567.854	8.99E+11	-9055.959	
3.89E+06								
163.080	0.002196	2.05E+07	-2.72E+05	-0.000283	559.976	8.99E+11	-7907.086	
3.89E+06								
164.160	0.001904	2.02E+07	-2.80E+05	-0.000259	551.846	9.00E+11	-6854.005	
3.89E+06								
165.240	0.001638	1.99E+07	-2.86E+05	-0.000235	543.498	9.00E+11	-5895.305	
3.89E+06								
166.320	0.001397	1.96E+07	-2.92E+05	-0.000211	534.962	9.00E+11	-5029.537	
3.89E+06								
167.400	0.001182	1.93E+07	-2.97E+05	-0.000188	526.266	9.00E+11	-4255.220	
3.89E+06								
168.480	0.000992	1.90E+07	-3.02E+05	-0.000165	517.434	9.01E+11	-3570.847	
3.89E+06								
169.560	0.000826	1.86E+07	-3.05E+05	-0.000142	508.489	9.01E+11	-2974.886	
3.89E+06								
170.640	0.000685	1.83E+07	-3.08E+05	-0.000120	499.449	9.01E+11	-2465.789	
3.89E+06								
171.720	0.000567	1.80E+07	-3.10E+05	-0.000101	490.331	1.21E+12	-2041.991	
3.89E+06								
172.800	0.000467	1.76E+07	-3.12E+05	-9.11E-05	481.148	5.38E+12	-1680.786	
3.89E+06								
173.880	0.000370	1.73E+07	-3.14E+05	-8.76E-05	471.911	5.38E+12	-1333.343	
3.89E+06								
174.960	0.000278	1.70E+07	-3.15E+05	-8.42E-05	462.632	5.38E+12	-999.396	
3.89E+06								
176.040	0.000189	1.66E+07	-3.16E+05	-8.08E-05	453.321	5.38E+12	-678.673	
3.89E+06								
177.120	0.000103	1.63E+07	-3.17E+05	-7.75E-05	443.988	5.39E+12	-370.904	
3.89E+06								
178.200	2.11E-05	1.59E+07	-3.17E+05	-7.43E-05	434.644	5.39E+12	-75.820	
3.89E+06								
179.280	-5.75E-05	1.56E+07	-3.17E+05	-7.11E-05	425.297	5.39E+12	206.853	
3.89E+06								
180.360	-0.000133	1.52E+07	-3.17E+05	-6.81E-05	415.956	5.39E+12	477.384	
3.89E+06								
181.440	-0.000204	1.49E+07	-3.16E+05	-6.50E-05	406.631	5.39E+12	736.046	
3.89E+06								
182.520	-0.000273	1.46E+07	-3.15E+05	-6.21E-05	397.330	5.40E+12	983.108	
3.89E+06								
183.600	-0.000339	1.42E+07	-3.14E+05	-5.92E-05	388.059	5.40E+12	1218.842	
3.89E+06								
184.680	-0.000401	1.39E+07	-3.12E+05	-5.64E-05	378.828	5.40E+12	1443.516	
3.89E+06								
185.760	-0.000460	1.35E+07	-3.11E+05	-5.37E-05	369.642	5.40E+12	1657.399	
3.89E+06								
186.840	-0.000517	1.32E+07	-3.09E+05	-5.10E-05	360.509	5.41E+12	1860.756	
3.89E+06								
187.920	-0.000571	1.29E+07	-3.07E+05	-4.84E-05	351.436	5.41E+12	2053.851	
3.89E+06								
189.000	-0.000621	1.25E+07	-3.04E+05	-4.58E-05	342.427	5.41E+12	2236.945	
3.89E+06								
190.080	-0.000670	1.22E+07	-3.02E+05	-4.34E-05	333.490	5.41E+12	2410.297	
3.89E+06								
191.160	-0.000715	1.19E+07	-2.99E+05	-4.10E-05	324.630	5.41E+12	2574.164	
3.89E+06								

192.240	-0.000758	1.16E+07	-2.96E+05	-3.86E-05	315.852	5.41E+12	2728.800	3.89E+06
193.320	-0.000798	1.13E+07	-2.93E+05	-3.63E-05	307.160	5.41E+12	2874.457	3.89E+06
194.400	-0.000836	1.09E+07	-2.90E+05	-3.41E-05	298.560	5.42E+12	3011.387	3.89E+06
195.480	-0.000872	1.06E+07	-2.87E+05	-3.20E-05	290.056	5.42E+12	3139.835	3.89E+06
196.560	-0.000906	1.03E+07	-2.83E+05	-2.99E-05	281.652	5.42E+12	3260.047	3.89E+06
197.640	-0.000937	1.00E+07	-2.80E+05	-2.79E-05	273.351	5.42E+12	3372.265	3.89E+06
198.720	-0.000966	9.72E+06	-2.76E+05	-2.59E-05	265.158	5.42E+12	3476.725	3.89E+06
199.800	-0.000993	9.42E+06	-2.72E+05	-2.40E-05	257.075	5.43E+12	3573.666	3.89E+06
200.880	-0.001018	9.13E+06	-2.68E+05	-2.22E-05	249.107	5.43E+12	3663.318	3.89E+06
201.960	-0.001041	8.84E+06	-2.64E+05	-2.04E-05	241.255	5.43E+12	3745.910	3.89E+06
203.040	-0.001062	8.56E+06	-2.60E+05	-1.86E-05	233.522	5.43E+12	3821.668	3.89E+06
204.120	-0.001081	8.28E+06	-2.56E+05	-1.70E-05	225.911	5.43E+12	3890.811	3.89E+06
205.200	-0.001098	8.00E+06	-2.52E+05	-1.53E-05	218.423	5.43E+12	3953.556	3.89E+06
206.280	-0.001114	7.73E+06	-2.48E+05	-1.38E-05	211.062	5.43E+12	4010.116	3.89E+06
207.360	-0.001128	7.47E+06	-2.43E+05	-1.23E-05	203.828	5.44E+12	4060.700	3.89E+06
208.440	-0.001140	7.21E+06	-2.39E+05	-1.08E-05	196.723	5.44E+12	4105.515	3.89E+06
209.520	-0.001151	6.95E+06	-2.34E+05	-9.40E-06	189.749	5.44E+12	4144.763	3.89E+06
210.600	-0.001161	6.70E+06	-2.30E+05	-8.05E-06	182.907	5.44E+12	4178.642	3.89E+06
211.680	-0.001169	6.46E+06	-2.25E+05	-6.74E-06	176.198	5.44E+12	4207.348	3.89E+06
212.760	-0.001175	6.22E+06	-2.21E+05	-5.48E-06	169.623	5.44E+12	4231.070	3.89E+06
213.840	-0.001181	5.98E+06	-2.16E+05	-4.27E-06	163.183	5.44E+12	4249.998	3.89E+06
214.920	-0.001185	5.75E+06	-2.12E+05	-3.11E-06	156.878	5.45E+12	4264.313	3.89E+06
216.000	-0.001187	5.52E+06	-2.07E+05	-1.99E-06	150.708	5.45E+12	4274.195	3.89E+06
217.080	-0.001189	5.30E+06	-2.02E+05	-9.22E-07	144.675	5.45E+12	4279.821	3.89E+06
218.160	-0.001189	5.09E+06	-1.98E+05	1.08E-07	138.778	5.45E+12	4281.361	3.89E+06
219.240	-0.001189	4.87E+06	-1.93E+05	1.09E-06	133.017	5.45E+12	4278.984	3.89E+06
220.320	-0.001187	4.67E+06	-1.89E+05	2.04E-06	127.393	5.46E+12	4272.854	3.89E+06
221.400	-0.001184	4.47E+06	-1.84E+05	2.94E-06	121.904	5.46E+12	4263.130	3.89E+06
222.480	-0.001181	4.27E+06	-1.79E+05	3.81E-06	116.551	5.46E+12	4249.969	3.89E+06
223.560	-0.001176	4.08E+06	-1.75E+05	4.63E-06	111.333	5.46E+12	4233.522	3.89E+06
224.640	-0.001171	3.89E+06	-1.70E+05	5.42E-06	106.251	5.46E+12	4213.935	3.89E+06
225.720	-0.001164	3.71E+06	-1.66E+05	6.18E-06	101.302	5.46E+12	4191.352	

226.800	-0.001157	3.54E+06	-1.61E+05	6.89E-06	96.487	5.46E+12	4165.912	3.89E+06
227.880	-0.001149	3.36E+06	-1.57E+05	7.58E-06	91.804	5.46E+12	4137.752	3.89E+06
228.960	-0.001141	3.20E+06	-1.52E+05	8.23E-06	87.253	5.46E+12	4107.003	3.89E+06
230.040	-0.001132	3.04E+06	-1.48E+05	8.84E-06	82.833	5.46E+12	4073.794	3.89E+06
231.120	-0.001122	2.88E+06	-1.43E+05	9.43E-06	78.542	5.46E+12	4038.249	3.89E+06
232.200	-0.001111	2.73E+06	-1.39E+05	9.98E-06	74.380	5.46E+12	4000.489	3.89E+06
233.280	-0.001100	2.58E+06	-1.35E+05	1.05E-05	70.345	5.46E+12	3960.632	3.89E+06
234.360	-0.001089	2.43E+06	-1.31E+05	1.10E-05	66.437	5.46E+12	3918.791	3.89E+06
235.440	-0.001076	2.30E+06	-1.26E+05	1.15E-05	62.653	5.46E+12	3875.077	3.89E+06
236.520	-0.001064	2.16E+06	-1.22E+05	1.19E-05	58.992	5.46E+12	3829.596	3.89E+06
237.600	-0.001051	2.03E+06	-1.18E+05	1.23E-05	55.454	5.46E+12	3782.452	3.89E+06
238.680	-0.001037	1.91E+06	-1.14E+05	1.27E-05	52.035	5.46E+12	3733.744	3.89E+06
239.760	-0.001023	1.79E+06	-1.10E+05	1.31E-05	48.736	5.46E+12	3683.568	3.89E+06
240.840	-0.001009	1.67E+06	-1.06E+05	1.34E-05	45.554	5.46E+12	3632.019	3.89E+06
241.920	-0.000994	1.56E+06	-1.02E+05	1.37E-05	42.487	5.46E+12	3579.185	3.89E+06
243.000	-0.000979	1.45E+06	-98276.	1.40E-05	39.535	5.46E+12	3525.153	3.89E+06
244.080	-0.000964	1.34E+06	-94499.	1.43E-05	36.694	5.46E+12	3470.006	3.89E+06
245.160	-0.000948	1.24E+06	-90782.	1.46E-05	33.964	5.46E+12	3413.824	3.89E+06
246.240	-0.000932	1.15E+06	-87125.	1.48E-05	31.343	5.46E+12	3356.684	3.89E+06
247.320	-0.000916	1.06E+06	-83532.	1.50E-05	28.828	5.46E+12	3298.661	3.89E+06
248.400	-0.000900	9.68E+05	-80001.	1.52E-05	26.419	5.46E+12	3239.825	3.89E+06
249.480	-0.000883	8.84E+05	-76534.	1.54E-05	24.113	5.46E+12	3180.244	3.89E+06
250.560	-0.000867	8.03E+05	-73132.	1.56E-05	21.908	5.46E+12	3119.983	3.89E+06
251.640	-0.000850	7.26E+05	-69795.	1.57E-05	19.802	5.46E+12	3059.104	3.89E+06
252.720	-0.000833	6.52E+05	-66524.	1.59E-05	17.793	5.46E+12	2997.667	3.89E+06
253.800	-0.000815	5.82E+05	-63320.	1.60E-05	15.881	5.46E+12	2935.728	3.89E+06
254.880	-0.000798	5.15E+05	-60184.	1.61E-05	14.061	5.46E+12	2873.341	3.89E+06
255.960	-0.000781	4.52E+05	-57114.	1.62E-05	12.333	5.46E+12	2810.558	3.89E+06
257.040	-0.000763	3.92E+05	-54113.	1.63E-05	10.694	5.46E+12	2747.427	3.89E+06
258.120	-0.000746	3.35E+05	-51180.	1.63E-05	9.143	5.46E+12	2683.994	3.89E+06
259.200	-0.000728	2.81E+05	-48316.	1.64E-05	7.677	5.46E+12	2620.304	3.89E+06

260.280	-0.000710	2.31E+05	-45520.	1.65E-05	6.295	5.46E+12	2556.397	3.89E+06
261.360	-0.000692	1.83E+05	-42794.	1.65E-05	4.994	5.46E+12	2492.313	3.89E+06
262.440	-0.000674	1.38E+05	-40137.	1.65E-05	3.773	5.46E+12	2428.088	3.89E+06
263.520	-0.000657	96310.	-37549.	1.66E-05	2.628	5.46E+12	2363.756	3.89E+06
264.600	-0.000639	57135.	-35031.	1.66E-05	1.559	5.46E+12	2299.350	3.89E+06
265.680	-0.000621	20642.	-32583.	1.66E-05	0.563319	5.46E+12	2234.901	3.89E+06
266.760	-0.000603	-13244.	-30204.	1.66E-05	0.361427	5.46E+12	2170.435	3.89E+06
267.840	-0.000585	-44598.	-27895.	1.66E-05	1.217	5.46E+12	2105.980	3.89E+06
268.920	-0.000567	-73496.	-25655.	1.66E-05	2.006	5.46E+12	2041.559	3.89E+06
270.000	-0.000549	-1.00E+05	-23485.	1.65E-05	2.729	5.46E+12	1977.194	3.89E+06
271.080	-0.000531	-1.24E+05	-21384.	1.65E-05	3.390	5.46E+12	1912.907	3.89E+06
272.160	-0.000514	-1.46E+05	-19353.	1.65E-05	3.990	5.46E+12	1848.715	3.89E+06
273.240	-0.000496	-1.66E+05	-17391.	1.65E-05	4.531	5.46E+12	1784.635	3.89E+06
274.320	-0.000478	-1.84E+05	-15498.	1.64E-05	5.015	5.46E+12	1720.684	3.89E+06
275.400	-0.000460	-2.00E+05	-13674.	1.64E-05	5.444	5.46E+12	1656.873	3.89E+06
276.480	-0.000443	-2.13E+05	-11919.	1.64E-05	5.821	5.46E+12	1593.217	3.89E+06
277.560	-0.000425	-2.25E+05	-10233.	1.63E-05	6.147	5.46E+12	1529.724	3.89E+06
278.640	-0.000407	-2.35E+05	-8614.771	1.63E-05	6.424	5.46E+12	1466.405	3.89E+06
279.720	-0.000390	-2.44E+05	-7065.149	1.62E-05	6.655	5.46E+12	1403.267	3.89E+06
280.800	-0.000372	-2.51E+05	-5583.614	1.62E-05	6.841	5.46E+12	1340.316	3.89E+06
281.880	-0.000355	-2.56E+05	-4169.961	1.61E-05	6.984	5.46E+12	1277.559	3.89E+06
282.960	-0.000337	-2.60E+05	-2823.981	1.61E-05	7.086	5.46E+12	1214.998	3.89E+06
284.040	-0.000320	-2.62E+05	-1545.457	1.60E-05	7.150	5.46E+12	1152.637	3.89E+06
285.120	-0.000303	-2.63E+05	-334.175	1.60E-05	7.178	5.46E+12	1090.478	3.89E+06
286.200	-0.000286	-2.63E+05	810.085	1.59E-05	7.170	5.46E+12	1028.521	3.89E+06
287.280	-0.000269	-2.61E+05	1887.540	1.59E-05	7.130	5.46E+12	966.767	3.89E+06
288.360	-0.000251	-2.59E+05	2898.410	1.58E-05	7.059	5.46E+12	905.213	3.89E+06
289.440	-0.000234	-2.55E+05	3842.909	1.58E-05	6.959	5.46E+12	843.859	3.89E+06
290.520	-0.000217	-2.50E+05	4721.251	1.57E-05	6.832	5.46E+12	782.701	3.89E+06
291.600	-0.000200	-2.45E+05	5533.646	1.57E-05	6.681	5.46E+12	721.735	3.89E+06
292.680	-0.000184	-2.38E+05	6280.300	1.56E-05	6.506	5.46E+12	660.958	3.89E+06
293.760	-0.000167	-2.31E+05	6961.413	1.56E-05	6.310	5.46E+12	600.364	

3.89E+06								
294.840	-0.000150	-2.23E+05	7577.182	1.55E-05	6.096	5.46E+12	539.948	
3.89E+06								
295.920	-0.000133	-2.15E+05	8127.794	1.55E-05	5.864	5.46E+12	479.704	
3.89E+06								
297.000	-0.000117	-2.06E+05	8613.432	1.54E-05	5.617	5.46E+12	419.626	
3.89E+06								
298.080	-9.99E-05	-1.96E+05	9034.271	1.54E-05	5.356	5.46E+12	359.705	
3.89E+06								
299.160	-8.33E-05	-1.86E+05	9390.478	1.54E-05	5.084	5.46E+12	299.936	
3.89E+06								
300.240	-6.68E-05	-1.76E+05	9682.211	1.53E-05	4.803	5.46E+12	240.310	
3.89E+06								
301.320	-5.02E-05	-1.65E+05	9909.621	1.53E-05	4.513	5.46E+12	180.820	
3.89E+06								
302.400	-3.37E-05	-1.55E+05	10073.	1.53E-05	4.218	5.46E+12	121.457	
3.89E+06								
303.480	-1.73E-05	-1.44E+05	10172.	1.52E-05	3.920	5.46E+12	62.213	
3.89E+06								
304.560	-8.55E-07	-1.33E+05	10207.	1.52E-05	3.619	5.46E+12	3.079	
3.89E+06								
305.640	1.55E-05	-1.22E+05	10179.	1.52E-05	3.318	5.46E+12	-55.952	
3.89E+06								
306.720	3.19E-05	-1.11E+05	10086.	1.51E-05	3.019	5.46E+12	-114.890	
3.89E+06								
307.800	4.83E-05	-99794.	9930.621	1.51E-05	2.723	5.46E+12	-173.743	
3.89E+06								
308.880	6.46E-05	-89170.	9711.239	1.51E-05	2.433	5.46E+12	-232.519	
3.89E+06								
309.960	8.09E-05	-78818.	9428.416	1.51E-05	2.151	5.46E+12	-291.227	
3.89E+06								
311.040	9.72E-05	-68805.	9082.222	1.51E-05	1.878	5.46E+12	-349.874	
3.89E+06								
312.120	0.000113	-59200.	8672.718	1.51E-05	1.616	5.46E+12	-408.468	
3.89E+06								
313.200	0.000130	-50072.	8199.956	1.51E-05	1.366	5.46E+12	-467.016	
3.89E+06								
314.280	0.000146	-41488.	7663.984	1.50E-05	1.132	5.46E+12	-525.526	
3.89E+06								
315.360	0.000162	-33518.	7064.838	1.50E-05	0.914695	5.46E+12	-584.004	
3.89E+06								
316.440	0.000178	-26228.	6402.550	1.50E-05	0.715767	5.46E+12	-642.456	
3.89E+06								
317.520	0.000195	-19688.	5677.144	1.50E-05	0.537289	5.46E+12	-700.888	
3.89E+06								
318.600	0.000211	-13966.	4888.641	1.50E-05	0.381121	5.46E+12	-759.304	
3.89E+06								
319.680	0.000227	-9128.702	4037.052	1.50E-05	0.249122	5.46E+12	-817.710	
3.89E+06								
320.760	0.000243	-5245.574	3122.390	1.50E-05	0.143151	5.46E+12	-876.109	
3.89E+06								
321.840	0.000260	-2384.340	2144.658	1.50E-05	0.065069	5.46E+12	-934.504	
3.89E+06								
322.920	0.000276	-613.112	1103.861	1.50E-05	0.016732	5.46E+12	-992.897	
3.89E+06								
324.000	0.000292	0.000	0.000	1.50E-05	0.000	5.46E+12	-1051.290	
1.94E+06								

Please note that because this analysis makes computations of ultimate moment capacity and pile response using nonlinear bending stiffness that the above values of total stress due to combined axial stress and bending may not be representative of actual conditions.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection              =     0.22097676 in
Computed slope at pile head       =    -0.00160438
Maximum bending moment            =      22953263. lbs-in
Maximum shear force               =  -317090.82912 lbs
Depth of maximum bending moment   =      147.96000 in
Depth of maximum shear force      =      178.20000 in
Number of iterations              =            153
Number of zero deflection points  =              2
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 1.57E+05	M= 0.000	0.0000	0.2209768	2.2953E+07	-317091.

The analysis ended normally.

Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

6 – Planting Plan Portion of 404 Permit Application

To:	Brian Elkington Fisheries Coordinator U.S. Fish and Wildlife Service	From:	Jeff Brown, Sr. Env. Scientist Cody Fleece, Sr. Env. Scientist Stantec Consulting Services Inc.
File:	175631016	Date:	April 10, 2013

REFERENCE: BALLVILLE DAM EIS PLANTING PLAN

PURPOSE OF THIS MEMO

The purpose of this memo is to provide detail of the initial proposed planting plan and additional wetland planting enhancements. This information is based on current plans and permit drawings (April 2014; Attachment).

BACKGROUND

The U.S. Fish and Wildlife Service (USFWS) is the lead agency for developing a Draft Environmental Impact Statement (DEIS) for the Ballville Dam Removal Project. The USFWS is the lead agency based on the funding commitment of $2 million from the Great Lakes Restoration Initiative (GLRI) through the Great Lakes Fish and Wildlife Restoration Act (Act)(16 U.S.C. 941 §4321 et seq.). The Act authorizes the USFWS to work in partnership with States, Tribes, and other Federal agencies for the restoration of fish and wildlife resources in the Great Lakes Basin.

Issuance of funding under the Act constitutes a discretionary federal action by the USFWS and is thus subject to the NEPA. As the lead agency, the USFWS has determined that an Environmental Impact Statement is appropriate for meeting compliance with the NEPA. The NEPA process requires that federal agencies integrate an interdisciplinary environmental review process that evaluates a range of alternatives, including the No Action Alternative, as part of the decision-making process.

DESCRIPTION

Planting vegetation is an important part of river restoration. The purpose of planting is to stabilize exposed sediment, stream banks, side slopes and the areas surrounding the ICS piers. Planting vegetation may also help to control the release of sediment downstream, establish native riparian and floodplain species, and control the spread of invasive species. With these goals in mind Stantec proposes to plant the following: a seasonal cover crop, a native floodplain-upland herbaceous species mixture, a native wetland herbaceous species mixture, a high composition of perennial grasses within mixtures, an assortment of shrub livestakes, bare-root tree seedlings, and containerized trees.

The planting areas cover the south abutment access road and staging area, the exposed sediment areas after the reservoir drawdown, and the channel restoration and seawall modification areas. The planting areas are dependent on cooperation from private land owners. The exposed sediment areas are controlled by how the reservoir draws down, thus the proposed planting plans are only estimates that cannot be accurately validated until the reservoir actually draws down. The exposed areas surrounding the reservoir were delineated by using the relocated channel model (discussed in Section 5.2.2.) along with the aerial photography. The exposed sediment areas were further divided into two separate planting

zones based on the expected gradient and substrate following the drawdown. The access road on the north bank will not be seeded or planted with trees. This area will remain as access road for maintenance to the ICS. In total, the project area was divided into 5 separate planting zones that will be planted at separate phases of the project.

The seed mix composition and specifications and costs were derived with the assistance from the Ohio Prairie Nursery. The seed mixtures were selected based off the existing site conditions, seed availability, and recommended stream restoration species.

ENVIRONMENTAL COVENANT

A legal mechanism for protecting wetland and stream mitigation sites must be established by the applicant. The Environmental Covenant is the preferred legal mechanism by OEPA to protect wetland mitigation sites in perpetuity. An environmental covenant has a holder, owner, and Ohio EPA is a non-holding agency. The holder and the owner can be the same entity or they can be different, but Ohio EPA is always a non-holding agency. An environmental covenant is Ohio EPA's preferred method of protecting a site in perpetuity, and it is preferred that the holder and owner are different entities. A conservation easement has a holder and an owner. The holder and the owner have to be different entities. Ohio EPA is not a party in the conservation easement and that's why a covenant is preferred.

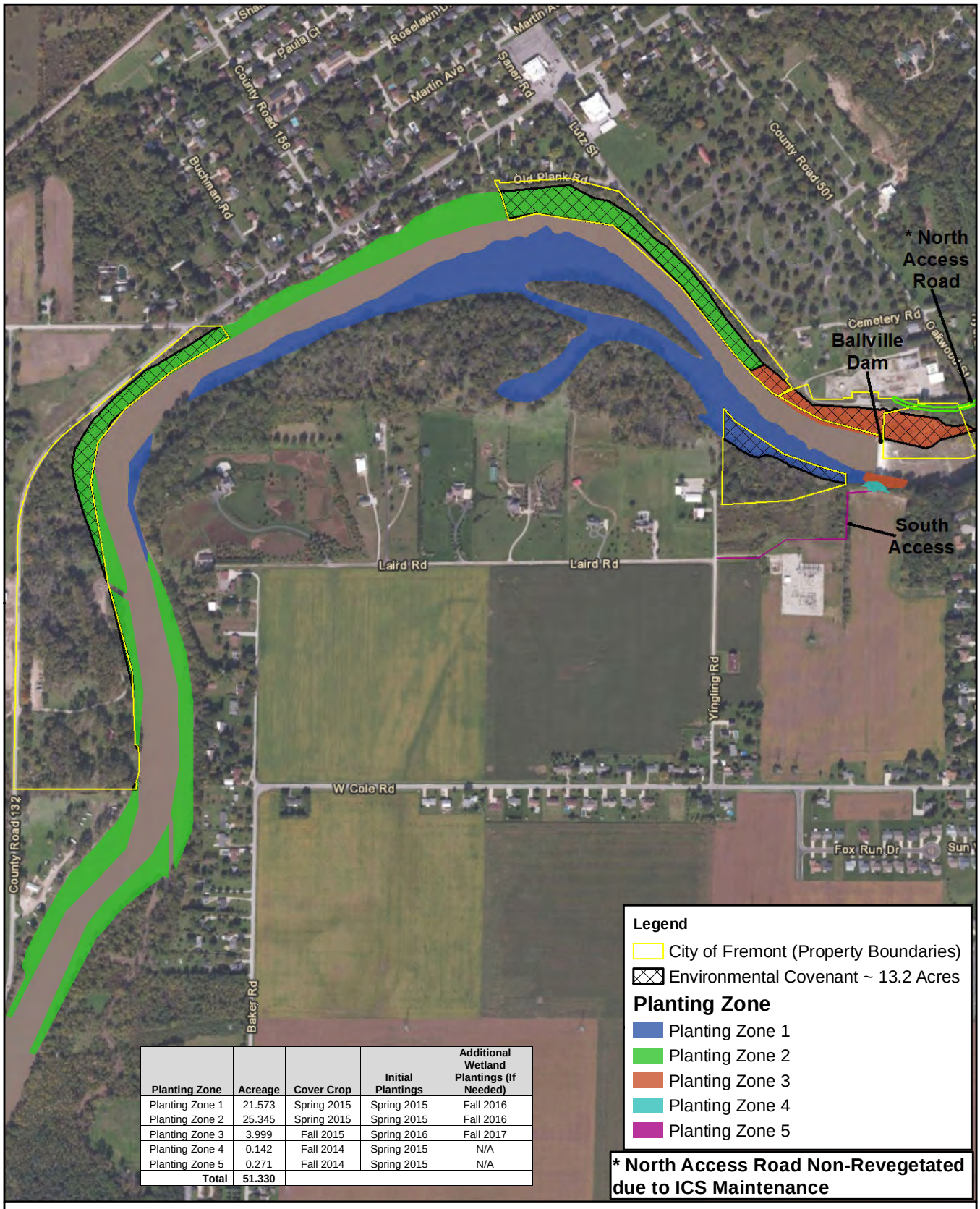
The environmental covenant was established for this project by intersecting the City of Fremont owned parcels with the proposed planting zones. This easement is a total of 13.2 acres intersecting Planting Zones 1, 2 and 3 (Figure 1).

Stantec understands that upon completion of the 401 water quality certification monitoring requirements and performance goals will be set fourth for wetland mitigation sites.

SEEDING AND PLANTING SCHEDULE

The following proposed plantings mitigation actions will occur on site within the impacted areas (See Figure 5-1, 5-2, 5-3). These mitigation efforts will employ an adaptive management strategy that will allow the system to naturally equilibrate. The generated models cannot accurately predict the sediment transport and the formation of inside depositional areas that may harbor wetlands. Our models can only allow us attempt to predict the location of exposed sediment. The acreage and location of planting zones are subject to change and can only be confirmed after the reservoir is dewatered and sediment is settled over time.

By seeding in these areas we hope to stabilize soil and control erosion, establish native plant communities, maintain plant biodiversity and aesthetics, enhance the establishment of new wetland plant communities, promote the establishment of in-kind replacement or wetland types ((i.e Palustrine Forest (PFO) for PFO)) and decrease the spread of invasive species. When developing these planting plans, Stantec understands the significance to enhance the establishment of new JWUS PFO wetlands by planting facultative species. However, in order to reach these goals, the new exposed areas must first be stabilized. Thus, in order to promote substrate stability it is important to plant a variety of upland and wetland species (not just wetland species). Wetland development including floodplain forest would be colonized in large part by volunteer tree species from the local seed bank.



Planting Zone	Acreage	Cover Crop	Initial Plantings	Additional Wetland Plantings (If Needed)
Planting Zone 1	21.573	Spring 2015	Spring 2015	Fall 2016
Planting Zone 2	25.345	Spring 2015	Spring 2015	Fall 2016
Planting Zone 3	3.999	Fall 2015	Spring 2016	Fall 2017
Planting Zone 4	0.142	Fall 2014	Spring 2015	N/A
Planting Zone 5	0.271	Fall 2014	Spring 2015	N/A
Total	51.330			

Basemap: ESRI

Planting Plan (Wetland Mitigation)

N W E S

U.S. FISH & WILDLIFE SERVICE

U.S. DEPARTMENT OF THE INTERIOR MARCH 3, 1849

Ballville Dam Project

0 400 800 Feet

Figure 1

Stantec proposes to the re-vegetate and seed the following on-site areas: access roads and disturbed staging areas (Planting Zones 4 &5), exposed areas as a result of the incremental drawdown of the reservoir (Planting Zones 1 & 2), and areas directly impacted from construction activities surrounding the Ballville dam and seawall (Planting Zone 3).

Cover Crop

Temporary winter rye or cereal rye (*Secale cereale*) would be more appropriate for fall and early winter plantings and common oat (*Avena sativa*) is a common spring cover crop. Cover crops are recommended to be broadcasted for all 5 planting zones at moderate amounts. A lower amount (lbs/per acre) of cover crop seed is recommended when broadcasted in conjunction with drilling the main perennial seed mixture.

Temporary Cover Crop						
Planting Zone	**Expected Planting Time**	**Common Name**	**Scientific Name**	***Wetland Indicator**	**Pounds (PLS) per Acre**	**Pounds in Planting Zone**
1	Spring	Common Oat	*Avena sativa*	UPL	20	431
2	Spring	Common Oat	*Avena sativa*	UPL	20	507
3	Fall	Winter Rye	*Secale cereale*	NI	40	160
4	Fall	Winter Rye	*Secale cereale*	NI	40	6
5	Fall	Winter Rye	*Secale cereale*	NI	40	11
*Northcentral and Northeast Region			Pure Live Seed (PLS)	**Total**	**160**	**1,115**

Planting Zone 1

Zone 1 is representing the flat to gentle gradients surrounding the de-watered reservoir. The cover crop would be broadcasted conjunctively with the main herbaceous seed mix. The herbaceous seed mixture is a wetland seed mix composed of obligate and facultative graminoids, sedges and forbs. A large amount of perennial rye grass seed will be in the mix to combat reed canarygrass. Due to the time of the year (Spring 2015), conditions will be wet, we recommend drilling where seeds are planted 2 inches depth into the soil. Bare-root seedlings and livestakes that typically grow in wetlands will also be planted in this zone pending the amount of exposed rocky substrate.

Planting Zone 1					
Custom Blend Herbaceous Seed Mix					
Common Name	**Scientific Name**	**Wetland Indicator (NCNE)**	**Composition (%)**	***Pounds (PLS) per Acre**	**Pounds in Planting Zone**
Virginia Wild Rye	*Elymus virginicus*	FACW	34.36	6.18	133.42
Nodding Wild Rye	*Elymus canadensis*	FACU	30.05	5.41	116.69
Partridge Pea	*Chamaecrista fasciculata*	FACU	12.50	2.25	48.54
Swamp Milkweed	*Asclepias incarnata*	OBL	6.25	1.13	24.27
Rice Cut Grass	*Leersia oryzoides*	FACW	3.12	0.56	12.12
Shallow/Lurid Sedge	*Carex lurida*	OBL	3.12	0.56	12.12
Ohio Spiderwort	*Tradescantia ohiensis*	FACU	3.12	0.56	12.12

Tall Ironweed	*Vernonia altissima*	FACW	1.87	0.34	7.26
Gray' sedge	*Carex grayi*	FACW	1.25	0.23	4.85
Fowl Manna Grass	*Glyceria striata*	OBL	0.94	0.17	3.65
Common Tussock Sedge	*Carex stricta*	OBL	0.62	0.11	2.41
New England Aster	*Symphyotrichum novae-angliae*	FACW	0.62	0.11	2.41
Wild Bergamot	*Monarda fistulosa*	FACU	0.62	0.11	2.41
Spotted Joe Pye	*Eupatorium maculatum*	OBL	0.47	0.08	1.83
Blue Vervain	*Verbena hastata*	FACW	0.44	0.08	1.71
Dark Green Bulrush	*Scirpus atrovirens*	OBL	0.31	0.06	1.20
Common Rush	*Juncus effusus*	OBL	0.19	0.03	0.74
Great Lobelia	*Lobelia siphilitica*	FACW	0.06	0.01	0.23
Monkey Flower	*Mimulus ringens*	OBL	0.06	0.01	0.23
*18 PLS Lb/acre drilled or if used 25 PLS Lb/acre broadcast		**Total**	**100**	**18**	**388**
Live Staking Planting Schedule; Along Bankfull; ~5,400 Linear Feet					
Common Name	**Scientific Name**	**Wetland Indicator (NCNE)**	**Spacing**	**Quantity**	
Black Willow	*Salix nigra*	OBL	3x3	900	
Silky Dogwood	*Cornus amomum*	FACW	3x3	900	
Elderberry	*Sambucus canadensis*	FACW	3x3	900	
Arrowwood	*Viburnum dentatum*	FAC	3x3	900	
			Total	**3,600**	
Bare-Root Seedlings					
Common Name	**Scientific Name**	**Wetland Indicator (NCNE)**	**Spacing**	**Quantity**	
American Elm	*Ulmus americana*	FACW	10 x 10	1,566	
Box Elder	*Acer negundo*	FAC	10 x 10	1,566	
Silver Maple	*Acer saccharinum*	FACW	10 x 10	1,566	
Pin Oak	*Quercus palustris*	FACW	10 x 10	1,566	
Cottonwood	*Populus deltoides*	FAC	10 x 10	1,566	
River Birch	*Betula nigra*	FACW	10 x 10	1,566	
			Total	**9,396**	

Planting Zone 2

Planting Zone 2 is representative of exposed sediment surrounding the de-watered reservoir that is moderate to severe gradient with possible exposed cliff and upper zone. The soil in these areas is projected to be wet close to the water's edge to wet-mesic further up the riparian zone. Therefore, a mix of facultative wetland species will be planted in this zone with a large amount of facultative to upland grasses to compact and stabilize soil. Livestakes within the lower margin area will also be planted pending the rocky substrate exposure.

Planting Zone 2					
Custom Blend Herbaceous Seed Mix					
Common Name	**Scientific Name**	**Wetland Indicator (NCNE)**	**Composition (%)**	**Pounds (PLS) per Acre**	**Pounds in Planting Zone**
Virginia Wild Rye	*Elymus virginicus*	FACW	25.00	5	126.72
Nodding Wild Rye	*Elymus canadensis*	FACU	21.25	4.25	107.71
Indian Grass	*Sorghastrum nutans*	FACU	12.50	2.5	63.36
Partridge Pea	*Chamaecrista fasciculata*	FACU	12.50	2.5	63.36
Little Bluestem	*Schizachyrium scoparium*	FACU	10.63	2.126	53.88
Prairie Cordgrass	*Spartina pectinata*	FACW	9.38	1.876	47.55
Switch Grass	*Panicum virgatum*	FAC	3.12	0.624	15.81
Showy Tick Trefoil	*Desmodium canadense*	FAC	2.50	0.5	12.67
Ohio Spiderwort	*Tradescantia ohiensis*	FACU	1.44	0.288	7.30
Black-eyed Susan	*Rudbeckia hirta*	FACU	0.63	0.126	3.19
Wild Bergamot	*Monarda fistulosa*	FACU	0.31	0.062	1.57
New England Aster	*Symphyotrichum novae-angliae*	FACW	0.31	0.062	1.57
Smooth Aster	*Symphyotrichum laeve*	FACU	0.31	0.062	1.57
Blue Vervain	*Verbena hastata*	FACW	0.06	0.012	0.30
Tall Ironweed	*Vernonia altissima*	FACW	0.06	0.012	0.30
*20 PLS Lb/acre drilled or if used 30 PLS Lb/acre broadcast		**Total**	**100.00**	**20**	**506.89**
Live Staking Planting Schedule: Along bankfull; ~10,900 linear feet					
Common Name	**Scientific Name**	**Wetland Indicator (NCNE)**	**Spacing**	**Quantity**	
Black Willow	*Salix nigra*	OBL	3x3	1817	
Silky Dogwood	*Cornus amomum*	FACW	3x3	1817	
Elderberry	*Sambucus canadensis*	FACW	3x3	1817	
Arrowwood	*Viburnum dentatum*	FAC	3x3	1817	
			Total	**7,268**	

Planting Zone 3

Zone 3 will be the side slopes surrounding the channel restoration and seawall modification areas. After the grading, these channel side slopes will be moderate and will surround parts of the ice control structure. A specific application seed mix called the Retention Basin Slope Native Seed Mix from Ohio Prairie Nursery will be drilled in the spring following the broadcasted fall cover crop. This seed mix is designed for side slopes where water flows but does not collect. It is recommended to have a large amount (60%) of grass within the mixture to combat reed canarygrass. Containerized tree plantings will be planted for bank stability and for general public aesthetics.

Planting Zone 3		
Retention Basin Slope Native Seed Mix		
Common Name	**Scientific Name**	**Wetland Indicator (NCNE)**
Grasses requested @ 60% composition		
Big Bluestem	*Andropogon gerardii*	FACU
Switch Grass	*Panicum virgatum*	FAC
Indian Grass	*Sorghastrum nutans*	FACU
Forbs requested @ 40% composition		
Swamp Milkweed	*Asclepias incarnata*	OBL
Partridge Pea	*Chamaecrista fasciculata*	FACU
Lanceleaf Coreopsis	*Coreopsis lanceolata*	FACU
Purple Coneflower	*Echinacea purpurea*	NI
Ox Eye Sunflower	*Heliopsis helianthoides*	FACU
Dense Blazingstar	*Liatris spicata*	FAC
Wild Bergamot	*Monarda fistulosa*	FACU
Foxglove Beardtongue	*Penstemon digitalis*	FACU
Grey-Headed Coneflower	*Ratibida pinnata*	NI
Black-eyed Susan	*Rudbeckia hirta*	FACU
Brown-eyed Susan	*Rudbeckia triloba*	FACU
This specific application seed mix is prescribed to be planted for 1 Acre Drilled @ 10.0 PLS Lbs or 1 Acre Broadcast 15.0 PLS Lbs		

Containerized Tree Plantings				
Common Name	**Scientific Name**	**Wetland Indicator (NCNE)**	**Spacing**	**Quantity**
American Elm	*Ulmus americana*	FAC	30x30	25
Cottonwood	*Populus deltoides*	FAC	30x30	25
Red Maple	*Acer rubrum*	FAC	30x30	24
Black Walnut	*Juglans nigra*	FACU	30x30	24
Red Bud	*Cercis canadensis*	FACU	30x30	24
Pin Oak	*Quercus palustris*	FACW	30x30	24
River Birch	*Betula nigra*	FACW	30x30	24
Swamp White Oak	*Quercus bicolor*	FACW	30x30	24
			Total	**194**

Planting Zone 4

Zone 4 is the small tree removal area that will allow construction equipment to notch the dam at the south abutment. Temporary cover crop will be broadcasted following notching activities are complete. This is an upland riparian area well above the OHWM of the Sandusky River, therefore dry to mesic containerized trees (4-6 ft) will be planted.

Planting Zone 4				
Containerized Tree Plantings				
Common Name	**Scientific Name**	**Wetland Indicator (NCNE)**	**Spacing**	**Quantity**
Black Walnut	*Juglans nigra*	FACU	20x20	3
Black Cherry	*Prunus serotina*	FACU	20x20	3
Sugar Maple	*Acer saccharum*	FACU	20x20	3
Common Hackberry	*Celtis occidentalis*	FAC	20x20	3
Red Bud	*Cercis canadensis*	FACU	20x20	3
			Total	**15**

Planting Zone 5

Zone 5 is the access road leading to the south abutment notching area. This is currently an upland field along a tree line. It will be seeded with a fall cover crop and then in the following spring it will receive an upland herbaceous dry mesic mix.

Planting Zone 5					
Custom Blend Upland Herbaceous Seed Mix					
Common Name	**Scientific Name**	**Wetland Indicator (NCNE)**	**Composition (%)**	**Pounds per Acre**	**Pounds in Planting Zone**
Grasses					
Little Bluestem	*Schizachyrium scoparium*	FACU	10	3	0.81
Indian Grass	*Sorghastrum nutans*	FACU	10	3	0.81
Nodding Wild Rye	*Elymus canadensis*	FACU	25	7.5	2.03
Switch Grass	*Panicum virgatum*	FAC	10	3	0.81
Big Bluestem	*Andropogon gerardii*	FACU	5	1.5	0.41
		Total	**60**	**18**	**4.86**
Forbs					
Black-eyed Susan	*Rudbeckia hirta*	FACU	7	2.1	0.57
Partridge Pea	*Chamaecrista fasciculata*	FACU	7	2.1	0.57
Common Milkweed	*Asclepias syriaca*	UPL	8	2.4	0.65
Showy Tick Trefoil	*Desmodium canadense*	FAC	1	0.3	0.08
Plains Coreopsis	*Coreopsis tinctoria*	FACU	5	1.5	0.41
Wild Bergamot	*Monarda fistulosa*	FACU	6	1.8	0.49
Beardtongue	*Penstemon digitalis*	FACU	1	0.3	0.08
Evening Primrose	*Oenothera biennis*	FACU	5	1.5	0.41
		Total	**40**	**12**	**3.24**

Wetland Seeding Enhancements

After the initial seeding and planting discussed above and the site has settled, if needed and applicable during the monitoring process, we propose to enhance wetland re-establishment by planting hydrophytic vegetation in newly developed wetland areas such as low lying swales, point bars or braided channels. And, if needed (during the monitoring process), we propose to continue to combat the further invasion of reed canary grass and other invasive species. Controlling the spread of invasive plants may require further seeding, burning or herbicide spraying. The selected species (Table 8-10) are based on the existing site wetland plant assemblages and controlling reed canarygrass.

If Needed, Additional Wetland Seeding			
	Common Name	Scientific Name	Wetland Indicator(NCNE)
Grasses	Rice Cut Grass	*Leersia oryzoides*	FACW
	White Grass	*Leersia virginica*	FACW
	Freshwater Cord Grass	*Spartina pectinata*	FACW
	Fowl Manna Grass	*Glyceria striata*	OBL
	River-Bank Wild Rye	*Elymus riparius*	FACW
	Virginia Wild Rye	*Elymus virginicus*	FACW
Sedges and Rushes	Gray' sedge	*Carex grayi*	FACW
	Woolly-Fruit Sedge	*Carex lasiocarpa*	OBL
	Lamp Rush	*Juncus effusus*	OBL
Forbs	Round-Leaf Thimbleweed	*Anemone canadensis*	FACW
	Greendragon	*Arisaema dracontium*	FACW
	Swamp Milkweed	*Asclepias incarnata*	OBL
	Devil's-Pitchfork	*Bidens frondosa*	FACW
	Small-Spike False Nettle	*Boehmeria cylindrica*	OBL
	Spotted Touch-Me-Not	*Impatiens capensis*	FACW
	Pale- Yellow Iris	*Iris pseudacorus*	OBL
	Virginia Blueflag	*Iris virginica*	OBL
	Canadian Wood-Nettle	*Laportea canadensis*	FACW
	Great Blue Lobelia	*Lobelia siphilitica*	FACW
	Cardinal Flower	*Lobelia cardinalis*	OBL
	Cut-Leaf Water-Horehound	*Lycopus americanus*	OBL
	Fringed Yellow-Loosestrife	*Lysimachia ciliata*	FACW
	Creeping-Jenny	*Lysimachia nummularia*	FACW
	Allegheny Monkey-Flower	*Mimulus ringens*	OBL
	Golden Groundsel	*Packera aurea*	FACW
	Ditch-Stonecrop	*Penthorum sedoides*	OBL
	Swamp smartweed	*Persicaria hydropiperoides*	OBL

	Smooth phlox	*Phlox glaberrima*	FACW
	Wedgeleaf	*Phyla lanceolata*	OBL
	Canadian Clearweed	*Pilea pumila*	FACW
	Green-Head Coneflower	*Rudbeckia laciniata*	FACW
	Bitter Dock	*Rumex obtusifolius*	FAC
	Swamp Dock	*Rumex verticillatus*	OBL
	Lizard's-Tail	*Saururus cernuus*	OBL
	Mad Dog Skullcap	*Scutellaria lateriflora*	OBL
	Late Goldenrod	*Solidago giganteae*	FACW
	Farewell-Summer	*Symphyotrichum lateriflorum*	FAC
	Farewell-Summer	*Symphyotrichum novae-angliae*	FACW
	Simpler's Joy	*Verbena hastata*	FACW
	Wingstem	*Verbesina alternifolia*	FACW
Shrubs, Trees and Woody Vines	Black Willow	*Salix nigra*	OBL
	American Elm	*Ulmus americana*	FACW
	Cottonwood	*Populus deltoides*	FAC
	Silver Maple	*Acer saccharinum*	FACW
	Box Elder	*Acer negundo*	FAC
	Rough-Leaf Dogwood	*Cornus drummondii*	FAC
	River-Bank Grape	*Vitis riparia*	FAC
If Needed Reed Canarygrass Invasive Control			
	Virginia Wild Rye	*Elymus virginicus*	FACW
	Hairy Wild Rye	*Elymus villosus*	FACU
Note: some seeds in this plant list may not be for sale at time of planting			

COST ESTIMATES

The contractor has a choice to drill or broadcast the seed mixture. If the seed mixture is drilled it would require fewer pounds per acre and be less expensive. The table below presents both mechanisms. Due to the nature of floodplain restoration, broadcasting would be adequate for cover crops but drilling is the recommended seeding technique for planting the herbaceous seed mixtures. Drilling provides a more assured way of making sure the seed is not washed away by potential floods from the wet season. The additional labor costs associated with drilling are not included in this table. This table only reflects the high seeding rates of broadcasting. A custom seed mixed created by Stantec was quoted by the Ohio Prairie Nursery (see attachments) showing the recommended seeding rates for planting Zones 1 & 2. Planting zones 3 would use the a specific application seed mix produced by Ohio Prairie Nursery called the Retention Basin Slope Native Seed Mix. Live stakes were priced at 4.00 per stake and bare root seedlings were priced at $2.00 per seedling. Containerized trees varied in price ($35.00 to 55.00 per tree) and size depending on the tree nursery.

Planting Zones	Temporary Cover Crop	Herbaceous Seed Mix (Broadcasting)	Herbaceous Seed Mix (Drilling)	Live Stakes	Bare-Root Seedlings	Containerized Trees	Totals (broadcasting option)	Totals (drilling option)
Planting Zone 1	$57.30	$41,979.25	$30,225.06	$14,400.00	$18,792.00	N/A	$75,228.55	$63,474.36
Planting Zone 2	$67.32	$33,568.83	$22,379.22	$29,072.00	N/A	N/A	$62,708.15	$51,518.54
Planting Zone 3	$54.27	$3,760.00	$2,500.00	N/A	N/A	$9,085.50	$12,899.77	$11,639.77
Planting Zone 4	$1.93	N/A	N/A	N/A	N/A	$719.25	$721.18	$721.18
Planting Zone 5	$3.68	$204.28	N/A	N/A	N/A	N/A	$207.96	$207.96
Totals	$184.50	$79,512.36	$55,104.28	$43,472.00	$18,792.00	$9,804.75	$151,765.61	$127,561.81
Note: These costs do not include labor costs (broadcasting is less expensive than drilling in terms of labor costs). These costs also do not include the discussed wetland seeding enhancements.						**Total (7% sales tax)**	**$162,389.20**	**$136,491.14**

Phase 3a Sequence:

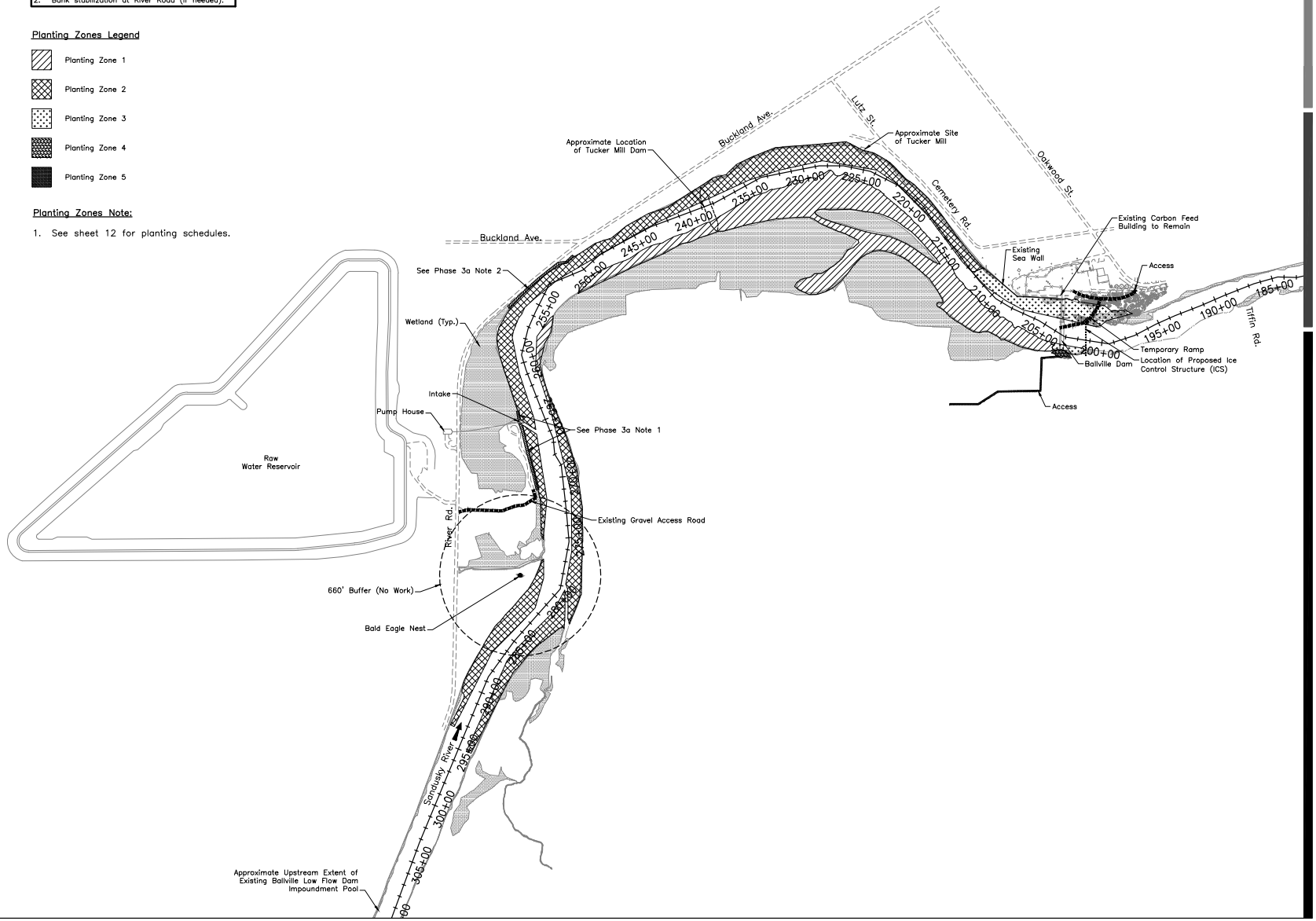
1. Bank stabilization at Intake (if needed).
2. Bank stabilization at River Road (if needed).

Planting Zones Legend

- Planting Zone 1
- Planting Zone 2
- Planting Zone 3
- Planting Zone 4
- Planting Zone 5

Planting Zones Note:

1. See sheet 12 for planting schedules.



Stantec

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Legend

- Major Contour
- Minor Contour
- Edge of Water
- Fence
- Overhead Electric Line
- Property Line
- Sign
- Guy Wire
- Power/Light Poles
- River Mile (RM 18.6)

Notes

1. Multiple topographic surveys are represented. Stantec performed bathymetric survey of impoundment in June 2011 and bathymetric survey downstream of the dam January and April 2012. Topographic survey to the North and South of the impoundment was performed by The U.S. Army Corps of Engineers, 2010.
2. Property Information taken from County Auditor GIS Data (Available online at http://www.sanduskycountygis.org/sandgis/) and physical deeds (available at the County Courthouse).
3. Wetlands delineated by USACE.

Revision	By	Appd.	YY.MM.DD

Issued	By	Appd.	YY.MM.DD

File Name: 30015c-011-ph3a.dwg	CW	SDP	JGB	14.01.24
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Client/Project

City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title

Phase 3a - Bank Stabilization, Revegetation and Instream Restoration Work

Project No. 175630015

Scale 1"=400' (0 200' 400' 800')

Drawing No.

Sheet 11 of 20

Revision 0

SaveDate: 2014/01/23 1:13 PM LogIn: Williams, Cheyenne
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Ballville Dam Project -- Appendix A6

NOT TO SCALE

Ballville Dam River Restoration Seeding Schedule

Planting Zone 1-5 (Temporary Cover Crop)
Planting Area: 51.3 acres

Planting Zone	Expected Planting Time	Common Name	Scientific Name	*Wetland Indicator	Pounds (PLS) per Acre	Pounds in Planting Zone
1	Spring	Common Oat	*Avena sativa*	UPL	20	431
2	Spring	Common Oat	*Avena sativa*	UPL	20	507
3	Fall	Winter Rye	*Secale cereale*	NI	40	160
4	Fall	Winter Rye	*Secale cereale*	NI	40	6
5	Fall	Winter Rye	*Secale cereale*	NI	40	11
				Total	160	1,115

*Northeastern and Northwest Region Pure Live Seed (PLS)

Planting Zone 1 (flat to moderate gradient within former reservoir)

Planting Area: 21.573

Custom Blend Herbaceous Seed Mix

Common Name	Scientific Name	Wetland Indicator (NCNE)	Composition (%)	*Pounds (PLS) per Acre	Pounds in Planting Zone
Virginia Wild Rye	*Elymus virginicus*	FACW	34.36	6.18	133.42
Nodding Wild Rye	*Elymus canadensis*	FACU	30.05	5.41	116.69
Partridge Pea	*Chamaecrista fasciculata*	FACU	12.50	2.25	48.54
Swamp Milkweed	*Asclepias incarnata*	OBL	6.23	1.12	24.27
Rice Cut Grass	*Leersia oryzoides*	FACW	3.12	0.56	12.12
Shallow/Lurid Sedge	*Carex lurida*	OBL	3.12	0.56	12.12
Ohio Spiderwort	*Tradescantia ohiensis*	FACU	3.12	0.56	12.12
Tall Ironweed	*Vernonia altissima*	FACW	1.87	0.34	7.28
Gray' sedge	*Carex grayi*	FACW	1.25	0.23	4.85
Fowl Manna Grass	*Glyceria striata*	OBL	0.94	0.17	3.65
Common Tussock Sedge	*Carex stricta*	OBL	0.62	0.11	2.41
New England Aster	*Symphyotrichum novae angliae*	FACW	0.62	0.11	2.41
Wild Bergamot	*Monarda fistulosa*	FACU	0.62	0.11	2.41
Spotted Joe Pye	*Eupatorium maculatum*	OBL	0.47	0.08	1.83
Blue Vervain	*Verbena hastata*	FACW	0.44	0.08	1.71
Dark Green Bulrush	*Scirpus atrovirens*	OBL	0.31	0.06	1.20
Common Rush	*Juncus effusus*	OBL	0.19	0.03	0.74
Great Lobelia	*Lobelia siphilitica*	FACW	0.06	0.01	0.23
Monkey Flower	*Mimulus ringens*	OBL	0.06	0.01	0.23
*18 PLS Lbs/acre drilled or 1 used 25 PLS Lbs/acre broadcast		Total	100	18	388

Live Staking Planting Schedule; Along Bankfull; ~5,400 Linear Feet

Common Name	Scientific Name	Wetland Indicator (NCNE)	Spacing	Quantity
Black Willow	*Salix nigra*	OBL	3x3	900
Silky Dogwood	*Cornus amomum*	FACW	3x3	900
Elderberry	*Sambucus canadensis*	FACW	3x3	900
Arrowwood	*Viburnum dentatum*	FAC	3x3	900
			Total	3,600

Bare-Root Seedlings

Common Name	Scientific Name	Wetland Indicator (NCNE)	Spacing	Quantity
American Elm	*Ulmus americana*	FACW	10 x 10	1,566
Box Elder	*Acer negundo*	FAC	10 x 10	1,566
Silver Maple	*Acer saccharinum*	FACW	10 x 10	1,566
Pin Oak	*Quercus palustris*	FACW	10 x 10	1,566
Cottonwood	*Populus deltoides*	FAC	10 x 10	1,566
River Birch	*Betula nigra*	FACW	10 x 10	1,566
			Total	9,396

Planting Zone 2 (moderate to severe gradient within former reservoir)

Planting Area: 25.345

Custom Blend Herbaceous Seed Mix

Common Name	Scientific Name	Wetland Indicator (NCNE)	Composition (%)	Pounds (PLS) per Acre	Pounds in Planting Zone
Virginia Wild Rye	*Elymus virginicus*	FACW	25.00	5	126.72
Nodding Wild Rye	*Elymus canadensis*	FACU	21.25	4.25	107.71
Indian Grass	*Sorghastrum nutans*	FACU	12.50	2.5	63.36
Partridge Pea	*Chamaecrista fasciculata*	FACU	12.50	2.5	63.36
Little Bluestem	*Schizachyrium scoparium*	FACU	10.63	2.126	53.88
Prairie Cordgrass	*Spartina pectinata*	FACW	9.38	1.876	47.55
Switch Grass	*Panicum virgatum*	FAC	3.12	0.624	15.81
Showy Tick Trefoil	*Desmodium canadense*	FAC	2.50	0.5	12.67
Ohio Spiderwort	*Tradescantia ohiensis*	FACU	1.44	0.288	7.30
Black-eyed Susan	*Rudbeckia hirta*	FACU	0.60	0.120	3.19
Wild Bergamot	*Monarda fistulosa*	FACU	0.31	0.062	1.57
New England Aster	*Symphyotrichum novae-angliae*	FACW	0.31	0.062	1.57
Smooth Aster	*Symphyotrichum laeve*	FACU	0.31	0.062	1.57
Blue Vervain	*Verbena hastata*	FACW	0.06	0.012	0.30
Tall Ironweed	*Vernonia altissima*	FACW	0.06	0.012	0.30
*20 PLS Lbs/acre drilled or 1 used 50 PLS Lbs/acre broadcast		Total	100.00	20	506.89

Live Staking Planting Schedule: Along bankfull; ~10,900 linear feet

Common Name	Scientific Name	Wetland Indicator (NCNE)	Spacing	Quantity
Black Willow	*Salix nigra*	OBL	3x3	1817
Silky Dogwood	*Cornus amomum*	FACW	3x3	1817
Elderberry	*Sambucus canadensis*	FACW	3x3	1817
Arrowwood	*Viburnum dentatum*	FAC	3x3	1817
			Total	7,268

Planting Zone 3 (channel restoration area including seawall)

Planting Area: 3.999 acres

Retention Basin Slope Native Seed Mix produced by the Ohio Prairie Nursery https://ohioprairienursery.com

Common Name	Scientific Name	Wetland Indicator (NCNE)
Grasses requested @ 50% composition		
Big Bluestem	*Andropogon gerardii*	FACU
Switch Grass	*Panicum virgatum*	FAC
Indian Grass	*Sorghastrum nutans*	FACU
Forbs requested @ 40% composition		
Swamp Milkweed	*Asclepias incarnata*	OBL
Partridge Pea	*Chamaecrista fasciculata*	FACU
Lanceleaf Coreopsis	*Coreopsis lanceolata*	FACU
Purple Coneflower	*Echinacea purpurea*	NI
Ox Eye Sunflower	*Heliopsis helianthoides*	FACU
Dense Blazingstar	*Liatris spicata*	FAC
Wild Bergamot	*Monarda fistulosa*	FACU
Foxglove Beardtongue	*Penistemon digitalis*	FACU
Grey-Headed Coneflower	*Ratibida pinnata*	NI
Black-eyed Susan	*Rudbeckia hirta*	FACU
Brown-eyed Susan	*Rudbeckia triloba*	FACU

This specific sod cutter seed mix is prescribed to be planted for 1 Acre Drilled @ 10.0 PLS Lbs or 1 Acre Broadcast 15 PLS Lbs

Containerized Tree Plantings

Common Name	Scientific Name	Wetland Indicator (NCNE)	Spacing	Quantity
American Elm	*Ulmus americana*	FAC	30x30	25
Cottonwood	*Populus deltoides*	FAC	30x30	25
Red Maple	*Acer rubrum*	FAC	30x30	24
Black Walnut	*Juglans nigra*	FACU	30x30	24
Red Bud	*Cercis canadensis*	FACU	30x30	24
Pin Oak	*Quercus palustris*	FACW	30x30	24
River Birch	*Betula nigra*	FACW	30x30	24
Swamp White Oak	*Quercus bicolor*	FACW	30x30	24
			Total	194

Zone 4 (south abutment staging area)

Planting Area: 0.142 acres

Containerized Tree Plantings

Common Name	Scientific Name	Wetland Indicator (NCNE)	Spacing	Quantity
Black Walnut	*Juglans nigra*	FACU	20x20	3
Black Cherry	*Prunus serotina*	FACU	20x20	3
Sugar Maple	*Acer saccharum*	FACU	20x20	3
Common Hackberry	*Celtis occidentalis*	FAC	20x20	3
Red Bud	*Cercis canadensis*	FACU	20x20	3
			Total	15

Planting Zone 5 (south access road

Planting Zone: 0.27

Custom Blend Upland Herbaceous Seed Mix

Common Name	Scientific Name	Wetland Indicator (NCNE)	Composition (%)	Pounds per Acre	Pounds in Planting Zone
Grasses					
Little Bluestem	*Scoizachyrium scoparium*	FACU	10	3	0.81
Indian Grass	*Sorghastrum nutans*	FACU	10	3	0.81
Nodding Wild Rye	*Elymus canadensis*	FACU	25	7.5	2.03
Switch Grass	*Panicum virgatum*	FAC	10	3	0.81
Big Bluestem	*Andropogon gerardi*	FACU	5	1.5	0.41
		Total	60	18	4.86
Forbs					
Black-eyed Susan	*Rudbeckia hirta*	FACU	7	2.1	0.57
Partridge Pea	*Chamaecrista fasciculata*	FACU	7	2.1	0.57
Common Milkweed	*Asclepias syriaca*	UPL	8	2.4	0.65
Showy Tick Trefoil	*Desmodium canadense*	FAC	1	0.3	0.08
Plains Coreopsis	*Coreopsis tinctoria*	FACU	5	1.5	0.41
Wild Bergamot	*Monarda fistulosa*	FACU	6	1.8	0.49
Beardtongue	*Penistemon digitalis*	FACU	1	0.3	0.08
Evening Primrose	*Oenothera biennis*	FACU	5	1.5	0.41
		Total	40	12	3.24

Stantec

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Revision	By	Appd.	YY.MM.DD

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File Name: 30015c-012-ptsch.dwg	CW	SDP	JGB	14.01.24
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project
City of Fremont

Ballville Dam Removal

Sandusky County, Ohio

Title
Phase 3a - Planting Schedules

Project No. 175630015
Scale NONE
Drawing No.
Sheet 12 of 20
Revision 0

SaveDate: 2014/01/23 11:17 AM Login: Wilkens, Cheyenne
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Ballville Dam Project -- Appendix A6

NOT TO SCALE

Seed Mix Specification

Ballville Dam Removal Zone 1 - Sandusky River Item Code 011714-1A

Recommended Seeding Rates

Hydro Seeded / Broadcast	**Drilled**
25.0 pounds / acre	18.0 pounds / acre
0.57 pounds / 1000 sq. ft.	89 seeds / sq. ft.
124 seeds / sq. ft.	

Category	% by Weight	% by Seed
Forb	26.02%	36.90%
Grass/Grasslike	73.98%	63.10%

Moisture	Seasonally Wet
Light	Prairie/Meadow Sun
Application	Floodplain
Attracts	Hummingbirds
	Pollinators
	Songbirds

Specially prepared for Joey Seamands of Stantec for Ballville Dam Removal - Sandusky River.

Species Name	Common Name	%
Elymus virginicus	Virginia Wild Rye	34.36%
Elymus canadensis	Nodding Wild Rye	30.05%
Chamaecrista fasciculata	Partridge Pea	12.50%
Asclepias incarnata	Rose Milkweed	6.25%
Leersia oryzoides	Rice Cut Grass	3.12%
Tradescantia ohiensis	Ohio Spiderwort	3.12%
Carex lurida	Shallow/Lurid Sedge	3.12%
Vernonia altissima	Tall Ironweed	1.87%
Carex grayi	Gray's Sedge	1.25%
Glyceria striata	Fowl Manna Grass	0.94%
Carex stricta	Common Tussock Sedge	0.62%
Aster novae-angliae	New England Aster	0.62%
Monarda fistulosa	Wild Bergamot	0.62%
Eupatorium maculatum	Spotted Joe Pye	0.47%
Verbena hastata	Blue Vervain	0.44%
Scirpus atrovirens	Dark Green Bulrush	0.31%
Juncus effusus	Common Rush	0.19%
Lobelia siphilitica	Great Lobelia	0.06%
Mimulus ringens	Monkey Flower	0.06%

Ohio Prairie Nursery
PO BOX 174
Hiram, OH 44234

330.569.3380
330.569.7090
www.OhioPrairieNursery.com
info@ohioprairienursery.com

Seed Mix Specification

Ballville Dam Removal Zone 2 - Sandusky River Item Code 011714-1B

Recommended Seeding Rates

Hydro Seeded / Broadcast	**Drilled**
30.0 pounds / acre	20.0 pounds / acre
0.69 pounds / 1000 sq. ft.	58 seeds / sq. ft.
87 seeds / sq. ft.	

Category	% by Weight	% by Seed
Forb	18.12%	25.94%
Grass/Grasslike	81.88%	74.06%

Species Name	Common Name	%
Elymus virginicus	Virginia Wild Rye	25.00%
Elymus canadensis	Nodding Wild Rye	21.25%
Chamaecrista fasciculata	Partridge Pea	12.50%
Sorghastrum nutans	Indian Grass	12.50%
Schizachyrium scoparium	Little Bluestem	10.63%
Spartina pectinata	Prairie Cordgrass	9.38%
Panicum virgatum	Switch Grass	3.12%
Desmodium canadense	Showy Tick Trefoil	2.50%
Tradescantia ohiensis	Ohio Spiderwort	1.44%
Rudbeckia hirta	Black-eyed Susan	0.63%
Aster laevis	Smooth Aster	0.31%
Aster novae-angliae	New England Aster	0.31%
Monarda fistulosa	Wild Bergamot	0.31%
Vernonia altissima	Tall Ironweed	0.06%
Verbena hastata	Blue Vervain	0.06%

Moisture	Mesic
Light	Prairie/Meadow Sun
Application	Native Grassland
Attracts	Hummingbirds
	Pollinators
	Songbirds

Specially prepared for Joey Seamands of Stantec for Ballville Dam Removal - Sandusky River.

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Estimate

Date	Estimate #
1/17/2014	E71843

Stantec
11687 Lebanon Rd.
Cincinnati, Ohio 45241-2012

Project

Item	Description	Qty	UOM	Total
	Ballville Dam Removal - Sandusky River			
Custom Blend ...	011714-1A Zone 1 - Ballville Dam Removal - Sandusky River - application rate is 25 PLS Lb / acre broadcast, 18 PLS Lb / acre drilled)	1	PLS Lb	77.86
Custom Blend ...	011714-1B Zone 2 Ballville Dam Removal - Sandusky River - application rate is 30 PLS Lb / acre broadcast, 20 PLS Lb / acre drilled)	1	PLS Lb	44.15
5 to 7	Quote valid for 30 days. Lead time is 5 to 7 working days at time of quote. Exact composition of mix may vary due to species availability, or market conditions, at time of order. Additional costs may apply for special bagging requirements.			

Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

7 – No Action Alternative Memorandum

Memo

Stantec

To:	Brian Elkington Fisheries Coordinator U.S. Fish and Wildlife Service	From:	Jeff Brown, Sr. Env. Scientist Cody Fleece, Sr. Env. Scientist Stantec Consulting Services Inc.
File:	175631016	Date:	May 7, 2013

Reference: Ballville Dam EIS Alternative 1 – No Action

Purpose of this Memo

The purpose of this memo is to have a written detail of the development of the No Action Alternative including assumptions and literature referenced. This information is based on previous investigations and probable costs for repair by ARCADIS (2005). The majority of this will be provided in the NEPA document; however, this information is prepared ahead of the NEPA document to assist in preparation of the environmental consequences for the project. Specifically, this document provides:

- Background for development of the No Action Alternative;
- Description of the No Action Alterative
    - Describe the structural deficiencies of the Ballville Dam;
    - Describe the activities required for repair/rehabilitation; and
    - Provide an estimate for rehabilitation and continued operation of the dam.

Background

The U.S. Fish and Wildlife Service (USFWS) is the lead agency for developing a Draft Environmental Impact Statement (DEIS) for the Ballville Dam Removal Project. The USFWS is the lead agency based on the funding commitment of $2 million from the Great Lakes Restoration Initiative (GLRI) through the Great Lakes Fish and Wildlife Restoration Act (Act)(16 U.S.C. 941 §4321 et seq.). The Act authorizes the USFWS to work in partnership with States, Tribes, and other Federal agencies for the restoration of fish and wildlife resources in the Great Lakes Basin.

Issuance of funding under the Act constitutes a discretionary federal action by the USFWS and is thus subject to the National Environmental Policy Act (NEPA). As the lead agency, the USFWS has determined that an Environmental Impact Statement (EIS) is appropriate for meeting compliance with the (NEPA). The NEPA process requires that federal agencies integrate an interdisciplinary environmental review process that evaluates a range of alternatives, including the No Action Alternative, as part of the decision-making process. The No Action Alternative is developed for evaluation (40 CFR Part 1502.14(d)) for which other action alternatives are measured against. The No Action Alternative represents the state of the environment without the Proposed Action or any of the alternatives. No USFWS funding would be provided to the project with selection of the No Action Alternative.

Reference: Ballville Dam EIS Alternative 1 – No Action

The Ballville Dam has been subject to multiple inspections and analyses since 1980. In 1980, the Ohio Department of Natural Resources (ODNR) Division of Water performed a Phase I inspection of the dam for the U.S. Army Corps of Engineers Pittsburg office. No structural or hydraulic problems of significance were observed during visual inspections (ODNR 1981). This report recommended four areas where further investigation was needed. Those areas were:

1. Evaluations by a structural dam engineer should occur for the right overflow toe, the foundation at noted eroded areas along the entire toe of the dam, stability of the dam and sea wall for the Probable Maximum Flood (PMF), erosion characteristics of the channel rock downstream of the dam, and the left abutment wall foundation related to erosion and deterioration.

2. Repair surface locations where deterioration has occurred.

3. Periodic visual inspection and monitoring of seepage areas.

4. Implementation of standard operation and maintenance procedures.

A stability analysis of the dam was performed in 1984 by Dodson-Lindblom Associates, Inc. Plans for stabilizing the sea wall were prepared in 1987 by Feller, Finch, & Associates, Inc. However, these plans were not implemented by the City of Fremont (City).

The ODNR inspected the dam in 1998 and 2003 (ODNR 2004 from ARCADIS 2005). The 2003 inspection found that concrete conditions observed in 1998 were continuing to deteriorate. Three areas requiring attention and action from the City were identified: 1.) repairs and investigations, 2.) maintenance and operation, and 3.) monitoring. These items were not different from what the 1981 inspection report found, however, specifications of maintenance were provided regarding the “lake drain,” or sluice gate. The City was given until December 2007 to meet the required remedial measure identified in the report including implementation of any developed construction plans. However, no remedial actions have occurred to date.

Results from an investigation by ARCADIS FPS, Inc. (ARCADIS) were provided in 2005 to the City in response to the ODNR 2004 inspection report. Their report provided details from investigating the dam and sea wall including the ability to safely pass the Probable Maximum Flood (PMF) and the deterioration of the concrete structures. The report concluded that:

1. The dam could not safely pass the PMF;

2. The spillway and central sections have adequate stability for all loading conditions including the PMF;

3. The sea wall could be unstable for floods greater than the top of the sea wall;

4. Routine maintenance, e.g. vegetation removal, should be performed; and

5. The deterioration of the concrete did not endanger the stability of the structures.

In addition to performing stability analyses and further assessing the deteriorating conditions, ARCADIS prepared probable project costs for the sea wall modification and concrete repairs, as well as provided costs for completion of an operation, maintenance, and inspection manual, and lastly an emergency action plan for the Ballville Dam. All costs were developed in 2004/2005.

The report recommended the following remediation measures be undertaken to address concerns from ODNR and USACE regarding the dam safety. Specifically, ARCADIS recommended the following:

1. the sea wall should be stabilized using one of two methods: 1.) gravity stabilization with grouted riprap on uphill side, or 2.) post-tensioned anchors through the wall and into bedrock;

2. the concrete on the dam be repaired by removing the deficient concrete, preparation of the surface, placement of reinforced concrete, shotcrete and/or epoxy on structures and in bedrock scour voids; and

3. Steel guards installed on certain structure corners.

Description

The draft EIS requires analysis of a "no action alternative" for comparison with other action alternatives. If the Ballville Dam is not removed then extensive repairs would be required to bring the dam to ODNR dam safety standards. There are no current (2013) estimated probable costs for the repair of the dam. The ARCADIS (2005) investigation report is the most current assessment available for the Ballville Dam; therefore, the No Action Alternative is based on conclusions and recommendations provided in that report.

As described above, the ARCADIS (2005) report presented several remediation needs for the dam and sea wall. Below are items that make up the No Build Alternative.

Lake Drain. The "lake drain" refers to the sluice gates on the dam. Six gates were originally built, but after the 1969 modification only two remained operational. In 1980, the ODNR found one sluice gate was inoperable and the other was leaking to some degree (ODNR 1981). In order to repair concrete deteriorations on the dam, the water level on the reservoir will need to be lowered by opening the gate(s). The ARCADIS (2005) probable costs of construction included costs for marine equipment and labor for sluice gate rehabilitation (see Appendix H in report). Proper function of the sluice gates is required to address other repairs to the concrete. Additionally, it is required for dam safety that these gates be operable (ODNR 2004). See Attachment 1 for description and costs for rehabilitation of the sluice gates.

Concrete Repairs. Considerable concrete deterioration has occurred on the dam; especially those areas that were repaired in 1969. Additionally, there are some limited undermining along the toe of the spillway sections and central non-overflow section that require filling. ARCADIS (2005) found these conditions nonthreatening to water retaining structures, but recommended their repairs for long term serviceability of the dam. Plates 1 and 2 in Attachment 1 provide detail and location where concrete repairs are needed. Overall, the estimated construction

costs ranged from $2,346,000 and $2,287,000. Differences in the costs were due to percent contingency and design and construction administration activities. Details of the probable costs are presented in Attachment 1. The primary items are:

1. Replacement of shotcrete on the left abutment downstream training wall;

2. Replacement of shotcrete on all surfaces of the central nonoverflow walls;

3. Installation of formed concrete walls at the downstream end of the central non-overflow section and at the base of the training wall next to the left spillway and non-overflow section;

4. Filling of the void under the toe of the right spillway section;

5. Installation of steel angles on the upstream corners of the raw water intake for protection; and

6. Injection of epoxy into cracks in the left side of the central non-overflow section.

Replacement of shotcrete is likely to be accomplished by removing all loose material, cutting the void edges with a saw, using anchoring wire mesh in the void, and reapplication of shotcrete. This repair is not permanent but likely to last approximately 50 years based on previous environmental conditions.

The filling of voids along the downstream toe would likely require preparing the surface by cutting the edges and installation of wire mesh that is securely anchored to the prepared surface. Fill below the waterline would require tremie concrete to fill the void in the wetted conditions.

ARCADIS (2005) noted that steel plating was used below the water line for protection against debris impact into the structure prior to falling over the spillway. Installation of similar steel plating would likely help against continued deterioration. Installation would require replacement of the shotcrete (as depicted above) and then securing steel plates along the corners with drilled shafts for large welded rebar/steel bars.

Injection of the epoxy into cracks would require surface preparation and cleaning and then injection of the epoxy for filling. This action would help prevent these areas from further deterioration from thaw/freeze and other environmental conditions.

Access to the structure for filling voids and other repair of the structure is not specifically stated in the report. It is reasonable to assume that permits such as 404/401/10 may be needed due to work (including fill) within the Sandusky River.

Sea Wall. The sea wall was found by ARCADIS (2005) to be at risk of failure in floods that would crest the wall. The overflowing water would erode the backfill and possibly cause collapse. This is similar to the condition that destroyed the dam during construction in 1911.

Two solutions were developed in order to prevent the sea wall from failing: gravity alternative and post-tension alternative.

The gravity alternative would remove the soil behind the sea wall down to rock and replace it with a non-erodible material that would remain stable during a cresting of the wall. ARCADIS (2005) proposed roller compacted concrete (RCC) or rock fill consolidated with grout as possible materials. A figure depicting a typical cross section using the gravity alternative is provided in Attachment 2. Probable costs for this alternative were estimated to be $1,777,000 in 2005. Details of the probable costs are presented in Attachment 2.

The second alternative is the post-tension alternative. This alternative requires the installation of post-tensioned anchors in the sea wall. This alternative assumes that the concrete in the existing seawall is suitable and that subsurface rock is capable to resist the anchor loads. Extensive geotechnical investigation of both the subsurface rock and the sea wall will be necessary to confirm the feasibility of this alternative. A figure in Attachment 2 depicts a typical cross section using the post-tensioned alternative method. Probable costs for this alternative were estimated to be $2,856,000 in 2005. Details of the probable costs are presented in Attachment 2.

Operational Manuals. In order to bring the dam into compliance, two documents must be developed: 1.) an operations, maintenance, and inspection manual and 2.) an emergency action plan. These documents provide discussion of the various modifications and utilize the results of hydrology and hydraulics modeling. ARCADIS (2005; Appendix B) estimated a cost of $33,000 to prepare these documents.

Summary

The ODNR has identified deficiencies with the Ballville Dam that have been recommended for repair and rehabilitation since 1980. Currently, the dam and sea wall are not operating in accordance with ODNR safety standards. The 2005 report prepared by ARCADIS is the most current document that provides analyses of stability of the dam and sea wall as well as estimated probable costs for remediation to bring the dam into compliance with ODNR safety standards. This report is the basis for the No Action Alternative for the Ballville Dam Removal project draft EIS being led by the USFWS.

The four major items that the ARCADIS 2005 report focused on included:

- structural stability during the PMF,
- repair of concrete,
- stabilization of the sea wall, and
- standard operation and inspection procedures.

While the dam was found to be stable during the PMF it is in need of concrete repairs. The sea wall was found not to be stable during a quarter of the PMF flow (approximately 50,000 cfs).

Two alternatives were developed to address this instability: gravity and post-tension alternatives. Finally, in order to own and operate a dam in Ohio owners are required to have operation and maintenance manuals on file with ODNR as well as inspection procedures and past reports available. The table below provides estimated costs for rehabilitation of the dam to meet ODNR standards.

Item	Costs (low)
Concrete Repairs	$2.3 - $2.4 Million
Sea Wall Stabilization	
Gravity Alternative	$1.8 Million
Post-tension Alternative	$2.9 Million
Operational Manuals	$33 Thousand

Source: ARCADIS 2005

The No Action Alternative ranges from $4.1 to $5.3 million based on 2005 estimates. The concrete repair differences are based on differences in the design and administration of construction. The gravity alternative would be the most cost effective and efficient alternative for stabilizing the sea wall. The preparation of the manuals is required and provided as a single cost.

Literature Cited

ARCADIS. 2005. Ballville Dam Investigation Report. Report prepared for City of Fremont and Ohio Dept. of Natural Resources, Division of Water.

(ODNR) Ohio Dept. of Natural Resources – Division of Water. 2003. Dam Safety Inspection Report. File No. 1231-003. 14 pp.

(ODNR) Ohio Dept. of Natural Resources – Division of Water. 1981. Phase I Inspection Report National Program of Inspection of Non-federal Dams – Ballville Dam. Report prepared for U.S. Army Corps of Engineers Pittsburg District, Federal Inventory No. OH-809, Ohio File No. 1231-003. 9 pp, plus appendices.

Attachment 1 – Concrete Repairs and Plates
- Construction Cost Estimate – Concrete Repairs
- Plate 1 – Sea Wall Modifications and Concrete Repairs
- Plate 2 – Details for Concrete Repairs

Attachment 2 – Sea Wall Stabilization and Figures
- Probable Project Cost – Sea Wall Modification – Gravity Alternative
- Plate 3 – Gravity Alternative
- Probable Project Cost – Sea Wall Modification – Post-tension Alternative
- Plate 4 – Post-Tension Alternative

Construction Cost Estimate
Concrete Repairs
Ballville Dam
10-Sep-05

Description	Unit	Quantity	Unit Price	Item Total	
Mobilization	LS	1	75,000.00	$75,000	
Erosion Control and Water Quality Protection	LS	1	25,000.00	25,000	
Marine Equipment and Labor					
Barge and crane rental	MO	5	7,300.00	36,500	
Crew	MO	5	86,000.00	430,000	
Sluice Rehabilitation	LS	2	25,000.00	50,000	
					$616,500
Left Abutment - Training Wall					
Scaffolding and lift equipment	LS	1	10,000.00	10,000	
Scaling of loose shotcrete	SF	1,860	2.30	4,278	
Surface preparation	SF	1,860	9.20	17,112	
Fence removal	LS	1	1,000.00	1,000	
Mesh installation	SF	1,860	6.90	12,834	
Shotcrete	SF	1,860	19.50	36,270	
New fence on concrete structures	LS	1	3,000.00	3,000	
Grading and seeding on abutment	SF	1	5,000.00	5,000	
					89,494
Chlorination Building Substructure					
Removal of vegetation and sediment from intake deck	LS	1	5,000.00	5,000	
Scaffolding and lift equipment	LS	1	5,000.00	5,000	
Scaling of loose shotcrete	SF	630	2.30	1,449	
Surface preparation	SF	630	9.20	5,796	
Mesh installation	SF	630	6.90	4,347	
Shotcrete	SF	630	19.50	12,285	
					33,877
Left Spillway Section - Formed Concrete Wall Adjacent to Central Nonoverflow Section					
Foundation preparation (hand methods by divers)	Day	3	2,000.00	6,000	
Surface preparation	SF	50	20.00	1,000	
Installation of dowels	EA	40	100.00	4,000	
Reinforcing steel	LB	100	10.00	1,000	
Formwork erection (3 ft high by 20 ft long in 2 feet of water)	LS	1	6,000.00	6,000	
Setup to pump concrete (150 feet to central nonoverflow section)	LS	1	4,500.00	4,500	
Concrete in place (tremie underwater by pumping)	CY	5	500.00	2,500	
Formwork removal (3 ft high by 20 ft long in 2 feet of water)	LS	1	3,000.00	3,000	
					28,000

Epoxy Injection for Training Wall Adjacent to Central Nonoverflow Section					
Installation of work platform	LS	1	5,000.00	5,000	
Anchor installation	EA	20	100.00	2,000	
Epoxy injection	LF	50	50.00	2,500	
					9,500
Central Nonoverflow Section - Formed Concrete Wall at Downstream End					
Removal of vegetation and sediment	LS	1	10,000.00	10,000	
Foundation preparation (hand methods by divers)	Day	5	2,000.00	10,000	
Surface preparation	SF	250	20.00	5,000	
Installation of dowels	EA	100	100.00	10,000	
Reinforcing steel	LB	700	5.00	3,500	
Formwork erection (5 ft high by 50 ft long in 3 feet of water)	LS	1	12,000.00	12,000	
Setup to pump concrete (200 feet to central nonoverflow section)	LS	1	5,000.00	5,000	
Concrete in place (tremie underwater by pumping)	CY	22	250.00	5,500	
Formwork removal (5 ft high by 50 ft long in 3 feet of water)	LS	1	6,000.00	6,000	
					67,000
Central Nonoverflow Section - Downstream Buttresses					
Scaffolding and lift equipment	LS	1	50,000.00	50,000	
Scaling of loose shotcrete	SF	9,500	2.30	21,850	
Surface preparation	SF	9,500	9.20	87,400	
Fence removal	LS	2	1,000.00	2,000	
Mesh Installation	SF	9,500	6.90	65,550	
Shotcrete	SF	9,500	19.50	185,250	
New fence on buttresses	LS	2	3,000.00	6,000	
					418,050
Central Nonoverflow Section - Upstream Piers and Intake					
Scaffolding and lift equipment	LS	1	12,000.00	12,000	
Scaling of loose shotcrete	SF	2,260	2.30	5,198	
Surface preparation	SF	2,260	9.20	20,792	
Mesh Installation	SF	2,260	6.90	15,594	
Shotcrete	SF	2,260	19.50	44,070	
Installation of dowels for corners	EA	40	100.00	4,000	
Installation of protective steel angles for corners	EA	4	1,000.00	4,000	
					105,654
Right Spillway Section - Undercut Area at Toe of Spillway					
Diversion of flow within work limits	LS	1	10,000.00	10,000	
Foundation preparation (hand methods by divers)	Day	10	2,000.00	20,000	
Formwork erection (2 ft high by 10 ft long in 5 feet of water)	LS	1	8,000.00	8,000	
Setup to pump concrete (250 feet from right abutment)	LS	1	8,000.00	8,000	
Concrete in place (tremie underwater by pumping)	CY	25	250.00	6,250	
Formwork removal (2 ft high by 10 ft long in 5 feet of water)	LS	1	4,000.00	4,000	
					56,250

Subtotal Construction				$1,424,325
Allowance for Disruption by High Water During Construction (20 percent)				$284,865
Contingency (20 percent)				$341,810
Total Construction				$2,051,000
Design and Construction Administration				
Engineering Design and Permitting	LS	125,000.00	1	125,000
Construction Administration	LS	29,000.00	1	29,000
Construction Inspection	LS	77,000.00	1	77,000
Construction Material Testing	LS	5,000.00	1	5,000
Total Probable Project Cost				$2,287,000

Subtotal Construction				$1,424,325	$1,424,325
Allowance for Disruption by High Water During Construction (20 percent)				$284,865	
Contingency (25 percent)				$418,810	
Total Direct Construction				$2,128,000	
Design and Construction Administration					
Engineering Design	LS	1	125,000.00	125,000	
Construction Administration	LS	1	90,000.00	90,000	
Construction Testing	LS	1	3,000.00	3,000	
Total Estimated Construction Cost				$2,346,000	

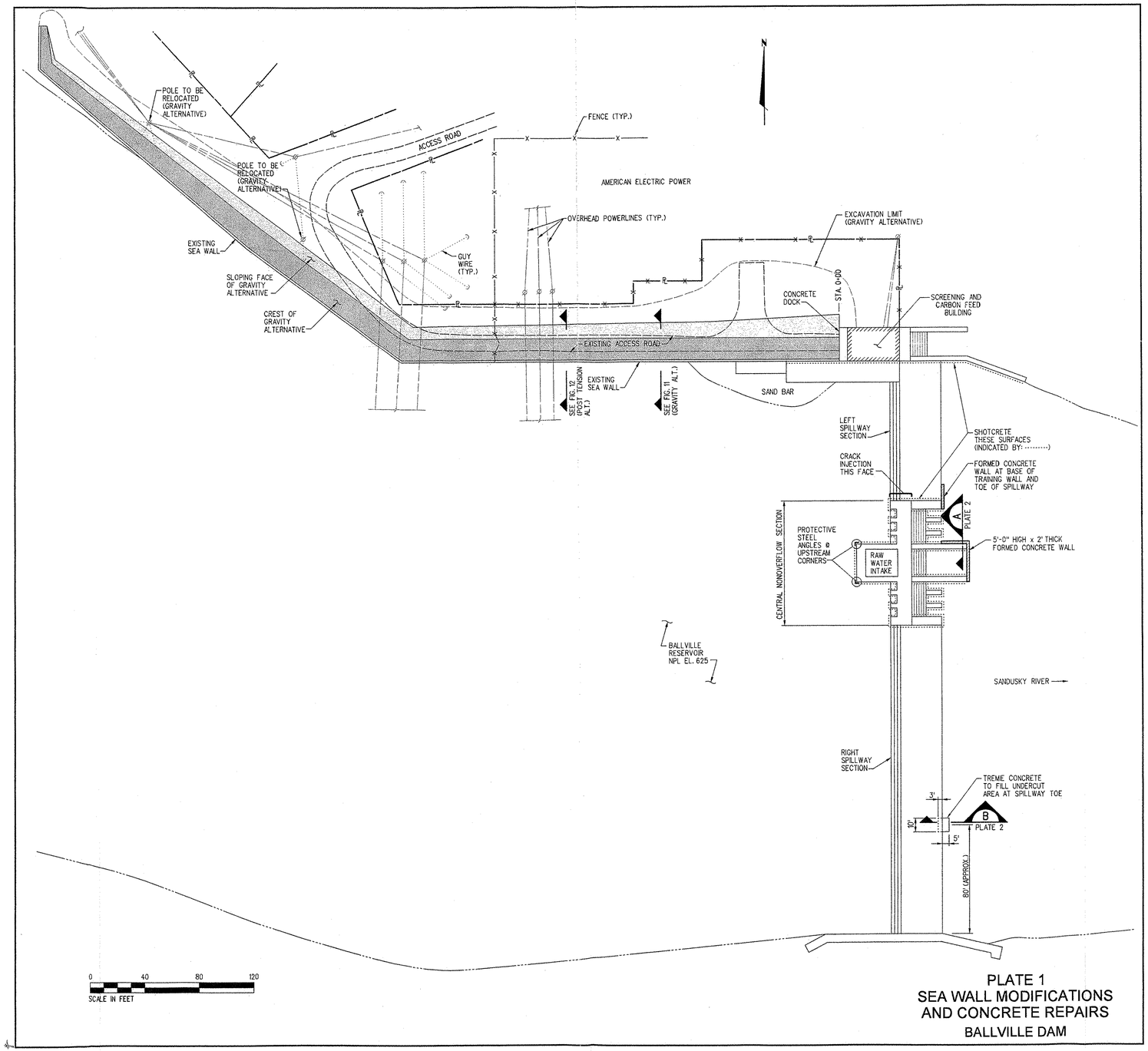
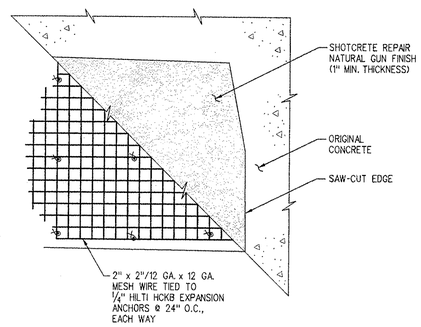
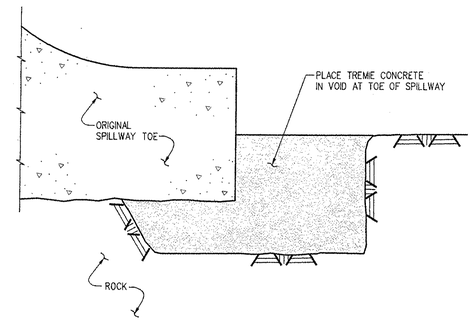


PLATE 1
SEA WALL MODIFICATIONS
AND CONCRETE REPAIRS
BALLVILLE DAM



TYPICAL SHOTCRETE REPAIR

NOT TO SCALE



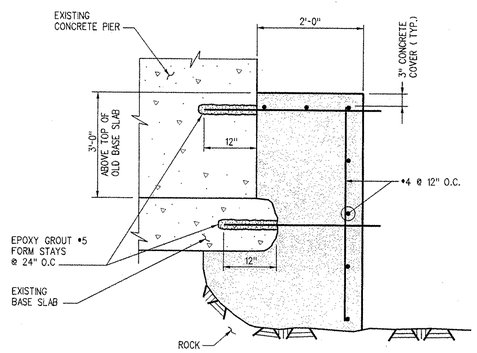
SECTION B

SCALE: 3/8"=1'-0"

0 1 2 3 4 8

SCALE IN FEET

CONCRETE FILL FOR VOID
UNDER TOE OF RIGHT SPILLWAY SECTION



SECTION A

SCALE: 3/4"=1'-0"

0 1 2 3 4

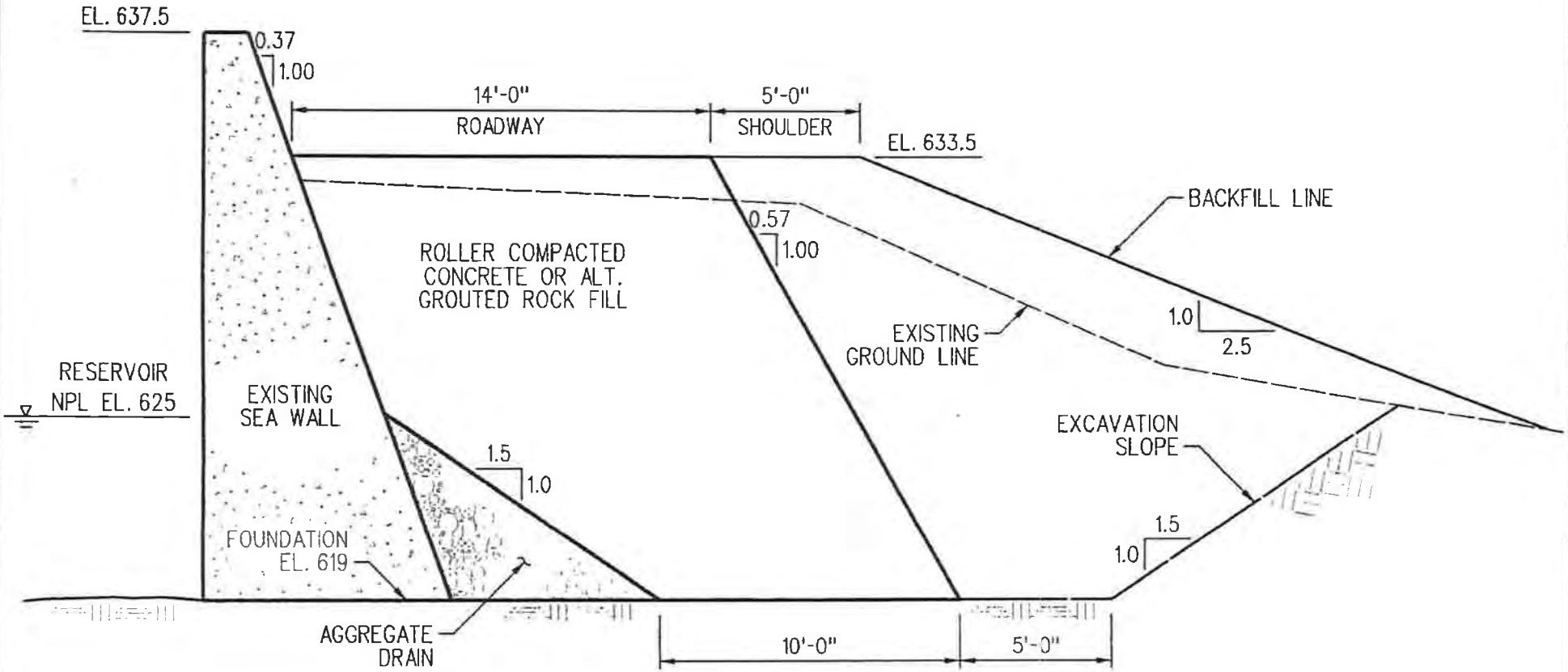
SCALE IN FEET

FORMED CONCRETE WALL AT
DOWNSTREAM END OF
CENTRAL NONOVERFLOW SECTION

PLATE 2
DETAILS FOR
CONCRETE REPAIRS
BALLVILLE DAM

Probable Project Cost
Sea Wall Modification - Gravity Alternative
Ballville Dam
10-Sep-05

Description	Unit	Unit Price	Quantity	Item Total
Mobilization	LS	75,000.00	1	$75,000
Fence Removal	LS	5,000.00	1	5,000
Erosion Control	LS	3,000.00	1	5,000
Powerline Relocation	LS	80,000.00	1	80,000
Excavation	CY	9.60	10,100	96,960
Diversion and Care of Water	LS	10,000.00	1	10,000
Foundation Preparation	LS	50,000.00	1	50,000
Aggregate Drain	CY	50.00	600	30,000
Roller Compacted Concrete	CY	145.00	5,300	768,500
Backfill	CY	4.75	6,100	28,975
Miscellaneous Site Work	LS	10,000.00	1	10,000
Finish Grading	LS	3,000.00	1	3,000
Seeding	acre	2,500.00	2	5,000
Crushed Stone on Parking Lot and Road	CY	40.00	160	6,400
Fencing	LS	4,000.00	1	4,000
Subtotal Construction				$1,177,835
Contingency (25 percent)				295,165
Total Construction				$1,473,000
Design and Construction Administration				
Engineering Design and Permitting	LS	125,000.00	1	125,000
Geotechnical Investigation	LS	20,000.00	1	20,000
Roller Compacted Concrete Mix Design	LS	35,000.00	1	35,000
Construction Administration	LS	24,000.00	1	24,000
Construction Inspection	LS	90,000.00	1	90,000
Construction Material Testing	LS	10,000.00	1	10,000
Total Probable Project Cost				$1,777,000



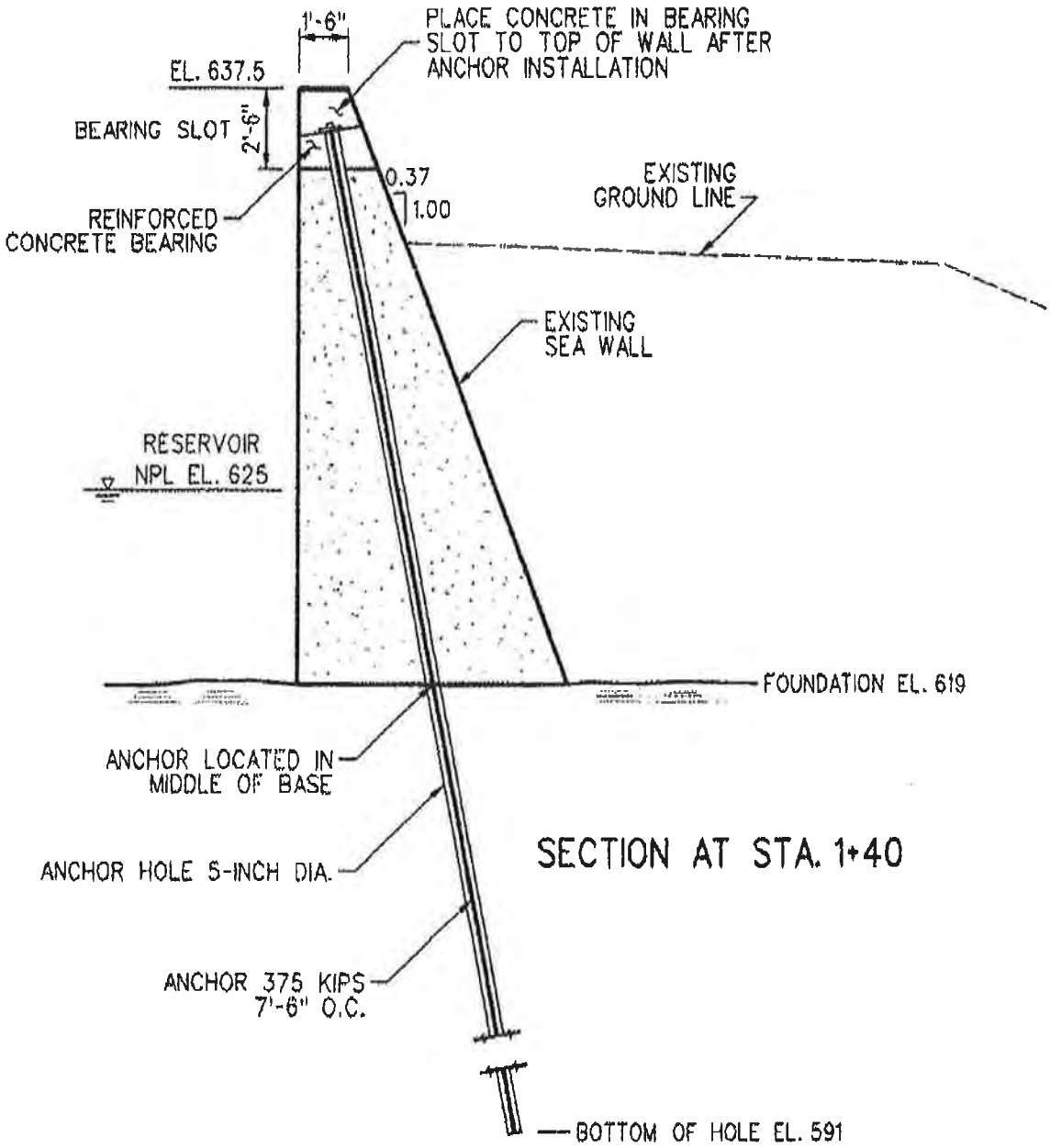
SECTION AT STA. 1+40

NOTE: 14'-0" WIDE CONCRETE CREST AT EL. 633.5 TO SERVE AS ACCESS ROAD TO CHLORINATION BUILDING.

GRAVITY ALTERNATIVE
BALLVILLE SEA WALL MODIFICATION
FIGURE 11

Probable Project Cost
Sea Wall Modification - Post Tension Alternative
Ballville Dam
9-Sep-05

Description	Unit	Unit Price	Quantity	Item Total
Mobilization	LS	75,000.00	1	$75,000
Miscellaneous Site Work and Erosion Control	LS	3,000.00	1	3,000
Cut Bearing Slots in Sea Wall, total for job	EA	1,925.00	101	194,425
Anchor Installation - Station 0+00 to 1+30				
Setup, 26 holes	EA	2,100.00	26	54,600
Drill 26 Holes, 5-inch dia, 5-ft o.c., 53 LF each	LF	68.00	1,400	95,200
Pressure Test, 26 holes	EA	280.00	26	7,280
Grout, 26 holes	CF	22.00	1,400	30,800
Construct Reinforced Concrete Bearing	EA	1,950.00	26	50,700
Redrill Holes for Anchors, 26 holes	LF	34.00	1,400	47,600
Anchor Material Cost	LB	4.00	11,400	45,600
Install Anchors, including grouting bond length	EA	1,688.00	26	43,888
Tension Anchors, including grouting unbonded length	EA	2,650.00	26	68,900
Anchor Installation - Station 1+30 to 6+20				
Setup, 65 holes	EA	2,100.00	65	136,500
Drill 65 Holes, 5-inch dia, 7-ft 6-in o.c., 44 LF each	LF	68.00	2,900	197,200
Pressure Test, 65 holes	EA	280.00	65	18,200
Grout, 65 holes	CF	22.00	2,900	63,800
Construct Reinforced Concrete Bearing	EA	1,950.00	65	126,750
Redrill Holes for Anchors, 65 holes	LF	34.00	2,900	98,600
Anchor Material Cost	LB	4.00	23,600	94,400
Install Anchors, including grouting bond length	EA	1,688.00	65	109,720
Tension Anchors, including grouting unbonded length	EA	2,650.00	65	172,250
Anchor Installation - Station 6+20 to 7+10				
Setup, 10 holes	EA	2,100.00	10	21,000
Drill 10 Holes, 3.5-inch dia, 10-ft o.c., 33 LF each	LF	56.00	330	18,480
Pressure Test, 10 holes	EA	22.00	10	220
Grout, 10 holes	CF	22.00	330	7,260
Construct Reinforced Concrete Bearing	EA	1,950.00	10	19,500
Redrill Holes for Anchors, 10 holes	LF	28.00	330	9,240
Anchor Material Cost	LB	4.00	1,700	6,800
Install Anchors, including grouting bond length	EA	1,688.00	10	16,880
Tension Anchors, including grouting unbonded length	EA	2,650.00	10	26,500
Restore Wall Crest, 101 slots	EA	1,500.00	101	151,500
Crushed Stone on Roadways	CY	60.00	40	2,400
Cleanup and Site Restoration	LS	5,000.00	1	5,000
Subtotal Construction				$2,019,193
Contingency (25 percent)				498,807
Total Construction				2,518,000
Design and Construction Administration				
Engineering Design and Permitting	LS	125,000.00	1	125,000
Geotechnical Investigation	LS	55,000.00	1	55,000
Construction Administration	LS	43,000.00	1	43,000
Construction Inspection	LS	115,000.00	1	115,000
Total Probable Project Cost				$2,856,000



NOTES:

1. CUT BEARING SLOT IN CREST 2 FT BY 2 FT AT EACH ANCHOR LOCATION.
2. DRILL, GROUT AND REDRILL HOLES BEFORE INSTALLATION OF ANCHOR.

POST-TENSION ALTERNATIVE
BALLVILLE SEA WALL MODIFICATION
FIGURE 12

Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

8 – Fish Passage Structure Alternative Memorandum

Memo

Stantec

To:	Brian Elkington, Fisheries Coordinator	From:	Michael Chelminski, P.E. Jeff Brown, Sr. Env. Scientist Cody Fleece, Sr. Env. Scientist
	U.S. Fish and Wildlife Service		Stantec Consulting Services Inc.
File:	175631016	Date:	May 7, 2013

Reference: Ballville Dam EIS Alternative 2 –Fish Elevator

Purpose of this Memo

The purpose of this memo is to provide a conceptual design for a fish elevator (also called a "fish lift") at the Ballville Dam as an alternate way to provide for fish passage on the Sandusky River. The intent of this memo is to provide information for understanding how a fish elevator for upstream fish passage at Ballville Dam may be constructed, operated, and maintained.

Background

The U.S. Fish and Wildlife Service (USFWS) is the lead agency for developing a Draft Environmental Impact Statement (DEIS) for the Ballville Dam Removal Project based on the funding commitment of $2 million from the Great Lakes Restoration Initiative (GLRI) through the Great Lakes Fish and Wildlife Restoration Act (Act)(16 U.S.C. 941 §4321 et seq.). The Act authorizes the USFWS to work in partnership with States, Tribes, and other Federal agencies for the restoration of fish and wildlife resources in the Great Lakes Basin.

Issuance of funding under the Act constitutes a discretionary federal action by the USFWS and is thus subject to the National Environmental Policy Act (NEPA). As the lead agency, the USFWS has determined that an Environmental Impact Statement (EIS) is appropriate for meeting compliance with NEPA. The NEPA process requires that federal agencies integrate an interdisciplinary environmental review process that evaluates a range of alternatives, including the other feasible action alternatives, as part of the decision-making process. The Fish Elevator Alternative was developed for evaluation as an alternative for allowing fish movement upstream of the dam without dam removal.

Overview of Fish Elevator Systems

Fish elevator systems have the potential to provide for upstream passage of target fish species and/or life stages that may not be provided upstream-passage for "flow-through" (e.g., vertical slot, Denil, pool-and-weir) fishpasses, as swimming speeds are not relevant to the actual vertical transport of the fish. Constraints on upstream passage (lifting) are therefore limited to having fish enter and safely exit the lift. Fish lifts may therefore be appropriate for fish that have relatively low swimming speeds, such as walleye, or relatively large fish, such as sturgeon, which may not successfully pass upstream through flow-through fishpasses.

The operational regime of a fish elevator system is generally comprised of the following components:

1. Attraction of fish into the fishpass inlet (hydraulic exit);
2. Guidance of fish into a trap system;
3. Closure of the trap system;
4. Lifting of the trap;
5. Discharge of the fish into a sorting system[1];
6. Release of target fish species into an outlet channel; and
7. Discharge of fish into the upstream environment.

The fundamental component of a fish elevator system is a means for trapping target fish species, and is typically locating in the vicinity of the downstream end of the structure around which upstream passage is desired. The entrance of the trap system must be located in an area that is readily accessible to the target fish species during the target seasonal migration period(s), and performs in a manner that is similar to a volitional fish passage system.

Criteria that need to be considered in the development of a suitable entrance into the trap system include its location, geometry, attraction flow, and conditions in the adjacent reach of the river. The trap entrance must be in a location that is accessible to the target fish species during seasonal flows in the Sandusky River. It should be assumed that the fish elevator would be designed to function at flows that are less than the noted 75th percentile exceedence flow (156 cfs) as upstream passage may be critically important during low flow conditions.

Guiding fish into the trap system requires that the geometry and location of the facility entrance function over a range of flows (e.g., from 150 to 2,500 cfs). The vertical extent of the entrance must be well below (e.g., at least 3 to 4 feet [ft]) the elevation of the normal tailwater at the minimum flow, and may need to extend to the elevation of the bottom of the adjacent streambed if the target fish species preferentially move along the bottom. Augmentation of flow would be necessary to provide for suitable attraction flow, and would likely be variable, with increased attraction flow during higher flows in the river. If conditions in the immediate vicinity of the entrance are very turbulent, the design of the entrance structure may need to incorporate protrusions into the tailrace that provide for hydraulic conditions that allow for fish to move upstream in the tailrace to the trap entrance.

Flow augmentation can be provided using a gravity feed from the upstream impoundment, and would require introduction of flow in the vicinity of the facility entrance and introduction of flow

[1] The presence of undesirable introduced species in the Great Lakes, such as sea lamprey, likely necessitates inclusion of a sorting facility for removal of undesirable species to prevent introduction upstream from Ballville Dam.

through the trap system. Each system would need control valves to manage appropriate flow speeds at the entrance and approach to the trap.

The trap system could operate on a regular basis (e.g., every half-hour) or on an "on-demand" basis based on visual observation of fish in the trap or other method(s). The trap system could be comprised of a positive gate structure that would be closed prior to lifting or a passive system, such as a fyke screen that would inhibit departure of fish following entry into the trap.

Lifting of the trap would be performed using a mechanical lift system. Hydraulic lift systems could be used, but could result in accidental discharge of oil. It is expected that noise associated with a properly design and maintained lift system would be minimal, and could be further controlled by enclosing the lift structure inside of a paneled superstructure.

Discharging of fish from the trap can be performed by volitional swimming with a "crowder" or by emptying of the trap (e.g., tipping) using a mechanical system; the latter approach is recommended. Fish would be discharged into a sorting facility were non-target species would be manually removed. The sorting facility would be comprised of tanks with a constant water supply. The size and number of sorting tanks would be determined based on the number of fish requiring handling. Unsorted passage may be possible under some conditions if determined appropriate (e.g., when it is determined that no undesirable species will be present in the lift.

Design and Operational Requirements

Primary design components of fish elevators have constraints associated with the need for continuous mechanical operations during seasonal migration periods to provide for upstream fish passage. Existing access for construction and operation of a fish lift is limited to the left (north) abutment of Ballville Dam. While the non-overflow section of the dam between the left and right spillways has bays that could, conceivably, be used to house a fish lift, this location is impractical because of poor access (i.e., across a footbridge), potential for floods overtopping the structure, and lack of suitable covered space for sorting/exclusion operations. Figure 1 provides a conceptual layout of what a fish elevator system may look like at the Ballville Dam.

Typical components of a fish lift include 1) siting at an appropriate location along the downstream side of the dam, 2) provisions for suitable attraction flow to guide fish into inlet, 3) a trap system, 4) a lifting system, 5) sorting system, and 6) a fishpass outlet. General concepts for each of these six components for a fish lift at Ballville Dam are described below;

1) **Siting**: The area adjacent to the left abutment of the dam appears to be generally suitable for installation of a fish lift. A primary requirement is that the structure be located where it is not subject to damage from flow passing over the north spillway. This is generally as depicted on the figure "Fish Lift North Abutment."

2) **Attraction Flow**: Attraction flow into the trap is necessary to guide fish into the trap section at the base of the fish lift. The general configuration of this system will be similar to a flow-through fishpass. The design of the attraction flow requires information on hydraulic conditions in the area immediately downstream from the north spillway and

further downstream. Selection of an appropriate attraction flow discharge and orientation of the attraction "jet" at the base of the dam would need to be evaluated based on a range of flows during the seasonal upstream passage period(s). In general, it is suggested that the attraction flow should be parallel to the retaining wall that extends downstream from the north abutment of the dam.

The volume and jet velocity of the attraction flow depend on a variety of factors; a conceptual estimate of total attraction flow is 50 cubic feet per second (cfs), comprised of 25 cfs discharged through the trap system and 25 cfs of augmented attraction flow discharged into the plunge pool in the immediate vicinity of the trap inlet. Both the trap system and augmentation flow can be provided using conduits from the upstream impoundment with appropriate controls and fittings (e.g., valves, diffusers).

It must be verified that the target fish species are able to ascend to the plunge pool immediately downstream from the north spillway prior to final site selection. Given the general unsuitability of the south abutment of the dam, modification of the downstream channel may be appropriate if barriers to upstream passage are identified downstream from the north spillway.

3) **Trap System**: The trap system is generally located upstream from the fishpass entrance. In general, the trap may be viewed as similar to a fyke net, with fish passing through a narrowing slot prior to entering the trap that is part of the lifting system. Attraction flow (assumed here as 25 cfs) must be routed through the trap system, and requires a barrier fence at the upstream end of the trap. A temporary closure fence would be required at the inlet of the trap; this fence would be closed prior to lifting and reopened upon completion of a lifting cycle when the trap is returned to the bottom of the trap well.

4) **Lifting System**: The lifting system is comprised of a "lift bucket" to allow fish to be persistently wet during vertical transport. The lift bucket must be sized to accommodate expected numbers of fish and the largest size fish that may be expected. It is recommended that the minimum internal dimension be at least 6 feet. The volume of water in the lift bucket must be sufficient to limit the potential for asphyxiation of fish due to oxygen depletion during lifting. Based on an assumed lift speed of 0.5 ft/second and a lift height of 30 feet, the duration of lifting would be 60 seconds, and asphyxiation is therefore not identified here as a primary constraint on operational effectiveness.

   A conceptual lift bucket volume is 4 feet x 6 feet with a depth of water of 2 feet, or 48 cubic feet (~ 360 gallons, 3,000 pounds). Screening along the side would allow for draining-off of water during lifting and containment of fish. Note the reported weight is similar with/or without fish as they displace water. This is a large lift bucket; in practice, the actual dimensions could be reduced.

   Various types of mechanical and hydraulic systems may be appropriate for the lifting mechanism. In general, the use of hydraulic systems is not recommended due to the

potential for release of hydraulic fluid in the event of a system failure (e.g., burst hydraulic line). A mechanical chain hoist or winch system is recommended.

Auto cycling of lifting and gate operations is a possibility, but would not eliminate the need for sorting if exclusion of undesirable species is required. It is expected that a fish lift at Ballville Dam could be cycled (up and down) in approximately 15 minutes. During periods when numbers of migrating fish are low, it is expected that filling of the trap would represent the limiting factor on cycle time.

5) **Sorting System**: Exclusion of undesirable species would likely be required as part of fish lift operation at Ballville Dam. It is expected that removal and disposal of upstream migrating sea lamprey would be required at any upstream fish passage system at Ballville Dam. A lift or lock system would facilitate this, and would require construction of a trapping and sorting facility; such a facility would be best located at the fish lift outlet. This system would require holding pools and means to effectively sort, capture, and dispose of undesirable species.

6) **Fishpass Outlet**: The fishpass outlet should be located well upstream from the north spillway. Depending on the target species and life stages for upstream passage, detailed hydraulic studies may be necessary to assure that fish can successfully move upstream from the fishpass outlet with minimal risk of being swept downstream and over the spillway.

Discussion of Previously-Noted Issues

- Aesthetics: A properly designed and constructed fish lift would be marginally visible.
- Operation of mechanical systems is not expected to result in noise in excess of that produced by water flowing over the dam.
- The likelihood of breakdowns of a properly designed and maintained system is not expected to occur

Downstream Fish Passage

Fish elevator systems are not used for downstream fish passage. The suggested approach to accommodate downstream fish passage at Ballville Dam is to construct a notch in the north (river-left) spillway that is the primary flow pathway at lower flows. Suitability of downstream passage over spillways generally requires a downstream plunge pool depth of at least 25 percent of the hydraulic height of the structure. At an approximate hydraulic height of 30 feet, the minimum plunge pool depth would need to be 7.5 feet.

Design Criteria for Ballville Dam

The objective of a fish elevator system is to provide for upstream passage of target fish species at Ballville Dam, including walleye, white bass, and greater redhorse. A fundamental

component of fish elevator systems is trapping of fish prior to lifting the elevator component for release upstream. Fish elevators, therefore, do not provide for volitional upstream fish passage. A beneficial component of fish elevator systems is that they provide for trapping of fish which allows for exclusion of undesirable and/or invasive species, such as sea lamprey (*Petromyzon marinus*) and a variety of Asian carp.

Target migration periods for the three target fish species for upstream passage at Ballville Dam are presented in Table 1 along with seasonal flow statistics that were developed as part of the Ballville Dam Removal Feasibility Study (FS). A fish elevator system is not necessarily as constrained as a flow-through fish passage system (e.g. fish ladder) by low and high flow conditions, and, conceptually, may function at a broader range of flow relative to a flow-through system. However, fish must be able to reach the entrance to the fish elevator system and must be able to successfully exit the system and proceed upstream.

Based on a presumed requirement for upstream fish passage at a range of flows between the 75th and 25th exceedence percentiles, the range of flows during which a fish elevator at this site should provide for safe, timely, and effective upstream fish passage for the target fish species is from approximately 150 to 2,500 cubic feet per second (cfs).

Table 1: Seasonal Migration and Staging Periods for Target Fish Species

Fish Species	**1-Mar**	**15-Mar**	**1-Apr**	**15-Apr**	**1-May**	**15-May**	**1-Jun**	**15-Jun**
Walleye								
White Bass								
Greater Redhorse								

	Monthly Hydrologic Statistics (cfs)			
Flow Statistic	March	April	May	June
75% Exceedence	510	467	288	156
Median	954	1020	476	341
25% Exceedence	2,490	2,400	1,075	800

= Low-Level Activity
= Peak Activity

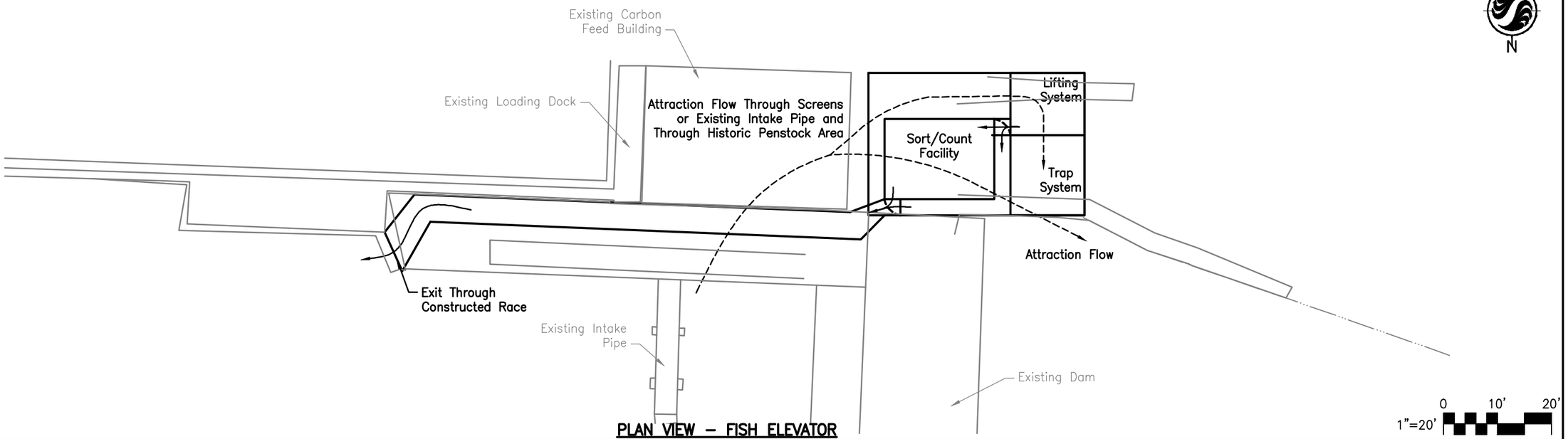
This alternative would include the concrete repairs to the dam, stabilization of the sea wall, and development of operation and maintenance manuals as described in the No Action Alternative. Additionally, it would require the construction of the elevator structure. A conceptual opinion of probable cost presented in the 2011 Ballville Dam Removal Feasibility Study is shown below.

Reference: Ballville Dam EIS Alternative 2 –Fish Elevator

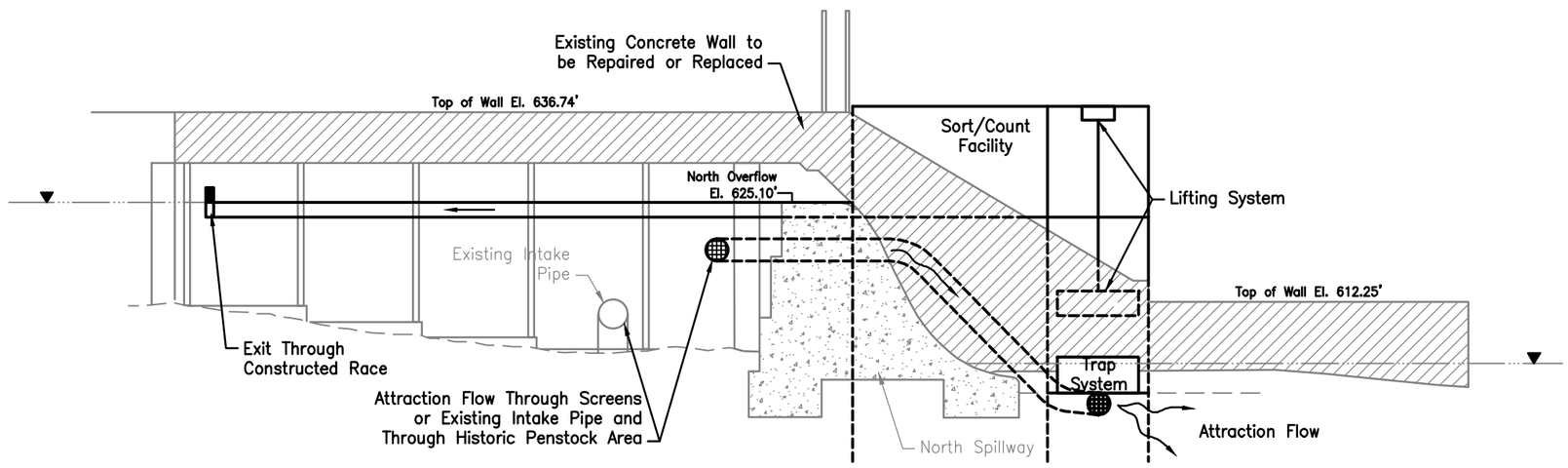
Opinion of Probable Cost for Fish Passage Facility

No.	Item	Total Cost
Construction Phase		
1	Coffer dam	$150,000
2	Tailrace excavation	$250,000
3	Fishway foundation elements	$200,000
4	Steel superstructure (structural elements)	$225,000
5	Fishway controls (mechanical elements)	$175,000
6	Fishway attraction flow piping	$350,000
7	Volitional channel, control gate	$300,000
8	Construction phase engineering support	$90,000
9	Construction QA/QC	$120,000
	Total Construction:	**$1,860,000**
	Construction Contingency (30 percent)	**$558,000**
Operation & Maintenance		
1	Annual Labor	$70,000
2	Annual Miscellaneous Maintenance	$5,000
3	Fishway Control Replacement (Annuitized over 15 years)	$17,500
4	Capitalized Cost (assuming 2 percent interest per year)	$4,625,000
	Total Capitalized Operation & Maintenance Cost:	**$4,717,500**
Design and Permitting		
1	Additional Dam Safety Analyses	$150,000
2	Additional Subsurface / Geotechnical Exploration	$100,000
3	Design of fish passage - Modeling and agency coordination	$100,000
4	Design of fish passage - Structural	$150,000
5	Design of fish passage - Mechanical	$80,000
6	Permitting	$200,000
	Total Design and Permitting:	**$780,000**
	Total Fish Passage Costs:	**$7,915,500**

Attachment: Conceptual Layout of Fish Elevator at Ballville Dam



PLAN VIEW – FISH ELEVATOR



ELEVATION VIEW – FISH ELEVATOR

April, 2013

SaveDate: 2013/04/30 2:23 PM Login: Withers, Cheyenne
v:\1756\active\175630015\environmental\drawing\sheet_files\fish_elevator\fish_elevator.dwg

Stantec Consulting Services Inc.
11687 Lebanon Road
Cincinnati, Ohio
45241–2012
Tel. 513.842.8200
Fax. 513.842.8250
www.stantec.com

Notes

Client/Project
City of Fremont
Ballville Dam Removal

Figure No.
1

Title
Conceptual Layout of Fish Elevator at Ballville Dam

Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

9 – Jurisdictional Determination, Department of the Army

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207-3199

REPLY TO

March 31, 2011

Regulatory Branch

SUBJECT: Jurisdictional Determination for Department of the Army Application No. 2011-00046

Terry Overmeyer, Mayor
323 South Front Street
Fremont, OH 43420

Dear Mayor Overmeyer:

This is in reference to a wetland delineation that was conducted on the approximate 445.4-acre study area for the Ballville Dam Removal/Sandusky River Restoration Project located in the City of Fremont, Sandusky County, Ohio.

The Corps regulates work in or affecting navigable waters of the United States pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403)and 33 Code of Federal Regulations 322, 329. The Corps also regulates the discharge of dredged or fill material in waters of the United States pursuant to Section 404 of the Clean Water Act and applicable regulations (33 U.S.C. § 1344; 33 C.F.R. 320 et seq.).

The wetland delineation study conducted on August 30, 2011 through September 3, 2011 determined that the study area contains twenty wetlands totaling approximately 63.37-acres, four relatively permanent waters (RPW) totaling approximately 3,488.2 linear feet, and 15,372.7 linear feet of the Sandusky River, a traditional navigable water (TNW) (See Wetland Delineation Maps 1 through 6B, and Tables 1&2). Wetland data sheets are included in Attachment I and Ohio Environmental Protection Agency (Ohio EPA) Ohio Rapid Assessment Method (ORAM) for Wetland Categorization datasheets are included in Attachment II.

Regulatory Branch
SUBJECT: Jurisdictional Determination for Department of the Army Application No. 2011-00046

Table 1. Wetlands Identified within the Ballville Dam Removal Project Study Area

Name	Area (Acres)	Description	Federal Jurisdiction	ORAM Score*
Wetland 1	6.29	Emergent/Scrub-Shrub/Forested	10/404	71.5 (Category 3)
Wetland 2	0.04	Emergent/Scrub-Shrub/Forested	404	71.5 (Category 3)
Wetland 3	0.19	Emergent/Scrub-Shrub/Forested	404	71.5 (Category 3)
Wetland 4	34.11	Emergent/Scrub-Shrub/Forested	10/404	71.5 (Category 3)
Wetland 5	2.47	Emergent/Scrub-Shrub/Forested	10/404	71.5 (Category 3)
Wetland 6	0.08	Emergent/Scrub-Shrub	10/404	46.5 (Category 2)
Wetland 7	0.02	Emergent	10/404	44.5 (Modified 2)
Wetland 8	0.9	Emergent/Scrub-Shrub/Forested	10/404	68.5 (Category 3)
Wetland 9	0.18	Emergent/Scrub-Shrub/Forested	10/404	68.5 (Category 3)
Wetland 10	0.04	Emergent/Scrub-Shrub/Forested	10/404	68.5 (Category 3)
Wetland 11	0.55	Emergent/Scrub-Shrub	10/404	68.5 (Category 3)
Wetland 12	0.05	Emergent/Scrub-Shrub	10/404	68.5 (Category 3)
Wetland 13	1.68	Emergent/Scrub-Shrub/Forested	10/404	42.5 (Modified 2)
Wetland 14	2.47	Emergent/Scrub-Shrub/Forested	10/404	75 (Category 3)
Wetland 15	10.89	Emergent/Scrub-Shrub/Forested	10/404	75 (Category 3)
Wetland 16	1.23	Emergent/Scrub-Shrub/Forested	10/404	52 (Category 2)
Wetland 17	0.09	Emergent	10/404	14.5 (Category 1)
Wetland 18	0.19	Emergent/Scrub-Shrub/Forested	10/404	68.5 (Category 3)
Wetland 19	1.87	Emergent/Scrub-Shrub/Forested	10/404	68.5 (Category 3)
Wetland 20	0.03	Emergent/Scrub-Shrub/Forested	10/404	68.5 (Category 3)

*Preliminary score (OEPA has not verified)

Regulatory Branch
SUBJECT: Jurisdictional Determination for Department of the Army Application No. 2011-00046

Table 2. Streams Identified within the Ballville Dam Removal Project Study Area

Name	Length (linear ft)	Area (Acres)	Description	Federal Jurisdiction
Sandusky River	15,372.7	108.81	TNW	10/404
Stream 1	2,496.6	0.43	RPW	404
Stream 2	691.2	0.20	RPW	404
Stream 3	200.1	0.02	RPW	404
Stream 4	100.3	0.01	RPW	404

Although the wetlands

I am hereby verifying the Federal wetland boundary as shown on the attached wetland delineation maps. This verification was confirmed on 3/31/2011 and will remain valid for a period of five (5) years from the date of this correspondence unless new information warrants revision of the delineation before the expiration. At the end of this period, a new wetland delineation will be required if a project has not been completed on this property and additional impacts are proposed for waters of the United States. Further, this delineation/determination has been conducted to identify the limits of the Corps Clean Water Act jurisdiction for the particular site identified in this request. This delineation/determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985, as amended. If you or your tenant are USDA program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resource Conservation Service prior to starting work.

Based upon this delineation and on-site observations, I have determined that wetlands1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 totaling approximately 63.14 acres on-site are below the plane of the ordinary high water mark (OHW) of the Sandusky River, a navigable water of the United States and thus subject to regulation under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act. Wetlands 2 and 3 totaling 0.23 acres and streams 1, 2, 3, and 4 totaling 3,488.2 linear feet in the study area are part of a surface water tributary system to a navigable water of the United States as noted on the attached Jurisdictional Determination forms (Attachment III). Therefore, wetlands 2 and 3 and streams 1, 2, 3, and 4 are regulated under Section 404 of the Clean Water Act. Department of the Army authorization is required if you propose a discharge of dredged or fill material in any of these areas.

Finally, this letter contains an approved jurisdictional determination for the subject parcel. If you object to this determination, you may request an administrative appeal under Corps regulations at 33 CFR Part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and Request for Appeal (RFA) form. If you request to appeal the above determination,

Regulatory Branch
SUBJECT: Jurisdictional Determination for Department of the Army Application No. 2011-00046

you must submit a completed RFA form within 60 days of the date on this letter to the Great Lakes/Ohio River Division Office at the following address:

Ms. Pauline Thorndike
Review Officer
Great Lakes and Ohio River Division
CELRD-PDS-O
550 Main Street, Room 10032
Cincinnati, OH 45202-3222
Phone: 513-684-6212

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 C.F.R. part 331.5, and that it has been received by the Division Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be received at the above address by **May 30, 2011**.

It is not necessary to submit an RFA to the Division office if you do not object to the determination in this letter.

Questions pertaining to this matter should be directed to me at (716) 879-4109, by writing to the following address: U.S. Army Corps of Engineers, 1776 Niagara Street, Buffalo, New York 14207, or by e-mail at: richard.j.ruby@usace.army.mil

Sincerely,

SIGNED

Richard Ruby
Biologist

Enclosures

CC: Scott Peyton, Stantec
Cody Fleece, Stantec
Ben Smith, OEPA
Randy Bournique, OEPA

Attachment I
Wetland Data Sheets

Attachment II
ORAM Data Sheets

Attachment III
Jurisdictional Determination Forms

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: City of Fremont		File Number: 2011-00046	Date: 3/31/2011
Attached is:			See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)		A
	PROFFERED PERMIT (Standard Permit or Letter of permission)		B
	PERMIT DENIAL		C
X	APPROVED JURISDICTIONAL DETERMINATION		D
	PRELIMINARY JURISDICTIONAL DETERMINATION		E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/CECW/Pages/reg_materials.aspx or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- **ACCEPT:** If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.

- **OBJECT:** If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- **ACCEPT:** If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.

- **APPEAL:** If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- **ACCEPT:** You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.

- **APPEAL:** If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or

objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact: Mr. Richard Ruby U.S. Army Corps of Engineers 1776 Niagara Street Buffalo, New York 14207 (716) 879-4109 richard.j.ruby@usace.army.mil	If you only have questions regarding the appeal process you may also contact: Ms. Pauline Thorndike U.S. Army Corps of Engineers Great Lakes and Ohio River Division 550 Main Street, Room 10032 Cincinnati, OH 45202-3222 (513) 684-6212;FAX(513) 684-2460

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

_____ Signature of appellant or agent.	Date:	Telephone number:

Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

10 – Threatened and Endangered Mussel Surveys in the Ballville Dam Project Area

Threatened and Endangered Freshwater Mussel Surveys in the Sandusky River within the Ballville Dam Removal Project Area

Prepared for:
USFWS and ODNR on behalf of the City of Fremont

Authors
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February 02, 2012
File: 175630015

Ms. Melanie Cota
U.S. Fish and Wildlife Service
4625 Morse Road
Columbus, Ohio 43230

Reference: Ballville Dam Removal Project

Dear Ms. Cota:

Please find the enclosed materials concerning the potential for the occurrence of Federally-listed freshwater mussel species in the vicinity of Ballville Dam in the Sandusky River, Fremont, Ohio. These materials were prepared to facilitate coordination between the U. S. Fish and Wildlife Service, the Ohio Department of Natural Resources, and the U. S. Army Corps of Engineers on the 404 Permit that will be prepared for this project. Please contact me if you have questions, comments, or concerns about any of the materials provided.

Respectfully,

STANTEC CONSULTING SERVICES INC.

Cody Fleece
Senior Ecologist
Tel: (513) 842-8238
Fax: (513) 842-8250
cody.fleece@stantec.com

Attachment: Threatened and Endangered Freshwater Mussel Surveys in the Sandusky River within the Ballville Dam Removal Project Area

c. Jim Ellis, Mayor of Fremont
Roger Knight, Ohio Department of Natural Resources
Brian Mitch, Ohio Department of Natural Resources
Tim Kwiatkowski, Ohio Department of Natural Resources
Joseph Krawczyk, U. S. Army Corps of Engineers
Scott Peyton, Stantec Consulting

Executive Summary

The City of Fremont has plans to remove the Ballville Dam from the Sandusky River. The Ballville Reservoir is currently the primary drinking water supply for Fremont, Ohio; however, issues of poor water quality and insufficient water quantity prompted construction of a new reservoir. Some of the benefits of dam removal include the removal of a potential hazard (deterioration of the dam and sea wall are an increasing concern for downstream flooding), and the restoration of a free-flowing river which will allow aquatic life to move further upstream.

The Ohio State University Bivalve database indicated that valves for several species of special interest at both the State and Federal level have been found in proximity to the proposed dam removal project. The U.S. Fish and Wildlife Service recommended field surveys be conducted to determine if Federally-listed mussel species occurred within the impact zone of the proposed dam removal; the Ohio Department of Natural Resources echoed this recommendation for State-listed species.

The objective of this study was to determine the presence or probable absence of freshwater mussels in the project area. Stantec Consulting Services was retained by the City of Fremont to conduct these mussel surveys, and did so on September 1st and 2nd, 2011. A total of 81 live mussels representing 12 species were encountered, with one additional species added in the form of a weathered valve. No Federally-listed species were found and are presumed absent. Therefore, the proposed work may affect but is not likely to adversely affect Federally-listed species. One State-threatened (threehorn wartyback) and 23 State-species-of-concern (deertoe) were observed; work will proceed in consultation with ODNR.

Table of Contents

EXECUTIVE SUMMARY E.1

1.0 INTRODUCTION 1
1.1 BACKGROUND 1
1.1.1 Project Setting 1
1.1.2 Proposed Action 1
1.1.3 Ecological Setting 3
1.1.4 Regulatory Setting 3
1.1.5 Distribution of freshwater mussels in project area 4

2.0 SPECIAL STATUS SPECIES 6
2.1 NORTHERN RIFFLESHELL (*EPIOBLASMA TORULOSA RANGIANA*) 6
2.1.1 Distribution and Population Status 6
2.1.2 Life History 6
2.2 RAYED BEAN (*VILLOSA FABALIS*) 7
2.2.1 Distribution and Population Status 7
2.2.2 Life History 7
2.3 THREEHORN WARTYBACK (*OBLIQUARIA REFLEXA*) 7
2.3.1 Distribution and Population Status 7
2.3.2 Life History 8
2.4 DEERTOE (*TRUNCILLA TRUNCATA*) 8
2.4.1 Distribution and Population Status 8
2.4.2 Life History 8

3.0 METHODS 9

4.0 RESULTS 10
4.1 SITE CONDITIONS 10
4.2 HABITAT 10
4.3 FRESHWATER MUSSEL SURVEYS 11
4.3.1 Timed Searches 12
4.3.2 Quantitative Sampling 15

5.0 CONCLUSION 15

6.0 DISCUSSION 16

7.0 LITERATURE CITED 16

Figures

Figure 1 Mussel Survey Locations 2
Figure 2 Lengths of Encountered Live Mussels 12

Tables

Table 1 Federal- and State-Listing Status for Freshwater Mussel Species Potentially Occurring in the Project Area 5
Table 2 Coordinates for Survey Locations in Decimal Degrees, Project in State Plane Ohio South 9
Table 3 Mussels Collected from the Sandusky River During Both Timed and Quadrat Searches in 2011; Counts for Live (L), Fresh Dead (FD), Weathered (W), and Sub-Fossil (SF) 11
Table 4 Counts for Live (L), Fresh Dead (FD), Weathered (W), and Sub-Fossil (SF) Specimens Encountered in Timed Searches 13
Table 5 Counts for Live (L), Fresh Dead (FD), Weathered (W), and Sub-Fossil (SF) Specimens Encountered in the Dive Transects 14
Table 6 Counts for Live Mussel Specimens Encountered During Quantitative Sampling at DS-5 15

Appendices

Appendix A Study Plan and USFWS Approval Letter
Appendix B Representative Photographs
Appendix C Federal Permit
Appendix D State Permit

1.0 Introduction

1.1 BACKGROUND

The City of Fremont, Ohio plans to remove the Ballville Dam from the Sandusky River. This dam was initially constructed between 1911 and 1913 by the Fremont Power and Light Company as part of a hydro-electric company. The City of Fremont bought the land and facilities in 1959 and repurposed the dam to provide the city's water supply. Due to progressive deterioration and recent violations of drinking water standards, the City of Fremont has begun construction on an above-ground raw water reservoir which will make the Ballville Dam unnecessary.

1.1.1 Project Setting

The Ballville Dam is approximately 407 feet long and 34.4 feet high. It is composed of left and right spillways on either side of a non-overflow section. It is a Class I structure (ODNR 2004), the highest hazard rating, due to the probable loss of life if the dam were to fail during a flood event.

Stored sediment volume and sediment transport is of concern to this project. Evans and Gottgens (2007) estimated that approximately 1,240,000 cubic yards (CY) of sediments are stored in the reservoir basin. Revised estimates based on new information suggest that the stored volume is closer to 840,000 CY (Stantec 2011). The dam is located on exposed bedrock that extends several miles upstream. The backwater from the impoundment extends to just downstream of the Rice Road Bridge (Figure 1).

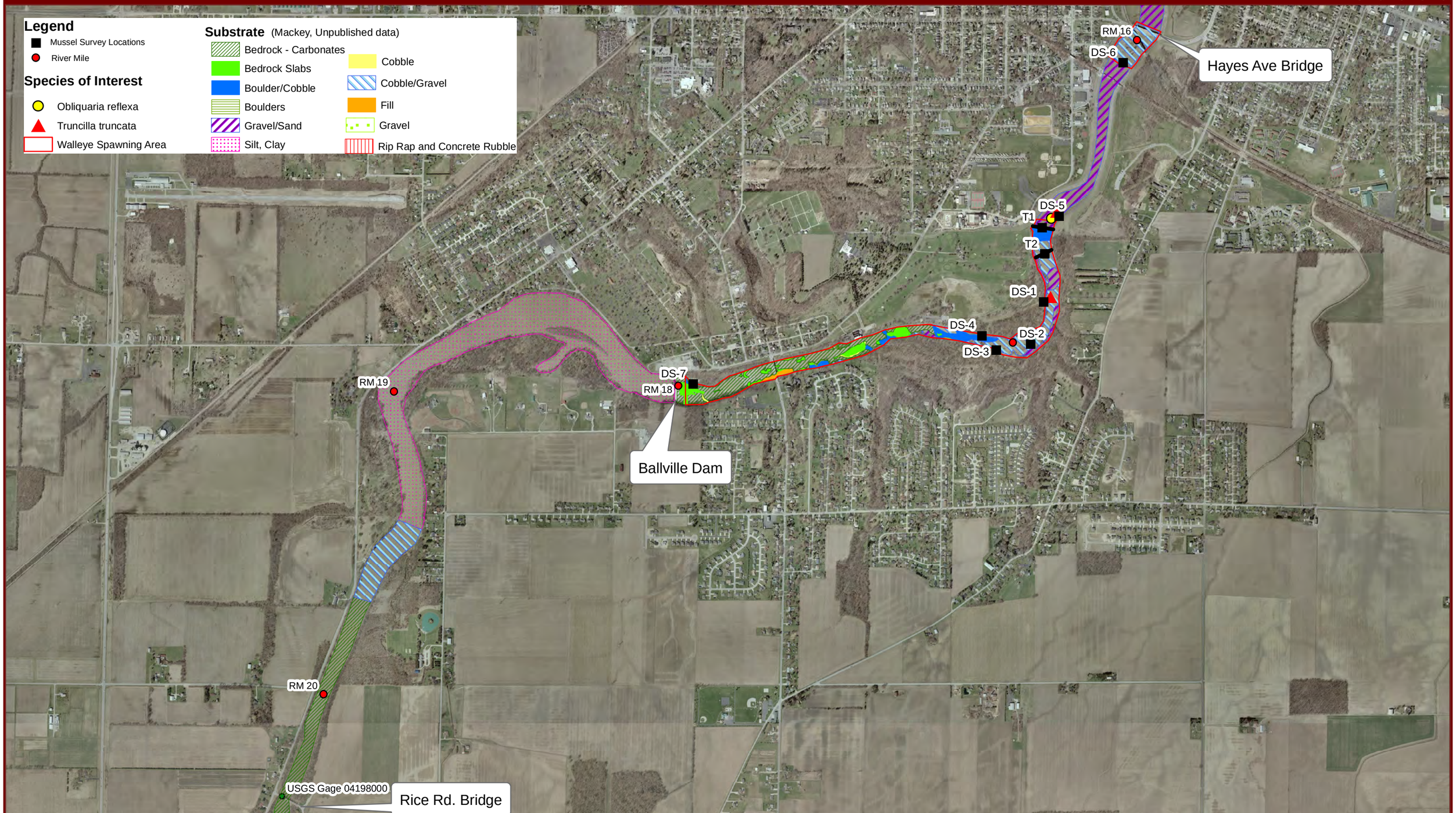
Dam inspections dating back to 1980 have noted spalling[1] and minor cracks in the structure's concrete, with some areas displaying an increase in severity. Further detailed descriptions of the dam and its history, appurtenances, and issues can be found in other reports and investigations (U.S. Army Corps of Engineers (USACE) 1981; Dodson-Lindblom Associates 1984; ODNR 1999 and 2004; Arcadis 2005; Stantec 2011).

1.1.2 Proposed Action

The City of Fremont has proposed to conduct this dam removal beginning in August 2012, with the impoundment drawdown occurring between September and October 2012. The complete dam would be removed and the restoration activities started in early 2013. It is proposed that the drawdown be accomplished by creating incrementally larger and deeper notches in the spillway(s) during low-flow periods/months in lieu of full impoundment drawdown and dry removal. This drawdown may not begin until the newly constructed raw water reservoir is complete and fully operational.

[1] Spalling refers to flaking or fragmenting of material from the dam.

This map is for reference only and should not be used for construction.



Geographic Information Systems

V:\1756\active\175630015\gis\mxd\Mussel Assessment\MusselReport.mxd

0 0.25 0.5 Miles

1 inch = 1,375 feet

N

Figure 1- Mussel Survey Locations

Sandusky River, Sandusky County, Ohio

Stantec

The sequence of construction and staged removal of the dam will be designed in a manner that minimizes the release of sediment. Stantec anticipates that as much as 15 to 40 percent of the accumulated sediment volume may be retained with proper sediment management – potentially as little as 500,000 to 700,000 CY of the 840,000 CY of stored sediment will be released following the dam removal (Stantec 2011).

During the drawdown phase, stabilization measures such as aggressive seeding and vegetation strategies will be implemented to reduce the amount of sediment contributed to the river from newly exposed margins and banks.

In recent months, it has been determined that it will be necessary to install an ice control structure near the upstream limits of the impoundment (USACE 2011). The purpose of this structure is to collect ice as a means to mitigate potential downstream flooding (see Stantec 2011 for more detail) and increased sedimentation from scour of recently exposed sediment. This feature of the project was not anticipated at the time of the mussel surveys. Consequently, this area was not surveyed.

1.1.3 Ecological Setting

The Ballville Dam falls within the Marblehead Drift/Limestone Plain ecoregion of the Huron-Erie Lake Plains; this region is typified by limestone-dolomite ridges and islands, and areas of thin glacial drift. Originally beech forests and elm-ash swamp forests were common in this region, and many geographically isolated endemic plant species occurred there (Griffith et al. 2008). Today, agriculture on artificially drained land is prevalent throughout the Sandusky River watershed.

Major land uses in the Lower Sandusky River watershed (HUC 04100011) include cultivated crops (78.2 percent), developed open space (6.6 percent), and deciduous forest (6.5 percent). The remaining proportion within the region includes developed low intensity, pasture/hay, emergent wetlands, grasslands, developed medium intensity, other, and open water (OEPA 2009). The nearby City encompasses approximately 8 square miles with a population of 16,654, which yields a population density of 2,155 persons per square mile. (Census 2005-2009).

1.1.4 Regulatory Setting

The federal ESA [16 U.S.C.1531 et seq.] became law in 1973 and provides for the listing, conservation, and recovery of endangered and threatened species. The USFWS is the agency responsible for protecting and monitoring populations of listed endangered species. Section 7(a)(2) of ESA states that each federal agency shall insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species, or result in destruction or adverse modification of designated critical habitat. A federal action includes approval of a permit or license, including Section 404 permits under the Clean Water Act.

Section 9 of ESA prohibits the take of listed species. Take is defined by ESA as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect.” The definition of harm includes adverse habitat modification. Actions of federal agencies that do not result in jeopardy or adverse modification, but that could result in a take, must be addressed under Section 7.

The Ohio Department of Natural Resources (ODNR) is responsible for protecting State-listed species in Ohio. Mussels are specifically protected under Chapter 1501:31-17 of Revised Ohio Administrative Code, which states it is unlawful to take, collect, or otherwise harm mussels.

1.1.5 Distribution of freshwater mussels in project area

The Ohio State University Bivalve database indicates that valves for one Federally-endangered, one proposed Federally-endangered species, two State-threatened, and six State-species-of-concern have been found in proximity to the proposed project (within the Sandusky River in Sandusky County, in Sandusky Bay in Erie County, or upstream in Seneca County) (Table 1). Most of these records were found prior to 1977, but some have been found as recently as 1992. As well, a limited study of the impounded area was conducted in support of efforts to construct the raw water reservoir intake (EnviroScience 2010). No live or dead mussels were found within the survey area, however, one live giant floater (*Pyganodon grandis*) was found approximately 100 feet downstream. The surveyed area was characterized as having exceedingly poor habitat for freshwater mussels.

Table 1. Federal- and State- listing status for freshwater mussel species potentially occurring in the project area.

Species	Federal Status	State Status**
Elktoe (*Alasmidonta marginata*)	none*	species-of-concern
Purple wartyback (*Cyclonaias tuberculata*)	none*	species-of-concern
Northern riffleshell (*Epioblasma torulosa rangiana*)	endangered*	endangered
Wavyrayed lampmussel (*Lampsilis fasciola*)	none*	species-of-concern
Black sandshell (*Ligumia recta*)	none*	threatened
Threehorn wartyback (*Obliquaria reflexa*)	none*	threatened
Round pigtoe (*Pleurobema sintoxia*)	none*	species-of-concern
Kidneyshell (*Ptychobranchus fasciolaris*)	none*	species-of-concern
Deertoe (*Truncilla truncata*)	none*	species-of-concern
Rayed bean (*Villosa fabalis*)	proposed endangered#	endangered

* USFWS Federally-Listed Species by Ohio Counties, October 2011

The Federal Register 50 CFR Part 17, Tuesday November 2, 2010

**http://www.dnr.state.oh.us/Home/ExperienceWildlifeSubHomePage/Endangeredthreatenedspeciesplaceholder/resourcesmgtplansspecieslist/tabid/5664/Default.aspx accessed October 24, 2011.

2.0 Special Status Species

2.1 NORTHERN RIFFLESHELL (*EPIOBLASMA TORULOSA RANGIANA*)

2.1.1 Distribution and Population Status

The present day distribution of northern riffleshell (*Epioblasma torulosa rangiana*) as illustrated by the USFWS Recovery Plan (USFWS, 1994) is greatly restricted and includes only Fish Creek along the Indiana/Ohio border, Big Darby Creek, the Detroit River near the Michigan/Ontario border, the upper Green River in Kentucky, the Elk River in West Virginia, and the Alleghany River, French Creek, and LeBoeuf Creek in Pennsylvania (USFWS, 1994). Historically, this species was once widespread, although only locally common, in Ohio, Pennsylvania, Michigan, Ontario, Indiana, Illinois, Kentucky, and possibly Tennessee (Williams et al., 1993).

Historical records for this species exist in the Sandusky River (Watters et al. 2009) and northern riffleshell are known from the nearby Maumee River drainage (Grabarkiewicz and Crail 2006; 2007; Grabarkiewicz 2008). The northern riffleshell was listed as endangered without critical habitat on 22 February 1993 by the U. S. Fish and Wildlife Service (Federal Register 58(13): 5638-5642). It is also listed as State-endangered in Ohio.

2.1.2 Life History

The northern riffleshell is bradytictic and Watters et al. (2009) report that gravid females have been observed from September to June of the following year. Females of this species parasitize fish by trapping them between their valves, “inflating” a mantle gasket around the head of the fish, and pumping glochidia onto the fish (Barnhardt 2010). This behavior reportedly may last for 5 to 10 minutes. Odee and Watters (2000) determined that glochidia encysted on banded darter (*Etheostoma zonale*), bluebreast darter (*E. camarum*), and brown trout (*Salmo trutta*) successfully metamorphosed in a laboratory setting. Brown trout is an exotic species whose geographic range overlaps minimally with northern riffleshell due to restrictive thermal habitat requirements. Therefore its potential to serve as a viable host may be limited. The distribution maps presented in Trautman (1975) suggest that neither banded darter or bluebreast darter are known to the Sandusky River basin, therefore other fish species must also be hosts for this species because northern riffleshell historically was present in this basin.

Habitat for the northern riffleshell is variable. The northern riffleshell occurs in riffle areas with swift currents in a substrate of coarse sand and gravel to a substrate of firmly packed fine gravel, typically in shallow (few inches to six feet deep) water (Parmalee and Bogan, 1998).

2.2 RAYED BEAN (*VILLOSA FABALIS*)

2.2.1 Distribution and Population Status

The rayed bean (*Villosa fabalis*) historically occurred throughout much of the Ohio and Tennessee River drainages (Butler 2002). This historic range includes 112 streams, lakes, and man-made canals in ten states; in Tennessee, rayed bean was historically found in the Tennessee River and 12 of its tributary streams (USFWS 2010). Currently, the rayed bean is thought to be extant in only 28 streams and 1 lake in six different states and one Canadian province; the species has been extirpated from long reaches of former habitat (USFWS 2010). Historically, this species was widely distributed in the Sandusky River (Watters et al. 2009); more recently, rayed bean are known from the nearby Maumee River drainage (Grabarkiewicz and Crail 2006; 2007; Grabarkiewicz 2008). The rayed bean was listed by the USFWS as proposed endangered on 2 November 2010 and is listed as State-endangered in Ohio.

2.2.2 Life History

The rayed bean is a small mussel, usually less than 45 mm in length, with a smooth-textured green, yellowish-green, or brown shell with numerous dark green wavy lines. This species is sexually dimorphic, with the male's shell shape elongated and the female's smaller and elliptical.

Gravid females have been collected from May to October indicating that rayed bean is a long term brooder (bradytictic). Females attract fish hosts by lying on their side and moving the papillae along the mantle of the gill. Fish are infected by contacting these lures and the glochidia are thought to parasitize the gills of their hosts. White et al. (1996) identified Tippecanoe darters (*Etheostoma tippecanoe)* as a host for this mussel species. In a laboratory setting mottled scuplin (*Cottus bairdi)*, greenside darters (*Etheostoma blennidodes)*, rainbow darters (*Etheostoma caeruluem)*, and largemouth bass (*Micropterus salmoides)* were also identified as potential hosts (Woolnough 2002).

The rayed bean is typically found in riffle habitats of small to medium rivers or along wave washed shorelines of glacial lakes. This species is commonly associated with small gravel and sand substrates and is known to attach to substrate particles using byssal threads (Hoggarth pers. comm. 2010). The rayed bean is sometimes associated with aquatic vegetation [*e.g.* water-willow (*Justica americana*)].

2.3 THREEHORN WARTYBACK (*OBLIQUARIA REFLEXA*)

2.3.1 Distribution and Population Status

The threehorn wartyback (*Obliquaria reflexa*) is known to occur throughout most of the Mississippi River drainage from western Pennsylvania north into Michigan and Minnesota and south into Texas, Louisiana, Mississippi and Alabama (Parmalee and Bogan 1998). Historically, this species was recorded from Lake Erie and its tributaries, but is now presumed extirpated

from much of this region due to zebra mussel invasion; otherwise it is considered stable throughout its range (Schloesser et al. 2006). Records exist for this species in the Sandusky bay area, and they are sporadically found in the Maumee River (Watters et al. 2009). This species is listed as threatened in the state of Ohio, but is globally secure (NatureServe 2011).

2.3.2 Life History

A medium-sized (to 80 mm) mussel, the threehorn wartyback is a fairly slow-growing and long lived mussel that is very heavy for its size with a rounded outline that is pointed on the posterior. This species also has characteristic knobs located medially that alternate between the left and right valves from the umbo to the ventral margin (Watters et al. 2009).

This species is tachytictic, meaning that glochidia are released in the summer; reported fish hosts include goldeye (*Hiodonta alosoides*), silverjaw minnow (*Ericymba buccata*), common shiner (*Luxilus chrysocephalus*), and longnose dace (*Rhinichthys cataractae*) (Barnhart and Baird 2000, Watters et al. 2009). The common shiner is the most likely host in the Sandusky River.

This species is considered a river and lake species that is occasionally found in smaller creeks. Threehorn wartyback tolerates both slackwater and swift currents, shallows and depths of 18-20 feet, and can be found in muddy sand or cobble substrates (Watters et al. 2009, Parmalee and Bogan 1998).

2.4 DEERTOE (*TRUNCILLA TRUNCATA*)

2.4.1 Distribution and Population Status

The deertoe (*Truncilla truncata*) is known to occur throughout the Mississippi River drainage from western Pennsylvania to Michigan and Minnesota, south to Iowa, Kansas, Texas, Louisiana, Tennessee, and northern Alabama (Parmalee and Bogan 1998). It is known from tributaries of Lake Erie (NatureServe 2011). Historical records exist for this species in the Sandusky River; as well, the deertoe is locally abundant in the nearby Maumee River drainage (Grabarkiewicz and Crail 2006; 2007; Grabarkiewicz 2008, Watters et al. 2009). This species is listed as a species of concern by the state of Ohio, but is globally secure (NatureServe 2011). The Ohio State University Bivalve database (OSUBD 2011) contains only one record of a deertoe specimen from Sandusky County, Ohio, and this record is a single subfossil valve found at an archaeological site.

2.4.2 Life History

A small to medium-sized (average 50 mm, can reach 90 mm) mussel, the deertoe is a fast growing but short-lived species with a triangular outline, that is heavy for its size (Watters et al. 2009). Gravid females have been found in Ohio in April, indicating that this is a bradytictic species; sauger (*Sander canadensis*) has been confirmed as a fish host to this species and the freshwater drum (*Aplodinotus grunniens*) is a potential host (Parmalee and Bogan 1998, Watters et al. 2009), though the sauger has been extirpated from this area.

These mussels are typically found in rivers and lakes, rarely in smaller streams, and they prefer packed sand and gravel substrates, but are somewhat generalists in both substrates and river size (Watters et al. 2009, Parmalee and Bogan 1998).

3.0 Methods

The objective of this study was to determine the presence or probable absence of State and Federally-listed species in the project area. Mussel surveys were performed under Stantec's Federal Permit TE38821A-0 and Ohio Division of Wildlife Wild Animal Permit 14-174 on September 1st and 2nd of 2011. Surveys were conducted in accordance with the proposed study plan dated July 18th, 2011. USFWS approval of the survey was received on July 19th, 2011. Both documents are provided in Appendix A. Representative photographs of the project area and the sample locations are presented in Appendix B. Coordinates for the sample locations are presented in Table 2.

Table 2. Coordinates for survey locations in decimal degrees, projection in State Plane Ohio South.

Site	Northing	Westing
DS-1	41.32998	-83.11511
DS-2	41.32817	-83.11583
DS-3	41.32791	-83.11778
DS-4	41.32852	-83.11861
DS-5	41.33367	-83.11427
DS-6	41.34027	-83.11069
DS-7	41.32636	-83.13501

Both qualitative and quantitative surveys were conducted; qualitative surveys were conducted in high quality habitats and quantitative sampling supplemented the qualitative assessment in locations where more than six species were collected.

Qualitative surveys consisted of timed searches for live mussels by using viewing buckets and/or tactile searches. Survey efforts began at the downstream end of the site and progressed upstream against the current to prevent unnecessary reductions in visibility resulting from disturbance of the sediments. Person hours were recorded as the total time multiplied across the number of surveyors. Two dive transects were also performed in areas too deep for wading surveys. Transects were established perpendicular to the stream channel and spaced out at 50 meter intervals. A weighted stainless steel chain, spaced in 10 meter increments, was then used to measure a search area of one meter to either side of the transect. In each survey type, surveyors removed live mussels from the substrate and held them temporarily until data could be recorded on species identity. Gender and reproductive status were also recorded where possible. Surveyors recorded species identity for all fresh dead valves encountered but only

recorded information of weathered or sub-fossil valves in circumstances that led to an increase in the total species count. Representative dead valves were identified to species and added to the collection at the Cincinnati Museum of Natural History.

Quantitative surveys consisted of the establishment of sample plots in high density mussel habitats. This was accomplished by establishing survey lines parallel to the streambank and excavating substrates from within 0.25 meter^2 quadrats placed on the stream bed to define the sampling area. Up to 150 mm (six inches) of substrate was removed from each quadrat and sieved by hand to capture live animals. A minimum of 40 quadrats were excavated during quantitative sampling, for a total survey area of 10 meters. Surveyors moved in the upstream direction and each sample plot was adjacent to the preceding one. Only one qualitative survey yielded over six species; therefore, only one set (40 quadrats) of quantitative sampling was conducted.

4.0 Results

4.1 SITE CONDITIONS

Mean daily streamflow at USGS Gauge 04198000 near Fremont, Ohio on September 1, 2011, was 151 cubic feet per second and on the 2nd it was 129 cubic feet per second. Mean daily flows for these dates over the period of record are 325 and 328 cubic feet per second respectively. On September 1st water temperature was 23.7 degrees Celsius, the DO was 7.63 mg/L, and the oxygen saturation was 89.2%. The sky was mostly clear for the survey days, except for a passing rain event in the late morning of September 1, 2011.

4.2 HABITAT

Substrates in the surveyed locations ranged from good (coarse sand/gravel) to poor (bedrock/silt) (Figure 1). DS-7 was the least suitable of the surveyed locations: exposed bedrock interspersed with deep pools provided poor habitat for mussels. DS-6 and DS-5 contained good sand and gravel substrates, and DS-5 was the most mussel-rich of the locations surveyed. DS-4 contained fine-grained interstitial substrates, but prevalent cobble and boulders provided limited mussel habitat. DS-3 was a mix of coarse cobble and rubble; limited mussel habitat was likely only between the large rocks. DS-2 contained sandy substrates and provided moderate habitat. DS-1 had good substrates: primarily sand mixed gravel, and was the second most mussel-rich survey site.

Overall, substrates within the dive transects were predominantly cobble and sand, though T1 had a substantial amount of boulders at several of the 10-meter increments (6 out of 17), and T2 was primarily boulder substrate at 4 out of 10 measured points. Water depths at the transects ranged from 1 to 6 feet at T1 and 1 to 10 feet at T2.

4.3 FRESHWATER MUSSEL SURVEYS

Stantec surveyed areas from immediately below the dam to the Hayes Avenue Bridge on September 1st and 2nd, 2011. Eighty-one (81) live animals and thirty (30) valves comprising thirteen species were observed (Table 3). No Federally-listed taxa were found. However, one live threehorn wartyback (Ohio-threatened) and 23 live deertoes (Ohio-SOC) were observed. A total of twelve (12) live species were captured in the surveys. Measured lengths for white heelsplitter (*Lasmigona complanata*), pink heelsplitter (*Potamilus alatus*), mapleleaf (*Quadrula quadrula*), and deertoe suggest the presence of multiple size classes (Figure 2). However, most of these individuals were large and, with the exception of deertoe, there was no apparent evidence of juvenile recruitment. The remaining species consisted of three or fewer individuals.

Table 3. Mussels collected from the Sandusky River during both timed and quadrat searches in 2011; counts for live (L), fresh dead (FD), weathered (W), and sub-fossil (SF) specimens.

Common Name	Species	Live	Fresh Dead	Weathered	Subfossil
Mucket	*Actinonaias ligamentina*	1			
Threeridge	*Amblema plicata*	1			1
Pocketbook	*Lampsilis cardium*	1			
White heelsplitter	*Lasmigona complanata*	19		5	
Fluted shell	*Lasmigona costata*	2		2	
Fragile papershell	*Leptodea fragilis*	2			
Three-horn wartyback	*Obliquaria reflexa*	1			
Pink heelsplitter	*Potamilus alatus*	19		4	
Giant floater	*Pyganodon grandis*	3		2	1
Pimpleback	*Quadrula pustulosa*	1			
Mapleleaf	*Quadrula quadrula*	8	3	2	1
Creeper	*Strophitus undulatus*			1	
Deertoe	*Truncilla truncata*	23		7	1
	Total	**81**	**3**	**23**	**4**

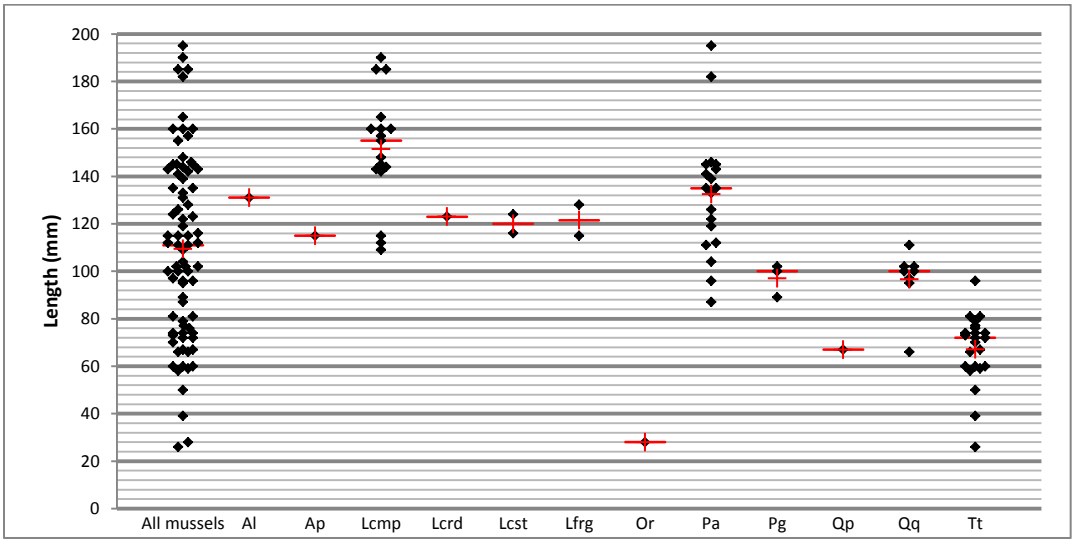


Figure 2. Lengths of encountered live mussels. Al – *Actinonaias ligamentina*, Ap = *Amblema plicata*, Lcmp = *Lasmigona complanata*, Lcrd = *Lampsilis cardium*, Lcst = *Lasmigona costata*, Lfrg = *Leptodea fragilis*, Or = *Obliquaria reflexa*, Pa = *Potamilus alatus*, Pg = *Pyganodon grandis*, Qp = *Quadrula pustulosa*, Qq = *Quadrula quadrula*, Tt = *Truncilla truncata*

4.3.1 Timed Searches

Total search effort for qualitative surveys, including the dive transects, conducted on September 1st and 2nd equaled 661 minutes (Table 4 and 5). Fifty-five live individuals were encountered at the nine survey sites downstream of the dam. The live mussel fauna was represented by nine species. One of the species, deertoe, is a State of Ohio-species-of-concern. No Federally-listed species were collected either live or freshly dead.

Catch per unit effort was highest at sites DS-5 and DS-1; zero live captures were recorded at sites T2, DS-3, DS-4, and DS-7 (no mussels specimens of any category were encountered at T2, DS-3 and DS-4). Eight live species were collected at DS-5. The most numerous species was white heelsplitter accounting for 35 percent of the live individuals encountered during the survey. The pink heelsplitter and deertoe were the second and third most abundant species and comprised 24 and 22 percent of the live captures respectively. Two of these species, white heelsplitter and pink heelsplitter, were found at 3 or more of the 9 survey locations and together they account for 58 percent of the live individuals captured in timed searches.

Table 4. Counts for live (L), fresh dead (FD), weathered (W), and sub-fossil (SF) specimens encountered in timed searches.

Species	DS-1				DS-2				DS-3	DS-4	DS-5				DS-6				DS-7				Grand Total
	L	FD	W	SF	L	FD	W	SF			L	FD	W	SF	L	FD	W	SF	L	FD	W	SF	L
Mucket (*Actinonaias ligamentina*)									no mussels captured	no mussels captured					1								1
Threeridge (*Amblema plicata*)											1			1									1
White heelsplitter (*Lasmigona complanata*)	5		1								11		4		1								19
Flutedshell (*Lasmigona costata*)											1		1				1						1
Fragile papershell (*Leptodea fragilis*)											1				1								1
Pink heelsplitter (*Potamilus alatus*)	2		1		1						10		3										13
Giant floater (*Pyganodon grandis*)	2							1			1										2		3
Mapleleaf (*Quadrula quadrula*)											3		2	1						3			3
Creeper (*Strophitus undulatus*)																					1		
Deertoe (*Truncilla truncata*)			3								12		4										12
Grand Total	9		5		1			1			40		14	2	3		1			3	3		55
Search Duration (person hours)	1.07				1				1	0.33	2.5				1.42				1.67				8.98
CPUE (live mussels per person hour)	8.4				1				0	0	16				2.1				0				6.1
Species Count	3				1				0	0	8				3				0				9

Table 5. Counts for live (L), fresh dead (FD), weathered (W), and sub-fossil (SF) specimens encountered in the dive transects.

Species	T1				T2
	L	FD	W	SF	
Mucket (*Actinonaias ligamentina*)					no mussels captured
Threeridge (*Amblema plicata*)					
White heelsplitter (*Lasmigona complanata*)	2				
Flutedshell (*Lasmigona costata*)					
Fragile papershell (*Leptodea fragilis*)					
Pink heelsplitter (*Potamilus alatus*)					
Giant floater (*Pyganodon grandis*)					
Mapleleaf (*Quadrula quadrula*)					
Creeper (*Strophitus undulatus*)					
Deertoe (*Truncilla truncata*)					
Grand Total	2				
Search Duration (min)	80				42
Species Count	1				0

4.3.2 Quantitative Sampling

Quantitative sampling was conducted at only one site, as only DS-5 yielded more than six species during the qualitative sampling. Seven species were collected during the quadrat searches, and three species were added to the total species count of the project area (Table 4). No Federally-listed species were collected during the quantitative surveys. One specimen of threehorn wartyback, a State of Ohio-threatened species, was collected during the quantitative sampling. The deertoe, a State-species-of-concern, was also encountered, and was, in fact, the most numerous species collected, comprising 42 percent of the live individuals collected from the quadrats, followed by pink heelsplitter at 23 percent.

Table 6. Counts for live mussel specimens encountered during quantitative sampling at DS-5.

Species	L	SF
Plain pocketbook (*Lampsilis cardium*)	1	
Flutedshell (*Lasmigona costata*)	1	
Threehorn wartyback (*Obliquaria reflexa*)	1	
Pink heelsplitter (*Potamilus alatus)*	6	
Pimpleback (*Quadrula pustulosa*)	1	
Mapleleaf (*Quadrula quadrula*)	5	
Deertoe (*Truncilla truncata*)	11	1
Total	26	1
Live mussels/m^2	2.6	

5.0 Conclusion

- T2, DS-4, DS-3, and DS-2 were dominated by coarse-grained substrates and provided poor habitat for mussels.
- T1 was coarse-grained in the mid-channel areas but was dominated by thick deposits of silt/clay on the channel margins.
- Substrates immediately below the dam were almost entirely bedrock and provided poor habitat for mussels.
- Substrates at DS-5, DS-1, and, to a lesser extent, DS-6 were suitable for mussel habitation.
- Freshwater mussels were present in the survey area in low abundance and only 81 live animals were captured.
- No Federally-listed species were observed during this effort.
- One State-threatened individual threehorn wartyback (*O. reflexa*) and 23 deertoe (*T. truncata*), a State-species-of-concern, were found.

6.0 Discussion

Surveys conducted based on the approved study plan (July 19th, 2011) found no Federally-listed species in the project area. Due to the presumed absence of Federally-listed mussel taxa within the project area, the generally poor habitat conditions, and the lack of historic records in the project area, suggests that the proposed work may affect but is not likely to adversely affect any Federally-listed species.

The surveys did find a total of 24 State-listed species (1 threehorn wartyback (Ohio-threatened) and 23 deertoe (Ohio-species-of-concern). Therefore, this project will proceed in consultation with the ODNR.

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Appendix A

Study Plan and USFWS Approval Letter

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July 18, 2011
File: 175630015L01

Ms. Angela Boyer
Fish and Wildlife Biologist
U.S. Fish & Wildlife Service
4625 Morse Road, Suite 104
Columbus, Ohio 43230

Reference: Proposed Study Plan for Mussel Surveys in Support of the Ballville Dam Removal Project Sandusky River, Fremont, Ohio

Dear Ms. Boyer:

This correspondence was prepared to present a draft study plan for conducting freshwater mussel surveys in the Sandusky River in the vicinity of the Ballville Dam. The Ohio Department of Natural Resources and the City of Fremont would like to complete these surveys in late August of 2011 and would appreciate comment on our proposal at your earliest convenience.

BACKGROUND

The Ohio Department of Natural Resources (ODNR), together with the City of Fremont, seeks to remove the Ballville Dam from the Sandusky River (Attachment 1). The dam, located approximately 2.4 km southwest of Fremont, was initially built in 1911 for hydro-electricity production, but was destroyed by a flood in 1913. Rebuilt soon after, the dam was converted to steam production; hydroelectric generation was discontinued in 1946 and the dam was sold to the City in 1959. The Ballville Reservoir serves as the primary drinking water supply for Fremont. All of the water retaining structures in the Ballville Dam were built of concrete and are founded on bedrock; the dam is ~10 m high and spans ~122 m across the Sandusky River. Based on soundings performed in 1985, the reservoir extends approximately 3.4 km upstream of the dam. The reservoir area at normal pool level is approximately 9.7ha with a water storage capacity of 303,300 m^3.

This proposed dam removal is feasible for the city because an alternate water supply, a new 2.8-million kiloliter reservoir, is being constructed adjacent to the river upstream of the dam and is expected to be operational by summer 2011. The new water supply will address serious issues of poor water quality (high in nitrates) and insufficient water quantity, especially during seasonal low flow periods. Removal will also alleviate serious issues related to the deterioration of the dam and the sea wall, which require immediate attention for flood control protection (ODNR 1998). Additionally the Ballville Dam serves as a major barrier to aquatic life on the Sandusky River and the removal of the dam would restore the free flowing river and should restore the habitat and water quality of this impounded length of the lower Sandusky River (Biological and Water Quality Study of the Sandusky Bay Tributaries, 2009). The Sandusky River supports a commercial and recreational walleye fishery that could exceed $100 million annually. The removal of Ballville Dam would double the length of river available to the walleye migration and increase the spawning habitat 15 fold, and therefore could boost the economic output from the Ohio fishery. Overall, the Ballville Dam has become an ecological, health, and safety issue and is more than 20 years older than the normal life expectancy for a dam. The removal of the dam will have immediate and long lasting economical and ecological impacts.

Reference: Proposed Study Plan for Mussel Surveys in Support of the Ballville Dam Removal Project, Sandusky River, Fremont, Ohio

Project Design

Stantec Consulting Services, Inc. (Stantec) recently began the engineering design phase for removal of the Ballville Dam on the Sandusky River within the City of Fremont, Ohio. One of the principal challenges of the project is management of stored sediment. Evans and Gottgens (2007) estimated that approximately 1,300,000 m^3 of sediments are stored in the reservoir basin. Revised estimates based on new information suggest that the stored volume is closer to 460,000 m^3. Stantec is currently preparing a feasibility study that will examine various removal alternatives (e.g., complete and immediate removal vs. phased and prolonged removal) and their impact on sediment transport competence and capacity in the lower channel. Results of this study will be made available to USFWS, ODNR, and the public at large.

Aquatic Habitat in the Project Area

The dam is located on exposed bedrock that extends downstream to approximately river mile 17.4 (Attachment 1). Photographs of habitat conditions at the photo points are presented in Attachment 2. Few spent valves were observed in this reach and those that were observed consisted of *Pyganodon grandis* and *Utterbackia imbecillis*. These valves likely originated from upstream of the dam rather than from within the reach. Suitable substrates for mussels first appear as the channel emerges from the confined valley below river mile 17.4. The U.S. Army Corps of Engineers flood control project begins at approximately river mile 16.7. Substrates change dramatically at this point from cobble/gravel dominant immediately upstream to primarily sand/silt/small gravel dominant. Coarser more stable substrates appear again upstream of the Hayes Avenue Bridge. Casual observation of spent valves below the dam included *Lampsilis cardium*, *Lasmigona complanata*, *Truncilla truncata*, *Potamilus alatus*, and *Quadrula quadrula*.

Substrates in the impounded reach immediately upstream of the dam are primarily loosely consolidated silt and clay. Near the terminus of the backwatered area, substrates coarsen and are comprised of rubble and cobble. Another bedrock outcrop is present from well upstream of the Tiffin Road Bridge to the transitional area described above (Attachment 1).

Potential Impact to Listed Mussels

The Ohio State University Bivalve database indicates that valves for *Epioblasma torulosa rangiana* (proposed federally endangered), *Villosa fabalis* (proposed federally endangered), *Ligumia recta* (state threatened), *Ptychobranchus fasciolaris* (state species of concern), *Pleurobema sintoxia* (state species of concern), *Lampsilis fasciola* (state species of concern), and *Cyclonaias tuberculata* (state species of concern) have been found in proximity to the proposed project. However, most of these records were found prior to 1976, but have been found as recently as 1995. Furthermore, most of the historical records are from no closer than approximately 20 miles upstream of the project area. EnviroScience (2010) conducted a limited study of the impounded area in the reservoir in support of efforts to construct the drinking water intake. No live or dead mussels were found within the survey area, however, one live giant floater was found approximately 30 meters downstream. The surveyed area was characterized as having exceedingly poor habitat for freshwater mussels.

If listed mussels are present within the construction footprint, they could be directly affected by crushing from heavy equipment or demolition debris. If listed mussels are present downstream of the dam they may be impacted indirectly by the transport and deposition of fine sediment currently stored behind the impoundment. Mussels upstream of the impounded area should not be affected by headward channel incision due to the presence of erosion resistant bedrock outcrops.

Reference: Proposed Study Plan for Mussel Surveys in Support of the Ballville Dam Removal Project, Sandusky River, Fremont, Ohio

Regulatory Requirements

The ODNR and the City of Fremont will use the engineering studies and other supporting information to seek authorization to remove the Ballville Dam under Section 404 of the Clean Water Act. The U.S. Army Corps of Engineers is required to coordinate with the U.S. Fish and Wildlife Service and ODNR on potential impacts to special status species that may occur as a result of the proposed project. On February 2, 2011, Stantec sent a letter requesting dialogue with the U.S. Fish and Wildlife Service regarding the need for studies to determine if federally listed species occur in the project area. In the response letter dated March 2, 2011 (Attachment 3), the U.S. Fish and Wildlife Service recommended that, based on the potential for the project to impact freshwater mussels including the rayed bean (*Villosa fabalis*), field surveys be conducted to determine if federally listed mussel species occurred within the impact zone of proposed dam removal. Correspondence from ODNR (Attachment 4) expressed many of the same concerns about state-listed species.

PROPOSED STUDY PLAN

Objectives

The objective of this study plan is to:

- Determine the presence or probable absence of federal and state-listed freshwater mussels in the project area,

Presence-Absence Surveys

Mussel surveys will be performed using Stantec's Federal Permit TE38821A-0 (Attachment 5) and Ohio Division of Wildlife Wild Animal Permit 14-174 (Attachment 6). We propose to conduct qualitative and quantitative surveys within the construction foot print including access areas and work areas downstream of the dam. For the purposes of this proposal we assumed that an area extending approximately 100 meters downstream of the proposed project would be sufficient. We also propose to conduct qualitative surveys in high quality habitats between the dam and the State Street Bridge (Attachment 1).

Qualitative surveys will consist of timed searches for live mussels by using viewing buckets and/or tactile searches. Surveying efforts will begin at the downstream end of the site and progress upstream against the current to prevent unnecessary reductions in visibility resulting from disturbance of the sediments. Surveyors will remove live mussels from the substrate and place them in mesh bags to be held temporarily until data can be recorded on species identity and shell dimensions. Gender and reproductive status will also be recorded if possible. Spent valves encountered during the survey will be identified to species and representative spent valves will be retained and added to the collection at the Cincinnati Museum of Natural History.

Surveyors will also establish quantitative sample plots in high density mussel habitats within the construction footprint. This will be accomplished by establishing survey lines parallel to the streambank and excavating substrates from within 0.25 meter^2 quadrats placed on the stream bed to define the sampling area. Up to 15 cm of substrate will be removed from each quadrat and will be sieved through a coarse screen. The number of quadrats to be sampled will depend on the mussels densities encountered in the field and the amount of potentially suitable habitat present at the sample site.

SCUBA divers will survey two transects between points P 7 and P 8 (Attachment 1). Transects will be established perpendicular to the stream channel and spaced out at 50 meter intervals. The survey will be conducted using a weighted stainless steel chain, spaced in 10 meter increments with a search area of one meter to either side of the transect. All live mussels, fresh dead, and weathered mussels found within a 10

meter section of transect will be placed in a mesh bag and taken to stream bank for identification and data entry. All live mussels will be identified and returned to the stream substrate in the section of transect where it was found. No live mussels will be retained.

CONCLUSION

Thank you for your assistance on this matter. If you have questions about the materials provided or the proposed approach, please contact me at the numbers provided below.

Sincerely,

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Attachment:

c. Melanie Cota, U.S. Fish & Wildlife Service
Brian Mitch, Ohio Department of Natural Resources
Becky Jenkins, Ohio Department of Natural Resources
Tim Kwiatowski, Ohio Department of Natural Resources
Brian Schwartz, U.S. Army Corps Engineers
Steve Malone, Ohio Environmental Protection Agency
Sam Derr, City of Fremont
Scott Peyton, Stantec Consulting

Reference: Proposed Study Plan for Mussel Surveys in Support of the Ballville Dam Removal Project, Sandusky River, Fremont, Ohio

From:	Angela_Boyer@fws.gov
Sent:	Tuesday, July 19, 2011 10:32 AM
To:	Fleece, Cody
Cc:	Melanie_Cota@fws.gov
Subject:	Re: Mussel Survey Study Plan for Ballville Dam Removal Project

Dear Mr. Fleece,

This is in response to your July 18, 2011 request for an amendment to your Federal Fish and Wildlife Permit No. TE38821A-0 to conduct a 2011 survey for federally listed freshwater mussels in the Sandusky River. The survey site is located in the vicinity of the Ballville Dam Removal Project in Freemont, Sandusky County, Ohio.

The Service has reviewed your proposal for the mussel survey. The U.S. Fish and Wildlife Service, Columbus, Ohio Field Office has no objection to the survey as proposed. This notification serves as written concurrence that Stantec is authorized to proceed with the mussel survey as described in your request. Upon completion of the survey, we request that you submit an electronic copy of the survey results to this office for review. Please include the latitude and longitude coordinates for the survey site in the report. If any federally listed mussels, rayed bean (*Villosa fabalis*), and/or snuffbox (*Epioblasma triquetra*) are found during the survey, please notify this office within 48 hours. Please carry a copy of this site specific authorization and your Federal permit while conducting the survey. If you have questions, or if we may be of further assistance in this matter, please contact me.

Sincerely,
Angela Boyer
Endangered Species Coordinator for Ohio
U.S. Fish and Wildlife Service
4625 Morse Road, Suite 104
Columbus, OH 43230
(614) 416-8993, ext. 22
(614) 416-8994 FAX
angela_boyer@fws.gov

Appendix B

Representative Photographs

Appendix B: Representative Photographs

a) Collected from DS-1

b) Collected from DS-5

c) Quadrula pustulosa

d) Quadrula pustulosa

e) Truncilla truncata

f) Actinonaias ligamentina

a) DS-1

b) Mussels collected at DS-1

c) DS-2 downstream view

d) DS-2 upstream view

e) DS-3 downstream view

f) DS-3 upstream view

g) DS-4 downstream view

h) DS-4 upstream view

i) DS-5 downstream view

j) DS-5 upstream view

k) DS-6 downstream view

l) DS-6 upstream view

m) DS-7

n) DS-7

o) DS-7

p) DS-7

Appendix C

Federal Permit

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

3-201
(1/97)

FEDERAL FISH AND WILDLIFE PERMIT

1. PERMITTEE

STANTEC CONSULTING SERVICES
KENTUCKY OFFICE
1901 NELSON MILLER PARKWAY
LOUISVILLE, KY 40223
U.S.A.

2. AUTHORITY-STATUTES
16 USC 1539(a)

REGULATIONS
50 CFR 17.22

50 CFR 13

3. NUMBER
TE38821A-0

4. RENEWABLE
☒ YES
☐ NO

5. MAY COPY
☒ YES
☐ NO

6. EFFECTIVE
05/19/2011

7. EXPIRES
12/31/2012

8. NAME AND TITLE OF PRINCIPAL OFFICER *(If #1 is a business)*
STEVE D. HALL
SENIOR ASSOCIATE, ECOLOGICAL SERVICES

9. TYPE OF PERMIT
NATIVE ENDANGERED SP. RECOVERY - E WILDLIFE

10. LOCATION WHERE AUTHORIZED ACTIVITY MAY BE CONDUCTED
ON LANDS SPECIFIED WITHIN THE ATTACHED SPECIAL TERMS AND CONDITIONS

11. CONDITIONS AND AUTHORIZATIONS:

A. GENERAL CONDITIONS SET OUT IN SUBPART D OF 50 CFR 13, AND SPECIFIC CONDITIONS CONTAINED IN FEDERAL REGULATIONS CITED IN BLOCK #2 ABOVE, ARE HEREBY MADE A PART OF THIS PERMIT. ALL ACTIVITIES AUTHORIZED HEREIN MUST BE CARRIED OUT IN ACCORD WITH AND FOR THE PURPOSES DESCRIBED IN THE APPLICATION SUBMITTED. CONTINUED VALIDITY, OR RENEWAL, OF THIS PERMIT IS SUBJECT TO COMPLETE AND TIMELY COMPLIANCE WITH ALL APPLICABLE CONDITIONS, INCLUDING THE FILING OF ALL REQUIRED INFORMATION AND REPORTS.

B. THE VALIDITY OF THIS PERMIT IS ALSO CONDITIONED UPON STRICT OBSERVANCE OF ALL APPLICABLE FOREIGN, STATE, LOCAL OR OTHER FEDERAL LAW.

C. VALID FOR USE BY PERMITTEE NAMED ABOVE.

C.1. FOR LISTED BAT SPECIES, VALID FOR USE BY JAMES KISER, DOUGLAS STEPHENS, JEFFREY BROWN, KRISTEN WATROUS, JEFFREY SCHWIERJOHANN, DAVID SAUGEY, JAMES EVANS, JOSEPH JOHNSON, AND LINDSAY WIGHT. WES CUNNINGHAM MAY WORK UNDER THE AUTHORITY OF THIS PERMIT FOR GRAY BAT ONLY. TRAINED ASSISTANTS MAY WORK ON PERMITTED ACTIVITIES UNDER THE DIRECT AND ON-SITE SUPERVISION OF JAMES KISER, DOUGLAS STEPHENS, JEFFREY BROWN, KRISTEN WATROUS, OR JEFFREY SCHWIERJOHANN. AT LEAST ONE NAMED PERMITTEE MUST REMAIN PRESENT AT EACH MIST-NET SITE WHILE IT IS BEING OPERATED.

C.2. FOR LISTED MUSSELS AND FISH SPECIES, VALID FOR USE BY JAMES KISER, DOUGLAS STEPHENS, SAM CALL, AND CODY FLEECE. TRAINED ASSISTANTS MAY WORK ON PERMITTED ACTIVITIES UNDER THE DIRECT AND ON-SITE SUPERVISION OF JAMES KISER, DOUGLAS STEPHENS, SAM CALL OR CODY FLEECE.

C.3. FOR COPPERBELLY WATERSNAKE, VALID FOR USE BY JAMES KISER. TRAINED ASSISTANTS MAY WORK ON PERMITTED ACTIVITIES UNDER THE DIRECT AND ON-SITE SUPERVISION OF JAMES KISER.

C.4. FOR CAROLINA NORTHERN FLYING SQUIRREL, VALID FOR USE BY JEFFREY SCHWIERJOHANN. TRAINED ASSISTANTS MAY WORK ON PERMITTED ACTIVITIES UNDER THE DIRECT AND ON-SITE SUPERVISION OF JEFFREY SCHWIERJOHANN.

C.5. FOR BOG TURTLE, VALID FOR USE BY JEFFREY SCHWIERJOHANN. TRAINED ASSISTANTS MAY WORK ON PERMITTED ACTIVITIES UNDER THE DIRECT AND ON-SITE SUPERVISION OF JEFFREY SCHWIERJOHANN.

D. ACCEPTANCE OF THIS PERMIT SERVES AS EVIDENCE THAT THE PERMITTEE AND ITS AUTHORIZED AGENTS UNDERSTAND AND AGREE TO ABIDE BY THE TERMS OF THIS PERMIT AND ALL SECTIONS OF TITLE 50 CODE OF FEDERAL REGULATIONS, PARTS 13 AND 17, PERTINENT TO ISSUED PERMITS. SECTION 11 OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED, PROVIDES FOR CIVIL AND CRIMINAL PENALTIES FOR FAILURE TO COMPLY WITH PERMIT CONDITIONS.

E. Permittee is authorized to take Indiana bats (*Myotis sodalis*), Gray bats (*M. grisescens*), Ozark big-eared bats (*Corynorhinus townsendii ingens*), Virginia big-eared bats (*C. t. virginianus*), listed mussel and fish species identified in

☒ ADDITIONAL CONDITIONS AND AUTHORIZATIONS ALSO APPLY

12. REPORTING REQUIREMENTS
ANNUAL REPORT DUE: 01/31

ISSUED BY	TITLE	DATE
Lisa Mandell	acting CHIEF - ENDANGERED SPECIES	05/19/2011

Attachment 1, the Copperbelly water snake (*Nerodia erythrogaster neglecta*), Carolina Northern Flying Squirrel (*Glaucomys sabrinus coloratus*) and the Bog Turtle (*Clemmys muhlenbergii*) for scientific research aimed at recovery of the species: presence/absence surveys, studies to document habitat use, population monitoring, and evaluate potential impacts of industrial, commercial, and military activities as described herein.

F. Presence/absence surveys and studies to document habitat use are authorized at the following locations:

F.1. Locations within Region 3 of the USFWS: Illinois, Indiana, Iowa, Michigan, Missouri, and Ohio, upon receipt of written concurrence from Field Supervisor, as outlined in Condition G.

F.2. Locations within Region 4 of the USFWS: Kentucky, Tennessee, Alabama, Georgia, Arkansas, Mississippi, North Carolina, and South Carolina upon receipt of written concurrence from Field Supervisor, as outlined in Condition G.

F.3. Locations within Region 5 of the USFWS: Connecticut, Delaware, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia upon receipt of written concurrence from Field Supervisor, as outlined in Condition G.

F.4. Throughout Oklahoma upon receipt of written concurrence from Field Supervisor, as outlined in Condition G.

G. For all locations specified in Condition F., Permittee shall request site specific authorization from the USFWS Field Supervisor for the state in which activities are proposed to occur at least 15 days prior to conducting any activities. Your notification must be in writing and must indicate:

G.1. Location of proposed activities, including project site, county, and state.

G.2. A description of the activities (i.e., surveys, radio-telemetry studies, etc.) and the species for which the research activity is proposed.

G.3. Dates when the project is proposed to take place.

G.4. Evidence that Permittee has received any required contracts to complete the activities.

G.5. You may proceed with activities only upon receipt of written concurrence from the Field Supervisor. *Your concurrence letter must be carried with this permit to authorize the activities identified in Conditions H - M below.*

MAMMAL SPECIES

H. The attached "Indiana Bat Mist-Netting Guidelines" shall be followed. Permittee shall also adhere to following conditions involving capture and handling of bats:

H.1. Bats may be captured with mist nets by personnel identified in C.1. The monitoring interval for mist nets may not exceed 15 minutes. Captured bats should be held for a maximum of 30 minutes, unless injured. In extenuating circumstances, bats shall be held for no longer than 45 minutes.

H.2. Bats may only be captured with harp traps with written concurrence from the Field Supervisor in the state in which trapping is proposed. Harp traps must be continually monitored. Captured bats may be held for a maximum of 30 minutes, unless injured. In extenuating circumstances, bats shall be held for no longer than 45 minutes.

H.3. Permittees may carry out non-intrusive measurements on captured bats. Celluloid split-ring or lipped metal bands having a unique identifier may be applied to the forearms of captured bats prior to release.

H.4. Holohil Systems, or similar radio transmitters may be applied during summer roosting period via nontoxic skin bond adhesive such as colostomy glue. It is recommended that the total weight of the package (transmitter and adhesive) not exceed 5% of the bat's body weight. The lightest transmitters capable of accomplishing the required task should be used, especially with pregnant females and newly volant juveniles. Total weight of the package (transmitter and adhesive) is not to exceed 0.8 grams or 10% of the bat's body weight, whichever is less. Bats carrying transmitters must be monitored daily for at least three days, or until the transmitter falls off, whichever occurs first.

H.5. No trapping activities shall occur within 20 meters of an Indiana bat maternity roost site, either natural or artificial roosts, unless Permittee receives prior written approval from the U.S. Fish and Wildlife Service Field Supervisor for the state in which the activities are proposed to occur.

H.6. Caves, mines, or other suitable hibernation sites may be quietly searched by permittee and no more than 3 assistants at one time. Where hibernacula area and safety conditions allow, individuals entering caves are recommended to utilize night vision goggles or red-filtered light and to remain in the cave no more than 90 minutes to complete the work.

H.7. Equipment used to capture and handle bats shall be cleaned and decontaminated according to the attached "Disinfection Protocol for Bat Field Studies." In addition, you are required to use the most recent handling protocols available by checking the protocols posted on the USFWS website at: http://www.fws.gov/WhiteNoseSyndrome/research.html. You must visit the web site at least once every six weeks to assure that your activities are conducted according to the most recent USFWS approved protocols.

I. The following conditions apply to activities involving capture of Carolina Northern Flying Squirrels:

I.1. Presence/absence studies and studies to document habitat use shall be conducted by personnel identified in Condition C.4.

I.2. Trapping shall be conducted from spring through mid-autumn (April 1 - October 30). Traps shall not be set when clear moonlit nights are expected or during extremely cold, wet or windy weather.

I.3. Squirrels shall be captured using wire mesh live-traps of a size appropriate for chipmunks. Metal box traps shall not be used. Suitable bait (peanut butter-oat, bacon grease-fruit) and bedding material (leaves and/or cotton batting) shall be inserted into the traps, while moss, leaves, or other natural material is placed over traps to break the outline and to provide cover. Traps shall be secured to the ground or attached horizontally to large, mature trees at a height of 6 feet. Trees shall be flagged or visibly marked at trap location.

I.4. Twenty to 40 traps shall be placed in area to be assessed at a minimum spacing of 50 meters, with 1 - 2 transects through the area. Traps shall be run a minimum of 1 week per area. All traps shall be inspected twice daily (morning and evening).

I.5. Identifying ear tags and/or ear tattoos may be applied to individual squirrels for recapture information and long-term monitoring.

I.6. Holohil Systems, or similar radio-telemetry equipment may be used to study habitat use. Radio-collar type transmitters may be applied to individuals. Transmitters may not exceed 5% of the animal's body weight including collar and transmitter.

MUSSEL SPECIES

J. Permittee is authorized to take (only in the context of harass by survey) mussel species identified in Attachment #1 for scientific research aimed at recovery of the species. The following conditions apply to actions related to presence/absence surveys for mussel species:

J.1. Presence/absence studies and surveys to monitor mussel communities shall be conducted by personnel identified in Condition C.2.

J.2. Permittee may take (remove from the substrate for identification, data collection and return) mussels by hand using divers.

J.3. Permittee may temporarily hold specimens in mesh bags, either suspended in the water or held in a container containing river water, while awaiting identification and data collection. Specimens may be held for up to 3 hours provided that they are held in the water in bags that allow free movement of water the mussels were taken from or held in buckets of water that is changed every hour [every half-hour when air temperatures are at or above 80° Fahrenheit (F)] and replaced with water freshly taken from the water where the mussels were collected. Specimens must be returned to the locality from which they were taken. No live specimens may be removed from the site. Live specimens that cannot be identified at the site must be photographed for identification purposes and immediately returned to the substrate.

J.4. Collection of specimens must be done only when the air temperature is above 32° F and the water temperature is above 40° F. Specimens may be returned to the substrate as follows: 1) for surveys at water temperatures at or above 50° F, mussels may be dropped back into the water after identification; 2) for surveys conducted at water temperatures between 40° F and 50° F, mussels must be returned to the substrate by divers. Divers should loosen approximately one square foot of substrate by hand or with a tool to a depth of approximately eight inches

and place the mussel approximately half way into the loosened substrate, near the center of the loosened area, siphon (posterior) end up and pointing upstream. Specimens must be returned unharmed within three hours to the locality where taken, or relocated as authorized by Condition J.6.

J.5. All live mussels will be measured (length and height) and, if possible, sexed and aged. No intrusive activities are permitted. Random samples will be taken and sample locations will be determined using a stratified, random design. Data collected will include descriptions of external morphometry and reproductive status.

J.6. No live specimens may be removed from the survey sites, except for specimens encountered in circumstances which would reasonably be expected to result in stranding due to low or receding water.

FISH SPECIES

K. Permittee is authorized to take (only in the context of harass by survey) fish species identified in Attachment #1 for scientific research aimed at recovery of the species. The following conditions apply to actions related to presence/absence surveys for fish species:

K.1. Presence/absence studies and surveys to monitor fish communities shall be conducted conducted by personnel identified in Condition C.2.

K.2. Permittee may hold specimens for a maximum of 15 minutes for photographic documentation and non-intrusive data collection, and will be released unharmed at the point of capture.

K.3. Electrofishing surveys are only authorized by written concurrence of the U.S. Fish and Wildlife Service Field Supervisor for the state in which the activity is proposed.

REPTILE SPECIES

L. The following conditions apply to survey activities for copperbelly water snake:

L.1. Visual searches of habitat may be conducted to assess habitat quality and to determine presence or absence of copperbelly water snake.

L.2. Time searches shall be based on protocol developed and discussed by Kingsbury (Attachment 2).

L.3. Drift fences may also be employed for more quantifiable population estimates.

M. The following conditions apply to activities involving capture and release of Bog Turtles to determine presence or absence within suitable habitat:

M.1. Surveys shall be conducted from April 15 - June 15 (May 1 - June 30 for the Lake Plain Recovery Unit) when air and water temperatures are at least 55° F.

M.2. Surveys shall be conducted during the day, at least one hour after sunrise and no later than one hour before sunset.

M.3. Surveys may be done when it is sunny or cloudy. Surveys may be conducted during light rain provided air temperatures are at or above 65° F.

M.4. A minimum of 4 surveys per wetland are needed to adequately assess for presence of turtles. At least two of the 4 surveys shall be completed in May. From mid-April to mid-May, surveys must be separated by six or more days. From mid-May to mid-June, surveys should be separated by at least 3 days. If bog turtles are found on the first, second, or third survey visit, no additional survey is needed to establish presence. Four surveys must be completed to establish absence of bog turtles at a site.

M.5. Survey time shall be 4 to 6 person-hours per acre of survey area per visit. Both random, opportunistic searching and transect surveys should be used in each wetland.

M.6. Walk quietly through the wetland to observe turtles. Bog turtles may be basking on sedge tussocks and mossy hummocks, or be half-buried in shallow water or rivulets. Do not step on the tops of tussocks or hummocks to avoid destroying nests. Be sure to search areas where turtles may not be visible, such as under mats of dead vegetation, shallow pools, underground springs, open mud areas, vole runways and under tussocks.

M.7. Turtles may be captured by hand. Photo-documentation is required for each bog turtle captured. Photos should be in color and of sufficient detail and clarity to identify the bog turtle to species and individual. Photos of each individual should include: carapace, plastron, and face/neck markings. In order to obtain face/neck photos, place turtle gently on the ground and wait until the turtle extends its head. Do not harass the turtle in an attempt to obtain face/neck photos. If shell notching is to be done, photo-documentation should be completed after the notching.

M.8. Each turtle captured may be marked (with a shell notch) in accordance with State permitting requirements and marking system.

M.9. All bog turtles must be returned to the point of capture as soon as possible on the same day of capture. Turtles shall be held only long enough to identify, weigh, measure, mark (when needed) and photograph them. Exposure to high temperatures must be avoided.

M.10. Any bog turtles that are found dead may be collected according to the protocols described in the attached Bog Turtle Bulletin and submitted to the USGS-National Wildlife Health Lab as described therein.

N. Permittee shall notify the U.S. Fish and Wildlife Service Field Supervisor(s) for the state in which the activity occurred (Condition P.) in writing of any newly discovered species locations within 7 days of discovery unless otherwise specified by the Field Supervisor(s). Notification shall be provided in writing with a copy to the office identified in condition Q.1.

O. No injury or mortality is anticipated or allowed as a result of authorized activities. In the event that any injury or mortality occurs, all activities must cease. The circumstances of any injury or mortality must be reported in writing within 48 hours to the office listed in Condition Q.1., the appropriate U.S. Fish and Wildlife Service field office(s) (Condition R.), and the nearest U.S. Fish and Wildlife Service Law Enforcement office (Attachment #3). Before you reinitiate studies authorized by this permit, you must receive written authorization from the U.S. Fish and Wildlife Service (address in Condition Q.1.). Dead or moribund specimens may be retained for further study only with the written permission of the U.S. Fish and Wildlife Service, Bloomington, Minnesota, Regional Office. Any specimens that are not authorized for retention are to be chilled and promptly transferred to the U.S. Fish and Wildlife Service for potential necropsy and/or contaminants analysis.

P. Reports are due on January 31 of each year the permit is in effect. At a minimum, your report must include:

P.1. The date, time, locations (using UTM, latitude-longitude, section descriptors, or accurately plotted on USGS maps) of all specimens encountered as well as all data collected on the individuals.

P.1.a. For bats, include all data collected, such as age, sex, weight, and any evidence of disease or injury. Your report must include copies of completed INDIANA BAT SURVEY AND BANDING DATA forms for all survey sites (attached) and band numbers of all Indiana and gray bats banded.

P.1.b. For flying squirrels, include data collected on age, sex, weight, ear tags and/or ear tattoos, radio transmitters and collars attached.

P.1.c. For bog turtles, include dates of site visits, time spent per designated survey area per wetland per visit, names of surveyors, a site map including wetlands and delineations of designated survey areas, size of each wetland and designated survey area within each wetland, survey effort per visit, a description of the wetlands within the project area (e.g., acreage, vegetation, soils, hydrology), weather conditions, locations of capture, sex, carapace length-straight line and maximum length, carapace width, weight, and details about scars and injuries.

P.2. Include information on locations surveyed for threatened/endangered species where no specimens were encountered.

P.3. Location and characteristics of bat roost trees and bat colonies.

P.4. Information on any injuries and/or mortalities and disposition of specimens.

P.5. Copies of any separate reports and/or publications resulting from work conducted under the authority of this permit.

P.6. Copies of all site-specific authorization letters required under Condition G.

Q. Copies of your reports shall be sent to the offices listed below. When possible, electronic copies shall be submitted in lieu of hard copies in MS Word, Rich Text Format, or other file format that is compatible with the receiving office.

Q.1. Lisa Mandell
U.S. Fish and Wildlife Service
Ecological Services
5600 American Blvd. W.
Suite 990
Bloomington, Minnesota 55437-1458
(612/713-5343; fax 612/713-5292)
permitsR3ES@fws.gov

Q.2. Cam Shaw
U.S. Fish and Wildlife Service
Attn: Permit Coordinator (AES/TE/P)
1875 Century Boulevard, Suite 200
Atlanta, Georgia 30345-3301
(904/731-3191; fax 404/679-7081)
permitsR4ES@fws.gov

Q.3. Alex Hoar
U.S. Fish and Wildlife Service
Endangered Species Division
300 Westgate Center Drive
Hadley, Massachusetts 01035-9589
(413/253-8631; fax 413/253-8482)
permitsR5ES@fws.gov

Q.4. Marty Tuegel
Regional Recovery Permits Coordinator
U.S. Fish and Wildlife Service, Region 2
P.O. Box 1306
Albuquerque, New Mexico 87103-1306
(505/248-6651; fax 505/248-6788)
permitsR2ES@fws.gov

Q.5. For all studies involving Indiana bat:
Lori Pruitt
Endangered Species Coordinator
U.S. Fish and Wildlife Service
Ecological Services Field Office
620 S. Walker Street
Bloomington, Indiana 47403-2121
(812/334-4261 x1211; fax 812/334-4273)

R. Additionally, based on geographic area, reports and publications shall be submitted to the following:

R.1. For studies conducted in Illinois:

R.1.a. Jody Millar
Endangered Species Coordinator for Illinois/Iowa
U.S. Fish and Wildlife Service
Ecological Services Field Office
1511 47th Ave.
Moline, Illinois 61265
(309/757-5800, x202; fax 309/757-5807)

R.1.b. Joe Kath
Endangered Species Coordinator
Illinois Department of Natural Resources
Endangered and Threatened Species Program
One Natural Resource Way
Springfield, IL 62702-1271
(217/785-8764; fax 217/785-2438)

R.2. For studies conducted in Indiana:

Katie Gremillion-Smith
Endangered Species Coordinator
Indiana Department of Natural Resources
Division of Fish and Wildlife
Room W273, 402 W. Washington St.
Indianapolis, Indiana 46204-2267
(317/232-8160; fax 317/232-8150)

R.3. For studies conducted in Iowa:

R.3.a. Jody Millar
Endangered Species Coordinator for Illinois/Iowa
U.S. Fish and Wildlife Service
Ecological Services Field Office
1511 47th Ave.
Moline, Illinois 61265
(309/757-5800, x202; fax 309/757-5807)

R.3.b. Daryl Howell
Endangered Species Coordinator
Iowa Department of Natural Resources
Parks, Recreation, and Preserves
Wallace State Office Building
East 9th and Grand Avenue
Des Moines, Iowa 50319-0034
(515/281-8524)

R.4. For studies conducted in Michigan:

R.4.a. Barbara Hosler
Endangered Species Coordinator for Michigan
U.S. Fish and Wildlife Service
2651 Coolidge Road
East Lansing, Michigan 48823
(517/351-6326; fax 517/351-1443)

R.4.b. Christopher Hoving
Michigan Department of Natural Resources
Wildlife Division
5th Floor, Stevens T. Mason Bldg.
P.O. Box 30028
Lansing, Michigan 48909
(517/373-1263; fax 517/373-6705)

R.5. For studies conducted in Missouri:

R.5.a. Amy Salveter
Deputy Project Leader
U.S. Fish and Wildlife Service
Missouri Ecological Services Field Office
101 Park DeVille Drive, Suite A
Columbia, Missouri 65203-2132
(573/234-2132; fax 573/234-2181)

R.5.b. Stephanie Liebi
Scientific Collecting Permit Coordinator
Missouri Department of Conservation
Endangered Species and Natural History Division
2901 W. Truman Blvd.
P.O. Box 180
Jefferson City, Missouri 65102-0180
(573/751-4115 ext. 3574; fax 573/526-5582)

R.6. For studies conducted in Ohio:

R.6.a. Angela Boyer
Endangered Species Coordinator for Ohio
U.S. Fish and Wildlife Service
Ecological Services Field Office
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614/416-8993, x22; fax 614/416-8994)

R.6.b. Carolyn Caldwell
Endangered Species Coordinator
Ohio Department of Natural Resources
Division of Wildlife
2045 Morse Road
Building G
Columbus, OH 43229-6693
(614-265-6329)

R.7. For studies conducted in Wisconsin:

R.7.a. Cathy Carnes
Endangered Species Coordinator
U.S. Fish and Wildlife Service
Ecological Services Field Office
2661 Scott Tower Drive
New Franken, Wisconsin 54229
(920/866-1717 x1732; fax 920/866-1710)

R.7.b. Rebecca Schroeder
Chief, Bureau of Endangered Resources
Department of Natural Resources
Box 7921
Madison, Wisconsin 53707-7921
(608/266-5244; fax 608/266-2925)

R.8. For studies conducted in Alabama:

Daphne Field Office
Bill Pearson, Field Supervisor
1208-B Main Street
Daphne, Alabama 36526
(251/441-5181)

R.9. For studies conducted in Arkansas:

Arkansas Field Office
Mark Sattelberg, Field Supervisor
110 South Amity
Suite 300
Conway, Arkansas 72032-8975
(501/513-4470)

R.10. For studies conducted in Connecticut, Massachusetts, New Hampshire, Rhode Island and Vermont:

New England Field Office
Tom Chapman, Field Supervisor
70 Commercial Street, Suite 300
Concord, NH 03301
(603/223-2541)

R.11. For studies conducted in Delaware and Maryland:

Chesapeake Bay Field Office
Leopoldo Miranda, Field Supervisor
177 Admiral Cochrane Drive
Annapolis, MD 21401
(410/573-4500)

R.12. For studies conducted in Georgia:

Georgia Field Office
Sandy Tucker, Field Supervisor
West Park Center
Suite D
105 West Park Drive
Athens, GA 30606-3175
(706/613-9493)

R.13. For studies conducted in Kentucky:

Frankfort Field Office
Lee Andrews, Field Supervisor
J C Watts Federal Bldg., Rm 265
330 West Broadway
Frankfort, KY 40601-8670
(502/695-0468)

R.14. For studies conducted in Mississippi:

Jackson Field Office
Ray Aycock, Field Supervisor
6578 Dogwood View Pkwy, Ste A
Jackson, MS 39213-7856
(601/965-4900)

R.15. For studies conducted in New Jersey:

New Jersey Field Office
Eric Davis, Field Supervisor
927 N. Main Street, Building D
Pleasantville, NJ 08232-1454
(609/646-9310)

R.16. For studies conducted in New York:

New York Field Office
David Stilwell, Field Supervisor
3817 Luker Road
Cortland, NY 13045
(607/753-9334)

R.17. For studies conducted in North Carolina:

Asheville Field Office
Brian Cole, State Supervisor
160 Zillicoa Street
Asheville, NC 28801-1082
(828/258-3939)

R.18. For studies conducted in Pennsylvania:

Pennsylvania Field Office
Clint Riley, Field Supervisor
315 So. Allen Street, Suite 322
State College, PA 16801-4850
(814/234-4090)

R.19. For studies conducted in South Carolina:

Charleston Field Office
Field Supervisor
176 Croghan Spur Road, Suite 200
Charleston, SC 29407-7558
(843/727-4707)

R.20. For studies conducted in Tennessee:

Cookeville Field Office
Mary Jennings, Field Supervisor
U.S. Fish and Wildlife Service
446 Neal Street
Cookeville, TN 38501-4027
(931/528-6481)

R.21. For studies conducted in Oklahoma:

Oklahoma Field Office
Dixie Birch, Field Supervisor
U.S. Fish and Wildlife Service
9014 E. 21st St.
Tulsa, Oklahoma 74129
(918/581-7458)

R.22. For studies conducted in Virginia:

Virginia Field Office
Cindy Schulz, Field Supervisor
6669 Short Lane
Gloucester, VA 23061
(804/693-6694)

R.23. For studies conducted in West Virginia:

West Virginia Field Office
Deborah Carter, Field Supervisor
Route 250 South, Elkins Shopping Plaza
694 Beverly Pike
Elkins, WV 26241
(304/636-6586)

R.24. For studies conducted in Florida:

North Florida Field Office
Dave Hankla, Field Supervisor
7915 Baymeadows Way, Suite 200
Jacksonville, FL 32256-7517
(904/731-3336)

Panama City Field Office
Field Supervisor
1601 Balboa Avenue
Panama City, FL 32405
(850/769-0552)

cc: FWS/Region 2, 4, 5, and 6 (AES/TE)
FWS, TE Coordinators for IL, IN, IA, MI, MN, MO, OH, and WI
DNR/DOC, TE Coordinators for IL, IN, IA, MI, MN, MO, OH, and WI

END

Attachment 1

Stantec Consulting Services
Listed Fish and Freshwater Mussels Authorized for Take
In Accordance With Permit TE38821A

Fish

Etheostoma chienense	Relict darter
Etheostoma percnurum	Duskytail darter
Notropis albizonatus	Palezone shiner
Phoxinus cumberlandensis	Blackside dace
Scaphirhynchus albus	Pallid sturgeon

Mussels

Alasmidonta atropurpurea	Cumberland elktoe
Conradilla caelata	Birdwing pearlymussel
Cyprogenia stegaria	Fanshell
Dromus dromas	Dromedary pearlymussel
Epioblasma brevidens	Cumberland combshell
Epioblasma capsaeformis	Oyster mussel
Epioblasma florentina walkeri	Tan riffleshell
Epioblasma obliquata obliquata	Purple catspaw
Epioblasma torulosa rangiana	Northern riffleshell
Fusconaia cuneolus	Finerayed pigtoe
Fusconaia cor	Shiny pigtoe
Hemistena lata	Cracking pearlymussel
Lampsilis abrupta	Pink mucket
Obovaria retusa	Ring pink
Pegias fibula	Littlewing pearlymussel
Plethobasus cicatricosus	White wartyback pearlymussel
Plethobasus cooperianus	Orangefoot pimpleback
Pleurobema clava	Clubshell
Pleurobema plenum	Rough pigtoe
Potamilus capax	Fat pocketbook
Quadrula cylindrical strigillata	Rough rabbitsfoot
Villosa perpurpurea	Purple bean
Villosa trabilis	Cumberland bean

Appendix D

State Permit

DIVISION OF WILDLIFE
Ohio Department of Natural Resources

Division of Wildlife Headquarters
2045 Morse Road, Bldg. G
Columbus, Ohio 43229-6693
1-800-WILDLIFE

Vicki J. Mountz, Acting Chief

April 11, 2011

Stantec Consulting Services
Attn: James Kiser
712 Alum Rd
Whitley City, KY 42653

Dear Mr. Kiser:

This letter authorizes you, and those working under your supervision to work with Ohio endangered and threatened bat and mussel species, including the Indiana bat (*Myotis sodalis*). By authority of the Endangered Species Act (ESA), you are hereby designated as an agent of the ODNR, Division of Wildlife (DOW) to conduct work on federally listed species of bats and mussels in Ohio. Your designation as an agent of DOW is effective beginning 16 March 2011 and will expire 15 March 2014. If necessary, you may request an extension of this designation to continue your work with federally listed species of bats and mussels in Ohio.

Effective until 15 March 2014, this designation allows you to (1) collect endangered specimens of mussels for survey and inventory purposes. (2) add dead Indiana bat and mussel specimens salvaged during field work to the OSU Museum of Biological Diversity's permanent collection, (3) monitor mussel beds of federally listed mussels in Ohio, (4) monitor roost sites or survey suspected locations of federally listed bats in Ohio, (5) locate additional mussel beds, roosts or locations of federally listed species in Ohio, (6) set mist nets, utilizing current USFWS white nose syndrome (WNS) decontamination protocol in the vicinity of potential federally listed bat roost sites and determine use, (7) band federally listed bats in Ohio (contact Jennifer Norris for bands).

The United States Fish and Wildlife Service (USFWS) and DOW are partners in a cooperative agreement under Section 6c of the ESA. Your designation as an agent of the DOW means your work with federally listed species in Ohio is permitted under federal regulations 50 CFR 17.21c and 50 CFR 17.31b. This includes aid to sick, injured, or orphaned species [50 CFR 17.21c (3) (i)] and salvage of dead specimens useful for scientific study [50 CFR 17.21c (3) (iii)]. You must notify the USFWS of any such taking as outlined in 50 CFR 17.21c (4). In addition to salvage activities, you are authorized to take species of federally endangered species, as outlined in 50 CFR 17.21c (5), provided your activities meet the guidelines outlined in 50 CFR 17.21c (5) (i) - 50 CFR 17.21c (5) (iv).

A copy of 50 CFR 17 is attached to this letter for your review. In particular, please review 50 CFR 17.21 and 17.31. Note that a separate permit under Section 10 of the ESA is necessary in the case where you might hold live federally listed species longer than 45 days. Permit requests under Section 10 of the ESA should be directed to endangered species biologist Angela Boyer in Columbus, Ohio (614-416-8993 ext. 22). If you have questions about whether any proposed activities are covered under this authority or need any other assistance, contact the USFWS.

Information gathered from your work will be valuable to the DOW. A written report summarizing your findings should be provided to the following individuals; Jennifer Norris, at the Olentangy Wildlife Research Station, 8589 Horseshoe Rd., Ashley, OH 43003 and Angela Boyer, U.S. Fish and Wildlife Service, 4625 Morse Rd., Suite 104, Columbus, OH 43230. Annual reports are due by 15 March for the previous year.

Notify Jennifer Norris at (740) 747-2525 ext. 26 or mobile at (419) 602-3141 within 24 hours if an Indiana bat is found or if WNS is suspected on any bats observed. Please provide latitude and longitude coordinates or a thorough description of where the bat was observed.

Sincerely,

VICKI J. MOUNTZ
Acting Chief

VJM/mm

Enclosure

cc: C. Caldwell
J. Navarro
J. Norris
A. Boyer, USFWS
file

DIVISION OF WILDLIFE

Ohio Department of Natural Resources

Division of Wildlife Headquarters
2045 Morse Road, Bldg. G
Columbus, Ohio 43229-6693
1-800-WILDLIFE

WILD ANIMAL PERMIT: 14-174

SCIENTIFIC COLLECTION

Vicki J. Mountz
Acting Chief, Division of Wildlife

DATE ISSUED
4/7/2011

Others authorized on permit

YES (SEE ATTACHMENT)

JAMES D. KISER
STANTEC CONSULTING
712 ALUM ROAD
WHITLEY CITY, KY 42653

SOCIAL SECURITY NUMBER: XXX-XX-1983

is hereby granted permission to take, possess, and transport at any time and in any manner specimens of wild animals, subject to the conditions and restrictions listed below or any documents accompanying this permit.

This permit, unless revoked earlier by the Chief, Division of Wildlife, is effective from: 3/16/2011 to: 3/15/2014

This permit must be carried while collecting wild animals and be exhibited to any person on demand.

THIS PERMIT IS RESTRICTED TO THE FOLLOWING

1. Permittee may collect bats, fish, and aquatic macroinvertebrates for presence/absence of species. Endangered species may be taken in accordance with a letter permit from the chief expiring in March 2014.
2. Permittee must follow current USFWS WNS decontamination protocols.
3. Please notify Jennifer Norris at 740-747-2525 ext. 26 or 419-602-3141 if an Indiana bat is located or if visible signs of WNS are observed.
4. Twenty-four hours prior to collecting activities, permittee must contact the local wildlife officer or nearest wildlife district office to advise locations and duration of sampling.
5. All voucher specimens are to be deposited at FMSM facilities or the Ohio State University, Museum of Biological Diversity.
6. Collection is prohibited the Killbuck, Big Darby, Little Darby, Fish Creek (Williams County) and Division of Wildlife properties without explicit written permission from the Chief of the Division of Wildlife.
7. Permittee must provide an annual report of collecting activities to the Division of Wildlife. Report shall provide species, quantity and locations of collection. Please provide data in the Wildlife Diversity Database format using the enclosed excel file.

Locations of Collecting

STATEWIDE WITH NOTED EXCEPTIONS

Equipment and method used in collection:

PRESENCE/ABSENCE BY SNORKELING, DIVING, HAND GRABBING, ELECTROFISHING, MACROINVERTEBRATE SAMPLERS, MIST NETS, HARP TRAPS

Name and number of each species to be collected:

BATS, INCLUDING INDIANA BATS, ENDANGERED MUSSELS, FISH AND AQUATIC MACR0INVERTEBRATES FOR SURVEY AND INVENTORY.

RESTRICTIVE DOCUMENTS ACCOMPANYING THIS PERMIT? NO

This permit is not valid for collecting migratory birds, their nests, or eggs unless a current permit from the U.S. Fish and Wildlife Service has been obtained.

NO ENDANGERED SPECIES MAY BE TAKEN WITHOUT WRITTEN PERMISSION FROM THE CHIEF

ATTACHMENT

This attachment to Scientific Collecting Permit #14-174 authorizes the following persons to conduct the activities listed on the permit, within the conditions and restrictions set forth. Each person must carry and exhibit upon request, a copy of the permit and this attachment when conducting any of the listed activities. The person named on the permit assumes full responsibility for the actions of the persons on this list and for completing and submitting all required reports.

Name	SSN or Driver License
DOUG STEPHENS	XXX-XX-0287
SAM (SKIP) CALL	XXX-XX-3084
JEFF BROWN	XXX-XX-1617
JEFF SCHWIERJOHANN	XXX-XX-2843
JOE JOHNSON	XXX-XX-6548
CODY FLEECE	XXX-XX-1253
KRISTEN WATROUS	XXX-XX-7067
LINDSEY WRIGHT	XXX-XX-3425
TONY EVANS	XXX-XX-5830
KIM CARTER	XXX-XX-9117

Ballville Dam Project

Final Environmental Impact Statement:

Appendix A – Project Surveys, Reports, and Memoranda

11 – Sandusky River Response to Sediment Release at Ballville Dam as a result of the Proposed Action Alternative

Memo

Stantec

To:	Brian Elkington Fisheries Coordinator U.S. Fish and Wildlife Service	From:	Cody Fleece, Sr. Assoc Ecologist Tim Taylor, P.E. Scott Peyton, P.E. Stantec Consulting Services Inc.
File:	175631016	Date:	October 18, 2013

Reference: Sandusky River Response to Sediment Release at Ballville Dam as a Result of the Proposed Action

INTRODUCTION

The purpose of this memo is to provide a qualitative description of the expected channel response and the subsequent biological response associated with the proposed removal of Ballville Dam on the Sandusky River near Fremont, Ohio. This memo addresses potential impacts associated with sediment release during and after removal of the dam on the following four items:

1. Navigation;
2. Flood conveyance and capacity;
3. Water quality; and
4. Aquatic biota.

BACKGROUND

The U.S. Fish and Wildlife Service (USFWS) is the lead agency for developing a Draft Environmental Impact Statement (DEIS) for the Ballville Dam Project. The USFWS is the lead agency based on the funding commitment of $2 million from the Great Lakes Restoration Initiative (GLRI) through the Great Lakes Fish and Wildlife Restoration Act (Act)(16 U.S.C. 941 §4321 et seq.). The Act authorizes the USFWS to work in partnership with States, Tribes, and other Federal agencies for the restoration of fish and wildlife resources in the Great Lakes Basin.

Issuance of funding under the Act constitutes a discretionary federal action by the USFWS and is thus subject to the National Environmental Policy Act (NEPA). As the lead agency, the USFWS has determined that an Environmental Impact Statement is appropriate for meeting compliance with the NEPA. The NEPA process requires that federal agencies integrate an interdisciplinary environmental review process that evaluates a range of alternatives, including the No Action Alternative, as part of the decision-making process. This memorandum was developed ahead of the NEPA document to assist in preparation of the environmental consequences chapter of the DEIS for the project.

CONCEPTUAL DAM REMOVAL APPROACH

Four alternatives, including the No Action Alternative, are being evaluated in the DEIS. The Proposed Action is divided into three phases with each phase having multiple objectives for meeting dam removal goals. In summary, the phases are:

- Phase 1
  - Construct access to south abutment (September 2014)
  - Notch spillway to elevation 615 feet (November 2014)
- Phase 2
  - Sediment stabilization (March 2015)
  - Construct ramp (May-June 2015)
  - Construct Ice Control Structures (July-October 2015)
  - Remove dam (September-November 2015)
  - Channel restoration (November-December 2015)
- Phase 3
  - Bank stabilization/planting/in-stream work (Summer 2016)
  - Remove any remaining pieces of dam designated for removal and modify sea wall (August-November 2016)
  - Remove Tucker Dam (if necessary; Fall 2016).

CHANNEL RESPONSE OVERVIEW

The entire Proposed Action is segmented into three phases; each with sub-phases designed to complete the project in the least environmentally damaging way. Phase 1 would remove a small section of the dam resulting in a “notch” in the south spillway of Ballville Dam that is 20 feet wide and 10 feet tall. Notching the dam would produce a base level change and would lower the hydraulic control on pool elevation from 625 to 615 feet at low flows. The upstream channel within the former pool would be expected to respond to this new elevation control with a series of adjustments such as upstream knickpoint[1] migration, incision, and subsequent below water channel widening (Schumm and Parker 1973, Womack and Schumm 1977). This cycle of knickpoint migration, incision, and widening would likely occur repeatedly until a new stable bed elevation is achieved along the length of the impoundment. However, it is possible that the next phase of dam demolition would begin before the process of adjustment is complete. Fine-grained sediments would be mobilized and exported to downstream reaches during and immediately after construction associated with the notch. The magnitude of sediment export would be limited by the relatively small hydraulic capacity of the notch (Riggsbee et al. 2007) and may not differ substantially from the existing condition. Coarse-grained sediments, if present, are not expected to pass over the dam. Additional sediment would be exported by storm-generated stream flows in the months following the notch.

The remainder of Ballville Dam would be demolished during Phase 2. Channel adjustment and sediment export would follow similar processes described above. However, channel incision

[1] A “knickpoint” is a localized area of high channel slope and is often a focal point for channel adjustments.

would be constrained by currently submerged bedrock outcrops rather than the dam. A pulse of stored sediment would be exported to downstream reaches during the demolition process. Subsequent pulses would be mobilized during storm generated high flow events. The impoundment would no longer constrain the physical forces necessary to mobilize and transport coarse-grained substrates.

It is not possible to calculate the exact volume of sediment discharge using currently available scientific methods. However, studies from other dam removal projects can be used to place sediment loads in context (Major et al. 2012). The Marmot Dam, on the Sandy River in Oregon, was demolished in a single rapid breach. Fifteen percent of the total stored sediment volume was exported downstream in the first 60 hours after breaching. Another 35 percent was exported during the winter wet season following the initial breaching of the dam. Storms in the winter months of the second wet season resulted in an additional six percent of the total sediment yield from the former impoundment, which suggests that the channel approached a dynamic equilibrium. Thus 44 percent of the total stored sediment volume remained in place and was not transported to downstream reaches of the Sandy River.

The notch strategy is intended to diminish the initial delivery of sediment to downstream reaches by limiting the depth of incision to elevation 615 feet rather than the much lower bedrock elevation of 596 feet. This strategy also constrains storm driven export because the impoundment would maintain backwater conditions during higher flows. The dimensions of the notch are only large enough to convey approximately 2,000 cubic feet/second (cfs), which is large enough for approximately 90 percent of the summer and autumn discharge values. Larger flows would continue to produce backwater conditions behind the dam. Under the backwater conditions both slope and velocity would be reduced thereby limiting shear stress available to initiate sediment mobilization. Riggsbee et al. (2007) demonstrated that backwater conditions caused by a notch limited both sediment concentrations and overall loading during storm events in comparison to measurements collected after complete removal of the dam. The notch would concentrate flows on one side of the dam and would allow demolition to occur under drier conditions. The notch would also draw down the pool level enough for seeding to occur on approximately 20 acres of formerly submerged areas in an attempt to limit erosion and mobilization of fine grained sediment.

NAVIGATION

Demolition of Ballville Dam and the subsequent release of sediments would result in localized accumulation (aggradation) of sediment in the reach downstream from the dam. Prior studies of dam removal (Doyle et al. 2005, Major et al. 2012) have documented the formation of a “sediment wedge.” Currently available scientific methods do not allow for accurate predictions regarding the initial location of the sediment wedge or its size. Sediment transport modeling conducted by Stantec (2011) suggests that depths of sediment aggradation would vary spatially. The results of the 1-dimensional sediment transport analysis indicate that the maximum height of aggraded sediment would be approximately 2.5 ft in the reach of the river confined by levees

through Fremont; however, typical depths of sediment would be less than 1 ft. Note that this analysis did not include evaluation of localized aggradation, which could result in greater reductions in depth. The maximum sediment aggradation depths were calculated during summer low flows; the stream power generated by the river through the leveed section even during small flood events (i.e. the 5- or 10-year flow) is sufficient to transport enough volume of sediment to bring the channel back to pre-dam breach conditions.

Regardless of the sediment wedge's initial size and position, it would be expected to degrade over time as it migrates downstream and as sediment is redistributed over a larger area with each successive high flow event. The rate of wedge migration and sediment dispersal are dependent upon the flow regime over a period of years following removal of the dam. If the dam removal is followed by a succession of large flow events, the rate of wedge migration and sediment redistribution would be more rapid. If flows are small, channel would likely respond less quickly. The sediment wedge that formed following removal of Marmot Dam was still present after two years and contained approximately 25 percent of the total volume of sediment eroded from the reservoir (Major et al. 2012).

The Marmot Dam example differs from the Proposed Action in several significant ways. First, a substantial fraction of the sediment stored behind Marmot Dam was comprised of gravel and larger sized sediments. These coarse grained sediments were deposited in the sediment wedge whereas sand and smaller-sized particles were transported beyond the wedge and broadly dispersed further downstream (Major et al. 2012). Gradation analysis on bulk samples of seven vibracores collected from the Ballville Dam impoundment showed that over 90 percent of the material stored behind the dam was comprised of silt and clay (AECOM 2010). These particles have very low entrainment thresholds and would mobilize more readily than the sediments that formed the wedge associated with the Marmot Dam removal. Second, Marmot Dam was breached in a single event and 89 percent of the total sediment transport occurred in the first winter after demolition (Major et al. 2012). Ballville Dam would be demolished in phases over a 14 month period. This approach was designed to result in the release of smaller volumes of sediment over a longer time frame (not one event). This is expected to minimize the size of the sediment wedge and the magnitude of suspended sediment associated with any given storm event (see Riggsbee et al. 2007).

The sediment wedge would not be expected to form immediately below the dam due to the small grain size of the sediment stored in the pool as well as the relatively steep gradient of the river reach between the dam and the U.S. Army Corps of Engineers (USACE) flood control project. Some sediment may deposit in the levee section during low flows, however, the absence of a floodplain (due to the levee confinement) greatly increases near bed shear stresses and stream power during high flows. Consequently, high flow sediment transport capacity would be expected to be very high in this part of the Sandusky River. The reach of the river near Brady's Island is potentially susceptible to sediment aggradation, particularly the side channel on the eastern end of the island. Therefore some short-term impacts to motorized watercraft navigation may occur there and elsewhere in the lower river. However, the effect of

the sediment wedge diminishes with distance from the dam due to: (1) the dispersal of sediment over a larger area; (2) deposition of sediments on bars, islands, and floodplains; and (3) the export of the smallest particles to Lake Erie.

Impacts to navigation in the Sandusky River, Muddy Bay, and Sandusky Bay may be placed in perspective by comparing the sediment volume stored by Ballville Dam to the total surface area available for deposition. If it is assumed that 470,400 cubic yards (CY) would be exported following dam removal (consistent with Major et al. 2012) and that sediment would deposit on less than ¼ of the surface area available, then the depth of deposition would be approximately 3/8 of an inch. Even if the entire volume stored by the reservoir was mobilized, the depth of deposition would be only 2/3 of inch. Consequently, it is unlikely that Ballville Dam removal would cause long term impacts to navigation. It is also important to recognize that loading from removal of the dam would be small in comparison to loading from the Sandusky River watershed. It is currently estimated that 840,000 CY are stored in the impoundment. Between 1979 and 2002, the Sandusky River watershed delivered 8,828,000 CY yards of sediment to the USGS Gauge 0419800 located at Tindall Bridge. Approximately 867,000 CY were delivered by the watershed in a single year and 143,000 CY in a single day (Stantec 2011). The mean annual load is approximately 368,000 CY, nearly half the estimated volume of material currently stored in the impoundment (840,000 CY). While dam removal would certainly contribute sediment to the river, in most years loads would fall within the natural range of variation for the watershed.

FLOOD CONVEYANCE AND CAPACITY

The potential for sediments currently stored upstream of Ballville Dam to affect flood conveyance and capacity in the Sandusky River near Fremont was covered in greater detail by the Ballville Dam Removal Feasibility Study (Stantec 2011). The potential for increased flooding in Fremont was not identified as a critical issue because of (1) flood capacity associated with the freeboard of the levee system, and (2) the high sediment transport capacity of river during high flow events.

Sediment transport modeling was performed using hydrologic and sediment data from the USGS gage located upstream of the Ballville Dam at Tindall Bridge. The modeled scenarios included “wet” and “dry” years as well as “heavy” and “light” sediment loading. Results indicate that aggradation of sediment is likely to occur in downstream reaches, but that this aggradation would not result in increases of water surface elevations in excess of 1 ft through the leveed reach in Fremont. This is below the available freeboard within the levee system. To state in another way, if the “dry” condition occurs and the maximum aggradation is observed, the sediment would be flushed out of the leveed section on the rising limb of the flood hydrograph before the peak flow occurs. The most pronounced area of sediment aggradation appeared near the Highway 20 Bridge north of Fremont and resulted in a water surface elevation increase of less than 0.1 ft. Localized shoaling of sediment could occur depending on various factors including, but not limited to, the flow regime, river morphology, and flow obstructions.

WATER QUALITY

The magnitude and duration of water quality impacts resulting from dam removal depend on many factors including:

- the volume and composition of sediments stored upstream of the dam;
- river discharge at the time of the breach and in the months that follow;
- suspended solids and/or turbidity concentrations at the time of the breach;
- channel slope;
- basin area;
- time that has passed since demolition; and
- the distance from the dam location.

There have been other dam removals on the Sandusky River in Ohio. The St. John's Dam was a 151 feet long by 7.2 feet high dam located upstream of the Ballville Dam on the upper Sandusky River. This dam was breached in a two phase process. Phase 1 involved breaching the dam with a 13.1 by 3.3 feet notch (Granata et al. 2008). Phase 2 completely removed the dam. The dam stored approximately 250,000 CY of sediment comprised of sand and gravel. Notching of the dam occurred on March 18, 2003, on the falling limb of the hydrograph at a flow of 2,659 cfs. The increase in suspended solids resulting from construction activity was negligible in comparison to suspended solids loading from the watershed. Suspended solids concentrations prior to the notch were approximately 140 parts/million (ppm) and continued to decline for the duration of construction activities.

Complete demolition of St. Johns Dam occurred on November 17, 2003. Discharge during the demolition was approximately 71 cfs. Demolition of the dam produced a temporary flood wave that peaked at 1,166 cfs and attenuated within eight hours. Suspended sediment concentrations prior to demolition were approximately 20 ppm and increased sharply to 59 ppm but returned to pre-demolition levels in less than 24 hours. By June of the following year (2004), turbidity levels measured below the dam location were indistinguishable from turbidity levels measured upstream of the former dam. This was true for both moderate flow conditions (177 cfs) and storm events (1,413 cfs) that produced concentrations of approximately 60 Nephelometric Turbidity Units (NTU) and 130 NTU respectively. These results suggest that after only seven months, the delivery of sediment from the upper watershed overshadowed sediment delivered from the reservoir.

Marmot Dam on the Sandy River in Oregon was breached in a single event in October of 2007 (Major et al. 2012). Peak suspended sediment concentration during the breach was 49,055 ppm and turbidity approached 1,000 NTU. Suspended sediment concentrations in the months that followed were a function of discharge and dropped off quickly after storm events. Concentrations during storms following the breach often exceeded 10,000 ppm but concentrations during baseflow were generally less than 10 ppm. Turbidity measurements exhibited a similar pattern with storm events generating the highest concentrations (100 – 1,000 NTU) followed by extended periods of low concentrations during lower flows (0.1 – 10 NTU). By

December of 2007, less than three months after the demolition, suspended solids concentrations returned to levels that were similar to an upstream control station. The spatial extent of water quality impacts dissipated within six miles of the dam location, even in the months immediately following demolition.

Sethi et al. (2004) measured total suspended sediment concentrations upstream and downstream of a demolished dam on Koshkonong Creek in Wisconsin. They did not report stream discharge values for the dates when water quality samples were collected but based on the range of values it appears that most samples were collected during low flow periods because of the low concentrations observed (0.005 to 1.0 ppm). Concentrations differed significantly between the upstream and downstream sample locations, with downstream locations having the highest concentrations. Elevated concentrations were observed over 2.5 years after dam demolition. However, although concentrations differed in a statistical sense, it is unlikely that the observed differences were biologically meaningful because the overall low concentrations (e.g., 0.005 to 0.05 ppm) fell well below effect thresholds for most organisms (Newcombe and Jensen 1996).

The Lowell Mill Dam on the Little River in North Carolina was demolished over a period of approximately eight months. Demolition occurred in three phases. First was removal of the flashboards controlling the pool elevation; eight months later the dam was breached to grade; and within two weeks of the initial breach, the dam was completely demolished (Riggsbee et al. 2007). The maximum observed suspended sediment concentration (approximately 70 ppm) occurred as a result of the first big storm event following complete removal of the dam. The maximum concentration observed at an upstream sample point was approximately 30 ppm for the same sample period. Although concentrations at the upstream and downstream sample locations differed during storm generated high flow periods they rapidly approached unity on the receding limb of the hydrograph after only two to three days. Riggsbee et al. (2007) also concluded that elevated total suspended solids loads dissipated less than 6.2 miles from the dam location and were indistinguishable from upstream loads.

In all of the examples above, suspended sediment concentrations were naturally high during storm events and dam removal caused additional incremental increases in concentrations. Concentrations remained high for the duration of the storm event and in the days after as the hydrograph receded to base flow levels. High concentrations dissipated with increased distance from the dam and were similar to upstream values within approximately six miles of the demolition site. Concentrations during base flows were low and equaled or approached concentrations observed prior to demolition. With the exception of Marmot Dam, observed concentrations generally fell below effect thresholds for aquatic biota (see following sections). The Proposed Action, like the Lowell Mill Dam and the St. Johns Dam, would employ the use of a notch to control concentrations in the early stages of dam removal. The Proposed Action would also re-seed approximately 20 acres of exposed sediment upstream of the dam with the intent to stabilize as much sediment in place as possible. Demolition for the Proposed Action would be sequenced to occur in the fall, just before the onset of the wet season. The timing of

construction is important because it would avoid making releases during the low flow summer months when water quality impacts would be the greatest and when the river has the least capacity to move sediment. Ballville Dam is fairly large and the Phase 2 demolition would require several days, perhaps weeks. This approach differs significantly from the Marmot Dam where the breach occurred almost instantaneously. The slower approach for lowering the base levels should help to keep suspended sediment concentrations low in comparison to Marmot Dam.

AQUATIC BIOTA

FRESHWATER MUSSELS

Stantec (2012a) surveyed the Sandusky River between the Ballville Dam (RM 18.0) and the Hayes Avenue Bridge (RM 16.0) in September 2011. Seventy-nine live animals, comprising 13 species were observed. No Federally listed taxa were found, however, one live three-horned wartyback (*Obliquaria reflexa*), an Ohio threatened species, was observed as were 23 deertoe (*Truncilla truncata*), an Ohio Species of Concern. Freshwater mussels may be adversely impacted by one of four mechanisms: (1) direct impacts from construction and/or the operation of heavy equipment; (2) stranding caused by stage changes resulting from demolition of the dam; (3) scour and mobilization of bed substrates resulting from increased stream power after demolition of the dam; and (4) increased sediment load to downstream reaches. Impacts from construction would be avoided by limiting construction to areas near the dam. The exposed bedrock in the area immediately below the dam provides very poor habitat and no live mussels were found during 2011 surveys. Impacts from the pool drawdown and headward channel incision would be minimized by capturing and relocating stranded freshwater mussels to locations outside of the drawdown area. Relocation of mussels would be consistent with agency approved study plans.

The Proposed Action would cause short-term, temporary increases in sediment load downstream of the current dam location. Potential effects to freshwater mussels include physiological stress from elevated suspended sediment concentrations and habitat changes resulting from increased sediment load. Increased sediment load in rivers is a frequently cited cause for widespread mussel population declines (e.g., Brim Box and Mossa 1999). However, some studies indicate that freshwater mussels can endure short term environmental stressors by closing their valves and entering a quiescent state (Sheldon and Walker 1989, Haag 2012). In a review of sediment focused literature, Haag (2012) concluded that increased sedimentation was a plausible explanation for some localized extirpations but that there was “an almost complete lack of direct evidence” linking sedimentation to enigmatic freshwater mussel declines.

Suspended sediment concentrations

The influence of suspended sediment concentrations on freshwater mussel distribution and abundance has been infrequently researched. Bucci et al. (2008) conducted laboratory experiments on freshwater mussel feeding at various suspended sediment concentrations.

They found that valve gape (an indication of feeding activity) for fat muckets (*Lampsilis siliquoidea*) during periods of low (<20 NTU) and high turbidity (20 – 75 NTU) did not differ significantly, whereas valve gape for the invasive Asiatic clam (*Corbicula fluminea*) did. The experimental concentrations did not reach levels sufficient to cause valve closure in the fat mucket. However, the test concentrations were higher than those observed during base flow for the three case studies where NTU values were reported (Granata et al. 2008, Sethi et al. 2004, Majors et al. 2012) suggesting that normal feeding for this species would not be impaired by the Proposed Action.

Beussink (2007) exposed fish, infested by larval mussels (glochidia), to high concentrations of suspended sediment ranging between 1,000 and 5,000 ppm for a 48 hour period. Increased sediment concentrations resulted in reduced gill attachment and metamorphosis rates. Sediment treatments equal to 5,000 ppm often, but not always, resulted in greater than 90 percent mortality for the glochidia. However, glochidial metamorphosis rates for lesser sediment concentrations ranging between 1,000 and 2,500 ppm were often statistically indistinguishable from experimental controls (0 ppm). The exact threshold for the lethal effect was not determined in this study but is likely higher than the maximum observed concentration in the Sandusky River (2,420 ppm) for the period between 1979 and 2002.

Burial

One plausible mechanism for adversely affecting freshwater mussels is burial by increased sediment load. Marking (1979) (as cited in Watters 1999) found that 50 percent of fat muckets and pocketbooks (*Lampsilis cardium*) could successfully extricate themselves when buried in sediment to a depth of nearly seven inches. A similar proportion of Wabash pigtoes (*Fusconaia flava*) self-extricated from a depth of only four inches, an indication of the differential abilities among species. Krueger et al. (2007) experimentally buried mussels under nearly 16 inches of sediment and observed between six and 13 percent mortality after 48 hours. The exact cause of mortality was not determined but was probably sediment anoxia. Sheldon and Walker (1989) studied two freshwater mussel species in a laboratory setting and found differential susceptibility to low oxygen concentrations between species that primarily occur in lentic (lake like) habitats and those that occur in lotic (flowing water) habitats. Species that rely on riffles, runs, and other habitats with fast flowing oxygenated water were less able to tolerate low oxygen concentrations.

Lewis and Reibel (1984) studied the burrowing behavior of three mussel species in liquefied mud, compacted clay, sand, and washed gravel. Animals placed on their side in liquefied mud had difficulty turning to an upright digging position but were able to burrow as a result of depressions caused by the weight of the animal and frequent expulsion of water from the siphons. Rates of burrowing in the remaining substrates varied by species and grain size with the burial depths the lowest in the coarsest substrates. Nonetheless, the mussels were able to bury in widely divergent substrate types, indicating a high degree of adaptability to the varied conditions that mussels inevitably encounter in natural settings. These results confirm the work

of Strayer (1981) and Hardison and Layzer (2001) among others documenting the flexible use of substrates by mussels.

Some burial and subsequent mortality of freshwater mussels in the low gradient reaches of the Sandusky River below the dam is probable, especially in areas susceptible to sediment aggradation. However, field and laboratory studies demonstrate that mussels can endure substantial deposition and in some cases levels that are greater than anticipated for the Proposed Action. It is also clear that mussels occur in a wide range of substrate size classes. Release of sediments from Ballville Dam would likely cause temporary reduction in sediment grain sizes in the reach downstream of the dam. If the extent of deposition is modest, then resident animals should be able to adapt to the changing conditions.

Response to Dam Removal

Few studies have directly examined the impact of dam removal on downstream mussel populations. Sethi et al. (2004) studied the response of a rapid dam breach on habitat and mussels in Koshkonong Creek in Wisconsin. Unfortunately, the experimental design did not include a control site so the results are difficult to interpret. The authors found that the total area of substrates comprised of silt and sand increased significantly over pre-project levels. This effect did not occur immediately but was observed nearly three years after the dam removal. Total mussel density did not differ from pre-project levels three months after the dam breach but was significantly lower in the third summer after removal. However, because of issues with the experimental design it is difficult to discern whether this decline was related to the dam removal, to natural population variability, or to factors related to search efficiency (e.g., river discharge, visibility, etc.).

More recently Heise et al. (2013) studied the effect of dam removal on mussel populations in the Deep River in North Carolina. This project differed from the one described in Sethi et al. (2004) in several ways. First, drainage area for the study site on the Deep River was an order of magnitude larger, the dam stored little sediment, and the drawdown occurred over weeks rather than hours. The authors observed short-term increases in fine-grained substrates in the year following the dam removal but sample locations returned to pre-project values in the second year of sampling. None of the mussel community metrics studied, including mussel density and species richness, detected significant effects from the dam removal.

Because of the emphasis on sediment control measures proposed for the Ballville Dam Project, it is anticipated that effects to downstream mussel populations, if any, would be short-term. Further, any adverse impacts would be offset by restored riverine habitat, elimination of a migratory barrier for fish (host) movement, and increased genetic exchange between isolated upstream and downstream populations. Further, both phases of demolition would be scheduled for the fall when stream temperatures are low and metabolic demand by mussels would also be low (Myers-Kinzie 1998) thereby minimizing the potential for physiological stress and mortality.

FISH

Potential adverse impacts of the Proposed Action for the Ballville Dam Project to fish include:

- physiological stress from increased suspended solids concentrations;
- feeding impairment;
- reduced reproductive success; and
- changes to structural habitat quality and composition from sediment deposition.

Physiological stress

Hesse and Newcomb (1982) studied the impact of flushing (sluicing) reservoir sediments on water quality and fish populations in the Niobrara River in Nebraska. In October 1976 reservoir flushing increased suspended sediment concentrations in the river. Turbidity was measured at 3,750 Jackson Turbidity Unit[2] (JTU), total suspended solids measured 21,875 ppm, and a fish kill was documented. Low dissolved oxygen concentrations were also implicated as a contributing factor in the fish kill. Subsequent monitoring between June and September of 1979 measured turbidity as high as 2,075 JTU and total suspended solids as high as 14,540 ppm without a fish kill. The maximum observed concentration in the Sandusky River between 1979 and 2002 was 2,420 ppm, far lower than concentrations described above. Further, the reservoir flushing on the Niobrara River produced concentrations six times higher than those observed on the Sandusky River without a fish kill. Hydraulic modeling suggests that concentrations for the Ballville Dam Proposed Action would be expected to range between 50 and 500 ppm (Stantec 2011), therefore lethal effects to fish from physiological stress are not expected.

The demolition schedule for the Proposed Action has been designed such that sediment releases would occur during the cooler months of the year when the metabolic demand of aquatic organisms is low and oxygen saturation in the water would be high. This would assist in minimizing any respiratory distress that might occur from elevated suspended solids concentrations. Also, many aquatic insects, amphibians, and other organisms would be entering periods of dormancy (e.g., pupation, aestivation, etc.) during the cooler months of the year.

Feeding Impairment

The potential for feeding impairment resulting from release of Ballville Dam sediments depends on the (1) physiological capabilities and the lifestage of the organism under consideration and (2) the ambient concentrations delivered by the proposed project. Some organisms prosper under elevated suspended sediment concentrations. For example, Walleye have a special layer in the retina that is extremely sensitive to light thereby enabling adult Walleye to forage for prey in dark and/or turbid environments that cannot be exploited by competitors (Kerr et al. 1997, Hartman 2009). However, there are limits to this ability. In a review of available literature, Kerr et al. (1997) concluded that Walleye foraging could be impaired at suspended sediment concentrations ranging between 200 and 300 ppm. Further, not all lifestages are equal and

[2] JTU and NTU are essentially the same measure of turbidity, however, differing in measurement methods.

younger fish are widely viewed as being more susceptible to stressors than adult fish. Walleye and Yellow Perch were reared as fingerlings for 28 days under a clear water and turbid treatment (>= 100 NTU) (Clayton and Morris 2009). Yellow Perch exhibited greater survival (79 +- 2.1%) under the turbid treatment than in clear water (54 +- 9.2%). Walleye survived better in clear water treatment (83 +- 2.0%) than in the turbid treatment (57 +- 6.0%). Mion et al. (1998) demonstrated reduced larval Walleye survival in the Maumee and Sandusky River associated with high river and sediment discharge.

Sensitivity to suspended solids also varies between species. For example, Walleye and Smallmouth Bass are classified as moderately tolerant to turbidity while other species that may be present in the project area, such as Silver Redhorse (*Moxostoma anisurum*) and Shorthead Redhorse (*Moxostoma macrolepidotum*) are intolerant of prolonged high turbidity (Trebitz et al. 2007). Unfortunately we were unable to obtain any studies characterizing suspended sediment thresholds for intolerant non-game species. Others, such as the Common Carp (*Cyprinus carpio*), Yellow Perch, Gizzard Shad (*Dorosoma cepedianum*; Gonzalez et al. 2010), apparently thrive on elevated suspended sediment concentrations and are often found in waters where average low flow turbidities exceed 100 NTU.

Prior studies of suspended sediment concentrations and dam removals indicate that concentrations may initially be high during the breaching of the dam but that concentrations quickly decline to approach background concentrations. Other periods of elevated concentrations occur associated with storm events and high flows. Thus impacts to water quality will consist of a series of punctuated periods of elevated concentrations that may occur over a period of one to three years (Sethi 2004, Riggsbee et al. 2007, and Major et al. 2012). Fish communities evolved to tolerate increased concentrations for short periods. Since anticipated concentrations from releases would be within the range of natural variability, any adverse effects of increased suspended sediments are expected to be temporary and short-term.

Reduced reproductive success

Reproductive success may be adversely affected by the Proposed Action through (1) burial of eggs from increased sediment loads, (2) increased suspended sediment concentrations that interfere with egg metabolism, and (3) increased suspended sediment concentrations that interfere with fish behavior. Comprehensive egg burial studies exist for salmonids and some estuarine species (see Newcombe and Jensen 1996) but are lacking for species known to occur in the project area. Jennings et al. (2010) examined incubating Robust Redhorse (*Moxostoma robustum*) eggs in substrates in laboratory tanks with varying degrees of fine sediment (between zero and 75 %) to determine if there was a threshold of deposition that was harmful to egg survival. Mean intragravel dissolved oxygen concentrations were higher in the zero and 25 percent treatments (7.5 to 7.6 ppm) than the 50 and 75 percent treatments (6.3 to 7.5 ppm). Survival to emergence was highest in the treatment without fine sediment (35 to 80 %), declined rapidly for the 25 percent treatment (0 to 20 %), and was essentially zero in the highest

concentration treatments. While the Robust Redhorse does not occur in the project area, its behavior and habitat selection is similar to other extant redhorse species (e.g., Greater, River, Black).

Ambient water concentrations rather than substrate conditions are relevant to egg incubation and survival for species that deposit eggs on the surface of the stream bed or attach them to vegetation or other surfaces. Walleye eggs exposed to suspended sediment concentrations of 0, 100, 250, and 500 ppm showed no significant effects on survival (Suedel et al. 2012). In contrast, Gray et al. (2012) found that incubating Spotted Gar eggs had higher hatching success in clear water (94.8 % of eggs) versus experimentally manipulated turbid water (72.2 % at 5.5 NTU).

In addition to physiological effects, high suspended sediment concentrations may also affect reproductive behaviors. Sutherland (2007) exposed eggs of the crevice spawning minnow the Whitetail Shiner (*Cyprinella galactura*) to pulsed suspended sediments with concentrations of 0, 25, 50, 100, and 500 ppm. Spawning effort was affected at concentrations as low as 50 ppm and did not occur in four of the seven high concentration replicates. Based on the developmental state of the eggs it was also clear that reproduction was substantially delayed in the 100 and 500 ppm treatments.

Adverse impacts to reproduction will be avoided, to some degree, through the timing of the Proposed Action. Both the dam notch and complete dam demolition would occur in the fall, months before spring reproduction. Sediment released from construction activities and the subsequent winter storm events would occur at a time when eggs are not present in the Sandusky River. Sediment mobilized in spring storm events could possibly increase egg exposure to elevated sediment concentrations. The eggs of at least one species (Walleye) have demonstrated a fairly robust tolerance for elevated suspended solids concentrations and should not be affected by concentrations expected from the Proposed Action. Behavioral modification may be expected in some species as a result of high concentrations associated with storm events. However, storm generated concentrations are already high under the base line scenario and fish species in the project area and behavioral responses exhibited at present should not differ substantially from those expected with the Proposed Action. It is also important to recognize that impacts from the dam are temporary. Beneficial elements of the Proposed Action, such as increased fish passage, would be more permanent. Walleye, in particular, would benefit from an additional 22 miles of spawning habitat.

Changes to structural habitat quality

Major changes to structural habitat quality are not anticipated downstream of the dam. High gradient bedrock and cobble reaches, due to their high transport capacity, would experience little change in substrate composition or embeddedness as a result of the dam removal. Current Walleye spawning habitat should not be affected by sediment releases (Stantec 2011). In fact, these areas may be enhanced through restoration of coarse sediment supply from the upper watershed. It is unlikely that coarse sediments have passed below the dam in more than

100 years. Low-gradient reaches may experience aggradation associated with the sediment wedge described above. The spatial and temporal extent of this impact is currently unknown. However, adverse effects are expected to be short-term and temporary. Prior dam removal studies suggest that the duration of impact could be one to three years.

Restoration response

Although fish communities can be adversely impacted by increased turbidity after a dam removal, the impacts are temporary. Maloney et al. (2008) studied the impacts of a dam removal on the fish community in the Fox River in Illinois. Three years after the dam removal, the fish community shifted toward, but had not completely become, lotic. Former impoundments often lack instream structures (i.e. woody debris and boulders) and spawning habitat (coarser substrates, aquatic macrophytes) following dam removal. Kanehl et al. (1997) stated that it may take as long as five years for a former impoundment to show improvements in recovery following a dam removal. As impoundments revert to a free flowing state, additional restoration practices may be required to hasten the shift from a lentic to lotic habitat system (Maloney et al. 2008).

Studies of riverine impoundments typically document simplified fish communities as a result of poor habitat conditions (e.g., sediment anoxia, absence of spawning habitat, depressed macroinvertebrate production, and poor water quality; OEPA 2010a, OEPA 2010b). After the Woolen Mills Dam on the Milwaukee River in Wisconsin was removed, Smallmouth Bass increased in the stream reach due to the reintroduction of coarser sediments to the river (Kanehl et al. 1997; Nelson and Pajak 1990). Furthermore, more Smallmouth Bass spawning habitat became available following the dam removal (Staggs et al. 1995). Burroughs et al. (2010) examined the impacts of the removal of the Stronach Dam on the fish assemblage of the Pine River in Michigan. After the removal, eight fish species formerly restricted to areas downstream of the dam migrated to newly accessible areas upstream of the dam. Eighteen of the 25 species evaluated showed an increase in number after the removal, suggesting that dam removal may increase habitat availability for riverine fishes (Burroughs et al. 2010). Stantec (2012b) observed that the biomass of sensitive intolerant species, such as River Redhorse and Black Redhorse, increased by an order of magnitude only two years after removal of Englewood Dam on the Stillwater River in Ohio.

CONCLUSIONS

CHANNEL RESPONSE

- Demolition of Ballville Dam would instigate a series of channel adjustments that would export sediment currently stored in the impoundment to downstream reaches over 14 to 24 months.
- Most sediment export would occur within the first year following complete demolition of Ballville Dam but could take longer if the magnitude of seasonal storms is small and streamflows are insufficient to transport material.

NAVIGATION

- A sediment wedge is expected to form somewhere within the City of Fremont near the transition of the steep bedrock reach and the lower gradient part of the Sandusky River.
- Sediment transport models indicate that the maximum height of aggraded sediment would be approximately 2.5 ft in the leveed reach but that typical depths would be less than 1.0 ft.
- The effects of the sediment release would gradually diminish over time as sediment is mobilized and redistributed by storm events or would immediately be diminished if a larger storm occurs shortly after dam removal.
- Motorized watercraft navigation may be temporarily impaired while the channel adjustments progress.

FLOOD CONVEYANCE AND CAPACITY

- Hydraulic models suggest that sediment aggradation could cause a water surface elevation increase at flood flows of less than 0.1 ft.
- It is expected that the City will be protected from this increase because of (1) the flood capacity associated with the freeboard of the levee system, and (2) the high sediment transport capacity of river during high flow events.

WATER QUALITY

- Suspended sediment concentrations observed at other dam removal projects vary considerably depending on site specific conditions. In comparison to other projects reviewed, Ballville Dam:
    - Currently stores a higher volume and proportion of easily mobilized fine grained sediments.
    - Is located on a large river system with tremendous capacity to transport sediment.
- High suspended solids concentrations are largely produced by storm events and return to normal levels quickly with decreasing discharge.
- Measureable effects of dam removal activities dissipate within 6 – 12 miles of the dam.

AQUATIC BIOTA

- Fish, mussels, and other aquatic organisms are adapted to short-term elevated suspended solids concentrations
- Some aquatic community metrics (e.g., fish passage) recover quickly (weeks to months) from disturbances associated with dam removal while others (e.g., riparian vegetation) may require months to years to fully recover (Doyle et al. 2005)

DISCUSSION

Ballville Dam began to accumulate and store sediment from the Sandusky River watershed soon after its completion in 1912. It is currently believed to be in "equilibrium" and exports as much material as is received from the watershed. Approximately 840,000 CY of sediment are currently stored in the Ballville Dam Impoundment. Dredging and disposal of this material would be cost prohibitive with complete removal estimated at $45,000,000 (Stantec 2013). Demolition of Ballville Dam will release some proportion of the sediment to the lower part of the Sandusky River. While the general physical processes that cause sediment export from demolished dams are understood in a qualitative sense, there are no quantitative models that accurately predict total volumes to be exported, location of sediment deposits, and duration of impact. Fate and transport models can be useful, however, in helping to define the domain of the expected response and to understand the limits of extreme or worst case scenarios. Stantec (2011) modeled instantaneous transport of the entire volume of sediment in a single event. These models suggest that no more than 2.5 feet of sediment aggradation would occur in any single location and typical depths would be closer to 1.0 feet. Further, flood elevations would increase less than 0.1 feet. In reality, not all of the sediment would be exported from the impoundment nor would it happen in a single event. Instead sediment export would occur episodically in conjunction with storm generated steamflows over the course of several months or even years. The Proposed Action further seeks to minimize the impacts of sediment aggradation below Ballville Dam by 1) constraining the volume of sediment released in the first year by notching the dam, 2) spreading the timing of releases over a longer period to allow for redistribution of material released in year one during year two, 3) aggressive planting of exposed sediment flats to minimize the volume of material exported. In light of this information it is reasonable to conclude that adverse impacts to navigation and flood conveyance and capacity from the Proposed Action, if they occur at all, would be of limited magnitude and duration.

It is probable that demolition of Ballville Dam and the subsequent increase in sediment load would represent a disturbance to aquatic ecosystems and biota downstream of the dam. Due to uncertainties regarding the magnitude, duration, and rate of transport associated with the physical response of the river to increased sediment load, it is difficult to predict the ecological response. Based on our current understanding of the physical processes at work, the disturbances would be temporary and potentially within the current range of variation for this system. Nonetheless, many studies report declines in community metrics in the years following dam removal (e.g., Sethi 2004, Maloney et al. 2008) although notable exceptions exist (Heise et al. 2013). In either case evidence from longer term studies suggest that ecosystem components recover from the episodic disturbance caused by dam removal. Doyle et al. (2005) propose a conceptual model suggesting that some organisms and/or populations would likely recover quickly from dam removal (e.g., aquatic insects) while others would potentially require longer (e.g., riparian vegetation). This model is in general agreement with a wider body of literature on the topic of ecological recovery from anthropogenic disturbances. Borja et al. (2010) reviewed over 50 case studies of the recovery of estuarine and coastal ecosystems from various types of environmental degradation including oil spills, disposal of sewage sludge and

mine tailings, land reclamation, and long term wastewater discharges. An important conclusion from this work was that some reduction of the stressor or disturbance agent was necessary for recovery to begin but the reduction need not be complete for some recovery to progress. In the case of Ballville Dam, the primary stressor is the export of sediment currently stored in the impoundment to downstream reaches. As described in prior sections of this document, sediment deposits will degrade and redistribute over time. Although there are few comprehensive studies available on this topic, those that are available suggest that this happens quickly over the course of a few years. After only two years, the sediment wedge below the former Marmot Dam site contained only 25 percent of the original stored volume.

Of course the Proposed Action must be considered not only in terms of potential adverse impacts but also in terms of potential benefits. Removal of the Ballville Dam is one of those rare restoration projects that would deliver ecological benefits at local, regional, and international scales. At the local level, elimination of artificially-created lacustrine habitat associated with the dam impoundment will benefit the riverine ecosystem and continuity of aquatic habitat. Improvements to the structural and functional elements of aquatic habitat in the impounded reach of the Sandusky River will yield substantial improvements to Aquatic Life Uses. At the regional scale, an additional 22 miles of the Sandusky River will be opened to migratory fish species including Walleye, White Bass, and the State-threatened Greater Redhorse. Riverine walleye populations in the Sandusky system are currently constrained by access to approximately 20 acres of spawning habitat. Access to the upper river will increase available spawning habitat to approximately 300 acres. The supply of coarse-grained sediments may also be restored to sediment starved reaches downstream of the dam potentially replenishing critical but diminishing spawning habitats. Increased reproductive success at the regional scale will yield benefits far beyond the project site as people throughout Lake Erie from the United States and Canada will be able to catch fish that originated in the Sandusky River. In contrast to the wide spread and long lasting benefits derived from the Proposed Action, adverse impacts are expected to be short term and temporary.

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Ballville Dam Project

Final Environmental Impact Statement:

Appendix B – Public Comments

1 – Comments Received During Project Scoping

Ballville Dam Project EIS Scoping Comment Summary

Comment	From	Date	Comment Summary	Final EIS Suggested Sections Relating to Comments
1	Robert Morrison	10/28/2011	•Suggests modifying the existing dam to work as an Ice Control as a possibly cheaper alternative than removal and building Ice Control •Suggests raising the sluice gates and keep gates open to help inform the study	See Section 2.3.5 and Appendix A
2	Sheila Rohm	10/28/2011	•Dam is an important component of the community and is the new natural state, unclear why removal is being proposed	See Sections 4.6, 4.8, 4.9, 4.13, 5.6, 5.8, 5.9, 5.13, 5.14, and Appendix D
3	Bradford Child	11/1/2011	•Concerned about the amount of sediment that would be released if the dam is removed and asked question about the possibility of removing the sediment prior to removal •Suggests the value to the local community to keep the dam to produce hydroelectric power	See Sections 2.3.3, 4.1, 4.2, 5.1, 5.2, 5.14, and Appendix A
4	David Mosser	11/4/2011	•In favor of dam removal relating specifically to an interest in improving water quality and fishing	See Sections 1.3.3, 1.3.4, 4.2, 4.3, 4.4, 4.6, 4.9, 5.2, 5.3, 5.4, 5.6, 5.9, 5.14.3, Appendix A, and Appendix E
5	Randy Rohm	11/17/2011	•Dam is not a safety hazard, needs routine repair • Siltation estimate of 680,000 cubic yards is flawed •Sedimentation effects on Lake Erie and Walleye habitat would create an overall negative impact •*Migrating Walleye would likely be unable to move through the area after Removal* •Impounded condition has existed for about 150 years, wouldn't dam removal cause catastrophic collapse of new ecosystem? •Potential for unknown negative impacts of dam removal due to scale of project • Repair and repurpose the Dam for silt collection, to impede sediment movements downstream • Suggests waiting for the results of a Hydroelectric power study on the dam before action •Suggestion that this is a special interest project	See Sections 1.3.3, 1.3.4, 1.5, 1.6, 2.3.3, 2.3.4, 2.3.5, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 5.14, and Appendix A
6	Brent Borden	11/18/2011	•Dam should be preserved and used for hydroelectric power, as well as provides beautiful view	See Sections 2.3.3, 2.3.4, 2.3.5, 4.6, 4.8, 4.9, 4.13, 5.6, 5.8, 5.9, 5.13,

			•Concerned about vandalism, littering, and trespassing •Higher risk of floods	5.14, Appendix A, and Appendix D
7	James E. Evans	11/18/2011	•Endorse the removal of the dam •Three modifications to present the Feasibility Study plans include; 1) remove the dam during high flow conditions in the late fall; 2) install a series of "wing dams" in the former impoundment to stabilize sediments; and 3) to complete natural river restoration do not remove trees along stream banks, but let nature take its course	See Sections 3.1.1, 3.1.4, 4.1, 4.2, 5.1, 5.2, 5.14, and Appendix A
8	James R. Sherck	11/20/2011	•Inaccurate interpretation of Walleye information •Concerned about silt and its disposition if the dam were removed and its impacts • City water supply concerns if the dam is removed • Existing dam conditions •Safety concerns are being over stated • The dam should be used to generate hydroelectric power •Questions about wetland loss and ecological remediation in the impounded area if the dam is removed •Any reasons that favor removal are outweighed by those to keep it, there are irresolvable problems with removal	See Sections 1.3.3, 1.3.4, 2.3.3, 2.3.4, 2.3.5, 4.1, 4.2, 4.3, 4.13, 5.1, 5.2, 5.3, 5.13, 5.14, and Appendix A
9	Samuel Derr	11/21/2011	•In favor of dam removal to alleviate health and safety concerns and the continued cost of maintaining the dam with the reservoir completed	See Sections 1.3.2, 3.1.2, 4.2, 4.13, 5.2, 5.13, 5.14, and Appendix A
10	David Souder	11/21/2011	• Do not remove the dam, concerned about flooding and ice jam damage to local bridge structures • Could use the dam for hydroelectric power generation	See Sections 1.3.3, 2.3.1, 2.3.2, 2.3.3, 2.3.4, 2.3.5, 4.10, 4.13, 5.10, 5.13, and Appendix A
11	M Joe Michles	11/21/2011	• Does not want dam removed •Concerned about sediment disposition if removal occurs •Discusses pollution limiting Walleye as opposed to dam	See Sections 1.3.3, 1.3.4, 2.3.3, 2.3.4, 2.3.5, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 5.14, and Appendix A
12	Ballville Township Trustees	3/7/2012	•Would like the planned location for Ice Control Structure moved to the current dam location •Future maintenance of the structure would not be Ballville Township's responsibility, ownership and responsibility for this structure should be identified •Concerned about road damage from equipment	See Section 3.1.1, 3.1.4, 4.10, 5.10, and Appendix A
13	James R. Sherck	3/21/2012	•Concerns about the water reservoir storage capacity •Interested in remediation of endangered species in the vicinity of the project	See Section 1.3.3, 1.3.4, 4.3, 4.4, 5.3, 5.4, and Appendix A

Ballville Dam Project

Final Environmental Impact Statement:

Appendix B – Public Comments

2 – Draft Environmental Impact Statement Comments Received and Individual Responses

Appendix B2

DEIS Comments Received and Individual Responses

Comment Period January 24, 2014 – March 26th, 2014

On January 24, 2014, the U.S. Fish and Wildlife Service (Service) published a notice in the Federal Register stating the availability of the Draft Environmental Impact Statement (DEIS). This notice included information on how to obtain copies of and provide comments on these documents and information on the public meeting location and time. The public comment period for the abovementioned documents expired on March 26, 2014.

Service received comments through email at Brian_Elkington@fws.gov or at BallvilleDam@fws.gov and via hard copy comments mailed in to the Service Regional Office - Fisheries, 5600 American Boulevard W., Bloomington MN, 55437. This appendix includes all comments received and the responses to each.

Ballville-2014-01, Name: Streacker, G.
Comment:
Since growing up in Ballville Twonship and living on River Drive (first street south of the Sandusky River after crossing the Ballville bridge) since 1971, moving away to western Sandusky County in 1991 and then moving back to River Drive in 1998 (bought a house across the street from where currently my mom and dad still live) and growing up with two other brothers and when we were kids, the bus stop at times had 15 + kids lined up waiting to board the bus. (You knew when you got off the bus after school, there was going to be a football game, basketball game, baseball game or digging forts in the ground up by the dam in the woods just south of the dam (now currently owned by the Michaels) – catching some white bass, catfish and the occasionally walleye – we would start a campfire and have us some fish. Grabbing our inner tubes, jump off the base of the dam and floating down to the state street bridge (Chuckie Solander would pick us up in his pickup and we would do it again – best part was behind what is now the haunted hydro – good fast rapids) (where were our parents ???!!!!)

Moving forward to 2014, found memories are still there, but times have changed. TAKE HER (the Ballville Dam) DOWN. ARCADIS group is wrong – it is not structural safe and hasn't been for the last 20 years. On the south side upper portion of the dam, I have personally witnessed water coming thru the concrete wall when the water level gets high (when you can lay down on your belly and touch the water flowing over the dam with your finger tips-been there done that). At sometime in the near future water will get between the concrete crack, freeze and lift it off. Across the bottom of the dam, there are pot holes forming and some are rather deep (I advise not fishing off the base of the dam). Don't tell me it is structural sound.

Kids hang out above the dam, they swim above the dam (note the rope hanging in the tree if you get up there), they do drugs, they have sex (yes you can find the left behind artifacts).

The fun part, I'm an avid outdoorsman, so yes fishing is on the top of my list. Tear the dam down and you have fish from here to the City of Tiffin, Ohio water works department. The best spawning ground is above the dam (County Road 201 area) good gravel sandy bottom all the way to Tiffin. I think some people are missing the point. I understand waterfront property (my brothers and I own some in Ontario, Canada and wouldn't trade it for the world) and the value it has on land ownership etc. The residents of Fremont are complaining about high water bills, high sewage bills etc. but the way to offset that is make more money – it eases the out of pocket expense. Tear the Dam down, wait a couple of years, (maybe stock the river with some more walleye) and bingo you will have fisherman standing shoulder to shoulder (not on private ground) – more fisherman means more fishing license sold, means more bait/tackle sold, means people from outside of Sandusky county will come and spend the night/week etc (I have met several people from out of town as far away as Cincinnati, Michigan etc. while fishing Walleye in the Sandusky River). People have to eat – so restaurants will capitalize..So what is the real economic impact - $1,000.00 a $1,000,000.00 Talked to Maumee bait and tackle – he'll tell

you. Fremont City council wants to grow Fremont ?? you have a river and water – people love water – use it !!!!

My younger brother should be chiming in as well, as he has a creek that runs thru his backyard, that empties into the Sandusky river above the dam. As the river begins to rise, it does not allow the creek water to flow out fast enough, thus flooding the creek and his backyard. His thoughts are, the faster the water flows out of the river, the faster the creek will flow – I believe this to be true.

I could go on and on – point is, it's time to move on – TEAR HER DOWN !!!

Response:
Thank you for your comments. For more information regarding the current status of the Ballville Dam structure, please see section 1.3.2 of the EIS. Additionally, you may want to refer to sections 5.6 of the EIS with further description and information of the expected impacts of each alternative on different elements of recreation in the area.

Ballville-2014-02, Name: Cunningham, J.
Comment:
The other night I attended the informational event on the removal of Ballville dam at Fremont and questioned Scott Peyton about the proposed ice control structure. I honestly don't see a need for this structure since we haven't had a flood here as a result of an ice jam since the late 50's. This is because of the flood wall built by the Corp of Engineers to protect structures built in the flood plain in Fremont. Scott pointed out where they intended to put this ICS at about 175 feet below the present dam site in an area they call the falls. Because of the grade in this area I believe most ice will just work its way around these structures and they will be of little use. Eventually that ice will start jamming up where it did before near Brad's Island because this is about where the bay level water begins and the stream flow slows down. So you have a traffic jam event with ice cakes here if the channel isn't free. When the wind blows hard from the northeast the bay water level will even raise south of the State Street bridge. I don't have a problem with the dam removal since you are trying to restore this river to it's original condition. The river was actually designated as scenic some time back. I can understand piers for bridges but a structure like this seems out of place in a scenic river. I think the flood wall already handles this perceived ice jam problem quite well.

The residents of the Fremont area have spent enough money on the sum total of the projects involved here and I honestly can't see why we need to spend more on something that probably won't work because of the physics involved with water. In summary I think the dam should be

removed and the ICS shelved.
Thank you for your time.

Response:
Thank you for your comments. A 2008 report from the U.S. Army Corps of Engineers (USACE) Cold Regions Research and Engineering Laboratory (CRREL) entitled, *Impact of the Ballville Dam on Ice Jams in Fremont, Ohio*, discusses ice jams in the Sandusky River in the vicinity of Ballville Dam (USACE 2008). As part of the feasibility of dam removal, the USACE CRREL Ice Engineering Group performed Ice and Hydraulic Analysis of the Dam Removal (2011a). The CRREL used the ice routine within Hydrologic Engineering Centers River Analysis System (HEC-RAS) to model current and dam-removed conditions. Twenty-eight ice jam events from 81 years of data were utilized to calibrate the model. The results indicate that the removal of the dam will have an impact on ice jam processes in the vicinity of Fremont. Winter flood levels would likely be increased in the downtown area as the ice previously collected by the dam would be added to jams that form north of the City. According to USACE CRREL(2011a), stages downtown rose as much as 10.5 feet and increased on average from 3.5 to 7.0 feet over the 81 years modelled in the analysis. The floodwalls were high enough to protect from the majority of flood events. The USACE CRREL (2011a) concluded that "Based on this analysis, the removal of Ballville Dam will likely increase flood levels in Fremont, due to larger available ice volumes no longer retained by the dam. An ICS structure is recommended to retain that larger ice volume." The ICS was designed based on the guidance of the USACE CRREL (2011a) and is based on the best science and engineering information available.

Please refer to Appendix A5 in the Final EIS for the Ice Control Structure Design Report.

It is also important to note that the Sandusky River is designated as a Scenic River and as such we have had ODNR as a Cooperating Agency for this project. Through the course of this project ODNR has reviewed and commented on the Proposed Action and Project Alternatives and has no objection to placement of the ICS.

Ballville-2014-03, Name: Burroughs, J.
Comment:
I have copied you on a recent letter that I sent to Fremont Mayor Ellis. I have lived at X in Fremont, which is above the dam a couple of miles, for almost 25 years now and previously lived in Shorewood Village on the river which is very near where the Ohio Turnpike bridge crosses the Sandusky River, north of Fremont. I also was a minor in Geology in college and learned much about rivers and their habits.

As I point out in my letter to the mayor, the river rarely freezes behind my house due to river currents—the dam is the only cause of water slowing down enough to freeze, and, without it, the water would not only continually flow instead of being held back, it would also end up shallower and narrower for the most part which would eliminate any real or perceived threat of ice jams or damage from ice in the area.

The last time there was any real ice problem in Fremont was in 1959, which I very well remember, and the flood wall was not in place at that time to deter the spread of ice downstream from the dam.

Those of us above the dam are in hopes the dam can be removed and that our river can go back to what it once was in its natural state. We realized we will still face the potential of flooding on our properties and we can and will live with that threat going forward.

Removal of the dam, however, would at least relieve a fair amount of the flooding upstream that causes problems for all of those who live anywhere near the river valley as far south as Crestline and Upper Sandusky. It's the right thing to do.

As to the potential of a water shortage; we are not asking for the river water intake to be removed, just the dam, and the river will still flow above the intake. The upstream reservoir at Kildeer Plains is still available to send water to us as need be; which was done at least once in the past when the flood gates at the dam were opened and couldn't be closed.

Thanks for your attention and please take a minute to read my letter to the mayor below.

I am looking out my back windows right now at a Sandusky River that has no ice on it and is flowing freely---today is January 6, 2014 and it has been extremely cold since mid-December. Right now it is below zero outside. My point is that the only ice that has formed on the river up to now is between Ballville dam and Tindall bridge—why? Because the dam retards the flow of water so that it CAN freeze. This would seem to lay to rest your concerns about ice jams and ice damage being a reason not to remove the dam—the dam itself is the biggest cause of ice forming on the river upstream from the dam. Without it the river would flow freely and flowing water does not freeze—witness the Detroit River as a fine example as well as the area under the Sandusky Bay Bridge which rarely freezes due to flowing water.

I would also ask what the city's plans would be if the dam were to be repaired. Would these repairs include making the flood gates, (aka sluice gates), functional again? From memory, the last time the gates were opened, we almost ran out of water because the gates wouldn't fully close and divers were sent down to fully close them. However, if the dam would have had functioning flood gates all these years we might not have the delta that has formed behind the dam which, as I understand it, was one major reason for considering a reservoir to begin with. Opening the flood gates allows sediment to flow through rather than gather into the delta we have today. I would also submit that any project that would purport to repair the dam

wouldn't fully repair it without addressing the flood gates—it's just not a fully functional dam without them!

It has been stated to me in the past that the flood gates only make a small difference in the water level above the dam when it floods—but that small difference might be a large difference in certain flooding situations to those of us located above the dam all the way to Crestline. Flood gates also help to alleviate pressure against the dam caused by flooding and ice jams, thereby extending the life of the dam.

That's my input as a long time, almost 40 years, owner of property on the Sandusky River. I know those that own property on the current pond behind the reservoir have campaigned long and hard to save the dam and I appreciate their concerns. But their deeds no more promise them a pond in their backyards than my deed promises my property will never flood; and they will still have a beautiful view of the river and they'll own more exposed property as a result—not to mention having one of the greatest white water rafting areas—potentially—in the country!

Response:

Thank you for your comments. A 2008 report from the U.S. Army Corps of Engineers (USACE) Cold Regions Research and Engineering Laboratory (CRREL) entitled, *Impact of the Ballville Dam on Ice Jams in Fremont, Ohio*, discusses ice jams in the Sandusky River in the vicinity of Ballville Dam (USACE 2008). As part of the feasibility of dam removal, the USACE CRREL Ice Engineering Group performed Ice and Hydraulic Analysis of the Dam Removal (2011a). The CRREL used the ice routine within Hydrologic Engineering Centers River Analysis System (HEC-RAS) to model current and dam-removed conditions. Twenty-eight ice jam events from 81 years of data were utilized to calibrate the model. The results indicate that the removal of the dam will have an impact on ice jam processes in the vicinity of Fremont. Winter flood levels would likely be increased in the downtown area as the ice previously collected by the dam would be added to jams that form north of the City. According to USACE CRREL(2011a), stages downtown rose as much as 10.5 feet and increased on average from 3.5 to 7.0 feet over the 81 years modelled in the analysis. The floodwalls were high enough to protect from the majority of flood events. The USACE CRREL (2011a) concluded that "Based on this analysis, the removal of Ballville Dam will likely increase flood levels in Fremont, due to larger available ice volumes no longer retained by the dam. An ICS structure is recommended to retain that larger ice volume." The ICS was designed based on the guidance of the USACE CRREL (2011a) and is based on the best science and engineering information available. Please refer to Appendix A5 in the EIS for the Ice Control Structure Design Report.

Regarding your questions and comments in relation to the operation of the sluice gates, these would be rehabilitated as needed and functional under the No Action or Fish Elevator Structure alternatives, along with having recurring operations to ensure continued functionality and safety. Please see section 3.1.2.1. Regarding the flood storage capacity of the Ballville Dam and

Impoundment please refer to the Flood Storage Capacity Memo in Appendix A3 for the capacity and functionality of Ballville Dam as a flood control structure.

Ballville-2014-04, Name: Rice, D.

Comment:

I, personally, feel we should not put any money into preserving the dam in Ballville (Fremont) unless it can be proven to be financially beneficial to the RESIDENTS. If that is not possible then I would like to see it removed.

Response:

Thank you for your comments.

Ballville-2014-05, Name: Mehling, M. and Mehling, A.

Comment:

My wife and I object! to the removal of the dam, we would like to see it updated and repaired, we feel the dam is a investment for the city, a good insurance,incase the reservoir ever fails, Besides the beauty of site sound and smells, of the water. What would we do if the reservoir liner ever leaks, gets contaminated/polluted we will need the dam for a back up. We would like to see the dam fixed. what will happen to the people down stream? thank you reading this and giving us some consideration.

Response:

Thank you for your comments.

For information on the water supply intake for the reservoir please see Section 4.13.2 *Existing Conditions*. "The bottom of the 60 inch intake pipe is located at 610.5 feet above mean sea level and 2.5 feet below the elevation of the existing bedrock river bottom. The surrounding apron is 25 feet long and declines 2.5 feet to direct water from the river to the intake pipe during low flow conditions". Based on these specifications, the new intake is expected to be able to supply water during low flows. Additionally, it is our understanding that the system has the capability to draw water from the river to be stored in the reservoir, but it can also draw water for immediate use, not placing it in the reservoir first. This capability may assist in regards to a possible future failure of the reservoir. However, we recommend contacting the City of Fremont directly regarding concerns about the life expectancy and disposition of the reservoir system.

Regarding the question about what will happen to people downstream, we assume your statement to be related to the release of sediment under the two dam removal alternatives. Please refer to section 5.1 of the EIS for detailed information of expected impacts.

Ballville-2014-06, Name: Slough, E.

Comment:

I have followed with great interest the lengthy process to remove the Baldville Dam, the creation of an alternative reservoir and ultimately the possiblity of reopening that section of the Sandusky river. I applaud those who are in support of the dam's removal. I've read through the most recent ESI report and my only question is what's the hold up? I thought the decision to drop the dam was set in stone? Wasn't an ESI report done way before they started digging the new reservoir? The only thing that concerns me for the city of Fremont is the ice issue and possible flooding. The report offers several options but doesn't layout what the alternative fixes could be if the river is re-opened. It is clear in the report that leaving the dam is not an option for ice control.

I am an avid boater (kayaker) and have paddled the upper stretches of the Sandusky river many times. The idea of being able to navigate this stretch is exciting. The prospect that there may be some small rapids unveiled after the river silts out is even more exciting. I also follow with great interest the walleye runs that happen each year on the Sandusky and Maumee Rivers. This is a unique opportutnity for sportsmen, economic development and expanding the spawing grounds for that wonderful fish. The Sandusky river is a breautiful, winding river through a fairly rural part of our region and expanding the opportunity to open up another 22 miles is exciting.

Myself and other boaters from the Toledo area are excited to see the dam come down. Many of us have followed a similar project on the Cuyahoga River where they demolished two dams this past fall and are looking forward to making the trip over to paddle this newly flowing section. It's exciting that we may be able to do the same with a river that is a closer drive.

Response:

Thank you for your comments. In response to your comment about ice and flooding, the method to address ice jams and potential flooding is described for each alternative in the EIS Chapter 3. A 2008 report from the U.S. Army Corps of Engineers (USACE) Cold Regions Research and Engineering Laboratory (CRREL) entitled, *Impact of the Ballville Dam on Ice Jams in Fremont, Ohio*, discusses ice jams in the Sandusky River in the vicinity of Ballville Dam (USACE 2008).

As part of the feasibility of dam removal, the USACE CRREL Ice Engineering Group performed Ice and Hydraulic Analysis of the Dam Removal (2011a). The CRREL used the ice routine within Hydrologic Engineering Centers River Analysis System (HEC-RAS) to model current and dam-removed conditions. The results indicate that the removal of the dam will have an impact on ice jam processes in the vicinity of Fremont. Winter flood levels would likely be increased in the downtown area as the ice previously collected by the dam would be added to jams that form north of the City. The ICS was designed based on the guidance of the USACE CRREL (2011a) and is based on the best science and engineering information available.

Under Alternative 1 No Action and Alternative 2 Rehabilitate Dam Install Fish Elevator Structure, the existing dam would continue to act in its current capacity in controlling ice flows. Under these two alternatives, no additional ice control is proposed.

Ballville-2014-07, Name: Streacker, B.

Comment:

Thank you for asking for public opinion regarding the removal of the Ballville Dam. The Dam area of the Sandusky River has long held a special place in my heart as I lived in its' back yard as a youth and spent countless hours exploring the area. That being said, I believe it is time to say goodbye to this structure. The reasons why are quite simple. I feel it is important to restore the river back to its original state. This will open areas up-river of the dam to more recreational opportunities to be enjoyed by many. I realize the folks who live between the dam and Tindall Bridge will have a "change in scenery" and I am sure these folks stand against the dam removal. They need to ask themselves, Is that stance for the greater good?

The folks against the dam removal need to understand that the greater good also includes generations who are not yet in the tax paying system. Throughout my school years my science teachers always said…….”Water Always Wins!” I have seen this proven true many times in my life and I'm sure you have too. This is a 100 year old dam holding back what? Water! Even if we repair the dam now, this water will one day win. Why wait & let our ancestors deal with this? It is in the best interest of the folks in this county to bear this responsibility now! I have many fond memories of the Ballville Dam. I would challenge others to do what I have done……..Check their emotions at the door & make the right decision for our areas economic future. Remove the dam now. Every year we wait will only add to the expense!

Response:

Thank you for your comments.

Ballville-2014-08, Name: Mosser, D.

Comment:

Having read through all 255 pages of "Ballville Dam DEIS" released Jan. 2014, I want to say that I still support removal of the Ballville Dam. I do have some concern about a couple of issues.

Will the citizens of Fremont, of which I am one, have to pay for wetland remediation? Is it clear, that the new water intake on S.River Rd. will be able to supply water at the new intake when the Ballville Dam impoundment is lowered? Those are my to major issues of concern.

The "Proposed Action" seems to be the least environmentally stressful option, but would be streched out over a longer time frame. I would also be open to "Alternative 3", which would have more short term environmental impact, but would be a shorter term disruption.

To make it clear, I fully support the removal of the Ballville Dam. I just want to make sure everything is taken into account first. We the citizens of Fremont, have already been through one financial disaster, with the exorbitant cost of building the reservoir.

As I stated in my first public comment email to you from 11/4/11, I have watched the Ballville Dam impoundment steadily deteriorate in water quality, having fished that area for many years. I am 61 years old now, and spent a good 50 years fishing what were "hot spots" that became "dead spots", because of poor water quality. Increased sedimentation,lower dissolved oxygen levels, and stagnant water conditions caused increased incidence of algal blooms during low flow, high heat conditions.

The algal bloom situation presented itself, in the early summer of 2013, in the new reservoir. The Ballville Dam impoundment was heavily laden with algae ready to bloom, it kind of had that "pea soup" appearance. Well, this was pumped into the new reservoir, and sure enough, a week or less later algae started blooming in the reservoir. Fremont Water employees, spent the rest of the summer and into the fall, spraying algaecide along the shoreline by boat, 2 to 3 times a week to keep it under control. It wasn't until it finally got cold enough, and the turnover occurred that it stopped.

I believe that with the Ballville Dam removed, this problem will be greatly reduced, due to the faster flow rates and reduced detention time at the water intake. I believe this is a water quality issue not only for the health of the Sandusky River itself, but also for those of us that consume water coming from the Sandusky River.

Response:

Thank you for your comments.

For information on wetland mitigation please see Section 5.2.2.3.4 *Wetlands*. Elements relating to specific requirements for wetland mitigation will be determined during the U.S. Army Corps of Engineers permitting process, any costs associated with that work will be determined at that

time and will include input by the City of Fremont in the development of their proposed mitigation plan.

For information on the water supply intake for the new reservoir please see Section 4.13.2 *Existing Conditions*. "The bottom of the 60 inch intake pipe is located at 610.5 feet above mean sea level and 2.5 feet below the elevation of the existing bedrock river bottom. The surrounding apron is 25 feet long and declines 2.5 feet to direct water from the river to the intake pipe during low flow conditions". Based on these specifications, the new intake is expected to be able to supply water during low flows.

Under the current regime, water is held behind dam and may create larger back water or eddy areas which may increase the frequency of algal blooms within the impoundment. We agree that the removal of the dam would reduce the possibility of algal blooms in the impoundment area, however it is important to note that there may also be naturally occurring algal species in the Sandusky River prone to blooms, unrelated to impoundment. It is likely that these algae are less likely to bloom in flowing water and therefore we anticipate a reduction in the amount of algal blooms in the current impoundment area if dam were removed due to the change in hydrologic regime. It is unclear what, if any impact dam removal in the river would have water quality in the upground impoundment as those alga may still be present and able to be drawn into the reservoir system.

Ballville-2014-09, Name: Eibling, A.
Comment:
I consider myself a stakeholder in this project for a variety of reasons that include being an heir to riverfront property on the Sandusky River, an avid enthusiast of multi species fishing and the diversity of fish species, and what I can best describe as near spiritual connection to the river that flows through the city of my youth, Tiffin, Ohio. It is my hope that the sheer volume of time that I have spent in and around the river, along with the aforementioned vested interest provide some amount of merit for consideration of my comments.

The exhaustingly comprehensive DEIS is very impressive in content and scope. Clearly the expertise and credentials of the individuals and agencies represented leave little to nothing to be gained by a simple enthusiast. I ask only to share an opinion and this opinion includes an end goal that I hope is the standard that all of the alternatives are measured against. This end goal is to return the Sandusky River to as close as possible to its historic flow. This would mean the removal of the Ballville Dam. It is somewhat trivial to me as to whether this would happen in a single season or multiple, whether devices were installed to deal with ice – or not, as long as it is

removed. As the dam no longer serves a useful purpose for generating power or as a municipal water supply, it eludes me as to why the goal would not be to let the river return to a more natural state. It is sad that our human manipulation has so profoundly messed up this river, that we have to worry about the repercussions of removing something that shouldn't have been there in the first place. At least we can agree that when it was built, it was necessary and those individuals were naïve to the environmental impact. This makes the dam's construction both understandable and excusable. Some 100 years later, this is not applicable and now we are responsible to take action. Clearly this action is to remove the dam.

While the impact of dams on fish populations throughout the Great Lakes is well documented, I also wanted to address the Ballville Dam as it relates to the Lake Sturgeon. I only recall one note regarding the Lake Sturgeon in the DEIS, and this seems like an oversight. For many people, the Lake Sturgeon is considered the Grand Matriarch of the Great Lakes and the single species worthy of being the 'litmus test' for the overall health of the entire Great Lakes. Archeological dig sites in Seneca County (this would be well upstream of the Ballville Dam) produced bones from Lake Sturgeon, indicating the species did in fact migrate this far up the river. With catches of Lake Sturgeon occurring in the Portage and Maumee Rivers in the 2000's, it is not absurd to think that the fish could still be present in the Sandusky River. Noting the life expectancy of a female Lake Sturgeon, it is feasible that a fish that came into existence above the Ballville Dam, could return to spawn exactly where it was imprinted over 100 years ago – if the dam were removed. Could fish be out there waiting to swim the river following a path set by their ancestors, or even a path they swam in their youth?! The thought of this is truly awe inspiring. Even if that specific scenario was determined to be ruled out by no existing remnant Sandusky River spawning sturgeon left , certainly the dam's removal could make a re-introduction plausible.

I implore, you and your agency, to do everything possible to see the removal of the Ballville Dam.

Response:

Thank you for your comments. Regarding your statement about Lake Sturgeon, historical documents reference that they were at one time present, as indicated by the Ohio Archaeological and Historical Publications, Volume XIII, 1904, Page 230 "M. Keeler, who came to Lower Sandusky in 1840, says that it is difficult to cross the river in a boat, in the spring season when the fish were going up. They filled the whole channel of water. He frequently saw three or four wagon loads of white bass taken out with one draw of the seine. The barrels of packed fish branded Dickinson, Birchard and Grant were to be found all through the east. Sturgeon weighing from seventy to a hundred pounds were common; cat fish and muscalonge from twenty to fifty pounds..." Although Lake Sturgeon is one possible species which could benefit from the Preferred Alternative or Alternative 3, it is unclear how long it may take for natural immigration

and reproduction to occur, or how successful the species would be given present conditions in the area.

Ballville-2014-10, Name: Keefe, J.
Comment:
As an avid sportsman, angler, and Lake Erie Charter Captain; I respectfully submit that I am **IN SUPPORT OF** the Ballville Dam removal project. With a declining fish population on Lake Erie we should do whatever we can to increase the potential for successful spawns. For obvious reasons, the 22 miles of prime habitat spawning grounds will have a positive impact on future fish stocks. In addition to helping the overall lake population of fish, this will also have a positive impact on the overall economy of the immediate area as more and more fisherman visit during spring spawning runs. In my mind, this only makes sense to procede as this has been in the works for so long it is a travesty. Had we have acted quickly to begin with, we certainly would have been enjoying the benefits already!

Response:
Thank you for your comments.

Ballville-2014-11, Name: Aiple, C.
Comment:
Let 'em in. We want to spend money in Fremont!

Response:
Thank you for your comments.

Ballville-2014-12, Name: Troup, C.
Comment:

As an avid sportsman, Ohio Taxpayer, and angler, I respectfully submit that I am **IN SUPPORT OF** the Ballville Dam removal project. With a declining fish population on Lake Erie we should do whatever we can to increase the potential for successful spawns. For obvious reasons, the 22 miles of prime habitat spawning grounds will have a positive impact on future fish stocks. In addition to helping the overall lake population of fish, this will also have a positive impact on the **overall economy** of the immediate area as more and more fisherman visit during spring spawning runs. In my mind, this only makes sense to proceed as this has been in the works for so long it is a travesty. Had we have acted quickly to begin with, we certainly would have been enjoying the benefits already!

Response:
Thank you for your comments.

Ballville-2014-13, Name: Coykendale, C.
Comment:
Please count me as one who thinks the Ballville Dam should be removed. It would benefit the walleye, which would benefit the walleye fishing, which would benefit the city of Fremont.

Response:
Thank you for your comments.

Ballville-2014-14, Name: Mason, B.
Comment:
After attending the Ballville Dam meeting and reading the DEIS and the overviews, I am totally on board with the proposed action. The other options are not even close. $8/10 million tax dollars saved, 22 miles of river reopened, 60 miles of river improved (long term). And the most significant historical landmark in our county restored which are the lower rapids on the Sandusky River. Fremont and Sandusky County can set an example for all watersheds running thru farmland. Maintain a filter strip right of way corridor thru the affected area. Also give tax abatement to the landowners for their reclaimed property (willing to help with the plan). I envision a flood every year in Fremont of fish, fishermen, canoe, kayaks and their dollars! Think wolf to Roger Young park. Heck lets make it all the way to the county line.

Response:
Thank you for your comments.

As described in sections 3.1.1 and 3.1.4 of the EIS, working with local land owners, the dam removal alternatives include seeding and vegetative strategies designed to control invasive plant colonization and help establish and promote restoration of the riparian area.

One option for land owners whose properties expand due to the dam removal and impoundment drawdown is for that newly exposed land to be placed into a conservation easement, which may provide some tax abatement. A special program of the nature you propose would have to be part of a local process and we would suggest contacting the City of Fremont Mayor's office to further explore this option.

Ballville-2014-15, Name: Rohm R.
Comment:
Having read the Draft Environmental Impact Study [DEIS] regarding the purposed removal of the Ballville Dam at its length, I am struck with the fact that there are numerous inconsistencies throughout the study. Conclusions are inconsistent with other studies made previous to this one.

It is wholly factitious to once again invoke the upstream spawning of Lake Erie Walleye as reason to remove the Ballville Dam. As ODNR's Division of Fish and Wildlife is fully aware, the lake walleye population is incapable of swimming upstream as this species is intolerant of large uphill stream transits even if a fish ladder were installed. Furthermore, during the spawning season in the Sandusky River, the Spring river runoff is at its seasonal highest. This would make the upstream transit for walleye impossible due to the fact they are not strong swimmers such as salmon. Walleye spawn in the spring during the elevated flow period. Walleye are relatively weak swimmers relegated to moderate or low current environments. That is why Walleye predominately spawn in lakes near reefs and bay environments. Low water flow rates and moderate to low turbidity levels are a requirement for creating an ideal spawning environment. The upstream environment of the Sandusky River cannot provide such an environment due to extreme elevation drops from Upper Sandusky, Ohio area down through Tiffin, Ohio area and from Tiffin to the Base of the Ballville Dam. Total fall is around 450 feet from the headwater area to the base of the Ballville Dam. Within the first two miles upstream from the Ballville Dam is an elevation rise of more than 50 feet. Walleye will never spawn above the Ballville Dam because they can't swim upstream against the flows presented. That is fact, which seems to be essentially denied in the recent DEIS study.

Denying the realities does not make the DEIS true. In fact it raises questions as to the validity of the entire study.

Response:

Thank you for your comments. Although walleye are characterized as relatively weak swimmers, Peake et al. (2000) (as well as McConville and Fossum 1981, Winterton 1975, Kerr et al. 1997) quantified walleye swimming speeds experimentally and determined that peak swimming speeds (which would indicate maximum laminar flow that a walleye could withstand in a river system) were measured at a 1.6-2.6 m/s range. These were values used in the EIS to explore the potential impact of the ICS on current velocity and walleye and other species migration through the area (pg 5-38). The analysis conducted in the EIS suggested that nearly half the time, modeled current velocities were well below the lower end of the range of maximum walleye swimming speed. Additionally, in the Sandusky River (at both Fremont and Tiffin), and other river systems in the Great Lakes that support walleye spawning populations, spring current velocities are higher than (or similar to) the Sandusky River. For example, in the Maumee River, maximum and mean spring current velocities are 27-80% higher than those observed in the Sandusky River at Fremont and Tiffin (http://waterdata.usgs.gov/usa/nwis/rt). The Maumee River currently supports a significant walleye spawning population. Additional rivers (including the Oswegatchie (NY) and Tittabawassee (MI)) have current velocities similar to those observed in the Sandusky River (Kerr et al. 1997). Analysis of flow velocities in these rivers during the spring (March-May) indicates that mean daily flow velocities never exceed the maximum swimming speed of walleye, and maximum daily flow velocities infrequently exceed maximum walleye swimming speeds (Peake et al. 2000). Given this information, there is little evidence to suggest that current velocity in these sections of the Sandusky River will impede upstream migration of walleye (or a host of other species that would benefit from the Proposed Action). As detailed in the EIS, walleye are highly migratory, capable of relatively large migrations, e.g. tagging data suggest some Lake Erie walleye migrate through the Detroit and St. Clair Rivers, high velocity rivers, to locations in southern Lake Huron (Belore et al. 2010).

In Lake Erie, and other Great Lakes, walleye as well as other migratory species make long spawning runs up tributaries to reproduce. Preigel (1970) documented walleye spawning migrations up to 240 km in the Winnebago-Fox-Wolf system of Wisconsin, while walleye from Saginaw Bay migrate long distances to spawn (88 km) in the Tittabawasse River, MI (Jude 1992). In Lake Erie, Maumee River walleye will migrate upriver as far as Grand Rapids, Ohio to reproduce, a distance of nearly 50 km. In addition to the Maumee River, in Lake Erie there currently are six existing tributary spawning stocks of walleye (Huron River, MI, Maumee River, Sandusky River, and Grand River, Ohio, Cattaraugus Creek, New York, and Grand River, Ontario). In addition, there are open-lake reef spawning stocks of walleye (primarily western basin reef complex). Some evidence suggests that these spawning populations are genetically predisposed to using tributary or open-lake spawning locations (Jennings et al. 1996). Therefore,

given the existing evidence of walleye reproduction in Lake Erie tributaries, there is no supporting evidence to suggest that walleye won't (and don't currently) utilize the Sandusky River and other Great Lakes tributaries for reproduction.

In addition, a host of other fish species would likely utilize additional habitat upstream of the Ballville Dam if it were accessible to them. With respect to walleye reproduction in other Great Lakes systems, in Lakes Huron, Superior, Michigan, and Ontario, multiple river spawning stocks exist. A summary of their location and status can be found in Colby et al. 1991 and Roseman et al. 2010. Lastly, work conducted by Plott (2000) suggested that walleye relocated above the Ballville Dam in 1997-1998 migrated upstream to suitable spawning habitat and effectively spawned.

Ballville-2014-16, Name: Collins, C.
Comment:
I am writing as concerned citizen to provide comments for the draft environmental impact statement (EIS) related to the Ballville Dam removal. I am concerned about population declines of aquatic biota, especially the bivalve species, and ecosystem health downstream of the dam. If a dam removal alternative is selected, the stored sediments behind the impoundment will transport sediment downstream, resulting in considerable impacts on the aquatic community. Although many of these potential issues are addressed in the current ESI, I believe several impacts were overlooked. I urge the Fish and Wildlife Service (Service) to consider the following EIS sections and issues in selecting the final alternative.

1. One procedural comment, the source "Major et al. 2012" is cited three times in EIS (pages 5-4; 5-14; 5-34) but the source is missing from the EIS literature cited.

2. Section 5.1.2.2 - If the dam were removed the sediment will create a blanket on the river bottom ranging from 3/8 inch to one foot deep downstream from the dam. The sediment can damage fish and mussel spawning grounds and cover leaf packs, a habitat and food resources for invertebrates, rendering them unusable. Suspended sediments can also cause damage to roots and stems of macrophytes through abrasions and scour algae and insects as they are unable to attach to silt covered substrate. Sediments can also fill interstitial spaces thus killing fish such as the Greater Redhorse (Ohio threatened and classified as "intolerant" to water quality degradation) and fragmenting sessile organism populations including the three-horn wartyback (Obliquaria reflexa; Ohio Threatened) and deertoe (Truncilla truncata; Ohio species of concern) as well as others.

3. Section 4.2.2.4.3 - The sediment contains seven metals above the threshold effect levels (TEL) and one metal, iron, above the exceeded probable effect level (PEL), moderate levels of Semi-Volatile Organic Compounds, breakdown products of dichlorodiphenyltrichloroethane (DDT), and Polyaromatic Hydrocarbons (PAH). The sediment will resuspend and transport downstream upon dam removal. In additional to potential adverse effects on the aquatic life, I personally would not feel comfortable swimming or consuming fish that was caught downriver. I am sure families within the area (who may have not read the EIS and are not aware of these contaminates) share similar concerns.

4. Section 4.3.2.2 - Macroinvertebrates were neglected in this EIS. There was no mention of (or lack of) macroinvertebrates in the field survey nor was there an analysis stating potential impacts on the macroinvertebrate community. Although, macroinvertebrates are not charismatic species and are not directly included in the Services' mission, they are vital to ecosystem health and upper trophic levels. Serve impacts to macroinvertebrates communities can indirectly and adversely affect migratory birds, endangered species, and other living treasures that the Service shall protect and conserve.

With these comments in mind, it is my position that the Service should employ a dam removal alternative. Increasing stream connectivity and improving upstream habitat outweighs potential, mostly temporary negative effects. However, adverse effects should be minimized when possible. Here I propose several minimizing solutions:

(1) Drain the reservoir in order to excavate the remaining sediment. This can be accomplished by creating a channel inland and diverting the flow of the river using earthen dams. The flow of the Sandusky River will circumnavigate the dam allowing for excavation work. Once the contaminated sediment and Ballvile Dam is removed, the earthen dam can be inundated thus allowing the flow to return to its natural channel. This method has been successfully implemented for similar dam removals in Oregon and Colorado. The issue associated with this alternative is that a portion of land will have to be altered to channel the river. This alternative will transport less sediment and less harmful contaminated sediment downstream but new concerns arrive regarding the transport and deposit of the contaminated sediments. Nevertheless, this alternative should be further researched and considered in order to adequately protect the downstream ecosystem.

(2) The Service should conduct population fragmentation modeling in order to predict how sediment transport will impact downstream species (including macroinvertebrates).

Although the transport of the sediment itself is difficult to model, modeling population fragmentation of a particular species or species can help in evaluating population consequences of increased sediment caused by a dam removal. In cases where increased sediment can result in serious population consequences for a species, a need for inexpensive methods of collecting and relocating the species may need to be created.

(3) The Service should permit, fund, or conduct pre and post dam removal research to evaluate how the habitat and its species were affected. With a scarcity of scientific studies of dam removals, quantitative research from this dam removal will provided data to model future dam removals. With aging dam infrastructures across the U.S., the decision to remove dams will be presented more frequently. Research from a Ballvile Dam removal can provide vital insight for future dam removals.

Thank you for your hard work in preparing this EIS and your consideration of these comments.

Response:

Thank you for your comments, please see below our detailed response by section outlined in your submission.

1. The full citation for Major et al. 2012 will be placed into the Literature Cited section of the DEIS and Final EIS.

2. For more information on the impacts of sediment transport to downstream reaches on various aquatic organisms of the Sandusky River please see Appendix A11, Stantec 2013 – Sediment Transport Memo. Section 5.1.2.2, also states "The maximum sediment aggradation depths were calculated during summer low flows; the stream power generated by the river through the leveed section even during small flood events (i.e. the 5- or 10-year flow), however, is sufficient based on our analysis to transport enough volume of sediment to bring the channel back to pre-dam breach conditions." It should be noted that the proposed action was designed to result in the release of smaller volumes of sediment over a longer time frame, as opposed to a single breach. This is intended to minimize the size of the sediment wedge released downstream and the magnitude of suspended sediment associated with any given storm event. Additionally, phased demolition would decrease the severity of the initial impact on plants and animals as compared to a single breach event. The timing of construction is also planned to avoid sensitive life history windows for key aquatic species. Sections 5.3.2.1 *Construction Effects*, 5.3.2.2 *Post-Construction Effects*, and 5.3.2.3 *Mitigation Measures* discuss the impact of the Proposed Action on fish and wildlife, Please refer to these sections for more information on expected impacts to fish and macroinvertebrates. Impacts resulting from the export of sediment are expected to be lesser magnitude (e.g. fish mortality is not expected) and temporary. The scientific literature supports the idea that ecosystems are resilient to disturbances (Borja et al. 2010) and recovery is expected within a few of years dependent on water flow conditions.

3. In response to this comment, substantial additional information has been added to the EIS. Please see EIS Section 4.2.2.4.4 Sediment Quality for a discussion on the Ballville Impoundment sediment contaminants and EIS Section 5.1.2.2 for a discussion of the impact of the sediment release on the downstream environment, fish, and macroinvertebrates.

Regarding fish consumption, the Sandusky River is currently under a fish consumption advisory. The 2014 Ohio Sport Fish Consumption Advisory Booklet states that the Sandusky River from State Route 598 (Middletown) to the mouth (Lake Erie) including Crawford, Seneca, Sandusky, and Wyandot Counties, has a fish consumption advisory of:

- Common Carp and Smallmouth Buffalo (PCB's),

- Channel Catfish 16 inches and greater, Rock Bass and Smallmouth Bass (Mercury).

These impairments are unrelated to the Ballville Project and the proposed release of sediment is not expected to impact the Sport Fish Consumption Advisory. There is not a skin contact advisory in effect for the lower Sandusky River. These standards are typically driven by bacteria counts in the waterbody and the export of sediment from the impoundment is not expected to affect contact advisories.

4. Previous studies on the effects of dam removals on macroinvertebrates suggest that downstream macroinvertebrate assemblages may experience a temporary reduction in abundance after the sediment from a dam is released (Crosa et al. 2010), however communities have been known to recover in a relatively short amount of time (3 months to 2 years (Crosa et al. 2010; Maloney et al. 2008)). Additionally a lotic assemblage of macroinvertebrates can replace a lentic assemblage in former impoundments within one to two years (Stanley et al. 2002; Maloney et al. 2008), resulting in a net improvement to aquatic life use in the formerly impounded area. Sections 5.3.2.1 and 5.3.2.2 describe the anticipated impact on benthic macroinvertebrates. Additionally Section 5.3.2.3 describes that freshwater mussels that are exposed during the drawdown of the impoundment will be collected and relocated to suitable habitat upstream of the dam as a mitigation measure to reduce potential impacts to populations that occur within the project area.

Minimizing Solutions Response:

(1) The option of dredging the impoundment was discussed in a memo titled "Opinion of probable cost for dredging the Ballville Dam Impoundment," written by Stantec (2014) (Appendix A2). A cost table was created for a partial dredge option (200,000 cubic yards (CY) of sediment) and a full dredge option (800,000 CY). The probable cost including the hydraulic dredge, dewatering with geotextile, loading, hauling, and disposal is $26,153,895.00 for 200,000 CY, and $93,426,236.00 for 800,000 CY. In light of these costs, and the opinion of sediment quality by Evans and Gottgens (2007) as described in the EIS Section 4.2.2.4.4, it was determined that dredging the impoundment was neither necessary nor economically feasible. We have added an Alternative to EIS Section 2.3.7 to describe this concept and why it was not selected for further analysis.

(2) There are several studies that discuss the impact of dam removals on macroinvertebrates, see the discussion above on macroinvertebrates. Also, Sections 5.3.2.1 and 5.3.2.2and Appendix

A11 Stantec 2013 – Sediment Transport Memo discuss the impact of dam removal on fish and freshwater mussels, citing several published studies on ecological impacts and recovery rates of various aquatic species after dam removal. Additionally Section 5.3.2.3 describes that freshwater mussels that are exposed during the drawdown of the impoundment will be collected and relocated to suitable habitat upstream of the dam as a mitigation measure to reduce potential impacts to populations that occur within the project area.

(3) Project monitoring is an important component of this work. We are working with a cooperating agency on the project, the Ohio Department of Natural Resources, to ensure a pre- and post-project monitoring plan is in place for aquatic populations utilizing the lower Sandusky river relating to the Proposed Alternative. Pre-project monitoring characterizing the current fish community in the area around the Ballville Dam, and to quantify migratory fish abundance has been completed (OEPA 2011a; Ross 2013). Pre-construction mussel surveys were conducted in portions of the project area (Stantec 2011a; Enviroscience 2010), to document species diversity. Fish assessment surveys will be completed periodically into the future to quantify potential responses in the fish community. Mussel relocation surveys and post-relocation monitoring will be conducted to document the impact of the project on mussels moved from the impoundment area. More information on monitoring has been added to the EIS Section 5.3.2.3.

Ballville-2014-17, Name: Hunter, D.

Comment:

The Ballville Dam needs to be removed A.S.A.P. for the good of the community.

Response:

Thank you for your comments.

Ballville-2014-18, Name: Sherck, J.

Comment:

RELEASE OF SEDIMENT FROM THE IMPOUNDMENT AREA

In general the Ballville Dam has been collecting river sediment for over 100 years to the point that 15 years ago the Committee to Save the Ballville Dam, a local citizen's group, estimated that 3 M Cubic Yards of sediment was contained in the impoundment area. In 2002, the Evans study estimated 1.3 M Cubic Yards of silt was contained in the impoundment area. In 2011, SANTEC reduced that amount to an estimated 850,000 cubic yards of mobile silt, by excluding the "new island" of silt that formed during the 1988 drought, which supposedly figured into the Evans

estimate. These are all estimates. Do we really know what the true amount of the sediment is and how much will be released?

A) What effect, direct or indirect, will the sediment release have on the harmful alga blooms in the lower portion of the Sandusky River, Sandusky Bay, and Lake Erie?

The 2010 Great Lakes Restoration Initiative's Action Plan lists as its most urgent issue the cleaning up of toxics (combating invasive species was second to this goal). The explosion of various types of cyanobacteria in recent years has caused shocking and deadly "Harmful Alga Blooms" in Lake Erie. One needs only to look at the aerial photos taken of Lake Erie in the Fall of 2011 to see virtually the entire Western Basin of the Lake covered in the harmful alga bloom, spewing out of Maumee Bay and followed close behind by that flowing out of Sandusky Bay. Lake Erie is fighting for its very life, during these periods of massive and deadly blooms.

The sediment contained in the impoundment area is not the normal seasonal farmland runoff. To a large extent, it is highly compacted phosphorus and nitrogen. Witnesses to the creation of the impoundment area's "new island" during the 1988 drought were shocked to see tree growth 30 feet high within five years of the island's birth.

The Ballville Dam has gathered sediment for over 100 years. Yet, the testing of that sediment is woefully inadequate as no sample grid was ever established and little more than a handful of samples were actually taken and analyzed. To say that decomposing DDT and seven heavy metals above the threshold level, with iron above the probable effect level, are proper to be expelled into Lake Erie, because it is no worse than what is already there is rather staggering. Even if you accept the premise, it is still an apples and oranges comparison, as the material in the Lake is compacted and static, as opposed to the material behind the dam that will be let loose and free flowing.

Therefore, the following course of action should be taken as to this issue: 1) a specific study should be conducted on what effect the release of silt, which is primarily nothing more than contaminated fertilizer, will have on lower river, bay, and lake alga blooms; this should be done by mapping the most intense areas of bloom and super imposing them over the map models of anticipated silt deposits 2) a proper sampling grid should be imposed upon the impoundment silt, with appropriate sampling taken and analyzed, so that an accurate study of the impounded silt can be obtained; 3) a specific study should be conducted on what environmental effect that free flowing phosphorous silt (contaminated with heavy metals and decaying DDT) will have on the river, bay and lake's environment, as opposed to the immobilized silt that is already present there.

B) What effect, direct or indirect, will the sediment release have on the existing spawning beds of Sandusky River Walleye stock that exist North of the Ballville Dam in the Sandusky River and Sandusky Bay?

The DEIS material dealing with the Sandusky River Walleye Stock is by and large, incomplete, inaccurate and internally inconsistent. First, the DEIS must recognize why this study and action is being taken. It is not for general stream connectivity and all the proposed ensuing benefits to

stream health. It is for one reason only: the desire of the ODNR to give Sandusky River Walleye Stock the opportunity to expand their river spawning grounds upstream of the Ballville Dam. A failure to recognize this fact is fatal to any meaningful report.

Countless ODNR e-mails, memoranda, reports, and articles, uncovered by Freedom of Information Requests, establish that the sole motivation behind this effort is to enhance the Sandusky River Stock of Walleye (which is miniscule compared to the total Walleye population in Lake Erie), by allowing walleye access to the river south of the Ballville Dam. Walleye Fishing in Lake Erie is the number one sport fishing in the state and is a billion dollar industry.

To this end, the ODNR entered into a single project agreement with the City of Fremont on June 11, 2008, entitled **"Construction of an Upground Reservoir (the "Reservoir") and removal of the Ballville Dam (the "Dam") on the Sandusky River"** (emphasis in the original) and hereinafter referred to as the "Project."

The "Project" is one. The building of the Reservoir and the proposed removal of the dam are indivisible by the terms of the contract. The ODNR secured for the city $5 M dollars for a reservoir project that was to cost $8 to 13 M dollars but ended up costing the city $45 M dollars, since the reservoir was built on karst topography, a base of limestone referred to in common terms as Swiss Cheese Rot. In return, the city bound itself to the ODNR to remove the Ballville Dam, even though no engineering studies, no construction studies and no Environmental Studies had been performed—an unconscionable action, in an apparent violation of the use of federal and state money.

What is even more abhorrent is the ODNR's continued insistence and the DEIS's conclusion, in reliance upon Jones et al (2003); page 5-64 of the DEIS, that the removal of the Ballville Dam would provide the Walleye access to 22 miles of new spawning habitat. While, in truth, the ODNR's Weimer, February 1, 2010, study of tagged Sandusky River Walleye, the only study of its kind, yielded "surprising" results in that "…the river4 spawning portion of the Sandusky walleye stock is currently minor compared to the bay-spawning portion of the stock." The report concluded that: "**Remarkably, it appears that river-spawning walleye do not ascend far enough upstream to be impeded by the Ballville Dam."** (my emphasis added.) The further most upstream point in any of the walleyes' migration was 2.5 km downstream from the dam.

Even if an exceptionally, strong and adventuresome walleye made it to the area of the dam, in contravention of the ODNR's tagged study, it would then either be faced with one of two daunting prospects: one, either jumping over the waterfalls of the Lower Sandusky, historically referred to in numerous archival documents, but which have not been found, as they either are buried in silt or do not exist, or two, running miles against the current of upstream, white-water rapids. Neither scenario is possible.

Even though there is no prospect, based upon the ODNR's tagged study and the geographic nature of the impoundment area of the river, for Walleye to use the area upstream of the Ballville Dam, if the dam were removed, the ODNR and the DEIS continue to advocate this false proposition. More disturbing is the willingness of the ODNR and the DEIS to risk serious

damage or eradication of the existing Walleye spawning grounds in the lower portion of the Sandusky River and the Sandusky Bay by releasing the silt behind the dam.

Therefore the following course of action should be taken as to this issue:
1) an immediate study should be undertaken to perform a detailed mapping of all existing walleye spawning sites or sites conducive to walleye spawning in the lower portion of the Sandusky River and Sandusky Bay; 2) a detailed silt flow model, based on various weather conditions and current flows, should be made as to where the silt will flow and ultimately come to rest, based upon a percentage of probability; 3) that model should be superimposed over the spawning beds with expert review of the damage-specific silt loads will have on those beds.

Finally, a major inconsistency exists in the DEIS at 4-14, relative to the Walleye spawning beds. In one section, the DEIS states that: "Coarse-grained particles transported as bed load are deposited within the impoundment before reaching the Ballville Dam. The long term replenishment of spawning substrates downstream of the impoundment depends on deposition of these coarse-grained particles and habitat replenishment is compromised by this process."

Then, in the very next paragraph the following comment is made: "Recent sediment studies presented in Stantec (2011) suggest that the dam is approaching, or has reached an equilibrium state where very little new material is stored directly behind the dam despite the high volumes of sediment delivered from the watershed."

Therefore, the DEIS should be corrected in all relevant places to say that recent studies show the impoundment area has reached equilibrium and no longer has a detrimental effect in impounding coarse-grained particles necessary for spawning beds.

Furthermore, the DEIS must be corrected to reflect that ODNR's Weimer, February 1, 2010 tagged study shows that the Ballville Dam does not impede walleye movement upstream.

C) What effect, direct or indirect, will the sediment release have on the marshlands of the lower Sandusky River and Sandusky Bay, and navigation in those areas?

The Sandusky River north of Fremont meanders slowly to the Sandusky Bay. Along its course it encounters some of the finest marshlands in the country, which, in turn, house some of the most exclusive and famous hunting clubs in America. The marshes have, from centuries of farming in the watershed, been subject to sedimentation pressures.

Likewise, the Sandusky River and Sandusky Bay have become subject to heavy sedimentation. Parts of the Bay and River are either no longer navigable or barely navigable, including the entrance into the Bay from the River.

Therefore the following course of action should be taken as to this issue:
1) An immediate study should be undertaken to determine any direct or indirect effects the sediment release will have on the ecosystem of the marshlands, given the phosphorous-fertilizer nature of a sediment that is also contaminated with heavy metals and decomposing DDT. 2) An immediate study should be undertaken to determine any direct or indirect effects the sediment

release will have on existing boat navigation of the lower portion of the Sandusky River, including marshland tributaries, and Sandusky Bay. This study should include present-day sounding updates of all navigational charts and how those +depth numbers will change once the silt is released.

THE VALUE OF THE BALLVILLE DAM AND THE IMPOUNDMENT AREA

The Ballville Dam and impoundment area have provided the City of Fremont with a reliable, public water supply for a half-century. The newly constructed up ground reservoir has dealt with the occasional high nitrate alerts during times of heavy rain run-offs from the Sandusky River Watershed. To imply in the DEIS at 1-6 and 4-53 that the new reservoir will supply Fremont with an adequate supply of water in times of drought, and the impoundment area is no longer needed is a complete falsehood. This section of the DEIS must be re-written to reflect the true situation of what will happen to Fremont's water supply.

The Ballville Dam has also effectively served for over a century as an Ice Control Structure, and continues to do so today. It is not an experimental device, it works and it has proven itself effective in holding back ice jams.

The Ballville Dam was built for the purpose of generating electricity. Currently, a permit has been issued by the United States Department of Energy to explore that possibility.

A) Is it an unconscionable act, exceeding the standards of misfeasance and malfeasance, for those participating in the drafting of the DEIS to give the impression that the residents of the City of Fremont will have more than a sufficient supply of water to survive a drought situation when the Ballville Dam is removed and impoundment area released, while knowing that the City of Fremont is left with significantly less than the bare minimum of a 100 day supply of water?

At page 4-53 of the DEIS, the report uses 14 MGD, Fremont's water treatment capacity, as it's daily supply and concludes that the impoundment area holds 80 MGD or a five day supply. The DEIS further concludes that 730 MG raw water storage reservoir provides adequate storage capacity for water demands and provides for reserve under low river flow conditions. Dividing the 730 MG by the 14 MGD figure the DEIS uses, Fremont has a 52 day supply of water. This is 48 days less than the bare minimum of 100 days needed to survive severe drought situations. The 100-day "bare minimum" figure was developed years ago by ODNR planners. Attached to this report as Exhibit A are three e-mails from Leonard Black of the ODNR, setting the 100 day minimum, and warning about the Fremont Energy Plant coming on line, and the city not having sufficient water impoundment with the new reservoir. In fact, under this scenario, the City would have been left with out water for extended periods of time during the 1954, 1969, and 1988 droughts.

Even if the 14 MGD were changed to 10.7 MGD, current city usage of 4 MGD plus the city's legal obligation to provide Fremont Energy with 6.7 MGD, the city would then have an 8 day reserve in the impoundment area, but still only a 68 day supply in the reservoir—far short of the 100 day minimum and again unable to survive the 1954, '69, and '88 droughts.

The outright fallacy of Fremont having a sufficient supply of water, if the dam is removed, is perpetuated throughout the report, particularly at 5-100, where “Water Usage” figures are totally out of date. Fremont is already exceeding the usage projected for 2024 contained in the DEIS!

The DEIS fails to recognize the true importance of the Ballville Dam as it relates to Fremont’s water supply. The 80 MG in the impoundment area, while important in a drought situation, is not the critical factor; it is the high capture rate system that is in play with the dam. That is, during a drought situation, virtually all the water flowing down the river is caught in the area behind the dam where the gravity flow pipe transports it to the filtration plant. This is a high capture rate system or nearly a 100% capture rate during droughts.

Compare this to the pump system in place at the new reservoir. That is a low capture rate system or, perhaps, a no-capture system during droughts. During a drought situation, the river water would be encased in silt if the dam were removed, and the water would have to be pumped out of that silt. This is problematic as the DEIS cannot, at this time, predict where the channel will be or finally settle once the dam is removed. In fact, no assessment of property owners’ new boundaries will be made for 4 or 5 years, due to the fluid nature of the situation. Yet, the intake for new reservoir is stationary, a short distance from the river’s edge. If the channel settled on the opposite side of the river, this would be disastrous for the city during droughts.

Additionally, if the Ballville Dam were removed the City would be relying on a single reservoir for its water source. There would be very few, if any, cities the size of Fremont in Ohio or elsewhere that would find itself in a similar situation. What aggravates the situation is that the reservoir was redesigned 6 times during its construction; it ended up being built on a non suitable site of karst topography; the city sued the architect for malpractice; the cost went from early estimates of 8 to 13 million dollars to 45 million; a liner system was installed with no leak detection system and built without a clay bottom; and the reservoir has only been functioning for one year at this point.

Finally, the original purpose in building the Ballville Dam in 1913 was to create hydroelectric power. Hydroelectric power is green energy. Yet, the
DEIS eliminates it in its scoping process, because it does not meet the need for stream connectivity. This is a rather remarkable decision, given the DEIS is an environmental impact study. What could be more significant, in an environmental sense, in losing a structure that was built for the generation of electric power, green energy, at the dawn of the electrical age. The dam successfully generated green energy for a period of years, when generators were in their early form of development.

Modern computer operated generators are far more efficient, less costly to operate, and generate far more electricity than their historic counterparts. The United States has a stated goal of both being energy independence and having a clean environment. This usage of the dam could have direct impacts on the option of an electric fish ladder system and electric powered water gates, if some of the electric current generated was diverted for that purpose.

Currently, the United States Department of Energy has issued a permit to a private company to explore the use of the dam as a hydroelectric generating structure. Why is the United States

Department of Energy not an interested party in these proceedings? Why have they not reviewed the DEIS and have not been brought into the decision making, since their permit is at stake?

Therefore the following course of action should be taken as to this issue:
1) an immediate study should be undertaken to determine the usable amount of water in Fremont's new reservoir, allowing for a realistic drawdown to preserve fish stock and allow for sedimentation; further, the study should accurately reflect Fremont's current water needs and projected water needs 20 years and 30 years into the future. 2) an immediate study should be undertaken to determine the impact of moving from a high capture rate system with the Ballvile Dam in place during times of drought to a low or no-capture rate pumping system if the dam is removed. 3) an immediate study should be taken to assess the risk of removing the Ballville Dam and relying upon the reservoir as the city's sole source of water, given the reservoir's construction history. 4) a full study of the Dam's use as a structure to produce hydroelectric power should be undertaken by the DEIS, as this is an environmental impact study and hydro power is green energy; further the US Department of Energy should be a reviewing party to the DEIS, as they have a departmental interest in this matter.

The Ballville Dam has historically served a valuable function as an Ice Catching Dam for over a Century. It works. Why replace it, at a cost of millions, for an Ice Control Structure (ICS) that will be experimental when placed in a river as wide as the Sandusky? What hazard will the ICS present to kayakers, those in canoes, and those in rafts and inner tubes coming off the rapids at high speeds? Will this structure cause serious injury or even death to fast water enthusiasts? What studies have been conducted on the quantity, type, and volume of debris that will accumulate as a result of the ICS? Who will be responsible to clean out the debris? What studies have been done as to the cost of cleaning the structure and maintaining it?

The historic 1959 Fremont Flood proved the value of the Ballville Dam as an ice catching device. An enormous ice pack formed North of Fremont in the area of Brady's Island. Heavy rains and snow melt caused the water level at State Street Bridge to rise over 19 feet, well over flood stage at that time as the city flood walls were years away. South of Fremont, the Ballville Dam was holding back a similar ice pack of enormous height, width and length. According to the Army Corp of Engineers modern day calculations, if the Ballville Dam did not exist and that ice pact became part of the impediment North of Fremont, then the water level at State Street Bridge would have risen another six feet. This would then have dwarfed the 1913 flood.

Has the ICS suggested for Fremont been used on a river of such width, with such current? If not then, it is an experiment. What if the structure does not survive the force of the ice? Or, is over run by the rising waters? The record of the Ballville Dam has been solidly established as a flood control device by impeding ice flow.

The debris that floats down the Sandusky River and goes over the Ballville Dam during ice jams and general high water is copious and varied. The residents along the impoundment area will testify to hundreds of large trees, limbs, old tires, washing machines, refrigerators, sections of motor vehicles, and large unidentifiable objects all heading down the river in a parade of waste and rubble. These items are interspersed in the glacier of ice when the ice jam breaks, or they

simply float down without ice, during the several times of high water that occur during other seasons of the year.

What happens when these items are trapped at the ICS? Who will clean up the mess? What are the costs of maintenance of the structure and the periodic clean ups? The pillars of the ICS are 15 feet apart. Many canoes are longer than 15 feet. What will be the harm caused to those who enter the ICS going sideway after coming down from the rapids and strikes one of the 10 ft tall pillars? What about large rafts or those in inner tubes? Or, kayakers who hit the structure head on? Who will be responsible for their injuries? Who is liable for creating a hazardous situation?

Therefore the following course of action should be taken as to this issue:
1) a thorough review should be made of any Ice Control Structures in place that have the same dimensions as the one proposed for the Sandusky River, spanning a similar width, with equivalent water and ice flows, and determine how effective they have been in creating and holding back ice jams. If no similar structures are in place, then this proposal should be deemed experimental as to the conditions existing on the Sandusky River. 2) a serious safety study should be conducted on what hazards the ICS will create for those using canoes, kayaks, rafts, inner tubes and other small water craft that might venture the fast moving water, if the dam is removed and the ICS built. 3) a full study should be initiated on the environmental consequences of the debris fields that will be created at the base of the ICS, including the clean up costs and potential damage it could cause to the ICS—realizing that this will be a recurring event several times a year.

THE HINES EMERALD DRAGONFLY (somatochlora) WAS OBSERVED IN THE AREA ADJACENT TO THE IMPOUNDMENT WATERS.

My residence and property is adjacent to the water in the Ballville Dam impoundment area. Every summer our patio and garden area have many dragonflies, mostly the Common Whitetail Dragonfly and the Blue Dasher Dragonfly. Many years ago, I, infrequently, noticed an unusual type of dragonfly, distinctive for its bright green eyes and rather greenish, metallic like body. I looked this insect up and am confident it is Hines Emerald Dragonfly, as it is exactly as depicted in the photos.

Some years I would see several of them, other years none. I saw one last year (2013), near the back steps of the house as I exited onto the patio. In the scoping process for the DEIS, I alerted Brian Elkington to seeing the Hines Emerald Dragonfly in extensive comments I made about the scoping process.

I have, however, found no mention of the insect in the DEIS. My understanding is the Hines Emerald Dragonfly is on the federal endangered species list. I also believe that the impoundment area, with its small lake effect and generally calm summertime waters would be a good habitat for this creature, given the significant, layered limestone outcroppings that encase the river near the end of the impoundment waters.

Therefore the following course of action should be taken as to this issue: a thorough field study should be made of the impoundment waters and adjacent land areas to confirm the

existence of Hines Emerald Dragonfly and when found to conduct an environmental study on how the removal of the dam and the impoundment waters would effect that endangered insect.

THE VALUE OF RESIDENTIAL HOMES THAT BORDER THE IMPOUNDMENT AREA WILL DECREASE SIGNIFICANTLY IF THE BALLVILLE DAM AND IMPOUNDMENT AREA ARE REMOVED.

The DEIS simply omits any appraisals of current residential property fronting the impoundment area. Further, the DEIS fails to provide anticipated appraised property values if the dam and impoundment area are removed on these residential properties, choosing instead simply to cite a study by Provencher et.al. (2008), claiming that dam removal has little impact on property values in the short run.

The residential property owners currently enjoy a bucolic setting, consisting of a wide river that often resembles a placid lake, framed by woods, and home to a variety of waterfowl. If the dam is removed, the river will loose its lake effect and sink down into a channel of silt. The waterfowl will then disappear, and so might the river itself disappear from view, depending upon where it relocates and how far down in the silt it is obscured.

It is simply ridiculous to say that the residential property values will not drop significantly, based upon this scenario. Attached to this document is Exhibit B, which is a letter from a licensed Ohio appraiser, familiar with these homes that abut the impoundment area. The appraiser concludes: "It is, therefore, my opinion that the residential properties on the Northerly side of the Ballville Dam impoundment area **will drastically drop in monetary value**, (emphasis in the appraisal letter) upon the removal of the Ballville Dam and the loss of the impoundment lake."

Therefore the following course of action should be taken as to this issue: the drafters of the DEIS should be honest and eliminate such duplicitous statements, that, by their very nature cast doubt on every sentence that is in this report. That section, at 5-71, should be rewritten to reflect reality.

THE CITY FACES THE POTENTIAL OF CIVIL LITIGATION ON A VARIETY OF ISSUES, FROM A NUMBER OF SOURCES, IF THE BALLVILLE DAM IS REMOVED.

The City of Fremont, in building the reservoir project, got mired down in litigation, incurring great costs to its citizens. The initial contractor on the project sued the city. Then the City sued the project's architect. Then, the second contractor demanded an extra $ 9 Million. Counter suits were filed.
A property owner sued the City for damage to his property; that suit ended up in the Ohio Supreme Court. The end result was a project initially estimated to cost $8 Million on the low side, ended up costing the city $45 Million, and seriously compromised its water funds.

The removal of the Ballville Dam, in my view, carries many more legal hazards than building a reservoir. No dam, the size of the Ballville Dam, has ever been removed in Ohio. In addition to the normal disputes that can arise between architects, engineers, and contractors, as well as cost

overruns, the city faces possible exposure on a variety of fronts not seen in normal construction projects.

The chance for unintended consequences is real. Since it is impossible to precisely predict where the silt will go and build up, potential damage may occur in marinas, on private property, hunt clubs, and marshland. This has the potential to trigger class-action claims of people similarly situated in damage situations that are not large enough to be pursued individually. Clean up and maintenance issues exist with the ICS and adjoining property owners. The ICS may create a hazardous condition to recreational enthusiasts, and individual property owners may seek redress for damages as to the drawing of the new boundary lines and decreased property values.

Therefore the following course of action should be taken as to this issue: a thorough legal evaluation should be made of all potential torts that might arise from the discharge of the silt, the building, maintenance and use of the ICS, and other direct damages that property owners might suffer as a result of the project. Much of this potential liability could be avoided all together if the silt behind the dam were removed before the project was started.

CONCLUSION

The driving force behind the combined reservoir/Ballville Dam removal project was the ODNR's desire to allow Sandusky River Walleye Stock greater access to gravel areas upstream of the dam that would be conducive to spawning, as Walleye Fishing represents big money for Ohio. The building of the reservoir turned out to be a nightmare for the City. The reservoir was built on an unsuitable site of karst topography, resulting in lawsuits for faulty design and raising questions as to its problem free, longterm use. The building of the reservoir was a financial catastrophe for the City of Fremont and its water rate payers.

Since the combined project began years ago, it has now been established, through the ODNR's tagged walleye study, that the Sandusky River Walleye Stock principally breed in the Sandusky Bay and Lower portions of the Sandusky River. The study concludes that the Ballville Dam does not impede their travel upstream as they do not come anywhere near the dam. Even if they did (which they do not) they would then either have to jump over waterfalls or swim through miles of rapids.

If the dam is removed and the glacier of silt is allowed to flow downstream, it will put at possible risk the very Sandusky River Walleye Spawning Grounds the ODNR is trying to expand, by covering them and disturbing them. The silt, which is contaminated with heavy metals and deteriorating DDT, is essentially "fertilizer on steroids"—a potent mix of phosphorous and nitrogen, from farm field runoff, that caused tree seedlings to grow over 30 feet within 5 years. When this mix hits the lower portion of the Sandusky River and Sandusky Bay, it will serve as a delightful smorgasbord of nutrients for the varied, toxic bacteria that create the harmful alga blooms which gush from the mouth of the Sandusky River, through the bay and into a lake, that is fighting off an assault, the likes of which it has never seen. It would be ironic, indeed, that the folks who created the Great Lakes Restoration Initiative's Action Plan, a plan whose first priority is to clean up the toxics in the lake, may now decide to aid and abet these micro organisms in their modern day Battle of Lake Erie.

If all this is not bad enough, the City of Fremont will be left with an insufficient water supply for the approximately 20,000 individuals who depend upon it. Any way you play with the numbers, the city will have a water supply that will be far less than the bare minimum 100 day supply that is necessary to survive drought situations. There are words to describe the act of leaving a city of this size without a sufficient water supply; they are: unconscionable, immoral, scandalous, and illegal. (Note: the City did have a contract with the State to augment the flow of the Sandusky River in times of drought by releasing water from the Killdeer Reservoir near Upper Sandusky; this contract was unilaterally cancelled by the state a few years ago when the Killdeer Reservoir suffered a partial collapse.)

Furthermore, with the dam removed, the City will have to build a new, ice control structure, as the Ballville Dam served admirably as an effective flood control device by holding back massive amounts of ice from joining ice jams north of the city. It should be noted that this is just another construction project where cost overruns could well occur. And, unlike the Ballville Dam's proven track record of effectively holding back ice, this new structure is yet to be proved to work under the features of the Sandusky River. This new device will create many new and costly problems for the City and impact adversely Ballville Township, the political subdivision upon which the structure will be built. Maintenance, clean-up costs, and new river hazards will now exist where none of these problems existed before.

With the removal of the Ballville Dam, there will forever be lost the ability to create green energy with hydroelectric power, particularly as technology makes strides for greater efficiency in the generation of such electricity.

Finally, a city already financially impaired by a run-a-way reservoir project, now faces numerous new perils in potential litigation with these new projects and for what purpose? Not for the walleye, not for City's water supply, not for the health of Lake Erie, not for Fremont's Flood Control System, and not for the Hines Dragon Fly and the myriad types of water fowl and other wildlife that have made the impoundment area and surrounding marsh land their habitat for the last century.

Response:

Thank you for your comments, please see below our detailed response by section outlined in your submission.

For information on the quantity of sediment in the impoundment, please see the "Opinion of probable cost for dredging the Ballville Dam Impoundment," under EIS Section 4.2.2.4.3 regarding sediment quantity (Stantec 2013). The estimate presented by Stantec included information such as bathymetry and sediment soundings that were not available to Evans. Stantec (2013) reported, "It is important to note that much of the depositional area above normal pool is now covered with mature vegetation and is unlikely to mobilize even if the dam is removed. Therefore, the estimate of 840,000 CY of sediment is appropriate when considering

potentially mobile sediment." The total expected release is currently estimated at 500,000 - 700,000 CY. As your comment notes, these quantities are estimates based on the best available science and understanding of sediment mobilization under a removal scenario.

A) The cooperating agencies agree that addressing phosphorus loading, and subsequent Harmful Algal Blooms (HABs), on Lake Erie is an issue. This phosphorus loading, and the subsequent blooms, likely are having an adverse impact on Lake Erie water consumption, recreational use, and fish and wildlife populations, and have continued to grow in size and scope over the previous decade. The primary reason for the increased incidence of HABs in the western basin is associated with the increases in Dissolved Reactive Phosphorus (DRP), or phosphorus that is dissolved in the water and highly bioavailable (Daloglu et al. 2012). The phosphorus associated with the sediments stored behind the Ballville Dam is particulate phosphorus, or phosphorus that is adsorbed to the sediment, and therefore, much less bioavailable than the DRP fraction is. As you pointed out, the HABs associated with the Sandusky River, in spite of the presence of the Ballville Dam, are quite large and are associated with the DRP that is moving through the system. The cooperating agencies feel that the removal of the Ballville Dam will have minimal impact on the size and extent of the HABs due to the particulate nature of the phosphorus, and ultimately will have wide ranging benefits to the fish and wildlife resources, and water quality in the Sandusky River and associated bay and lake. We would encourage you to review the Ohio Phosphorus Task Force Phase II Report at http://www.epa.state.oh.us/portals/35/lakeerie/ptaskforce2/Task_Force_Report_October_2013.pdf to view strategies that ODNR, OEPA, and ODA are implementing to address the DRP and HABs issues in Lake Erie.

Regarding the recommendation to initiate a specific study on the effects that the release of silt will have on the lower river, bay and lake algae blooms. A quantitative analysis of the interaction of these variables is not feasible using currently available scientific tools. We have used the best available science, which in the case consists of information regarding sediment loads from the watershed, sediment stored by the impoundment, sediment chemistry, and the spatial configuration of the various locations to study the expected impacts of each alternative. The qualitative analysis of this information suggests:

- Much of the phosphorous in the sediment stored by the dam is biologically unavailable for algal growth
- Sediment loads will not increase appreciably due to demolition of Ballville Dam
- Because of seasonal streamflow patterns, most sediment transport will occur when algal growth is not a concern
- Not all of the sediment will reach Lake Erie as some will be stored on floodplain, bars, or islands or dispersed throughout the river and bays.

In combination, these lines of evidence suggest that Ballville Dam may cause temporary but unsubstantial increases in nutrient loads to Lake Erie.

For a detailed discussion of the Ballville Impoundment sediment, please see Section 4.2.2.4.4 *Sediment Quality* of the EIS. Levels of contaminants associated with the sediments behind the Ballville Dam were similar to those observed in Lake Erie sediments. Additionally, the cooperating agencies disagree that the sediment in Lake Erie is "compacted and static". Sediment in the open waters of the western basin of Lake Erie is mobilized quite frequently from storm/wind driven events, and behaves similarly to the sediment behind the Ballville Dam. The cooperating agencies feel that the Evans and Gottgens (2007) survey conducted to characterize the contaminant burden of the sediments behind the Ballville Dam was adequate to characterize those contaminant levels and has evaluated the risks of the sediment release with respect to the potential benefits of Ballville Dam removal to the upper/lower Sandusky River, Sandusky Bay, and Lake Erie.

B) The Sandusky River Walleye stock is a part of the entire fish community (comprised of 88 species) that will likely benefit from increased connectivity in the Sandusky River if the Ballville Dam is removed. The information captured in the EIS, details the current extent of knowledge on Walleye (and other species) in the Sandusky River system, and the vast majority of the information is derived from peer-reviewed literature sources, which have had extensive technical review for accuracy and completeness. Other sources presented in the EIS were reviewed extensively by internal staff that are highly trained in fisheries biology and management, ecology, and environmental science, therefore the commenters supposition that the information presented is incomplete and inaccurate is not well founded.

It should be noted that the purpose and needs identified in the EIS, as outlined by the cooperating agencies, is to:

1. Restore and expand upon self-sustaining fishery resources within the lower Sandusky River by providing fish passage in the Sandusky River at the Ballville Dam impoundment site in both the upstream and downstream directions, and

2. Restore system connectivity and natural hydrologic processes between the impounded area upstream of Ballville Dam and the lower Sandusky River, which would restore riverine fish and wildlife habitat, resulting in a net gain in the amount of free-flowing riverine habitat

The cooperating agencies have presented several alternatives that either do not meet, partially meet, or completely meet the purpose and needs. The EIS details two options which fully meet the above purpose and needs that involve dam removal, one being a phased removal option and one being dam removal in a single phase. Both of these options meet the second need identified to restore stream connectivity and will likely result in all the proposed ensuing benefits to stream health. In addition, these two options will provide additional upstream spawning habitat for a

host of Lake Erie migratory fish species (as well as Walleye), which could result in regional benefits to Lake Erie and the five jurisdictions that have management and regulatory authority over Lake Erie fisheries management. The commenter is correct that Walleye are an ecologically and economically important species on Lake Erie and ODNR, per their mission, supports any action to improve fish and wildlife resources and their habitats for the benefit of all Ohioans.

The ODNR, Division of Wildlife mission specifically is "To conserve and improve fish and wildlife resources and their habitats for sustainable use and appreciation by all" (ODNR, DOW 2012). Walleye, as a part of the fish community, and the habitats that fish and wildlife resources utilize in the Sandusky River, likely will benefit from the proposed action. The biological and ecological expertise within the ODNR, Division of Wildlife continues to see the removal of the Ballville Dam as the most fruitful option to achieving their above stated mission.

We do feel that the commenter is misinterpreting a number of pieces of information that were presented in the EIS, and the cooperating agencies encourage the commenter to thoroughly review the referenced documents. First, the Jones et al. (2003) publication modeled the potential Walleye production from habitats above the Ballville Dam associated with larval outmigration at longer distances. The modeling results clearly suggest that spawning habitats above the dam have the potential to contribute significant larval production in the river to larval nursery areas in Sandusky Bay. This manuscript demonstrated that, although variable across years, larval Walleye produced above the dam, up to Tiffin, have the potential to reach the larval nursery grounds in Sandusky Bay. Dr. Mike Jones' contact information is also available for additional discussions on the efficacy of the science presented in the manuscript.

The technical report (Weimer 2010) cited by the commenter identifies a number of points that are consistent with our current understanding of Walleye in the Sandusky River system including:

1) Multiple sub-stocks may be using Sandusky Bay as a staging area, prior to migrating to their final spawning location (Sandusky river/bay, reef complex, or potentially Maumee River). Data from both Weimer (2010) and Thompson (2009) suggests this, as only half of the 197 Walleye tagged by Thompson (2009), were subsequently located in Sandusky Bay. Given this information, it remains difficult to fully understand the relative proportion of fish that migrate up the Sandusky River, remain in Sandusky Bay to reproduce, or leave the Sandusky system to reproduce in other locations.
2) Why a lower percentage of Walleye than expected migrated up the Sandusky River to reproduce is uncertain, however, as stated in Thompson (2009) "The small proportion of Walleye traveling upriver could be explained in terms of conditional reproductive strategies (Maynard Smith 1982; Gross 1996) in response to environmental change. That spawning individuals can adaptively respond to change by substituting habitats is not a new concept. McAughey and Gunn (1995) demonstrated that lake trout (*Salvelinus*

namaycush) used new spawning habitats when historical grounds were experimentally covered. In addition, Atlantic salmon (*Salmo salar*) explored different spawning areas when confronted with an impassable dam (Gerlier and Roche 1998). In the ODNR study, Walleye could be responding adaptively to habitat reductions in the Sandusky River by choosing alternate spawning locations in Sandusky Bay." Similar conclusions were drawn in Weimer (2010). Therefore, the response seen by Weimer (2010) and Thompson (2009) could be due to the continued aggradation of spawning habitat below the Ballville Dam.

3) Regarding the statement made by Weimer (2010) "it appears that river-spawning Walleye do not ascend far enough upstream to be impeded by the dam," it should be noted that the final report actually reads "River-spawning walleye do not ascend far enough upstream to be impeded by the Ballville Dam…Walleye appear to prefer spawning in the lower portions of the Sandusky River's available habitat". The results from this study indicated that tagged walleye were not located upstream of the existing spawning habitat, however, these results should be interpreted in light of the findings of Thompson (2009), who reported that "the presence of preferred walleye spawning substrate, gravel and cobble, was an important predictor of walleye locations during the entire spawning season". These results, coupled with the paucity of gravel and cobble substrates located just downstream of the Ballville Dam, due to the Ballville Dam trapping gravel and cobble substrate upstream, suggest that walleye and other species will seek out more suitable spawning habitat if they have access to it.
4) Additionally, the ODNR DOW currently restricts fishing from March 1-April 30 at locations directly downstream of the dam (Ohio Administrative Code 1501:31-13-01) because historically fish had congregated here and fishermen were targeting and snagging Walleye. This regulation went into effect in the late 1970s, when the Sandusky River Walleye stock was much larger, and the spawning habitat extended up into this region. Currently, Walleye are harvested in this area after the restrictions are lifted (Matthew Liebengood, ODNR Wildlife Officer, personal communication) indicating that some fish move upstream of the current extent of spawning habitat in the Sandusky River.

Although walleye are characterized as relatively weak swimmers, Peake et al. (2000) (as well as McConville and Fossum 1981, Winterton 1975, Kerr et al. 1997) quantified walleye swimming speeds experimentally and determined that peak swimming speeds (which would indicate maximum laminar flow that a walleye could withstand in a river system) were measured at a 1.6-2.6 m/s range. These were values used in the EIS to explore the potential impact of the ICS on current velocity and walleye and other species migration through the area (pg 5-38). The analysis conducted in the EIS suggested that nearly half the time, modeled current velocities were well below the lower end of the range of maximum walleye swimming speed. Additionally, in the Sandusky River (at both Fremont and Tiffin), and other river systems in the Great Lakes that support walleye spawning populations, spring current velocities are higher than (or similar to) the Sandusky River. For example, in the Maumee River, maximum and mean

spring current velocities are 27-80% higher than those observed in the Sandusky River at Fremont and Tiffin (http://waterdata.usgs.gov/usa/nwis/rt). The Maumee River currently supports a significant walleye spawning population. Additional rivers (including the Oswegatchie (NY) and Tittabawassee (MI)) have current velocities similar to those observed in the Sandusky River (Kerr et al. 1997). Analysis of flow velocities in these rivers during the spring (March-May) indicates that mean daily flow velocities never exceed the maximum swimming speed of walleye, and maximum daily flow velocities infrequently exceed maximum walleye swimming speeds (Peake et al. 2000). Given this information, there is little evidence to suggest that current velocity in these sections of the Sandusky River will impede upstream migration of walleye (or a host of other species that would benefit from the Proposed Action). As detailed in the EIS, walleye are highly migratory, capable of relatively large migrations, e.g. tagging data suggest some Lake Erie walleye migrate through the Detroit and St. Clair Rivers, high velocity rivers, to locations in southern Lake Huron (Belore et al. 2010).

The waterfalls referenced in the comment do not appear to be present as a barrier to fish movement in the rivers current for or based on review of historical documents or images. A thorough analysis of the potential presence was presented in the EIS page 4-5, therefore, I refer the commenter to this section. In addition to information presented in that section, Von Schon (1908) identified the location of the Upper Sandusky Falls as upstream of Tindall Bridge and the Lower Rapids as being located in the City Fremont. Based on our research, neither of these features, which would be better described as cascades, represents a barrier to fish passage. Any other "falls", if present in the study area, would be similarly configured and therefore would not present a barrier to fish.

There is a significant probability, although with some uncertainty, that Walleye will migrate above the Ballville Dam for reproductive purposes, however, the population response may take some time. In spite of some uncertainty, we feel that the additional benefits associated with increased connectivity for other species (White Bass, Redhorse etc.), the enhanced fish community in the currently impounded section, and the potential for re-nourishment of gravel/cobble substrate in downstream spawning reaches meets purpose and need for the project.

Concerns of the cooperating agencies over the short-term impacts of the dam removal options lead the group to recommend phased removal of the dam as the Proposed Action to minimize the potential impacts to the downstream Walleye/white bass spawning habitat and meet the purpose and need for the project.

Regarding the recommended course of action:

1) Detailed mapping of all existing Walleye spawning sites in the lower portion of the river and Sandusky Bay has already been completed by a number of authors (Gillenwater et al. 2006, Thompson 2009), and conclusions from the Weimer (2010) telemetry study indicate that "Walleye that were spawning in the river were located in or near the historic

spawning grounds in Fremont; no new river spawning areas were identified during this study," therefore no further study is necessary.

2) Sediment modeling results were presented in the EIS and were used to help inform the selection of the Proposed Action as the recommended course of action.
3) See above.

Statements regarding the storage of coarse-grained sediment and the "equilibrium state" of the impoundment are not inconsistent. The total volume of stored sediment is currently dominated by the supply of fine sediment from the watershed. The entrainment threshold for these particles is very low and some material is exported out of the reservoir with each storm event while new material from the watershed is stored. Thus the reservoir is at equilibrium. Coarse material is not easily entrained and cannot be passed over the dam. Given sufficient time, coarse materials would eventually displace stored fine sediment. However, because supply of coarse-grained sediment from the watershed is low this process would require thousands of years and would occur on a geologic timeframe.

Coarser sediments such as coarse sand and gravel are continuing to be trapped by the dam at the upstream end of the impoundment as the water velocity slows. This pattern of deposition and settling of coarse sediment was noted by Evans et al. (2002): the sediment texture is 5:10:85 ratio of gravel:sand:silt near the dam and 20:20:60 at the upstream end of the impoundment. A discussion of the equilibrium status of the sediment has been added to EIS Section 4.2.2.4.3.

C) Impact of sediment release on Marshlands and navigation

For more information on the impact of the sediment release on downstream water quality please see the discussion in Section 4.2.2.4.4 *Sediment Quality* in the EIS.

The Appendix A11 Sediment Transport Memo discusses the impact of sediment release on navigation and the amount of sediment deposition that could occur in the Sandusky River, Muddy Bay, and Sandusky Bay.

Regarding the impact of the sediment on downstream marshes, Herdendorf (1987) states: "The upper end of Sandusky Bay possesses one of the largest concentrations of coastal wetlands on Lake Erie. The wetlands fringe the entire shoreline of Muddy Creek Bay and extend several kilometers up the estuaries of the Sandusky River."

The freshwater wetlands (marshes) of Lake Erie were formed in the deltas of rivers that flow into the lake and into protected shallow areas. Many wetland areas in Lake Erie are now managed and protected from water level changes by artificial dikes (Mitsch and Gosselink 1993). The upper reaches of the estuaries in Muddy Bay contain both diked and undiked marshes.

Again Herdendorf (1987) explains: "If it were not for the network of dikes, it is likely that the erosive action of waves would eliminate much of the wetland vegetation in Sandusky Bay. The

ability to regulate water levels in managed marsh units has proven to be a useful tool in altering species composition and thereby increasing waterfowl food and nesting cover. Most of the diked marshes are owned by shooting clubs and managed predominantly for waterfowl utilization and some mammal propagation. The waters of the western Lake Erie basin are more turbid than the other basins because of large sediment inputs from the Detroit, Maumee, Portage, and Sandusky Rivers, wave resuspension of silts and clay from the bottom, and high algal productivity."

The pulses of sediment from the dam removal will be transported and dispersed into Muddy Bay and Sandusky Bay during high flow events. The silt stored behind the dam easily suspends in moving water, is highly mobile, and is slow to settle out of the water column. The amount of sediment available for transport is equivalent to approximately one year of sediment loading from the Sandusky River. The staged removal of the dam will limit the amount of sediment that mobilizes during each stage, resulting in multiple pulses of smaller amounts of sediment being transported into Muddy Bay and Sandusky Bay over the two year time frame.

One of the main causes of loss of coastal marshlands is wave action from Lake Erie. As stated above, many high quality marshes are protected from waves by man-made dikes, and these areas are actively managed for waterfowl and other game. Thus most wetlands are isolated from the increased supply. The remaining wetlands may be affected by sediment releases, however the magnitude is expected to be small and temporary due to

- Staged removal of the dam that constrains the volume of sediment exported per unit time,
- Widespread dispersal of material that limits the amount of deposition at any location, and
- The distance to the project area allows for diminution of the sediment wedge.

1. ARCADIS (2008) modelled the performance of the reservoir under average and drought conditions. The assumptions in the model were:

- Water Usage: current demands (2008) are 3.9 MGD; future demands (2024) are 9.1 MGD; included projected 4 MGD for Fremont Energy Center.

-Water Supply: minimum pumping rate of 3 MGD and maximum rate of 40 MGD; pumping rates limited to 90% of net stream flow (net stream flow is based on minimum required flow of 8.2 MGD throughout the year, minimum flow of 209 MGD maintained in river from April to June, and no June pumping due to high nitrate levels).

-Water Loss: estimates were made for evaporation, seepage, and sedimentation.

Based on model results using data provided by the City of Fremont (January 9, 2014), the off-channel reservoir and pumping station would provide sufficient capacity for existing and projected future water usage for the three worst drought years on record. The reservoir has a storage capacity of 730 MG.

As described in Section 2.3.3 of the EIS, the construction of a hydroelectric facility at Ballville Dam does not aid in achieving any portion of the purpose and need of the project (Section 1.5 and 1.6), nor would it assist in reducing or eliminating environmental impacts relating to any part of the fully analyzed alternatives. However, it should be noted that the two alternatives analyzed which would retain Ballville Dam, the No Action Alternative and the Fish Passage Structure Alternative, do not necessarily preclude a future addition of hydroelectric power.

The Federal Energy Regulatory Commission website explains Preliminary Permits as "A preliminary permit, issued for up to three years, which does not authorize construction; rather, it maintains priority of application for license (i.e., guaranteed first-to-file status) while the permittee studies the site and prepares to apply for a license. The permittee must submit periodic reports on the status of its studies. It is not necessary to obtain a permit in order to apply for or receive a license." (https://www.ferc.gov/industries/hydropower/gen-info/licensing/pre-permits.asp) It is our understanding that a preliminary permit was issued to Ballville Hydroelectric Group LLC, and that although a preliminary permit provides priority application status, it does not convey special expertise or responsibility to the Federal Energy Regulatory Commission to be considered a cooperating agency specifically on this project. The production of green energy is not a component of the purpose and need for this project. In the interim, it is our understanding that Montgomery Watson Harza has been contracted by the City to specifically look at this issue amongst other elements of the Ballville Dam Project.

1. Please review Appendix A5 ICS Design Memo for information regarding the decisions and rational for the pier ICS design. The ICS was designed consistent with guidelines and standards provided by the Cold Regions Research and Engineering Laboratory (CRREL) within the U.S. Army Corps of Engineers.

2. There are several boating safety resources available online. The American Whitewater Association has a list of safety guidelines for paddlers and other recreational users as well as an accident database (https://www.americanwhitewater.org/content/Safety/view/). Also another canoe and kayak safety webpage links to several canoe and kayaking association and groups while also providing safety information. (http://ncspldc.org/ncspldc/topics/canoe%20and%20kayak%20safety.htm). Furthermore, the state of Ohio Department of Natural Resources Division of Watercraft has a paddling safety tips website (http://watercraft.ohiodnr.gov/education-safety/safety-tips-for-every-boater/activity-specific-safety/paddlers).

3. The debris which collects on the ICS will be removed in a manner similar to that of dislodging debris from bridge piers.

The Hine's emerald dragonfly, (*Somatochlora hineana*) is listed as "endangered" under the Endangered Species Act of 1973, as amended. It was first discovered and named from

specimens taken near Indian Lake, Logan County, Ohio. Historically the species has been documented from 3 areas in Ohio: Logan, Lucas, and Williams Counties. It was last documented in Ohio in 1961, and according to the Service's Recovery Plan for the species, it is thought to be extirpated from both Ohio and Indiana (USFWS 2001).

Between 1991 and 1999 a concerted effort was made to survey dragonflies in Ohio, resulting in 1,792 new county records and nine new state records (Glotzhober and Moody 2002). During the summer of 2000, Glotzhober and Moody (2002) worked under contract with the Ohio Department of Natural Resources Division of Wildlife to re-survey the state for the Hine's emerald dragonfly. Teams of at least two people inspected over 12 sites in Ohio with high quality habitat for the species. A total of 22 days in the field were spent searching these sites but no specimens of Hine's emerald dragonfly were found (Glotzhober and Moody 2002).

Hine's emerald dragonflies require marshes and sedge meadows fed by calcareous groundwater seepage and underlain by dolomite bedrock (USFWS 2001). This type of habitat is not present at or around the Ballville dam impoundment.

There are at least 164 species of dragonfly in Ohio, many of which have green eyes and green bodies, including multiple species of *Somatochlora* with a similar appearance to Hine's emerald dragonfly. These include: *S. linearis* (widely distributed and common in Ohio), *S. tenenbrosa* (widely distributed in Ohio), and *S. ensigera* (Glotzhober and McShaffrey 2002). To differentiate between the species of *Somatochlora* requires careful observation of the anal appendages located at the tip of the abdomen (Glotzhober and McShaffrey 2002). No photos of the observed dragonfly were provided with the comment letter, precluding further analysis to verify the species observed.

The Service has determined that: the project area does not support suitable habitat for the Hine's emerald dragonfly; the species is thought to be extirpated from the state of Ohio based on state-wide dragonfly surveys between 1991-2000; the species has never been documented from Sandusky County; a number of similar-appearing species exist which are common in Ohio and could be confused with the Hine's emerald dragonfly; no photos of the specimen observed within the project area have been provided; and, the observation has not been verified by a biologist familiar with dragonfly identification. Therefore the Service believes that Hine's emerald dragonfly is not present within the project area, and this species will not be considered further in the EIS.

It is difficult to know what change will occur to property values on the impoundment in the short and long term under any of the alternatives analyzed. It is expected that if Ballville Dam were to be removed, property values in the area may fluctuate. However, it is unclear what value may be placed on the adjoining properties in the short term, while the area returns to natural riverine habitat, or in the long term once the river channel has stabilized and riparian corridor has been established.

A licensed appraiser in the State of Ohio familiar with the area has the opinion that the "residential properties on the Northerly side of the Ballville Dam impoundment will drastically drop in monetary value, upon the removal of the Ballville Dam and the loss of the impoundment lake." However, no further explanation or justification was provided to add context to their opinion. Alternatively, the peer-reviewed literature on this topic suggests that property values near an impoundment or dam tended not to change or to slightly increase after a dam was removed and a free-flowing river replaced the impoundment (Lewis et al. 2008; Provencher et al. 2008). Ultimately, each project is unique and although it is clear that the presence of Ballville Dam has likely impacted property values, and therefore removal of Ballville Dam will likely impact local property values as well. In both in the short and long term it is unclear how values may fluctuate and what other complicating factors may be additive to determining future values. Additional discussion of potential changes in property values has been added to EIS Section 5.7.2.2.1.

The ICS is expected to be no more hazardous than bridge piers and other structures that already exist in the river. However, water recreation enthusiasts may not recognize the structure as they approach; therefore, as a mitigation measure the City will post signs upstream of the ICS warning recreational boaters that structure may present a water hazard at certain flows. This approach is similar to one that is currently in place for hundreds of low head dams across the United States. This has been added as a mitigation measure in the EIS Sections 5.6.2.3 and 5.6.5.3.

An evaluation of potential future litigation is outside the scope of this EIS. We would encourage you to work directly with the City of Fremont for further information on this topic.

Ballville-2014-19, Name: Laird, D.
Comment:
As a young boy, in the 1950's, I witnessed the fall and rise of the water in the Sandusky River as electricity was produced. My immediate neighbor was John Zickafoos, a Ballville Township Trustee and a farmer. I helped him with his farming. On our work breaks, he told stories about the construction of the Ballville dam, which he helped build.

The construction schedule took a leap when concrete was first placed. 300 loads of concrete were placed on September, 24, 1912. Work continued, the northern dam, 86.5 feet long, was completed thereafter. Approximately 2/3rds of the south dam, 228 feet long, was completed; the latter being under construction when the 1913 flood water rose at the construction site. A wooden cribing was constructed to hold the water out of the construction area. However, at 10:10 AM on March 25th,1913, Chief Engineer Hurtless watched as the cribing left loose. There is no evidence that any concrete of the dam, broke away. (The Rutherford B. Hayes Presidential

Center).

The dam has had five owners through the years; Fremont Power and Light Company, Sandusky River Power Company, Ohio State Power Company, Ohio Power Company, and the City of Fremont. (Sandusky County Recorder's office).

"The presence of contaminated sediments in the Ballville Reservoir would be a major impediment to removal of the dam." (Contaminant Stratigraph of the Ballville Reservoir, Sandusky River, NW Ohio: Implications for Dam Removal) (by James E. Evans and Johan F. Gottgens, Department of Geology, Bowling Green State University; 2006).

A fish ladder, to allow Walleye and other fish, to go up the river, is very expensive compared to a very small added habitat for the fish. What percentage increase would this habitat offer?

A cost/benefit analysis would have to be performed to determine the feasibility of using the dam for electric generation. Clean air electric generation may be eligible for federal funding.

To do nothing, at this time, is an option. New technology, in the future, may cast a light on an existing structure.

Response:

Thank you for your comments.

For a discussion on the sediment quality in the impoundment, please see the discussion in comment 2014-16.

Installing a fish ladder will open up 22 miles of spawning habitat to migratory fish. This additional habitat could produce between 10,000,000 and 149,000,000 larval fish on an annual basis based on the analysis completed in the Feasibility Study for Ballville Dam Removal (Stantec 2011).

As described in Section 2.3.3 of the DEIS, the construction of a hydroelectric facility at Ballville Dam does not aid in achieving any portion of the purpose and need of the project (Section 1.5 and 1.6), nor would it assist in reducing or eliminating environmental impacts relating to any part of the fully analyzed alternatives. Therefore hydroelectric generation could not be funded by the currently allocated State and Federal funding sources and is not considered further in this EIS. However, it should be noted that the two alternatives analyzed which would retain Ballville Dam, the No Action Alternative and the Fish Passage Structure Alternative, do not necessarily preclude a future addition of hydroelectric power by other entities. In the interim, it is our understanding that Montgomery Watson Harza has been contracted by the City to specifically look at this issue amongst other elements of the Ballville Dam Project.

Ballville-2014-20, Name: Foster, W.

Comment:
As a member of the Izzak Walton League of America I fully support the removal of the Ballville Dam. Removal of this dam will allow the Sandusky River help heal its self back to a more natural state. Fremont Ohio has done nothing to keep this dam in good repair for 30 plus years. Does anyone think they can now come up with the money to repair this dam to the required standards.

They can claim they want this as a back up system for water. But this foot dragging is all about the money people spend in Fremont during the fish runs in the spring. I really do not think that is a good reason to stop the removal of this dam.

What back up system have they had in place for the last 30 years? That dam could have failed anytime and then what would they have done for water.

The story the mayor wants to put out does not hold any water.

Response:
Thank you for your comments.

Ballville-2014-21, Name: Lauer, J.
Comment:
I am writing to you about the Ballville Dam in Fremont, Ohio. I was the Fremont City Auditor retiring in November, 2012. I feel that this is a No Brainer in regards to what the City of Fremont should do --- Tear the Dam Down and the sooner the better. I have read the Draft Environmental Impact Statement (DEIS) and I am totally in favor of tearing the dam down in stages with an Ice Control Structure by the dam...

I have lived in Fremont my whole life (over 66 years) and I care about Fremont. I am very active in the community and know many people in the area. I can tell you the majority (not a small majority) want the dam taken down. The problem is a few people who live in the Ballville Township and along the river have contributed big dollars to the campaigns of some city councilmen and the mayor to get them to support the repairing of the dam. These individuals have been telling the citizens of Fremont a lot of incorrect information and also use scare tactics to get the people to agree with them. It is sad that these politicians are not for what is best for Fremont and the people have water bills. I know that my water bill will go up $12 - $15 or more a month if we don't take the dam down. We have grants to take the dam down when used there will be no cost or very little as compared to repairing the dam. The repairing

the dam will cost 10 million or more plus paying the State of Ohio (ODNR) 5 million for a grant the City of Fremont received for the construction of the reservoir. The dam is over 100 years old and is a life threatening accident waiting to happen. This makes no sense to repair the dam.

I know that you are hearing from these politicians that are for repairing the dam and others that live along the river giving you all the wrong reasons to save the dam. I hope that you are hearing from residents of Fremont that know what is going on and want the dam taken down.

I keep in contact with Scott Zody (ODNR) on this issue and know that he and the ODNR want the dam taken down.

The financial part is a strong reason for tearing the dam down but also the restoring the natural hydrological processes over a 40 mile stretch of the Sandusky River, re-open fish passage to 22 miles of new habitat, restore flow conditions for fish access to new habitat above the impoundment, and improve overall conditions for native fish communities in the Sandusky River system both upstream and downstream of the Ballville Dam are also strong reasons to tear the dam down.

I feel very confidant that the U.S. Fish and Wildlife Service wants to move forward for future generations and will recommend tearing the dam down in phases with the ICE Control Structure.

I appreciate your helping the City of Fremont moving forward in a positive way.

Response:
Thank you for your comments.

In EIS section 5.7.4.2.1 and section 5.7.3.2.1 under the dam rehabilitation alternatives, the City has indicated that increases in the cost of water rates may be required to carry this out. If this increase occurred, it would have financial impacts on local residents. However, it is unclear exactly what the increase may be at this time. Our efforts were to make this EIS as complete and accurate as possible regarding impacts of each alternative. We appreciate you providing cost estimates and would recommend discussing specific rate increases with the City of Fremont Mayor's Office.

Also, in EIS Section 2.1.2, Section 3.1.2.5, and Section 3.1.3.2 we have added a discussion of the potential for repayment of $5 million dollars from the City to ODNR related to an agreement identified during project scoping.

Ballville-2014-22, Name: Weaver, J.
Comment:
I endorse the removal of the Ballville Dam, located on the Sandusky River, in Ballville Township, Sandusky County, and owned by the City of Fremont, Ohio.

The recent E.I.S. study clearly shows the ecological benefits that would be gained through enhanced water quality and increased fishing and recreational opportunities. The release of sediment during the removal phase is not significant and can help replenish fish spawning beds downstream.

With dam removal, the economic impact to the current and future water users would be minimal.

If, however, the dam is repaired, the additional costs to the consumers would be devastating. Monthly water bill increases could approach $12.00 over 20 years based on a recent estimated repair cost of $18 million *. This cost will be significantly higher if "below the water line" inspections reveal major structural damage. The Ohio Dam Safety Board would also require that the dam meet base-level safety requirements, these associated costs are unknown at this time.

*(Borrowing $1.5 million at current rates will add approximately $1.00 to the average water bill of city consumers. Township residents, who are water consumers, will see an additional $1.30 for every $1.5 million borrowed).

Response:
Thank you for your comments.

In EIS Section 5.7.4.2.1 and Section 5.7.3.2.1 under the dam rehabilitation alternatives, the City has indicated that increases in the cost of water rates may be required to carry this out. If this increase occurred, it would have financial impacts on local residents. However, it is unclear exactly what the increase may be at this time. Our efforts were to make this EIS as complete and accurate as possible regarding impacts of each alternative. We appreciate you providing cost estimates and would recommend discussing specific rate increases with the City of Fremont Mayor's Office.

Ballville-2014-23, Name: Francis, J.; Lake Erie Committee
Comment:
The Lake Erie Committee (LEC) of the Great Lakes Fishery Commission (GLFC) has reviewed the Ballville Dam Draft Environmental Impact Statement. The LEC supports the proposed action consisting of incremental dam removal with ice control structures.

The LEC is made up of a senior fisheries management representative from each of the managing jurisdictions bordering Lake Erie (Michigan Department of Natural Resources, New York State Department of Conservation, Ohio Department of Natural Resources, Ontario Ministry of Natural Resources, and Pennsylvania Fish and Boat Commission) to collaborate on research and management activities impacting shared aquatic resources within the Lake Erie basin.

The LEC is structured around guiding principles and fish community objectives that are meant to provide a common framework for appropriately protecting, enhancing, managing and monitoring aquatic species and habitat within the Lake Erie basin (Ryan et al 2003). The proposed alternative is consistent with, and directly benefits at least three of the LECs fish community objectives:

- Protect and restore self-sustaining, stream-spawning stocks of walleye, white bass, lake sturgeon, and rainbow trout in riverine and estuarine habitat

- Provide sustainable harvests of walleye, yellow perch, smallmouth bass, and other desired fishes

- Protect, enhance, and restore fish habitat throughout the watershed to preventdegradation and foster restoration of the fish community

The LEC recommends the proposed alternative due to significant aquatic habitat and species enhancements that would occur for shared aquatic resources. This alternative will allow unobstructed fish passage to an addition 22 miles of the Sandusky River. A diverse fish community of 88 native species have used the river and bay system for some or all of their life stages, and are expected to benefit from additional access to approximately 300 acres of spawning, rearing, and feeding habitat. Species that would benefit from the proposed alternative include white bass, smallmouth bass, northern pike, walleye, and yellow perch, which all provide important fisheries for all the managing jurisdictions throughout the Lake Erie basin. In addition, a recent study assessing potential impacts of removing the dam on the Lake Erie walleye population estimated that increasing the current available spawning habitat by only 25 acres in the reach immediately upstream of the dam could produce between 10,000,000 and 149,000,000 larval fish on an annual basis (Jones et al 2003). This additional production would be on average eight times greater than the walleye yield in the habitat below the dam. Interagency tagging studies have also shown that the Sandusky River walleye spawning population is a particularly migratory stock that provides fishery benefits throughout Lake Erie (Wang et a1 2007).

The LEC is also actively engaged in sea lamprey assessment, mitigation, and control within the Lake Erie basin, and the proposed alternative would open up 22 miles of previously inaccessible habitat. However, the US Fish and Wildlife Service has surveyed the Sandusky River above and below the dam and have never documented sea lamprey within the project area. There is a very low likelihood that sea lamprey would become established in the newly accessible river section if the dam is removed since habitat conditions are not optimal. Therefore, the LEC believes the

removal of the dam will not negatively impact our collective efforts to control the spread of sea lamprey within the Lake Erie basin.

In summary, the LEC supports the proposed action because it is consistent with our collective fish community objectives and our commitment to collaboratively protect, enhance, and manage shared aquatic resources.

Response:
Thank you for your comments.

Ballville-2014-24, Name: Spangler, D.; Lake Erie Charter Boat Association, Lake Erie Waterkeeper Inc.,
Comment:
The Lake Erie Charter Boat Association and the Lake Erie Waterkeeper, Inc., would like to go on record supporting the removal of the Ballville Dam.

Opening any stream or river to its natural flow is always a good thing. In this case, removal of Ballville Dam will re-open many miles of Sandusky River access to such economically important sport fish such as walleye and white bass. The additional spawning grounds will increase the overall population of walleye in Lake Erie, as well as, the size of the Sandusky River spawning runs. This could mean millions of dollars for the local economy.

The open river flow will also improve water quality by reducing or eliminating the excessive nitrogen build-up that has been a summer issue for many years and has resulted in numerous warnings from Ohio EPA. The reduced nutrient flow will also help alleviate the heavy algae blooms that have plagued Sandusky Bay and Lake Erie for many years.

Seven years ago ODNR issued a notice to the city of Fremont that the dam was being operated in violation of the law due to the safety conditions at the dam. Removal would eliminate this liability.

Comparing costs associated with the alternatives results in an absolutely clear choice and that choice is dam removal. There is $7.8 million available in grant funding, which is more than is needed for either dam removal alternative. The two keep the dam alternatives could cost up to $18.6 million with zero grant dollars available. That does not include the $5 million that was awarded the city by the ODNR to build the drinking water reservoir and will need to be returned, as dam removal was a condition of that award.

Eliminating the safety concerns, reducing environmental impacts, improving aquatic habitat, increasing tourism income and saving $23 million, all make removing the Ballville Dam the best viable option.

Response:
Thank you for your comments.

Ballville-2014-25, Name: Brooke, C.; Sandusky River Watershed Coalition
Comment:
The Sandusky River Watershed Coalition is a grassroots organization focused on conservation and enhancement of the Sandusky River watershed and its natural resources. With this in mind and after attending and reviewing the materials regarding the Ballville Dam, we have a question of in regards to the ice structure.

Why is the ice structures been established at height of eight feet since high water levels are not a concern before they reach a minor flood stage of ten feet? If the concern for ice movement is during high water events the height of the ice structures seem to be inconsistent. Considering that after this winter, one of the coldest for some time, the only locations issued a flood alert were behind the dammed areas of the Sandusky River. If the dam is holding back and slowing the waters, why is there so much greater concern once the Ballville Dam is removed allowing waters to more freely flow thus reducing the freezing of the river? In the first very cold snap and the higher river levels due to a prior thawing event, behind the Dam areas in Sandusky, Seneca and Wyandot Counties were the only frozen sections of the river. Later once water levels receded, there was less flow but still much of the river still did not completely freeze.

At one time the concern for the ice jams was for the bridge structures in the downtown Fremont area. This winter demonstrated that the Ballville Dam did not hold back all the ice since there was on point where the area between the State Street bridge and Roger Young Park area was completely ice loaded. How will an ice structure in the area of the Ballville Dam area prevent this when the Ballville Dam structure current did not? And what purpose will it serve if the ice jams are created further downstream?

Response:
Thank you for your comments.

For a discussion on the need for an ICS, please see the response in Comment 2014-02.

The ICS was designed consistent with guidance and standards provided by the CRREL, with the U.S. Army Corps of Engineers. The height calculation for the piers is documented in Appendix A5, the ICS Design Report. Stantec calculated the pier height necessary to pass a 10-percent chance flood event without overtopping the piers. Based on this model, an ICS height of 12 feet was predicted. Please refer to Appendix A5 for ICS pier elevations.

Ballville-2014-26, Name: Weslow, J.; Izaak Walton League

Comment:

Thank you for allowing us to comment on the topic of the Ballville Dam on the Sandusky River in Ohio.

I am the current president of the Tiffin Seneca County Izaak Walton League and I have been authorized by our board of directors to send this on behalf of **OUR OVER 500 MEMBERS.** We have over 10 acres of property on the Sandusky River in Seneca County about 6 miles south of the Ballville Dam. Our organization supports many community outdoor functions and has been established in this location for over 80 years. We are conservation minded in our actions. (Which we can discuss at another time if required).

The main purpose for this public comment is to say **"We support the complete removal of the Ballville Dam"** as set forth years ago when the City of Fremont accepted the removal.

We can' imagine why after these long years of waiting for the Dam to be removed there would be some late attendees to the table who would reverse such a well thought out plan. Our over 500 members say to them **" Let The Ballville Dam come down"** . If by some strange circumstances the late attendees get their way. We have some suggestions.

1. Boy Scouts and Girl Scouts Canoing along the Sandusky River need to take out above the Dam and then put back in below the Dam, or vice-versa when traveling in reverse. We as Adult Scout leaders have to trespass on private property with the Scouts as we have no alternative to get a Kyack or Canoe or Raft thru the Dam structure and back into the river. **SO;** Please add to the costs of keeping the Dam a Canoe take out and put in area above and below the Dam.
2. It is obvious that Fremont wants to monopolize the White Bass and Walleye spawning run for their own financial gain. We think that if the Dam is repaired there should be an excess tax imposed on fishing licenses and tackle sold in the entire Sandusky County and this money go to Counties south of the Dam. The collection and distribution of these funds be handled by The Fremont City Council. And monitored by the Ohio DOW
3. Please have the Fremont and Sandusky County folks return the funds they got from the Division of Wildlife. So the DOW can use the funds to help some other Ohio projects to restore other badly needed resources.

I hope that this public comment is reviewed and if there are any questions or requests for further comment you will not hesitate to call me.

Response:
Thank you for your comments.

We appreciate your suggestions regarding addition of a canoe portage and “excess tax” if the dam is not removed. However these actions would not meet the stated purposes and needs for the proposed project, therefore these features have not been included in the EIS alternatives.

If the dam is not removed, it is our understanding that all Federal funding that was granted to the project for dam removal will be returned to the originating agency. Additionally, in EIS Section 2.1.2, Section 3.1.2.5, and Section 3.1.3.2 we have added a discussion of the potential for repayment of $5 million dollars from the City to ODNR related to an agreement identified during project scoping.

Ballville-2014-27, Name: Pelloso, L.; U.S. Environmental Protection Agency
Comment:
The U.S. Environmental Protection Agency (USEPA) has reviewed the Draft Environmental Impact Statement (Draft EIS) for the Ballville Dam Project located in Sandusky County, Ohio. This letter provides our comments on the Draft E1S, pursuant to the National Environmental Policy Act

(NEPA), the Council on Environmental Quality's NEPA Implementing Regulations (40 CFR 1500- 1508), and Section 309 of the Clean Air Act. The Ballville Dam is located approximately 18 river miles upstream of Lake Erie, in Ballville Township, upstream of the City of Fremont, in Sandusky County, Ohio. Its location falls within a 70-mile stretch of the Sandusky River, designated as one of 10 reaches of state-designated scenic river in Ohio. It was built on the Sandusky River between 1911 and 1913. Originally built as a run of-the-river hydroelectric generation facility, it was soon abandoned as a hydroelectric facility because seasonal flow in the river was insufficient to meet power generating requirements of the plant. The City of Fremont (City) bought the land and facilities in 1959 and re-purposed the dam to provide the City's water supply. Since the purchase of the Ballville Dam by the City in 1959, the impounded area has been used as a source of public water. Due to ongoing drinking water quality violations, the Ohio Environmental Protection Agency (OEPA) ordered the City to construct an off stream reservoir to serve as a drinking water source. As of late 2013, this new off-stream raw water reservoir,

now constructed, is currently the primary source of drinking water for the City of Fremont. The Ballville Dam and the impounded area are no longer necessary as a public water supply for the City of Fremont.

Progressive deterioration of the dam and an adjacent north bank seawall bas been noted in successive inspections by the Ohio Department of Natural Resources (ODNR), beginning in 1980. The last known maintenance performed on the structure occurred in 1969. The dam is currently classified by ODNR as a Class I structure; this is the highest hazard rating due to the probable loss of life if the dam were to fail during a flood event. In addition to safety issues, the Ballville Dam divides the aquatic ecology of the lower Sandusky River, altering biological functions and impacting both riparian and aquatic habitats otherwise provided by a historically-connected Sandusky River watershed. The dam represents an impassable barrier to upstream movement of all aquatic organisms and to downstream movement of many aquatic organisms, and has altered natural hydrologic and sediment transport functions in the Sandusky River.

The Draft EIS states the project needs are to restore and expand upon self-sustaining fishery resources within the lower Sandusky River by providing fish passage in the Sandusky River at the Ballville Dam impoundment site in both the upstream and downstream directions. Project needs are also to restore system connectivity and natural hydrologic processes between the impounded area upstream of Ballville Dam and the lower Sandusky River, which would restore riverine fish and wildlife habitat, resulting in a net gain in the amount of free-flowing riverine habitat. The purposes for the issuance of Federal funds and preparation of this Draft EIS, as stated in the document, are to restore natural hydrological processes over a 40-mile stretch of the Sandusky River, re-open fish passage to 22 miles of new habitat, restore flow conditions for fish access to new habitat above the impoundment, and improve overall conditions for native fish communities in the Sandusky River system both upstream and downstream of the Ballville Dam, thereby restoring self-sustaining fish resources.

The Draft EIS evaluates alternative methods of providing fish passage upstream and downstream of the Ballville Dam location, restoring natural hydrologic and sediment transport regimes, and addressing dam safety and liability. A No-Action Alternative and three action alternatives are studied in the Draft EIS. The Proposed Action, Alternative 4. is Incremental Dam Removal with installation of an ice control structure (ICS). The Proposed Action would be divided into three phases with each phase having multiple objectives for meeting dam removal goals. In summary, the phases are: I) the initial notching of the Ballville Dam; 2) sediment stabilization, dam removal, and ice control structure construction; and 3) sea wall modification along the north bank of the river upstream of the dam removal, and restoration of the project area. Phase 3 would also include the demolition of any remnants of Tucker Dam, if necessary. The Tucker Dam was reportedly built between 1835 and 1858 and was a nine foot tall timber crib design that used water power to work a flour grist-mill, This dam and mill was reported to be operational into the early 1900's and was located within the current Ballville Dam impoundment.

Based on our analysis, USEPA's rates the Draft EIS as **"Environmental Concerns – Insufficient Information" (EC-2).** Please see the enclosed "Summary of Rating Definitions." USEPA recommends that the Final EIS address the following comments, which generally relate to wetland and water resource impacts, mitigation, water quality, endangered species, historic preservation, and sediment issues.

WETLAND AND WATER RESOURCE IMPACTS

• The Proposed Action will require direct impacts to 0.67 acre of wetlands and 2.34 acres of the Sandusky River, and indirect impacts to 53.90 acres of wetlands. A Section 404 permit under the Clean Water Act is required by the U.S. Army Corps of Engineers (USACE) for proposed discharges of dredged or fill materials to Waters of the United States. The Section 404 approval is contingent upon the project complying with the Section 404(b)(1) guidelines under the Clean Water Act. These guidelines are summarized as follows:
• Least Environmentally Damaging Practicable Alternative (LEDPA) - There must be no practicable alternative to the proposed discharge (impacts) which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences; Furthermore, an alternative is considered practicable if "it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." [40 CFR Part 230.3]
• No Violation of Other Laws - The proposed project must not cause or contribute to violation of state water quality standards or toxic effluent standards, and must not jeopardize the continued existence of federally-listed endangered or threatened species or their critical habitat(s);
• No Significant Degradation - The project must not cause or contribute to significant degradation of Waters of the United States; and
• Minimization and Mitigation of Adverse Impacts - The project must include appropriate and practicable steps to avoid impacts to regulated Waters of the United States; where impacts are unavoidable, it must demonstrate how impacts have been minimized; and compensatory mitigation must be provided to offset unavoidable, minimized impacts to the aquatic ecosystem. The Draft EIS did not discuss how sequencing established by the Clean Water Act Section

404(b)(l) guidelines has been applied, namely, avoidance first, then demonstration of impact minimization, then mitigation for unavoidable, minimized impacts. A discussion on proposed mitigation for unavoidable, minimized wetland impacts (both direct and indirect) was also not included in the Draft EIS.

1) Recommendations: The Final EIS should include additional information on the proposed mitigation for both direct and indirect wetland impacts, including mitigation ratios, mitigation type, mitigation location(s), etc. This information should align with information provided to both USACE and OEP A for Section 404 permitting and Section 401 Water Quality Certification.

• Permanent impacts to six wetlands (Portions of Wetland 6,14,15,18, and 19, and all of Wetland 17) are proposed in the Draft EIS. No figures showing wetland impact locations were provided in the Draft EIS; however, the U.S. Fish and Wildlife Service (USFWS) provided additional information to USEPA via email on March 24, 2014, including wetland impact figures from the Section 404 and Rivers and Harbors Act Section 10 permit application submitted to USACE. With the exception of permanent impacts to Wetland 18 and Wetland 6 for installation of ICS piers, and temporary impacts to Wetland 18 and Wetland 19 for construction of the northern access ramp into the river, neither the Draft EIS nor the wetland impact figures clearly justify why any other permanent wetland impacts (fill) would be required to implement the Proposed Action. Many impacts descriptions state, "place soil and rock fill for channel restoration." The Draft EIS was not clear on why fill is proposed to be placed into wetlands for "channel restoration."

2) Recommendations: Recommendations for the Final EIS are as follows:

o The Final EIS should clarify why fill into the Sandusky River is proposed for "channel restoration." Page 5-5 of the Draft EIS states, "The Proposed Action would provide a small level of assistance in training of the river and creating a new thalweg (i.e. line of lowest elevation within a watercourse); however, the channel would determine its own course based on water volume and velocity." If the channel will be allowed to determine its own course, then no fill or other interceding in its finding its new course should be required.

o The majority of the wetlands proposed to be permanently impacted are forested Class 3 wetlands. Due to their high quality, permanent impacts to these wetlands should be avoided to the extent required only to remove the dam and install the ICS system.

• The Draft EIS states that the Proposed Action would be "self-mitigating" and that no off-site compensatory mitigation for impacts (either direct or indirect) to wetlands is expected. Direct impacts to wetlands are currently proposed to be 0.67 (0.09 acre to Class 1 wetlands, 0.01 acre impact to Class 2 wetlands, and 0.57 acre impact to Class 3 wetlands.) acre; indirect impacts are proposed to be 53.90 acres (0.18 acre of Modified Class 2 wetlands, 1.23 acres of Class 2 wetlands, and 52.49 acres of Class 3). Indirect wetland impacts are attributed primarily to the loss of wetland hydrology associated with the drop in water level following dam removal. In addition to wetland fill, the loss of (via indirect impacts to) over 50 acres of wetlands, primarily high quality Class 3 forested wetlands, is of significant concern to USEPA. Many wetland functions and values will be lost if these wetlands revert to upland areas. While the Draft EIS states that there is the potential for the development of new wetlands in areas currently inundated by the Ballville Dam impoundment (in the range of23-55 acres), there is substantial uncertainty as to the quality, location, and acreage of wetlands that may actually develop post-dam removal. Furthermore, information provided in the March 2014 Section 404/Section 10 application to USACE states a prediction of 51 acres of wetland development (Including fringe, in-stream, or forested floodplain wetland types) in the vicinity of the dam removal.

3) Recommendations: USEP A does not concur that the Proposed Action would be self-mitigating. USEPA concurs with mitigation ratios for direct wetland impacts proposed in the Section 404/Section 10 application (2:1 for Class 2 wetland impacts and 3:1 for Class 3 wetland impacts). The Final EIS should be updated to include specific narrative information on proposed mitigation for direct wetland impacts. Additionally, USEPA recommends that USFWS continue to work with USACE to develop an acceptable mitigation ratio and mitigation plan to compensate for indirect wetland impacts that meets requirements of the 2008 Mitigation rule (40 CFR230). Details on mitigation for indirect wetland impacts (including mitigation ratios, mitigation type, mitigation location(s), etc.), should be included in the Final EIS.

• The Draft EIS states that there is the potential for the development of new wetlands in areas currently inundated by the Ballville Dam impoundment (in the range of23-55 acres). The March 2014 Section 404/Section 10 application predicts 51 acres of wetland development in the vicinity of the dam removal, yet then states a conservative prediction of 14.5 acres of wetland creation. While USEPA concurs that predictions regarding the exact size, location, and type of newly-formed wetlands post-dam-removal are uncertain, there are currently no substantive commitments proposed in the Draft EIS that ensure project implementation results in no net loss of wetlands.

4) Recommendation: USEP A encourages additional coordination between USFWS and the wetland regulatory agencies to ensure that project implementation does not result in a net loss of wetland. The Final EIS should discuss how USFWS is in compliance with Executive

Order 11990 (protection of Wetlands).

• The Draft EIS does not clearly discuss the effect the proposed project will have on lowering the pool elevation behind the dam. Information provided to USEPA by USACE on March 24, 2014, indicates that demolition of the dam will lower the pool elevation by approximately 30 feet near the dam. Page 5-2 of the Draft EIS states, "The upstream channel within the former pool would be expected to respond to this new elevation control with a series of adjustments such as upstream knickpoint migration, incision, and subsequent widening ... until a new stable bed elevation is achieved along the length of the current impoundment." However, there was no real discussion in the Draft EIS about the likelihood of instability over a period of many years as the river adjusts to a new, stable channel. In the interim period, the channel may headcut, which. May induce incision, wasting of banks, and channel widening. Channel instability may also contribute to erosion of the 20+ acres of exposed sediments proposed to be seeded and stabilized post-dam removal.

5) Recommendation: The Final EIS should include additional information on fluvial geomorphology changes expected or possible in the new channel as it forms post-dam

removal, and the potential for these fluvial processes to affect the proposed restoration efforts.

• The Proposed Action includes construction of an access ramp into the river to allow construction equipment to demolish the dam. The access ramp is "estimated to be 7,400 CY [cubic yards] of soil, rock, and concrete rubble." Additionally, the Draft EIS and the Draft Permitting Drawings (Appendix A, Sheet 7 of 19) did not discuss or show placement of any temporary culverts under the access ramp to allow for maintenance of river flow.

6) Recommendation: USEPA supports only the use of non-sediment-producing materials to construct the temporary access ramp (i.e., no dirt). Additionally, appropriately-sized culverts should be installed in the access ramp, particularly between Stations 11+00 and 13+00. This temporary access ramp is proposed to be in place for many months, and should allow for passage of normal river flow during the time it is in place.

• Installation of the ice control structures (phase 2C) appears to be proposed during active flow (wet conditions).

7) Recommendation: USEPA recommends that construction of ice control structures be done in the dry, using temporary dewatering methods, such as cofferdams, around each proposed concrete pier.

• The Draft EIS (Phase 2E) on page 3-6 proposes "channel restoration," which would include "placement of "28. 000 CY of fill consisting of offsite rock and soil materials as well as some concrete rubble from the demolished dam and leftover access ramp. This material would be used for grading of the new bank benches." This proposal is reiterated on page 5-9, "The remaining clean rubble would be used with other clean fill to complete other channel restoration goals.

Approximately 28, 000 CY of fill would be needed to reshape and guide the river channel after dam removal and installation of the ICS."

8) Recommendations: The Final EIS should include modifications that take into account, clarify, and otherwise provide narrative information on the following issues:

o What is meant by "other clean fill" on page 5-9?

o What is meant by "other channel restoration goals" on page 5-9?

o What is meant by "reshape and guide the river channel" as stated on page 5-91

o The statement to "reshape and guide the river channel" (page 5-9) appears to be in conflict with the statement on page 5-5, "The Proposed Action would provide a small level of assistance in training of the river and creating a new thalweg (i.e. line of lowest

elevation within a watercourse); however, the channel would determine its own course based on water volume and velocity." USEPA does not support efforts to establish a new river thalweg. The river should be left to establish its own new natural path post-dam removal.

o USEPA does not support placement of 28,000 cubic yards of concrete rubble or other "clean fill" as proposed in the Draft EIS. There is no justification for placement of this material within the river channel.

• The Draft EIS (Phase 3A) on page 3-6 describes "Bank stabilization/planting/stream work." However, the narrative that follows does not discuss any bank stabilization, plantings, or stream work.

9) Recommendation: In the Final EIS, narrative information for Phase 3A should be updated to describe any proposed bank stabilization efforts, the linear footage of proposed stabilization, and the type of stabilization, plantings, and work to be implemented. Reference to figures (either in the Final EIS or appendices) showing this work should be included. Plant lists for proposed plantings should be included. Additionally, USEPA supports the use of non-hard-armoring bank stabilization methods.

MITIGATION AND ADAPTIVE MANAGEMENT

• As no formal mitigation was proposed in the Draft EIS, there was no information provided on mitigation and adaptive management post-darn-removal.

10) Recommendation: The Final EIS should include a monitoring and adaptive management plan. The plan should include a description of proposed monitoring activities at wetland development sites upstream of the dam and any formal mitigation sites, including quantifiable and measureable success criteria for all ecosystem restoration work, and should specify the length of the monitoring period(s). Additional information on the party(ies) who will maintain mitigation/restoration sites in perpetuity should also be included.

WATER QUALITY

• The Sandusky River is listed as impaired (i.e., not meeting state water quality standards) (Including flow alteration(s), habitat alterations, nutrients (nitrate), polychlorinated biphenyls ([PCBs] in fish tissue), and sediment (sedimentation). on the OEPA Clean Water Act Section 303(d) list of impaired waterbodies. However, the Draft EIS did not include a discussion of 303(d)-listed impairments, nor did it include a discussion of implications to water quality for proposed impacts to 303(d)-listed waterbodies or to waterbodies upstream of a 303(d)-listed waterbody.

11) Recommendation: The Final EIS should provide information on the current impairments listed for the Sandusky River, and describe how implementation of the proposed project could potentially affect the waterbody (with regard to specific listed impairments).

• The Draft EIS (page 1-10) states, "Within the project area, the Sandusky River's Aquatic Life Use Standard is Warm Water Habitat (WWH). The Sandusky River was sampled at five locations between river mile (RM) 5.5 and J 8.05 in 2009. The Sandusky River at the Ballville Dam (RM J 8.05) was found to be in non-attainment of the WWH designation due to siltation and direct habitat alteration." However, the Draft EIS did not speak to how removal of the dam could or would modify aquatic life use water quality standards.

12) Recommendation: The Final EIS should provide additional information on how implementation of the proposed project could potentially affect aquatic life use standards in this portion of the Sandusky River.

THREATENED AND ENDANGERED SPECIES

• The Draft EIS on page 5-46 states, "Due to project schedule, clearing of 0.25 acres for the south workpad is expected to occur in September. During this time, Indiana bats could be migrating through the project area and using areas of suitable wooded habitat for roosting and/or foraging. In order to avoid direct effects to Indiana bats from removal of 0.25 acres of forest habitat during the migration period, the following actions will be taken: (1) a habitat assessment of the 0.25 acre area of tree clearing would be completed to identify any potential roost trees and assess the quality of the habitat for foraging; (2) if potential roost tree(s) exist, an emergence survey would be conducted, following Service protocol, to determine if bats are using the tree(s) for roosting; (3) if no bats are detected emerging from the tree(s), the tree(s) would be cut the day following the second night of survey; (4) if a bat(s) is detected emerging from the tree the tree would not be cut. Emergence surveys would be repeated until two consecutive nights without any bat emergence are documented. Then the tree(s) would be cut the day following the second night of survey. This would avoid direct impacts to Indiana bats from removal of roost trees. "

13) Recommendation: USEPA requests that the Final EIS include language duplicating these efforts [to avoid impacts to the Indiana hat] for the Northern Long-Eared bat.

• The Northern Long-Eared bat is proposed for listing under the Endangered Species Act (ESA) by USFWS. This bat utilizes forested habitat and may occur within portions of the project area, as 107.9 acres of potential habitat for this species exists within the project area. The Draft EIS indicates on page 4-28 that the Ballville Darn project area has not been surveyed for the Northern Long-Eared bat. While tree cutting on the north side of the river will adhere to seasonal restrictions (no tree cutting between April I and October I) to avoid direct impacts to bats and breeding birds, development of the south workpad proposes clearing of 0.25 acre before October 1st.

14) Recommendations: Following language in the Draft EIS to protect the Indiana bat, USEPA recommends that USFWS commit to the following in the Final EIS to protect the Northern Long-Eared bat:
o Coordinating all tree removal scheduled before October 1 with ODNR; and
o Assessing habitat and undertaking bat surveys (i.e. emergence counts) before tree clearing. In order to ensure no harm to wildlife, felling of trees over 7 inches diameter at breast height (DBII) should be undertaken after two nights of consecutive surveys showing no bat emergence from that specific tree (as per protocol discussed for the Indiana bat on page 5-46 of the Draft EIS).

HISTORIC PRESERVATION

• USFWS has determined that removal of the Ballville dam would have an adverse effect on the dam but not on the adjacent former hydroelectric plant. The Proposed Action would permanently remove the darn, thus removing it from eligibility for listing on the National Register for Historic Places. Due to the permanency of the action, this adverse effect is considered a significant impact. The Draft EIS states on page 2-25, "A Programmatic Agreement [PA] between the Ohio Historic Preservation Office [OHPO], the [US. Fish and Wildlife] Service, and the Consulting Parties is currently being developed. "A draft of this PA was included in appendices to the Draft EIS.

15) Recommendation: The Final EIS should include copies of correspondence sent to and received from the OHPO since the publication of the Draft EIS, with updates on the status of the PA provided. Information on the status of mitigation development for the adverse effect should also be included.

VEGETATION AND WILDLIFE HABITAT

• Approximately 0.25 acre of tree removal is proposed adjacent to the Sandusky River to create access to the south abutment (Phase lA), along with 0.30 acre of tree removal to construct the northern access ramp to the dam (phase 2B). Forested impacts appear to be slightly over 0.50 acre total. Page 6-13 of the Draft EIS states, "…the 0.5 acres of forested area would in part be seeded and returned to a natural state post construction, although would not be readily returned to forested area." The Draft EIS was unclear on why these areas could not be replanted to forested area.

16) Recommendation: The Final EIS should include a commitment to reforest all forested areas proposed to be cleared, using trees native to northwest Ohio.

• The Draft EIS states on page 3-3 and 3-4 that as a result of the Phase 1 south notching of the dam, approximately 20 acres of sediment currently inundated by the impoundment would be exposed, and that "an approved mixture of seed would be broadcast across the exposed surface

then mulched to prevent sediment erosion and seed desiccation." However, a plant list was not provided in the Draft EIS or appendices.

17) Recommendation: The Final EIS should include a plant list proposed for seeding of exposed areas upstream of the dam. The list should include species common name, Latin name, wetland indicator status, and broadcast rate.

SEDIMENTS AND SEDIMENT RELEASE

• The Draft EIS did not discuss testing of the sediments impounded behind the Ballville Dam. No discussion was provided on how a decision was made to release sediments downstream versus excavate them for beneficial reuse or for proper upland disposal.

18) Recommendation: The Final EIS should include additional information on sediment testing and how the determination to flush sediment downstream (versus removing it) was made.

PROJECT CLARIFICATION AND ADDITIONAL INFORMATION

• Temporary access roads are proposed to be constructed on both the north and south sides of the river. Page 5-58 of the Draft EIS states that the areas disturbed to construct temporary access roads will be re-graded and reseeded. However, areas to be deforested are not proposed to be reforested as part of restoration efforts.

19) Recommendations: The Final EIS should confirm that all areas where temporary access roads will be constructed will be re-graded back to original grade, reseeded with native vegetation, and replanted with trees (in areas where trees will be removed).

• The Draft EIS was not clear on the final disposal locations for both bedrock removed for ICS installation as well as concrete removed from dam removal and seawall deconstruction. A small amount of concrete debris (1,900 cubic yards) from dam demolition will be directed to fall into two scour holes located downstream of the south spillway and north overflow. Page 3-6 of the Draft EIS suggests that the rest of the concrete rubble (28,000 cubic yards) may be utilized to grade a channel lead starting 300 feet upstream of the dam (which USEPA does not support; see comments on Page 5). However, the Draft EIS is not conclusive that this is necessary.

20) Recommendation: The Final EIS should identify the final disposal location for all waste (including bedrock and concrete) to be disposed offsite. The Final EIS should also provide assurances that no waste streams will be disposed of in other Waters of the United States.

• The Draft EIS referenced general topics and concerns identified during the scoping process, but did not include specific scoping comment letters and emails received or formal responses provided to any of the recommendations.

21) Recommendation: The Final EIS should include an appendix with all comment letters and emails received from all agencies, entities, and individuals, and provide direct, specific line by- line responses to comments and recommendations received on the Draft EIS. The Final EIS should also include an appendix that contains copies of correspondence sent to and received from any other state or Federal agencies regarding the project.

Response:

Thank you for your comments, please see below our detailed response by section outlined in your submission. We have added numbering to help identify our specific responses to each recommendation.

1) At a minimum, wetland mitigation will include a holistic mitigation plan based on identified debits and credits to the Sandusky River ecosystem in the immediate area of the Ballville Dam and impoundment area, as well as to the downstream watershed. The current proposal for wetland mitigation is detailed in the "Ballville Dam Removal and Sandusky River Restoration Project Pre-Construction Notification—401/404 Permit Application" (Application) submitted to the Corps and Ohio EPA, and dated March 6, 2014. In summary, the Application included "in-kind" wetland mitigation of at least 14.5 acres of wetland restoration within the former impoundment. The Application also included "out-of kind" mitigation through restoration of the Sandusky River in the project area. The Application described out-of kind mitigation as follows:

> "The removal of the Ballville Dam restores a valuable aquatic resource, the Sandusky River, and provides benefit to both the local and regional environments. Table 8-14, provides a summary of those benefits and assigns their increased function to a credit value compared to the debit value of what will be lost. Functional equivalence ratios were determined by evaluating the functional quality of existing and proposed aquatic and wetland resources. For example, based on data collected within the Ballville impoundment and from nearby areas in free flowing reaches of the river it is expected that fish community scores will increase by a factor of 1.3 to 1.6, aquatic macroinvertebrate scores should increase by a factor of 5.7 to 9.7, QHEI scores should increase by a factor of 2.3, walleye spawning habitat will increase by a factor of 15, and fish access to mainstem river habitats will increase by a factor of 2.2."

The Service and the City of Fremont are continuing to work with the Corps and Ohio EPA to develop a mitigation plan that will meet the requirements of Section 401, 404, and 10, described in the context of the 401 and 404 permits. Implementation of the plan will be included as a condition to the 404/401/10 permits. At the time of this EIS, the wetland mitigation plan had not been finalized so the details of the final mitigation plan are not available.

As part of their standard permit review under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, the Corps will produce an Environmental Assessment (EA). The Corps will incorporate by reference, relevant portions of the Service EIS, but will also add additional information where necessary addressing wetlands mitigation before issuing their permit.

2) The location of the notch and the sequence of dam demolition are both measures intended to encourage the river to form a low flow channel close to the south bank in the vicinity of the ICS. Both historical photographs and river mechanics suggest that this is the natural location for the river. Consequently, the concrete columns for the ICS are also proposed in locations along the south side of the river extending northward across the low flow channel and floodplain. The proposed channel grading will consist of 1) placement of fill downstream of the current dam location, and 2) fill cut upstream of the current dam location. This channel shaping will result in construction of a terrace (see Section A-A' on sheet 8 of 19 in Appendix A5). Without this terrace the river could potentially flank the ICS rendering it ineffective. Additional detail has been added to EIS Section 3.1.1.2.5.

In Section 3.1.1.2.5 we describe the notching of the dam in Phase 1B is designed to "train" the river to flow through the restoration area to the south (Sheet 10 of 20 of Proposed Action Memo Appendix A4). While it is expected that the river would naturally grade it, there may be need to grade a channel lead starting approximately 300 feet (91.4 meters) upstream of the dam. Once the stream reaches bedrock the stream would be fairly set and grading of the benches on either bank can occur. Any rubble used as fill would be buried with soil. Earth moving equipment such as track hoes, bulldozers, and other equipment would be used to grade the benches (Section 3.1.1.2.2) such that they would have a more gradual slope along the sea wall and downstream to the access point. Grade ratio would depend on need at the time of restoration. Stabilization measures would be used to prevent erosion. These measures include seeding and vegetative strategies designed to control invasive plant colonization. A planting plan was designed, detailing a planting list (common name, Latin name, and wetland indicator) for each seed mixture species and the estimated seeding rate (Appendix A6). The planting plan will be part of the Section 404/401 Clean Water Act permit application and water quality certification process.

Additionally, in Section, 5.2.2.1.2 we indicate that under the proposed action alternative approximately 1,900 CY of clean concrete rubble fill from the demolition would remain permanently in two concrete disposal areas that are approximately 0.2 and 0.5 acres (0.1 to 0.2 hectares) in size in order to level the river bed and fill the scour pools. These onsite concrete disposal areas are depicted on Figure 3-1. The remaining clean rubble would be used with other clean fill to complete other channel restoration goals. Other restoration goals could include shaping the floodplain topography to promote the formation of fringe wetlands and/or floodplain wetlands, addressing rilling or gully formation on exposed sediments upstream of the dam, or other adaptive actions to address erosion or habitat enhancements as upstream river conditions

change (Also see Section 5.2.2.3.4). Approximately 28,000 CY of fill would be needed to reshape and guide the river channel after dam removal and installation of the ICS. This fill would be placed in and along approximately 866 linear feet of the Sandusky River, and would cover approximately 4.38 acres.

The total area of directly impacted Category 3 wetlands is 0.57 acres. The main activities causing these direct impacts are placed rock and soil fill for the access ramp, channel restoration, installation of the ICS, and placed soil for bank stabilization (if needed) near the intake for raw water reservoir.

Proposed fill in wetlands 14 and 15 totals 0.10 acres and will only be placed if needed. This fill would be placed to stabilize the existing intake for the water supply reservoir. These wetlands are located directly adjacent to the intake, but impacts will be avoided if at all possible (Figure 5-2).

Impacts to Wetlands 17, 18, and 19 (all Category 3 wetlands) total 0.47 acres. These wetlands are located within the main area of construction adjacent to the dam (Figure 5-1). Wetlands 18 and 19 are primarily being filled to allow temporary access to the dam, but fill is planned to be removed once construction is complete. However, it should be noted that wetland 18 and 19 may also be impacted by channel shaping/grading, if necessary, once the stream channel flow has settled in its primary location. A small amount of fill will be placed in wetlands 18 and 19 for construction of the ICS. As stated above, the channel shaping will keep the river in the low flow channel where the ICS will be constructed.

While the project design has incorporated as many measures as possible to avoid direct impacts (placement of fill) in Category 3 wetlands, due to the proximity of Category 3 wetlands to the dam and areas immediately surrounding it, all impacts could not be avoided.

3) The Service and the City of Fremont are continuing to work with the Corps and Ohio EPA to develop a mitigation plan that will meet the requirements of Section 401, 404, and 10, described in the context of the 401 and 404 permits. See response to USEPA Comment 1 above. Implementation of the plan will be included as a condition to the 404/401/10 permits. At the time of this EIS, the wetland mitigation plan had not been finalized so the details of the final mitigation plan are not available. The Corps will produce an Environmental Assessment (EA). The Corps will incorporate by reference, relevant portions of the Service EIS, but will also add additional information where necessary addressing wetlands mitigation before issuing their permit. The term “self-mitigating” has been removed from the EIS.

4) Currently, these issues are not resolved. We are waiting for the Corps’ decision on whether out-of-kind mitigation (i.e., restoration and enhancement of Sandusky River habitat and water

quality) is an acceptable form of wetland mitigation that would result in no-net loss for wetlands from this project. Coordination and consultation to resolve these components of the 404 process between the City and the Corps, with our agencies including the Service will continue.

Executive Order 11990, Protection of Wetlands (E.O.) directs that Federal agencies shall "… provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for …providing Federally undertaken, financed, or assisted construction and improvements…" Further, "… each agency, to the extent permitted by law, shall avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds (1) that there is no practicable alternative to such construction, and (2) that the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use." E.O. 11990 also provides for opportunity for public review of plans for new construction in wetlands (including draining of wetlands).

Agencies are directed to consider "factors relevant to a proposal's effect on the survival and quality of the wetlands. Among these factors are: (a) public health, safety, and welfare, including water supply, quality, recharge and discharge; pollution; flood and storm hazards; and sediment and erosion; (b) maintenance of natural systems, including conservation and long term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources; and (c) other uses of wetlands in the public interest, including recreational, scientific, and cultural uses."

The Proposed Action would result in some indirect wetland impacts (wetland drainage) from loss of hydrology due to drawdown of the impoundment (included under "New construction" in the E.O.). Some existing wetlands within the impoundment will be dewatered and revert to upland areas, while new wetlands will be created adjacent to the River's new location. The Service is working with project partners to complete the Section 10/404/401 permitting processes, including developing a detailed comprehensive mitigation plan to offset the impact of the potential wetland losses within the Sandusky River ecosystem. Through this permitting process the cooperating agencies will come to an acceptable resolution regarding the impacts to wetlands in the area due to the Proposed Action (or Alternative 3) as we strive for a balanced approach to habitat restoration in the project area.

While the Proposed Action would result in some indirect wetland impacts from loss of hydrology due to drawdown of the impoundment, the Service has also considered whether there are other practicable alternatives to this alternative and what measures could be implemented to minimize harm to the wetlands. In this EIS we fully analyze multiple other alternatives to the action (for summary see Table 6-1) and describe minimization measures for each alternative (EIS Section 5.2.2.3, 5.2.3.3, 5.2.4.3, and 5.2.5.3). Further, the EIS also considers the impacts of the project on the relevant factors described in the E.O. (See Table 6-1).

In summary, though wetland losses may result from loss of hydrology within the former impoundment, the Cooperating agencies are currently working through the Section 10/404/401 permitting processes to develop a comprehensive mitigation plan that will offset wetland impacts within the context of the Sandusky River Ecosystem. The Service has evaluated multiple alternatives, their effects on the human environment, and has engaged the public in review of the alternatives. The Proposed Action would result in improved public safety, improved water quality within the Sandusky River, maintained flood control, enhanced natural systems, enhanced natural hydrological processes, benefits to native fish and wildlife species, and maintained recreational uses (Table 6-1). Thus we believe that the Proposed Action is consistent with the intent of the E.O.

We will include in the Final EIS a discussion of how Service is in compliance with Executive order 11990 in Section 5.2.2.2.4.

5) Sediment transport dynamics are described in detail in Appendix A11. The channel is expected to reach a relatively stable position within one to two years of the complete removal. The data presented in Major et al. (2012) demonstrated that approximately 50 percent of the stored sediment volume was exported in the first year after removal, but only six percent in the second year despite much higher flows. The small magnitude of export in the second year is an indication of a channel approaching stability. Ballville Dam differs from Marmot in several key characteristics (e.g. small sediment grain size), nonetheless, adjustment is expected to require only a few years not “many” years as indicated in the comment. The volume of sediment estimated for export is 450,000 – 700,000 CY. Additional discussion has been added to EIS Section 5.1.2.2.

6) The access ramp leading from the north river bank to the downstream face of the dam will be constructed using concrete rubble, natural rock, and crushed rock. The access road will be constructed after the initial notch has been cut through the south spillway and the reservoir has been significantly lowered. Water is not anticipated to discharge over the north spillway section of Ballville Dam during the Phase 2 Construction period when the river flows are typically at the lowest levels of an annual cycle and the river is being diverted through the notch. The profile of the proposed access road includes a low point in the vicinity of the river bed near the north river bank and downstream of the north spillway. This low point in the access road will act as a ford or low water crossing. Should the project site experience a rainfall event that raises the reservoir level and allows water to discharge over the top of the north spillway, the water will then discharge over the low water crossing and continue downstream.

As needed dependent on conditions, the contractor may elect to install small culverts on the order of 24 to 48-inches in diameter in the current low point of the access ramp to allow any water that may seep through the spillway or north abutment of the dam to drain downstream without impacting the usability of the causeway.

7) A description has been added to section 3.1.1.2.3 and 3.1.4.1.2 regarding the installation of the ICS and more detail regarding work to be done in the dry. An excerpt from that section now reads:

The installation of the ice control structure (ICS) can be performed during modestly active flow conditions anticipated during the low flow annual periods. The Contractor would use best management practices to isolate drill cuttings and prevent concrete from entering the watercourse during installation of the piers. The Contractor would implement water management practices during the installation of the ICS piers to maintain flow in the Sandusky River.

The contractor will access the pier locations using equipment placed directly in the riverbed. During drilling and construction of the piers, river flow will be temporarily diverted around the immediate work area, thereby preventing drill cuttings and concrete from entering the watercourse. It is assumed the contractor will use a large track-mounted drill rig to core bedrock. Drill cuttings may be used onsite for the access ramp to the dam. Concrete for the ICS piers will be delivered from local suppliers using commercial rubber-tired transit mixers.

The riverbed in this area is exposed bedrock with a few areas covered or filled with fine and course sediment. The contractor may require further temporary leveling for equipment access and safe construction. Leveling material, such as sand and gravel, may account for approximately 50 cubic yards of temporary fill within the Sandusky River.

The contractor, in conjunction with the planned access ramp for the dam, would likely build a temporary access road parallel to the entire length of the ICS alignment (Figure 3-1). This road would facilitate access for smaller rubber-tired vehicles and be safer for workers on foot. The road would contain approximately 700 cubic yards of fill, mainly placed within the Sandusky River (540 cubic yards, 0.103 acres). Of the 700 cubic yards, approximately 80 cubic yards would be placed within Jurisdictional Wetland 18 (0.019 acres) and 80 cubic yards in Wetland 6 (0.015). The access road would be comprised of materials, such as large gravels and cobbles, capable of withstanding river flow. The road may have a low section to pass water flow over the access road surface. Alternatively, a number of conduits may be installed beneath the road to pass expected flows. River diversion may be local to each pier or installed to surround groups of piers as construction proceeds. River flow may be diverted partially, depending upon the location of the work. Flows through main channels would be split around pier worksites within the center of the channel. The particular system used to accomplish this would be the responsibility of the Contractor and done using best management practices.

For ICS construction, the contractor would generally follow the below sequence:

1. Create a level access path for the construction equipment (or the equipment would travel on the exposed rock river bed) along the ICS alignment.

2. Install a river diversion system (coffer, water dams, etc.) in order to work “in the dry.”

3. Install drip pans/trays beneath equipment to catch oil and gas leaks.

4. Install a local diversion (sandbags, etc.) at each pier site to guard against cuttings and concrete from entering the water course. Deploy seepage sumps and pumps.

5. Upon completion of construction remove from the river bed any equipment, materials and placed fill.

8) The location of the notch and the sequence of dam demolition are both measures intended to encourage the river to form a low flow channel close to the south bank in the vicinity of the ICS. Both historical photographs and river mechanics suggest that this is the natural location for the river. Consequently, the concrete columns for the ICS are also proposed in locations along the south side of the river extending northward across the low flow channel and floodplain. The proposed channel grading will consist of 1) placement of fill downstream of the current dam location, and 2) fill cut upstream of the current dam location. This channel shaping will result in construction of a terrace (see Section A-A' on sheet 8 of 19 in Appendix A5, Section 3.1.1.2.5 of the Final EIS). Without this terrace the river could potentially flank the ICS rendering it ineffective. "Other clean fill" would consist of loamy river sediment cut from the graded areas upstream of the dam and potentially rock used in construction of the causeway. All filled loamy areas, excluding the ICS maintenance access road, will be planted with native vegetation according to the planting plan presented in Appendix A6. Other restoration goals could include shaping the floodplain topography to promote the formation of fringe wetlands and/or floodplain wetlands, addressing rilling or gully formation on exposed sediments upstream of the dam, or other adaptive actions to address erosion or habitat enhancements as upstream river conditions change (Also see Section 5.2.2.3.4). The intent of this is to provide flexibility to address erosion, address gully formation, or rilling in extreme cases.

9) The planting plan will be submitted as appendix A10. The construction plans under the Proposed Action and Alternative 3 will also have the planting plans included, which include planting zones, cost estimates, environmental covenant, and plant species list.

MITIGATION AND ADAPTIVE MANAGEMENT

10) The Service and the City of Fremont are continuing to work with the Corps and Ohio EPA to develop a mitigation plan that will meet the requirements of Section 401, 404, and 10, described in the context of the 401 and 404 permits. Implementation of the plan will be included as a condition to the 404/401/10 permits. At the time of this EIS, the wetland mitigation plan had not been finalized so the details of the final mitigation plan are not available. The Corps will produce an Environmental Assessment (EA). The Corps will incorporate by reference, relevant portions of the Service EIS, but will also add additional information where necessary addressing wetlands mitigation before issuing their permit. The components mentioned in your

recommendation will be included in the final mitigation plan as components of the Section 401, 404, and 10 processes.

WATER QUALITY

11) This language has been added to the EIS. Please see Section 5.2.2.2.5 regarding specific impairments listed for the Sandusky River and the expected impacts of the Proposed Action on the waterbody.

12) An easement for stream mitigation sites will not be required if the project is considered self-mitigating and out-of-kind mitigation would be accepted. However the appropriate performance standards for aquatic life use designation (via QHEI score increase) and timeline will need to be provided in a formal proposed monitoring report.

The Sandusky River is listed as impaired on the OEPA Clean Water Act Section 303(d) list of impaired waterbodies. The 2008 Waterbody Report for Sandusky River Mainstem (State List ID 04100011 001, Downstream Tymochtee Creek to Mouth) states that the impairments to the Sandusky River include flow alterations, habitat alterations, nutrients (nitrate), PCB's in fish tissue, and sedimentation / siltation.

Removing the dam will improve habitat conditions by restoring a riverine system to the former impoundment. This action will improve water quality, and restore free-flowing riverine habitat that was altered by the presence of the dam. Additionally, the dam currently traps fine sediment, causing excessive siltation at RM 18.05. Removing the dam will reduce the accumulation of silt and other fine sediments in this reach of the Sandusky River, and will restore coarse sediment transport to downstream reaches. This action will not reduce the input of nutrients into the Sandusky River watershed, nor will it reduce the presence of PCB's in fish tissue. No PCB contamination was found in the sediment cores from a study of the Ballville Dam Impoundment by Evans and Gottgens (2007), therefore we do not believe that the sediment release will exacerbate the fish contamination issue.

The Sandusky River at RM 18.05 (Sandusky River Upstream Ballville Dam) is in non-attainment of the Aquatic Designated Life Use Standards caused by siltation and direct habitat alteration from the Ballville Dam. Removing the dam will reduce the accumulation of silt and other fine sediments in this reach of the Sandusky River, and will restore coarse sediment transport to downstream reaches. Aquatic fish and macroinvertebrate community index scores were below the threshold for WWH biocriteria, indicating that this reach has impaired biological communities (See Section 4.2.2.4.1 *Designated Beneficial Uses*). The dam alters habitat conditions and impairs aquatic communities. Removing the dam will improve habitat conditions by restoring a riverine system to the former impoundment. This action will improve water quality, and restore free-flowing riverine habitat that was altered by the presence of the dam.

The above information has been added to the EIS Section 5.2.2.2.5.

THREATENED AND ENDANGERED

13) & 14) The Northern long-eared bat was proposed for listing under the Endangered Species Act (ESA) on Oct. 2, 2013. No critical habitat has been proposed at this time. A final listing decision is expected by April 2, 2015. Species proposed for listing are not afforded protection under the ESA; however as soon as a listing becomes effective, the prohibition against jeopardizing its continued existence and "take" applies regardless of an action's stage of completion. Therefore any adverse effects to Northern long-eared bats that might occur due to clearing of 0.25 acres of trees prior to April 2, 2015 are not prohibited, though other avoidance and minimization measures have been proposed to minimize potential effects to this species both prior to listing, and if a decision is made to list the species.

We appreciate USEPA's comment suggesting emergence surveys to document Northern long-eared bat roost trees. However, northern long-eared bats do not always use the same kinds of trees (large dead trees) for roosts as Indiana bats do. They generally use smaller trees with cracks or crevices, and may roost low to the ground. Therefore emergence surveys may not be effective at detecting (and thereby avoiding impact to) this species.

Clearing of trees between Oct. 1, 2014 and March 31, 2015 falls within the time frame when Northern long-eared bats would be hibernating and not using forested summer habitat. Therefore tree clearing between Oct. 1 and March 31 is not likely to adversely affect Northern long-eared bats. If the species is listed and tree clearing is to occur between April 1 and September 30, 2015, surveys to detect the presence or likely absence of the species within the areas to be cleared would be implemented. If Northern long-eared bats are detected during the surveys and take of the species cannot be avoided, then formal consultation under Section 7 of the Endangered Species Act will be implemented.

Additional language has been added to the EIS Sections 5.4.2.1.1 and 5.4.2.3 to reflect these changes.

Because the species is proposed to be listed under the Federal ESA, consultation with the Service under Section 7 of the ESA is appropriate if the species is listed. The Northern long-eared bat is currently listed as a "species of concern" by Ohio DNR. Ohio DNR is a cooperating agency on this EIS and has reviewed and provided comment on this document multiple times. The Service will continue to coordinate with ODNR on the content of the EIS, including avoidance and minimization measures to protect the Northern long-eared bat.

HISTORIC PRESERVATION

15) Included in the Draft EIS appendices were copies of correspondence to that point regarding Historic Preservation, including the draft Programmatic Agreement. Included as appendix D to the Final EIS is our correspondence with the Ohio Historic Preservation Office as well as the signed Programmatic Agreement. EIS Section 5.8 has been updated to reflect the information in

the signed Programmatic Agreement. Further, information on impacts and mitigation are included as a component of the Programmatic Agreement (Section 2.4).

VEGETATION AND WILDLIFE HABITAT

16) Information regarding in-kind-mitigation (PFO to PFO) is discussed in the planting plan memo. Within the planting plan a commitment is made to reforest the site by planting bare root saplings and containerized trees. However it is made apparent that the main objective of the planting plan is to stabilize the site and combat the proliferation of reed canarygrass. This will allow the local seedbank to successfully propagate forest succession. The only disturbed area that is not proposed to be planted is the north access path. The project plan is to maintain this path for future maintenance of the ICS and as a possible public access to the river for the City and local community.

17) A planting plan was designed and submitted as a memo and can be found in Appendix A6. Included in the plans are a detailed planting list (common name, Latin name and wetland indicator) for each seed mixture species and the estimated seeding rate.

SEDIMENTS AND SEDIMENT RELEASE

18) Additional detailed discussion of sediment quality in Ballville Impoundment has been added to the EIS, please see Section 4.2.2.4.4. We have added an Alternative to EIS Section 2.3.7 to describe an option to dredge the Ballville Dam impoundment prior to dam removal, and why this alternative was not selected for further analysis. Data for this discussion is based on a memo from Stantec (2013) titled "Opinion of probable cost for dredging the Ballville Dam impoundment" which discusses the potential costs of dredging the impoundment. That memo has been included as Appendix A2 to the EIS.

PROJECT CLARIFICATION AND ADDITIONAL INFORMATION

19) Within the planting plans memo is a description of each planting zone and its disposition post project. Planting zone 5 covers the south abutment access road. This area will be seeded with native upland grasses and forbs. Re-grading will not be necessary. Planting zone 4 represents the south abutment staging area. This area will have containerized trees planted. Grading will not be necessary. The access road to the north that leads to the channel restoration area (Planting Zone 3) is not included on the planting plans. This access road is currently a wide trail which will require some expansion and stabilization for heavy equipment during dam removal. The project plan is to maintain this path for future maintenance of the ICS and as a possible public access to the river for the City and local community.

20) Montgomery Watson Herza (MWH) will be responsible for determining the disposal site of the waste material, and moving the material to the disposal site. This is meant to allow them to

select the nearest and best suited disposal sites depending on the material being removed and the current status of the different receiving locations. Waste material moved offsite will not be disposed of in waters of the United States. Some material described previously as "clean" fill will be utilized as noted in section 3.1.1.2.4 and section 3.1.4.1.3 within the Sandusky River immediately downstream of the dam site. "After completion of the ICS, demolition of the dam would commence. Approximately 15,000 CY of dam rubble would be removed, of which potentially 1,900 CY could be used to fill scour holes below the existing dam. Rubble from the dam is not expected to transport downstream. Smaller pieces, the size of gravel, could potentially transport but would not be expected to occur in measureable volumes."

21) As discussed and clarified during a phone conversation with EPA, all correspondence relating to comments on the Draft EIS have been included within this section of the Final EIS appendix (B2). This includes all comments received and the written responses regarding how the comment was addressed in the EIS.

Ballville-2014-28, Name: Krawczyk, J.; U.S. Army Corps of Engineers
Comment:
The following Corps of Engineer comments are provided in response to the Service Ballville Dam Project DEIS, published on January 24th, 2014:

1. Page 1-2: States that Goal 3 of 6, of the GLRI Act is, "enhancement and creation of wetlands that result in net gain in the amount of those habitats." **The DEIS document would not support goal 3 of the GLRI Act, if the proposed action and/or alternative 3 resulted in the net loss of wetland habitat. Subsequent sections of the DEIS document indicate that the project could result in a net loss of between 14.1 to 45.9 acres of forested floodplain wetland habitat, from indirect impacts (due to loss of hydrology).**
2. Page 1-2: Indicates that in 2010, a task force of 16 federal agencies and many of the region's governors released the GLRI Action Plan covering five urgent issues called focus areas. One of the focus areas was "Restoring wetlands and other habitats." **The DEIS document would not support the wetland restoration focus area, if the proposed action and/or alternative 3 resulted in the net loss of wetland habitat. Subsequent sections of the DEIS document indicate that the project could result in a net loss of between 14.1 to 45.9 acres of forested floodplain wetland habitat, from indirect impacts (due to loss of hydrology).**
3. Page 1-12: Section 1.5: In part, the paragraph states that, these actions (restore natural hydrological processes over a 40-mile stretch of the Sandusky River, re-open fish passage to 22 miles of new habitat, restore flow conditions for fish access to the new habitat above the impoundment, and improve overall conditions for native fish communities in the Sandusky

River) would support the goals of the Act and the GLRI. **See Corps comment 1 above, regarding GLRI goal 3.**

4. Page 2-18: Table 2-1: **The Alternative numbers noted in the "Results" column, for alternatives 6-10 do not match the Alternative numbers noted in the "Alternative Number" column.**

5. Pages 1-12 and 1-13: Sections 1.5 (Purpose for the Federal Action) and Section 1.6 (Need for the Federal Action): **These two sections are verbose. For improved clarity, the Corps suggests including a succinct and clearly articulated project 'Purpose' and 'Need'. The 'Need' would clearly describe the problem and the 'Purpose' would clearly describe the action(s) that is being proposed to solve the problem(s)**. **For example, "The purpose of the proposed project is ___. This purpose will satisfy the following need(s)."**

6. Pages 3-3 & 3-4: Based on the description: Concrete rubble from the dam will be directed into scour holes below the dam during Phase 1B (November 2014). Concrete rubble would remain in the river until the end of Phase 3 (fall 2016). **Why does this rubble have to remain in the river for this length of time? Can this material be removed to an upland location, during the demolition process?** Updated: 3-26-14

7. Page 3-6: 3rd paragraph of 3.1.1.2.4: Indicates that approximately 1,900 cubic yards of clean concrete rubble fill (out of 15,000 cubic yards of concrete rubble from dam demolition), would remain in the scour holes, to level the river bed. **Why is it necessary to keep this fill in place?**

8. Page 3-6: 3.1.1.2.5: Indicates that, "Restoration of the project area would include approximately 28,000 CY of fill consisting of offsite rock and soil materials as well as some concrete rubble from the demolished dam and leftover access ramp." **How would the applicant ensure that only clean concrete rubble would be used?**

9. Page 3-7 & 3-8: Table 3-1 (Proposed Action Estimated Cost Opinion): This section indicates that there are $2 million awarded by the Service (through the Great Lakes Fish and Wildlife Restoration Act to ODNR) and approximately $5.8 million awarded by OEPA through the WRRSP program to carry out the dam removal alternative. The 'Total Dam Removal Costs' indicated in Table 3-1 is approximately $6.4 million. Similarly, Table 3-5 on page 3-25, 'Proposed Action Estimated Cost Opinion' for Alternative 3 indicates a 'Total Dam Removal Cost' of approximately $5.9 million. **This information seems to indicate that excess funds of $1.1 - $1.9 million may be available. Could excess funds be used to mitigate direct and indirect (secondary) wetland impacts that are described in subsequent sections of the DEIS document?**

10. Page 3-17: 3.1.3.1.5 (Sorting System): This section indicates that a fish elevator system could be configured to allow the removal and disposal of upstream migrating invasive species such as Asian Carp and Sea Lamprey, if present. **Is there a protocol in place to deal with invasive aquatic species in a newly opened habitat, in the case of dam removal?**

11. Page 4-5: Table 4-1 (Streams Identified Within the Ballville Dam Project Area): **Is there a corresponding map, which identifies the locations of these streams?**

12. Page 4-6: 3 and 4th Paragraphs: **The described landmarks (e.g., River Cliff Golf Course, Roger Young Park) are not correlated with a corresponding map. Is a corresponding map available to assist in readers with this description?**
13. Page 4-4: 4.2.2.2 (Surface Water): Includes a reference to USACE 2011b. **It's unclear to what this reference is pointing.**
14. Page 4-10: Section 4.2.2.3 (Wetlands): This section indicates that "Figure 3-3 provides the locations of wetlands within the Project Area." **Figure 3-3 is the Fish Elevator Conceptual Design Plan. Is there another figure that clearly illustrates the location of wetlands within the project area?**
15. Page 4-16: 4.31 (Scope of Analysis): **The statement that, "This section does not discuss rare, threatened, or endangered species as these are discussed earlier" seems misplaced. The threatened and endangered species evaluation and discussion occurs later in the document, not earlier.**
16. Page 5-8: 5.2.1 (Impact Criteria): This section states (in part) that, "Project effects to water resources would be considered significant should any of the following result: (bullet one) Lost function of wetlands, streams, and/or floodplain." The second paragraph of this section further states, "Impacts to water resources are discussed in the following sections as either direct or indirect" and that, "Indirect or secondary impacts refer to hydrological alteration that may consequentially occur as a result of dam removal." **This section of the DEIS defines and prefaces *direct* and *indirect* impacts to wetlands and also indicates that lost wetland functions would be considered a significant effect. Therefore, by this documents own account, compensatory wetland mitigation, to offset direct and secondary impacts to federal wetlands should be considered in this DEIS. Presently, subsequent sections of the DEIS do not propose active compensatory mitigation for large wetland impacts associated with the proposed action and alternative 3. The document instead refers to the proposed action and alternative 3 as self-mitigating.**
17. Page 5-9: 5.2.2.1.2 (Surface Water): **First paragraph refers to streams illustrated on Figure 4-3. This figure does not appear to illustrate streams as stated.**
18. The main body of the DEIS document (e.g., Section 5.2 WATER RESOURCES) does not appear to contain a figure illustrating the location of wetlands that are discussed in this section of the document. Additionally, there does not appear to be a reference to such a map in the DEIS appendix. Could such a figure be added to this section?
19. Page 5-10: 5.2.2.1.4 (Wetlands) and Table 5-1: **Indicate 0.67 acre of direct wetland fill from the proposed action. However, Page 5-12 (paragraph3) indicates 0.62 acre of direct wetland impact. Which of these values is correct?**
20. Page 5-18 (Fringe Wetlands): potential for approximately 13.2 acres of fringe wetland to be recovered along the banks of the Sandusky River. **Please define 'recovered wetland'?**
21. Pages 5-19 thru 5-20 (Forested Floodplain Wetlands): According to this section, "49.9 acres of Forested Flood Plain wetland would be subject to indirect impacts from loss of hydrology; potentially 35.8 acres of new wetland could be formed, which totals a net loss of 14 acres of

forested floodplain." This section also indicates that the newly exposed sediment "would be seeded with native riparian vegetation" and that "Adaptive management strategies would be used depending on actual exposed areas, substrate, and property ownership." **This section of the document does not provide any detail on proposed wetland plantings. The use of the term 'riparian vegetation' suggests that the forested wetland would be replaced with a non forested wetland type. The Corps recommends that the applicant first consider in-kind replacement of lost wetland types (i.e., replacing forested wetlands with a forested wetland type). Additionally, a replacement ratio of 0.2:1 seems inadequate to replace a high quality, forested floodplain wetland.**

22. Page 5-21 (Table 5-2 Wetland Type and acreage before and after the dam is removed showing the net gain/loss of wetland upstream of the dam): This table indicates a post construction range of forested wetland type from 4 to 35.8 acres. This range of expected forested wetlands would result in a net loss of -14.10 to -45.90 acres of Forested Floodplain wetland type. **The Corps recommends that: a. A definite and unambiguous compensatory wetland mitigation acreage be provided (in place of the a range of possible post-construction wetland acreage outcomes provided within this DEIS); b. A comprehensive wetland planting plan be provided; and c. Concrete performance goals (e.g., X acres of wetland will be constructed by X date) be provided (in place of the 'adaptive management' approach discussed within this DEIS). Additionally, the Corps recommends that the applicant consider in-kind mitigation for loss to 49.9 acres of forested floodplain wetland. A net loss of between 14.1 and 45.9 acres of wooded wetlands is large and must be given larger consideration than has been offered in this DEIS document.**

Furthermore, this wetland loss appears to run contrary to the previously stated GLRI goal (3), of 'enhancement and creation of wetlands' (page 1-2 of the DEIS); the GLRI Action Plan focus area of, 'restoring wetlands and other habitats' (page 1-2 of this DEIS); and appears to be remain 'significant' (as defined on page 5-8) where project effects would result in 'lost function of wetlands, streams, and/or floodplain.'

23. Page 5-23: 5.2.2.3.4 (Wetlands): The last sentence states that, "No off-site compensatory mitigation for impacts to wetlands would be expected. The Proposed Action would be considered 'self-mitigating' due to the restorative nature of the project." **The Corps disagrees with the assessment that the project is 'self-mitigating' because the project proposes (i.e., proposed alternative and alternative 3) to enhance one resource type (river habitat) at the expense of another resource type (largely forested floodplain wetlands). The Corps recommends the consideration of wetland replacement for both direct and indirect wetland impacts. The hierarchy for considering mitigation for all direct and indirect wetland impacts should be: a. mitigation bank credits, b. in-lieu fee program credits, c. permittee responsible mitigation under a watershed approach, d. permittee-responsible mitigation, onsite and in-kind, and d. permittee-responsible mitigation, off-site and/or out-of-kind The river restoration aspect of the project would be taken into account when considering the amount of wetland restoration that would be required (i.e., the river restoration aspect of the**

project may be used to partly offset the required mitigation ratio for the wetland impacts). The net loss of -14.10 to -45.90 acres of forested floodplain wetland type appears excessive, even when considering the river connectivity restoration aspect of the proposed action. The Corps recommends that a specific wetland mitigation plan be proposed to compensate for direct and indirect wetland impacts.

24. Page 5-27: 5.2.4.1.4 (Wetlands): **It is not clear whether the wetland impact from this alternative is 0.09 acre in total or 0.1 acre.**

25. Page 5-28: 5.2.4.2.4 (Wetlands): **This section indicates that 0.09 acre Wetland 17 would be filled requiring some compensatory mitigation to mitigate for this (direct) impact. However, if this particular alternative was selected (Alternative 2 – Rehabilitate Dam, Install Fish Passage), and this was the only wetland impact associated with this alternative, then the Corps may not require compensatory mitigation for a direct impact of less than 0.1 acre.**

26. Page 5-29: 5.2.4.3.4 (Wetlands): **Second paragraph references the need to mitigate Category 1 wetland at a ratio of 1:1. See comment above regarding mitigation of this wetland area. The Corps may not require mitigation for wetland impacts of less than 0.1 acre.**

27. Page 5-31: 5.2.5.2.4 (Wetlands) and page 5-32: 5.2.5.3.4 (Wetlands): **See the Corps comment 23 above, regarding the 'self-mitigating' statement made in this DEIS document.**

28. Page 5-72: first paragraph: "Seeded and non-seeded areas would gradually vegetate in response to the new water line. At first herbaceous plants would grow, but after several years, woody plants would begin to appear. Over time, these areas would become floodplain forests. **The Corps would prefer more certainty and less speculation about post project wetland acreage development. The Corps recommends the formulation of a concrete mitigation plan, as described on Corps comment 22 above.**

29. Page 5-108: Table 5-7 (Summary Table of potential effects considered for cumulative effects analysis): The table indicates that the potential effect to 'Water Resources' would be, 'Project would result in the loss of 54 acres of wetlands and the gain of 23-55 acres of wetlands that were formerly inundated.' **No definite wetland creation acreage has been provide in this DEIS document. See Corps comment 22 above, regarding the Corps recommendation that a definite and unambiguous wetland acreage value be provided for compensatory wetland mitigation. Additionally, the wetland acreage range provided in Table 5-7 would entail changes in wetland types (as previously indicated in Table 5-2, page 5-21). These changes in wetland types are not readily apparent in this table and perhaps a revision or cross-reference is warranted, to improve the accuracy of this information.**

30. Page 6-3: Table 6-1 (Comparison of Anticipated Impacts for Each Alternative): **A range of 'wetland gained' values is utilized in previous sections of this document (23-55 acre range is used in Table 5-7 on page 5-108 and a similar value of 22.80 – 54.60 acres is used in Table 5-2 on page 5-21). However, here a definite value of 53.78 acres of 'wetland gain' is**

provided and the range of values used in previous sections of this DEIS have been dropped. This appears to be inconsistent with the use of ranges in previous sections of the DEIS document. The Corps preference is for the use of a definite value.

31. Page 6-8: Table 6-2 (Mitigation Measures): This table indicates that, "The proposed action would be considered 'self-mitigating' due to the restorative nature of the project. **See Corps comment 23 above regarding the 'self-mitigating' nature of the proposed action and alternative 3.**

Response:

Thank you for your comments, please see below our detailed response by number outlined in your submission.

1. Section 1.1 does indicate that Goal 1 of the Great Lakes Fish and Wildlife Restoration Act is "restoring and maintaining self-sustaining populations of fish and wildlife resources" as well as Goal 3 towards "Protecting, maintaining, and, where degraded and destroyed, restoring fish and wildlife habitat, including the enhancement and creation of wetlands that result in a net gain in the amount of those habitats." The proposed action or Alternative 3 would support both Goal 1 and components of Goal 3 through restoring and maintaining self-sustaining fish populations and their habitats in the Sandusky River. Working with project partners to complete the Section 10/404/401 permitting process we hope to come to an acceptable resolution regarding the impacts to wetlands in the area due to the Proposed Action or Alternative 3 as our cooperating agencies strive for a balanced approach to habitat restoration in the project area. Through this process, the Corps will produce an Environmental Assessment (EA). The Corps will incorporate by reference, relevant portions of the Service EIS, but will also add additional information where necessary addressing wetlands mitigation before issuing their permit.

2. Section 1.1 does indicate the five Great Lakes Restoration Initiative focus areas, the fourth being "Restoring wetland and other habitats." While there are expected to be impacts to wetlands due to the Proposed Action or Alternative 3, these alternatives would also promote the restoration of aquatic habitats in the Sandusky River, in part working towards that same focus area. Working with project partners to complete the Section 10/404/401 permitting process we hope to alleviate this concern and come to an acceptable resolution regarding the impacts to wetlands in the area due to the Proposed Action or Alternative 3. Through this process, the Corps will produce an Environmental Assessment (EA). The Corps will incorporate by reference, relevant portions of the Service EIS, but will also add additional information where necessary addressing wetlands mitigation before issuing their permit.

3. Please refer to the response to comment one.

4. This was a formatting error that has been corrected.

5. The Service has reviewed the Purpose and Need discussions in Sections 1.5 and 1.6 of the EIS. We believe these sections accurately characterize the purposes and needs for the project. Only minor grammatical changes were incorporated.

6. Demolition of the notch in Phase 1b will occur from above the dam. At this time, no causeway below the dam is proposed during this phase, partially as a minimization measure. Consequently, equipment would have no way to access the scour holes to remove the material as it is being directed downstream.

7. Although not ecologically necessary to keep the fill in place, this approach was developed initially as a cost savings measure, i.e. no need to pay for hauling and removal of clean rubble. It is expected that the scour holes would fill in naturally over time if the rubble is removed. However, they would likely trap cobble sized material moving downstream that would otherwise assist in replenishing downstream spawning habitats.

8. The Ballville Dam structure is approximately 15,000 CY of reinforced concrete consisting of clean concrete materials, approximately 14,000 CY of which is comprised of sand and gravel river materials and approximately 800 to 1,000 CY of steel rebar. During demolition of the dam the contractor will be instructed to direct only fill with unreinforced concrete into the designated disposal areas (scour holes). This will require the contractor to separate the steel rebar and haul it offsite. The process that involves separating out the rebar from the concrete fill materials includes breaking up the larger concrete materials into boulder to cobble size rubble using a jack hammer or hoe-ram and separating the different materials using a claw, front loader, or bull dozer. A bulldozer may be used to push and spread the clean fill materials.

9. The Service grant can only be used for dam removal and cannot be used for mitigation. OEPA - WRRSP funds are not typically used for mitigation but do not appear to be prohibited from such a use, although it is our understanding that mitigation is not the intended use of these funds at this time. It is our understanding that the City may elect to engage in a dialogue with OEPA requesting the use of these funds for mitigation.

10. Section 5.3.2.2 of the EIS discusses the risk of invasion of two invasive species, Sea Lamprey and Asian Carp. Sea Lamprey was determined to not be of issue anywhere in the Sandusky River, upstream or downstream of the dam. Additionally, experts agreed that the proposed action would not provide increased Risk Potential of Asian Carp to Lake Erie (Appendix E). However, there was mixed Expert characterization of Asian Carp Risk Potential to the Sandusky River under the Proposed Action: two of the Experts projected an increase in Risk Potential, whereas four of the experts projected no change in Risk Potential.

As a part of the Asian Carp Regional Coordinating Committee, USGS is currently working on control strategy development for Asian Carp in waterways. If there are isolated occurrences of Asian carp in certain locations in Ohio's Lake Erie drainage basin, ODNR has developed, and will implement a response plan to address the occurrence. The response plan is a part of

ODNR's Asian Carp Tactical Plan. Also, management techniques were a component of the Invasive Species Risk Analysis (Appendix E) which does provide expert opinion as to a few strategies that might be effective at controlling Asian Carp in the system, however, significant research and development still needs to occur to determine whether these are, in fact, effective control tools.

11. On March 31, 2011 the Jurisdictional Determination for Department of Army Application No. 2011-00046 letter (USACE 2011) was submitted by Richard Ruby of the Corps Buffalo District. Included in the letter were a series of delineation maps that show spatial location of the jurisdictional water features including the streams in Table 4-1. This letter was added to the Appendix A9 and the figures are now in the body of the FEIS as figures 5-1, 5-2, and 5-3.

12. Figure 4-3 displays both River Cliff Golf Course and Roger Young Park. Figure 4-3 was updated so that these areas are easier to see and a reference to these figures was inserted after these areas were mentioned in the text on page 4-6.

13. This citation (USACE 2011) is referring to: 2011b. Jurisdictional Determination for Department of the Army Application No. 2011-00046. Letter signed by Richard Ruby and dated March 31, 2011. The parenthesis following the first mention of this reference was updated to read "(USACE 2011; Jurisdictional Determination)"

14. This was corrected to read Figure "4"-3 not Figure 3-3.

15. This was corrected in the EIS.

16. Wetland impacts are significant in the context of the project alternatives and we agree must be given due consideration. As such, we have worked with the Corps to clarify the language in the EIS in these sections to provide all detail available at this time and describe the process for determining wetland mitigation. As such, wetland mitigation will include a holistic mitigation plan based on identified debits and credits to the Sandusky River ecosystem in the immediate area of the Ballville Dam and impoundment area, as well as to the downstream watershed, as conceptually proposed in the Sections 401/404/10 permit application submitted to the Corps in March 2014. Based on information provided by the Corps, the public notice of the permit application will be available online during the 30-day public notice. It's also available on the City of Fremont website: http://www.egovlink.com/fremont/news/news_info.asp?id=7573

The Service and the City of Fremont are continuing to work with the Corps and Ohio EPA to develop a mitigation plan that will meet the requirements of Section 401, 404, and 10. Implementation of the plan will be included as a condition to the 404/401/10 permits. At the time of this EIS, only a conceptual mitigation plan had been developed, so the details of a finalized mitigation plan are not available.

17. Figure 4-2 was created and added to the EIS to indicate the location of streams within the Project Area.

18. Three new figures were added to the EIS showing impacts to wetlands as well as language referring to these figures. This also allowed for additional language referring to grading activities occurring near the reservoir intake.

19. The value in Table 5-1 in the EIS was corrected from 0.62 to 0.58 acres. The direct impacts, in addition to 0.58 acres not adjacent to the dam, occur near the intake of the reservoir which totals 0.09 acres. Therefore, there is a total of 0.67 acres of direct impacts in Table 5-1 but only 0.58 acres identified as being adjacent the dam.

20. To clarify this point, we changed "Recovered" to use the word "develop". This refers to the wetlands that will form abutting the adjusted river at bankfull.

21. We added the word "canopy" after riparian to make it clear that the long term plan is for forest to replace forest (in-kind replacement), although this will take time to develop. We also have included some discussion about forest succession in the proposed Planting Plan (see Appendix A10). This planting scheme was developed with the intention of mitigating the site for the in-kind replacement of lost wetland types. By stabilizing the de-watered riparian zone with native forbs and grasses it creates a condition for local seedbank establishment, including riparian tree species. The planting plan also includes the planting of bare root tree seedlings, containerized trees and the pro-active control of invasive reed canarygrass.

Regarding the replacement ratio and wetland mitigation plan, the Service and the City of Fremont are continuing to work with the Corps and Ohio EPA to develop a mitigation plan that will meet the requirements of Section 401, 404, and 10, described in the context of the 401 and 404 permits. Implementation of the plan will be included as a condition to the 404/401/10 permits. At the time of this EIS, only a conceptual mitigation plan had been developed, so the details of a finalized mitigation plan are not available. The Corps will produce an Environmental Assessment (EA). The Corps will incorporate by reference, relevant portions of the Service EIS, but will also add additional information where necessary addressing wetlands mitigation before issuing their permit.

22. The Service and the City of Fremont are continuing to work with the Corps and Ohio EPA to develop a mitigation plan that will meet the requirements of Section 401, 404, and 10, described in the context of the 401 and 404 permits. Implementation of the plan will be included as a condition to the 404/401/10 permits. At the time of this EIS, only a conceptual mitigation plan had been developed, so the details of a finalized mitigation plan are not available. The Corps will produce an Environmental Assessment (EA). The Corps will incorporate by reference, relevant portions of the Service EIS, but will also add additional information where necessary addressing wetlands mitigation before issuing their permit. The language in this section of the EIS has been changed to reflect this clarification.

Please also see our response to comment 21 regarding the inclusion of a planting plan (see Appendix A6)

23. The Service and the City of Fremont are continuing to work with the Corps and Ohio EPA to develop a mitigation plan that will meet the requirements of Section 401, 404, and 10, described in the context of the 401 and 404 permits. Implementation of the plan will be included as a condition to the 404/401/10 permits. At the time of this EIS, only a conceptual mitigation plan had been developed, so the details of a finalized mitigation plan are not available. The Corps will produce an Environmental Assessment (EA). The Corps will incorporate by reference, relevant portions of the Service EIS, but will also add additional information where necessary addressing wetlands mitigation before issuing their permit. The language in this section of the EIS has been changed to reflect this clarification, the term "self-mitigating" has been removed from the EIS.

24. The wording in Section 5.2.4.1.4 was changed to clearly convey the temporary and permanent impacts to wetlands. The expected permanent impact would be 0.09 acre (0.04 hectare).

25. Thank you for the clarification, the wording in Section 5.2.4.2.4 was changed, explaining that the impacts are below the threshold for compensatory mitigation.

26. Thank you for the clarification, the wording in Section 5.2.4.3.4 was changed, explaining that the impacts are below the threshold for compensatory mitigation.

27. Please see our response to comment 23.

28. Please see our response to comment 22 and 21.

29. Please see our response to comment 23.

30. Table 6-1 has been updated to include the range of values as described in other sections of the document. The cooperating Agencies cannot identify a single value because of all the variables, therefore, a range is presented due to the project complexity. Unfortunately, a single value estimate is currently not possible to determine so with certainty.

31. Please see our response to comment 23.

Ballville-2014-29, Name: Ellis J.; City of Fremont

Comment:

1. I am concerned that there is too much uncertainty in the DEIS regarding what will happen to the silt currently behind the Ballville Dam if the Dam is removed. I appreciate that river flows and weather will have a significant impact on the distribution of the silt under the removal alternatives. Still, it would seem that a reasonably complete analysis of the potential impacts resulting from a removal of the Dam requires a greater effort to establishing a range of silt distribution down river and then at least consideration of the impacts of the high and low points of the range.

2. In regard to the potential distribution of the silt if the Dam is removed, it does not appear that there has been much attention given to potential impacts to specific identifiable wetland areas down river from the Dam. Of particular concern is the area of the hunt clubs near the mouth of the river.

3. If the Dam is removed, it appears that the quantity of silt released and flowing down river will be equal to one to two years of normal silt flow down river, which will be in addition to the normal annual quantity of silt flowing down the river. This quantity of silt flowing down river does not appear to be fully considered.

4. The information concerning potential contamination of the silt now behind the Dam is incomplete and appears to be taken from the Evans study. Yet the information in the Evans study concerning the quantity of silt behind the Dam has been disregarded. If the quantity number in the Evans study was deemed to be inaccurate, why is the information concerning the composition or contamination of the silt accepted as correct and used as the starting point in reviewing this issue?

5. The potential impact on the views from the residential properties bordering the current reservoir area behind the Dam from the growth of trees and other vegetation on the new wetland areas, as well as other potential impacts on the value of these properties, do not seem to be considered.

6. The analysis of the impact to existing recreational activities on the reservoir behind the Dam and adjacent areas from the removal of the Dam is incomplete and little apparent effort has been made to examine what would be necessary to mitigate these impacts.

7. I remain concerned that the suggested positive impact on the economy of the Fremont area from the removal of the Ballville Dam, apart from the general positive impact on Lake Erie fisheries, is not supported by any relevant data.

Response:

Thank you for your comments, please see below our detailed response by section outlined in your submission.

1. The movement of impounded sediment in response to the Proposed Action is addressed in EIS Sections 5.1.2 and 5.2.2. This has been one of the most rigorously studied issues related to this project. There has been an analysis of sediment loading data, stored sediment, a model of the behavior of exported sediments, and the impacts to physical habitat and aquatic organisms has been analyzed using data from other published studies (see EIS Appendices A3 and A8). This represents the best available science to our team on these issues and greater precision or accuracy is not feasible using the tools at our disposal. Instead, we describe expected maximum deposition in specific areas over temporal periods. For example, Section 5.1.2.2 states: "…the maximum height of aggraded sediment from an immediate release of the entire sediment wedge (840,000 CY) would be approximately 2.5 feet (0.8 meters) in the reach of the river confined by levees through Fremont; however, typical depths of sediment would be less than 1 foot (0.3 meters)." Additionally, we are confident that any impacts from sediment deposition will be of a short duration and that the river will return to pre-construction depths and contours downstream of the former impoundment within 1-2 years.

2. Regarding the impact of the sediment on downstream marshes, Herdendorf (1987) states: "The upper end of Sandusky Bay possesses one of the largest concentrations of coastal wetlands on Lake Erie. The wetlands fringe the entire shoreline of Muddy Creek Bay and extend several kilometers up the estuaries of the Sandusky River."

The freshwater wetlands (marshes) of Lake Erie were formed in the deltas of rivers that flow into the lake and into protected shallow areas. Many wetland areas in Lake Erie are now managed and protected from water level changes by artificial dikes (Mitsch and Gosselink 1993). The upper reaches of the estuaries in Muddy Bay contain both diked and undiked marshes.

Again Herdendorf (1987) explains: "If it were not for the network of dikes, it is likely that the erosive action of waves would eliminate much of the wetland vegetation in Sandusky Bay. The ability to regulate water levels in managed marsh units has proven to be a useful tool in altering species composition and thereby increasing waterfowl food and nesting cover. Most of the diked marshes are owned by shooting clubs and managed predominantly for waterfowl utilization and some mammal propagation. The waters of the western Lake Erie basin are more turbid than the other basins because of large sediment inputs from the Detroit, Maumee, Portage, and Sandusky Rivers, wave resuspension of silts and clay from the bottom, and high algal productivity."

The sediment transported downstream from the dam removal would be transported and dispersed into Muddy Bay and Sandusky Bay during high flow events. The silt stored behind the dam easily suspends in moving water, is highly mobile, and is slow to settle out of the water column. The amount of sediment available for transport is equivalent to approximately one year of sediment loading from the Sandusky River. The staged removal of the dam will limit the amount of sediment that mobilizes during each stage, resulting in multiple pulses of smaller amounts of sediment being transported into Muddy Bay and Sandusky Bay over the two year time frame.

One of the main causes of loss of coastal marshlands is wave action from Lake Erie. As stated above, many high quality marshes are protected from waves by man-made dikes, and these areas are actively managed for waterfowl and other game. Thus most wetlands are isolated from the increased supply. The remaining wetlands may be affected by sediment releases, however, the magnitude is expected to be small and temporary due to

- Staged removal of the dam that constrains the volume of sediment exported per unit time,
- Widespread dispersal of material that limits the amount of deposition at any location, and
- The distance to the project area allows for diminution of the sediment wedge.

3. For information on the quantity of sediment in the impoundment, please see the "Opinion of probable cost for dredging the Ballville Dam Impoundment," under the section regarding sediment quantity (Appendix A2). Stantec (2011) reported, "It is important to note that much of the depositional area above normal pool is now covered with mature vegetation and is unlikely to mobilize even if the dam is removed. Therefore, the estimate of 840,000 CY of sediment is appropriate when considering potentially mobile sediment." The total expected release is currently estimated at 500,000 - 700,000 CY. As your comment notes, these quantities are estimates based on the best available science and understanding of sediment mobilization under a removal scenario. Also, please see the response to comment number 1.

4. Additional information has been added to Section 4.2.2.4.4 *Sediment Quality* of the EIS to address this comment. Levels of contaminants associated with the sediments behind the Ballville Dam were similar to those observed in Lake Erie sediments. The methods used by Evans and Gottgen (2007) to assess contaminant levels within the sediment of the impoundment are standard, accepted methods, and the results are therefore appropriate to use in our analysis. Evans and Gottgen (2007) survey of the contaminant burden of the sediments behind the Ballville Dam was adequate to characterize those contaminant levels and have evaluate the risks of the sediment release.

5. It is difficult to know what change will occur to property values on the impoundment in the short and long term under any of the alternatives analyzed. It is expected that if Ballville Dam were to be removed, property values in the area may fluctuate. However, it is unclear what value may be placed on the adjoining properties in the short term, while the area returns to natural riverine habitat, or in the long term once the river channel has stabilized and riparian corridor has been established.

A licensed appraiser in the State of Ohio familiar with the area has the opinion that the "residential properties on the Northerly side of the Ballville Dam impoundment will drastically drop in monetary value, upon the removal of the Ballville Dam and the loss of the impoundment

lake." However, no further explanation or justification was provided to add context to their opinion. Alternatively, the peer-reviewed literature on this topic suggests that property values near an impoundment or dam tended not to change or to slightly increase after a dam was removed and a free-flowing river replaced the impoundment (Lewis et al. 2008; Provencher et al. 2008). Ultimately, each project is unique and although it is clear that the presence of Ballville Dam has likely impacted property values, and therefore removal of Ballville Dam will likely impact local property values as well. In both the short and long term it is unclear how values may fluctuate and what other complicating factors may be additive to determining future values. Additional information has been added to EIS Section 5.7.2.2.1 to assess this issue in more detail.

Impacts to the view of adjacent landowners during and after construction of the Proposed Action is addressed in EIS Section 5.9.2 and additional information has been added to this section to try and provide more context to potential changes in the view over time.

6. We used the City of Fremont's data to discuss recreational use of the impoundment as well as considering any public comments from scoping that discussed recreational use of the project area. There is little or no additional data on recreational use of the impoundment available to us. Impacts to recreation from the Proposed Action are discussed in detail in Section 5.6.2. The analysis suggests that, although some recreational experiences will change if the dam is removed (e.g, fishing in a river setting instead of an impoundment setting), the proposed action would not result in substantially different or fewer recreational opportunities. The main recreational uses of the area (fishing and boating) would still be available after the dam is removed.

7. We acknowledge that there is limited data regarding the economic benefits of removing a dam of this size in Sandusky County. Larger dam removals in other geographical areas, such as the Edwards Dam on the Kennebec River in Maine, have been studied extensively and were shown to have positive impacts. In Section 5.7 of the EIS, literature for other dam removal projects is cited, which indicates small positive impacts during construction as well as afterwards, however it is difficult to determine all the complex variables which may impact local economic outcomes in the long term in relation to this project. The EIS focuses on the intended goals of the dam removal while describing the idea that the proposed action also has the potential, based on the literature and other expected environmental impacts, to positively affect certain aspects of the local economy.

Ballville-2014-30, Name: Tebbe, S.; Ohio Department of Natural Resources

Re: 14-110; Fisheries and Habitat Conservation; Draft Environmental Impact Statement for the Ballville Dam Project on the Sandusky River, Sandusky County, Ohio.

Project: The project entails restoring and expanding upon self-sustaining fishery resources within the lower Sandusky River by providing fish passage, restoring system connectivity and natural hydrologic processes resulting in a net gain riverine habitat.

Location: The project is located in Ballville Township, Sandusky County, Ohio.
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.

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

The ODNR Natural Heritage Database has a record within the Sandusky River at the site for a population of the Greater Redhorse (*Moxostoma valenciennesi*), a state threatened fish.

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 with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees should be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between October 1 and March 31. If suitable trees must be cut during the summer months, a net survey must be conducted between June 15 and July 31, prior to cutting. Net surveys shall incorporate either two net sites per square kilometer of project area with each net site containing a minimum of two nets used for two consecutive nights, or one net site per kilometer of stream within the project limits with each net site containing a minimum of two nets used for two consecutive nights. If no tree removal is proposed, the project is not likely to impact this species.

The project is within the range of the piping plover (*Charadrius melodus*), a state and federally endangered bird species, and the Kirtland's warbler (*Setophaga kirtlandii*), a state and federally endangered species. These species do not nest in the state but only utilize stopover habitat as they migrate through the region. Due to the location, and the type of work planned, this project is not likely to impact these species.

The project is within the range of the eastern massasauga (*Sistrurus catenatus*), a state endangered species and a federal candidate snake species. The eastern massasauga uses a range of habitats including wet prairies and wetlands, as well as drier upland habitat. Due to the location, and the type of work planned, this project is not likely to impact this species.

The project is within the range of the Western banded killifish (*Fundulus diaphanous menona*), a state endangered species. Due to the location, this project is not likely to impact this species.

The project is within the range of the bobcat (*Lynx rufus*), a state endangered species. Due to the mobility of this species, the project is not likely to have an impact on this species.

The project is within the range of the American bittern (*Botaurus lentiginosus*), a state endangered bird. A statewide survey has not been completed for this species. A lack of records does not indicate the species is absent from the area. Nesting bitterns prefer large undisturbed wetlands that have scattered small pools amongst dense vegetation. They occasionally occupy bogs, large wet meadows, and dense shrubby swamps. If this type of habitat will be impacted, construction must be avoided in this habitat during the species' nesting period of May 1 to July 31. If this type of habitat will not be impacted, the project is not likely to impact this species.

The project is within the range of the king rail (*Rallus elegans*), a state endangered bird. A statewide survey has not been completed for this species. A lack of records does not indicate the species is absent from the area. If wetland habitat is located near the project area, construction must be avoided during the species' nesting period of May 1 to August 1. If no wetland habitat is in the vicinity of the project area, the project is not likely to impact this species.

The project is within the range of the northern harrier (*Circus cyaneus*), a state endangered bird. This is a common migrant and winter species. Nesters are much rarer, although they occasionally breed in large marshes and grasslands. Harriers often nest in loose colonies. A statewide survey has not been completed for this species. A lack of records does not indicate the species is absent from the area. If this type of habitat will be impacted, construction must not occur in this habitat during the species' nesting period of May 15 to August 1. If this habitat will not be impacted, the project is not likely to impact this species.

The ODNR Natural Heritage Database has no other records for rare or endangered species at this project site. We are unaware of any unique ecological sites, geologic features, animal assemblages, scenic rivers, state wildlife areas, nature preserves, parks or forests, national wildlife refuges or other protected natural areas within the project area. Our inventory program does not provide a complete survey of Ohio wildlife, 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.

Watercraft: The Division of Watercraft, Scenic Rivers Program has the following comments.

The Ohio Scenic Rivers Program supports the EIS proposed action of incremental dam removal with ice control structures. The Sandusky River is a designated State Scenic River from Harrison Smith Park in Upper Sandusky, Wyandot County to Rodger Young Memorial Park in Fremont, Sandusky County. The purpose of the Scenic Rivers Program is to maintain this stretch of the Sandusky River in a natural state to maintain the biological integrity of this high quality system. The proposed action in the draft EIS best supports this purpose and we recommend this action be carried forward.

Response:

Thank you for your comments, although they were received after the comment period had closed we have done our best to consider and incorporate them. Please see below our detailed response by section outlined in your submission.

Impacts of the Proposed Action on State-listed species including the Greater Redhorse and Indiana bat are addressed in EIS Section 5.4.3.1. We appreciate that you provided guidance that the project will have no effect on the piping plover, Kirtland's warbler, eastern massasauga, Western banded killifish, and bobcat.

Regarding the American bittern, king rail, and northern harrier, habitat suitable for these species is not found within the project area. The vast majority of the wetland habitat found in and around the project area are forested riparian wetlands adjacent to the Sandusky River. Marshes and grasslands are not present within the project area. Therefore the project should not impact these species.

Regarding the Ohio Scenic Rivers Program, the Sandusky River's Scenic River designation is discussed in EIS Sections 4.2.2.2 and 5.2.2.2.2. The Ohio Scenic Rivers Program is within a division of ODNR, and as a cooperating agency our team has coordinated with them to ensure the appropriate steps are taken to meet this designation while also achieving the purpose and needs for the project. No work within the river will occur until ODNR has provided written approval of the work.

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Ballville Dam Project

Final Environmental Impact Statement:

Appendix C – Memorandum of Understanding between Cooperating Agencies

MEMORANDUM OF UNDERSTANDING (MOU)
FOR
THE ENVIROMENTAL IMPACT STATEMENT
AT BALLVILLE DAM

BETWEEN THE

U.S. FISH AND WILDLIFE SERVICE,
DEPARTMENT OF THE INTERIOR

AND

BALLVILLE TOWNSHIP TRUSTEES

I. **AUTHORITY AND PURPOSE**: This MOU is entered into under the authority of the National Environmental Policy Act, the Fish and Wildlife Coordination Act of 1934 (16 U.S.C. 661)].

a. The purposes of this Memorandum of Understanding (MOU) are:

i. To confirm the formal designation of the Ballville Township Trustees as cooperating agencies to assist The United States Fish and Wildlife Service (Service) in guiding the preparation of the Draft and Final Environmental Impact Statement (EIS) for the Ballville Dam Project,

ii. To define the cooperating agency role, obligations, and responsibilities for participating in the preparation of the EIS,

iii. To facilitate the preparation of a EIS that will enable the cooperating agency to properly address potential program level environmental impacts for which they have expertise related to the alternatives under consideration, and

iv. To provide a framework for cooperation and coordination to facilitate completion of the National Environmental Policy Act (NEPA) process for the EIS, including issuance of any required findings, concurrences, or Records of Decision, and fulfill relevant environmental responsibilities.

II. **DESCRIPTION OF WORK**:

a. The Service is the lead Federal agency for this project. It is ultimately responsible for preparing the Draft and Final EIS, and for assuring compliance with the requirements of NEPA. Although the Service agrees to give full respect and recognition to the jurisdiction of the cooperating agencies, the Service is responsible for considering impacts to the quality of the natural and human environment associated with the proposed project. The Service will use the

environmental analyses, proposals, and special expertise of the cooperating agencies to the maximum extent possible consistent with its responsibilities, and as the lead agency, will retain ultimate responsibility for the EIS content. This includes defining the issues, determining purpose and need of the project, selecting or approving alternatives and mitigation measures, reviewing and requiring modification of the EIS, responding to comments on the EIS, and retaining responsibility for the conclusions of its environmental analysis.

b. The signatories' goal is to assist in the preparation of an EIS that contains all the information required in order to fulfill their NEPA and/or regulatory responsibilities and to make independent decisions on their respective subject area designations and issues under their purview for this process. As such, the cooperating agency is to participate in the NEPA process at the earliest appropriate time, make staff support available, exchange relevant information throughout the EIS process, submit independent recommendations, and assist the Service in developing responses to comments received on the EIS. Most of this work will be completed through administrative review of draft documents prior to public release. The cooperating agencies will not be responsible for the actual preparation of any portion of the EIS or related technical reports; however, they will provide comments to the Service on their respective resource designations. The cooperating agency will be kept appraised of the disposition of their comments. Additionally, the documents to be reviewed will be considered confidential and not to be shared outside the cooperating agency. In the event that draft documents are shared by a cooperating agency this agreement shall be terminated.

III. **PERIOD OF PERFORMANCE**: The period of this Agreement is from the date of signature of the Service Officer through the release of a Record of Decision on the Final EIS or September 30, 2013.

IV. **PROJECT OFFICERS**:

Service Project Officer:

Brian Elkington	
U.S. Fish and Wildlife Service	
Fisheries	Phone: (612) 713-5168
5600 American Blvd West	Fax: (612) 713-5289
Bloomington, MN 55437-1458	Brian_Elkington@fws.gov

Ballville Township Trustees Project Officer:

Robert Kusmer	
Ballville Township Trustees	Phone: (419) 332-9488
945 County Road 43	Fax: (419) 332-1165
Fremont, OH 43420	

V. **MODIFICATIONS**: Any party hereto may propose modifications or renewals at anytime during the period of this MOU's existence. A modification shall only become effective upon the written approval of the parties.

VI. **TERMINATION**: Either party may terminate this agreement following at least 30 days' written notification to the other parties of an intent to withdraw from the MOU. In such a circumstance, the parties hereby pledge to negotiate the termination conditions in good faith.

VII. **SPECIAL PROVISIONS**:

Tort Liability of the Parties: To the extent allowed by law, it is the intention of the parties to this agreement that each party will be responsible only for its own acts or omissions and the results thereof (whether based in negligence, recklessness or willfulness), and neither party shall be responsible for the negligent, reckless or willful acts or omissions of the other party and the results thereof. Each party will therefore assume all risks and liability to itself, its agents and employees, for any injury-to persons or property resulting from actions or operations of itself, its agents or employees and for any loss, cost, damage or expense resulting at any time from any and all causes due to any acts, or negligence, or the failure to exercise proper precautions of or by itself or its own employees or agents to this agreement. It is the further intention of this agreement that where both parties are found to share liability, the degree of each party's liability shall be limited to its degree of Culpability. The torts liability of the Federal Government will be determined under the Federal Tort Claims Act (28 U.S.C. 2671) while the liability of the Recipient will be determined by applicable federal and state laws.

In witness whereof, the following authorized officials of the parties hereto have executed this MOU as of the date(s) set forth below.

U.S. Fish and Wildlife Service

Signature

Todd J Turner

Typed or Printed Name

Assistant Regional Director-Fisheries

Typed or Printed Title

6/20/2012

Date

Ballville Township Trustees

Signature

W ROBERT KUSMER

Typed or Printed Name

BALLVILLE TWP. TRUSTEE

Typed or Printed Title

July 18, 2012

Date

MEMORANDUM OF UNDERSTANDING (MOU)
FOR
THE ENVIROMENTAL IMPACT STATEMENT
AT BALLVILLE DAM

BETWEEN THE

U.S. FISH AND WILDLIFE SERVICE,
DEPARTMENT OF THE INTERIOR

AND

CITY OF FREMONT

I. **AUTHORITY AND PURPOSE**: This MOU is entered into under the authority of the National Environmental Policy Act, the Fish and Wildlife Coordination Act of 1934 (16 U.S.C. 661)].

a. The purposes of this Memorandum of Understanding (MOU) are:

i. To confirm the formal designation of the City of Fremont as a cooperating agency to assist The United States Fish and Wildlife Service (Service) in guiding the preparation of the Draft and Final Environmental Impact Statement (EIS) for the Ballville Dam Fish Passage Project,

ii. To define the cooperating agency role, obligations, and responsibilities for participating in the preparation of the EIS,

iii. To facilitate the preparation of a EIS that will enable the cooperating agency to properly address potential program level environmental impacts for which they have expertise related to the alternatives under consideration, and

iv. To provide a framework for cooperation and coordination to facilitate completion of the National Environmental Policy Act (NEPA) process for the EIS, including issuance of any required findings, concurrences, or Records of Decision, and fulfill relevant environmental responsibilities.

II. **DESCRIPTION OF WORK**:

a. The Service is the lead Federal agency for this project. It is ultimately responsible for preparing the Draft and Final EIS, and for assuring compliance with the requirements of NEPA. Although the Service agrees to give full respect and recognition to the jurisdiction of the cooperating agencies, the Service is responsible for considering impacts to the quality of the natural and human environment associated with the proposed project. The Service will use the environmental analyses, proposals, and special expertise of the cooperating agencies to the maximum extent possible consistent with its responsibilities, and

as the lead agency, will retain ultimate responsibility for the EIS content. This includes defining the issues, determining purpose and need of the project, selecting or approving alternatives and mitigation measures, reviewing and requiring modification of the EIS, responding to comments on the EIS, and retaining responsibility for the conclusions of its environmental analysis.

b. The signatories' goal is to assist in the preparation of an EIS that contains all the information required in order to fulfill their NEPA and/or regulatory responsibilities and to make independent decisions on their respective subject area designations and issues under their purview for this process. As such, the cooperating agency is to participate in the NEPA process at the earliest appropriate time, make staff support available, exchange relevant information throughout the EIS process, submit independent recommendations, and assist the Service in developing responses to comments received on the EIS. Most of this work will be completed through administrative review of draft documents prior to public release. The cooperating agencies will not be responsible for the actual preparation of any portion of the EIS or related technical reports; however, they will provide comments to the Service on their respective resource designations. The cooperating agency will be kept appraised of the disposition of their comments. Additionally, the documents to be reviewed will be considered confidential and not to be shared outside the cooperating agency. In the event that draft documents are shared by a cooperating agency this agreement shall be terminated.

III. **PERIOD OF PERFORMANCE**: The period of this Agreement is from the date of signature of the Service Officer through the release of a Record of Decision on the Final EIS or September 30, 2013.

IV. **PROJECT OFFICERS**:

Service Project Officer:
Brian Elkington
U.S. Fish and Wildlife Service
Fisheries
5600 American Blvd West
Bloomington, MN 55437-1458

Phone: (612) 713-5168
Fax: (612) 713-5289
Brian_Elkington@fws.gov

City of Fremont Project Officer:
Mayor Jim Ellis
City of Fremont
323 South Front Street
Fremont, OH 43420

Phone: (419) 334-5900
Fax: (419) 334-8434
jellis@fremontohio.org

V. **MODIFICATIONS**: Any party hereto may propose modifications or renewals at anytime during the period of this MOU's existence. A modification shall only become effective upon the written approval of the parties.

VI. **TERMINATION**: Either party may terminate this agreement following at least 30 days' written notification to the other parties of an intent to withdraw from the MOU. In such a circumstance, the parties hereby pledge to negotiate the termination conditions in good faith.

VII. **SPECIAL PROVISIONS**:

Tort Liability of the Parties: To the extent allowed by law, it is the intention of the parties to this agreement that each party will be responsible only for its own acts or omissions and the results thereof (whether based in negligence, recklessness or willfulness), and neither party shall be responsible for the negligent, reckless or willful acts or omissions of the other party and the results thereof. Each party will therefore assume all risks and liability to itself, its agents and employees, for any injury-to persons or property resulting from actions or operations of itself, its agents or employees and for any loss, cost, damage or expense resulting at any time from any and all causes due to any acts, or negligence, or the failure to exercise proper precautions of or by itself or its own employees or agents to this agreement. It is the further intention of this agreement that where both parties are found to share liability, the degree of each party's liability shall be limited to its degree of Culpability. The torts liability of the Federal Government will be determined under the Federal Tort Claims Act (28 U.S.C. 2671) while the liability of the Recipient will be determined by applicable federal and state laws.

In witness whereof, the following authorized officials of the parties hereto have executed this MOU as of the date(s) set forth below.

U.S. Fish and Wildlife Service

Signature

Todd J Turner

Typed or Printed Name

Assistant Regional Director Fisheries

Typed or Printed Title

6/20/2012

Date

City of Fremont

Signature

JAMES H. ELLIS III

Typed or Printed Name

MAYOR

Typed or Printed Title

8/8/12

Date

MEMORANDUM OF UNDERSTANDING (MOU)
FOR
THE ENVIROMENTAL IMPACT STATEMENT
AT BALLVILLE DAM

BETWEEN THE

U.S. FISH AND WILDLIFE SERVICE,
DEPARTMENT OF THE INTERIOR

AND

OHIO DEPARTMENT OF NATURAL RESOURCES

I. **AUTHORITY AND PURPOSE**: This MOU is entered into under the authority of the National Environmental Policy Act, the Fish and Wildlife Coordination Act of 1934 (16 U.S.C. 661)].

a. The purposes of this Memorandum of Understanding (MOU) are:

i. To confirm the formal designation of the Ohio Department of Natural Resources (ODNR) as a cooperating agency to assist The United States Fish and Wildlife Service (Service) in guiding the preparation of the Draft and Final Environmental Impact Statement (EIS) for the Ballville Dam Project,

ii. To define the cooperating agency role, obligations, and responsibilities for participating in the preparation of the EIS,

iii. To facilitate the preparation of a EIS that will enable the cooperating agency to properly address potential program level environmental impacts for which they have expertise related to the alternatives under consideration, and

iv. To provide a framework for cooperation and coordination to facilitate completion of the National Environmental Policy Act (NEPA) process for the EIS, including issuance of any required findings, concurrences, or Records of Decision, and fulfill relevant environmental responsibilities.

II. **DESCRIPTION OF WORK**:

a. The Service is the lead Federal agency for this project. It is ultimately responsible for preparing the Draft and Final EIS, and for assuring compliance with the requirements of NEPA. Although the Service agrees to give full respect and recognition to the jurisdiction of the cooperating agencies, the Service is responsible for considering impacts to the quality of the natural and human environment associated with the proposed project. The Service will use the environmental analyses, proposals, and special expertise of the cooperating agencies to the maximum extent possible consistent with its responsibilities, and

as the lead agency, will retain ultimate responsibility for the EIS content. This includes defining the issues, determining purpose and need of the project, selecting or approving alternatives and mitigation measures, reviewing and requiring modification of the EIS, responding to comments on the EIS, and retaining responsibility for the conclusions of its environmental analysis.

b. The signatories' goal is to assist in the preparation of an EIS that contains all the information required in order to fulfill their NEPA and/or regulatory responsibilities and to make independent decisions on their respective subject area designations and issues under their purview for this process. As such, the cooperating agency is to participate in the NEPA process at the earliest appropriate time, make staff support available, exchange relevant information throughout the EIS process, submit independent recommendations, and assist the Service in developing responses to comments received on the EIS. Most of this work will be completed through administrative review of draft documents prior to public release. The cooperating agencies will not be responsible for the actual preparation of any portion of the EIS or related technical reports; however, they will provide comments to the Service on their respective resource designations. The cooperating agency will be kept appraised of the disposition of their comments. Additionally, the documents to be reviewed will be considered confidential and not to be shared outside the cooperating agency. In the event that draft documents are shared by a cooperating agency this agreement shall be terminated.

III. **PERIOD OF PERFORMANCE**: The period of this Agreement is from the date of signature of the Service Officer through the release of a Record of Decision on the Final EIS or September 30, 2013.

IV. **PROJECT OFFICERS**:

Service Project Officer:
Brian Elkington
U.S. Fish and Wildlife Service
Fisheries
5600 American Blvd West
Bloomington, MN 55437-1458

Phone: (612) 713-5168
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Phone: (419) 625-8062
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V. **MODIFICATIONS**: Any party hereto may propose modifications or renewals at anytime during the period of this MOU's existence. A modification shall only become effective upon the written approval of the parties.

VI. **TERMINATION**: Either party may terminate this agreement following at least 30 days' written notification to the other parties of an intent to withdraw from the MOU. In such a circumstance, the parties hereby pledge to negotiate the termination conditions in good faith.

VII. **SPECIAL PROVISIONS**:

Tort Liability of the Parties: To the extent allowed by law, it is the intention of the parties to this agreement that each party will be responsible only for its own acts or omissions and the results thereof (whether based in negligence, recklessness or willfulness), and neither party shall be responsible for the negligent, reckless or willful acts or omissions of the other party and the results thereof. Each party will therefore assume all risks and liability to itself, its agents and employees, for any injury-to persons or property resulting from actions or operations of itself, its agents or employees and for any loss, cost, damage or expense resulting at any time from any and all causes due to any acts, or negligence, or the failure to exercise proper precautions of or by itself or its own employees or agents to this agreement. It is the further intention of this agreement that where both parties are found to share liability, the degree of each party's liability shall be limited to its degree of Culpability. The torts liability of the Federal Government will be determined under the Federal Tort Claims Act (28 U.S.C. 2671) while the liability of the Recipient will be determined by applicable federal and state laws.

In witness whereof, the following authorized officials of the parties hereto have executed this MOU as of the date(s) set forth below.

U.S. Fish and Wildlife Service

Signature

Todd J Turner
Typed or Printed Name

Assistant Regional Director-Fisheries
Typed or Printed Title

6/30/2012
Date

Ohio Department of Natural Resources

Signature

James Zehringer
Typed or Printed Name

Director
Typed or Printed Title
Director, Department of Natural Resources

Date

Scott Zody, Chief, Division of Wildlife

MEMORANDUM OF UNDERSTANDING (MOU)
FOR
THE ENVIROMENTAL IMPACT STATEMENT
AT BALLVILLE DAM

BETWEEN THE

U.S. FISH AND WILDLIFE SERVICE,
DEPARTMENT OF THE INTERIOR

AND

UNITED STATES ARMY CORPS OF ENGINEERS

I. **AUTHORITY AND PURPOSE**: This MOU is entered into under the authority of the National Environmental Policy Act, the Fish and Wildlife Coordination Act of 1934 (16 U.S.C. 661)].

a. The purposes of this Memorandum of Understanding (MOU) are:

i. To confirm the formal designation of the United States Army Corps of Engineers (Corps) as a cooperating agency to assist The United States Fish and Wildlife Service (Service) in guiding the preparation of the Draft and Final Environmental Impact Statement (EIS) for the Ballville Dam Fish Passage Project,

ii. To define the cooperating agency role, obligations, and responsibilities for participating in the preparation of the EIS,

iii. To facilitate the preparation of a EIS that will enable the cooperating agency to properly address potential program level environmental impacts for which they have expertise related to the alternatives under consideration, and

iv. To provide a framework for cooperation and coordination to facilitate completion of the National Environmental Policy Act (NEPA) process for the EIS, including issuance of any required findings, concurrences, or Records of Decision, and fulfill relevant environmental responsibilities.

II. **DESCRIPTION OF WORK**:

a. The Service is the lead Federal agency for this project. It is ultimately responsible for preparing the Draft and Final EIS, and for assuring compliance with the requirements of NEPA. Although the Service agrees to give full respect and recognition to the jurisdiction of the cooperating agencies, the Service is responsible for considering impacts to the quality of the natural and human environment associated with the proposed project. The Service will use the environmental analyses, proposals, and special expertise of the cooperating agencies to the maximum extent possible consistent with its responsibilities, and

as the lead agency, will retain ultimate responsibility for the EIS content. This includes defining the issues, determining purpose and need of the project, selecting or approving alternatives and mitigation measures, reviewing and requiring modification of the EIS, responding to comments on the EIS, and retaining responsibility for the conclusions of its environmental analysis.

b. The signatories' goal is to assist in the preparation of an EIS that contains all the information required in order to fulfill their NEPA and/or regulatory responsibilities and to make independent decisions on their respective subject area designations and issues under their purview for this process. As such, the cooperating agency is to participate in the NEPA process at the earliest appropriate time, make staff support available, exchange relevant information throughout the EIS process, submit independent recommendations, and assist the Service in developing responses to comments received on the EIS. Most of this work will be completed through administrative review of draft documents prior to public release. The cooperating agencies will not be responsible for the actual preparation of any portion of the EIS or related technical reports; however, they will provide comments to the Service on their respective resource designations. The cooperating agency will be kept appraised of the disposition of their comments. Additionally, the documents to be reviewed will be considered confidential and not to be shared outside the cooperating agency. In the event that draft documents are shared by a cooperating agency this agreement shall be terminated.

III. **PERIOD OF PERFORMANCE**: The period of this Agreement is from the date of signature of the Service Officer through the release of a Record of Decision on the Final EIS or September 30, 2013.

IV. **PROJECT OFFICERS**:

Service Project Officer:
Brian Elkington
U.S. Fish and Wildlife Service
Fisheries
5600 American Blvd West
Bloomington, MN 55437-1458

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Corps Project Officer:
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Buffalo, NY 14207-3199

Phone: (716) 879-4186
Fax: (716) 879-4310
joseph.w.krawczyk@usace.army.mil

V. **MODIFICATIONS**: Any party hereto may propose modifications or renewals at anytime during the period of this MOU's existence. A modification shall only become effective upon the written approval of the parties.

VI. **TERMINATION**: Either party may terminate this agreement following at least 30 days' written notification to the other parties of an intent to withdraw from the MOU. In such a circumstance, the parties hereby pledge to negotiate the termination conditions in good faith.

VII. **SPECIAL PROVISIONS**:

Tort Liability of the Parties: To the extent allowed by law, it is the intention of the parties to this agreement that each party will be responsible only for its own acts or omissions and the results thereof (whether based in negligence, recklessness or willfulness), and neither party shall be responsible for the negligent, reckless or willful acts or omissions of the other party and the results thereof. Each party will therefore assume all risks and liability to itself, its agents and employees, for any injury-to persons or property resulting from actions or operations of itself, its agents or employees and for any loss, cost, damage or expense resulting at any time from any and all causes due to any acts, or negligence, or the failure to exercise proper precautions of or by itself or its own employees or agents to this agreement. It is the further intention of this agreement that where both parties are found to share liability, the degree of each party's liability shall be limited to its degree of Culpability. The torts liability of the Federal Government will be determined under the Federal Tort Claims Act (28 U.S.C. 2671) while the liability of the Recipient will be determined by applicable federal and state laws.

In witness whereof, the following authorized officials of the parties hereto have executed this MOU as of the date(s) set forth below.

U.S. Fish and Wildlife Service

Signature

Typed or Printed Name

Typed or Printed Title

Date

U.S. Army Corps of Engineers

Signature

Diane C. Kozlowski

Typed or Printed Name

Regulatory Branch Chief

Typed or Printed Title

9/5/12

Date

Ballville Dam Project

Final Environmental Impact Statement:

Appendix D – National Historic Preservation Act (NHPA)

1 – Final Programmatic Agreement

PROGRAMMATIC AGREEMENT (PA)

among
The U.S. Fish and Wildlife Service (USFWS),
The Ohio Historic Preservation Office (OHPO),
The Ohio Department of Natural Resources (ODNR),
The Ohio Environmental Protection Agency (OEPA),
The U.S. Army Corps of Engineers (USACE),
and
The City of Fremont (City),

Regarding

The Proposed Sandusky River Fish Passage Project (Project),
Ballville Township, Sandusky County, Ohio

WHEREAS, USFWS is helping to fund the Project to provide fish passage for migratory fish species along the Sandusky River in Sections 4, 5, 8, 9 and 17, T4N, R15E, in Ballville Township, Sandusky County, Ohio; and

WHEREAS, the funding of the Project triggered review of the undertaking under Section 106 of the National Historic Preservation Act (NHPA), 16 U.S.C. § 470 *et seq.*, § 470f, and its implementing regulations "Protection of Historic Properties" (36 CFR Part 800); and

WHEREAS, the terms used in this PA are defined in 36 CFR § 800.16; and

WHEREAS, USFWS has determined the Area of Potential Effects (APE) for the undertaking will include the project footprint, including the extant Ballville Dam (SAN-546-10) and its immediate vicinity (direct APE, 12.2 acres) and the surrounding parcels within the dam's view shed (indirect APE, 89.3 acres); and

WHEREAS, USFWS has completed studies to identify any prehistoric or historic district, site, building, structure, or object meeting the criteria for inclusion on the National Register of Historic Places (NRHP) within the Project's APE; and

WHEREAS, USFWS has determined, and the consulting parties have concurred, that the preferred alternative of the project will have an adverse effect upon the Ballville Dam, a historic property; and

WHEREAS, USFWS acknowledges that remnants of the Tucker Dam may be present approximately 4,500 feet upstream from Ballville Dam submerged under 8 feet of water and encased in sediment within the impoundment and adverse effects may occur to this structure during the Project, if present; and

WHEREAS, in accordance with 36 CFR Part 800.14(b)(1)(ii), execution of a Programmatic Agreement (PA) is appropriate because effects on historic properties within the APE cannot be fully determined prior to beginning work on the Project itself; and

WHEREAS, USFWS has consulted with the OHPO, ODNR, OEPA, USACE, and City to address effects of the Project on historic properties and has invited them to sign this agreement as Invited Signatories; and

WHEREAS, USFWS has consulted with the Sandusky County Historical Society and the Rutherford B. Hayes Presidential Center to address effects of the Project on historic properties and has invited them to sign this agreement as Concurring Parties; and

WHEREAS, in accordance with 36 CFR § 800.6(a)(1), USFWS has notified the Advisory Council on Historic Preservation (ACHP) of its adverse effect determination providing the specified documentation, and the ACHP has chosen not to participate in the consultation pursuant to 36 CFR § 800.6(a)(1)(iii);

NOW, THEREFORE, USFWS, OHPO, ODNR, OEPA, USACE, and City agree that the resolution of the Adverse Effects from the Project will be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

STIPULATIONS

USFWS will ensure that the following stipulations are carried out:

I. CONDITIONS

USFWS will ensure that the terms of this PA, barring unforeseen circumstances, are implemented as appropriate within the timeline of the project and prior to the start of demolition, when possible.

II. PROFESSIONAL STANDARDS

The studies and work required under the terms of this PA will be carried out by or under the direct supervision of a professional, hired after consultation with the City and paid by ODNR, who, at a minimum, meets the U.S. Secretary of the Interior's Professional Qualifications standards (48 FR 44716, September 29, 1983) in archeology, architecture, architectural history or history, as appropriate to the mitigation measure.

III. IDENTIFICATION AND TREATMENT

A. Mitigation of Adverse Effects to Ballville Dam

The Ballville Dam, built in 1912, is considered by USFWS to be eligible for inclusion on the NRHP under Criteria A and C. USFWS determines that the proposed removal of the Ballville Dam will constitute an Adverse Effect on the Ballville Dam. Mitigation for Criteria A and C are intended to provide further documentation of this structure both in the historical context of the region, as well as detailing the structure itself for the historical record.

1. Criterion A

To address Criterion A, a detailed Inventory of dams in Ohio contained in the comprehensive list maintained by the ODNR, constructed between 1880 and

1930, less than 50 feet tall and less than 800 feet long will be completed by the contractor. Please see Attachment A for explanation of the selection criteria and map for these 77 dams. Of these, it is estimated that, after closer study, between three and six will have been either constructed as or modified for hydroelectric power generation. While most of the inventory will consist of the listing of relevant characteristics (distilled into a paragraph description with their various attributes) for each dam, a more extensive background context and Ohio Historic Inventory Form will be completed for the hydroelectric dams identified. An additional, brief 5-7 page summary of the history of hydroelectric power generation in Ohio will also accompany the inventory forms.

Based upon the deliverables below, the objectives of this inventory will be to: (1) assist federal and state public agencies and private entities with documenting and evaluating these types of structures, especially hydroelectric power generating dams, if they are affected by state or federal cultural laws; (2) provide a starting point for future efforts by the public or governmental agencies to manage, preserve, and/or register significant examples of dam structures within Ohio; and (3) promote Ohio heritage tourism and public education as appropriate.

To develop the Inventory, ODNR, in consultation with the City and other consulting parties as appropriate, will hire an outside professional contractor to research and compile the necessary information based upon a detailed Scope of Work (SOW) flowing from this PA. A Work Plan (WP) based on the SOW will be submitted by the contractor to the USFWS and distributed to the consulting parties for comment within one (1) month of the contract date. Minimally, the WP will include a research design, list of project personnel, task timelines and milestones. The ODNR will compile the comments and work with the contractor to finalize the WP. The contractor will be required to notify consulting parties as the milestones are met and will be encouraged to distribute draft results for informal comment as the project proceeds.

As the primary task, the contractor will complete an inventory of the selected Ohio dams by reviewing documentation available from the National Inventory of Dams, the Ohio Department of Natural Resources – Dam Safety, the U.S. Army Corps of Engineers, USDA-Forest Service and other agencies with regulatory authority over water control structures. The “Geographic Names Information System” maintained by the U.S. Geological Survey could also be used as a source for identifying dam locations and common names. The Ohio Historical Society and OHPO files should also be consulted.

For the 77 dams within the study universe, the OHPO files should be closely consulted to identify previously determined NRHP-eligible and listed dams as well as the dams which have been evaluated and found to not meet NRHP criteria for eligibility. Additional information may be available in studies of Federal relief program activities, in WPA and CCC archives or from county or local historical societies. If available, photo images of the dams should be included as a visual reference of these structures. However, no site visits to the non-hydroelectric dams are warranted.

Minimally, the inventory developed during this task should include the following data attributes relating to structures in the temporal and spatial context provided above: County, City/Township, Site Name, Archaeological Site Number (if assigned), SHPO Structure Inventory Number (if assigned), Date of Construction, Date of Destruction (if applicable), Property Type, Dam Type, Material, Dam Height, Dam Length, Period of Power Generation (if a hydroelectric dam), Drainage Area, Generating Capacity at time of construction (if known for a hydroelectric dam), Current Condition (if known), Current Owner, National Register status, and Location (multiple fields utilizing legal description, Latitude and Longitude in decimal degrees, and property number). Other fields may be added as deemed appropriate by the contractor under the SOW. Additionally, the three to six hydroelectric dams would have the Ohio Historic Inventory Form filled out which would require a field visit to each dam site.

The draft report will be reviewed by each consulting party within six (6) months from the completion of the dam demolition. Comments should be forwarded to the USFWS who will work with the consultant to produce a final document. Final deliverables, consisting of the report with three main products, the hydroelectric power history, the inventories, and the Ohio Historic Inventory Forms are due within one (1) year of the completion of the dam demolition. Upon completion, a digital file containing the inventories will be transferred to ODNR. Once finalized, ten hardcopies of the final report, as well as a digital copy of the final report, will be provided to ODNR. ODNR will provide one hardcopy report and the digital file for each signatory to this agreement, especially the OHPO, for their future reference.

2. Criterion C

As will be addressed in a detailed SOW flowing from this PA, to address Criterion C, the consulting parties will complete a recordation comparable to the Historic American Buildings Survey / Historic American Engineering Record *(HABS/HAER)*. Minimally, work will consist of a heightened visual recordation of the Ballville Dam before and during demolition and will include close-up photographs and line drawings, as needed, to document the dam's internal construction. To complete the recordation, ODNR, in consultation with the City and other consulting parties as appropriate, will hire an outside professional contractor to compile the information for archival purposes. This information will be recorded before and during the removal of the Ballville Dam.

A WP based on the SOW will be submitted by the contractor to the USFWS and distributed to the consulting parties for comment within one (1) month of the contract date. Minimally, the WP will include a research design, list of project personnel, task timelines and milestones. The ODNR will compile the comments and work with the contractor to finalize the WP. The contractor will be required to notify consulting parties as the milestones are met and will be encouraged to distribute draft results for informal comment as the project proceeds. Of specific interest to the OHPO is how the contractor is meeting the HABS/HAER comparable standards outlined in the WP.

The draft report will be reviewed by each consulting party within six (6) months from the completion of the dam demolition. This includes a complete and accurate recordation of the interior of the structure with detailed drawings and photographs. The report must directly address the research objectives and must meet federal reporting standards. Final deliverables, consisting of the report is due within one (1) year of the completion of the dam demolition. Once finalized, ten hardcopies of the final report, as well as a digital copy of the final report, will be provided to ODNR. ODNR will provide one hardcopy report and the digital file for each signatory to this agreement, especially the OHPO, for their future reference. The completed original drawings/photographs and report will be maintained and archived at the Birchard Public Library for reference by the local community and others interested in hydropower on the Sandusky River.

B. Identification and Possible Mitigation Relating to Tucker Dam

During 2011, bathymetric surveys of the Ballville Dam Impoundment pool APE detected an anomaly below the waterline in the substrate profile approximately 4,500 feet upstream from the current Ballville Dam site. The anomaly within the sediments of the Sandusky River is located approximately where the historic literature and photographs seem to indicate the placement of Tucker Dam, a crib/timber dam reportedly built between 1835 and 1858, approximately 1,300 feet west of Tucker Mill. During operations, Tucker Dam was reported to be nine feet tall, and used water power to work a flour grist-mill into the early 1900's. The Tucker Mill site itself is not within the direct APE and currently consists of foundation ruins only.

If present, the remnants of what is believed to be Tucker Dam would be located approximately 8 feet below normal pool height of the impoundment. It is expected that the removal of Ballville Dam will lower the waterline significantly and expose the anomaly, allowing for further investigation and action as needed at that time.

It is likely that USFWS, working with the consulting parties, especially the ODNR, will be able to formally determine the presence/condition of Tucker Dam after the proposed demolition of Ballville Dam has begun. At that time, the USFWS, with consultations from the consulting parties to this agreement, will use the following process to determine the most appropriate actions given our best information at that time.

1. **Phase I Survey**
   When Ballville Dam is removed, the ODNR will compile concise documentation to present findings from a brief, focused, effort to look for the remains of the Tucker Dam. If the ODNR finds that Tucker Dam is not present and notifies the USFWS, then the USFWS will officially notify the consulting parties and the Project will proceed as planned with no further Section 106 compliance. However, if a portion, or all, of Tucker Dam is present, the ODNR, in consultation with the City and other consulting parties as appropriate, will hire an outside professional archaeological contractor to complete a Phase I archaeological survey.

2. **Phase II Evaluation**
   Probably conducted concomitant with the Phase I survey by the same archaeological contractor, ODNR will direct that Phase II investigations will be done on the Tucker Dam site (as feasible given the setting of the dam) to evaluate its integrity and significance. If the USFWS determines and the consulting parties concur that the remnants are not eligible for inclusion on the NRHP, the Section 106 compliance is completed for this portion of the undertaking. If the site remnants are determined eligible by USFWS, with concurrence by the consulting parties, then the USFWS will further consult with the consulting parties regarding the findings with consideration of need for any additional investigations.

3. **Phase III Mitigation**
   If Tucker Dam remains fully or partially in place and is deemed eligible for inclusion on the NRHP and portions below the waterline (and perhaps above the waterline) need to be removed for public safety, Phase III mitigation measures will be put in place to resolve the Adverse Effect. Consultations among the consulting parties will guide the USFWS in determining the appropriate mitigation measures.

C. Dispute Resolution

Should any signatory to this PA object in writing at any time to any actions proposed or the manner in which the terms of this PA are implemented, USFWS, within the limits of its authority, will consult with such party to resolve the objection. If USFWS determines that the objection cannot be resolved, that agency will:

1) Forward all documentation relevant to the dispute, including the resolution proposed by USFWS, to the Advisory Council on Historic Preservation (ACHP). ACHP will provide USFWS with its advice, pursuant to 36 CFR Part 800.2(b)(2), on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, USFWS will prepare a written response that takes into account any timely advice or comments from the ACHP, signatories and consulting parties regarding the dispute, and provide a copy of this written response. USFWS will then proceed according to its final decision.

2) Any ACHP comments provided in response to such a request will be taken into account in accordance with 36 CFR Part 800.7(c)(4).

3) If ACHP does not provide its advice regarding the dispute within thirty (30) days, USFWS may make a final decision and proceed accordingly. Prior to reaching a final decision, USFWS will prepare a written response that takes into account any timely comments regarding the dispute from the signatories and consulting parties to the PA and provide them and ACHP with a copy of the written response.

The responsibilities of USFWS to carry out all other actions subject to the terms of this PA that are not the subject of the dispute remain unchanged.

If at any time during the implementation of the measures stipulated in this PA an objection should be raised by the public, USFWS will notify the signatories to this PA and consult with the objecting party to seek resolution. If USFWS determines that the objection may be valid and cannot be resolved, it will decide if the objection is of such magnitude to seek the advice or comment of ACHP (as described above).

D. Reporting

Should there be an interruption of activity associated with the construction and/or mitigation for any significant length of time, ODNR will provide to the signatories, at the minimum every six (6) months, a project status letter regarding the completion of work associated with the above stipulations.

IV. TERMS OF AGREEMENT

A. The term of this PA will be 10 years from the date of execution by the last signatory, unless the parties agree to extend its term. If its stipulations have not been carried out, and prior to work continuing on the proposed Project and/or mitigation, USFWS, OHPO, ODNR, OEPA, USACE, or City, as appropriate, will either (a) amend the agreement pursuant to 36 CFR Part 800.6, (b) execute another agreement pursuant to 36 CFR Part 800.6 or 800.14, or (c) request, take into account, and respond to the comments of ACHP under 36 CFR Part 800.7.

B. The consulting parties agree that nothing in this PA is intended to diminish, modify, or otherwise affect the parties' statutory or regulatory authorities. This PA is neither a fiscal nor a funds obligation document, and the Consulting Parties agree that nothing herein shall obligate any party in the expenditure of funds, or for future payments of money, in excess of appropriations authorized by law.

V. AMENDMENT

A. Any party to this PA may withdraw from it by providing thirty (30) days' notice to the other parties, provided that the parties will consult during the period prior to withdrawal to seek agreement on amendments or other actions that would avoid withdrawal.

B. In the event of an early termination of the agreement pursuant to Paragraph V.A, and if demolition is ongoing, demolition that may result in an adverse effect to a historic property will cease, until either (a) USFWS executes an amendment to the agreement pursuant to 36 CFR Part 800.6, (b) executes another agreement pursuant to 36 CFR Part 800.6 or 800.14, or (c) USFWS requests, takes into account, and responds to the comments of ACHP under 36 CFR Part 800.7. USFWS will notify the signatories and consulting parties as to the course of action it will pursue.

VI. NOTICES

Any notice permitted or required by this PA shall be in writing, delivered to the persons listed below, or shall be deemed given five (5) days after deposit in the United States Mail, certified and postage prepaid, return receipt requested and addressed as follows, or at such other address as any party may from time to time specify to the other party in writing. Notices may be delivered by facsimile or other electronic means, provided that they are also delivered personally or by certified mail, and such electronic notices shall thereafter be deemed effective upon receipt. Notices shall be transmitted so that they are received within the specified deadlines.

USFWS: Brian Elkington, Region 3 Regional Office, 5600 American Boulevard West, Suite 990 Bloomington, MN 55407, Phone: (612) 713-5168, Brian_Elkington@fws.gov

OHPO: David Snyder, Archaeology Reviews Manager, Ohio Historic Preservation Office, 800 E. 17th Avenue, Columbus, OH 43211-2474, Phone: (614) 298-2000, Fax: (614) 298-2037, dsnyder@ohiohistory.org.

ODNR: Jeff Tyson, Ohio Department of Natural Resources, 305 E. Shoreline Dr. Sandusky, OH 43440, Phone: (419) 625-8062, Jeff.tyson@dnr.state.oh.us

OEPA: Steve Malone, Ohio Environmental Protection Agency, 50 W. Town Street Columbus, Ohio 43215, Phone: (614) 644-3663, steve.malone@epa.ohio.gov

USACE: Joseph W. Krawczyk, U.S. Army Corps of Engineers, Buffalo District, Regulatory Branch, 1776 Niagara Street, Buffalo, New York 14207-3199, Phone: (716) 879-4186, joseph.w.krawcyzk@usace.army.mil

City: Mayor Jim Ellis, City of Fremont, 323 S. Front, Fremont, Ohio 43420, Phone: (419) 334-5900, jellis@fremontohio.org

EXECUTION of this PA by USFWS, OHPO, ODNR, OEPA, USACE, and City, and implementation of its terms evidences that USFWS has taken into account the effects of this undertaking on historic properties and afforded ACHP a reasonable opportunity to comment.

Signatories

U.S. FISH AND WILDLIFE SERVICE

By _____ Date 6/2/14

Todd Turner, Assistant Regional Director, Fisheries, Midwest Region

PROGRAMMATIC AGREEMENT (PA)

among
The U.S. Fish and Wildlife Service (USFWS),
The Ohio Historic Preservation Office (OHPO),
The Ohio Department of Natural Resources (ODNR),
The Ohio Environmental Protection Agency (OEPA),
The U.S. Army Corps of Engineers (USACE),
The City of Fremont (City),

[redacted]

*Removed with Signatory Approval (5/27/2014)

Regarding

The Proposed Sandusky River Fish Passage Project (Project),
Ballville Township, Sandusky County, Ohio

OHIO HISTORIC PRESERVATION OFFICE

By_____ Date 5-15-14
Mark J. Epstein, Deputy State Historic Preservation Officer for Resource Protection and Review

PROGRAMMATIC AGREEMENT (PA)

among

The U.S. Fish and Wildlife Service (USFWS),
The Ohio Historic Preservation Office (OHPO),
The Ohio Department of Natural Resources (ODNR),
The Ohio Environmental Protection Agency (OEPA),
The U.S. Army Corps of Engineers (USACE),
The City of Fremont (City),

[redacted]

*Removed with Signatory Approval (5/27/2014)

Regarding

The Proposed Sandusky River Fish Passage Project (Project),
Ballville Township, Sandusky County, Ohio

OHIO DEPARTMENT OF NATURAL RESOURCES

By _____ Date 5-20-14
James Zehringer, Director

PROGRAMMATIC AGREEMENT (PA)

among

The U.S. Fish and Wildlife Service (USFWS),
The Ohio Historic Preservation Office (OHPO),
The Ohio Department of Natural Resources (ODNR),
The Ohio Environmental Protection Agency (OEPA),
The U.S. Army Corps of Engineers (USACE),
The City of Fremont (City),

[redacted]

*Removed with Signatory Approval (5/27/2014)

Regarding

The Proposed Sandusky River Fish Passage Project (Project),
Ballville Township, Sandusky County, Ohio

OHIO ENVIRONMENTAL PROTECTION AGENCY

By _____ Date 4/23/14
Craig W. Butler, Director

PROGRAMMATIC AGREEMENT (PA)

among

The U.S. Fish and Wildlife Service (USFWS),
The Ohio Historic Preservation Office (OHPO),
The Ohio Department of Natural Resources (ODNR),
The Ohio Environmental Protection Agency (OEPA),
The U.S. Army Corps of Engineers (USACE),
The City of Fremont (City),

[redacted]
*Removed with Signatory Approval (5/27/2014)

Regarding

The Proposed Sandusky River Fish Passage Project (Project),
Ballville Township, Sandusky County, Ohio

U.S. ARMY CORPS OF ENGINEERS

By Diane C. Kozlowski Date 21 May 2014
Diane C. Kozlowski, Chief, Regulatory Branch

PROGRAMMATIC AGREEMENT (PA)

among
The U.S. Fish and Wildlife Service (USFWS),
The Ohio Historic Preservation Office (OHPO),
The Ohio Department of Natural Resources (ODNR),
The Ohio Environmental Protection Agency (OEPA),
The U.S. Army Corps of Engineers (USACE),
The City of Fremont (City),

[redacted]
*Removed with Signatory Approval (5/27/2014)

Regarding

The Proposed Sandusky River Fish Passage Project (Project),
Ballville Township, Sandusky County, Ohio

CITY OF FREMONT

By_____ Date 5/12/2014
Mayor Jim Ellis

PROGRAMMATIC AGREEMENT (PA)

among
The U.S. Fish and Wildlife Service (USFWS),
The Ohio Historic Preservation Office (OHPO),
The Ohio Department of Natural Resources (ODNR),
The Ohio Environmental Protection Agency (OEPA),
The U.S. Army Corps of Engineers (USACE),
and
The City of Fremont (City),

Regarding

The Proposed Sandusky River Fish Passage Project (Project),
Ballville Township, Sandusky County, Ohio

Concurring Party

BALLVILLE TOWNSHIP

By_____ Date_____
Bob Kusmer, Trustee

PROGRAMMATIC AGREEMENT (PA)

among

The U.S. Fish and Wildlife Service (USFWS),
The Ohio Historic Preservation Office (OHPO),
The Ohio Department of Natural Resources (ODNR),
The Ohio Environmental Protection Agency (OEPA),
The U.S. Army Corps of Engineers (USACE),
The City of Fremont (City),

[redacted]

*Removed with Signatory Approval (5/27/2014)

Regarding

The Proposed Sandusky River Fish Passage Project (Project),
Ballville Township, Sandusky County, Ohio

Concurring Party

SANDUSKY COUNTY HISTORICAL SOCIETY

By _____ Date 04-14-14
Fred Recktenwald

PROGRAMMATIC AGREEMENT (PA)

among

The U.S. Fish and Wildlife Service (USFWS),
The Ohio Historic Preservation Office (OHPO),
The Ohio Department of Natural Resources (ODNR),
The Ohio Environmental Protection Agency (OEPA),
The U.S. Army Corps of Engineers (USACE),
The City of Fremont (City),

[redacted]

*Removed with Signatory Approval (5/27/2014)

Regarding

The Proposed Sandusky River Fish Passage Project (Project),
Ballville Township, Sandusky County, Ohio

Concurring Party

RUTHERFORD B. HAYES PRESIDENTIAL CENTER

By Nan Card Date 5/13/14

Nan Card

Ballville Dam Project

Final Environmental Impact Statement:

Appendix D – National Historic Preservation Act (NHPA)

2 – Correspondence Record

United States Department of the Interior

FISH AND WILDLIFE SERVICE

5600 American Boulevard West, Suite 990
Bloomington, MN 55437-1458

IN REPLY REFER TO:
FWS/AF

FEB 03 2012

Mr. David Snyder
Archaeology Reviews Manager
Ohio Historic Preservation Office
Ohio Historical Society
1982 Velma Avenue
Columbus, Ohio 43211-2497

RE: **Section 106 Review**: Sandusky River Fish Passage Project, Township of Ballville, Sandusky County, Ohio

Dear Mr. Snyder:

The U.S. Fish and Wildlife Service (Service) is helping to fund, through the Great Lakes Restoration Initiative and Great Lakes Fish and Wildlife Restoration Act, a project to provide fish passage for migratory fish species such as walleye, white bass and greater redhorse along the Sandusky River in Sections 4, 5, 8, 9, and 17, T4N, R15E, the Township of Ballville in Sandusky County, Ohio. The potential that this project will affect cultural resources eligible for listing on the National Register of Historic Places (NRHP) prompts our consultation with you under Section 106 of the National Historic Preservation Act (NHPA). The service is inviting you to be a consulting party for this project.

The Service, along with Stantec Consulting Services (STANTEC), the City of Fremont, the Ohio Department of Natural Resources (ODNR), and the Ohio Environmental Protection Agency (OEPA), are working to prepare a Draft Environmental Impact Statement (DEIS) to restore the Sandusky River to its natural flow conditions through the proposed removal of the extant Ballville Dam, built in 1912. Removing the dam would facilitate the restoration of aquatic organism passage and habitat connectivity both upstream and downstream of the dam site, the elimination of safety hazards and liability associated with the dam, the improvement of water quality, the management of impounded sediments, and an increase in recreational use of the river.

The dam no longer impounds water for hydroelectric energy production. The dam's current main function, as creating a drinking water supply, will become obsolete once the nearby City of Fremont is done constructing an up ground drinking water reservoir, scheduled to be completed Spring of 2012. Although the DEIS will examine the issues and concerns related to this complex project, it is believed by some that repairing and maintaining the deteriorating dam would be cost prohibitive for the city and its residents. In addition, the dam is currently out of compliance with the State of Ohio

dam safety regulations. Furthermore, the Sandusky River is currently not meeting its designated beneficial uses upstream of the dam. In conjunction with the preparation of this document to investigate the ramifications of the proposed removal, the service is investigating the historic nature of the proposed project site and what effect this may have on the dam.

The Area of Potential Effects (APE) for the project is somewhat subjective but is considered the dam pool itself and surrounding parcels within the dam's viewshed. It is 89.3 acres in size, but, the direct APE is only 12.2 acres. The ASC Group, Inc. (ASC) was subcontracted by STANTEC to conduct a cultural resources management survey of the entire APE. However, an archaeological survey was conducted only on the direct APE. The entire APE was field reviewed for standing structures.

A map of the APE and ASC's findings and recommendations are found in their final report entitled "Cultural Resources Management Survey for the Proposed Removal of the Ballville Dam, Ballville Township, Sandusky County, Ohio" by Douglas Terpstra, Chuck Mustain and Alan Tonetti, September 2011. Enclosed please find a copy of the final report for your review.

ASC's archaeological survey discovered only one archaeological site, 33SA598, which was a sparse prehistoric lithic scatter. It was found on the surface in a plowed field. ASC considers this site not to be eligible for inclusion on the NRHP. Their architectural survey recorded 33 buildings, structures and a historic cemetery more than 50 years of age within the APE. Of these, only three are recommended to be eligible for inclusion on the NRHP. These include the Ballville Dam (SAN-546-10), its associated Hydroelectric Plant (SAN-545-10), and the Jacob King Farmhouse (SAN-568-10) at 2022 South River Road.

We agree with ASC's recommendations on all three of these properties. The Ballville Dam and the Hydroelectric Plant are both considered by the Service to be eligible for listing under Criteria A and C. They could be thought of as contributing elements of a possible discontinuous historic district. The Jacob King Farmhouse (but not any associated land or outbuildings) is considered by the Service to be eligible under Criterion C. The Service determines that the proposed removal of the Ballville Dam will constitute an Adverse Effect on the Ballville Dam. However, the Service also determines that the removal will have No Adverse Effect on the Hydroelectric Plant or the Jacob King Farmhouse.

To mitigate the Adverse Effect to the Ballville Dam, the Service is proposing to enter into a Memorandum of Agreement (MOA) with you and the other the consulting parties. The consulting parties include the City of Fremont, the ODNR, the OEPA, the Ohio State Historic Preservation Office (OHPO), and the U.S. Army Corps of Engineers (USACE). The Sandusky County Historical Society and the Rutherford B. Hayes Presidential Center are considered to be interested parties. As such, although they would be consulted, they would not be signatories to the MOA. All are receiving similar consultation letters. Some mitigation options within the MOA may include an extensive Historic Architectural and Engineering Record (HAER) recordation of the Ballville Dam (satisfying Criterion C) and the writing of a publicly accessible history book on the Ballville Dam and its place in Ohio hydroelectrical history (satisfying Criterion A).

There is one other issue that may need to be addressed in the MOA. It is the question of the possible remnants of the Tucker Dam, located approximately 4,500 feet upstream from the Ballville Dam. Soundings from a hydrographic survey noted an anomaly in the riverbed at the possible location of

the remnant timber structure eight feet below the waterline and encased in sediment (see pages 66-67 in the report). The lowering of the waterline may expose this feature. In lieu of an expensive underwater survey, this could be dealt with as part of an MOA after (or while) the proposed removal of the Ballville Dam is carried out.

If you have any questions about these determinations, please contact my Regional Historic Preservation Officer, James Myster, at (612) 713-5439 or james_myster@fws.gov.

Sincerely,

Charles M. Wooley
Acting Regional Director

Enclosure

cc: James Myster, USFWS Regional Historic Preservation Officer

OHIO HISTORY

RECEIVED
MAR 15 2012
CITY OF FREMONT, OHIO

March 12, 2012

James Myster, Regional Historic Preservation Officer
U.S. Fish and Wildlife Service
5600 American Boulevard West, Suite 990
Bloomington, MN 55437-1458

Re: Ballville Dam Demolition
Fremont, (Ballville), Ballville Township, Sandusky County, Ohio

Dear Mr. Myster,

This is in response to correspondence from your office dated February 3, 2012 (received February 10) regarding the above referenced project. The comments of the Ohio Historic Preservation Office (OHPO) are submitted in accordance with provisions of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 [36 CFR 800]).

The project involves the demolition of Ballville Dam. Additional information is needed for us to continue with the Section 106 review for this project. We have questions concerning the review process, the involvement of consulting parties, and the identification of historic properties.

The correspondence transmits the report titled "Cultural Resources Management Survey for the Proposed Removal of the Ballville Dam, Ballville Township, Sandusky County, Ohio" by Douglas Terpstra, September 23, 2011. The report documents archaeological survey in the construction zone and an architecture-history survey in the Area of Potential Effects. The archaeological survey resulted in the identification of 1 archaeological site. The architecture-history survey resulted in the identification of 33 buildings including the Ballville Dam that was recommended as eligible for inclusion in the National Register of Historic Places.

We request clarification of the archaeological survey. The survey is described as being conducted in a flat agricultural field but the mapping shows the site on a steep hillside with no survey work conducted on the adjacent flat field.

We do not agree with all of the eligibility recommendations for architecture-history properties. Of particular concern, especially given the large construction work space staging area adjacent to Oakwood Cemetery, we recommend that Oakwood Cemetery should be regarded as an important place and afforded treatment parallel to eligible properties. In addition, we require completed inventory forms for identified properties to continue our review of the architecture-history properties.

There is much consultation needed before we might reach that point in the regulations where we agree on mitigation measures and initiate consultation to finalize a Memorandum of Agreement. It is not clear to us that the project justification and needs require the demolition of the dam. We recommend that consultation is needed to consider ways to avoid the demolition of the dam.

OHIO HISTORICAL SOCIETY
Ohio Historic Preservation Office
1982 Velma Avenue, Columbus, Ohio 43211-2497 ph: 614.298.2000 fx: 614.298.2037
www.ohiohistory.org

Any questions concerning this matter should be addressed to David Snyder at (614) 298-2000, between the hours of 8 am. to 5 pm. Thank you for your cooperation.

Sincerely,

David Snyder

David Snyder, Ph.D., Archaeology Reviews Manager
Resource Protection and Review

DMS/ds (OHPO Serial Number 1042932)

xc: Sam Derr, Service Director, City of Fremont, 323 S. Front Street, Fremont, OH 43420-3065

United States Department of the Interior

FISH AND WILDLIFE SERVICE

5600 American Boulevard West, Suite 990
Bloomington, Minnesota 55437-1458

IN REPLY REFER TO:
FWS/NWRS-VSO

MAY 3 0 2012

Dr. David Snyder
Archaeology Reviews Manager
Ohio Historic Preservation Office
Ohio Historical Society
1982 Velma Avenue
Columbus, Ohio 43211-2497

RE: **Section 106 Review**: Sandusky River Fish Passage Project, Township of Ballville, Sandusky County, Ohio (OHPO Number 1042932)

Dear Dr. Snyder:

We have received your response to our initial determinations for the above referenced project. In your March 12, 2012 letter, you indicated that you needed more information and consultation before you can comment. Your concerns seem to fall into 4 areas: (1) clarification of the archaeological survey results; (2) the need for inventory forms for all identified potentially eligible architectural properties; (3) concern over impacts to the nearby Oakwood Cemetery; and (4) further consultations regarding options to the demolition of the Ballville Dam.

To address concerns 1 and 2 we requested that the cultural subcontractor ASC Group, Inc. further clarify their archaeological site survey and submit the requested architectural inventory forms. Enclosed please find their supplemental report entitled "Addendum to the Cultural Resources Management Survey for the Proposed Removal of the Ballville Dam, Ballville Township, Sandusky County, Ohio" by David F. Klinge, Douglas Terpstra and Alan Tonetti, April 2012. The report includes the correction of the archaeological site 33SA598 location within the APE and 33 separate inventory forms for the architectural resources.

To address your concern over impacts to the Oakwood Cemetery, I requested further assurances from the contractor, Stantec Consulting Services that these impacts will be mitigated to the furthest extent possible. Their response is as follows...

No direct impacts to the cemetery are expected to occur. Any impacts to the cemetery would be temporary and indirect in nature. Fugitive dust from demolition of the nearby dam and truck traffic to haul away debris may temporarily increase dust in the area, traffic and construction noise, and interrupt views of the Sandusky River. To mitigate these potential impacts during construction the following best management practices will be used when appropriate:

- *Dampening of areas during dry and windy work hours*
- *Covering of debris being hauled away by truck to prevent material spillage*
- *Gravel placement at loading site to help curtail mud and dirt tracking onto roadways*
- *Temporary interruption of scenic expectation of the Sandusky River will be unavoidable during the demolition of the dam and for some time after the project as vegetation communities recover. The recovery process will be accelerated through aggressive establishment of plant species on the channel margins.*
- *Work during holidays and weekends will be avoided in an attempt to minimize impacts to the visitation experience during those times.*
- *Immediate roadway maintenance during demolition will be addressed on a case by case basis and repaired to extent practical.*

Your concern over full consultation is well noted. When you have formally commented on our specific determinations, we can discuss ways to resolve any adverse effects on historic properties within the APE. If you have any further questions about our determinations, please contact me at (612) 713-5439 or james_myster@fws.gov.

Sincerely,

James E. Myster
Regional Historic Preservation Officer

Enclosure

cc: Sam Derr, City of Fremont
Joseph Krawczyk, US Army Corps of Engineers
Roger Knight, Ohio Department of Natural Resources
Steve Malone, Ohio Environmental Protection Agency
Fred Recktenwald, Sandusky County Historical Society
Nan Card, Rutherford B. Hayes Presidential Center

June 25, 2012

James Myster, Regional Historic Preservation Officer
U.S. Fish and Wildlife Service
5600 American Boulevard West, Suite 990
Bloomington, MN 55437-1458

Re: Ballville Dam Demolition
Fremont, (Ballville), Ballville Township, Sandusky County, Ohio

Dear Mr. Myster,

This is in response to correspondence from your office dated May 30, 2012 (received June 4) regarding the above referenced project. The comments of the Ohio Historic Preservation Office (OHPO) are submitted in accordance with provisions of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 [36 CFR 800]).

The project involves the demolition of Ballville Dam. The correspondence transmits an addendum report providing requested information supplementing the completed archaeological and architectural surveys. The report documents archaeological survey in the construction zone and an architecture-history survey in the Area of Potential Effects. The archaeological survey resulted in the identification of 1 archaeological site. We agree that archaeological site 33-SA-598 is not eligible for inclusion in the National Register of Historic Places. The architecture-history survey resulted in the identification of 33 buildings including the Ballville Dam that was recommended as eligible for inclusion in the National Register of Historic Places.

We concur with your finding that the Ballville Dam and former hydroelectric plant buildings (SAN-545-10 and SAN-546-10) are eligible for inclusion in the National Register of Historic Places.

Oakwood Cemetery is to be regarded as an important place and the contractor has proposed measures to reduce temporary and indirect impacts. While this is helpful, we point out that the National Historic Preservation Act focuses concern on effects and not on impacts. As the consultation moves forward we will look to frame the findings for the Oakwood Cemetery in terms of Section 106 of the Act and its implementing regulations at 36 CFR 800.

There is a recommendation that a farmhouse along South River Road (SAN-568-10) meets National Register eligibility criteria. We agree. The consultants note that the house will not be impacted. Further consultation is needed to frame the findings for this property in terms of Section 106 of the Act and its implementing regulations at 36 CFR 800.

There is much consultation needed before we might reach that point in the regulations where we agree on mitigation measures and initiate consultation to finalize a Memorandum of Agreement. It is not clear to us that the project justification and needs require the demolition of the dam. We recommend that consultation is needed to consider ways to avoid the demolition of the dam.

OHIO HISTORICAL SOCIETY
Ohio Historic Preservation Office
8982 Velma Avenue, Columbus, Ohio 43211-2497 ph: 614.298.2000 fx: 614.298.2037
www.ohiohistory.org

Any questions concerning this matter should be addressed to David Snyder at (614) 298-2000, between the hours of 8 am. to 5 pm. Thank you for your cooperation.

Sincerely,

David Snyder

David Snyder, Ph.D., Archaeology Reviews Manager
Resource Protection and Review

DMS/ds (OHPO Serial Number 1044589, 1042932)

xc: Sam Derr, Service Director, City of Fremont, 323 S. Front Street, Fremont, OH 43420-3065

Ballville Dam Section 106 Historic Preservation Meeting

December 13, 2012; Fremont OH

Agenda

10:00am - Meet at community center and carpool to dam site
10:15am - 11:30am -Arrive at Ballville Dam Site and walk the site - Purpose: Brief introductions and view the structure so that we all have a visual reference for the project being discussed
11:30am - 1:00pm - Lunch at a local restaurant TBD - Purpose: Get to know each other in an informal setting
1:00pm - 3:00pm - Transition to nearby indoor meeting space - Purpose: Discuss current project planning and potential options relating to historical/cultural impacts moving forward
1:00-1:15pm - Present current status of Draft EIS and proposed alternative (Brian Elkington, USFWS)
1:15-1:30pm - Present one option for mitigation in the event Ballville Dam would be removed (James Myster, USFWS)
1:30-3:00pm - Dialogue about current Draft analysis and alternatives for proposed mitigation
3:00pm - Adjourn

Participants

Name:	Affiliation:	Email:	Phone:
Nan Card	Hayes Presidential Center	ncard@rbhayes.org	1-800-998-7737
Bill Damschroder	ODNR	Bill.Damschroder@dnr.state.oh.us	614-265-6882
John Navarro	ODNR	John.Navarro@dnr.state.oh.us	614-265-6346
Jeff Tyson	ODNR	Jeff.Tyson@dnr.state.oh.us	419-625-8062
Rich Carter	ODNR	Rich.Carter@dnr.state.oh.us	614-265-6345
Steve Malone	OEPA - DEFA	Steve.Malone@epa.state.oh.us	614-644-3663
Rahel Babb	OEPA - DEFA	Rahel.Babb@epa.state.oh.us	614-644-3711
James Myster	USFWS	James_Myster@fws.gov	612-713-5439
Bob Gable	ODNR, Scenic Rivers	bob.gable@dnr.state.oh.us	614-265-6814
Mike Wilkerson	ODNR, Wildlife	Mike.Wilkerson@dnr.state.oh.us	419-429-8375
Joe Jellick	OEPA - DEFA		614-644-3667
David Snyder	Ohio Historic Preservation Office	dsnyder@ohiohistory.org	614-298-2000
Fred Recktenwald	Sandusky County Historical Society		419-332-7558
Jim Ellis	City of Fremont	jellis@fremontohio.org	419-334-5900
Cody Fleece	Stantec	Cody.Fleece@stantec.com	513-842-8238
Bob Kusmer	Ballville Township	wrkusmer@sbcglobal.net	419-680-0938
Brian Elkington	USFWS	Brian_Elkington@fws.gov	612-713-5168
Jeff Brown	Stantec	Jeff.Brown@stantec.com	513-842-8200

Notes

*Please note that throughout this meeting we discussed the possibility that dam removal would be the preferred alternative, HOWEVER this is not yet decided and it will not be made until after public release of the Draft EIS for review and comment as well the signature of a Record of

Decision by our FWS Midwest Regional Director. We continue to work on the development of that document as well as fully analyze a suite of alternatives.

This meeting consisted of two main parts, a meeting onsite at the Dam as well as a indoor meeting to discuss the project status and Section 106.

For the onsite portion, we met on top of the structure, with brief discussions regarding some of the history, and the affects relating to Section 106 of dam removal were it be carried forward as the preferred alternative. We responded to specific questions relating to the currently suggested sequence of deconstruction events as well as the subsequent placement of Ice Control Structures to protect the Community from ice related flooding.

Following the onsite meeting, we viewed the new up ground reservoir site and shortly thereafter broke for lunch.

Following lunch we met at the Fremont Community Center were, after brief introductions, Brian Elkington, USFWS, started off the meeting with a description of the EIS development process undergone to date, the Purpose and Need for the project, and a draft timeline for continued development, public release, and completion of the EIS process. He also presented and described the alternative currently anticipated to become the preferred alternative, "Incremental Dam Removal with Ice Control Structure." This sparked discussion by the group with questions regarding public involvement in the process, details about the timeline and specific steps towards completion, and the possible inclusion of ideas for alternatives from the community.

James Myster, USFWS, then began to lead us in a conversation specifically regarding the Service's determination of National Register eligibility for the Ballville Dam site under A and C and that the currently anticipated alternative would present an adverse effect on the structures eligibility. It was also noted that although the federal agencies involved each have a responsibility to review NHPA compliance/actions, usually the Lead Federal Agency, in this case the USFWS, makes the ultimate decision, with input from the consulting and interested parties, as to how to best proceed in regards to NHPA and historic preservation.

The point was then made by David Snyder, OHPO, that there may be a lack of data and information compiled regarding the level of significance of the Ballville Dam related to other similar structures or historic elements in the region. In what ways may this dam be unique or important to the history of the area? To achieve this we may need some context of Dams in the region, perhaps a short report addressing how unique the hydro production was at the time,

perhaps the dams shape or size? When asked where to collect this type of information from, it was pointed out that this information might be available through research in databases, or unknown thesis or studies. It was also noted, USFWS, that this would likely be a reasonable path forward as it may eventually become a part of mitigation, if the structure were removed. Also noting we could pull together a thematic context for the report, such as "Hydro power dams in the region of that time period." When asked about the local historical significance of the structure the Interested parties in the room noted concerns of safety and cost to maintain the structure as well as weighing the human historic nature of the dam against the value of the ecological and natural history of the area.

A second point brought up was concern from our correspondence regarding the Oakwood Cemetery and affects that may be experienced at that site if demolition occurred. David Snyder posed a concern regarding the imposition a demolition may have on the peaceful nature and ambience expected at a cemetery and the importance of being respectful to the site and to those coming to visit loved ones. Noted by James, and others, I think the group does agree with David Snyders concern and would move forward under the assumption that if removal occurs, it would be done with as much care and respect as possible to the nearby cemetery as well as homeowners in the vicinity and using BMP's for the ecology of the area. However, to do so in a communally accepted way, we will need to talk through this topic more completely and develop a list of specific measures to ensure we are respectful of those nearby.

John Navarro with ODNR posed the question, What is common mitigation for this type of project? The USFWS responded noting that each different designation requires a different type of mitigation, to mitigate "A" it might generally be a short report depicting the uniqueness of the structure compared to others in the region. To mitigate "C" generally a HABS/HAER document may be produced which records in detail the structure, thereby allowing a future generation to build an exact replica of the structure if so desired. Although this is the generally accepted format, it was mentioned that we should, as a group, attempt to think more creatively, through the use of enhanced community preservation or educational elements if this moves forward. One component suggested was signage at the "Haunted Powerhouse" and, if removed, damsite

The last item discussed was the Tucker Dam, thought to be buried in the sediment upstream of the dam within the impoundment. This issue continues to be problematic in many ways, from historic preservation concerns, to economic, safety, ownership, and its potential impact on the project goals. Unfortunately, it seems that due to its potential placement we cannot feasibly confirm its presence, let alone its condition unless we are able to de-water some of that area and expose the issue more fully. We did however discuss the development of contingency

plans relating to its presence and what would be done given a suite of outcomes, e.g. it is present in good condition, present in poor condition, or it is not present within an MOA.

Action Items:

USFWS – Work internally to compile the information gathered at this meeting to being looking at a scope of work for a potential short report relating to a contextual theme.

United States Department of the Interior
FISH AND WILDLIFE SERVICE

5600 American Boulevard West, Suite 990
Bloomington, Minnesota 55437-1458

IN REPLY REFER TO:

FWS/NWRS-VSO

JUN 14 2013

Dr. David Snyder
Archaeology Reviews Manager
Resource Protection and Review
Ohio Historic Preservation Office
800 East 17th Avenue
Columbus, Ohio 43211

RE: Ballville Fish Passage Project, Meeting Follow-up; OHPO Numbers 1044589, 1042932

Dear Dr. Snyder:

At our consulting and interested parties meeting on December 13, 2012, you raised questions and concerns regarding public involvement, alternatives to dam demolition and mitigation of adverse effect to the Ballville Dam to be affected within the above referenced project. The intent of this letter is to provide you with additional information to help clarify our efforts to date and to ask your input into our proposal for a Programmatic Agreement (PA) to further the Section 106 process.

Public Involvement
I wanted to share with you some further history of the U.S. Fish and Wildlife Service's (Service) work with our partners regarding public outreach and coordination relative to the preferred alternative of the removal of the Ballville Dam, in Fremont, Ohio. The consideration of removal of Ballville Dam has been publicly known for some time as evidenced by local press stories dating back to the late 1990's and early 2000's. Removal was more seriously considered as design and construction of the above ground raw water reservoir began. As I understand it, the work towards researching the possible impacts of removing the Ballville Dam began more than a decade ago. Researchers have investigated the environment both upstream and downstream of the dam. Discussions between various agencies and the City of Fremont occurred regarding potential removal of the dam for a number of years prior to the Service becoming the Lead Federal Agency.

Although the Service did provide some funding assistance through our Wildlife and Sport Fish Restoration Program to assist with the up ground reservoir in 2009, it wasn't until 2010 when our Fisheries Program awarded the Ohio Department of Natural Resources funding for the proposed removal of Ballville Dam through the Great Lakes Fish and Wildlife Restoration Act, that Service became the Lead Federal Agency. This proposal was anonymously peer reviewed by experts in the field and selected for funding through a regional partner led proposal review process. At that time our team began discussions of NEPA Compliance and formal stakeholder coordination. Once the

team had determined an Environmental Impact Statement (EIS) would be most appropriate for this project, a Notice of Intent Announcement of Meeting, and Request for Comments were announced in the Federal Register (Federal Register Number [FWS–R3–FHC–2011–N187; 30140–1335–0000–W4]). There was a 30 day public comment period from October 21, 2011 to November 21, 2011.

The public meeting occurred on October 27, 2011 at the Vanguard Vocational School Technology Center in Fremont, Ohio. This meeting was announced in the local press and by word of mouth through City Officials at that time. I feel the meeting was a success with nearly 90 people in attendance, many of whom provided input, opinions, and concerns regarding the project. Comments were wide-ranging, but several recurring concerns were expressed. These concerns were primarily related to the significance of the structure to local residents, the disposition of the sediments in the impounded area, susceptibility of the local community to flooding if the structure were removed, water quality and fish population impacts of the project, concerns over the local water supply, and the potential to retrofit the structure. During this meeting, it was noted repeatedly that although the official comment period ended November 21, 2011, the Service would continue to accept comments as late in the process as possible and continue to communicate with those interested throughout the process. Below are excerpts from comments provided by three individuals relating to their interactions with the dam and how it impacts their lives.

"...I was born and raised in Ballville, and have passed over the Ballville bridge many, many times in my nearly 50 years, turning to gaze at the Ballville Dam and the general river's beauty as I went across. I saw it on my first bike. I saw it on the back of my brother's motorcycle. I saw it when I first drove a car. I chased a Blue Racer from the bottom of the dam up the steep south embankment. My kids have played at the bottom of the dam, and they've taken their kids there too... This is all part of that cultural change you mentioned, and I acknowledge that the loss of this dam will cause a big hole in my heart. A simple way to explain it: Each of these important landmarks make up what Ballville is known for: the Ballville bridge, Tindall bridge, and the Ballville Dam. Without the dam, it's just reduced to the Sandusky River. Have you stood on the bridge and looked at the dam? Try sitting next to the river sometime with your feet dangling over the rocks into the water, feeling the mist spray over you. It's just one of those memories that can't be beat...".

"...My residence abuts the Sandusky River in the area behind the dam, where a lake effect has been artificially created. The area is lush and overflowing with wildlife. I, along with many neighbors, enjoy a beautiful view of the river...".

"... I am totally in favor of the Ballville Dam removal. I have spent many years fishing in that section of the Sandusky River. I will be turning 59 years old soon, and have fished in that area for the better part of 50 years. I have seen big changes in the impoundment over the years as silt deposits continued to build up. The fishing quality went down, as the water became more oxygen depleted. The increase in algal blooms during periods of low flow and summer heat increased. A free flowing river is a healthy river. Please restore this section of the Sandusky River to it's natural flow. It's a water quality issue not only for the river itself but also for the citizen's of Fremont who consume the water".

Although the Draft EIS process was started officially on October 21, 2011 leading up to that point, the team had held several stakeholder meetings to engage in conversation about this project.

Stantec Consulting Services Inc. (Stantec), contracted by the City of Fremont to conduct a feasibility study for removal of the dam in 2011, helped to lead these meetings. A series of four stakeholder meetings occurred (1/13/2011; 4/14/2011; 10/27/2011; and 3/1/2012). These meetings were attended by various state and federal agencies, local watershed groups, local historical society, and City officials. These meetings were instrumental in gathering an initial understanding of the many important aspects of this project, such as biological, physical and cultural elements.

Additionally, discussions surrounding this project have been ongoing for many years, with news articles dating back to January of 2000 highlighting the concerns of "The Citizens Committee to Save Ballville Dam" and their thoughts relating to the removal of the structure. Those working on the Draft EIS have worked to incorporate and investigate many similar concerns to those noted in the aforementioned news articles. In addition, the team has worked to incorporate the ideas and comments that have been submitted to ensure this document is as complete and inclusive as possible. Based upon information received from these efforts we were able to develop an extensive list of alternatives for consideration and inclusion in the Draft EIS, as well as associated technical information to investigate the efficacy of those options.

Alternatives Considered

I would also like to take this opportunity to share with you that in drafting the alternatives section, the team considered ten different alternatives, ranging from no action, to maintaining and modifying the structure, to dam removal. Further analysis of these ten alternatives indicated that some alternatives were either economically or technically infeasible given the project site and parameters, or did not meet the purpose and/or need of the project. The team ultimately decided to carry four alternatives forward for full analysis. These four seemed most likely to be feasible and achieve all or most of the purpose and need of the project.

Two of the four alternatives include maintaining the structure in place (one is no action and the other is a fish ladder), while the other two include full removal (one is a single phase removal and one is a slower, multi-phased removal). It is unclear which of the four alternatives will be selected in the Record of Decision until we move further along the process, but our team does feel we have given due weight and consideration to the development of all the alternatives and that we are carrying forward the strongest candidates for consideration. We also want to ensure continued open and honest communication with you and the other stakeholders to ensure we are all working together no matter which alternative is selected.

We continue to develop the Draft EIS and as such continue to work with the comments provided to ensure we are incorporating them as appropriate. We are also open to further comments from the public and continue this coordination. We would like to have further conversations with yourself to discuss the alternatives as they are currently described and talk about the possibility of dam removal and what that would mean from a historical and cultural perspective for the region.

Mitigation of Adverse Effect to Ballville Dam

At our meeting in December, we also discussed the fact that the USFWS has determined that the dam is eligible for listing in the National Register of Historic Places under Criteria A and C. If dam removal were the selected alternative and if demolition were to be carried out, it would represent an adverse effect. We had spoken about the possibility of a Thematic Context or Multiple Property Listing (MPL) to address Criterion A, we also spoke briefly about the possibility of a HABS/HAER

report (or something equivalent that builds upon previous recordation) to address Criterion C. For Criterion A, we envision a completed Thematic context or MPL. To pursue such a document we have developed a draft scope of work to complete the document (attached). Please review it and provide comments back to ensure the product would be acceptable to the OHPO within a PA.

Additional topics included concern over nearby sites, including the Oakwood Cemetery and the Tucker Dam. As we continue to develop the Draft EIS, minimization of potential effects to nearby sites and local citizens under each alternative is being investigated in detail. Currently, through the use of non-invasive side-scan sonar, we are in the process of gathering more data on the physical characteristics of the remnants of the Tucker Dam which will help us all understand these components of the project.

If, after reviewing this letter, you have additional questions regarding this project, please feel free to contact me at 612-713-5439 or email (james_myster@fws.gov). I look forward to your response.

Sincerely,

James Myster
Regional Historic Preservation Officer

Enclosure

cc: Mayor Jim Ellis (City of Fremont)
Bob Kusmer (Ballville Township)
Jeff Tyson (ODNR)
Steve Malone (OEPA)
Joe Jellick (OEPA)
Joe Krawczyk (USACE)
Megan Seymour (USFWS)
Brian Elkington (USFWS)
Cody Fleece (Stantec Inc.)
Nan Card (Rutherford B. Hayes Presidential Center)
Fred Recktenwald (Sandusky County Historical Society)

OHIO HISTORY

July 29, 2013

James E. Myster
Regional Historic Preservation Officer / Archaeologist
Midwest Region (Region 3)
U.S. Fish and Wildlife Service
5600 American Boulevard West, Suite 1049
Bloomington, Minnesota 55437

Re: Ballville Dam Demolition
Fremont, (Ballville), Ballville Township, Sandusky County, Ohio

Dear Mr. Myster,

This is in response to correspondence from your office dated June 14, 2013 (received June 21) regarding the above referenced project. The comments of the Ohio Historic Preservation Office (OHPO) are submitted in accordance with provisions of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 [36 CFR 800]).

Thank you for providing the additional information regarding the consultation process and public involvement for this undertaking.

The correspondence also initiates a discussion on mitigation measures to resolve the adverse effect of the modifications and/or demolition to the Ballville Dam. In considering measures to resolve adverse effects, OHPO gives emphasis to appropriateness and proportionate responses. How important for preservation are the affected properties and how much will be lost as a result of the undertaking? USFWS is providing information from public comments that is helpful in assessing the effects and addressing these questions. We are concerned that State agencies are not similarly engaged in working through an independent review process at the state level.

USFWS has also provided preliminary information on project alternatives that could reduce the effects of the undertaking. We understand that there has been a good deal of analysis of different alternatives. We believe that further consultation on alternatives could be helpful after agencies have presented findings on historic properties. We believe that there is still a need to consider alternatives within a framework focused on reducing project effects to historic properties.

At this initial stage of development of mitigation ideas, my thinking is generally along the lines proposed in the scope of work attached to your correspondence. I can see where additional photographic documentation and the development of a multiple property listing database could be helpful. There is much work in front of us in spelling out with certain specificity how much photographic documentation will be agreed to and what the database and report deliverables would look like. However, compared to the tasks outlined in the scope of work, I would like to see relatively more emphasis on the development of a context for hydroelectric dams in Ohio and adjoining areas.

OHIO HISTORICAL SOCIETY
Ohio Historic Preservation Office
800 East 17th Avenue, Columbus, Ohio 43211 ph: 614.298.2000 fx: 614.298.2037
www.ohiohistory.org

A context creates a common reference for terms and relationships and also provides a framework to facilitate evaluations. For preservation, contexts are frequently developed to assist agencies recognize important characteristics. I see a need at this time not only to describe how these hydroelectric plants produced electricity but also to develop a framework to measure the impact of production of electricity at hydroelectric plants in Ohio. Why didn't Ohio make more extensive use of hydroelectric power? Was it the availability of coal and the inefficiency of turn-of-the-century hydroelectric turbines? Did the technology for dam construction also enter into this? Where hydroelectric power was generated, how did this interface with commercial development and growth of the grid providing power to individual households? I am not looking for a thesis on the history of hydroelectric power but rather a context that explores the complex relationships between the development and consumption of hydroelectric power. And, in turn, this context allows us to better understand and interpret the significance of dams in Ohio, especially those designed to produce hydroelectric power.

If the development of a multiple property listing database is agreed to, it is our expectation that the this development would be closely tied to the preparation of documentation to formally determine and list historic properties in the National Register of Historic Places, such as described in National Register Bulletin "Guidelines for Completing National Register of Historic Places Form, Part B: How to Complete the National Register Multiple Property Documentation Form."

Any questions concerning this matter should be addressed to David Snyder at (614) 298-2000, between the hours of 8 am. to 5 pm. Thank you for your cooperation.

Sincerely,

David Snyder

David Snyder, Ph.D., Archaeology Reviews Manager
Resource Protection and Review

DMS/ds (OHPO Serial Number 1049998, 1044589, 1042932)

Draft Ballville Programmatic Agreement

Elkington, Brian <brian_elkington@fws.gov> Mon, Sep 30, 2013 at 2:05 PM
To: "Tyson, Jeff" <Jeff.Tyson@dnr.state.oh.us>, "Krawczyk, Joseph W LRB" <Joseph.W.Krawczyk@usace.army.mil>, Jim Ellis <jellis@fremontohio.org>, Bob Kusmer <wrkusmer@sbcglobal.net>, "Jellick, Joe" <Joe.Jellick@epa.state.oh.us>, "Malone, Steve" <Steve.Malone@epa.state.oh.us>, "fremontauditor@ezworks.net" <fremontauditor@ezworks.net>, "ncard@rbhayes.org" <ncard@rbhayes.org>, Dave Snyder <dsnyder@ohiohistory.org>, "Rowan, Charles" <Charles.Rowan@dnr.state.oh.us>
Cc: Megan Seymour <Megan_Seymour@fws.gov>, James Myster <James_Myster@fws.gov>, "Fleece, Cody" <Cody.Fleece@stantec.com>, "Brown, Jeff" <Jeff.Brown@stantec.com>

Consulting Parties,

Attached you will find the most recent version of the draft Ballville Dam Project Programmatic Agreement (PA). James and I have worked to ensure this is as complete as possible and thought it was time to request comments back from the group as we prepare this document to be included unsigned as an appendix in the Draft EIS.

Please take some time to read through the PA and provide comments. We would like to have a conference call in 3 weeks with the group to talk about the project and have a dialogue about the mitigation elements within the PA. Please respond to the Doodle poll below to indicate your availability. Please note this meeting will be postponed if the government is shutdown at that time.

http://doodle.com/yr95zqpptrt9b7ut

Thank you for your time and for your consideration of this draft document.

Sincerely,

Brian Elkington
Deputy Program Supervisor - Fisheries
U.S. Fish and Wildlife Service - Midwest Region
5600 American Blvd W. Suite 990
Bloomington, MN 55437
(612) 713-5168 - Office
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DRAFT Ballville PA_9-30-13.doc
2896K

OHIO HISTORY

October 30, 2013

James E. Myster
Regional Historic Preservation Officer / Archaeologist
Midwest Region (Region 3)
U.S. Fish and Wildlife Service
5600 American Boulevard West, Suite 1049
Bloomington, Minnesota 55437

Re: Ballville Dam Demolition
Fremont, (Ballville), Ballville Township, Sandusky County, Ohio

Dear Mr. Myster,

This is in response to correspondence from your office dated September 30, 2013 (received September 30) transmitting the draft Programmatic Agreement for the above referenced project. The comments of the Ohio Historic Preservation Office (OHPO) are submitted in accordance with provisions of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 [36 CFR 800]).

This correspondence provides comments from current OHPO thinking on the Programmatic Agreement. We see a comprehensive and thoughtful document that contains much where we are in agreement. Our intention throughout these comments is to offer suggestions and recommendations to clarify process steps that will lead to the completion of the mitigation and to ensure that the mitigation measures support preservation efforts.

We insert comments, suggestions, and recommendations within the draft PA with different color and font. In a couple of places we insert wording when the reason for the insertion seems self-evident to us. In most other places we request or recommend changes with a brief explanation of our concern that suggests in general terms a direction that to us seems workable.

The draft PA contains a number of clauses that summarize the history of the consultation. We suggest in several places where it seems to us that that it would be clearer to focus more on the resolution of the adverse effect to the historic property and less on the history of the consultation. Also, in our opinion in several places it would be helpful to make more clear the distinction between effects (36 CFR 800.5) and eligibility (i.e., Criteria A and C; 36 CFR 800.4).

The thrust of our comments in this correspondence concerns clarification of what is to be included in the deliverables. As we offered in our July 29, 2013, correspondence, documentation along the lines of a multiple property listing could be useful by state and federal agencies in making preservation decisions regarding dams. We need to make sure that the PA provides the specific documentation needed to facilitate analysis that leads to well supported findings of eligibility. There is a critical need in Ohio for state agencies to have a database on dams designed to work with National Register determinations and National Historic Preservation Act findings and to be able to use this database with some facility in reaching and presenting findings.

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At this time OHPO is not convinced that the database will provide sufficient information that could lead directly to the development of a thematic context. Furthermore we are not convinced that the description of the summary report establishes with sufficient clarity the kinds of analysis needed in developing a context from an inventory. OHPO sees gaps in the sequence of steps that will be needed to reach the objectives of a thematic context. We believe that with some additional data and some additional analysis, and with some clarification, that the mitigation can take productive steps towards the stated objectives.

A context creates a common reference for terms and relationships and also provides a framework to facilitate evaluations. For preservation, contexts are frequently developed to assist agencies recognize important characteristics. Before finalizing the fields for the database I expect that the state and federal agencies who will be using this database will be able to demonstrate that the structure of the database will be useful and used in making decisions on the significance and eligibility of dams and that the fields and structure of the database will be useful in pursuing meaningful research questions regarding the history of dams in this area.

In the July 29, 2013, correspondence, OHPO expressed interest in development of a database that would support (eventually) the writing of a multiple property listing. We are not convinced at this time that the description of the extant datasets (see draft PA III.A.1. Paragraph 3) lay out the kind of foundation needed to posit a typology let alone could support the development of a multiple property listing. We request clarification demonstrating that a typology and database useful for historic preservation can likely result from the mitigation and deliverables.

It is our opinion that the deliverables must include a set of inventory forms and for Ohio properties we strongly recommend the use of the Ohio Historic Inventory form. Illustrating concerns we are raising regarding the fields in the database and the usefulness of the database (the preceding three paragraphs), we observe that the description of the database outlined in the draft PA does not list a field for the material or materials used in the construction of the dam and does not list a field evaluating the condition of the dam. It would not be surprising to find that the extant databases listed in the draft PA include some information on material and condition, but our experience cautions us that the information in the different databases may not be readily comparable and almost certainly any reference to condition will not be equivalent or interchangeable with how the term "condition" is used in historic preservation. Without any inventory forms developed from current field observations by historic preservation professionals we will lack the grounding and verification needed to evaluate the usefulness of the deliverables.

Any questions concerning this matter should be addressed to David Snyder at (614) 298-2000, between the hours of 8 am. to 5 pm. Thank you for your cooperation.

Sincerely,

David Snyder

David Snyder, Ph.D., Archaeology Reviews Manager
Resource Protection and Review

DMS/ds (OHPO Serial Number 1049998)

United States Department of the Interior

FISH AND WILDLIFE SERVICE

5600 American Boulevard West, Suite 990
Bloomington, Minnesota 55437-1458

In Reply Refer To:

FWS/NWRS-VSO

February 24, 2014 via email

Dr. David Snyder
Archaeology Reviews Manager
Resource Protection and Review
Ohio Historic Preservation Office
800 E. 17th Avenue
Columbus, OH 43211

RE: Programmatic Agreement, Ballville Dam Project, Ballville Township, Sandusky County, Ohio

Dear Dr. Snyder,

This is in response to correspondence from your office dated October 30, 2013, transmitting comments from the Ohio Historic Preservation Office (OHPO) staff, I would like to provide you with a revised copy of the Draft Programmatic Agreement outlining findings and describing proposed mitigation for the project. You will note we incorporated many of your extensive and thoughtful comments, and made significant clarifying changes to Section III. **Identification and Treatment**, subpart A(1) *Criterion A* and subpart B *Identification and Possible Mitigation Relating to Tucker Dam*. We will contact you shortly about setting up a conference call to describe the proposed changes and answer your and the other consulting parties' questions.

Before that call, please review this draft and provide any comments to me at 612-713-5439 or james_myster@fws.gov. I look forward to your response.

Sincerely,

James E. Myster
Regional Historic Preservation Officer

cc: Mayor Jim Ellis (City of Fremont), Bob Kusmer (Ballville Township), Jeff Tyson (ODNR), Steve Malone (OEPA), Joe Jellick (OEPA), Joe Krawczyk (USACE), Megan Seymour (USFWS), Brian Elkington (USFWS), Cody Fleece (Stantec Inc.), Nan Card (Rutherford B. Hayes Presidential Center), Fred Recktenwald (Sandusky County Historical Society)

March 25, 2014

James E. Myster
Regional Historic Preservation Officer / Archaeologist
Midwest Region (Region 3)
U.S. Fish and Wildlife Service
5600 American Boulevard West, Suite 1049
Bloomington, Minnesota 55437

Re: Ballville Dam Demolition
Fremont, (Ballville), Ballville Township, Sandusky County, Ohio

Dear Mr. Myster,

This is in response to correspondence from your office dated February 24, 2014, providing the revised Programmatic Agreement for the above referenced project. The agreement was discussed during our March 10, 2014, conference call. The comments of the Ohio Historic Preservation Office (OHPO) are submitted in accordance with provisions of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 [36 CFR 800]).

This correspondence provides comments on the Programmatic Agreement. Our intention throughout these comments is to offer suggestions and recommendations to clarify process steps that will lead to the completion of the mitigation and to ensure that the mitigation measures support preservation efforts.

Along the lines of the discussion during the conference call concerning Tucker Dam, we suggest some minor editing to establish that the consideration of the remains of Tucker Dam are to be decisive and brought promptly to conclusions. On Pages 4 and 5, I think that there are opportunities to be a little more direct in the PA. For the narrative on Tucker Dam and the evidence indicating that there might be remains of the dam in the project area, one suggestion is to provide much of this narrative in a separate document of a few pages that could be attached to the cover letter transmitting the PA rather than in the PA or attached to the PA.

- On Page 5, under Phase I Survey, we suggest removing the first sentence and editing the second sentence along the lines of "When Ballville Dam is removed, ODNR will compile concise Phase I level documentation to present findings from a brief, focused, effort to look for remains of the dam. USFWS will consult with the consulting parties regarding the findings with consideration of the need for any additional investigations."
- On Page 5, under Phase II Evaluation, some editing suggestions for the first sentence: "ODNR will conduct Phase II investigations to evaluate the integrity of the Tucker Dam site, if identified, as agreed upon as a result of the consultation following the Phase I survey (see above). If a Phase II study is conducted, USFWS will consult with the consulting parties regarding the findings of the evaluation." [Note, our suggestion is to move the ideas for avoidance to the separate document.]
- On Page 5, under Phase III Mitigation, last sentence word change, "...will guide the USFWS in is determining the appropriate mitigation measures."

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Mitigation to Ballville Dam.

- Criterion A. On Page 2, we suggest a minor editing to shift from "all dams in Ohio" to something along the lines of "...dams in Ohio contained in the comprehensive list maintained by the ODNR..." and we also suggest that here is a good place to reference the information in Attachment A.
- From the bottom of Page 2 and continuing on Page 3, our primary concern is for a cold reader to be able to pick up this agreement document and see clearly where there are check points that require providing information to specified consulting parties. To prepare the inventory and analysis required here, consultants will have to prepare a work plan describing in some detail how they will assemble the information and complete the task. We are concerned that the consultant does not have to contact OHPO about the research design and that the first opportunity that most of the consulting parties will have to look at this is when the draft report is submitted (see Page 4). If everything goes especially well this won't be a problem, but if there are any problems, by the time OHPO has a chance to look at the draft report it will be too late to make adjustments without having to completely re-do the research. We recommend that at the beginning of this section, immediately following the bold "1. Criterion A" subsection title, that it would be helpful to establish a series of check points.
- On Page 4, in subsection 1. Criterion A, it would be helpful to clarify the timelines (for instance, when is the draft report due?) and to clarify that the digital databases, digital files, and supporting documentation will be provided to OHPO as well as ODNR (and also other consulting parties if requested).

Continuing on Page 4, in subsection 2. Criterion C., we recommend addition of language to clarify the review process.

- Who reviews and are there different points of emphasis for different reviewers? This section establishes standards that the documentation must attain. But, as written, although ODNR is required to distribute, there is no requirement for ODNR or anyone else to review the documentation to make sure that all of the parts of the reporting documentation are in place and meet the standards that are established in the agreement document.

Any questions concerning this matter should be addressed to David Snyder at (614) 298-2000, between the hours of 8 am. to 5 pm. Thank you for your cooperation.

Sincerely,

David Snyder

David Snyder, Ph.D., Archaeology Reviews Manager
Resource Protection and Review

DMS/ds (OHPO Serial Number 1049998)

Elkington, Brian <brian_elkington@fws.gov>

Ballville Dam FINAL Programmatic Agreement

1 message

Elkington, Brian <brian_elkington@fws.gov> Mon, Apr 7, 2014 at 1:45 PM
To: Jim Ellis <jellis@fremontohio.org>, Bob Kusmer <wrkusmer@sbcglobal.net>, "Malone, Steve" <Steve.Malone@epa.state.oh.us>, "Jellick, Joe" <Joe.Jellick@epa.state.oh.us>, "Tyson, Jeff" <Jeff.Tyson@dnr.state.oh.us>, "Krawczyk, Joseph W LRB" <Joseph.W.Krawczyk@usace.army.mil>, fred recktenwald <f.recktenwald@aol.com>, "ncard@rbhayes.org" <ncard@rbhayes.org>, Dave Snyder <dsnyder@ohiohistory.org>
Cc: James Myster <James_Myster@fws.gov>, "Fleece, Cody" <Cody.Fleece@stantec.com>, "Brown, Jeff" <Jeff.Brown@stantec.com>, Megan Seymour <Megan_Seymour@fws.gov>

Consulting and Concurring Parties,

Attached you will find the Final Programmatic Agreement for the proposed removal of Ballville Dam. James incorporated the last round of comments received and we are requesting that you move it forward for signature by you, or your agencies appropriate representative.

You will note that each party has their own signature page. This was meant to allow everyone to route it through their individual signature process without having to wait, passing it in a chain from one to the next. Please send back to me your signed individual page via mail or scan and email. Once I have received them all, I will incorporate them into a single document and resend the fully signed agreement back to the group for everyone's records.

The fully signed Programmatic Agreement will be included in the Final EIS we are currently working on, so please be proactive in getting this routed and signed so that we can keep the EIS process moving forward.

Thank you for your time and input developing this agreement as a team. I look forward to finalizing the agreement together and having it in place to be utilized as needed upon EIS completion.

Thanks!

Brian Elkington
Deputy Program Supervisor - Fisheries
U.S. Fish and Wildlife Service - Midwest Region
5600 American Blvd W. Suite 990
Bloomington, MN 55437
(612) 713-5168 - Office
(612) 716-9215 - Cell
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2 attachments

Attachment A-Ballville PA.pdf
1206K

Ballville Final PA_4-7-14.pdf
74K

Elkington, Brian <brian_elkington@fws.gov>

Re: Ballville Dam PA

1 message

Elkington, Brian <brian_elkington@fws.gov> Fri, Jun 6, 2014 at 8:06 AM
To: Jim Ellis <jellis@fremontohio.org>, "Krawczyk, Joseph W LRB" <Joseph.W.Krawczyk@usace.army.mil>, "Malone, Steve" <Steve.Malone@epa.state.oh.us>, "Jellick, Joe" <Joe.Jellick@epa.state.oh.us>, "Tyson, Jeff" <Jeff.Tyson@dnr.state.oh.us>, Bob Kusmer <wrkusmer@sbcglobal.net>, Dave Snyder <dsnyder@ohiohistory.org>, "ncard@rbhayes.org" <ncard@rbhayes.org>, fred recktenwald <f.recktenwald@aol.com>
Cc: Megan Seymour <Megan_Seymour@fws.gov>, James Myster <James_Myster@fws.gov>

Consulting and Concurring Parties,

Thank you to everyone for responding to my message below regarding the change of Ballville Township from a consulting to a concurring party. I received responses from all signatories indicating they were approving the change without re-routing the document for signature. Attached you will find the final signed Programmatic Agreement reflecting this change. Please review this document and let me know if you have questions.

Thank you to everyone for working together to successfully complete this PA. The signed PA will be included in the Final EIS, which we continue to work through and hope to finalize soon.

Thanks and have a great weekend!

Brian Elkington
Deputy Program Supervisor - Fisheries
U.S. Fish and Wildlife Service - Midwest Region
5600 American Blvd W. Suite 990
Bloomington, MN 55437
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(612) 716-9215 - Cell
(612) 713-5289 - Fax

On Fri, May 23, 2014 at 11:11 AM, Elkington, Brian <brian_elkington@fws.gov> wrote:

> Consulting and Concurring Parties,
>
> I wanted to let you know that we have continued to receive and now have almost all signatures on the Final Programmatic Agreement (PA) for historic mitigation for the Ballville Dam Project. I also wanted to let the group know that based on my recent conversations with Ballville Township, they will need to be considered a Concurring Party for this PA instead of a Consulting Party.
>
> In its current format, Ballville Township is identified as a "Consulting Party" and is referenced as such in the body of the PA. I am proposing that without re-routing the document for new signatures amongst our individual organizations, we instead simply edit the document to move Ballville Township from a Consulting Party to a Concurring Party status. This will require minor edits to the body of the document itself as well as removing Ballville Township from the header of each signature page. Attached is the unsigned .pdf for your reference regarding this proposed switch.
>
> Would the Consulting and Concurring parties be comfortable with this modification to the already Signed PA? If so, I can make the edits here and provide a signed final PA to the group for everyone's review and records. If not, please let me know so that we can work to find an alternative solution.
>
> Please respond to this email confirming your response and either your agreement or disagreement with this approach by COB Wednesday, June 4.

Ballville Dam Project -- Appendix D2

Thanks and have a great memorial day weekend!

Brian Elkington
Deputy Program Supervisor - Fisheries
U.S. Fish and Wildlife Service - Midwest Region
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Ballville Final PA_5-27-14.pdf
1272K

Ballville Dam Project

Final Environmental Impact Statement:

Appendix E – Invasive Species Risk Assessment

Risk Analysis Form

Issue: Evaluation of Risk of Asian Carps Establishing in the Sandusky River above Ballville Dam, and Impacts to the Sandusky River and Lake Erie Ecosystems

Report Compiled by:
Michael H. Hoff
U.S. Fish and Wildlife Service

On Behalf of Expert Risk Analysis Panelists:
Terrance Ott
U.S. Fish and Wildlife Service

Jeff Tyson
Ohio Department of Natural Resources

Todd Kalish
Michigan Department of Natural Resources

Jim Markham
New York Department of Environmental Conservation

Rick Drouin
Ontario Ministry of Natural Resources

John Bossenbroek
University of Toledo

Ed Roseman
U.S. Geological Survey

Jeff Miner
Bowling Green State University

Ed Rutherford
National Oceanographic and Atmospheric Administration

Reuben Goforth
Purdue University

And

Rich Ruby
U.S. Army Corps of Engineers

August 2013

SUMMARY and SYNTHESIS

The Ballville Dam is located on the Sandusky River, in the Township of Ballville, Ohio, approximately 18 river miles upstream of Lake Erie. The dam is approximately 407 feet long and 34.4 feet high and currently is considered a complete barrier to the upstream passage of fish species. Currently, a Draft Environmental Impact Statement is being prepared to analyze possible alternatives to allow fish passage at the dam site. The current draft alternatives to allow fish passage are either dam removal, or the construction of a fish elevator system with a sorting facility. To analyze the possible impacts of fish passage at the site, invasive species issues are being considered. Although other species such as the sea lamprey (*Petromyzon marinus*) and quagga mussel (*Dreissena bugensis*) may also impact the Sandusky River upstream of Ballville Dam, if fish passage is enhanced by implementing one of the alternatives, in this summary we report on the expert analysis of:

- Risk of establishment of Asian carp species (silver carp [*Hypophthalmichthys molitrix*], and/or bighead carp, [*Hypophthalmichthys nobilis*], and/or grass carp [*Ctenopharyngodon idella*], and/or black carp [*Mylopharyngodon piceus*]), in the Sandusky River and Lake Erie, via various pathways, and
- Potential impacts, of an established population[s] of Asian carps, on the Sandusky River and Lake Erie.

To complete this analysis, a panel of eleven Experts was formed. Individuals were selected based on their expertise and knowledge related to the technical questions that formed the basis of the review, and in a manner to ensure broad representation of the various entities engaged in Asian carp prevention in the Lake Erie and the Sandusky River. One Expert did not complete most of the questionnaire, but instead focused only on completing portions of the questionnaire relating to Asian carp parasites and pathogens. The remaining ten Experts completed various components of the risk analysis questionnaire.

Ten of the Experts provided beliefs about self-sustaining populations of Asian carps in the Sandusky River, connected Lake Erie system (i.e., Lake Erie and tributaries up to the first fish barrier), and the connected Great Lakes system (Great Lakes, outside of Lake Erie, their connecting channels, and tributaries up to the first fish barrier). All Experts believed Asian carps have not established self-sustaining populations in the Sandusky River above Ballville Dam. Seven of the Experts believed Asian carps have not established self-sustaining populations in the connected Lake Erie system, and the connected Great Lakes system. Two Experts believe that grass carp have developed self-sustaining populations in the connected Lake Erie system, and the connected Great Lakes system. Information submitted by one Expert is interpreted to mean, based on references provided, that bighead and silver carps are established in the connected Lake Erie system, and the connected Great Lakes system.

Seven of the Experts completed enough of the questionnaire to characterize Risk Potential of Asian carps to Lake Erie, and six of the Experts completed enough of the questionnaire to characterize Risk Potential of Asian carps to the Sandusky River. Information in the completed risk analysis questionnaires are interpreted to mean that:

- Risk potential, of Asian carps to Lake Erie, does not change from the existing situation (Medium to High—see definitions in Table 1) to either management option (Ballville Dam removal, or elevator and fish sorting) (Table 1)
    - Uncertainty of those Risk Potential characterizations ranged from Very Uncertain to Moderately Certain (Table 2)
- Risk Potential, of Asian carps to the Sandusky River, is characterized by (Table 3):
    - All Experts, to not increase from the current situation (Medium to High) to a fish elevator and sorting management scenario
    - Four Experts, to not increase from the current situation (Medium) to the Ballville Dam removal scenario,
    - Two Experts, to increase from the current situation (Medium) to the Ballville Dam removal scenario (High)
        - Uncertainty of Expert characterizations of risk potential ranged from Very Uncertain to Moderately Certain (Table 4). The two Experts, who characterized an increase in Risk Potential under a Ballville Dam removal scenario, were Very Uncertain. Of the four Experts, who characterized no increase in Risk Potential under a Ballville Dam removal scenario, three provided enough information to characterize uncertainty. Those three experts varied in their characterization of uncertainty (Very Uncertain, Reasonably Uncertain, and Moderately Certain).

Therefore, of the two alternatives to the existing situation, Experts agreed that neither alternative provides increased Risk Potential of Asian carps to Lake Erie. Experts also agreed that a fish elevator and sorting operation does not project increased Risk Potential of Asian carps to the Sandusky River. However, under the Ballville Dam removal scenario, there is mixed Expert characterization of Asian Carp Risk Potential to the Sandusky River: two of the Experts projected an increase in Risk Potential from the current situation, whereas four of the experts projected no change in Risk Potential from the current situation.

Experts recommended some options for practical, effective, and efficient management actions to control abundance and mitigate impacts of Asian carps in the Sandusky River, if they establish self-sustaining populations there. Those recommendations include:

- "Generate a highly active fishery that targets asian carps at the time of aggregation in Sandusky River"
- "At this point, I think commercial harvest is the only real option, although given all of the ongoing work on control strategies, I suspect that new strategies will become available in the future."
- "Targeted commercial fishing"
- "Manage to maintain healthy, vibrant, resilient populations/communities of native and established fishes. For example, white bass likely will be in the system concurrent with early life history stages of carps – let's hope they eat them. Implement harvest of Asian carps when they become congregated for spawning. Explore options for control through physiological mechanisms (hormones, enzyme disruption, etc.) and foodweb. Continue to learn and apply successes from other systems where they have been established for longer periods."

- "I am not sure anything effective can be done in this situation. Possibly allow unlimited harvest of Asian Carp through any means might help keep the population in check, or install another dam with a trap and sort to only pass desirable species."
- "The MI DNR has an Asian Carp Management Plan that documents mitigation recommendations that very based on distribution and abundance levels (http://www.michigan.gov/dnr/0,4570,7-153-10364_52261_54896---,00.html)"
- "Release of sterile males to reduce the reproductive ability of the population."

Therefore, targeted harvest (i.e., recruitment overfishing) was the most frequently submitted recommendation for managing Asian carps, if they establish self-sustaining populations in the Sandusky River.

Table 1. Expert panel assessment of Asian carp Risk Potential to Lake Erie, associated with Ballville Dam management alternatives. Risk potential = integration of Risk of Establishment and Consequence of Establishment. Risk Potential of: Low is acceptable, Medium is uncomfortable, and High is unacceptable.

Expert	Current Situation (i.e., no change to Ballville Dam)	Ballville Dam Removal	Elevator and Fish Sorting
1	--[1]	--	--
2	High	High	High
3	Medium	Medium	Medium
4	High	High	High
5	High	High	High
6	Medium	Medium	Medium
7	Medium	Medium	Medium
8	--	--	--
9	--	--	--
10	Medium	Medium	Medium

[1] Insufficient information to characterize Risk Potential or Uncertainty.

Table 2. Uncertainty in Expert assessment of Risk Potential for Asian carp, in relation to Lake Erie, associated with Ballville Dam management alternatives. (Uncertainty Codes: VU=Very Uncertain, RU=Reasonably Uncertain, MC=Moderately Certain, RC=Reasonably Certain, VC=Very Certain.)

Expert	Current Situation (i.e., no change to Ballville Dam)	Ballville Dam Removal	Elevator and Fish Sorting
1	--	--	--
2	Very Uncertain	Very Uncertain	Very Uncertain
3	Moderately Certain	Moderately Certain	Moderately Certain
4	Very Uncertain	Very Uncertain	Very Uncertain
5	Moderately Certain	Moderately Certain	Moderately Certain
6	Very Uncertain	Very Uncertain	Very Uncertain
7	Reasonably Uncertain	Reasonably Uncertain	Reasonably Uncertain
8	--	--	--
9	--	--	--
10	--	--	--

Table 3. Expert panel assessment of Asian carp Risk Potential to the Sandusky River, associated with Ballville Dam management alternatives. Risk potential = integration of Risk of Establishment and Consequence of Establishment. Risk Potential of: Low is acceptable, Medium is uncomfortable, and High is unacceptable.

Expert	Current Situation (i.e., no change to Ballville Dam)	Ballville Dam Removal	Elevator and Fish Sorting
1	--	--	--
2	Medium	Medium	Medium
3	--	--	--
4	Medium	High	Medium
5	--	--	--
6	Medium	High	Medium
7	Medium	Medium	Medium
8	--	--	--
9	Medium	Medium	Low
10	Medium	Medium	Medium

Table 4. Uncertainty in Expert assessment of Risk Potential for Asian carp, in relation to the Sandusky River, associated with Ballville Dam management alternatives. (Uncertainty Codes: VU=Very Uncertain, RU=Reasonably Uncertain, MC=Moderately Certain, RC=Reasonably Certain, VC=Very Certain.)

Expert	Current Situation (i.e., no change to Ballville Dam)	Ballville Dam Removal	Elevator and Fish Sorting
1	--	--	--
2	Very Uncertain	Very Uncertain	Very Uncertain
3	--	--	--
4	Very Uncertain	Very Uncertain	Very Uncertain
5	--	--	--
6	Very Uncertain	Very Uncertain	Very Uncertain
7	Reasonably Uncertain	Reasonably Uncertain	Reasonably Uncertain
8	--	--	--
9	Moderately Certain	Moderately Certain	Moderately Certain
10	--	--	--