ORIGINAL

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December 9, 2011

Ms. Peggy Harding, Regional Engineer
Federal Energy Regulatory Commission
230 South Dearborn Street, Suite 3130
Chicago, IL 60604

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Re: Au Train - FERC Project No. 10856

SPILLWAY CAPACITY REMEDIATION – 60% DESIGN PACKAGE

REQUEST FOR COMMISSION DETERMINATION OF POTENTIAL LICENSE AMMENDMENT REQUIREMENT and/or COMMISSION DIRECTION OF ENVIRONMENTAL COORDINATION FOR PROPOSED ACTION

Dear Ms. Harding and Ms. Bose;

North American Hydro Holdings, on behalf of U.P. Hydro, (Licensee) hereby submits the 60% design package for construction of the auxiliary spillway located on the south end of the Au Train project. This design package is the culmination of site meetings with Stakeholders and Commission staff from your DC Office and several meetings with the Commission's Chicago Regional Office staff. The design package also includes the Consultant's responses to each item of the Commission's comment letter dated October 13, 2011, regarding the conceptual design presentation in the Commission's Chicago office on September 7, 2011. Electronic files are included in this package submittal.

NORTH AMERICAN HYDRO

The Licensee's August 4, 2011 letter contained an aggressive plan and schedule for the proposed action. Regarding the plan and schedule, that letter stated;

> *"We are eager to seek the permits from the appropriate Federal, State and local resource agencies required by the conditions and articles in the Au Train license. As you state in your July 5, 2011 letter, this would include the applicable agencies responsible for potential issues under the Endangered Species Act and the National Historic Preservation Act, as well as any necessary tribal consultation.*
>
> *At this time, it is our understanding that the Commission will; 1.) make the determination if the proposed action necessitates a license amendment, 2.) become the lead agency in directing the environmental coordination and, 3.) subsequently lead the Licensee and stakeholders through the appropriate consultation process to identify any potential environmental issues with this action. The Licensee awaits the Commissions direction on these steps. If the Stakeholders and the Licensee have understood this incorrectly please advise us otherwise as soon as possible. The Licensee believes that the primary environmental coordination for this proposed action would be with the administering authority (the Hiawatha National Forest Service) for the Wild and Scenic designated White Fish River.*
>
> *Until the Licensee receives the Commissions determination on whether the proposed action requires a license amendment, is directed as to the appropriate consultation process required, and the Licensee can formally engage the stakeholders through the appropriate process, the Licensee cannot specifically determine or speculate with any certainty what tasks and time frames will be associated with the environmental consultation, permitting and approval process."*

The Licensee awaits the Commissions determination on whether the proposed action requires a license amendment and/or is directed as to the appropriate consultation process. We are hopeful to receive Commission approval and direction soon to finalize the design and proposed schedule and commence with the environmental coordination matters.

It is the Licensee's intent to continue to work diligently and make every effort to meet the construction deadline of **December 31, 2012** as communicated to the Licensee in your letter dated August 26, 2008 and again in correspondence July 8, 2009. All the current risk reduction measures will continue to remain in place. If you have any questions related to the Au Train spillway capacity proposed action, please contact me directly, or Mr. Scott Klabunde at the North American Hydro Holding's corporate offices at (920) 293-4628 x14.

NORTH AMERICAN HYDRO

Sincerely,
North American Hydro Holdings
Agent for U.P. Hydro

for Chuck Alsberg
Chief Executive Officer

Cc; Yiying Xiong, Mead and Hunt
North American Hydro- Corporate office distribution

(cover letter only)
Theodore Geier, Regional Planning Hydrologist, USDA
David Silvieus, District Ranger Hiawatha National Forest
John Romanowski, Program Manager USDA Forest Service
Millard Fillmore, Au Train Township Supervisor
Jerry Doucette, Alger County Commissioner
Doug Scheuneman, Alger County Fish and Game Alliance
Steve Webber, Alger County Emergency Management Director
Paul Piszczek, Michigan DNR

Design Report Spillway Capacity Improvements

(60% final)

Au Train Hydroelectric Facility

FERC Project No. 6299

Au Train and Whitefish Rivers
Alger County, Michigan

Report prepared for

NORTH AMERICAN HYDRO

Neshkoro, Wisconsin

Report prepared by

Mead & Hunt

www.meadhunt.com

December 2011

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Appendices

1. Introduction

1.1 Background

The Au Train Hydroelectric Project (Project) does not currently have adequate spillway capacity to pass the Probable Maximum Flood (PMF) accepted by the Federal Energy Regulatory Commission (FERC). The PMF for the Project was calculated in 2009 by Ayres Associates, and has a peak inflow of 20,500 cubic feet per second (cfs).

Several conceptual designs for increasing the Project's spillway capacity have been developed in the past by various consultants. Most of the proposed alternatives have involved passing flows through or over the Project's South Levee, and down the Whitefish River. Due to the constrictive nature of the bridges downstream of the North Dam spillway, along with the close proximity of houses along the Au Train River downstream of the North Dam and the lack of development to the south, it is recommended that a portion of the flow during large flood events be passed to the south down the Whitefish River. This will reduce potential flooding impacts to Au Train River residents and properties.

Realizing the complex nature of trying to apportion flood flows in both directions, and the large amount of interested stakeholders involved in such a task, North American Hydro (NAH) scheduled a site meeting in June 2011 involving interested stakeholders. At the site meeting, NAH listened to the opinions of the stakeholders, and decided on an alternative that was considered to be satisfactory to the stakeholders.

The proposed alternative involves constructing an auxiliary spillway at the South Levee that will be activated at the 100-year flood event and breach to release flood flows down the Whitefish River in a controlled manner. The 100-year flood event was chosen as the triggering point for the auxiliary spillway with the intent to reduce the flow through the north dam to the Village of Au Train and relieve the flooding impact along the Au Train River. Preliminary inundation maps for the 100-year, 200-year, and 500-year flood events flowing from the North Dam were developed to demonstrate the additional downstream (from the north dam) structures impacted by floods larger than the 100-year event. These maps were submitted to the FERC in September 2011, following the meeting with the FERC Chicago Regional Office (CRO) on September 7, 2011. The 100-year flood triggering point was presented to the stakeholders at a meeting held on June 15, 2011, and was applauded by the stakeholders as a satisfactory solution to reduce the potential flooding impact to the Village of Au Train. The discussion results at the meeting were included in the letter submitted to the FERC by NAH on August 4, 2011.

The fixed ogee crest of the spillway at the North Dam will also be raised by 2 feet, and the walkway above the spillway will be removed to allow large flood events to be passed without the risk of debris being blocked on the walkway support stanchions.

2. Description of the Project

The Project is located on the Au Train River in Alger County in the state of Michigan. The main dam (also referred to as the North Dam) at the north end of the reservoir is located 15.3 miles upstream of the river's mouth at Lake Superior. The embankment dam (also referred to as the South Levee) at the south end of the reservoir is situated at the headwaters of the East Branch of the Whitefish River, approximately 28.8 miles upstream of the main stem's mouth at Lake Michigan.

The Project also consists of the North Dam at the north end of the reservoir, the South Levee at the south end of the reservoir, and the powerhouse located approximately 0.5 miles north of the North Dam. The project structures at the North Dam, from left to right looking downstream, consist of the left main embankment, north spillway, penstock intake, and right main embankment. Currently, the north spillway has a 98-foot-long ogee crest at elevation 779.3[1] and previously had 2-foot-high flashboards in place to create a normal maximum operating pool elevation of 781.3. The flashboards have since been removed because of a reservoir restriction put in place by the FERC. The crest of the north dam embankments vary from elevation 787.86 at its lowest, to 791.17 at its highest.

The South Levee is an earth embankment separating the Lake Superior and Lake Michigan basins at the south end of the reservoir. The embankment's crest has a width of 10 feet and varies from elevation 788.95 at its lowest, to 790.73 at its highest

The Project's reservoir covers approximately 1,557 acres and stores 12,342 acre-feet at the normal maximum pool elevation of 781.3 feet. The normal pool elevation maintained on site is between 781.3 feet and 777.3 feet.

[1] All elevations in this report are National Geodetic Vertical Datum (NGVD)-29.

3. Proposed Modifications

3.1 North Dam

3.1.1 North Dam spillway

The North Dam spillway currently has support stanchions in place that serve as supports for the walkway across the spillway, and also as vertical supports for the 2-foot high flashboards. The flashboards have not been in place during recent years because of a reservoir restriction put in place by the FERC. The supports are spaced at approximately 10 feet, and therefore have the potential to block debris during a large flood event. To allow easier passage of debris during flood events, the supports and walkway will be removed, and the fixed ogee crest of the spillway will be raised. The current crest of the ogee spillway is 779.3, and it will be raised 2 feet to elevation 781.3. This will allow the project to be operated at the maximum normal headwater elevation specified in the license. With the proposed modification to the north spillway, additional mitigating measures will be necessary to meet the required factors of safety for stability under FERC guidelines. The proposed north spillway will be reinforced with tensioned anchors grouted into competent rock. The post-tensioned anchors will provide both sliding and overturning resisting loads for stabilization. The details of the tensioned anchors will be determined at the final engineering stage.

3.1.2 North Dam embankment

The results of a crest survey performed in June 2011 showed that a portion of the left embankment at the North Dam is lower than what has been assumed previously. This low spot is at elevation 787.86 and is located approximately 150 feet from the west end of the embankment. This low section will be raised to elevation 789.0 to better match the remainder of the embankment.

The current slope stability analyses contained in the *Supporting Technical Information Document* (STID) indicate that the north embankment meets or exceeds the FERC's required factor of safety, with the exception of the upstream face during the normal maximum pool condition. Results indicate that the factor of safety (1.38) for the upstream face is slightly below the minimum value recommended by the FERC for the steady seepage at normal maximum pool (1.50).

Since the upstream face has not shown any signs of instability during the previous Part 12 Inspections and the slope (3H:1V) is relatively flat, we consider this slightly lower factor of safety acceptable.

3.2 South Levee

3.2.1 Proposed auxiliary spillway

A 50-foot-wide auxiliary spillway will be built at the South Levee with a crest elevation of 783.7 such that it begins overtopping at the 100-year event (reservoir inflow of 2,350 cfs) and breaches

in a controlled manner. The placement of the spillway was chosen to take advantage of the higher elevation of bedrock in this area and to promote flow towards the Whitefish River. Sheet pile training walls will be placed along the auxiliary spillway to prevent lateral expansion of the breach. Also, steel sheet pile walls will extend laterally along the south embankment both upstream and downstream of the auxiliary spillway to protect the embankment from the high velocity flows in the vicinity of the activated auxiliary spillway. Sheet pile cutoff walls will be placed at the upstream and downstream edges of the spillway to prevent headcutting into the reservoir, and a concrete apron will be placed between the two cutoff walls as additional scour prevention measure and to provide additional support to the sheet pile. The existing peat layer will be removed beneath the concrete apron and replaced with structural fill. Both the cutoff walls and the concrete apron will limit the breach depth to elevation 771.3. This elevation corresponds to the natural ground elevation in the location of the fuse plug. All sheet pile will extend to bedrock, which is at approximate elevation 757.

The crest of the auxiliary spillway embankment is high enough that wave protection is not needed to protect against wave run-up at normal pool conditions under a 60 mile-per-hour (mph) sustained wind. However, wave protection will be provided by placing rip rap along the upstream edge of the auxiliary spillway embankment. The wave protection is provided in case of waves occurring at a surcharged pool during a flood event smaller than the 100-year event. The wave run-up calculations are presented in Appendix A. Drawings of the proposed auxiliary spillway are presented in Appendix B.

3.2.2 Proposed geotechnical analyses

A boring was previously performed by STS Consultants in 2006 along the crest at the location of the proposed spillway. A 2.5-foot layer of peat was encountered beneath the embankment fill. The peat was underlain by a poorly graded gravel and silty sand. Limestone bedrock was encountered at elevation 757.4. A copy of Boring DH-3 is included in Appendix C.

To better define the elevation of rock upstream and downstream of this boring, four additional Standard Penetration Test (SPT) borings are planned. Two borings each will be performed upstream and downstream of the crest to obtain a soil profile within the spillway location. The subsurface program will better determine the limits of the peat layer and the top of rock elevation.

3.2.3 Improvements to existing levee

Wave action along the upstream face of the South Levee has caused some headcutting and sloughing to occur. Riprap will be placed along the upstream face of the South Levee from the toe of the embankment up to elevation 783.5 to protect it from wave-generated erosion over the range of normal pool elevations with a sustained wind speed of 60 mph.

A slope stability analysis was previously performed by Mead & Hunt, Inc. (Mead & Hunt) in 2009 to reflect the reconstruction of the embankment in 2006. The reconstruction included raising the crest to elevation 789.7 and flattening the downstream slopes. The results indicated that the embankment has adequate factors of safety for both steady seepage with normal pool and rapid drawdown loading conditions. The embankment did not meet the FERC guidelines under flood

pool assumptions, which were analyzed with a headwater and tailwater at elevations 788.0 and 779.6, respectively. During final design of the auxiliary spillway, the south embankment slope stability will be re-analyzed based upon revised tailwater elevation. If the factor of safety does not meet the FERC guidelines under revised tailwater conditions, stability measures such as a bench along the downstream toe may be required to increase the factors of safety during high headwater and tailwater events. The Licensee is currently working towards a solution to reduce the potential hazard from a failure of the south levee which will likely change the hazard classification of the south levee. Once the hazard classification is determined, the applicable FERC requirements will be determined and used as a basis for designing the stability measures for the structure.

4. Engineering and Analysis

4.1 Flood routings

Flood routings were performed to determine the size limit of the auxiliary spillway that would not affect homes along the Whitefish River when activated at the 100-year event, and could also adequately pass the PMF inflow of 20,500 cfs without overtopping any project structures. In August 2011 NAH hired AECOM of Marquette, Michigan, to survey the inhabitable structures along the Whitefish River downstream of the South Levee to determine their locations and first floor elevations. The survey results show homes and cabins scattered along the river for its entire length at varying elevations.

4.1.1 Model development

The flood routings were conducted using the unsteady-state modeling capabilities of the U.S. Army Corps of Engineers (USACE) Hydraulic Engineering Center River Analysis System (HEC-RAS), Version 4.1.0. The flow distribution for this project is relatively complex. Flows can pass from the reservoir through the north spillway and down the Au Train River to the north, and flows from the auxiliary spillway flow south through the Whitefish River. Therefore, three different reaches were developed as part of the model: the Slapneck and Johnson Creeks where the inflow hydrograph to the reservoir was introduced; a north reach that includes the north portion of the reservoir, the North Dam, downstream highway, and railroad bridges, and continues 600 feet beyond the railroad bridge; and a south reach that includes the southern portion of the reservoir, the South Levee (including auxiliary spillway), and continues 28.8 miles south of the south embankment to the mouth of the Whitefish River at Lake Michigan. All three reaches are connected at a junction within the reservoir. A schematic of the river reaches is presented in Appendix D.

The cross sections within the reservoir were obtained from a topographic map of the original river at the location of the reservoir before the North Dam and South Levee were built. The reservoir cross sections were verified by comparing the volume of the cross sections within the reservoir to the stage-storage table given in the 2004 Washington Group report. The volumes within the model match within 4% to those given in the table.

The Manning's roughness coefficients (Manning's "n") for the reservoir, and the Whitefish River channel and overbanks, were taken from the model developed by the Washington Group. The Manning's "n" value used for the reservoir was 0.03, and the Manning's "n" values used for the Whitefish River were 0.04 and 0.08 for the main channel and overbanks, respectively.

For the portion of the model representing the Au Train River, the Manning's "n" values were estimated based on aerial photos and field pictures. The manning's "n" values used for the Au Train River were 0.03 and 0.08 for the main channel and overbanks, respectively.

Both the North Dam and South Levee within the model were developed using project drawings, along with the results of a crest survey performed of all the project embankments in spring 2011 by AECOM. A discharge coefficient for the ogee crested spillway at the North Dam was

approximated using the methodology presented in the U.S. Bureau of Reclamation (USBR)'s *Design of Small Dams*, assuming an approach height of 25 feet and a design head of 4.8 feet (70% of the maximum head on the crest during PMF). The highway bridge downstream of the North Dam was developed within the model using bridge drawings obtained from the Michigan Department of Transportation (DOT), and the railroad bridge was modeled using dimensions measured by the licensee during a field visit.

The entire reach representing the Whitefish River to the south of the South Levee was obtained from a HEC-RAS model developed by Washington Group in 2006 as part of their *Design Flood Analyses for South Levee Alternatives.* Interpolated cross sections with a maximum spacing of 1,000 feet were used throughout the entire model.

4.1.2 Inflow hydrographs and boundary conditions

The PMF hydrograph used in this study was obtained from the 2009 PMF study conducted by Ayres Associates in 2009. The PMF developed by Ayres Associates was based on a Probable Maximum Precipitation (PMP) obtained from the 1993 Michigan-Wisconsin Probable Maximum Precipitation report. The peak PMF inflow derived was 20,500 cfs, which was approximately one-third of the value previously calculated.

The peak inflow for the 100-year event, which corresponds to when the auxiliary spillway at the south embankment activates, is 2,350 cfs. This value was obtained from the 2004 report by the Washington Group titled *Evaluation of Dam Modification Alternatives and Flood Frequency Analysis.* The PMF hydrograph was scaled down to produce the 100-year inflow hydrograph. A plot of the two hydrographs used in the model can be found in Appendix E.

A number of tributaries enter the Whitefish River downstream of the South Levee. Inflow hydrographs for these tributaries were developed as part of the Washington Group's 2006 study. Because these hydrographs were developed assuming a much larger PMF event, they were scaled down accordingly for the flood events modeled. These hydrographs were entered as lateral inflows within the model at the tributary confluences.

A known water surface was used as the downstream boundary condition for the south reach corresponding to the high water elevation of Lake Michigan. Normal depth was used as the boundary condition for the north reach. For all model runs, the initial stage of the reservoir at both dams was set equal to the normal pool elevation of 781.3, which corresponds to the proposed crest elevation of the ogee spillway at the North Dam.

4.1.3 Modeling methodology

The 100-year hydrograph was first run through the model assuming no activation of the auxiliary spillway to determine the required crest elevation of the auxiliary spillway embankment. The crest elevation was determined to be at 783.7 feet. A second run was made in which the 100-year hydrograph was routed through the project and the auxiliary spillway breached at overtopping as designed, at the peak stage of the reservoir. The with-failure and no-failure profiles were compared to identify the incremental flooding caused by the activation of the

auxiliary spillway. Under the no-failure condition, there is no flow released down the Whitefish River from the reservoir. The flows within the Whitefish River come from the tributaries below the South Levee.

A separate run was conducted in which the full PMF was routed through the project assuming the auxiliary spillway activated at overtopping as designed. The run was conducted in order to determine the maximum reservoir levels during the PMF for the proposed design.

The initial model runs assumed a 50-foot-long auxiliary spillway with vertical side slopes and the auxiliary spillway was breached to elevation 771.3, which is the elevation of the natural ground at the location of the spillway. The width of the auxiliary spillway is approximately four times the breach depth. A breach timing of 30 minutes was used for the analysis.

4.1.4 Modeling results

Results of the runs conducted for the 100-year event showed that three structures would be impacted by an activation of the auxiliary spillway during the 100-year event. These structures are located 7.05, 18.2, and 18.42 miles downstream of the South Levee, respectively. The structures at 7.05 and 18.24 miles downstream would already be flooded by more than 5 feet prior to the auxiliary spillway activation, and therefore the additional inundation caused by the activation of the auxiliary spillway is not considered unacceptable.

Only the single cabin 18.4 miles downstream of the South Levee would see an unacceptable incremental rise greater than two feet during an activation of the auxiliary spillway at the 100-year event. NAH is proposing to remove or relocate this cabin, thus eliminating the additional hazard potential associated with it. If NAH is successful in removing or relocating this structure, an activation of the auxiliary spillway would not cause significant incremental rise on any downstream structures. A matrix summarizing the impact to downstream structures caused by an activation of the auxiliary spillway during the 100-year event is presented in Appendix F.

The results of the run for the Full PMF are summarized below:

Maximum PMF Headwater El.:	788.11 feet
Maximum PMF Tailwater El. at North Dam:	785.14 feet
Maximum PMF Tailwater El. at South Dam:	775.35 feet
Maximum PMF Outflow at South Dam:	9,133 cfs
Maximum PMF Outflow at North Dam:	6,830 cfs
Total Project Outflow at PMF:	15,963 cfs

The PMF is attenuated by 22% through the reservoir. Also, the resulting PMF headwater elevation is slightly higher than the low point along the left embankment at the North Dam (elevation 787.86). Therefore, this portion of the embankment will need to be raised to provide adequate freeboard during the PMF event.

A CD containing the final HEC-RAS model accompanies this report.

4.1.5 Sensitivity runs

A series of sensitivity runs were conducted to determine the size limit of the auxiliary spillway without increasing the number of impacted downstream structures. The results showed that an increased width of the auxiliary spillway would cause flooding impact to additional downstream structures. Therefore, it was concluded that the maximum width of the auxiliary spillway was 50 feet.

4.1.6 Project headwater-discharge rating curve

A headwater discharge rating curve was developed using the results of the flood routings. The results from the flood routings would provide the most accurate representation of outflows from the project at various headwater elevations because the model accounts for submergence of the north spillway crest and the outflows through the activated auxiliary spillway. The project headwater-discharge rating curve is presented in Appendix G.

4.2 Auxiliary spillway

4.2.1 Wave protection

Wave run-up calculations were performed to assess the risk of waves overtopping the auxiliary spillway embankment. The wave run-up calculations were conducted using the USBR's ACER Technical Memorandum No. 2, *Freeboard Criteria and Guidelines for Computing Freeboard Allowances for Storage Dams*. The wind velocity used in the analysis was 60 mph. According to ACER TM No. 2, this velocity is at the lower range of recommended wind speeds for computing normal freeboard requirements. However, wind data presented in MWH's 2002 report titled *Probable Maximum Floods and Flood Routing for Au Train Hydroelectric Project* shows that the largest northerly wind speed recorded over an 18-year period at nearby K.I. Sawyer Airport was 54 mph. Therefore, the 60 mph windspeed for computing the wave run-up at auxiliary spillway during normal pool levels was considered adequate.

The calculations concluded that the expected wave run-up at the location of the auxiliary spillway for 60 mph sustained winds would be approximately 2.15 feet. The normal pool elevation is 781.3, and the proposed crest of the lowered embankment section at the auxiliary spillway is 783.7. The lowered embankment section at the auxiliary spillway provides 2.4 feet of freeboard, which is greater than what is required according to the wave run-up calculations.

Even though the crest of the lowered embankment section at the auxiliary spillway is high enough to prevent it from being overtopped by waves during normal operations, additional wave protection will be provided to prevent the section from being overtopped by waves when the reservoir is surcharged above normal pool during a flood event smaller than the 100-year flood. Only a small portion of the upstream edge on the lowered sand embankment making up the auxiliary spillway will be exposed and subject to overtopping during the 100-year event to initiate the breach of the embankment. This small exposed section or pilot channel will be protected behind a riprap berm placed upstream along the sloping upstream face of the lowered

embankment section. Small berms will be placed on either side of the pilot channel along the upstream edge of the lowered section to create continuous protection against wave action along the lowered embankment. The wave protection is shown on the conceptual drawings included in Appendix B.

4.2.2 Sheet pile geotechnical design

For the sheet pile walls, only the extreme load cases were evaluated. In the case of the training walls the loading condition was that of pool drawdown with the backfill saturated to the top of the wall, immediately post-PMF. In the case of the downstream cutoff wall, 8 feet of scour with saturated foundation materials behind the wall was analyzed. The concrete matt was used in the model as a top brace for the cutoff walls, and for a structural strut for the training walls.

The sheet-piling design was based on the Rankine model of lateral earth pressure using the free-earth support model for soil-structure interaction, with a requested factor of safety reduction in available passive soil resistance. The safety factor for embedment depth used in all cases was 1.5. In some cases, the piling may be deeper than that required structurally in order to effectively cut off potential seepage paths under the spillway and limit uplift forces.

4.3 South Levee

4.3.1 Embankment stability

The evaluation of the south embankment will be updated based on revised headwater and tailwater levels associated with passing flows to the north and south along with the evaluation of downstream hazards.

4.3.2 Embankment protection

Headcutting and sloughing along the upstream side of the South Levee has occurred over the past several years as a result of wave action along the embankment. Currently there is only riprap along a 500-foot-long section where the embankment has settled in the past.

Wave run-up calculations were performed assuming normal pool conditions for the portion of the South Levee that is currently unprotected. The calculations were conducted using ACER TM No. 2, using the same wind speed and methodology used for the wave run-up analysis conducted for the auxiliary spillway. However, the fetch length used was slightly larger than the fetch at the auxiliary spillway. The calculations resulted in a wave run-up of 2.17 feet, which is just slightly larger than what was calculated for the location of the auxiliary spillway. Therefore, it is proposed that riprap be placed from the toe of the embankment up to elevation 783.5 to protect during the full range of normal operating pools.

4.4 North Dam

4.4.1 Spillway stability

The north spillway will be designed to provide stability safety factors meeting or exceeding those presented in the FERC publication *Engineering Guidelines for the Evaluation of Hydropower Projects, Chapter 3: Gravity Dams* (revised October 2002).

The north spillway section will be evaluated for overturning and sliding stability with full hydrostatic uplift from heel to toe of the dam for all applicable load cases. Due to lack of resisting loads from the dead weight of the spillway, post-tension anchors will be added as additional resisting loads.

Appendix A. Wave Run-up Calculations for South Levee

Au Train South Levee Auxillary Spillway Wave Runup

Using ACER TM No. 2 *Freeeboard Criteria and Guidelines for Computing Freeboard Allowances for Storage Dams, by USBR*

Calculated by: NLH **Date:** 8/30/2011

Checked by: YX **Date:** 9/2/2011

Fetch Lengths

From Point 1		From Point 2	
Radial	**Length (ft)**	**Radial**	**Length (ft)**
1	5470	1	16955
2	6725	2	9708
3	8432	3	8124
4	10269	4	7285
5	24000	5	5646
6	5264	6	5085
7	3630	7	4330
8	1925	8	3974
9	1220	9	3627
Avg.	**7437 ft**	**Avg.**	**7193 ft**
	1.41 miles		**1.36 miles**

Fetch = 1.36 miles (from point 2, approximate location of notch)

Wind Velocity[1], V = 60 mph

θ = 18.4 ° (embankment slope = 3:1)

$$H_S = R_H 0.0177(V)^{1.23}(F)^{0.5}$$ (Eq. 4 of ACER TM No. 2)

H_S = 2.85 ft

$$H = 1.67 H_S$$ (from page 39 of ACER TM No. 2)

H = 4.76 ft

$$L = 5.12T^2$$ (Eq. 5 of ACER TM No. 2)

$$T = 0.559(0.589(V)^{1.23}(F))^{0.33}$$ (Eq. 6 of ACER TM No. 2)

T = 2.7 sec

L = 38.4 ft

L >> 2 x Reservoir Depth => **shallow water waves**

From Fig. 10 of ACER TM No. 2:

H = 2.6 ft

T = 2.6 sec

L = 34.61 ft (Eq. 5 of ACER TM No. 2)

$$R = \frac{H}{0.4 + (\frac{H}{L})^{0.5}\cot\theta}$$ (Eq. 7 of ACER TM No. 2)

Wave Runup, R = 1.72 ft

D = 8 ft = average depth along fetch at max normal pool

$$S = \frac{V^2 F}{1400D}$$ (Eq. 8 of ACER TM No. 2)

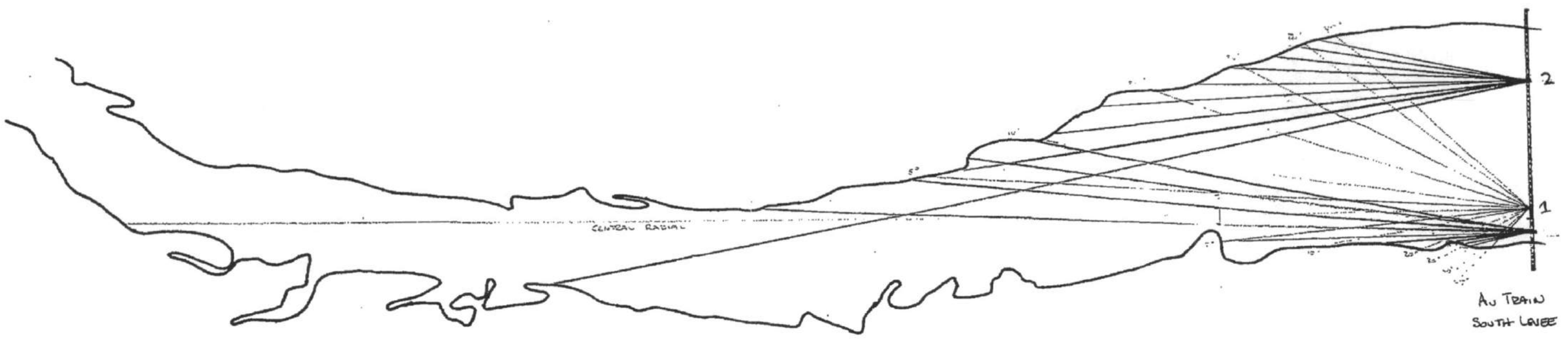
Wind Setup, S = 0.44 ft

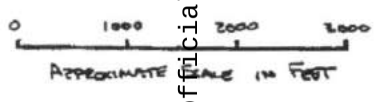
R + S = 2.15 ft

The crest of the proposed lowered embankment section at the auxiliary spillway will be at El. 783.7 and will therefore provide 2.4 feet of freeboard which is adequate protection against wave overtopping.

[1] Using the wind velocity of 60 mph as recommended by ACER TM No. 2 for normal freeboard. According to ACER TM No. 2. The largest northerly windspeed recorded at K.I Sawyer Airport was 54 mph between 1960 and 1978 according to MWH's 2002 *Probable Maximum Floods and Flood Routing* report.

▲ 5036.63





- Fetches for South Levee

CHECKED		TITLE	AuTrain South Levee Fetch Distance	SCALE:	
CORRECT				DATE:	
APPROVED				SKETCH NUMBER	
REVISIONS	②	③	④	⑤	

Appendix B. Auxiliary Spillway Conceptual Design Drawings

Appendix C. Boring DH-3 (performed by STS Consultants in 2006)

STS Consultants Ltd.

CLIENT: Wisconsin Public Service
LOG OF BORING NUMBER: DH-3 — Station 41+74
PROJECT NAME: AuTrain South Levee
ARCHITECT-ENGINEER: Washington Group, Inc.
SITE LOCATION: AuTrain, Michigan

DEPTH(FT) / ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE / RECOVERY	DESCRIPTION OF MATERIAL	% Passing No. 200 Sieve
				SURFACE ELEVATION +786.1	
2.5	1	SS			
5.0	2	SS		Fill: fine to medium sand - trace silt and fine to coarse gravel - brown - loose to very loose - moist to wet (SP)	
7.5					
10.0	3	SS			
12.5					
15.0	4	SS			
17.5				17.5	
				Amorphic peat - some wood - black - wet (Pt)	
20.0	5	SS		20.0	
	5A	SS		Fine to coarse gravel - some fine to coarse sand - gray - dense - wet (GP)	
22.5				22.5	
				Fine to medium sand - some silt - trace fine gravel - brown - loose - wet (SM)	
25.0				... continued	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1 2 3 4 5)
PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50)
STANDARD PENETRATION BLOWS/FT. (10 20 30 40 50)

7
3
2
2
2/.5
49/.5
4
171.0

BORING LOG 2 2-10904.GPJ STS.GDT 8/26/05

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

STS JOB NO. 2-10904 | SHEET NO. 1 OF 2

STS Consultants Ltd.

CLIENT: Wisconsin Public Service	LOG OF BORING NUMBER: DH-3 (Station 41+74)
PROJECT NAME: AuTrain South Levee	ARCHITECT-ENGINEER: Washington Group, Inc.
SITE LOCATION: AuTrain, Michigan	

SURFACE ELEVATION +786.1 (Continued)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	% Passing No. 200 Sieve
		S-1	SS			Fine to medium sand - some silt - trace fine gravel - brown - loose - wet (SM)	
27.5							
						28.7	
30.0		R-#1	HQ			Middle Ordovician Trenton Formation - white to gray fossiliferous limestone. Medium to thickly bedded. Fossils throughout - widely scattered stylolitic partings. Run #1 - 28.7 to 32.0 ft. Recovery = 91% RQD = 100% Fracture Frequency =0.9/ft.	
32.5		R-#2	HQ			Run 32 - 32.0 to 36.0 ft. Recovery = 100% RQD = 100% Fracture Frequency = 0.8/ft.	
35.0							
37.5		R-#3	HQ			Run #3 - 36.0 to 39.0 ft. Recovery = 100% RQD = 100% Fracture Frequency = 1.0/ft.	
39						39.0	
						End of boring Boring advanced to 9.0 ft. with solid stem auger Boring advanced from 9.0 to 28.7 ft. with rock bit and drilling fluid Boring advanced from 28.7 to 39.0 ft. with HQ3 barrel HW casing driven to 28.0 ft. Boring backfilled with cement grout ***Packer Test conducted between 31.6 and 39.0 ft. Hydraulic Conductivity = 1.80x10⁰ cm/sec**	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1, 2, 3, 4, 5)

PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10, 20, 30, 40, 50)

STANDARD PENETRATION BLOWS/FT. (10, 20, 30, 40, 50)

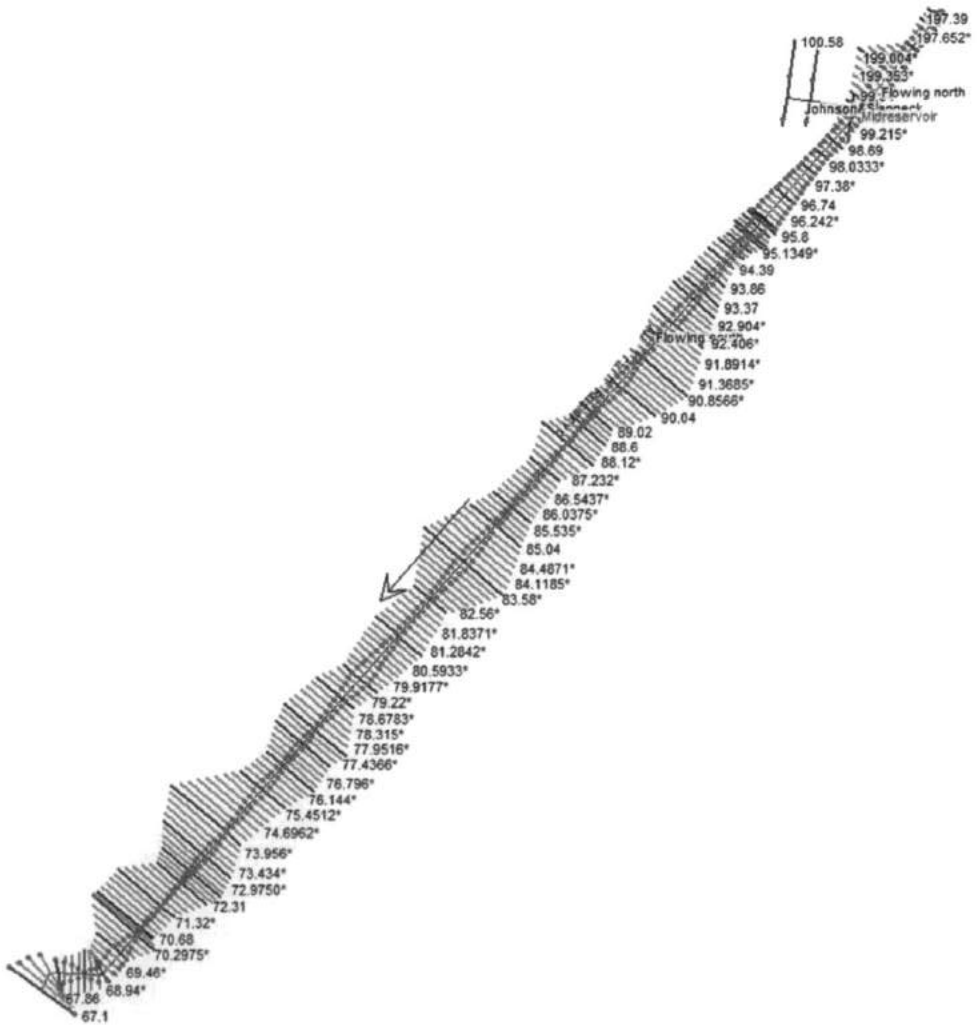
The stratification lines represent the approximate boundary lines between soil types: In situ, the transition may be gradual.

WL 8.8 ft. WS	BORING STARTED 6/30/05	STS OFFICE	02 - Marquette, Michigan
WL	BORING COMPLETED 6/30/05	ENTERED BY SKD	SHEET NO. 2 OF 2
WL	RIG/FOREMAN D-120/Randy T.	APP'D BY CRA	STS JOB NO. 2-10904

BORING LOG 2-10904.GPJ STS.GDT 8/26/05

Appendix D. Schematic of River Reaches

HEC-RAS Model Schematic

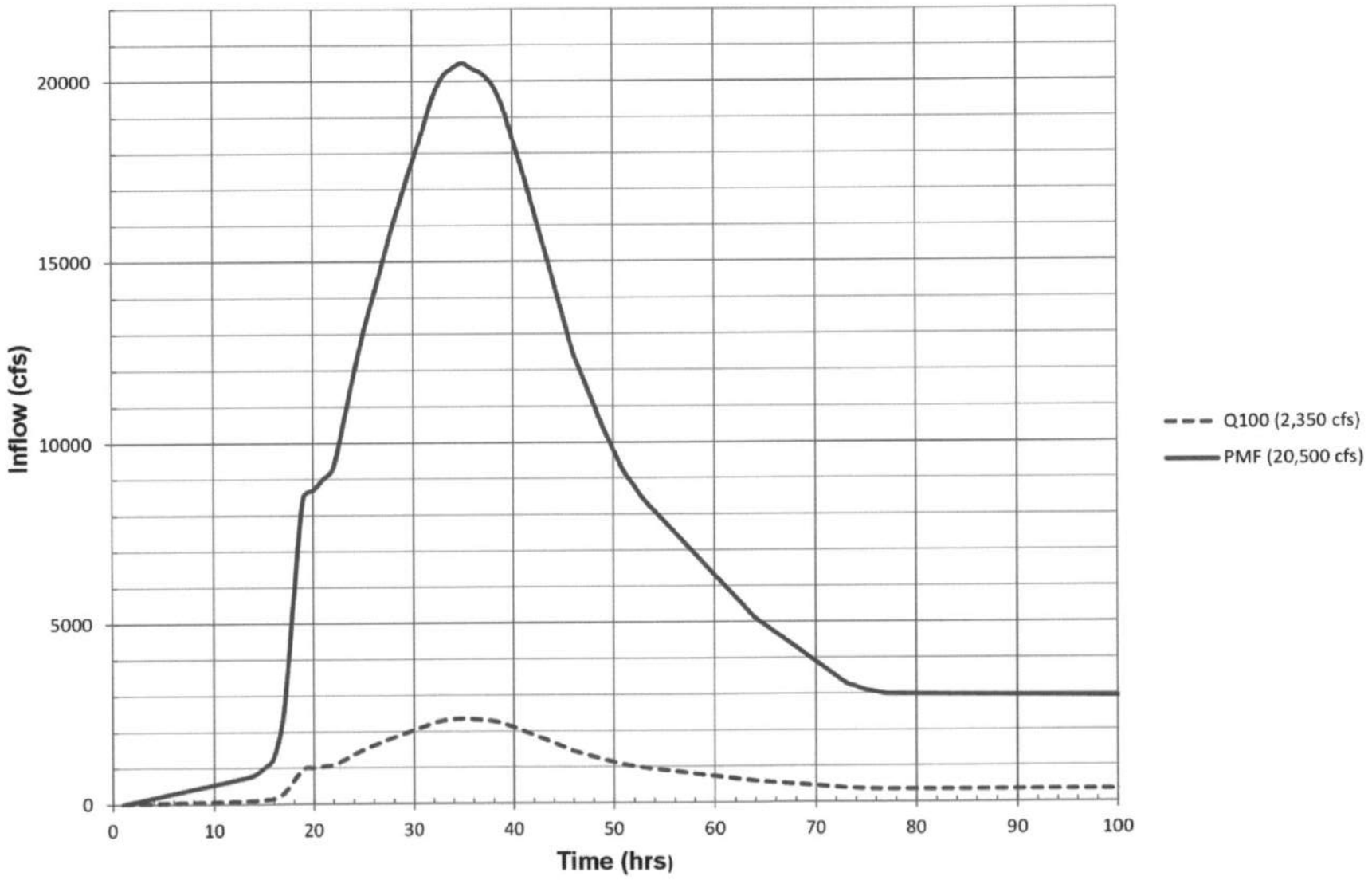


Mead&Hunt

Appendix E. Inflow Hydrographs for IDF Analysis

Inflow Hydrographs for IDF Analyis

Au Train Hydroelectric Project



Appendix F. Inundation Matrix

Q100 Structure Inundation Matrix

No significant flooding or additional hazard
Flooding prior to breach > 4 ft
Flooding prior to breach < 4 ft
Incremental rise due to breach > 2 ft
(for structures not flooded prior to breach)
Incremental rise due to breach > 2 ft
(for structures flooded by < 4 ft prior to breach)

Structure Information		Activate 50 ft Wide Sheet Pile Lined Aux. Spillway at Peak of 100-yr Event (2,350 cfs inflow)				
Structure No. (miles d/s)	First Floor Elevation (ft, NGVD)	Water Surface Before Breach (ft, NGVD)	Flooding Before Breach (ft)	Water Surface After Breach (ft, NGVD)	Flooding After Breach (ft)	Incremental Rise on Structure (ft)
0.88	790.69	764.31	no flooding	767.99	no flooding	N/A
4.91	765.15	743.93	no flooding	747.36	no flooding	N/A
7.05	714.76	721.84	7.08	726.2	11.44	4.83
14.33	680.15	642.12	no flooding	644.36	no flooding	N/A
15.31	658.8	634.34	no flooding	635.97	no flooding	N/A
15.311	664.59	634.34	no flooding	635.97	no flooding	N/A
15.48	642.79	633.22	no flooding	634.74	no flooding	N/A
16.43	630.79	627.89	no flooding	629.5	no flooding	N/A
17.57	623.25	618.68	no flooding	621.09	no flooding	N/A
17.84	622.3	616.72	no flooding	619.47	no flooding	N/A
17.841	627.51	616.72	no flooding	619.47	no flooding	N/A
17.85	634.99	616.72	no flooding	619.47	no flooding	N/A
17.88	623.28	616.72	no flooding	619.47	no flooding	N/A
17.95	623.09	615.07	no flooding	618.02	no flooding	N/A
17.98	619.42	615.07	no flooding	618.02	no flooding	N/A
18.09	618.31	615.07	no flooding	618.02	no flooding	0.07
18.18	620.76	612.61	no flooding	615.24	no flooding	N/A
18.2	619.59	612.61	no flooding	615.24	no flooding	N/A
18.24	606.91	612.61	5.7	615.24	8.33	2.92
18.29	621.61	609.77	no flooding	612.07	no flooding	N/A
18.41	615.22	609.77	no flooding	612.07	no flooding	N/A
18.42	609.02	609.77	0.75	612.07	3.05	2.53
19.7	624.44	595.15	no flooding	597.71	no flooding	N/A
20.47	604.44	590.97	no flooding	593.48	no flooding	N/A
21.43	598.64	587.56	no flooding	589.83	no flooding	N/A
21.71	594.54	586.82	no flooding	589.15	no flooding	N/A
21.85	593.06	586.13	no flooding	588.53	no flooding	N/A
21.851	589.46	586.13	no flooding	588.53	no flooding	N/A
21.9	593.81	586.13	no flooding	588.53	no flooding	N/A
21.93	597.7	585.48	no flooding	588.01	no flooding	N/A
22.39	594.88	584.08	no flooding	586.99	no flooding	N/A
22.63	589.44	582.78	no flooding	586.19	no flooding	N/A
23.29	597.57	581.36	no flooding	584.71	no flooding	N/A
23.42	591.11	581.17	no flooding	584.2	no flooding	N/A
23.8	588.04	580.86	no flooding	582.71	no flooding	N/A
23.84	586.54	580.73	no flooding	581.19	no flooding	N/A
24.46	586.27	580.75	no flooding	581.51	no flooding	N/A
24.47	588.87	580.75	no flooding	581.51	no flooding	N/A
24.471	588.06	580.75	no flooding	581.51	no flooding	N/A
25.05	596.62	580.73	no flooding	581.12	no flooding	N/A
25.06	598.06	580.73	no flooding	581.12	no flooding	N/A
25.12	584.78	580.73	no flooding	581.12	no flooding	N/A
25.15	587.26	580.73	no flooding	581.12	no flooding	N/A

Appendix G. Headwater-Discharge Rating Curve

Headwater-Discharge Rating Curve for Proposed Modifications

Au Train Hydroelectric Facility

North Spillway

Proposed raised crest El. =	781.3 ft, NGVD
Crest length =	98 ft
Assumed design discharge coefficient[1] =	3.95
Lowest crest El. of the North Embankments =	787.86 ft, NGVD

Proposed Auxiliary Spillway at South Levee

Auxiliary Spillway Embankment Crest El. =	783.7 ft, NGVD
Breached bottom El. =	771.3 ft, NGVD
Breached bottom width =	50 ft
Lowest crest El. of South Levee =	788.95 ft, NGVD

Proposed Headwater-Discharge Rating Curve

Reservoir El. (ft, NGVD)	Description	North Spillway		Auxiliary Spillway		Q_{total} (cfs)	Comments
		H (ft)	Q_{north}[2] (cfs)	H (ft)	$Q_{auxillary}$[2] (cfs)		
781.3	Normal Pool El.	0	0	10	0	0	
781.5		0.2	26	10.2	0	26	
782.0		0.7	180	10.7	0	180	
782.5		1.2	407	11.2	0	407	
783.0		1.7	728	11.7	0	728	
783.5		2.2	1106	12.2	0	1106	
783.7	Auxiliary spillway activates	2.4	1268	12.4	5605	6873	100-year event
784.0		2.7	1558	12.7	5961	7518	
784.5		3.2	2074	13.2	6331	8405	
785.0		3.7	2631	13.7	6698	9328	
785.5		4.2	3238	14.2	7070	10307	
786.0		4.7	3841	14.7	7464	11305	
786.5		5.2	4573	15.2	7830	12403	
787.0		5.7	5274	15.7	8241	13516	
787.5		6.2	6088	16.2	8626	14713	
788.0		6.7	6734	16.7	9043	15776	
788.1	PMF pool El.	6.8	6825	16.8	9133	15958	Full PMF event

[1] Design discharge coefficient calculated using Fig. 9-23 of *Design of Small Dams* assuming an approach height of 25 ft and a design head of 5 ft. These parameters were entered into the HEC-RAS model for the north spillway.

[2] North Dam spillway and auxiliary spillway outflows were obtained from the HEC-RAS model developed for the proposed condition.

Mead&Hunt

Mead & Hunt, Inc.
M & H Architecture, Inc
6501 Watts Road
Madison, Wisconsin 53719
608-273-6380
meadhunt.com

December 8, 2011

Mr. Scott Klabunde
North American Hydro, Inc.
116 N. State Street
Neshkoro, WI 54960-0167

Subject: Response to Comments from FERC letter dated October 13, 2011
Au Train Hydroelectric Project; FERC Project No. 10856

Dear Mr. Klabunde:

On October 13, 2011, the Federal Energy Regulatory Commission (FERC) Chicago Regional Office (CRO) issued a letter to North American Hydro (NAH) regarding the conceptual design presented at a meeting at the CRO on September 7, 2011. The following is a response to the comments in this letter. The FERC comments are included in italics followed by Mead & Hunt, Inc.'s (Mead & Hunt) response:

FERC Comment No. 1

The activation of the fuse plug at the 100-year flood event is unacceptable for a high or significant hazard dam. The main spillway section should pass as much flow as possible before the fuse plug or auxiliary spillway activates. You have indicated that activation of the fuse plug at the 100-year event prevents extensive property damage downstream of the North Dam by diverting flows to the South. You submitted inundation maps for the 100-year, 200-year, and 500-year flood events flowing from the North Dam along with a table reflecting the number of structures impacted for each flood event to demonstrate your point. This information is under review.

Response

A conceptual (60%) design of the auxiliary spillway has been completed in response to this comment letter. Per NAH's request, the conceptual design was performed assuming that the auxiliary spillway would be activated at the 100-year flood event. The 100-year flood event was chosen as the triggering point for the auxiliary spillway with the intent to reduce the flow through the north dam to the Village of Au Train and relieve the flooding impact along the Au Train River. Preliminary inundation maps for the 100-year, 200-year, and 500-year flood events flowing from the North Dam were developed to demonstrate the additional downstream (from the north dam) structures impacted by floods larger than the 100-year event. These maps were submitted to the FERC in September 2011, following the meeting with the FERC CRO on September 7, 2011. The 100-year flood triggering point was presented to the stakeholders at a meeting held on June 15, 2011, and was applauded by the stakeholders as a satisfactory solution to reduce the potential flooding impact to the Village of Au Train. The discussion results at the meeting were included in the letter submitted to the FERC by NAH on August 4, 2011.

FERC Comment No. 2

The potential for back-cutting with the activations of the fuse plug must be evaluated including: the water surface profile, the location of any hydraulic jumps and with channel velocities. The hydraulic model should extend far enough downstream in order to demonstrate that scour can not work its way back to the dam. If provisions are needed to prevent this from occurring, they should be provided. If the proposed riprap scheme is your selected alternative, then supporting computations must be provided.

Response

Sheet pile walls will be driven across the upstream and downstream edges of the auxiliary spillway to control the breach by preventing upstream back-cutting into the natural ground within the reservoir and souring at the downstream toe. The sheetpile walls will be driven deep enough to maintain a stable cross section during the activation of the auxiliary spillway. At the final engineering design stage, hydraulic analysis will be performed to identify the design velocities and scour potential upstream within the reservoir, at the breach section, and immediately downstream of the breach. The results of the hydraulic analysis will be used to determine the length of sheeting needed to prevent its undercutting and failure during the breach formation. We do not anticipate the widespread use of riprap for preventing back-cutting into the reservoir or scour protection within or downstream of the breach. The conceptual design drawings of the sheet pile walls are included in the *Design Report – Spillway Capacity Improvements (draft 60%)*, which is submitted with the letter.

FERC Comment No. 3

The fuse plug is proposed to be constructed in an area with a weak foundation. We know this because substantial settlement occurred as a result of the placement of just a few feet of fill. For this reason, the weak soil layer is to be removed of other positive means of support provided for the base of the auxiliary spillway.

Response

We propose to remove the weak foundation material in the area of the auxiliary spillway prior to its construction and replace it with structural fill.

FERC Comment No. 4

The conceptual design depends on riprap falling into specific locations to armor the wall of the fuse plug as it erodes. Since it would be next to impossible to ensure the riprap falls exactly where it is needed, this proposal is unacceptable. An alternative means of preventing lateral expansion of the fuse plug should be provided.

Response

Sheet pile walls along the edges of the breach have been incorporated into this conceptual design to prevent its lateral expansion beyond the limits of the lowered levee section during erosion. The conceptual design drawings of the sheet pile walls are included in the *Design Report – Spillway Capacity Improvements (draft 60%)*, which is submitted with the letter.

FERC Comment No. 5
Since a positive seepage cutoff has not been included in the design, the rationale should be explained.

Response
The south levee currently does not use a positive cutoff to control seepage. Sheetpile walls will be driven along the upstream and downstream edges of the auxiliary spillway and these sheet pile walls will reduce the seepage under the foundation of the auxiliary spillway. The sheetpile walls will be driven to the bedrock or a location that is deep enough to provide adequate seepage reduction.

FERC Comment No. 6
As noted in the STID, the stability of the South Levee under normal maximum pool only has a factor of safety of 1.3. If the South Levee is assumed to remain in place in your hydraulic model, then it needs to be stabilized to the required factors of safety to withstand all applicable loadings.

Response
The review of the loading case in question indicates that although the calculated factor of safety is 1.3 under the normal maximum pool elevation, the shallow downstream critical failure surface would not cause an uncontrolled release of the reservoir should failure occur. However, the factors of safety for the applicable loadings of the South Levee will be reviewed and measures identified to achieve the required factors of safety against sliding during the final design of the project modifications.

FERC Comment No. 7
All documentation presented at the meeting held on September 7, 2011 should be provided including the following:

a. *PowerPoint and PDF conceptual design presentations*
b. *Dam break analysis and results including the "rainbow" matrix table of dam break analysis results*
c. *IDF determination – Mead & Hunt's recommended IDF for the South Levee based on the dam break analysis*
d. *Breach configuration and design for 100 year event – A cross sectional view showing the breach parameters used in the dam break analysis*
e. *Justification of design and breach parameters – Rating table for project after proposed modifications and proposed measures to control the breach dimensions*
f. *South levee upstream slope protection to prevent head-cutting – Conceptual design drawings of proposed armoring of the upstream slope*

Response
All documentations required above are submitted on a DVD along with this letter. The IDF for the South Levee was not determined or presented at the meeting. The Licensee's intent is to complete the IDF analysis of the South Levee after the conceptual design is accepted by the FERC and the results will be incorporated into the final design report. Please note that part of the conceptual design has been modified to address the FERC's comments after the September 7 meeting, therefore, some of the information provided in response to this comment is out-dated. The latest design details and hydraulic

analysis are presented in the *Design Report – Spillway Capacity Improvements (draft 60%)*, which is submitted with the letter.

FERC Concluding paragraph

You quote your 2010 dam safety inspection report as stating that the North Dam has a high hazard potential and the South Levee has a low hazard potential. However, the statement that you quote goes on to say that further review of the hazard potential classification of the South Levee may be warranted. Based on the information we have received to date, the South Levee can no longer be considered to have a low hazard potential classification. Since the stability requirements for a significant or high hazard potential classification dam are the same, all project structures should be evaluated as such.

Response

The *Supporting Technical Information Document* (2007) states that the Au Train *Project:*

> is unique in that two separate drainage basins may be impacted by failure of the two separated dams that impound each end of the reservoir. Due to this unique aspect, we recommend a separate hazard potential rating for each dam (North Dam and South Levee) that is based on the unique characteristics and potential impact of each dam, rather than a single hazard potential for the entire project. In the December 1994 addendum to the October 1993 initial consultant's safety inspection report, the consultant ...also determined that failure of the South Levee would not be a hazard downstream. Breach analysis of a proposed fuseplug at the South Levee also indicated the South Levee has a Low downstream hazard potential with the fuseplug. However, potential erosion of the foundation may exacerbate breach flows, which has not been evaluated. We recommend that the licensee reevaluate the hazard potential of the South Levee using standard breach assumptions but allowing for erosion into the foundation to a firm substrate. I have reviewed the conditions downstream of the project and conclude that there have been no changes that would warrant a change in the hazard ratings. The hazard rating for the South Levee, which is currently rated a Low hazard structure, should be reevaluated to assess additional discharges that may result from erosion into the foundation.

Subsequent dam failure analyses have been performed simulating the controlled activation of the auxiliary spillway at the South Levee during the 100-year event. These studies indicate that only one temporary structure located in U.S. Forest Services lands downstream of the South Levee would experience an incremental stage rise greater than 2 feet. Plans to purchase this structure will be implemented once the proposed concept has been selected as the preferred option by the FERC and affected stakeholders. A concept using a sheetpile cutoff, rather than rip rap armoring, is being adopted to eliminate head-cutting into the reservoir and provide the "firm substrate" needed to prevent "erosion into the foundation" during failure. Finally, an IDF study will be performed to identify the effects of subsequent South Levee failures and extent of South Levee modifications needed, if any, to meet the "required factors of safety to withstand all applicable loadings."

It is our opinion that the uniqueness of the project and the measures proposed to limit the downstream consequences of failure of the South Levee support the earlier consultant's conclusion that a separate low hazard classification should be reinstated for the South Levee. Consequently, we are optimistic that we can work with the FERC and involved stakeholders to accomplish this objective.

If you have any questions or would like additional information, please contact me.

Sincerely,

MEAD & HUNT, Inc.

Yiying Xiong, P.E.

Enclosure

FEDERAL ENERGY REGULATORY COMMISSION
Office of Energy Projects
Division of Dam Safety and Inspections - Chicago Regional Office
230 South Dearborn Street, Suite 3130
Chicago, Illinois 60604
(312) 596-4430 Office - (312) 596-4460 Facsimile

In reply, refer to:
Project No. 10856
NATDAM No. MI00152

October 13, 2011

Mr. Chuck Alsberg
Chief Executive Officer
North American Hydro Holdings, Inc.
116 State Street, P.O. Box 167
Neshkoro, WI 54960

Re: Conceptual Design Presentation for Au Train Hydroelectric Project (P-10856)

Dear Mr. Alsberg:

This is in response to a meeting held on September 7, 2011 where you, your staff, and your consultants presented the conceptual design to add spillway capacity to your Au Train Hydroelectric Project, FERC Project No. 10856. Our comments follow:

1. The activation of the fuse plug at the 100-year flood event is unacceptable for a high or significant hazard dam. The main spillway section should pass as much flow as possible before the fuse plug or auxiliary spillway activates. You have indicated that activation of the fuse plug at the 100-year event prevents extensive property damage downstream of the North Dam by diverting flows to the South. You submitted inundation maps for the 100-year, 200-year, and 500-year flood events flowing from the North Dam along with a table reflecting the number of structures impacted for each flood event to demonstrate your point. This information is under review.

2. The potential for back-cutting with the activation of the fuse plug must be evaluated including: the water surface profile, the location of any hydraulic jumps and with channel velocities. The hydraulic model should extend far enough downstream in order to demonstrate that scour can not work its way back to the dam. If provisions are needed to prevent this from occurring, they should be provided. If the proposed riprap scheme is your selected alternative, then supporting computations must be provided.

3. The fuse plug is proposed to be constructed in an area with a weak foundation. We know this because substantial settlement occurred as a result of the placement of just a few feet of fill. For this reason, the weak soil layer is to be removed or other positive means of support provided for the base of the auxiliary spillway.

4. The conceptual design depends on riprap falling into specific locations to armor the wall of the fuse plug as it erodes. Since it would be next to impossible to ensure the riprap falls exactly where it is needed, this proposal is unacceptable. An alternative means of preventing lateral expansion of the fuse plug should be provided.

5. Since a positive seepage cutoff has not been included in the design, the rationale should be explained.

6. As noted in the STID, the stability of the South Levee under normal maximum pool only has a factor of safety of 1.3. If the South Levee is assumed to remain in place in your hydraulic model, then it needs to be stabilized to the required factors of safety to withstand all applicable loadings.

7. All documentation presented at the meeting held on September 7, 2011 should be provided including the following:

   a. PowerPoint and PDF conceptual design presentations

   b. Dam break analysis and results including the "rainbow" matrix table of dam break analysis results

   c. IDF determination – Mead & Hunt's recommended IDF for the South Levee based on the dam break analysis

   d. Breach configuration and design for 100 year event – A cross sectional view showing the breach parameters used in the dam break analysis

   e. Justification of design and breach parameters – Rating table of the project after proposed modifications and proposed measures to control the breach dimensions

   f. South levee upstream slope protection to prevent head-cutting – Conceptual design drawings of proposed armoring of the upstream slope

g. Elimination of debris restrictions on North dam crest – Conceptual design drawings of the proposed north dam modifications

You quote our 2010 dam safety inspection report as stating that the North Dam has a high hazard potential and the South Levee has a low hazard potential. However, the statement that you quote goes on to say that further review of the hazard potential classification of the South Levee may be warranted. Based on the information we have received to date, the South Levee can no longer be considered to have a low hazard potential classification. Since the stability requirements for a significant or high hazard potential classification dam are the same, all project structures should be evaluated as such.

Your conceptual design report should address the above-listed comments and should be submitted by **December 12, 2011**. If you have any questions, you may contact Ms. Angela Damron at (312) 596-4454 or me at (312) 596-4430.

Sincerely,

Peggy A. Harding, P.E.
Regional Engineer

North American Hydro Holdings, Inc.
116 State Street, P.O. Box 167, Neshkoro, WI 54960 USA
Tel 920-293-4628 Fax 920-293-8087 Email nah@nahydro.com Web www.nahydro.com

September 19, 2011

Ms. Peggy Harding, Regional Engineer
Federal Energy Regulatory Commission
230 South Dearborn Street, Suite 3130
Chicago, IL 60604

Re: Au Train - FERC Project No. 10856

- **Dam safety inspection follow-up letter dated August 22, 2011**
- **Previously identified outstanding work items**
- **September 7, 2011 CRO meeting follow-up action items**

Dear Ms Harding:

North American Hydro Holdings, on behalf of U.P. Hydro, (Licensee) hereby submits its responses to your dam safety inspection follow-up letter dated August 22, 1011, including previously identified outstanding work items, and the September 7, 2011 CRO spillway capacity deficiency meeting follow-up action items;

Dam safety inspection follow-up letter dated August 22, 2011

One item was identified during the July 26, 2011 inspection needing attention. Your letter stated; *"The vegetation along the entire length of the south levee should be maintained by clearing trees and shrubs as well as cutting tall grasses along the embankment slope and at least 15 feet beyond the toe."*

Routine vegetation maintenance has been performed along the entire length in such a manner as required. However, there currently are various minor areas needing additional attention to maintain the 15 foot distance. These areas are currently being addressed and will be completed by November 1, 2011. Future vegetation maintenance practice will include the additional areas identified.

NORTH AMERICAN HYDRO

Previously identified outstanding work items

Your letter requested a review of each of the previously identified work items, placing them in a priority ranking, schedule, justification, all with respect to mitigating the current risk.

We have reviewed each item and provided the current status for each item. Please find attached to this letter this matrix of outstanding items divided into four sections; 1) Actions identified by the PFMA Team, 2) Recommendations identified in the second Consultant's safety inspection report, 3) Recommendations identified in the third consultant safety inspection report, and 4) other items identified.

We have listed the current risk reduction measures. Please find this list attached to this letter. While the remediation work may not be completed in 2012 due to the complexity of the remediation and to that of the required environmental coordination we propose accelerating the following tasks with consideration to priority ranking and what could be done prior to final approvals for the South Levee auxiliary spillway;

1) Immediately begin negotiations for property purchases/relocations below the south levee that are impacted

2) Finalize the upstream bank protection adequacy for the north dam embankments and the south levee. Complete any additional necessary protection measures in 2012

3) Complete repairs in 2012 to the deteriorated concrete sections of the north dam

4) Installation of horizontal and vertical control points on the structures in 2012

5) In 2012, raise the portion of the north dam's left embankment crest that was identified as low during the recent 2011 survey

September 7, 2011 CRO meeting follow-up action items

In the Licensee's letter dated August 4, 2011, the Licensee presented the rationale for selecting the alternative of breaching the south levee. This approach includes the Stakeholder interests in limiting the public safety concerns of Lake Au Train residents and the Town of Au Train by restricting the flows to the north near the 100 year event. The Licensee presented the conceptual design to the CRO on September 7, 2011. Discussion ensued during the meeting regarding the trigger threshold for breaching the south levee. The Licensee was assigned to determine below the north dam, the structure count relationship between the 100, 200 and 500 year events. This work was completed

NORTH AMERICAN HYDRO

and submitted to your office via email on September 14, 2011. (A hard copy is attached to this letter.)

The results indicate that to allow the breach to occur above the 100 year event (ie; at the 200 year event) essentially doubles the homes affected. Setting the south levee breach threshold at the 100 year event is most appropriate. This threshold was originally selected by the Licensee based on Stakeholder input, including the photographic documentation of the flooding in the Town of Au Train and of the Lake Au Train residents during the 1980's 100 year flow event. We certainly understand that this finding may not strictly fit the Commission's guideline parameters for determining breach frequency. However, we must all agree that the design parameters should speak directly to minimizing public safety risk.

It is also noteworthy that the natural ground elevation of reservoir on the south end (or the watershed divide on which the south levee was constructed) has a very wide section thickness and is very flat and is approximately 776.30 feet MSL. Reservoir elevations are frequently below the 776.30 feet MSL south reservoir natural ground elevation and are authorized by the project license to be annually drawn down as low as 773.27 feet MSL. A significant portion of the year the south levee has no loading condition as the water elevations recede off the levee upstream slope toe and into the reservoir. A south levee breach to the natural ground or to reservoir depth along the natural divide will only loose this upper end of the reservoir. Additionally, the loss would be rather temporary, because of a short re-construction timeline for restoring the lost section.

In summary, we await your response on the conceptual breach design presented in your office. We believe the added risks posed to public safety to the North beyond the 100 year event justify the design trigger threshold proposed for the South levee breach. We propose accelerating several tasks as identified above, should the environmental review and coordination take significant time. We will await your approval to proceed with the final design optimization of the South levee breach, your direction to seek the permits from the appropriate Federal, State and local resource agencies required by the conditions and articles in the Au Train license and your determination on whether the proposed action requires a license amendment.

If you have any questions related to the Au Train spillway capacity matter, please contact me directly, or Mr. Scott Klabunde at the North American Hydro Holding's corporate offices at (920) 293-4628 x14. The Au Train project is indeed a unique project and we look forward to successfully resolving the spillway capacity concerns.

NORTH AMERICAN HYDRO

Sincerely,
North American Hydro Holdings
Agent for U.P. Hydro

FERC Chuck Alsberg
Chief Executive Officer

Attachments;

Matrix of Outstanding Items (updated September 21, 2011)

Current Risk Reduction Measures (updated September 21, 2011)

Summary of inundated structures along the Au Train River downstream of the North Dam (two sheets)

Cc: Theodore Geier, Regional Planning Hydrologist, USDA
David Silvieus, District Ranger Hiawatha National Forest
John Romanowski, Program Manager USDA Forest Service
Millard Fillmore, Au Train Township Supervisor
Jerry Doucette, Alger County Commissioner
Doug Scheuneman, Alger County Fish and Game Alliance
Steve Webber, Alger County Emergency Management Director
Paul Piszczek, Michigan DNR
Mead and Hunt
Federal Regulatory Commission, DHAC

North American Hydro- Corporate office distribution

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Matrix of Outstanding Items (updated September 19, 2011)

Actions Identified by the PFMA Team:

ACTION:	DUE DATE:	CURRENT STATUS:
Resurvey the South Levee to determine the current crest elevations and better define instrument location.	December 31, 2012	Most recent South Levee survey completed in 2011 by AECOM and included in 2011 DSSMP DSSMR update
Revise the inundation maps (north and south) after selection of the final scheme for spillway capacity upgrade.	December 31, 2012	Awaiting FERC approval of south levee auxiliary spillway breach parameters
Convert the elevation in the license application Exhibit F document from project datum to NGVD.	December 31, 2012	Will be included with all necessary Exhibit F drawing changes upon final construction
Reevaluate the South Levee seismic liquefaction triggering potential using the updated FERC guidelines.	December 31, 2012	Awaiting publication of updated FERC guidelines
Review the 2002 North Dam toe drain design to confirm if it meets filter criteria.	December 31, 2012	Awaiting FERC approval of south levee auxiliary spillway breach parameters and definition of levels and loading conditions
After establishing the PMF peak water level, re-compute the stability of the North Dam concrete spillway for all loading conditions.	December 31, 2012	Awaiting FERC approval of south levee auxiliary spillway breach parameters and definition of levels and loading conditions
Perform additional subsurface investigations at the South Levee to better define the top of solid bedrock, prepare geologic profiles and identify suitable borrow sources.	December 31, 2012	Upon FERC approval of South Levee auxiliary spillway design and as required
Study lowering the abandoned railroad embankment downstream of the North Dam as means of relieving a constriction on spillway discharge.	December 31, 2012	The State of Michigan under the authority of the National Historic Preservation Act filed with your office on June 6, 2011, a notice of no historic properties affected. However, the Licensee has not proposed increasing discharge to the North due to Stakeholder concerns regarding public safety
Prepare a new Emergency Action Plan for the area south of the project and notify the Delta County emergency action coordinator.	December 31, 2012	Awaiting FERC approval of south levee auxiliary spillway breach parameters and definition of inundation limits

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Study improvements to the North Dam spillway, including provision of trippable flashboards and removal of the walkway support stanchions.	December 31, 2012	A new North spillway configuration has been proposed including a fixed-crest providing a 100% open and unrestricted discharge
Confirm that the South Levee will fail when overtopped.	December 31, 2012	Proposed conceptual configuration presented and awaiting FERC approval for final design
Confirm that potential wave damage is not an issue for both the North Dam and South Levee.	December 31, 2012	Adequacy of embankment protection for wave damages will be included in final spillway capacity remediation design. A conceptual proposed South Levee auxiliary spillway has been presented.

Recommendations Identified in the Second Consultant's Safety Inspection Report		
RECOMMENDATION:	**DUE DATE:**	**CURRENT STATUS:**
Modify dam to provide adequate spillway capacity.	December 31, 2012	Proposed conceptual configuration submitted and awaiting FERC approval for final design
Reevaluate the stability of the overflow spillway after the PMF and IDF are approved.	December 31, 2012	Awaiting FERC approval of south levee auxiliary spillway breach parameters and definition of levels and loading conditions

Recommendations Identified in the Third Consultant's Safety Inspection Report		
RECOMMENDATION:	**DUE DATE:**	**CURRENT STATUS:**
The licensee is evaluating measures to pass the PMF. The project does not currently have discharge capacity to safely pass the PMF. The evaluation of discharge capacity should consider downstream constrictions at the North Dam, including impacts of the highway and old railroad bridges as well as the channel alignment. The spillway capacity upgrades should be completed within five years.	December 31, 2012	The Licensee has currently proposed to FERC a conceptual South Levee auxiliary spillway configuration that is designed to be utilized to protect/limit public safety issues to the North.
Stoplogs should remain out of the spillway until discharge capacity measures are completed unless a reliable means of removing them is implemented.	Is this item continually being addressed?	Stop logs have continuously remained out of the North spillway and will continue to remain out

The stability analysis for the North Dam should be reevaluated based on the IDF elevation, elevations at Piezometer SW-15, and foundation shear strength parameters. Uplift sensitivity analyses should be conducted to account for the potentially high uplift recorded in Piezometer SW-15. The analysis should be completed as part of the design for spillway capacity upgrades.	December 31, 2012	Adequacy of structure stability will be included in final spillway capacity remediation design. A conceptual proposed South Levee auxiliary spillway has been presented.
The existing riprap on the upstream face of the North Dam should be evaluated for waves generated by a 100-year wind in conjunction with design for spillway capacity upgrades.	December 31, 2012	Adequacy of embankment protection for wave damages will be included in final spillway capacity remediation design. A conceptual proposed South Levee auxiliary spillway has been presented.
Liquefaction potential should be reevaluated using new FERC criteria and site-specific peak ground acceleration (pga) in conjunction with design for spillway capacity upgrades.	December 31, 2012	Awaiting publication of updated FERC guidelines
Waves generated by a 100-year wind should be evaluated for their effect on the driftwood and riprap protection at the South Levee in conjunction with design for spillway capacity upgrades.	December 31, 2012	Adequacy of embankment protection for wave damages will be included in final spillway capacity remediation design. A conceptual proposed South Levee auxiliary spillway has been presented.
Reevaluate slope stability at the South Levee as part of the design for spillway capacity upgrades.	December 31, 2012	Adequacy of structure stability will be included in final spillway capacity remediation design. A conceptual proposed South Levee auxiliary spillway has been presented.
At the South Levee, evaluate the potential for further settlement and address this in the design for spillway capacity upgrades.	December 31, 2012	Adequacy of structure stability will be included in final spillway capacity remediation design. A conceptual proposed South Levee auxiliary spillway has been presented.
Horizontal and vertical control points should be installed on the spillway abutments and north gravity dam when spillway capacity upgrades are implemented.	December 31, 2012	Implemented in conjunction with final design for spillway capacity deficiency.
Visually inspect the exposed portions of the penstock between the surge tank and powerhouse weekly for further deterioration or leakage.	Is this item continually being addressed?	Yes, the exposed portion of the penstock between the surge tank and the powerhouse is inspected at least weekly

The deteriorated concrete on the spillway and upstream wingwalls should be repaired. Include repairs to deteriorated concrete at the upstream side of the spillway and upstream wingwalls with the spillway capacity upgrade design.	December 31, 2012	Implemented in conjunction with final design for spillway capacity deficiency.
Regularly clean the exposed top of the penstock between the powerhouse and surge tank of leaves and other debris.	Is this item continually being addressed?	Yes, incorporated into routine maintenance practice

Other Items Identified:

ITEM:	**DUE DATE:**	**CURRENT STATUS:**
Verify your plan to reduce response time in the event of a penstock rupture and inform us of your long-range plan for replacement of the penstock section below the surge tank.	February 1, 2012	An Emergency Action Plan time-sensitive update was filed with your office dated August 15, 2011. This filing verified a significant reduction in response time. The long-range plan for replacement of the penstock section below the surge tank will be filed by February 1, 2012.

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Au Train Hydroelectric Project

FERC Project #10856

Current Risk Reduction Measures (updated September 19, 2011)

- Flashboards removed lowering the North spillway crest by 2.0 feet to add reservoir storage potential during flood events but also increase spillway capacity
- North and South embankment crest elevation monitoring with annual surveys to verify crest elevations and track any settlement
- Operational changes to lower the reservoir before spring for more storage
- South Levee has been reshaped and raised. Rip Rap has been added for erosion protection. Vegetation has been removed at the downstream toe to improve visibility for inspections
- Both Delta(South) and Alger(North) County EMA's have been engaged due to flood waters going both North and South
- Time sensitive EAP response times were significantly improved recently due to Licensee's alarming and operating approach
- Weirs were added to the drain system so a more accurate seepage flow could be recorded and monitored
- The South IDF has been developed using unsteady state modeling and physical surveys of all structures to verify structure impact and understand risk, preliminary analysis of pursuing affected structure purchase/relocation
-

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NORTH AMERICAN HYDRO, INC.
AU TRAIN HYDROELECTRIC PROJECT
SPILLWAY CAPACITY MODIFICATIONS
F.E.R.C. PROJECT No. 10856

REVISION

FOR REVIEW ONLY
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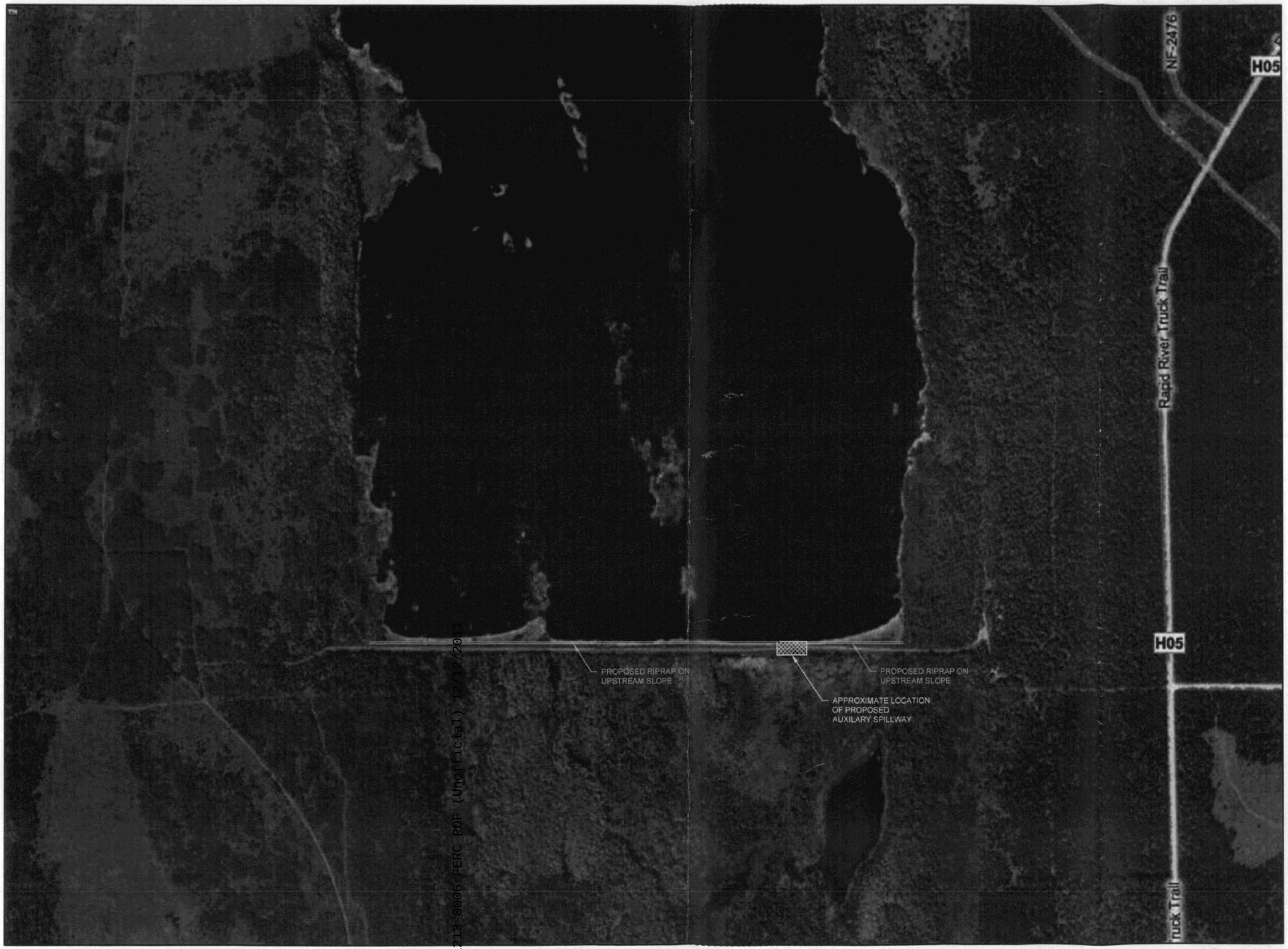
FERC NO. 10856
M&H NO. 14108-00-114919.01
DATE DEC. 5, 2011
DESIGNED BY NLH
DRAWN BY DMS
CHECKED BY JJB
SCALE: AS SHOWN

SHEET TITLE
SPILLWAY CAPACITY MODIFICATIONS PROJECT SITE PAP

01



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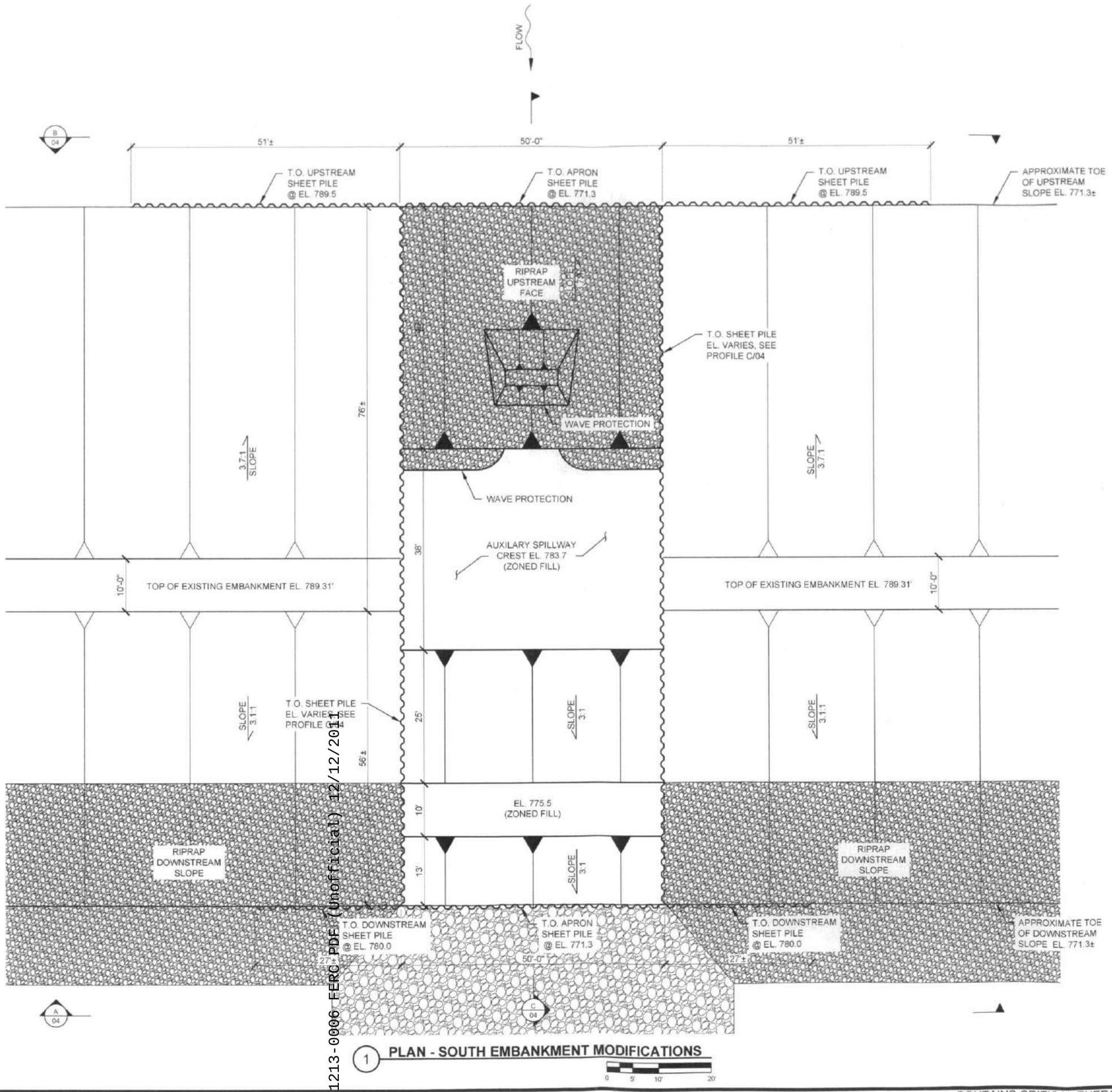
SHEET CONTENTS
SOUTH LEVEE MODIFICATIONS SITE MAP

02



1 PLAN - SOUTH EMBANKMENT MODIFICATIONS

0 5' 10' 20'

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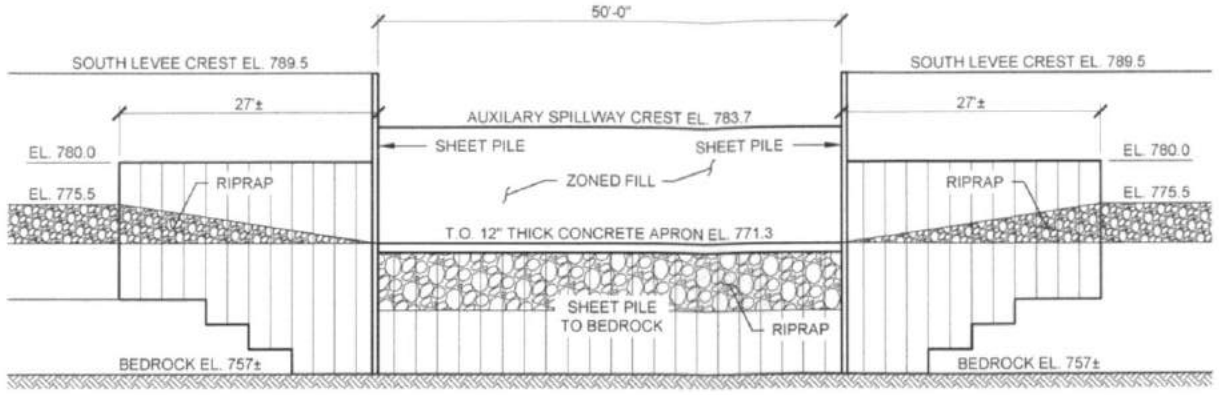
SHEET CONTENTS
AUXILARY SPILLWAY PLAN VIEW

03



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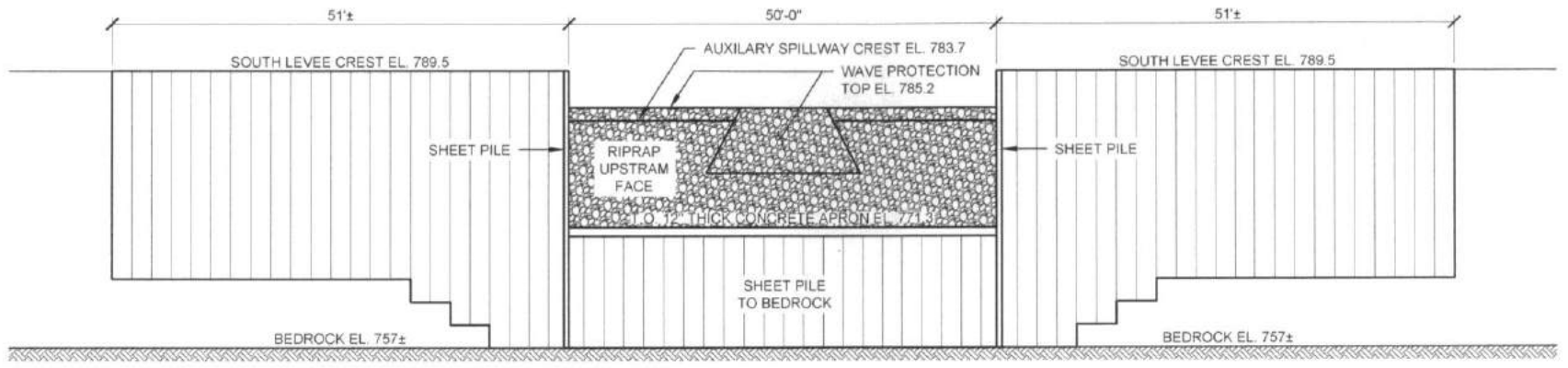

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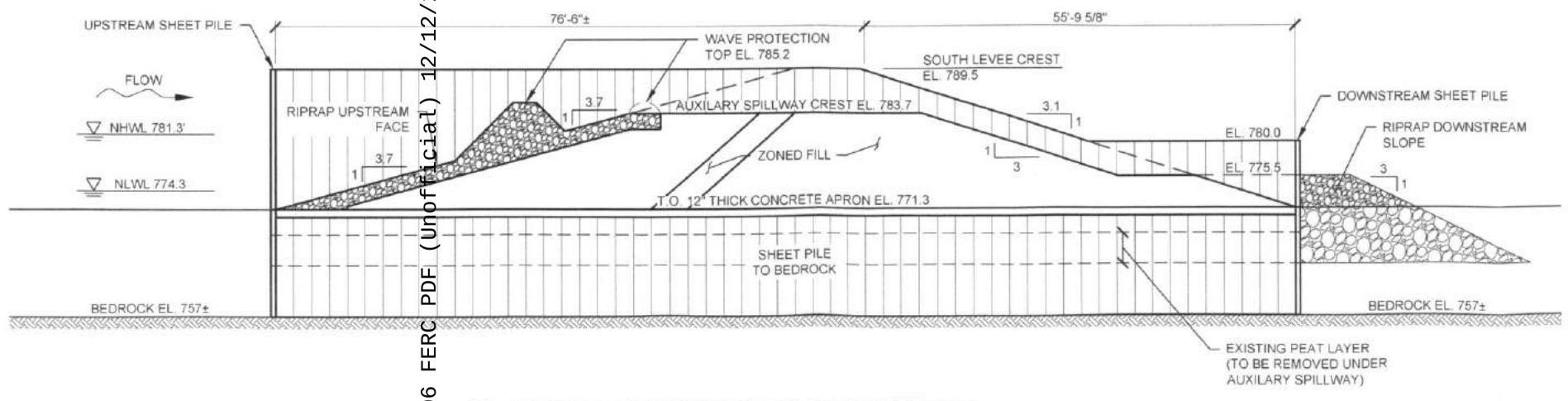

C **AUXILARY SPILLWAY PROFILE LOOKING LEFT**

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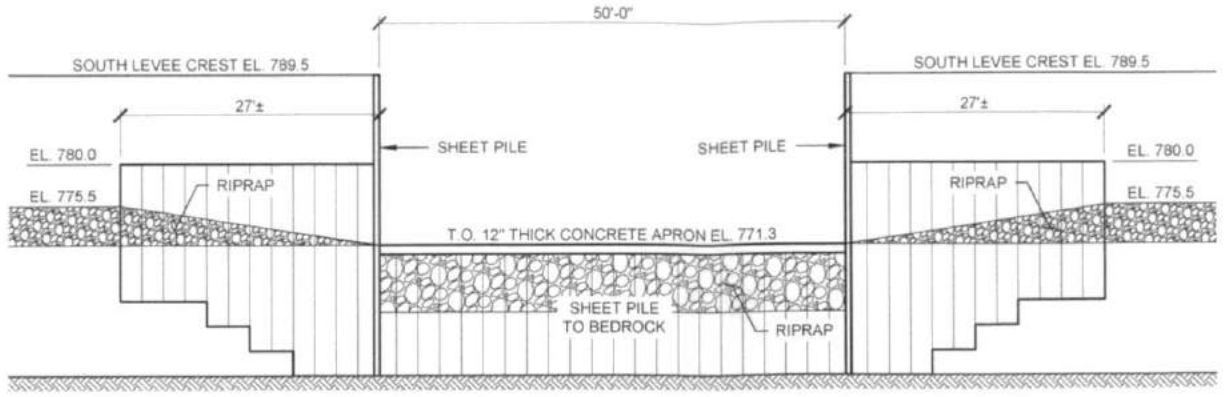
SHEET CONTENTS
AUXILARY SPILLWAY SECTIONS

04



POST ACTIVATION
AUXILARY SPILLWAY DOWNSTREAM ELEVATION

A

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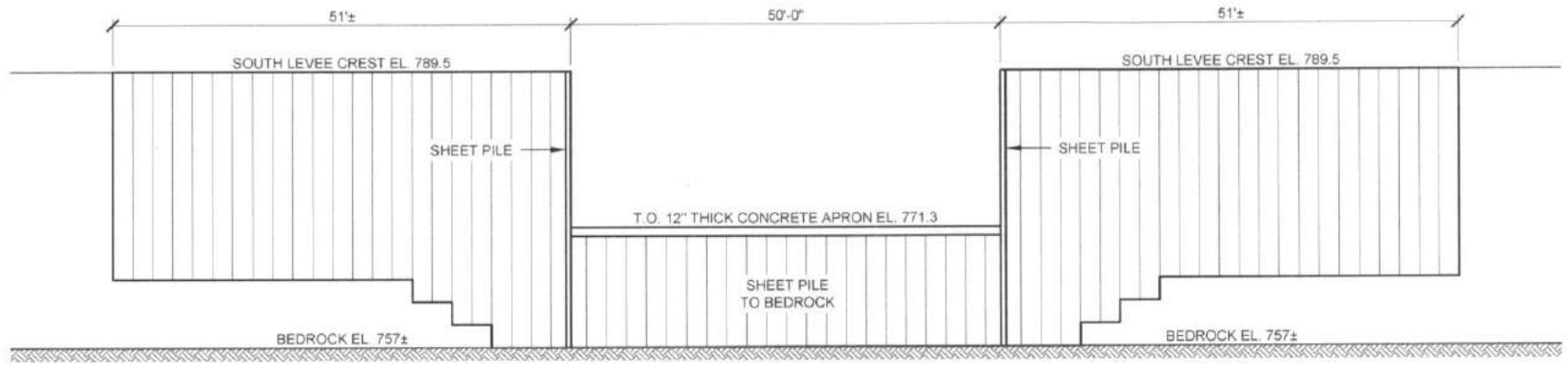

POST ACTIVATION
AUXILARY SPILLWAY UPSTREAM ELEVATION

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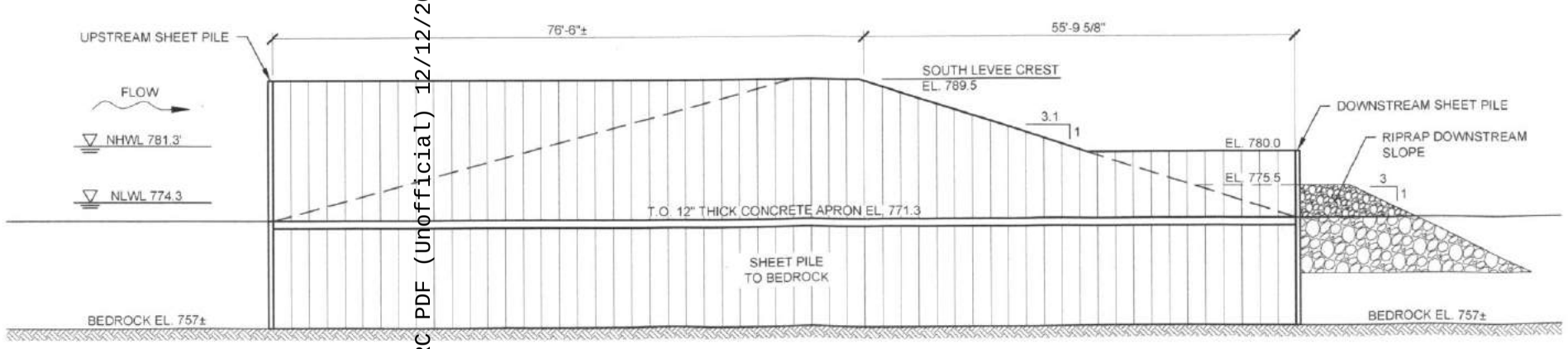

POST ACTIVATION
AUXILARY SPILLWAY PROFILE LOOKING LEFT

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SHEET CONTENTS
AUXILARY SPILLWAY
POST ACTIVATION
SECTIONS

05

SUMMARY OF INUNDATED STRUCTURES ALONG THE AU TRAIN RIVER DOWNSTREAM OF THE NORTH DAM		
FLOOD EVENT	NORTH DAM OUTFLOW (cfs)	NUMBER OF STRUCTURES INUNDATED
100-year	1,200	44
200-year	1,420	84
500-year	1,690	104

Orthophotograph Source: FSA-NAIP Alger County Mosaic, 1m, 2005

MAP KEY

STRUCTURE LOCATIONS	INUNDATION LEVELS
Inundated by 100-yr Outflow	100-yr Outflow
Inundated by 200-yr Outflow	200-yr Outflow
Inundated by 500-yr Outflow	500-yr Outflow

0 500 1,000 2,000 3,000 4,000 Feet

N

Inundation Maps and Impacted Structures to the North of the AuTrain Hydroelectric Facility

Sheet 1

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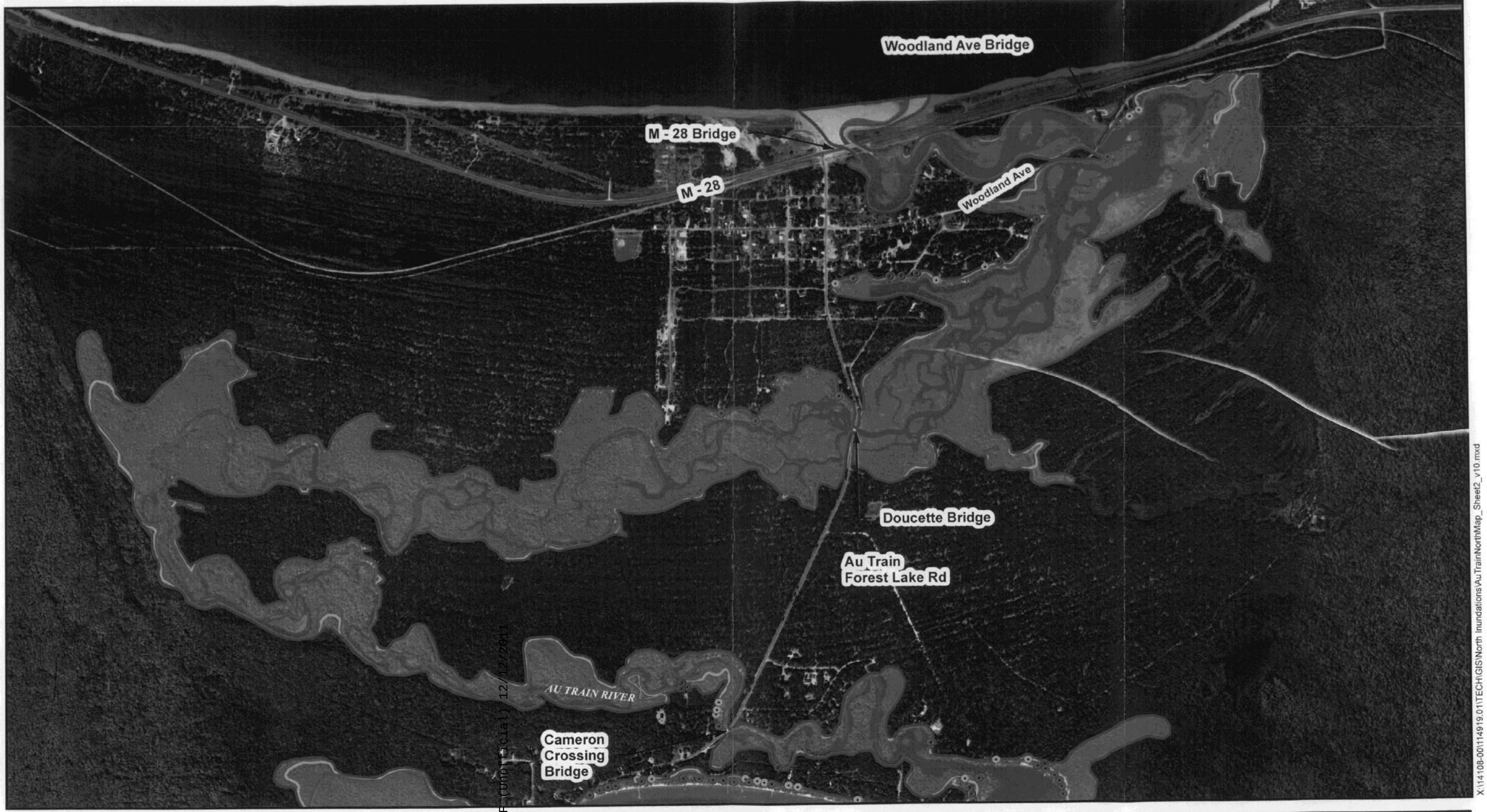
ALGER COUNTY, MICHIGAN
Sept 2011

X:\114108-00\114919.01\TECH\GIS\North Inundations\AuTrainNorthMap_Sheet1_v10.mxd



Orthophotograph Source: FSA-NAIP Alger County Mosaic, 1m, 2005

Map Key

STRUCTURE LOCATIONS
- Inundated by 100-yr Outflow
- Inundated by 200-yr Outflow
- Inundated by 500-yr Outflow

INUNDATION LEVELS
- 100-yr Outflow
- 200-yr Outflow
- 500-yr Outflow

0 500 1,000 2,000 3,000 4,000 Feet

N

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Inundation Maps and Impacted Structures to the North of the AuTrain Hydroelectric Facility

Sheet 2

North American Hydro, Inc.
ALGER COUNTY, MICHIGAN
Sept 2011

Document Content(s)