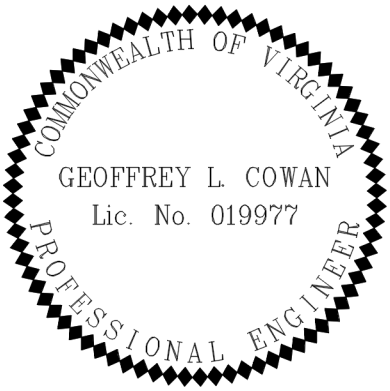
Dewberry

ARCHITECTS ENGINEERS
CONSULTANTS

LAKE JACKSON DAM

RADIAL GATE MODIFICATION FEASIBILITY STUDY



TECHNICAL MEMORANDUM

Prepared for:
Department of Public Works
Prince William County, VA

September 14, 2020

Geoffrey L. Cowan

Digitally signed by Geoffrey L. Cowan
Date: 2020.09.17 17:19:51 -04'00'

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PRINCE WILLIAM COUNTY

DEPARTMENT OF PUBLIC WORKS

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1. Background

Lake Jackson Dam is a 28'-high, 380'-long concrete gravity dam owned and operated by the Prince William County Department of Public Works. The dam was constructed for recreational purposes approximately 90 years ago. Prior to Prince William County ownership, the dam was used to generate hydropower for the Virginia Electric and Power Company.

The dam's spillway system is comprised of a 213'-long concrete Ogee-shaped weir with a crest elevation of 147.04' and a 25'-wide radial (tainter) gate with a crest elevation of 137.18'. Note that the Ogee crest elevation was acquired during a 2019 field survey of the dam while the radial gate crest elevation was obtained from previous design information and converted to the appropriate vertical datum for this study. The dam layout and elevations are included in the Michael Baker plan sheet in Appendix A. All elevation values in this study are referenced to the NAVD88 vertical datum.

Due to its age, the existing radial gate requires significant maintenance and is nearing the end of its useful life. The steel skin plate on the upstream side has been cleaned (sand blasted) and painted numerous times over the years, but evidence of pitting and deterioration of the steel plate is apparent. One of the most critical features of the radial gate system are the trunnions which transmit the gate load to the thrust piers and upon which gate rotation occurs during opening and closing of the gate. The trunnion pins require periodic lubrication to reduce friction during opening and closing of the gate and, although lubrication has occurred over the years, the effectiveness of current lubrication efforts is uncertain. If excessive trunnion pin friction develops at the pin-hub interface, excessive loads could be transmitted to the gate arms, which could result in possible failure of the gate structure. Other recurrent problems encountered in the past include leakage along the gate seals and binding of the gate against the thrust piers during warm temperatures. See "2020 Inspection Report – Lake Jackson Dam Spillway," prepared by Dewberry, for more details on the current condition of the radial gate. The thrust piers have been repaired recently to correct the binding problem and during those repairs it was noted that the quality of the concrete within the thrust piers appears to have degraded in some locations. In summary, the radial gate system (gate, trunnions, thrust piers, lifting apparatus, motor and supporting concrete deck) has aged to the point where a major, costly overhaul involving replacement of all or most of the radial gate system components is required to insure safe and reliable continued service.

Current operational procedures require Prince William County staff to open the radial gate during storms events when the reservoir level exceeds a certain threshold, including all large storm events and at times when hazardous snow or ice may be present on the catwalk leading to the gate controls. Prince William County is exploring the feasibility of modifying the dam to eliminate operation of the radial gate during storm events, thereby reducing risk to county staff and dam operational costs while protecting Lake Jackson residents from flooding and the risks associated with gate malfunction, human error, and power failure. Dewberry has been retained by the county to evaluate alternatives for modifications to the existing radial gate and ogee weir in order to reduce risks to County staff, increase the safety and reliability of the dam's spillway system, and reduce future operation and maintenance costs.

Information utilized in preparation of this report includes the following:

- 2-ft topographic contour data downloaded from Prince William County GIS (2018)
- Parcel and structure boundaries downloaded from Prince William County GIS (2018)
- Lake Jackson Dam Phase I Inspection Report (USAC, 1978)
- Lake Jackson Dam Hydrology and Hydraulics Report (Michael Baker, 2014)
- Prince William County FIS and HEC-2 modeling (FEMA, 1995, see Appendix B)

2. Conceptual Design Options

Dewberry analyzed six retrofit alternatives, each identified during discussions between Prince William County personnel and Dewberry engineers. Alternatives 1 – 4A presented in this technical memo were selected with the primary goal of causing minimal change to the normal pool elevation of the lake. This minimizes adverse impacts to structures such as docks along the existing shoreline and maintains the aesthetic nature of the lake. Alternatives 1, 2, 3A and 3B maintain the normal pool level between elevation 147.2' and 147.3', which is consistent with the existing normal pool elevation. Alternative 4A results in a slight reduction (approximately 4") in the normal pool elevation from 147.27' to 146.94'.

The alternatives presented in this technical memo would cause little or no change in the average annual flow or base flow over the dam. No flow would be diverted from or added to the lake before it reaches the spillway. Base flows out of Lake Jackson would continue to be conveyed over the dam at or near the current normal pool elevation.

All references to left and right are in relation to an observer facing downstream. Hydraulic schematics are visualized in Appendix C.

Alternative No. 1 – Replace existing radial gate and hoist system with a new radial gate and hoist system including new steel gate, trunnion assembly, side and bottom seal plates, stainless steel hoisting cables, motorized actuator, and housing. Under this alternative, PWC will continue operation of the new radial gate system during storm events following existing protocols.

It was assumed for modeling purposes that the radial gate was fully open for all storm events (i.e., the gate was opened to its maximum height of 13 feet).

Alternative No. 2 – Discontinue operation of gate during storm events while maintaining basic functionality of the existing gate system to ensure that it remains operational. The gate would remain in the closed position during all storm events and would only be raised to lower the lake level for maintenance activities or during emergency situations. Gate functionality would be tested at least once a year as part of the dam maintenance plan.

Alternative No. 3A – Remove radial gate, catwalk, and catwalk piers and replace the radial gate with a concrete ogee spillway section. In this scenario, the existing radial gate would be removed and replaced with a concrete spillway section with the same crest elevation as the existing ogee spillway. The catwalk spanning the length of the dam and the 1'-wide piers which support the catwalk would also be removed, while the 4'-wide thrust piers which currently support the radial gate would remain in place for cost reduction and stability purposes. Removal of the catwalk piers increases the effective weir length of the dam by approximately 13'. (See Appendix A for concept sketch and Photoshop rendering of this option as compared to the existing dam.)

Alternative No. 3B – Remove radial gate, catwalk, catwalk piers, and thrust piers and replace the radial gate with a concrete ogee spillway section. In this scenario, the existing radial gate would be removed and replaced with an ogee spillway section with the same crest elevation and shape as the existing ogee spillway. The catwalk spanning the length of the dam, the 1'-wide piers which support the catwalk, and the 4'-wide thrust piers which currently support the radial gate would all be removed. Removal of the catwalk piers and thrust piers increases the effective weir length of the dam by approximately 21'. (See Appendix A for concept sketch and Photoshop rendering of this option as compared to the existing dam.)

The existing radial gate provides low-level drawdown capability for Lake Jackson. Removal of the thrust piers would likely require that the replacement spillway section be ogee-shaped (matching the existing

ogee weir) to maintain dam stability. Note that for this type of spillway it would be difficult to install a new low-level drain.

Alternative No. 4A – Remove radial gate and replace with a 25'-wide fixed-crest concrete spillway section with a crest elevation 1' lower than the crest elevation of the existing ogee spillway (147.18'). The existing catwalk, catwalk piers, and thrust piers would be preserved. (See Appendix A for concept sketch and Photoshop rendering of this option as compared to the existing dam.)

Supplement to Above Alternatives: Add Low-Level Drain – Retrofit existing powerhouse structure with low-level drains to provide lake drawdown capability. Two 36"x36" sluice gates would be installed on the existing powerhouse bulkheads, allowing the lake level to be lowered to approximately 9.5 feet below normal pool. Flow would be discharged through the powerhouse. See Appendix J for conceptual design sketches of the drain.

The existing powerhouse underwent structural inspection in March 2020, at which time the powerhouse was determined to be in "fair" overall condition. Repair of the existing concrete and steel infrastructure would be required in order to ensure suitability of the powerhouse for use with the low-level drains.

Alternative No. 5 – Remove entire dam. The existing lake would be returned to riverine habitat. Detailed evaluation of this alternative was beyond the scope of this report. The Maryland Department of Natural Resources recently oversaw removal of the Bloede dam on the Patapsco River outside of Catonsville, MD. The Bloede dam was comparable in size to the Lake Jackson dam.

3. Additional Considerations

3.1. Sediment Analysis

While the extent of existing sediment accumulation in Lake Jackson was not quantified for this study and analysis of sediment accumulation was not included in this technical memo, several assumptions might be made about the impact removal of the radial gate could have on sediment accumulation.

When the existing radial gate is opened, sediment that has built up in front of the gate is washed downstream. This flushing action presumably keeps a "middle channel" in Lake Jackson free from additional sediment accumulation, extending upstream of the gate for some limited distance. Sediment accumulations located just upstream and below the existing radial gate crest and to the sides of the gate (towards the shorelines) are likely less affected by operation of the existing radial gate as those areas experience lower flow velocity and less flushing action when the gate is opened. If operation of the existing radial gate ceased entirely or if the radial gate were replaced with a solid weir wall, sediment accumulation would be expected in areas that were previously flushed out when the radial gate was opened.

Two of the alternatives described in this technical memo include provisions that could mitigate increased sediment accumulation to some extent. However, sediment flushing would not be the primary design function of those provisions. In Scenario No. 2, the existing radial gate would no longer be raised during normal storm events, but it would be operated on a scheduled maintenance basis or during emergency storm events. The gate maintenance schedule could be based on both an annual test of the gate's functionality as well as an established frequency of gate operation to facilitate sediment flushing from Lake Jackson as it currently occurs. However, less frequent operation of the gate could result in a larger quantity of sediment being released downstream during each gate opening event, due to the longer time available for sediment deposition/accumulation. Opening the gate during a period of

low flow, after an extended period of sediment accumulation, could result in detrimental environmental impacts downstream and should therefore be avoided.

In Scenario No. 4A, the existing radial gate would be removed and replaced with a fixed-crest concrete weir wall. The design of such a weir wall could include a low-level drain, such as a sluice gate, to permit lowering of the lake level during maintenance activities. The sluice gate could provide some amount of flushing of sediment from the area immediately upstream of the gate. The sluice gate would be smaller than the existing radial gate and would therefore be expected to flush a smaller amount and/or footprint of accumulated sediment upstream of the dam.

A detailed sediment study of Lake Jackson, including a bathymetric survey of the lake bottom, sediment sampling and characterization, and hydraulic modeling of sediment transport through the lake, could be performed to confirm and better quantify the assumptions listed above.

3.2. Environmental Impacts & Fish Life

Discontinuing operation of the existing radial gate during storm events (Alternative 2) would not be expected to negatively impact fish life within Lake Jackson. In fact, operation of the existing radial gate has been observed to cause harm to fish life when the gate is opened and fish swimming near the gate are swept into the downstream channel. An ecological or biological professional, such as an ichthyologist, could be engaged to perform a detailed study of the Lake Jackson ecosystem and assess the potential impacts of changes in dam operation and maintenance on existing fish populations.

Informal discussions with Dewberry environmental permitting staff indicate that removal of the radial gate or changes in its operation would most likely be considered a maintenance activity that does not significantly impact the site's function. In this case, it is possible that no environmental studies or permits would be required prior to construction.

4. Hydrology

The 10-year, 50-year, and 100-year storm discharges for the site were adopted from the FEMA Effective HEC-2 model. The 2-year storm discharge was extrapolated from the FEMA effective discharges. The base flow discharge was estimated using 20% of the annual average flow, or 20% of 1 cfs per square mile of drainage area. The total drainage area to the Lake Jackson dam is approximately 340 square miles.

Table 1. Study Discharges (cfs)

	Base Flow	2-Year Storm	10-Year Storm	50-Year Storm	100-Year Storm
Discharge (cfs)	68	6,100	24,000	42,000	50,000

5. Hydraulics

To model the existing dam spillway system, the HEC-RAS geometry file was configured to include an inline structure located immediately downstream of cross section "CF|110495". The inline structure included the main spillway (ogee weir with C = 3.94 at design head 12.6') and a radial gate component with a maximum opening height of 13'. The typical trunnion, opening, and head exponent values were assigned to the gate component while the gate crest was modeled as a broad-crested weir with a coefficient of 3.0. The catwalk piers and thrust piers were modeled as part of the weir crest profile, however, no flow contraction computations were performed or included in the modeling for this study. It is generally assumed that the effective weir length is somewhat shorter than the actual distance between the piers due to contraction of flow between the piers. By not including flow contraction effects in the existing

condition, the benefit associated with removing the piers (i.e. removing the obstruction to flow and therefore lowering the WSEs during storm events) are assumed to be slightly underestimated in this study.

To model Alternative 2 (discontinued operation of gate), the inline structure geometry was simplified to represent the existing ogee spillway with a raised section at the location of the closed gate (remove separate HEC-RAS gate component).

To model Alternatives 3A and 3B (remove catwalk/thrust piers), the inline structure geometry was further modified to remove piers as required and replace the radial gate with an extension of the ogee weir crest.

Alternative 4A (remove gate; preserve catwalk/thrust piers) was modeled with the thrust piers and catwalk intact. However, the gate was replaced by a 25' fixed-crest weir set 1' lower than the existing ogee spillway crest.

Alternative 5 (remove entire dam) was not modeled for this report.

Table 2. Peak Water Surface Elevations Just Upstream of Lake Jackson Dam (feet)

	Base	2-Year Storm	10-Year Storm	50-Year Storm	100-Year Storm
Alternative No. 1* - Replace Existing Radial Gate (Existing Condition)	*147.27***	149.64	155.01	159.08	161.05
Alternative No. 2 - Discontinue Operation of Gate During Storm Events	147.27	151.33	156.66	160.27	161.75
Alternative No. 3A - Remove Radial Gate & Replace with Fixed-Crest Ogee Section; Remove Catwalk & Catwalk Piers	147.24	150.82	155.71	159.09	160.52
Alternative No. 3B* - Remove Radial Gate & Replace with Fixed-Crest Ogee Section; Remove Catwalk, Catwalk Piers, & Thrust Piers	147.24	150.73	155.52	158.82	160.24
Alternative No. 4A - Replace Radial Gate with Weir Wall (crest el. 1' below ogee crest)	146.94	150.88	156.04	159.62	161.12

**Grey row shading indicates the alternatives that are under primary consideration.*
***Normal pool elevation based on normal sunny day operation (gate closed).*

Table 3. Peak Water Surface Elevations at Upstream Limit of Study (feet)
(Approx. 1.5 miles upstream of dam)

	Base	2-Year Storm	10-Year Storm	50-Year Storm	100-Year Storm
Alternative No. 1* - Replace Existing Radial Gate (Existing Condition)	*147.27***	150.13	157.42	162.91	165.25
Alternative No. 2 - Discontinue Operation of Gate During Storm Events	147.27	151.68	158.59	163.65	165.68
Alternative No. 3A - Remove Radial Gate & Replace with Fixed-Crest Ogee Section; Remove Catwalk & Catwalk Piers	147.24	151.2	157.9	162.91	164.94
Alternative No. 3B - Remove Radial Gate & Replace with Fixed-Crest Ogee Section; Remove Catwalk, Catwalk Piers, & Thrust Piers	147.24	151.13	157.77	162.75	164.78
Alternative No. 4A - Replace Radial Gate with Weir Wall (crest el. 1' below ogee crest)	146.94	151.27	158.14	163.24	165.29

**Grey row shading indicates the alternatives that are under primary consideration.*
***Normal pool elevation based on normal sunny day operation (gate closed).*

6. Summary of Modeling Results (Alternatives 1 – 4A)

- Water levels decreased upstream of the dam for Alternatives 3A and 3B during the 100-year storm as compared to the existing condition.
- Water levels increased upstream of the dam for all Alternatives during the 2- and 10-year storms as compared to the existing condition. Alternative 2 (discontinued operation of existing gate) causes the water level just upstream of the dam to vary from +0.70 feet (100-YR) to +1.69 feet (2-YR) as compared to the existing condition.
    - Comparison of Alternative 2 to Alternative 1 provides an approximate measure of the impact of operation of the existing gate on flood elevations. For example, the 100-year flood elevation immediately upstream of the dam is 161.05' when the radial gate is fully opened, compared to the 100-year flood elevation of 161.75' when the radial gate is closed. Fully opening the radial gate lowers the 100-year flood elevation by approximately 0.7' (8.4") as compared to leaving the radial gate closed during the storm event.
- Alternative 3A (removal of gate and catwalk piers) causes the water level just upstream of the dam to vary from -0.53 feet (100-YR) to +1.18 feet (2-YR) as compared to the existing condition.
- Alternative 3B (removal of gate, catwalk piers, and thrust piers) causes the water level just upstream of the dam to vary from -0.81 feet (100-YR) to +1.09 feet (2-YR) as compared to the existing condition.
    - Removal of the thrust piers in addition to the catwalk piers provides only marginal improvement when compared to Alternative 3A (removal of catwalk piers only).
- Alternative 4A (replacing radial gate with weir wall) causes the water level just upstream of the dam to vary from +0.07 feet (100-YR) to +1.24 feet (2-YR) as compared to the existing condition.
- The greatest comparative impact to water surface elevations is observed during the smallest storm event. During the 2-year storm, the water levels just upstream of the dam are raised by 1.09 to 1.69 feet when comparing Alternatives 2, 3A, 3B, and 4A to the existing condition

(Alternative 1). Storms smaller than the 2-year storm were not modeled for this technical memo. However, operation of the existing radial gate would be expected to have proportionally greater impact as storm frequency increases.

- None of the proposed retrofit alternatives result in significant impacts to existing water surface elevations downstream of Lake Jackson Dam.

7. Summary of Mapping Observations (Alternatives 1 – 4A)

A total of 35 residential structures are impacted during the largest storm event evaluated for this study (i.e. the 100-YR storm event) assuming the radial gate remains closed (i.e. ALT 2). 31 of these 35 residential structures are impacted already during current radial gate operation (ALT 1). The number of impacted homes decreases as the storm events become smaller and more frequent; for example, only one structure is affected by the 2-YR storm event. See table 3A for a tabulation of the alternatives and houses impacted. Note that the definition of an impacted structure means that the Water Surface Elevation of a given storm event (e.g. the 100-yr event) is above the Lowest Adjacent Grade (L.A.G.) of the structure.

Table 3A. Number of Homes Impacted by Alternatives

	Number of homes impacted by different alternatives			
	2-Year Storm	**10-Year Storm**	**50-Year Storm**	**100-Year Storm**
Alternative 1*	0	5	24	31
Alternative 2	1	8	29	35
Alternative 3A	1	8	25	30
Alternative 3B*	0	6	23	30
Alternative 4A	1	8	28	31

**Grey row shading indicates the alternatives that are under primary consideration.*
(Note: Alternative 1 represents current practice, i.e. no change.)

While the operation of the radial gate (ALT 1) during storm events does provide some benefits (see appendix E), for purposes of this technical memorandum, the effects of the radial gate should be reviewed in relation to the various proposed alternatives – ALT 2, 3A, 3B and 4A - which, when done so, shows the radial gate as providing only minimal benefit to these 35 properties during the 100-YR storm.

Excluding structures downstream of the dam (which are equally impacted under all Alternatives):

- 35 residential structures appear to be impacted by the 100-year storm, with most structures (31) impacted in the existing condition (Alternative 1) as well as Alternatives 2, 3A, 3B, and 4A.
- 29 residential structures appear to be impacted by the 50-year storm, with most structures (24) impacted in the existing condition (Alternative 1) as well as by Alternatives 2, 3A, 3B, and 4A.
- 8 residential structures appear to be impacted by the 10-year storm, with 5 of the 8 structures impacted in the existing condition (Alternative 1). All 8 of these structures are impacted by Alternatives 2, 3A, and 4A. Two of the 8 are not impacted by 3B (the remaining 6 are impacted).
- 1 residential structure appears to be impacted by the 2-year storm under Alternatives 2, 3A and 4A. This structure is not impacted in existing condition (Alternative 1).

The flood inundations maps of each storm profile are included in Appendix D (the effective FEMA Flood Insurance Rate Map (FIRM) is in Appendix B). An additional summary of flood elevations relative to the

35 impacted structures is summarized in Appendix E. Structure elevations were initially estimated based on location of structures relative to the 2' topographic contours offered by Prince William County GIS. This topography is not certified by a professional surveyor and thus only provides a rough estimate of the lowest adjacent grade of each structure (i.e. it cannot be determined which structures are raised and to what elevation). No final determination should be made as to the impact of any alternative on any specific structure as a result of these estimations with the exception of the (8) houses described below.

The 2' GIS contours show that 8 structures are likely impacted by the 10-year storm. These structures were investigated further. To develop a more accurate understanding of structure impacts, Dewberry conducted lowest adjacent grade (LAG) surveys on each of the 8 residences impacted by all or some of the Alternatives during the 10-year storm. These structures are included in the profile plots within Appendix F to demonstrate flood elevations relative to their respective lowest adjacent grade. The 8 structures are further highlighted in the tables in Appendix E and were confirmed to be impacted by the 10-year storm under some or all of the Alternatives. (In addition, one structure is also impacted by the 2-year storm under some of the alternatives). Additional information on flood profiles and elevations is included in Appendix G.

8. Cost Estimates

8.1. Construction, and Operations & Maintenance Costs

See Appendix H for the Preliminary Statement of Probable Construction Cost for each option and historical operations and maintenance costs for the existing gate and dam. Rough construction costs were calculated in consultation with a local demolition contractor and are based on the potential sequences of construction described in Section 8.2. Note that the estimated construction costs for Alternatives 1 – 4A include a 20% budget for engineering and permitting services and a 35% contingency. Table 4 summarizes cost estimates for the design concept options:

Table 4. Cost Estimates

Option Description	Estimate of Probable Construction Cost*	Estimate of Annual Operations Cost	Estimate of Annual Maintenance Cost	Estimated Operations & Maintenance Cost (Projected 40-YR Period)
Alternative No. 1	$1,741,000	$105,300	$137,000	$9,690,000 (No Inflation) $14,600,000 (2% Ann. Inflation)
Alternative No. 2	n/a	$0	$137,000	$5,480,000 (No Inflation) $8,300,000 (2% Ann. Inflation)
Alternative No. 3A	$1,750,000	$50,000**		$2,000,000 (No Inflation) $3,000,000 (2% Ann. Inflation)
Alternative No. 3B	$2,100,000	$25,000**		$1,000,000 (No Inflation) $1,500,000 (2% Ann. Inflation)
Alternative No. 4A	$1,099,000	$75,000**		$3,000,000 (No Inflation) $4,500,000 (2% Ann. Inflation)
Alternative No. 5	$6,000,000***	$0		$0

**Does not include purchase of any properties.*
***Cost estimate provided by PWC Department of Public Works staff.*
****Cost estimate obtained by reference to similar project (Bloede Dam, Catonsville MD, https://dnr.maryland.gov/fisheries/pages/fishpassage/bloede.aspx)*

8.2. Potential Sequences of Construction

<u>Option 1</u> – Replace Existing Radial Gate

Dam Retrofit

1. Divert upstream base flow via pumps and/or siphon system. Demolition slurry and other runoff to be collected in downstream sediment basin and treated before discharge.
2. Construct bulkhead across upstream side of thrust piers.
3. Remove existing radial gate and appurtenances.
4. Patch/repair thrust piers.
5. Install new radial gate and appurtenances.

<u>Option 3A</u> - Remove Radial Gate & Replace with Fixed-Crest Ogee Section; Remove Catwalk & Catwalk Piers

A. Retrofit Powerhouse with Low-Level Drain

1. Dredge upstream of powerhouse.
2. Remove turbines and repair existing steel/concrete as needed.
3. Retrofit powerhouse with (2) 36”x36” sluice gates.

B. Dam Retrofit

1. Divert upstream base flow through powerhouse. Demolition slurry (e.g. saw cutting dust/debris) and other runoff to be collected in downstream sediment basin and treated before discharge.
2. Remove radial gate, catwalk, catwalk piers, motorhouse.
3. Construct bulkhead across upstream side of thrust piers.
4. Construct ogee weir across former location of radial gate.
5. Patch and smooth concrete surface as needed across dam.

<u>Option 3B</u> - Remove Radial Gate & Replace with Fixed-Crest Ogee Section; Remove Catwalk, Catwalk Piers, & Thrust Piers

A. Retrofit Powerhouse with Low-Level Drain

1. Dredge upstream of powerhouse.
2. Remove turbines and repair existing steel/concrete as needed.
3. Retrofit powerhouse with (2) 36”x36” sluice gates.

B. Dam Retrofit

1. Divert upstream base flow through powerhouse. Demolition slurry and other runoff to be collected in downstream sediment basin and treated before discharge.
2. Remove radial gate, catwalk, catwalk piers, motorhouse, and thrust piers.
3. Construct bulkhead across upstream side of thrust pier footers.
4. Construct ogee weir across former location of radial gate.
5. Patch and smooth concrete surface as needed across dam.

<u>Option 4A</u> - Replace Radial Gate with Weir Wall (crest el. 1' below ogee crest)

A. Retrofit Powerhouse with Low-Level Drain

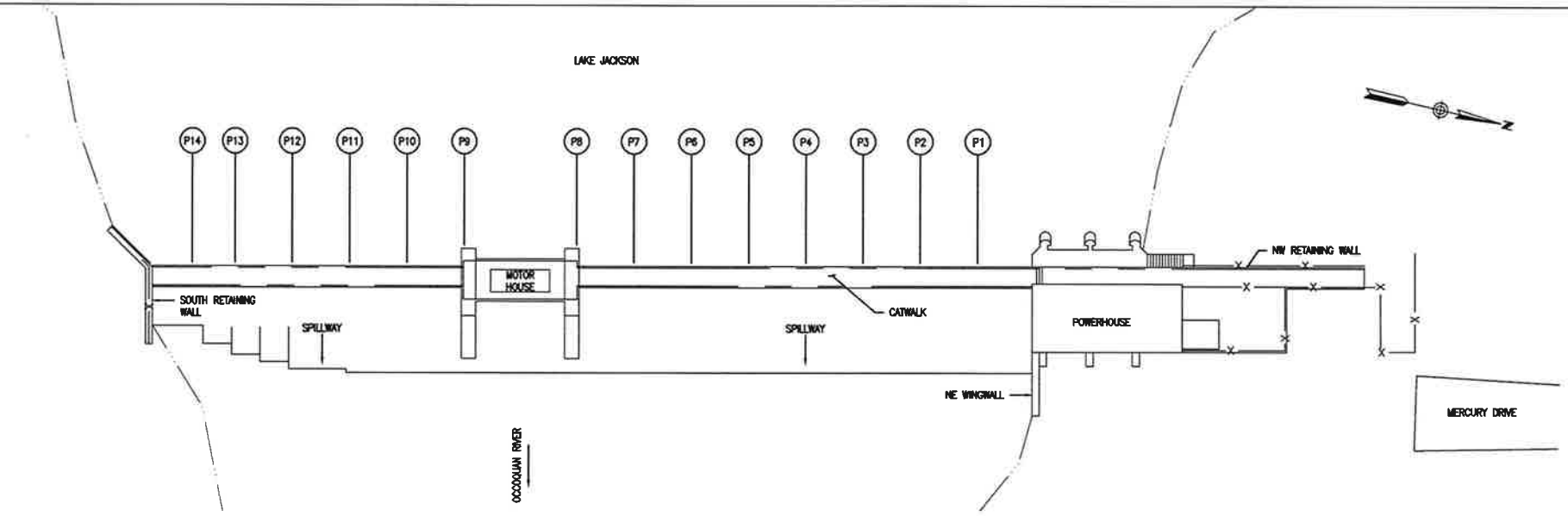
1. Dredge upstream of powerhouse.
2. Remove turbines and repairs existing steel/concrete as needed.
3. Retrofit powerhouse with (2) 36"x36" sluice gates.

B. Dam Retrofit

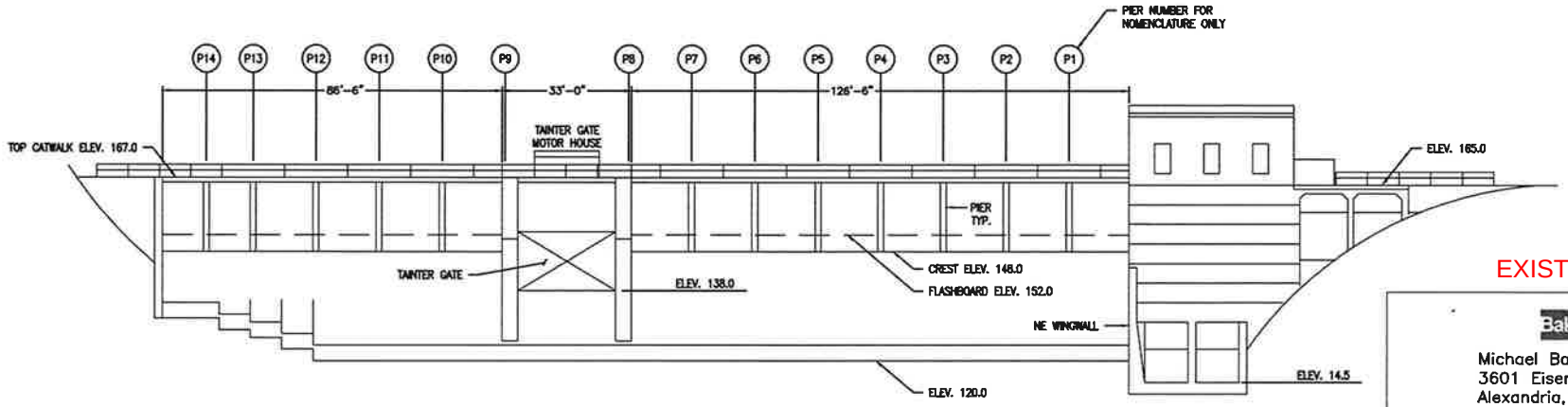
1. Divert upstream base flow through powerhouse. Demolition slurry and other runoff to be collected in downstream sediment basin and treated before discharge.
2. Remove radial gate and motorhouse.
3. Construct bulkhead across upstream side of thrust pier footers.
4. Construct fixed-crest concrete weir across former location of radial gate.

Appendix A

Plan and Elevation Views of Lake Jackson (Existing Dam & Options 3A, 3B, 4A)



PLAN
SCALE: 1" = 30'



DOWNSTREAM ELEVATION
SCALE: 1" = 30'

NOTE:
ADAPTED FROM 2006 LAKE JACKSON DAM INSPECTION REPORT

0 30
FEET SCALE

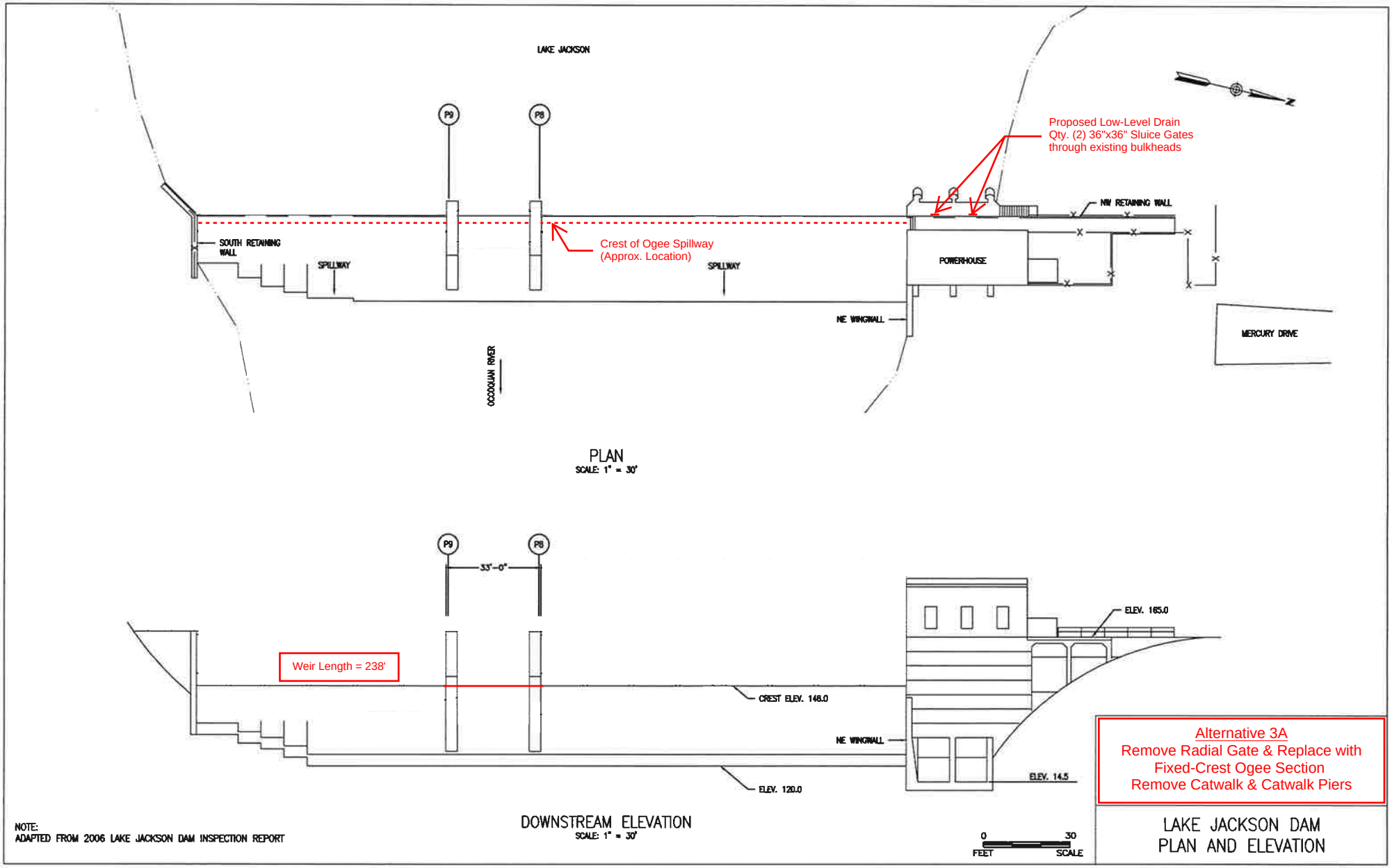
EXISTING DAM

Baker
Michael Baker Jr., Inc.
3601 Eisenhower Avenue
Alexandria, VA 22304

LAKE JACKSON DAM
PLAN AND ELEVATION

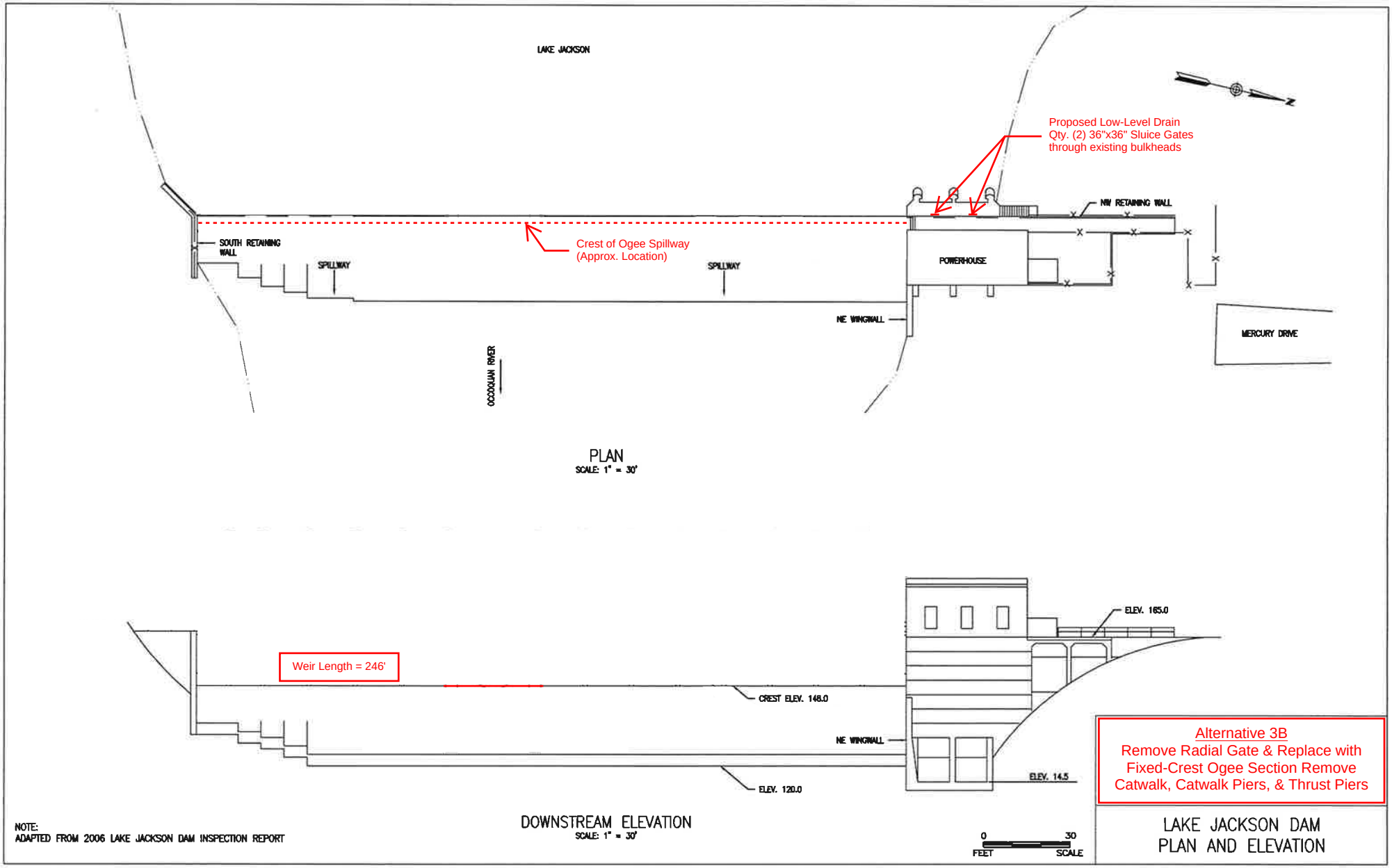
ELEVATIONS ARE NGVD29. TO CONVERT ELEVATIONS TO NAVD88, SUBSTRACT 0.82'

Existing Lake Jackson Dam
(View from Upstream)



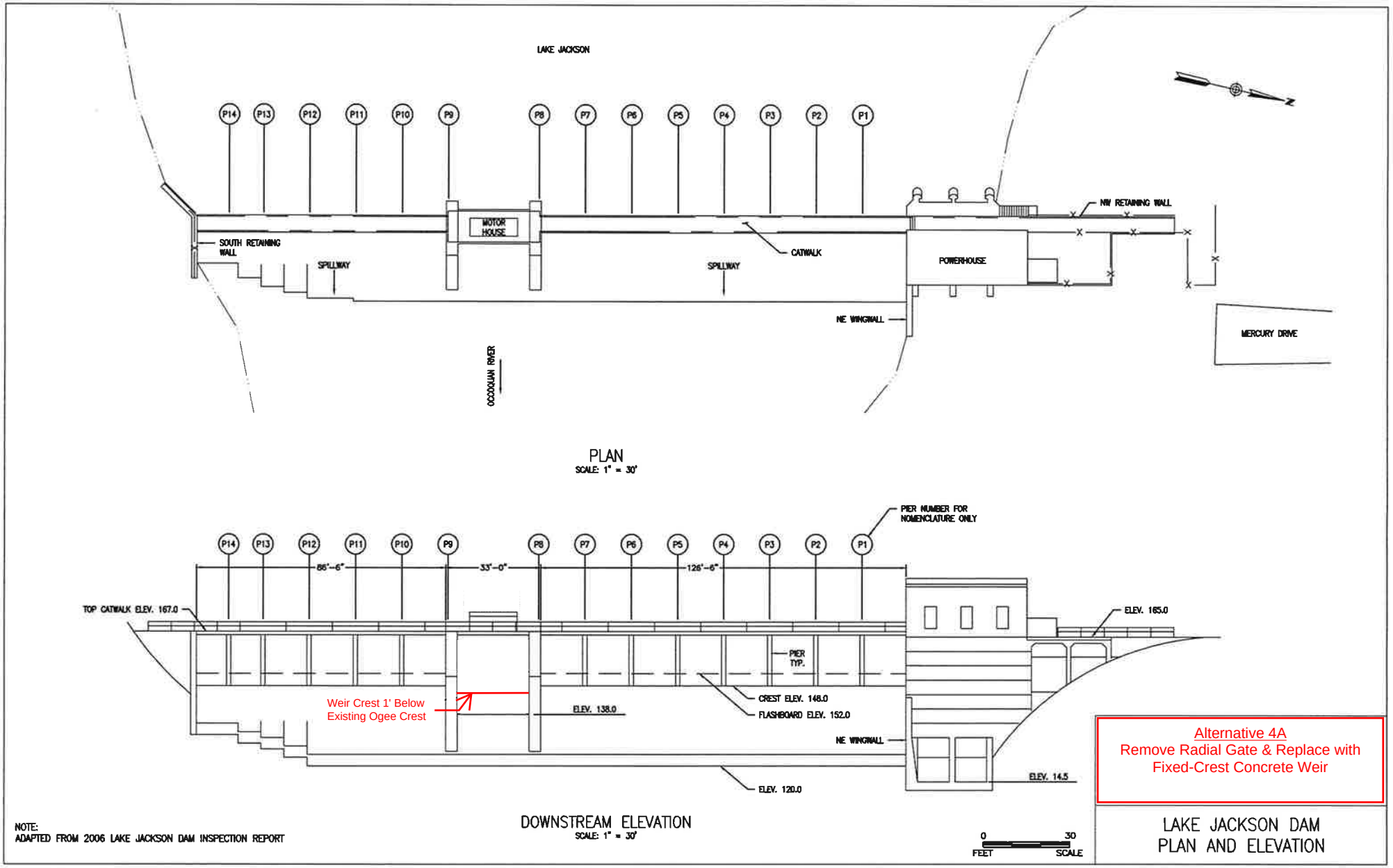
ELEVATIONS ARE NGVD29. TO CONVERT ELEVATIONS TO NAVD88, SUBSTRACT 0.82'


Alternate 3A
(View from Upstream)



ELEVATIONS ARE NGVD29. TO CONVERT ELEVATIONS TO NAVD88, SUBSTRACT 0.82'


Alternate 3B
(View from Upstream)



ELEVATIONS ARE NGVD29. TO CONVERT ELEVATIONS TO NAVD88, SUBSTRACT 0.82'

Alternate 4A
(View from Upstream)

Appendix B

FEMA Effective Flood Insurance Rate Map (FIRM)

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program; It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for possible updated flood hazard information prior to use of this map for property purchase or construction purposes.

Coastal base flood elevations apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NVGD), and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Areas of special flood hazard (100-year flood) include Zones A, AE, AH, AO, A99, V, and VE.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Floodway widths are provided in the Flood Insurance Study Report.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

For community map revision history prior to countywide mapping, see section 6.0 of the Flood Insurance Study Report.

For adjoining map panels see separately printed Map Index.

NOTE: The coordinate system used for the production of this Flood Insurance Rate Map (FIRM) is Universal Transverse Mercator (UTM), North American Datum of 1927 (NAD27), Clarke 1866 spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to the Transverse Mercator projection, NAD27. Differences in the datum and spheroid used in the production of FIRMS for adjacent communities may result in slight positional differences in map features at the community boundaries. These differences do not affect the accuracy of the information shown on the FIRM.

ATTENTION: Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, contact the National Geodetic Survey at the following address:

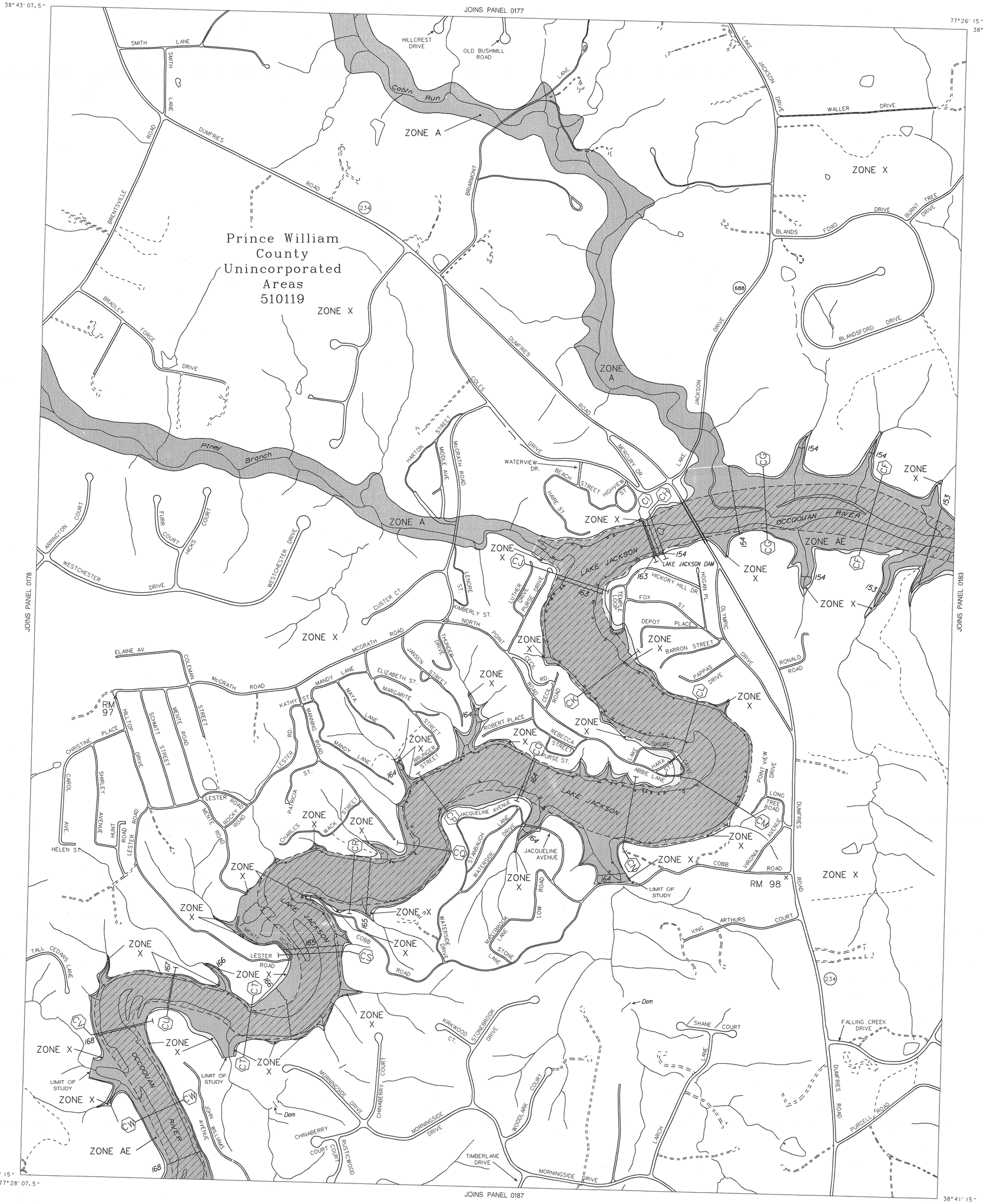
Vertical Network Branch, N/CG13
National Geodetic Survey, NOAA
Silver Spring Metro Center 3
1315 East- West Highway
Silver Spring, Maryland 20910
(301) 713-3191

Base Map Source: Base map information prepared by the Prince William County Office of Mapping. This information was compiled by photogrammetric methods from aerial photographs taken February 1987, and complies with U.S. National Map Accuracy Standards. Roads shown on this map represent edge of pavement. This map is based on the Transverse Mercator projection; the map edges represent parallels and meridians, the apparent tilt of the map is inherent in the use of this projection in a standardized map orientation.

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION IN FT. (NGVD)[1]	DESCRIPTION OF LOCATION
RM 97	284.29	At Lake Jackson, at southeast corner of intersection of McGrath Road and Hilltop Drive, cut nail in VEPCO pole 311B7007.
RM 98	297.01	At Lake Jackson, at southwest corner of T intersection of Cobb Road and State Route 234 (Dumfries Road), cut nail in C.M. pole 3-15-01-2079.

[1]National Geodetic Vertical Datum of 1929.



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- ZONE A — No base flood elevations determined.
- ZONE AE — Base flood elevations determined.
- ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE A99 — To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
- ZONE V — Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- ZONE VE — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- ZONE X — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile, and areas protected by levees from 100-year flood.

OTHER AREAS

- ZONE X — Areas determined to be outside 500-year floodplain.
- ZONE D — Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS*

Identified 1983 | Identified 1990 | Otherwise Protected Areas

*Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
- 513 — Base Flood Elevation Line; Elevation in Feet**
- A — A — Cross Section Line
- (EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone**
- RM7X — Elevation Reference Mark
- M1.5 — River Mile

**Referenced to the National Geodetic Vertical Datum of 1929

MAP REPOSITORY

Refer to Repository Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

JANUARY 5, 1995

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

Refer to the FLOOD INSURANCE RATE MAP effective date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE
500 0 500 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PRINCE WILLIAM COUNTY, VIRGINIA AND INCORPORATED AREAS

PANEL 179 OF 330

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
UNINCORPORATED AREAS	510119	0179	D

Notice to User: The MAP NUMBER shown below should be used when placing map orders; the COMMUNITY NUMBER shown above should be used on insurance applications for the subject community.

MAP NUMBER
51153C0179 D

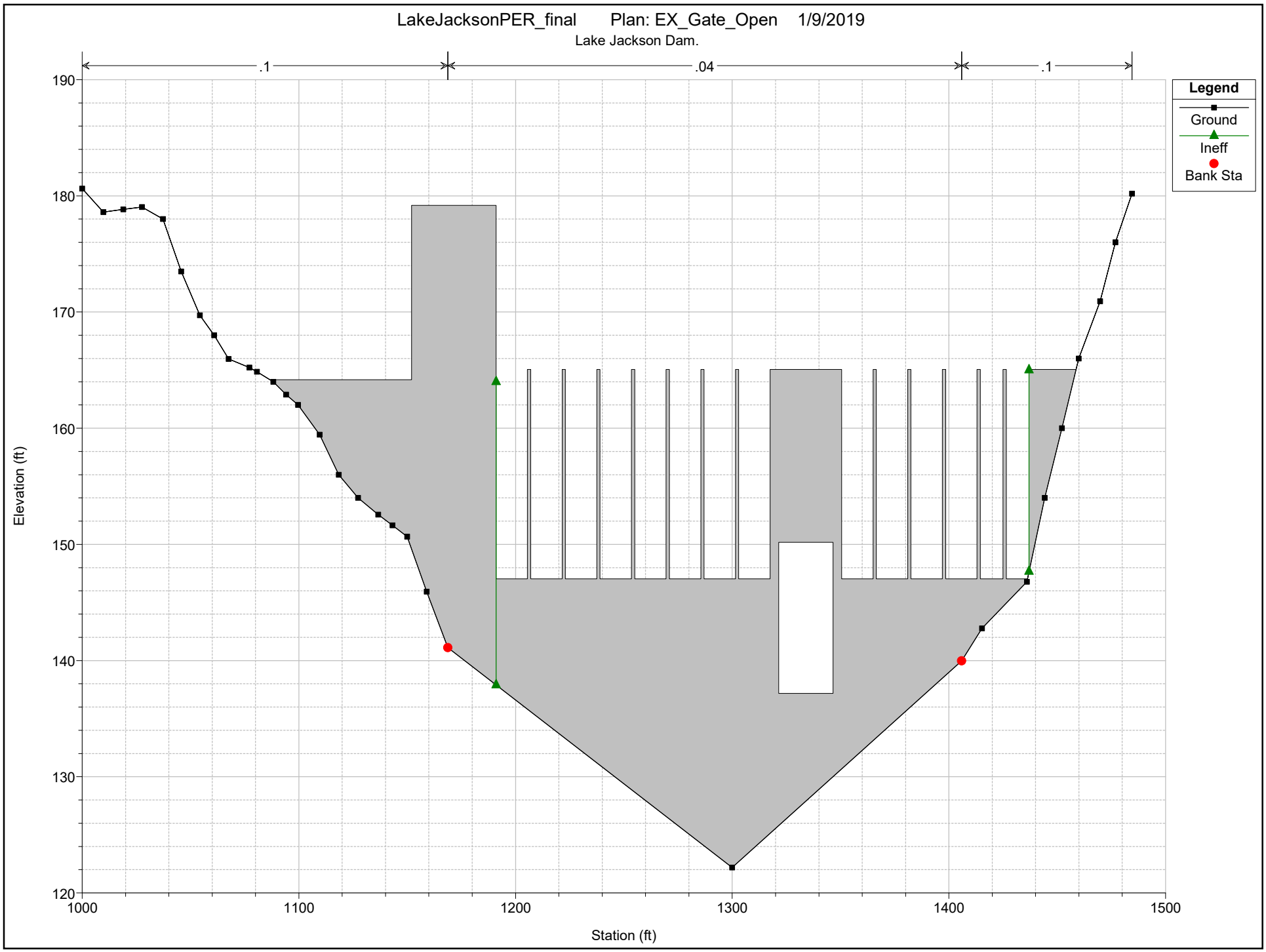
EFFECTIVE DATE:
JANUARY 5, 1995

Federal Emergency Management Agency

Appendix C

Profile View of Different Alternatives

OPTION 1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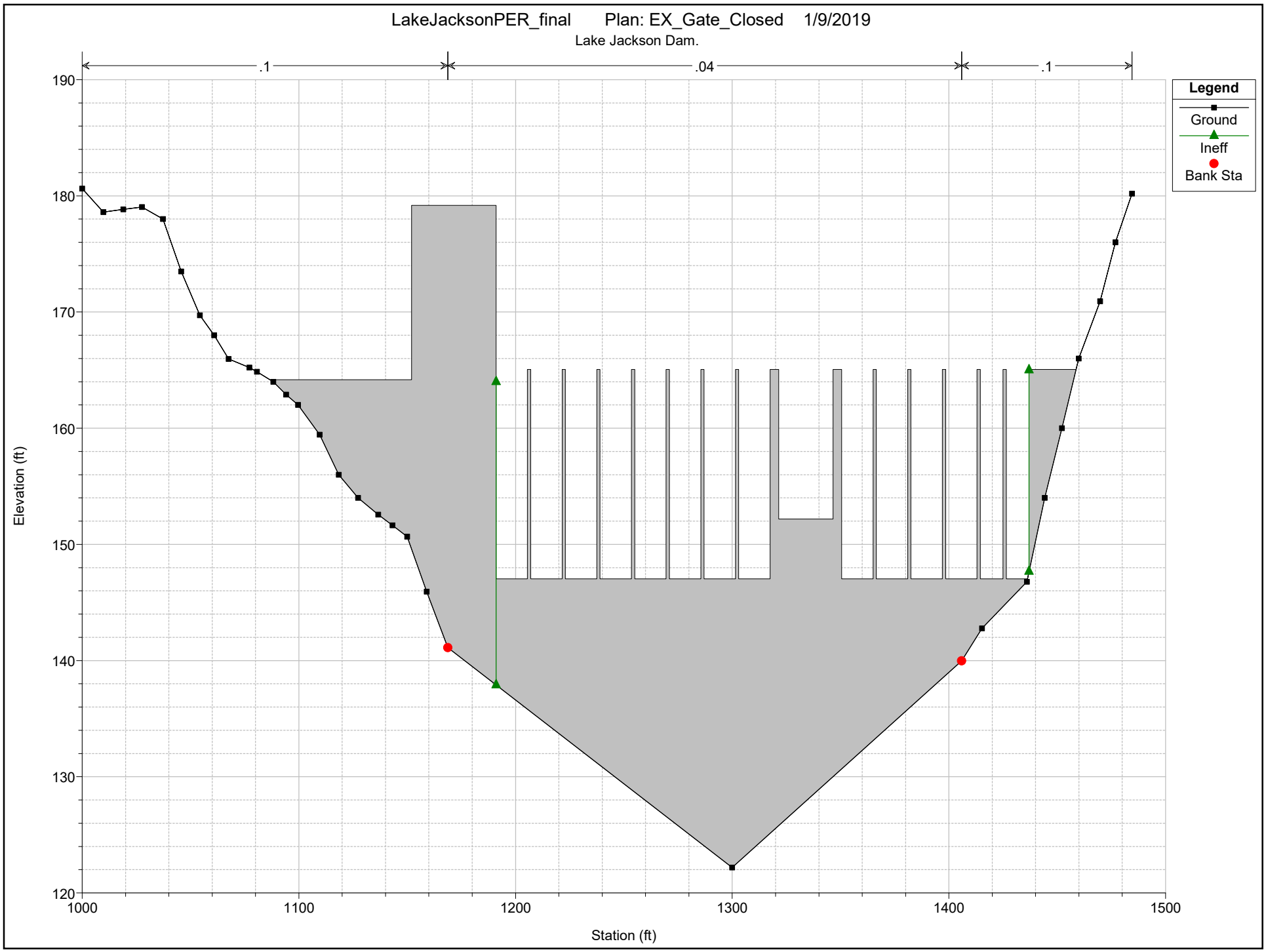
Lake Jackson Dam.
.1
.04
.1
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
190
180
170
160
150
140
130
120
1000
1100
1200
1300
1400
1500
Station (ft)

OPTION 2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Lake Jackson Dam.
.1
.04
.1
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
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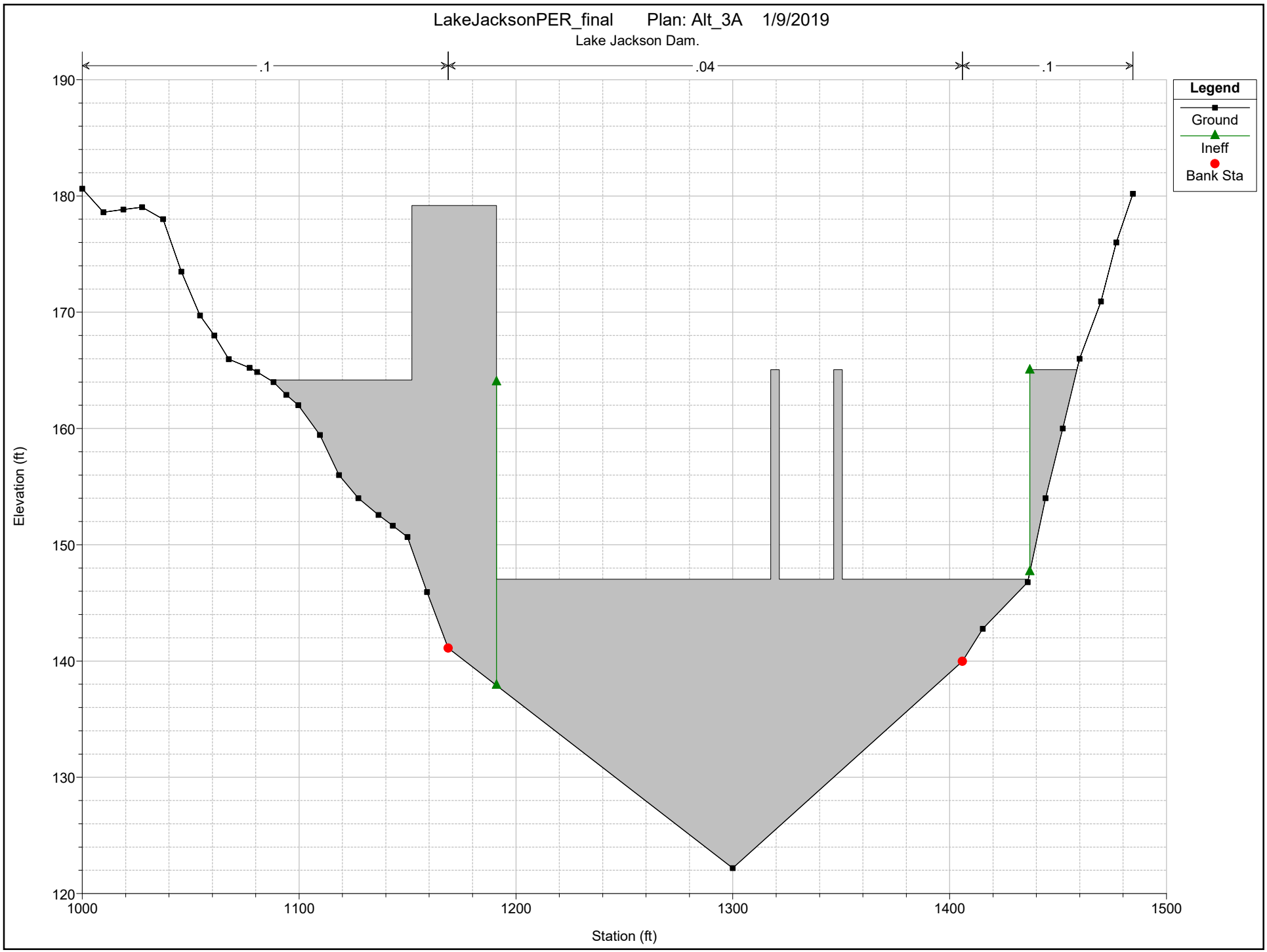
160
150
140
130
120
1000
1100
1200
1300
1400
1500
Station (ft)

OPTION 3A


LakeJacksonPER_final Plan: Alt_3A 1/9/2019
Lake Jackson Dam.
.1
.04
.1
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
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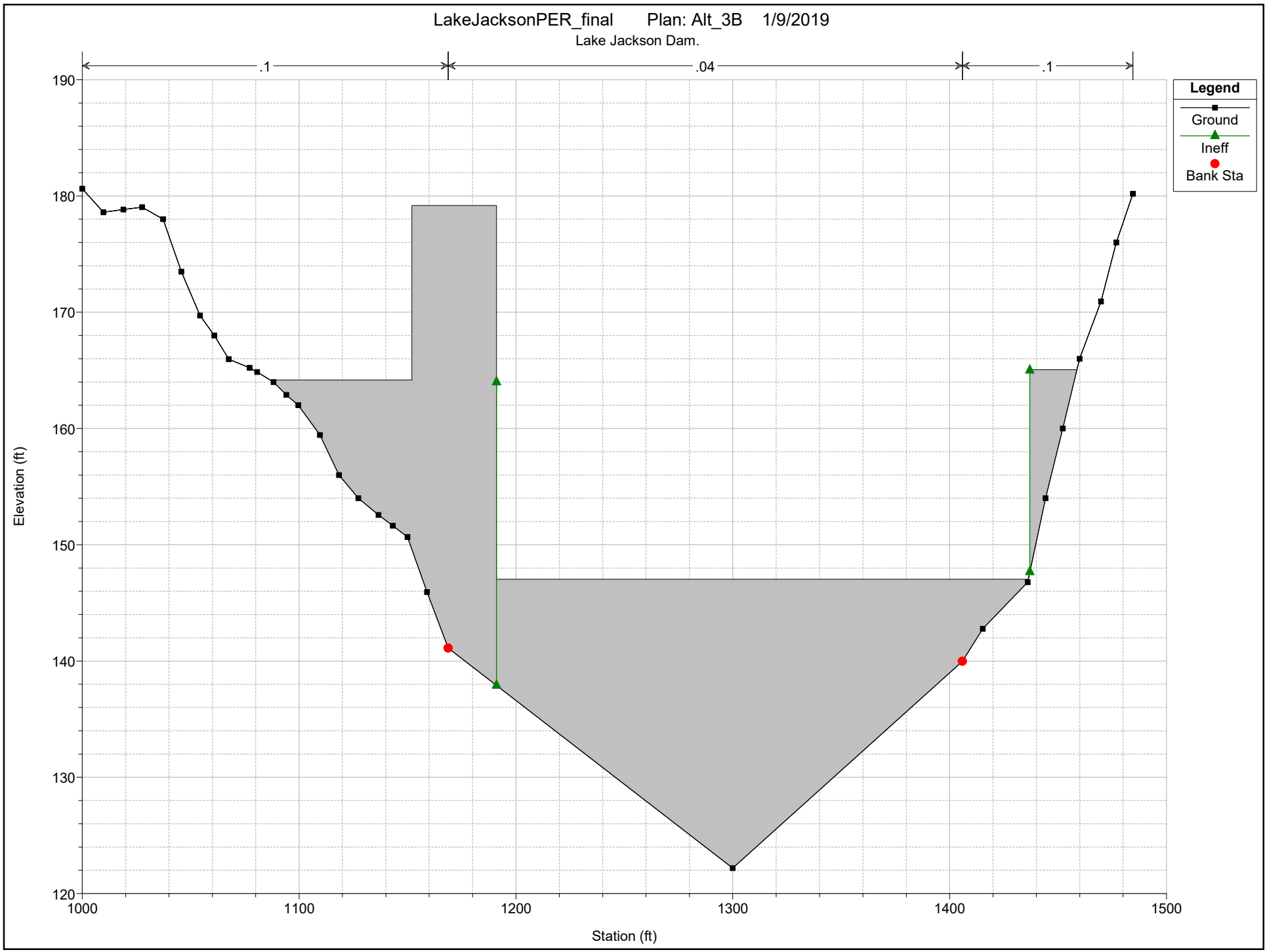
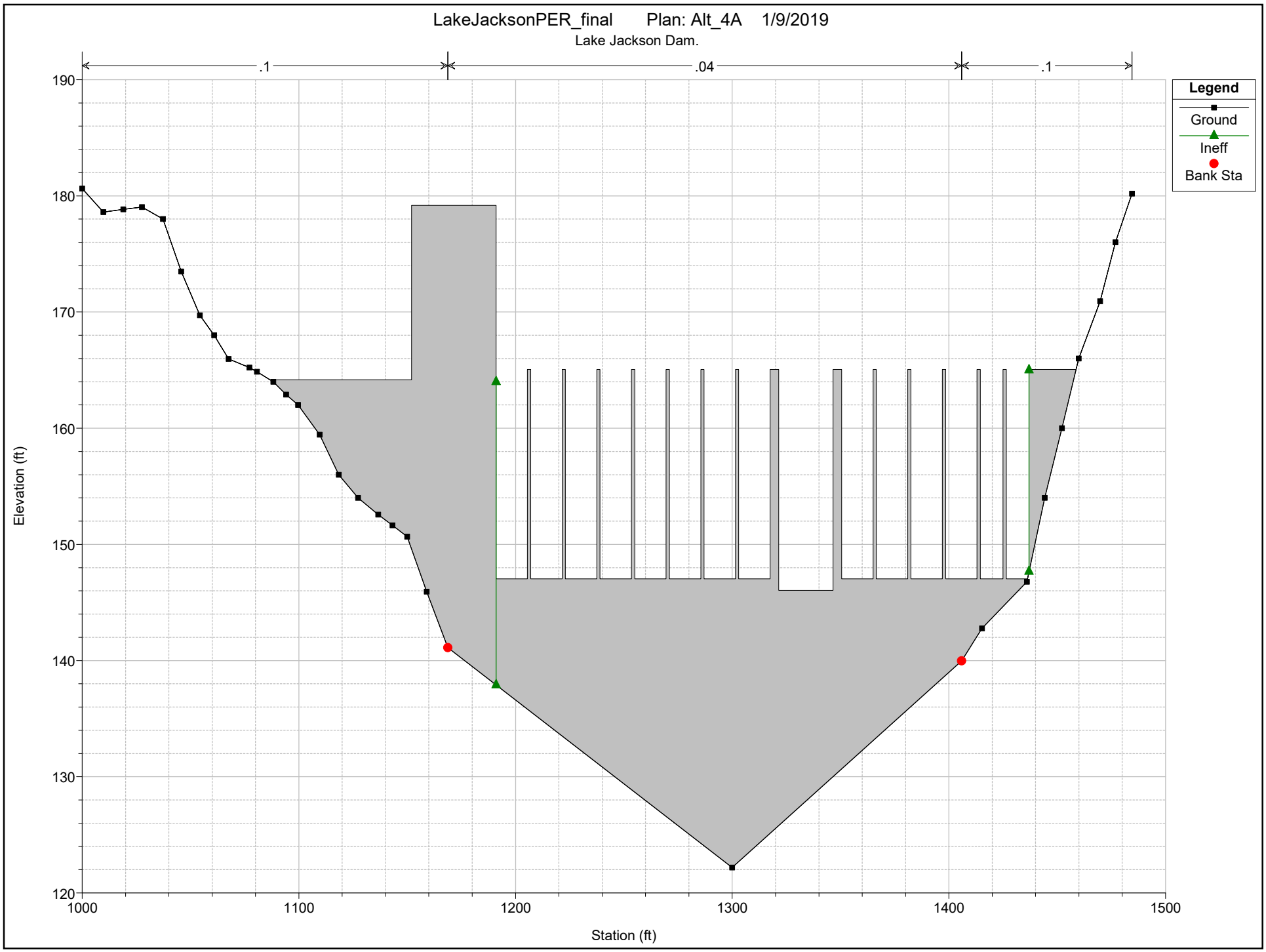
160
150
140
130
120
1000
1100
1200
1300
1400
1500
Station (ft)

OPTION 3B

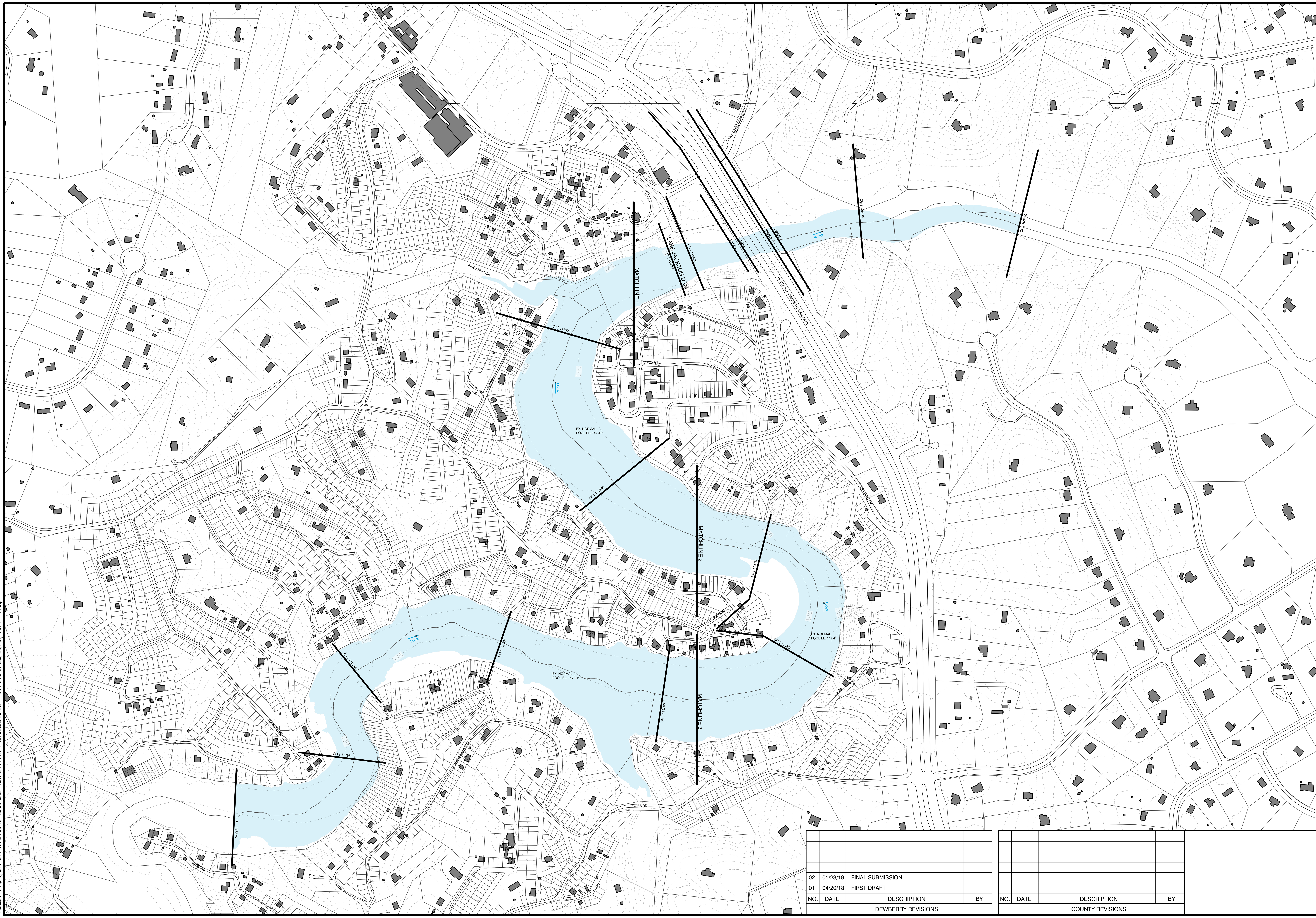

LakeJacksonPER_final Plan: Alt_3B 1/9/2019
Lake Jackson Dam.
.1
.04
.1
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
190
180
170
160
150
140
130
120
1000
1100
1200
1300
1400
1500
Station (ft)

OPTION 4A


LakeJacksonPER_final Plan: Alt_4A 1/9/2019
Lake Jackson Dam.
.1
.04
.1
Legend
Ground
Ineff
Bank Sta
Elevation (ft)
190
180
170
160
150
140
130
120
1000
1100
1200
1300
1400
1500
Station (ft)

Appendix D

Inundation Maps



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01	04/20/18	FIRST DRAFT	

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OVERALL VIEW

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number

Drawn By

Designed By

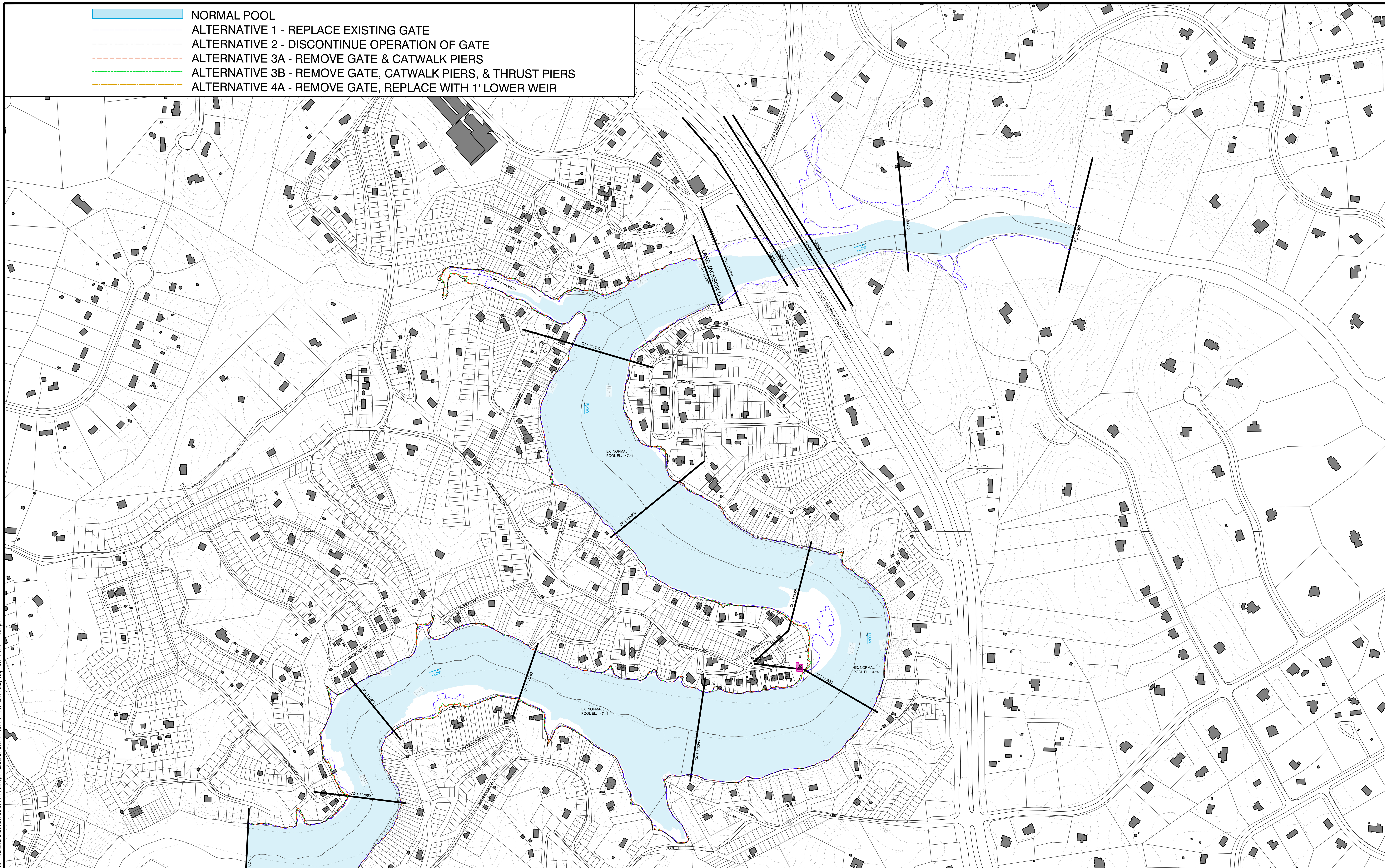
Checked By

Date 01/23/2019

Scale 1" = 250'

Sheet 1 Of 13

File Number M-854



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2-YEAR STORM EVENT FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number

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Designed By

Checked By

Date 01/23/2019

Scale 1" = 250'

Sheet 1A Of 13

File Number M-854

NORMAL POOL
ALTERNATIVE 1 - REPLACE EXISTING GATE
ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR

SAND BRIDGE CT
37
36
LAKE JACKSON DAM
CH | 110400
CI | 110495
CG | 109310
CF | 108300
110060
110010
109980
109930
FLOW
ROUTE 234 (PRINCE WILLIAM PKWY)
FOX ST
MATCHLINE 1
SEE SHEET 3
NAD 83 / NAVD 88

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2-YEAR STORM EVENT
FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number	
Drawn By	
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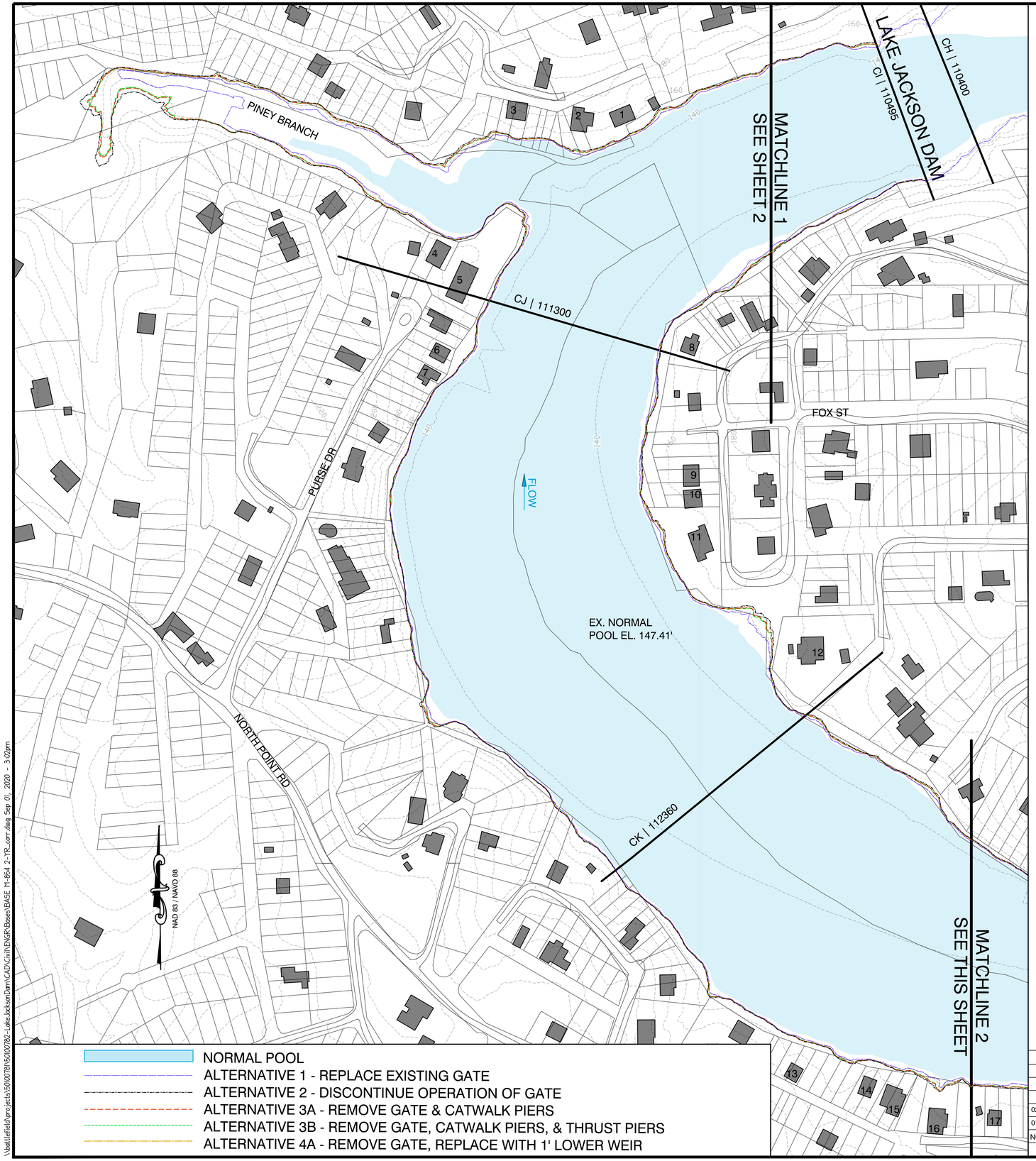
Date	01/23/2019
Scale	1" = 100'
Sheet	2 Of 13
File Number	M-854



NORMAL POOL
ALTERNATIVE 1 - REPLACE EXISTING GATE
ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR

NO.	DATE	DESCRIPTION	BY
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01	04/20/18	FIRST DRAFT	

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2-YEAR STORM EVENT
FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number
Drawn By
Designed By
Checked By
Date 01/23/2019
Scale 1" = 100'
Sheet 3 Of 13
File Number M-854

NORMAL POOL
ALTERNATIVE 1 - REPLACE EXISTING GATE
ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR

ROBERT PL
BRUNGER ST
NORTH POINT RD
FLOW
CP | 117355
CO | 116855
EX. NORMAL
POOL EL. 147.41'
JACQUELINE AVE
MANNING RD
CQ | 117960
WATERSIDE DR
CN | 115285
CR | 118875
COBB RD
COBB RD
MATCHLINE 3
SEE SHEET 3
NAD 83 / 88 NAVD

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2-YEAR STORM EVENT
FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number	
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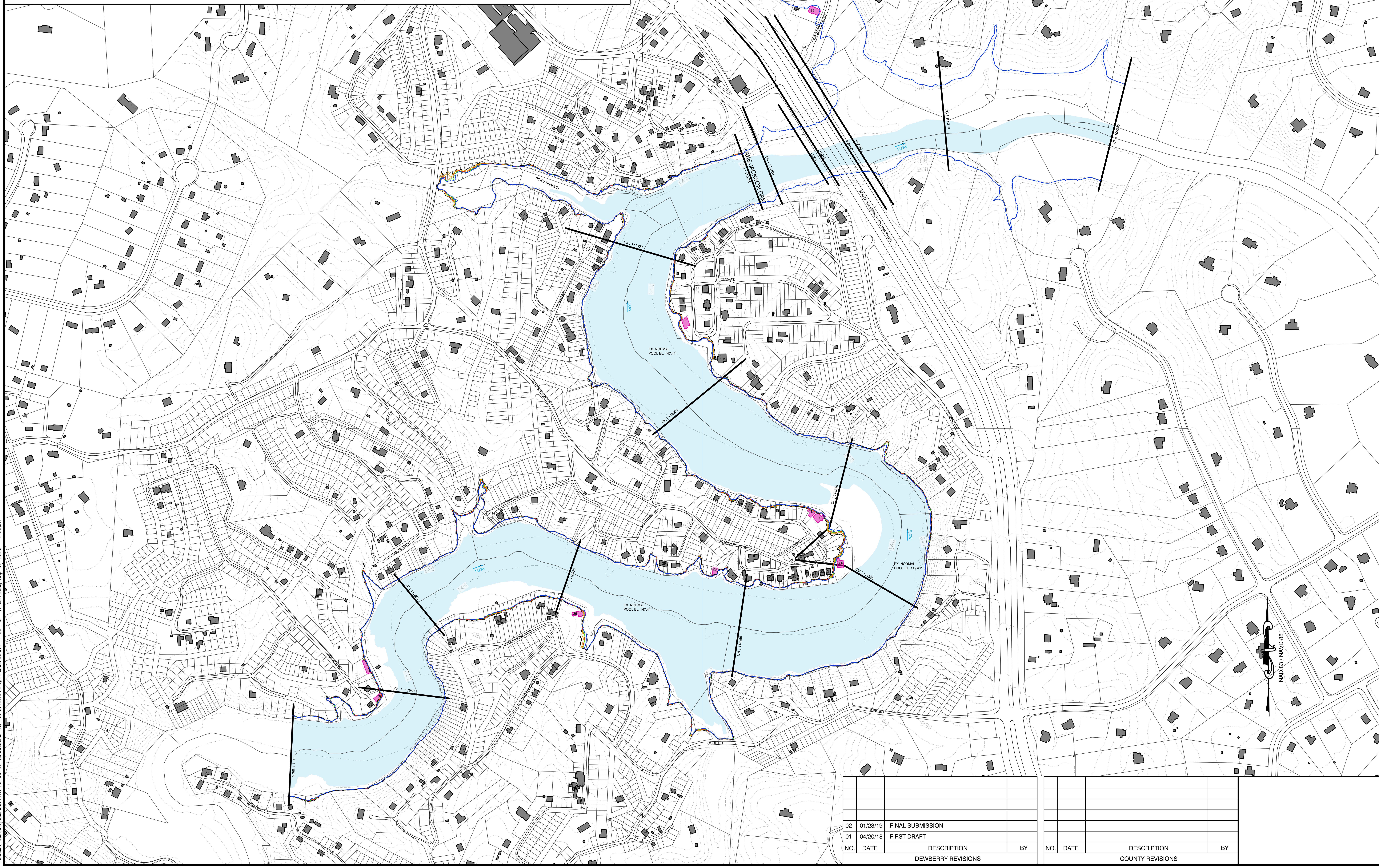
Designed By	
Checked By	
Date	01/23/2019
Scale	1" = 100'
Sheet	4 of 13
File Number	M-854

(light blue fill)	NORMAL POOL
(blue dashed line)	ALTERNATIVE 1 - REPLACE EXISTING GATE
(black dash-dot line)	ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
(red dashed line)	ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
(green dashed line)	ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
(orange dash-dot line)	ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR



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10-YEAR STORM EVENT FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number

Drawn By

Designed By

Checked By

Date 01/23/2019

Scale 1" = 250'

Sheet 4A Of 13

File Number M-854

NORMAL POOL
ALTERNATIVE 1 - REPLACE EXISTING GATE
ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR

37
36
SAND BRIDGE CT
LAKE JACKSON DAM
CI | 110495
CH | 110400
110060
110010
109980
109930
CG | 109310
CF | 108300
FLOW
ROUTE 234 (PRINCE WILLIAM PKWY)
FOX ST
MATCHLINE 1
SEE SHEET 6
NAD 83 / NVD 88

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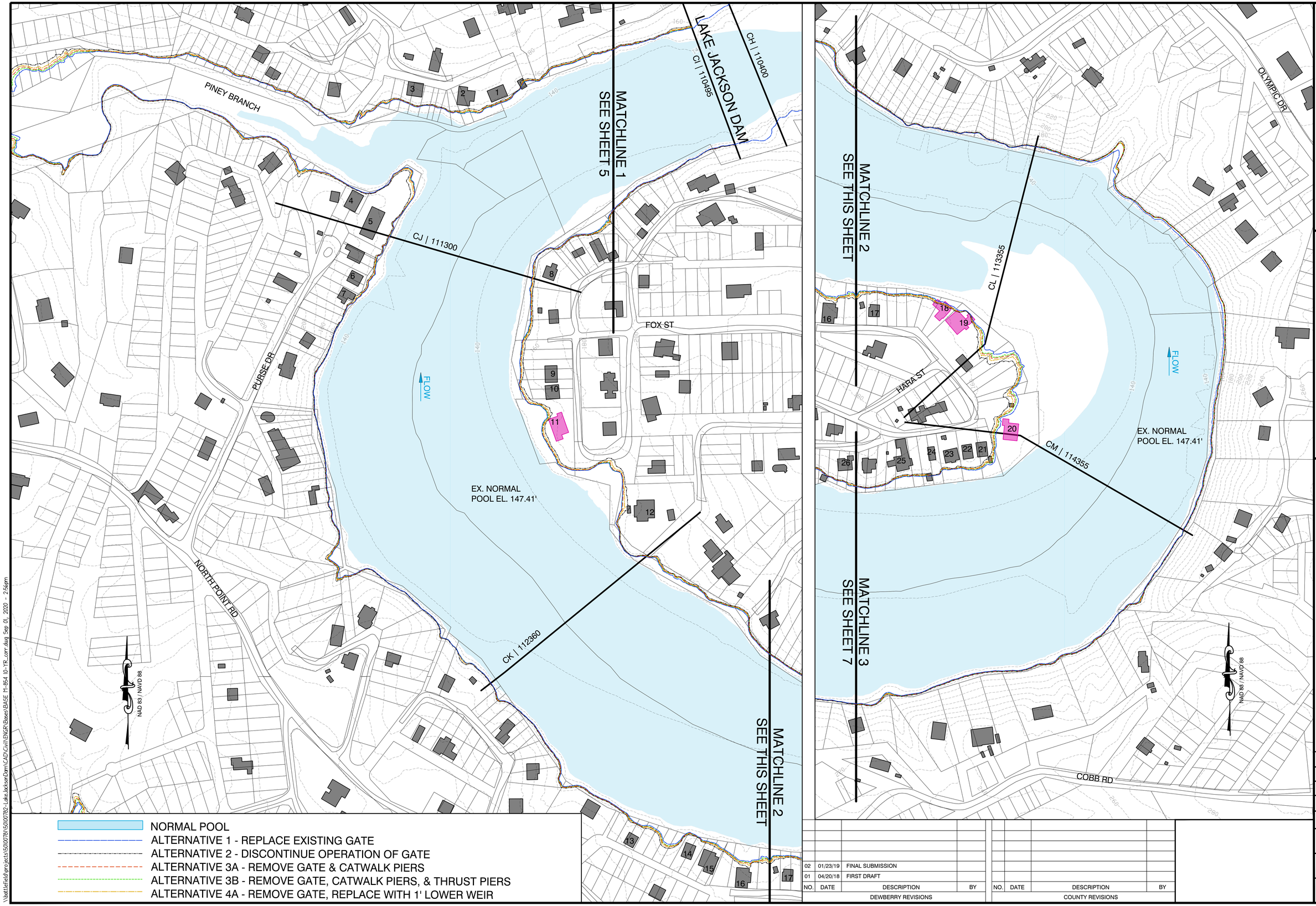
FAX: 703.468.2212

10-YEAR STORM EVENT
FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number	
Drawn By	
Designed By	
Checked By	
Date	01/23/2019
Scale	1" = 100'
Sheet	5 Of 13
File Number	M-854



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FAX: 703.468.2212

10-YEAR STORM EVENT
FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number	
Drawn By	
Designed By	
Checked By	
Date	01/23/2019
Scale	1" = 100'
Sheet	6 of 13
File Number	M-854

NO.	DATE	DESCRIPTION	BY
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01	04/20/18	FIRST DRAFT	

DEWBERRY REVISIONS

NO.	DATE	DESCRIPTION	BY

COUNTY REVISIONS

NORMAL POOL
ALTERNATIVE 1 - REPLACE EXISTING GATE
ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR

ROBERT PL
BRUINGER ST
NORTH POINT RD
FLOW
CP | 117355
CO | 116855
CN | 115285
CQ | 117960
CR | 118875
EX. NORMAL POOL EL. 147.41'
JACQUELINE AVE
MANNING RD
WATERSIDE DR
COBB RD
MATCHLINE 3
SEE SHEET 6
NAD 83 / NAVD 88
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29
28
27
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34
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33

\\battlefield\projects\50\00078\50\007782 - Lake Jackson Dam\CAD\Civil\ENGR\Base\BASE H-854 10-YR_corr.dwg Sep 01, 2020 - 2:56pm

NO.	DATE	DESCRIPTION	BY
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01	04/20/18	FIRST DRAFT	

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NO.	DATE	DESCRIPTION	BY

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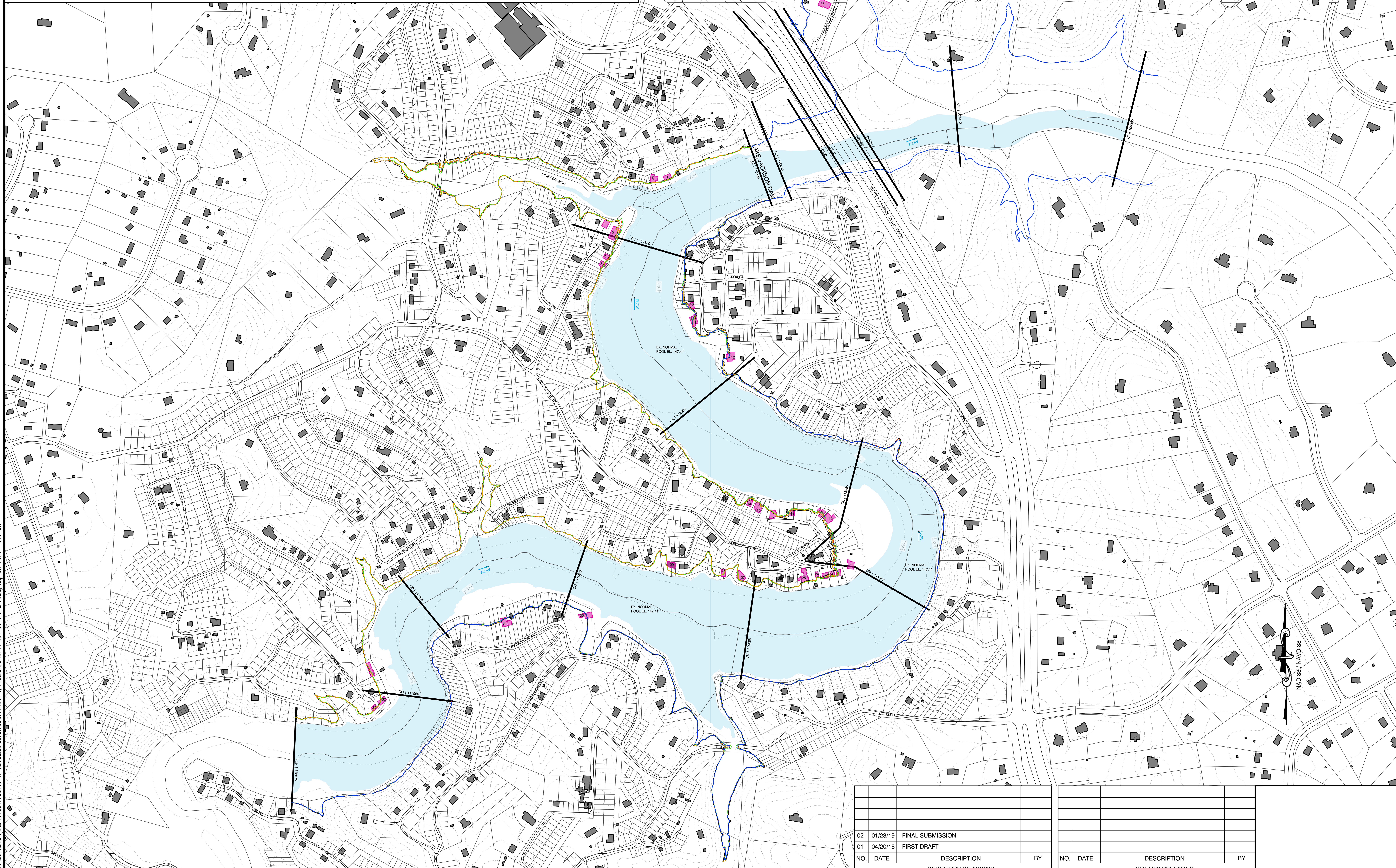
FAX: 703.468.2212

10-YEAR STORM EVENT
FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF
SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number	
Drawn By	
Designed By	
Checked By	
Date	01/23/2019
Scale	1" = 100'
Sheet	7 Of 13
File Number	M-854

NORMAL POOL
ALTERNATIVE 1 - REPLACE EXISTING GATE
ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR



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50-YEAR STORM EVENT FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

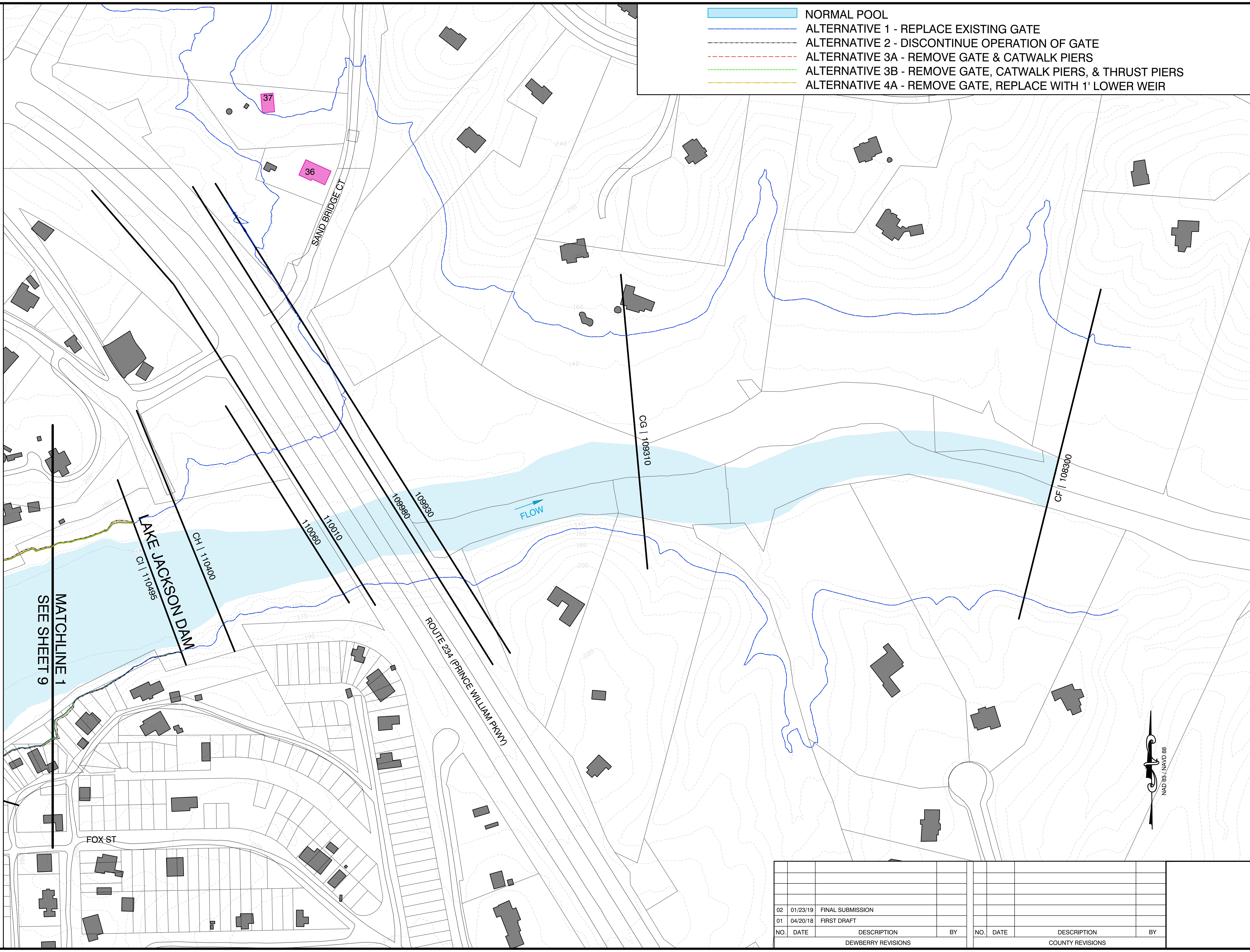
NO.	DATE	DESCRIPTION	BY
02	01/23/19	FINAL SUBMISSION	
01	04/20/18	FIRST DRAFT	

DEWBERRY REVISIONS

NO.	DATE	DESCRIPTION	BY

COUNTY REVISIONS

Plan Number
Drawn By
Designed By
Checked By
Date 01/23/2019
Scale 1" = 250'
Sheet 7A of 13
File Number M-854



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01	04/20/18	FIRST DRAFT					
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50-YEAR STORM EVENT
FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF
SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number
Drawn By
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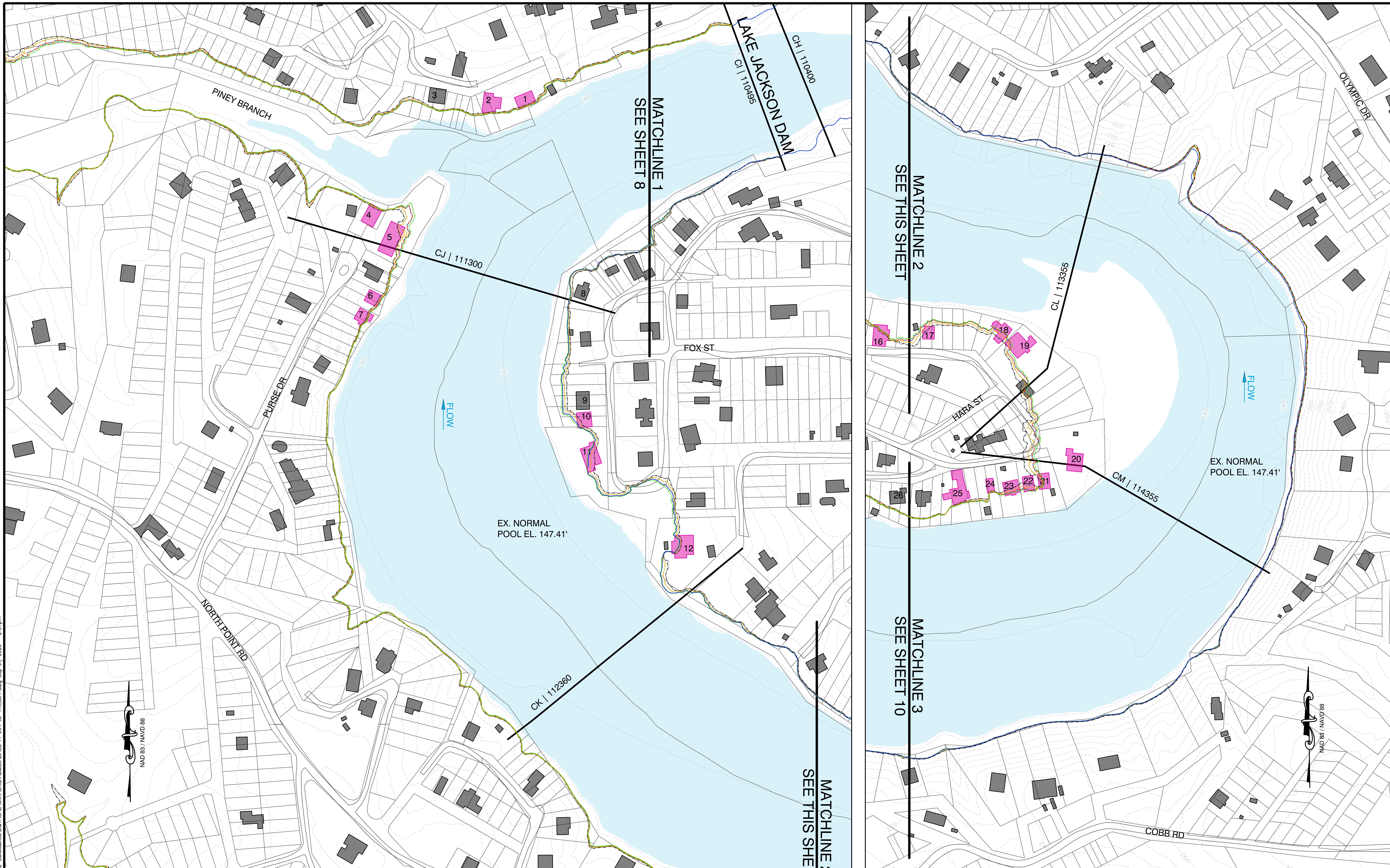
Date 01/23/2019
Scale 1" = 100'
Sheet 8 of 13
File Number M-854



NORMAL POOL
ALTERNATIVE 1 - REPLACE EXISTING GATE
ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR

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50-YEAR STORM EVENT
FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF
SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number
Drawn By
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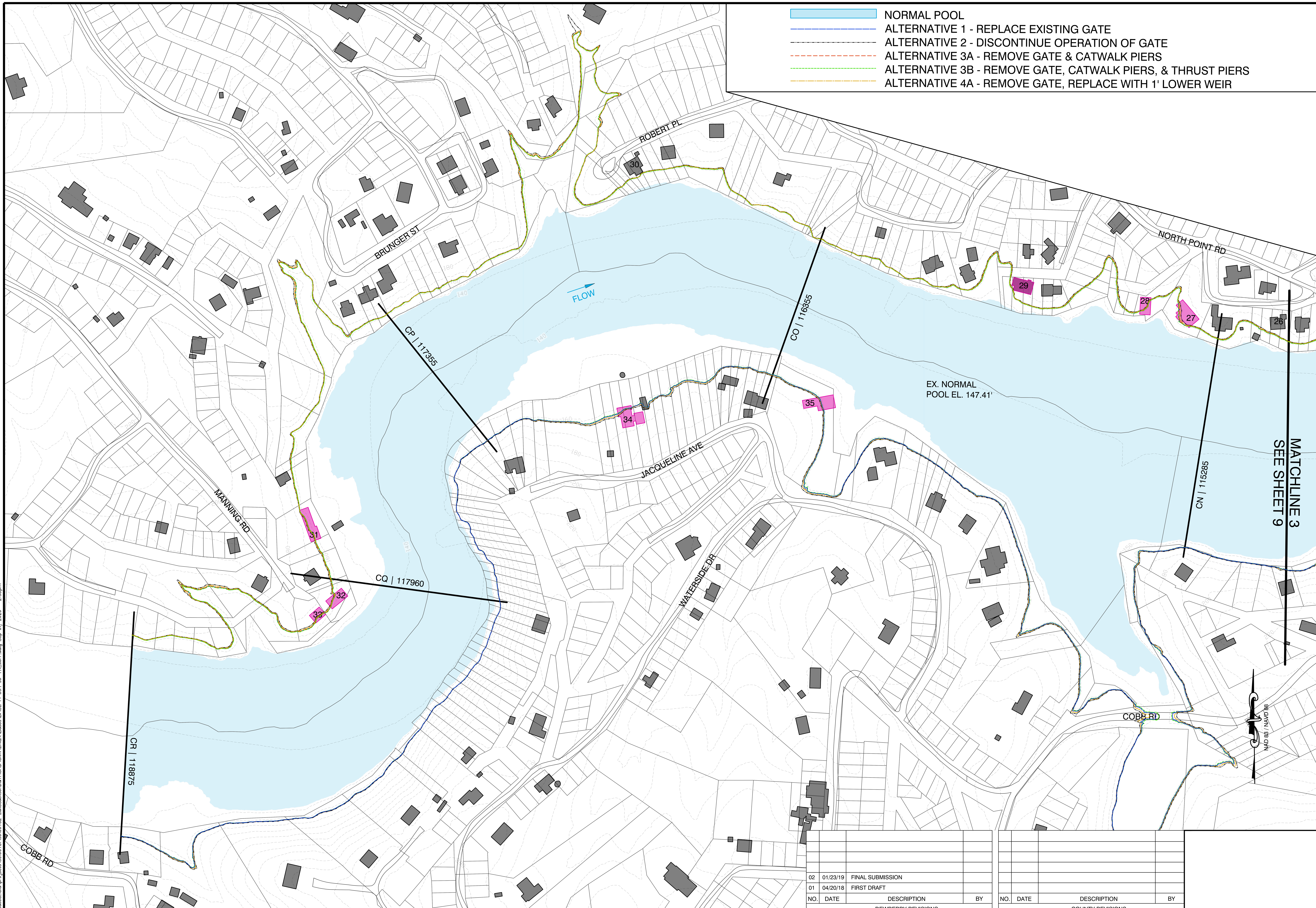
Date 01/23/2019
Scale 1" = 100'
Sheet 9 of 13
File Number M-854



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50-YEAR STORM EVENT FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

NO.	DATE	DESCRIPTION	BY
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01	04/20/18	FIRST DRAFT	

DEWBERRY REVISIONS

NO.	DATE	DESCRIPTION	BY

COUNTY REVISIONS

Plan Number
Drawn By
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Date 01/23/2019
Scale 1" = 100'
Sheet 10 of 13
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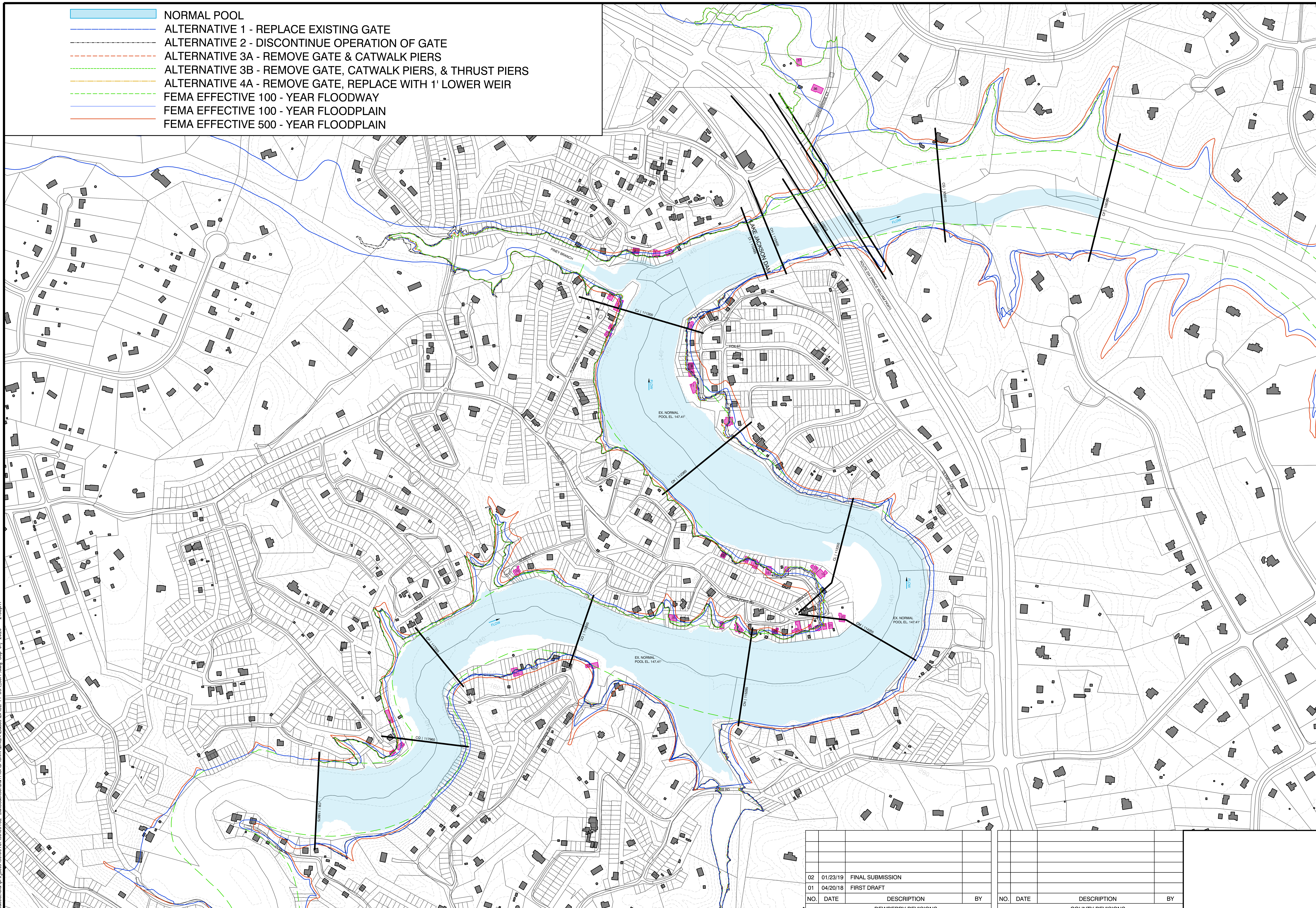

NO.	DATE	DESCRIPTION	BY
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100-YEAR STORM EVENT FLOOD INUNDATION LIMITS

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PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number

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Date 01/23/2019

Scale 1" = 250'

Sheet 10A of 13

File Number M-854

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NORMAL POOL
ALTERNATIVE 1 - REPLACE EXISTING GATE
ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR
FEMA EFFECTIVE 100 - YEAR FLOODWAY
FEMA EFFECTIVE 100 - YEAR FLOODPLAIN
FEMA EFFECTIVE 500 - YEAR FLOODPLAIN

37
36
SAND BRIDGE CT
LAKE JACKSON DAM
CI | 110495
CH | 110400
110060
110010
109980
109930
CG | 109310
CF | 108300
FLOW
ROUTE 234 (PRINCE WILLIAM PKWY)
FOX ST
MATCHLINE 1
SEE SHEET 12
NAD 83 / NAVD 88

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100-YEAR STORM EVENT
FLOOD INUNDATION LIMITS

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PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number	
Drawn By	
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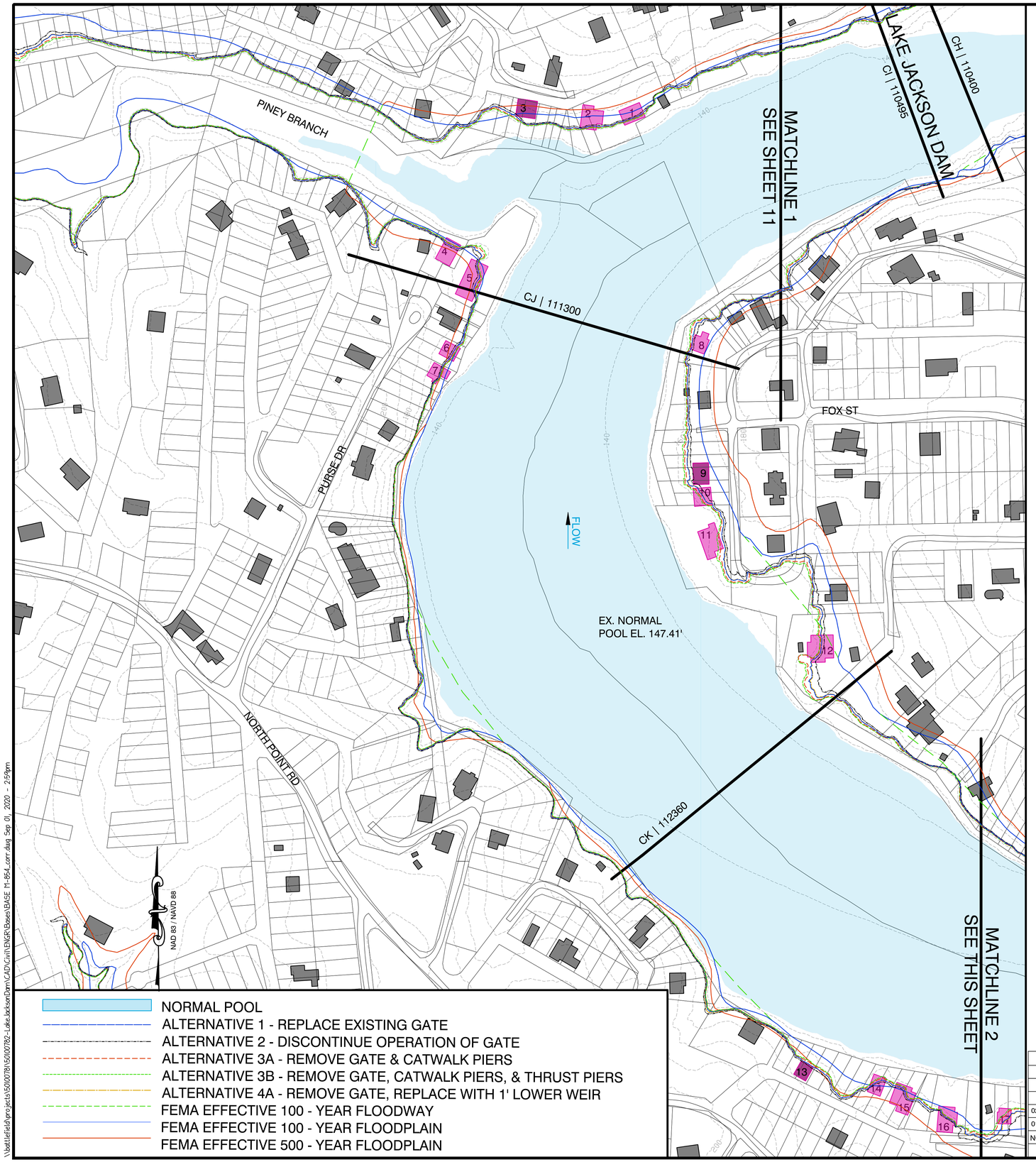
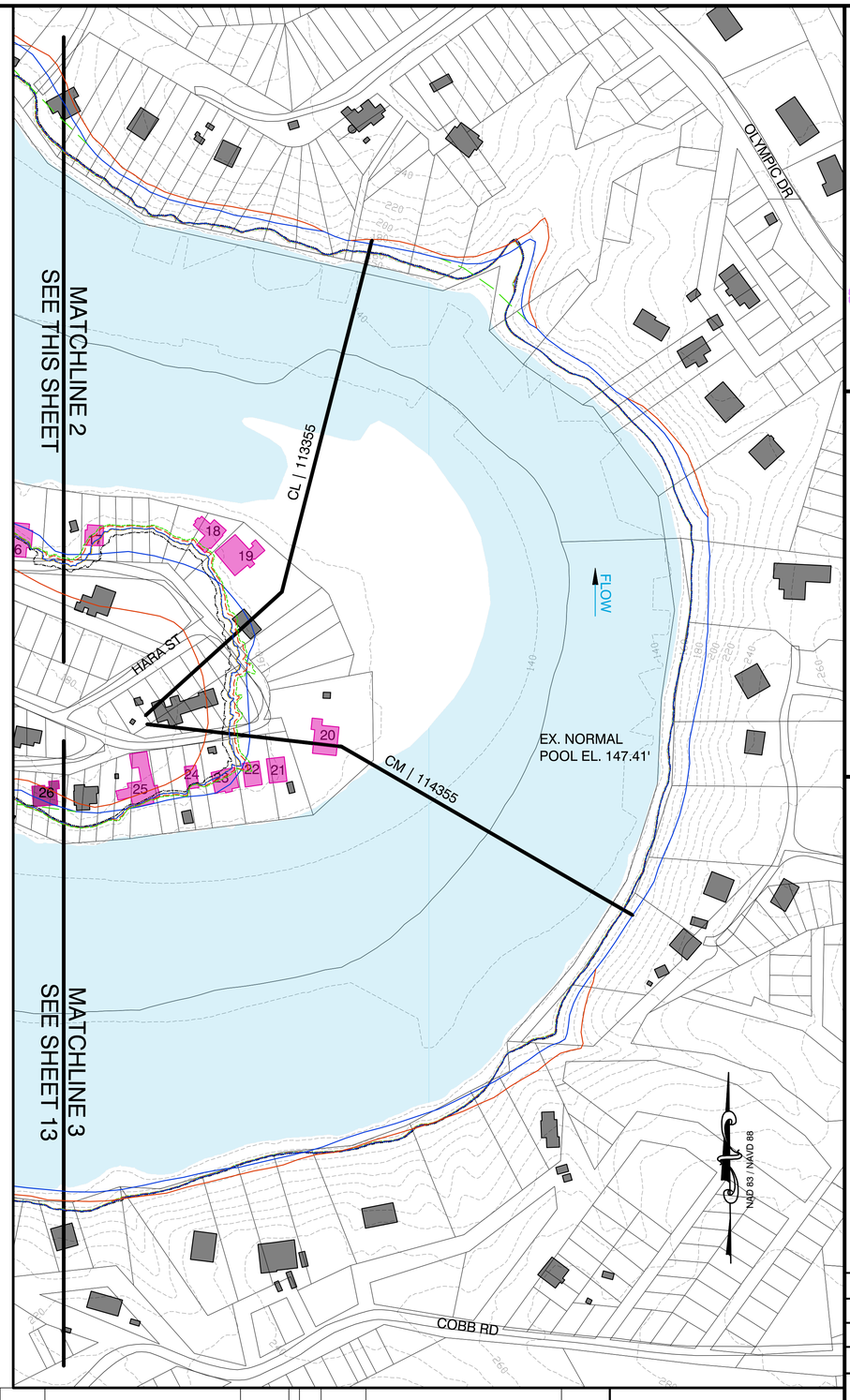
Checked By	
Date	01/23/2019
Scale	1" = 100'
Sheet	11 of 13
File Number	M-854





- NORMAL POOL
- ALTERNATIVE 1 - REPLACE EXISTING GATE
- ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
- ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
- ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
- ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR
- FEMA EFFECTIVE 100 - YEAR FLOODWAY
- FEMA EFFECTIVE 100 - YEAR FLOODPLAIN
- FEMA EFFECTIVE 500 - YEAR FLOODPLAIN

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100-YEAR STORM EVENT FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number	
Drawn By	
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Date	01/23/2019
Scale	1" = 100'
Sheet	12 Of 13
File Number	M-854

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NORMAL POOL
ALTERNATIVE 1 - REPLACE EXISTING GATE
ALTERNATIVE 2 - DISCONTINUE OPERATION OF GATE
ALTERNATIVE 3A - REMOVE GATE & CATWALK PIERS
ALTERNATIVE 3B - REMOVE GATE, CATWALK PIERS, & THRUST PIERS
ALTERNATIVE 4A - REMOVE GATE, REPLACE WITH 1' LOWER WEIR
FEMA EFFECTIVE 100 - YEAR FLOODWAY
FEMA EFFECTIVE 100 - YEAR FLOODPLAIN
FEMA EFFECTIVE 500 - YEAR FLOODPLAIN

ROBERT PL
BRUNGER ST
NORTH POINT RD
FLOW
CP | 117355
CO | 116855
CN | 115285
EX. NORMAL POOL EL. 147.41'
JACQUELINE AVE
MANNING RD
CQ | 117960
WATERSIDE DR
COBB RD
CR | 118875
COBB RD
MATCHLINE 3
SEE SHEET 12
NAD 83 / NAVD 88

30 29 28 27 26 35 34 31 32 33

NO.	DATE	DESCRIPTION	BY
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01	04/20/18	FIRST DRAFT	

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13575 HEATHCOTE BLVD.
SUITE 130
GAINESVILLE, VA 20155-6958
PHONE: 703.849.0471
FAX: 703.468.2212

100-YEAR STORM EVENT FLOOD INUNDATION LIMITS

LAKE JACKSON DAM
PRELIMINARY ENGINEERING STUDY OF SPILLWAY MODIFICATION ALTERNATIVES
Prince William County, Virginia

Plan Number	
Drawn By	
Designed By	
Checked By	
Date	01/23/2019
Scale	1" = 100'
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File Number	M-854

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Appendix E

Inundated Structures List

Table 1: Water surface elevations of impacted structures (RED numbers indicate water elevations above structure lowest adjacent grade; BLUE dash (–) shows water below structure).

MAP ID	GPIN	ADDRESS	OWNER*	SURVEYED OR (GIS APPROX) LOWEST ADJACENT GRADE (FT)	2-YR (APPROX. WSE, FT)					10-YR (APPROX. WSE, FT)					50-YR (APPROX. WSE, FT)					100-YR (APPROX. WSE, FT)				
					ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A
1	7894-21-5748	8379 HIGHVIEW ST MANASSAS, VA 20112	PERRY JODI E	(159)	–	–	–	–	–	–	–	–	–	–	159.30	160.50	159.30	159.10	159.80	161.30	162.00	160.80	160.50	161.40
2	7894-21-4945	8389 HIGHVIEW ST MANASSAS, VA 20112	CLARK RAYMOND RUSSELL & KATHERINE L SURV	(158.9)	–	–	–	–	–	–	–	–	–	–	159.30	160.50	159.40	159.10	159.90	161.40	162.10	160.90	160.60	161.40
3	7894-21-4045	8403 HIGHVIEW ST MANASSAS, VA 20112	[UNKNOWN]	(161.5)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	162.10	–	–	–
4	7894-21-2220	11581 PURSE DR MANASSAS, VA 20112	KOTECHA VINOD	(158.8)	–	–	–	–	–	–	–	–	–	–	159.50	160.60	159.50	159.20	160.00	161.50	162.20	161.00	160.70	161.60
5	7894-21-3217	11583 PURSE DR MANASSAS, VA 20112	MAROVELLI FORREST & ERIN R SURV	(159.4)	–	–	–	–	–	–	–	–	–	–	159.50	160.60	159.50	–	160.00	161.50	162.20	161.00	160.80	161.60
6	7894-21-2401	11595 PURSE DR MANASSAS, VA 20112	PIERCE WILLIAM & BERNADETT SURV	(159.6)	–	–	–	–	–	–	–	–	–	–	–	160.70	–	–	160.10	161.60	162.30	161.10	160.90	161.70
7	7894-20-2196	11599 PURSE DR MANASSAS, VA 20112	RAYFIELD STEVEN C	(157)	–	–	–	–	–	–	–	–	–	–	159.60	160.70	159.60	159.30	160.10	161.60	162.30	161.20	160.90	161.70
8	7894-21-7200	11610 TEMPLE LOOP MANASSAS, VA 20112	STALKER ROBERT J	(161.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	161.50	162.20	–	–	161.60
9	7894-20-7376	11640 TEMPLE LOOP MANASSAS, VA 20112	SQUIRES DONALD C & SHARRON W ET AL	(162.1)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	162.40	–	–	–
10	7894-20-7371	11650 TEMPLE LOOP MANASSAS, VA 20112	CANNON CRAIG W & CLAIRE E	(159)	–	–	–	–	–	–	–	–	–	–	159.70	160.80	159.70	159.50	160.20	161.80	162.50	161.30	161.00	161.90
11	7894-20-7363	11676 TEMPLE LOOP MANASSAS, VA 20112	BASSETT CHRISTY ANNE	155.97	–	–	–	–	–	–	156.90	156.00	–	156.30	159.70	160.90	159.70	159.50	160.30	161.80	162.50	161.30	161.10	161.90
12	7894-20-9941	8351 DEPOT PL MANASSAS, VA 20112	BITTINGER SAMUEL D 3RD & BETHANY A	(157.5)	–	–	–	–	–	–	–	–	–	–	159.90	161.00	160.00	159.70	160.40	162.10	162.70	161.60	161.30	162.10
13	7893-29-9462	8280 LAKE SHORE DR MANASSAS, VA 20112	TRAMONTE ROBERT C & LAURA M	(162.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	162.80	–	–	–
14	7893-39-0857	8258 LAKE SHORE DR MANASSAS, VA 20112	HENEGAR HAROLD H JR	(160.2)	–	–	–	–	–	–	–	–	–	–	–	161.10	–	–	160.60	162.20	162.80	161.70	161.50	162.30
15	7893-39-1655	8250 LAKE SHORE DR MANASSAS, VA 20112	KIM SONNY	(159.4)	–	–	–	–	–	–	–	–	–	–	160.10	161.10	160.10	159.80	160.60	162.20	162.80	161.70	161.50	162.30
16	7893-39-2451	8240 LAKE SHORE DR MANASSAS, VA 20112	FUGATE BRYON & TANYA FUGATE SURV	(157.3)	–	–	–	–	–	–	–	–	–	–	160.10	161.10	160.10	159.80	160.60	162.20	162.80	161.70	161.50	162.30
17	7893-39-3350	8220 LAKE SHORE DR MANASSAS, VA 20112	JONES STEPHEN O	(160.1)	–	–	–	–	–	–	–	–	–	–	–	161.10	–	–	160.60	162.20	162.80	161.70	161.50	162.30
18	7893-39-5148	8214 LAKE SHORE DR MANASSAS, VA 20112	JESSEL ESTHER L	155.8	–	–	–	–	–	–	157.10	156.20	156.00	156.50	160.10	161.10	160.10	159.80	160.60	162.20	162.80	161.70	161.50	162.30
19	7893-39-5742	8200 LAKE SHORE DR MANASSAS, VA 20112	FUW LLC	152.67	–	–	–	–	–	155.50	157.10	156.20	156.00	156.50	160.10	161.10	160.10	159.80	160.60	162.20	162.80	161.70	161.50	162.30
20	7893-39-6821	8151 NORTH POINT RD MANASSAS, VA 20112	BERGSTRESER LEE T & ELEANORA R	150.89	–	151.50	151.00	–	151.00	156.00	157.50	156.60	156.50	156.90	160.80	161.80	160.80	160.60	161.30	163.00	163.60	162.60	162.40	163.10
21	7893-39-6311	8159 NORTH POINT RD MANASSAS, VA 20112	BORDNER NANCY G & LYNNE A BEAHM	(157.7)	–	–	–	–	–	–	–	–	–	–	160.90	161.80	160.90	160.70	161.30	163.00	163.60	162.60	162.40	163.10
22	7893-39-5811	8161 NORTH POINT RD MANASSAS, VA 20112	BORDNER NANCY G & LYNNE A BEAHM	(160)	–	–	–	–	–	–	–	–	–	–	160.90	161.80	160.90	160.70	161.30	163.10	163.60	162.60	162.40	163.10

MAP ID	GPIN	ADDRESS	OWNER*	SURVEYED OR (GIS APPROX) LOWEST ADJACENT GRADE (FT)	2-YR (APPROX. WSE, FT)					10-YR (APPROX. WSE, FT)					50-YR (APPROX. WSE, FT)					100-YR (APPROX. WSE, FT)				
					ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A
23	7893-39-5310	8171 NORTH POINT RD MANASSAS, VA 20112	TEPPER MARTIN SAMUEL JR & BARBARA ANN	(160)	–	–	–	–	–	–	–	–	–	–	160.90	161.80	160.90	160.70	161.30	163.10	163.60	162.70	162.40	163.10
24	7893-39-5010	8181 NORTH POINT RD MANASSAS, VA 20112	TURNER WILLIAM P & JULIA E TURNER SURV	(160)	–	–	–	–	–	–	–	–	–	–	160.90	161.90	160.90	160.70	161.30	163.10	163.60	162.70	162.40	163.10
25	7893-39-4006	8191 NORTH POINT RD MANASSAS, VA 20112	VAN KIRK ROBERT	(160.9)	–	–	–	–	–	–	–	–	–	–	–	161.90	160.90	–	161.30	163.10	163.70	162.70	162.50	163.10
26	7893-39-2608	8201 ABBIE LN MANASSAS, VA 20112	KELLER JOSEPH F JR	(163.4)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	163.70	–	–	–
27	7893-39-0517	8247 ABBIE LN MANASSAS, VA 20112	FENLASON NORMAN & JANICE SURV	(159.3)	–	–	–	–	–	–	–	–	–	–	161.00	162.00	161.10	160.90	161.50	163.30	163.80	162.80	162.70	163.30
28	7893-29-9716	8255 SUNDERMAN PL MANASSAS, VA 20112	LILJENQUIST THOMAS R & ERIN N KILDAY T-C	154.78***	–	–	–	–	–	156.20	157.60	156.80	156.60	157.00	161.10	162.00	161.10	160.90	161.50	163.30	163.80	162.90	162.80	163.30
29	7893-29-6117	11851 MULLEN ST MANASSAS, VA 20112	CHARLES JOEL P & MARY ANNE SURV	(161.5)	–	–	–	–	–	–	–	–	–	–	–	162.00	–	–	–	163.20	163.80	162.90	162.80	163.30
30	7893-19-6748	8371 ROBERT PL MANASSAS, VA 20112	CASEY ASHTON E	(162.8)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	163.60	164.10	163.20	163.30	163.70
31	7893-08-8357	11891 MANNING RD MANASSAS, VA 20112	CORBLEY JAMES G & G A WEIS CORBLEY	155.83	–	–	–	–	–	157.10	158.30	157.60	157.50	157.80	162.40	163.20	162.40	162.20	162.80	164.70	165.20	164.40	164.20	164.70
32	7893-08-9240	11911 MANNING RD MANASSAS, VA 20112	WILSON JEFFREY A & ALVIN TRUESDALE SURV	157.08***	–	–	–	–	–	157.20	158.40	157.70	157.50	157.90	162.50	163.30	162.50	162.40	162.90	164.80	165.30	164.50	164.30	164.90
33	7893-08-8434	11999 MANNING RD MANASSAS, VA 20112	BEST LINDA & TERRI GULAN SURV	(161)	–	–	–	–	–	–	–	–	–	–	162.60	163.30	162.60	162.40	162.90	164.90	165.30	164.60	164.40	164.90
34	7893-28-0875	8448 JACQUELINE AVE MANASSAS, VA 20112	SUN MARGARET & HWA LUN LIU T-C	(159.8)	–	–	–	–	–	–	–	–	–	–	161.60	162.40	161.60	161.40	162.00	163.80	164.30	163.40	163.20	163.80
35	7893-18-6785	8400 JACQUELINE AVE MANASSAS, VA 20112	LINIHAN GARY & CONSTANCE SURV	156.78	–	–	–	–	–	–	157.60	156.80	–	157.10	161.10	162.00	161.10	160.90	161.50	163.20	163.80	162.90	162.60	163.30
DOWNSTREAM OF LAKE JACKSON																								
*36***	*7894-32-5147*	*11400 SAND BRIDGE CT MANASSAS, VA 20111*	*HINTOSH JEFFREY A*	(142.5)	–	–	–	–	–	142.90	142.90	142.90	142.90	142.90	150.30	150.30	150.30	150.30	150.30	153.30	153.30	153.30	153.30	153.30
*37***	*7894-32-4460*	*11380 SAND BRIDGE CT MANASSAS, VA 20111*	*GIBSON CURTIS A & BEVERLY J GIBSON*	*(150.1)*	–	–	–	–	–	–	–	–	–	–	150.30	150.30	150.30	150.30	150.30	153.40	153.40	153.40	153.40	153.40

****STRUCTURES LOCATED DOWNSTREAM OF DAM. NO CHANGES IN WSE WERE COMPUTED FOR THESE DOWNSTREAM STRUCTURES BECAUSE THE MODELING ASSUMPTIONS MADE FOR THIS STUDY DO NOT CONSIDER CHANGES IN RESERVOIR ATTENUATION EFFECTS BETWEEN THE VARIOUS SPILLWAY MODIFICATION ALTERNATIVES.**

***PWC GIS MAPPER AS OF DEC. 2018**

*****FROM FEMA FLOOD ELEVATION CERTIFICATE PROVIDED BY OWNER**

RED numbers (i.e. 150.3) indicate a water surface elevation over property lowest adjacent grade

BLUE dash (–) implies water surface elevations are below property lowest adjacent grade

Table 2: Water surface elevations on impacted structures (RED numbers indicate water elevations above structure lowest adjacent grade; BLUE shows water below structure).

MAP ID	GPIN	ADDRESS	OWNER*	SURVEYED OR (GIS APPROX) LOWEST ADJACENT GRADE (FT)	2-YR (APPROX. WSE, FT)					10-YR (APPROX. WSE, FT)					50-YR (APPROX. WSE, FT)					100-YR (APPROX. WSE, FT)				
					ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A
1	7894-21-5748	8379 HIGHVIEW ST MANASSAS, VA 20112	PERRY JODI E	(159)	149.66	151.34	150.83	150.75	150.90	155.12	156.75	155.81	155.62	156.14	159.30	160.47	159.31	159.05	159.83	161.31	162.00	160.80	160.53	161.38
2	7894-21-4945	8389 HIGHVIEW ST MANASSAS, VA 20112	CLARK RAYMOND RUSSELL & KATHERINE L SURV	(158.9)	149.66	151.34	150.83	150.75	150.90	155.14	156.77	155.83	155.64	156.15	159.34	160.50	159.35	159.09	159.87	161.36	162.05	160.85	160.58	161.43
3	7894-21-4045	8403 HIGHVIEW ST MANASSAS, VA 20112	[UNKNOWN]	(161.5)	149.66	151.34	150.83	150.75	150.90	155.16	156.78	155.85	155.66	156.17	159.37	160.53	159.38	159.13	159.90	161.40	162.08	160.89	160.61	161.47
4	7894-21-2220	11581 PURSE DR MANASSAS, VA 20112	KOTECHA VINOD	(158.8)	149.67	151.35	150.84	150.76	150.91	155.20	156.82	155.88	155.69	156.21	159.46	160.61	159.47	159.21	159.99	161.51	162.19	161.01	160.73	161.58
5	7894-21-3217	11583 PURSE DR MANASSAS, VA 20112	MAROVELLI FORREST & ERIN R SURV	(159.4)	149.67	151.35	150.84	150.76	150.91	155.21	156.82	155.89	155.70	156.21	159.47	160.62	159.48	159.22	160.00	161.52	162.20	161.02	160.75	161.59
6	7894-21-2401	11595 PURSE DR MANASSAS, VA 20112	PIERCE WILLIAM & BERNADETT SURV	(159.6)	149.67	151.35	150.84	150.76	150.91	155.25	156.86	155.93	155.74	156.25	159.56	160.70	159.57	159.32	160.08	161.63	162.30	161.13	160.86	161.70
7	7894-20-2196	11599 PURSE DR MANASSAS, VA 20112	RAYFIELD STEVEN C	(157)	149.68	151.35	150.84	150.76	150.91	155.26	156.87	155.94	155.75	156.26	159.57	160.71	159.58	159.33	160.10	161.64	162.32	161.15	160.88	161.71
8	7894-21-7200	11610 TEMPLE LOOP MANASSAS, VA 20112	STALKER ROBERT J	(161.1)	149.67	151.35	150.84	150.76	150.91	155.22	156.83	155.90	155.71	156.22	159.48	160.63	159.49	159.24	160.01	161.54	162.22	161.04	160.77	161.61
9	7894-20-7376	11640 TEMPLE LOOP MANASSAS, VA 20112	SQUIRES DONALD C & SHARRON W ET AL	(162.1)	149.68	151.36	150.85	150.77	150.92	155.31	156.91	155.98	155.80	156.30	159.67	160.80	159.68	159.43	160.19	161.76	162.42	161.26	161.00	161.82
10	7894-20-7371	11650 TEMPLE LOOP MANASSAS, VA 20112	CANNON CRAIG W & CLAIRE E	(159)	149.69	151.36	150.85	150.77	150.92	155.33	156.92	156.00	155.81	156.31	159.70	160.82	159.71	159.46	160.22	161.79	162.45	161.30	161.03	161.86
11	7894-20-7363	11676 TEMPLE LOOP MANASSAS, VA 20112	BASSETT CHRISTY ANNE	155.97	149.69	151.36	150.85	150.77	150.92	155.34	156.94	156.01	155.83	156.33	159.73	160.85	159.74	159.50	160.25	161.83	162.49	161.34	161.08	161.89
12	7894-20-9941	8351 DEPOT PL MANASSAS, VA 20112	BITTINGER SAMUEL D 3RD & BETHANY A	(157.5)	149.70	151.37	150.86	150.78	150.93	155.45	157.02	156.11	155.93	156.42	159.94	161.03	159.95	159.70	160.44	162.06	162.70	161.59	161.32	162.12
13	7893-29-9462	8280 LAKE SHORE DR MANASSAS, VA 20112	TRAMONTE ROBERT C & LAURA M	(162.4)	149.71	151.38	150.87	150.79	150.94	155.52	157.08	156.17	155.99	156.48	160.05	161.13	160.06	159.82	160.54	162.19	162.82	161.72	161.46	162.25
14	7893-39-0857	8258 LAKE SHORE DR MANASSAS, VA 20112	HENEGAR HAROLD H JR	(160.2)	149.72	151.39	150.88	150.80	150.95	155.52	157.08	156.17	156.00	156.49	160.05	161.13	160.06	159.83	160.55	162.19	162.82	161.72	161.47	162.25
15	7893-39-1655	8250 LAKE SHORE DR MANASSAS, VA 20112	KIM SONNY	(159.4)	149.72	151.39	150.88	150.80	150.95	155.53	157.08	156.17	156.00	156.49	160.05	161.13	160.06	159.83	160.55	162.19	162.82	161.72	161.47	162.25
16	7893-39-2451	8240 LAKE SHORE DR MANASSAS, VA 20112	FUGATE BRYON & TANYA FUGATE SURV	(157.3)	149.72	151.39	150.88	150.80	150.95	155.53	157.08	156.17	156.00	156.49	160.05	161.13	160.06	159.83	160.55	162.19	162.82	161.72	161.47	162.25
17	7893-39-3350	8220 LAKE SHORE DR MANASSAS, VA 20112	JONES STEPHEN O	(160.1)	149.72	151.39	150.88	150.80	150.95	155.53	157.09	156.18	156.00	156.49	160.06	161.14	160.07	159.83	160.55	162.20	162.83	161.73	161.47	162.26
18	7893-39-5148	8214 LAKE SHORE DR MANASSAS, VA 20112	JESSEL ESTHER L	155.8	149.72	151.39	150.88	150.80	150.95	155.54	157.09	156.18	156.01	156.50	160.06	161.14	160.07	159.84	160.55	162.20	162.83	161.73	161.48	162.26
19	7893-39-5742	8200 LAKE SHORE DR MANASSAS, VA 20112	FUW LLC	152.67	149.72	151.39	150.88	150.80	150.95	155.54	157.09	156.18	156.01	156.50	160.06	161.14	160.07	159.84	160.55	162.20	162.83	161.73	161.48	162.26
20	7893-39-6821	8151 NORTH POINT RD MANASSAS, VA 20112	BERGSTRESER LEE T & ELEANORA R	150.89	149.81	151.45	150.95	150.87	151.02	156.02	157.47	156.62	156.46	156.91	160.83	161.81	160.84	160.63	161.28	163.02	163.59	162.61	162.38	163.08
21	7893-39-6311	8159 NORTH POINT RD MANASSAS, VA 20112	BORDNER NANCY G & LYNNE A BEAHM	(157.7)	149.81	151.45	150.95	150.87	151.02	156.04	157.48	156.63	156.47	156.92	160.86	161.83	160.87	160.66	161.30	163.04	163.61	162.63	162.40	163.10

MAP ID	GPIN	ADDRESS	OWNER*	SURVEYED OR (GIS APPROX) LOWEST ADJACENT GRADE (FT)	2-YR (APPROX. WSE, FT)					10-YR (APPROX. WSE, FT)					50-YR (APPROX. WSE, FT)					100-YR (APPROX. WSE, FT)				
					ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A
22	7893-39-5811	8161 NORTH POINT RD MANASSAS, VA 20112	BORDNER NANCY G & LYNNE A BEAHM	(160)	149.81	151.45	150.95	150.87	151.02	156.04	157.49	156.64	156.48	156.93	160.86	161.84	160.87	160.66	161.31	163.05	163.62	162.64	162.41	163.11
23	7893-39-5310	8171 NORTH POINT RD MANASSAS, VA 20112	TEPPER MARTIN SAMUEL JR & BARBARA ANN	(160)	149.81	151.45	150.95	150.87	151.02	156.04	157.49	156.64	156.48	156.93	160.87	161.84	160.88	160.67	161.31	163.06	163.62	162.65	162.42	163.12
24	7893-39-5010	8181 NORTH POINT RD MANASSAS, VA 20112	TURNER WILLIAM P & JULIA E TURNER SURV	(160)	149.81	151.45	150.95	150.87	151.02	156.05	157.49	156.65	156.49	156.94	160.87	161.85	160.88	160.67	161.32	163.07	163.63	162.66	162.43	163.13
25	7893-39-4006	8191 NORTH POINT RD MANASSAS, VA 20112	VAN KIRK ROBERT	(160.9)	149.82	151.46	150.96	150.88	151.03	156.06	157.50	156.65	156.49	156.94	160.89	161.86	160.90	160.69	161.34	163.09	163.65	162.68	162.45	163.14
26	7893-39-2608	8201 ABBIE LN MANASSAS, VA 20112	KELLER JOSEPH F JR	(163.4)	149.82	151.46	150.96	150.88	151.03	156.09	157.52	156.68	156.52	156.97	160.94	161.91	160.95	160.74	161.38	163.14	163.70	162.73	162.51	163.20
27	7893-39-0517	8247 ABBIE LN MANASSAS, VA 20112	FENLASON NORMAN & JANICE SURV	(159.3)	149.84	151.47	150.97	150.89	151.04	156.16	157.58	156.75	156.59	157.04	161.04	161.99	161.05	160.85	161.47	163.25	163.80	162.84	162.71	163.30
28	7893-29-9716	8255 SUNDERMAN PL MANASSAS, VA 20112	LILJENQUIST THOMAS R & ERIN N KILDAY T-C	154.78***	149.84	151.47	150.98	150.90	151.04	156.17	157.58	156.76	156.60	157.04	161.05	161.99	161.06	160.85	161.48	163.25	163.80	162.85	162.75	163.30
29	7893-29-6117	11851 MULLEN ST MANASSAS, VA 20112	CHARLES JOEL P & MARY ANNE SURV	(161.5)	149.85	151.48	150.99	150.91	151.05	156.20	157.60	156.78	156.62	157.07	161.06	162.00	161.07	160.86	161.49	163.24	163.79	162.88	162.75	163.29
30	7893-19-6748	8371 ROBERT PL MANASSAS, VA 20112	CASEY ASHTON E	(162.8)	149.91	151.52	151.03	150.95	151.09	156.45	157.80	157.01	156.85	157.28	161.40	162.30	161.41	161.22	161.81	163.60	164.12	163.22	163.26	163.65
31	7893-08-8357	11891 MANNING RD MANASSAS, VA 20112	CORBLEY JAMES G & G A WEIS CORBLEY	155.83	150.05	151.62	151.14	151.06	151.21	157.09	158.32	157.59	157.45	157.84	162.41	163.19	162.41	162.24	162.76	164.70	165.15	164.37	164.20	164.74
32	7893-08-9240	11911 MANNING RD MANASSAS, VA 20112	WILSON JEFFREY A & ALVIN TRUESDALE SURV	157.08***	150.07	151.63	151.15	151.07	151.22	157.17	158.38	157.66	157.53	157.91	162.53	163.30	162.53	162.36	162.88	164.84	165.28	164.51	164.34	164.88
33	7893-08-8434	11999 MANNING RD MANASSAS, VA 20112	BEST LINDA & TERRI GULAN SURV	(161)	150.08	151.64	151.16	151.08	151.23	157.20	158.41	157.69	157.55	157.94	162.58	163.34	162.58	162.41	162.92	164.88	165.32	164.56	164.39	164.92
34	7893-28-0875	8448 JACQUELINE AVE MANASSAS, VA 20112	SUN MARGARET & HWA LUN LIU T-C	(159.8)	149.93	151.53	151.04	150.97	151.11	156.54	157.87	157.09	156.94	157.36	161.55	162.43	161.56	161.37	161.95	163.76	164.27	163.39	163.19	163.81
35	7893-18-6785	8400 JACQUELINE AVE MANASSAS, VA 20112	LINIHAN GARY & CONSTANCE SURV	156.78	149.86	151.49	151.00	150.92	151.06	156.23	157.62	156.81	156.65	157.09	161.07	162.00	161.08	160.87	161.50	163.24	163.78	162.86	162.63	163.29
DOWNSTREAM OF LAKE JACKSON																								
*36**	*7894-32-5147*	*11400 SAND BRIDGE CT MANASSAS, VA 20111*	*HINTOSH JEFFREY A*	(142.5)	131.88	131.88	131.88	131.88	131.88	142.90	142.90	142.90	142.90	142.90	150.28	150.28	150.28	150.28	150.28	153.32	153.32	153.32	153.32	153.32
*37**	*7894-32-4460*	*11380 SAND BRIDGE CT MANASSAS, VA 20111*	*GIBSON CURTIS A & BEVERLY J GIBSON*	*(150.1)*	131.90	131.90	131.90	131.90	131.90	142.93	142.93	142.93	142.93	142.93	150.32	150.32	150.32	150.32	150.32	153.35	153.35	153.35	153.35	153.35

**STRUCTURES LOCATED DOWNSTREAM OF DAM. NO CHANGES IN WSE WERE COMPUTED FOR THESE DOWNSTREAM STRUCTURES BECAUSE THE MODELING ASSUMPTIONS MADE FOR THIS STUDY DO NOT CONSIDER CHANGES IN RESERVOIR ATTENUATION EFFECTS BETWEEN THE VARIOUS SPILLWAY MODIFICATION ALTERNATIVES.

*PWC GIS MAPPER AS OF DEC. 2018

***FROM FEMA FLOOD ELEVATION CERTIFICATE PROVIDED BY OWNER

RED numbers (i.e. 150.3) implies water surface elevation over structure lowest adjacent grade

BLUE numbers (i.e. 150.3) implies water surface elevation below structure lowest adjacent grade

Table 3: Difference of water surface elevation and structure lowest adjacent grade (RED numbers indicate water elevations above structure lowest adjacent grade; BLUE shows water below grade).

MAP ID	GPIN	ADDRESS	OWNER*	SURVEYED OR (GIS APPROX) LOWEST ADJACENT GRADE (FT)	2-YR (APPROX. WSE, FT)					10-YR (APPROX. WSE, FT)					50-YR (APPROX. WSE, FT)					100-YR (APPROX. WSE, FT)				
					ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A
1	7894-21-5748	8379 HIGHVIEW ST MANASSAS, VA 20112	PERRY JODI E	(159)	-9.34	-7.66	-8.17	-8.25	-8.10	-3.88	-2.25	-3.19	-3.38	-2.86	0.30	1.47	0.31	0.05	0.83	2.31	3.00	1.80	1.53	2.38
2	7894-21-4945	8389 HIGHVIEW ST MANASSAS, VA 20112	CLARK RAYMOND RUSSELL & KATHERINE L SURV	(158.9)	-9.24	-7.56	-8.07	-8.15	-8.00	-3.76	-2.13	-3.07	-3.26	-2.75	0.44	1.60	0.45	0.19	0.97	2.46	3.15	1.95	1.68	2.53
3	7894-21-4045	8403 HIGHVIEW ST MANASSAS, VA 20112	[UNKNOWN]	(161.5)	-11.84	-10.16	-10.67	-10.75	-10.60	-6.34	-4.72	-5.65	-5.84	-5.33	-2.13	-0.97	-2.12	-2.37	-1.60	-0.10	0.58	-0.61	-0.89	-0.03
4	7894-21-2220	11581 PURSE DR MANASSAS, VA 20112	KOTECHA VINOD	(158.8)	-9.13	-7.45	-7.96	-8.04	-7.89	-3.60	-1.98	-2.92	-3.11	-2.59	0.66	1.81	0.67	0.41	1.19	2.71	3.39	2.21	1.93	2.78
5	7894-21-3217	11583 PURSE DR MANASSAS, VA 20112	MAROVELLI FORREST & ERIN R SURV	(159.4)	-9.73	-8.05	-8.56	-8.64	-8.49	-4.19	-2.58	-3.51	-3.70	-3.19	0.07	1.22	0.08	-0.18	0.60	2.12	2.80	1.62	1.35	2.19
6	7894-21-2401	11595 PURSE DR MANASSAS, VA 20112	PIERCE WILLIAM & BERNADETT SURV	(159.6)	-9.93	-8.25	-8.76	-8.84	-8.69	-4.35	-2.74	-3.67	-3.86	-3.35	-0.04	1.10	-0.03	-0.28	0.48	2.03	2.70	1.53	1.26	2.10
7	7894-20-2196	11599 PURSE DR MANASSAS, VA 20112	RAYFIELD STEVEN C	(157)	-7.32	-5.65	-6.16	-6.24	-6.09	-1.74	-0.13	-1.06	-1.25	-0.74	2.57	3.71	2.58	2.33	3.10	4.64	5.32	4.15	3.88	4.71
8	7894-21-7200	11610 TEMPLE LOOP MANASSAS, VA 20112	STALKER ROBERT J	(161.1)	-11.43	-9.75	-10.26	-10.34	-10.19	-5.88	-4.27	-5.20	-5.39	-4.88	-1.62	-0.47	-1.61	-1.86	-1.09	0.44	1.12	-0.06	-0.33	0.51
9	7894-20-7376	11640 TEMPLE LOOP MANASSAS, VA 20112	SQUIRES DONALD C & SHARRON W ET AL	(162.1)	-12.42	-10.74	-11.25	-11.33	-11.18	-6.79	-5.19	-6.12	-6.30	-5.80	-2.43	-1.30	-2.42	-2.67	-1.91	-0.34	0.32	-0.84	-1.10	-0.28
10	7894-20-7371	11650 TEMPLE LOOP MANASSAS, VA 20112	CANNON CRAIG W & CLAIRE E	(159)	-9.31	-7.64	-8.15	-8.23	-8.08	-3.67	-2.08	-3.00	-3.19	-2.69	0.70	1.82	0.71	0.46	1.22	2.79	3.45	2.30	2.03	2.86
11	7894-20-7363	11676 TEMPLE LOOP MANASSAS, VA 20112	BASSETT CHRISTY ANNE	155.97	-6.28	-4.61	-5.12	-5.20	-5.05	-0.63	0.97	0.04	-0.14	0.36	3.76	4.88	3.77	3.53	4.28	5.86	6.52	5.37	5.11	5.92
12	7894-20-9941	8351 DEPOT PL MANASSAS, VA 20112	BITTINGER SAMUEL D 3RD & BETHANY A	(157.5)	-7.80	-6.13	-6.64	-6.72	-6.57	-2.05	-0.48	-1.39	-1.57	-1.08	2.44	3.53	2.45	2.20	2.94	4.56	5.20	4.09	3.82	4.62
13	7893-29-9462	8280 LAKE SHORE DR MANASSAS, VA 20112	TRAMONTE ROBERT C & LAURA M	(162.4)	-12.69	-11.02	-11.53	-11.61	-11.46	-6.88	-5.32	-6.23	-6.41	-5.92	-2.35	-1.27	-2.34	-2.58	-1.86	-0.21	0.42	-0.68	-0.94	-0.15
14	7893-39-0857	8258 LAKE SHORE DR MANASSAS, VA 20112	HENEGAR HAROLD H JR	(160.2)	-10.48	-8.81	-9.32	-9.40	-9.25	-4.68	-3.12	-4.03	-4.20	-3.71	-0.15	0.93	-0.14	-0.37	0.35	1.99	2.62	1.52	1.27	2.05
15	7893-39-1655	8250 LAKE SHORE DR MANASSAS, VA 20112	KIM SONNY	(159.4)	-9.68	-8.01	-8.52	-8.60	-8.45	-3.87	-2.32	-3.23	-3.40	-2.91	0.65	1.73	0.66	0.43	1.15	2.79	3.42	2.32	2.07	2.85
16	7893-39-2451	8240 LAKE SHORE DR MANASSAS, VA 20112	FUGATE BRYON & TANYA FUGATE SURV	(157.3)	-7.58	-5.91	-6.42	-6.50	-6.35	-1.77	-0.22	-1.13	-1.30	-0.81	2.75	3.83	2.76	2.53	3.25	4.89	5.52	4.42	4.17	4.95
17	7893-39-3350	8220 LAKE SHORE DR MANASSAS, VA 20112	JONES STEPHEN O	(160.1)	-10.38	-8.71	-9.22	-9.30	-9.15	-4.57	-3.01	-3.92	-4.10	-3.61	-0.04	1.04	-0.03	-0.27	0.45	2.10	2.73	1.63	1.37	2.16
18	7893-39-5148	8214 LAKE SHORE DR MANASSAS, VA 20112	JESSEL ESTHER L	155.8	-6.08	-4.41	-4.92	-5.00	-4.85	-0.26	1.29	0.38	0.21	0.70	4.26	5.34	4.27	4.04	4.75	6.40	7.03	5.93	5.68	6.46
19	7893-39-5742	8200 LAKE SHORE DR MANASSAS, VA 20112	FUW LLC	152.67	-2.95	-1.28	-1.79	-1.87	-1.72	2.87	4.42	3.51	3.34	3.83	7.39	8.47	7.40	7.17	7.88	9.53	10.16	9.06	8.81	9.59
20	7893-39-6821	8151 NORTH POINT RD MANASSAS, VA 20112	BERGSTRESER LEE T & ELEANORA R	150.89	-1.08	0.56	0.06	-0.02	0.13	5.13	6.58	5.73	5.57	6.02	9.94	10.92	9.95	9.74	10.39	12.13	12.70	11.72	11.49	12.19
21	7893-39-6311	8159 NORTH POINT RD MANASSAS, VA 20112	BORDNER NANCY G & LYNNE A BEAHM	(157.7)	-7.89	-6.25	-6.75	-6.83	-6.68	-1.66	-0.22	-1.07	-1.23	-0.78	3.16	4.13	3.17	2.96	3.60	5.34	5.91	4.93	4.70	5.40
22	7893-39-5811	8161 NORTH POINT RD MANASSAS, VA 20112	BORDNER NANCY G & LYNNE A BEAHM	(160)	-10.19	-8.55	-9.05	-9.13	-8.98	-3.96	-2.51	-3.36	-3.52	-3.07	0.86	1.84	0.87	0.66	1.31	3.05	3.62	2.64	2.41	3.11

MAP ID	GPIN	ADDRESS	OWNER*	SURVEYED OR (GIS APPROX) LOWEST ADJACENT GRADE (FT)	2-YR (APPROX. WSE, FT)					10-YR (APPROX. WSE, FT)					50-YR (APPROX. WSE, FT)					100-YR (APPROX. WSE, FT)				
					ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A	ALT 1	ALT 2	ALT 3A	ALT 3B	ALT 4A
23	7893-39-5310	8171 NORTH POINT RD MANASSAS, VA 20112	TEPPER MARTIN SAMUEL JR & BARBARA ANN	(160)	-10.19	-8.55	-9.05	-9.13	-8.98	-3.96	-2.51	-3.36	-3.52	-3.07	0.87	1.84	0.88	0.67	1.31	3.06	3.62	2.65	2.42	3.12
24	7893-39-5010	8181 NORTH POINT RD MANASSAS, VA 20112	TURNER WILLIAM P & JULIA E TURNER SURV	(160)	-10.19	-8.55	-9.05	-9.13	-8.98	-3.95	-2.51	-3.35	-3.51	-3.06	0.87	1.85	0.88	0.67	1.32	3.07	3.63	2.66	2.43	3.13
25	7893-39-4006	8191 NORTH POINT RD MANASSAS, VA 20112	VAN KIRK ROBERT	(160.9)	-11.08	-9.44	-9.94	-10.02	-9.87	-4.84	-3.40	-4.25	-4.41	-3.96	-0.01	0.96	0.00	-0.21	0.44	2.19	2.75	1.78	1.55	2.24
26	7893-39-2608	8201 ABBIE LN MANASSAS, VA 20112	KELLER JOSEPH F JR	(163.4)	-13.58	-11.94	-12.44	-12.52	-12.37	-7.31	-5.88	-6.72	-6.88	-6.43	-2.46	-1.49	-2.45	-2.66	-2.02	-0.26	0.30	-0.67	-0.89	-0.20
27	7893-39-0517	8247 ABBIE LN MANASSAS, VA 20112	FENLASON NORMAN & JANICE SURV	(159.3)	-9.46	-7.83	-8.33	-8.41	-8.26	-3.14	-1.72	-2.55	-2.71	-2.26	1.74	2.69	1.75	1.55	2.17	3.95	4.50	3.54	3.41	4.00
28	7893-29-9716	8255 SUNDERMAN PL MANASSAS, VA 20112	LILJENQUIST THOMAS R & ERIN N KILDAY T-C	154.78***	-4.94	-3.31	-3.80	-3.88	-3.74	1.39	2.80	1.98	1.82	2.26	6.27	7.21	6.28	6.07	6.70	8.47	9.02	8.07	7.97	8.52
29	7893-29-6117	11851 MULLEN ST MANASSAS, VA 20112	CHARLES JOEL P & MARY ANNE SURV	(161.5)	-11.65	-10.02	-10.51	-10.59	-10.45	-5.30	-3.90	-4.72	-4.88	-4.43	-0.44	0.50	-0.43	-0.64	-0.01	1.74	2.29	1.38	1.25	1.79
30	7893-19-6748	8371 ROBERT PL MANASSAS, VA 20112	CASEY ASHTON E	(162.8)	-12.89	-11.28	-11.77	-11.85	-11.71	-6.35	-5.00	-5.79	-5.95	-5.52	-1.40	-0.50	-1.39	-1.58	-0.99	0.80	1.32	0.42	0.46	0.85
31	7893-08-8357	11891 MANNING RD MANASSAS, VA 20112	CORBLEY JAMES G & G A WEIS CORBLEY	155.83	-5.78	-4.21	-4.69	-4.77	-4.62	1.26	2.49	1.76	1.62	2.01	6.58	7.36	6.58	6.41	6.93	8.87	9.32	8.54	8.37	8.91
32	7893-08-9240	11911 MANNING RD MANASSAS, VA 20112	WILSON JEFFREY A & ALVIN TRUESDALE SURV	157.08***	-7.01	-5.45	-5.93	-6.01	-5.86	0.09	1.30	0.58	0.45	0.83	5.45	6.22	5.45	5.28	5.80	7.76	8.20	7.43	7.26	7.80
33	7893-08-8434	11999 MANNING RD MANASSAS, VA 20112	BEST LINDA & TERRI GULAN SURV	(161)	-10.92	-9.36	-9.84	-9.92	-9.77	-3.80	-2.59	-3.31	-3.45	-3.06	1.58	2.34	1.58	1.41	1.92	3.88	4.32	3.56	3.39	3.92
34	7893-28-0875	8448 JACQUELINE AVE MANASSAS, VA 20112	SUN MARGARET & HWA LUN LIU T-C	(159.8)	-9.87	-8.27	-8.76	-8.83	-8.69	-3.26	-1.93	-2.71	-2.86	-2.44	1.75	2.63	1.76	1.57	2.15	3.96	4.47	3.59	3.39	4.01
35	7893-18-6785	8400 JACQUELINE AVE MANASSAS, VA 20112	LINIHAN GARY & CONSTANCE SURV	156.78	-6.92	-5.29	-5.78	-5.86	-5.72	-0.55	0.84	0.03	-0.13	0.31	4.29	5.22	4.30	4.09	4.72	6.46	7.00	6.08	5.85	6.51
DOWNSTREAM OF LAKE JACKSON																								
*36**	*7894-32-5147*	*11400 SAND BRIDGE CT MANASSAS, VA 20111*	*HINTOSH JEFFREY A*	(142.5)	-10.62	-10.62	-10.62	-10.62	-10.62	0.40	0.40	0.40	0.40	0.40	7.78	7.78	7.78	7.78	7.78	10.82	10.82	10.82	10.82	10.82
*37**	*7894-32-4460*	*11380 SAND BRIDGE CT MANASSAS, VA 20111*	*GIBSON CURTIS A & BEVERLY J GIBSON*	*(150.1)*	-18.20	-18.20	-18.20	-18.20	-18.20	-7.17	-7.17	-7.17	-7.17	-7.17	0.22	0.22	0.22	0.22	0.22	3.25	3.25	3.25	3.25	3.25

****STRUCTURES LOCATED DOWNSTREAM OF DAM. NO CHANGES IN WSE WERE COMPUTED FOR THESE DOWNSTREAM STRUCTURES BECAUSE THE MODELING ASSUMPTIONS MADE FOR THIS STUDY DO NOT CONSIDER CHANGES IN RESERVOIR ATTENUATION EFFECTS BETWEEN THE VARIOUS SPILLWAY MODIFICATION ALTERNATIVES.**

***PWC GIS MAPPER AS OF DEC. 2018**

*****FROM FEMA FLOOD ELEVATION CERTIFICATE PROVIDED BY OWNER**

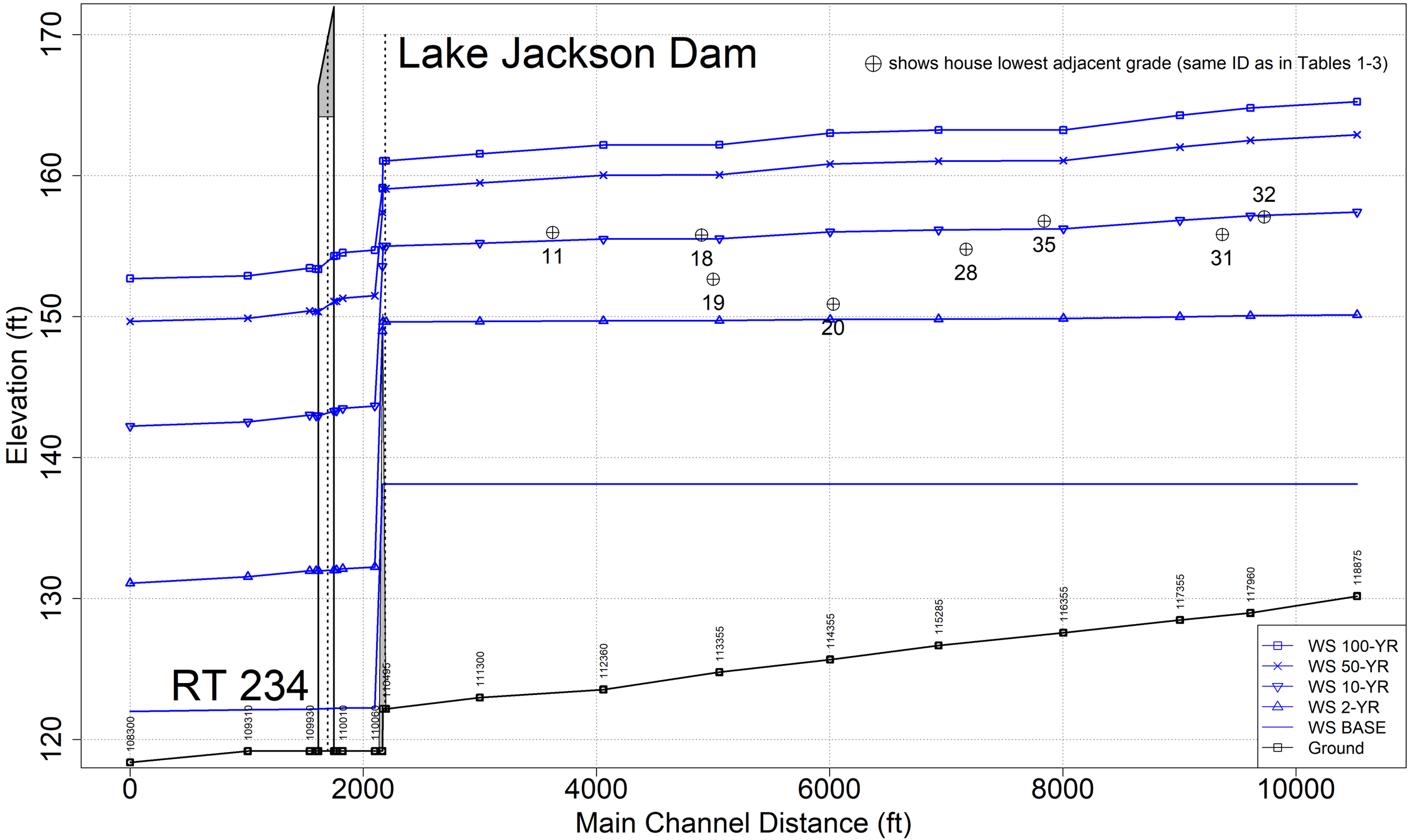
RED numbers (i.e. -0.2 implies water surface elevation over structure lowest adjacent grade

BLUE numbers (i.e. -0.2) implies water surface elevation below structure lowest adjacent grade

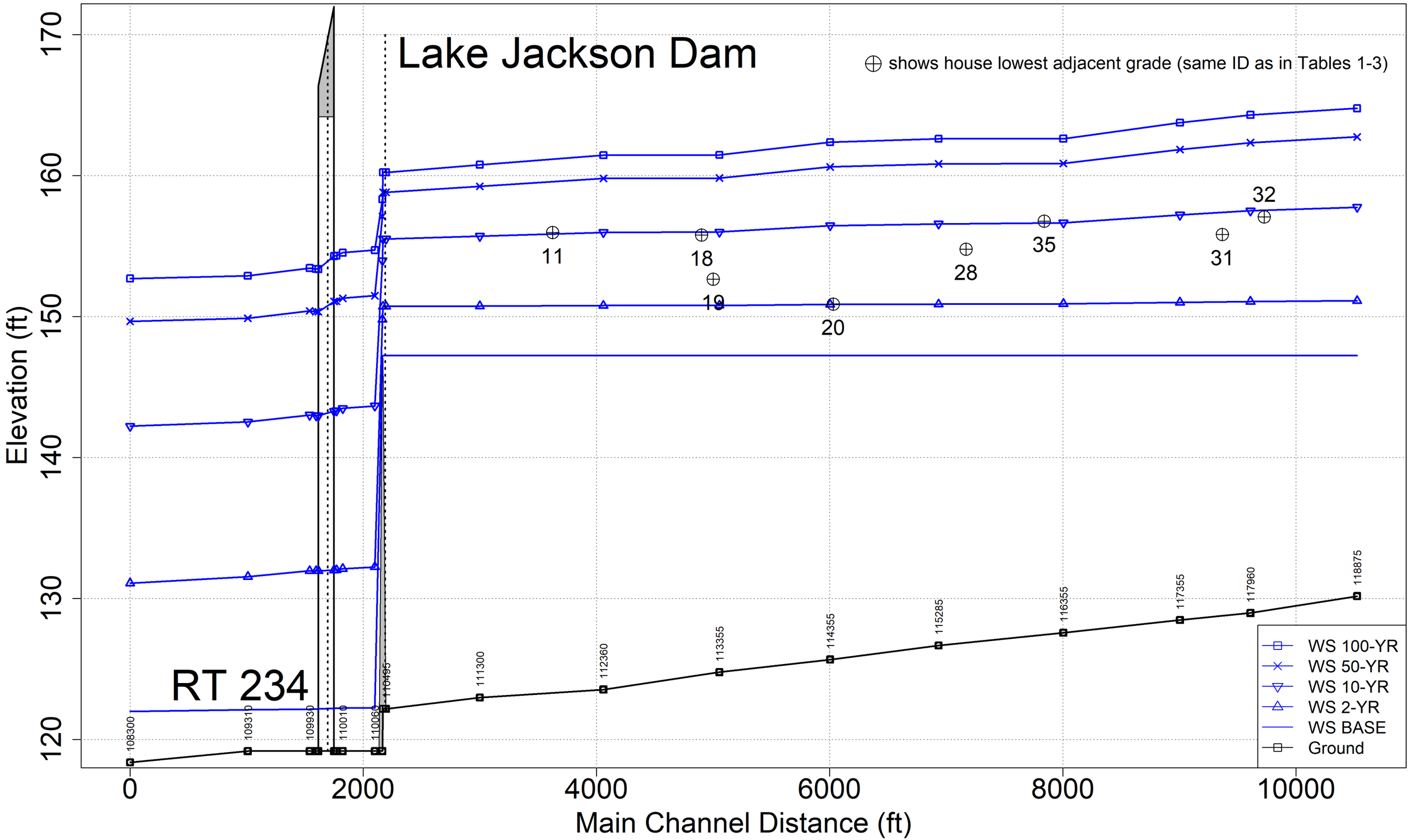
Appendix F

Inundation Profiles

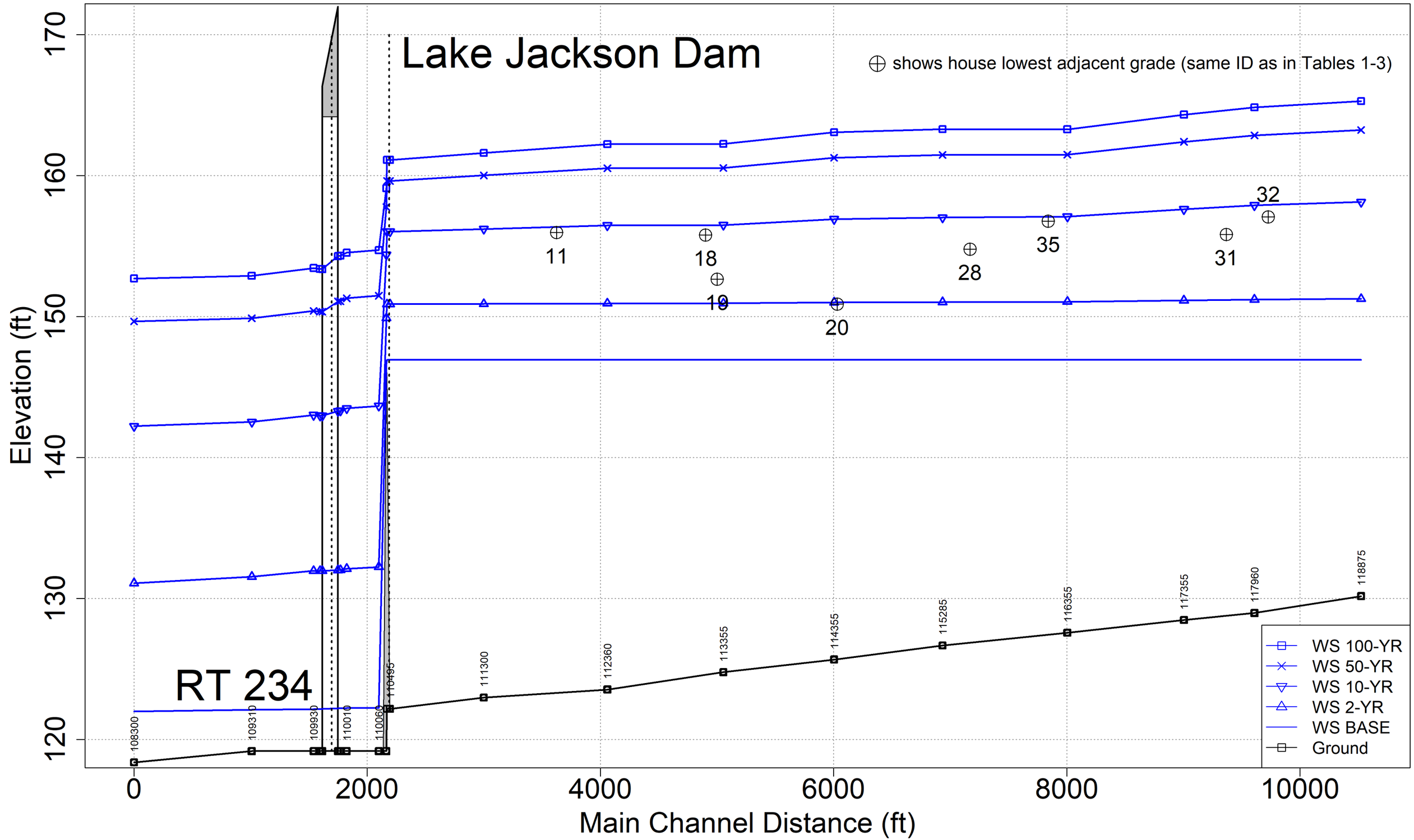
Alt 1 Profile



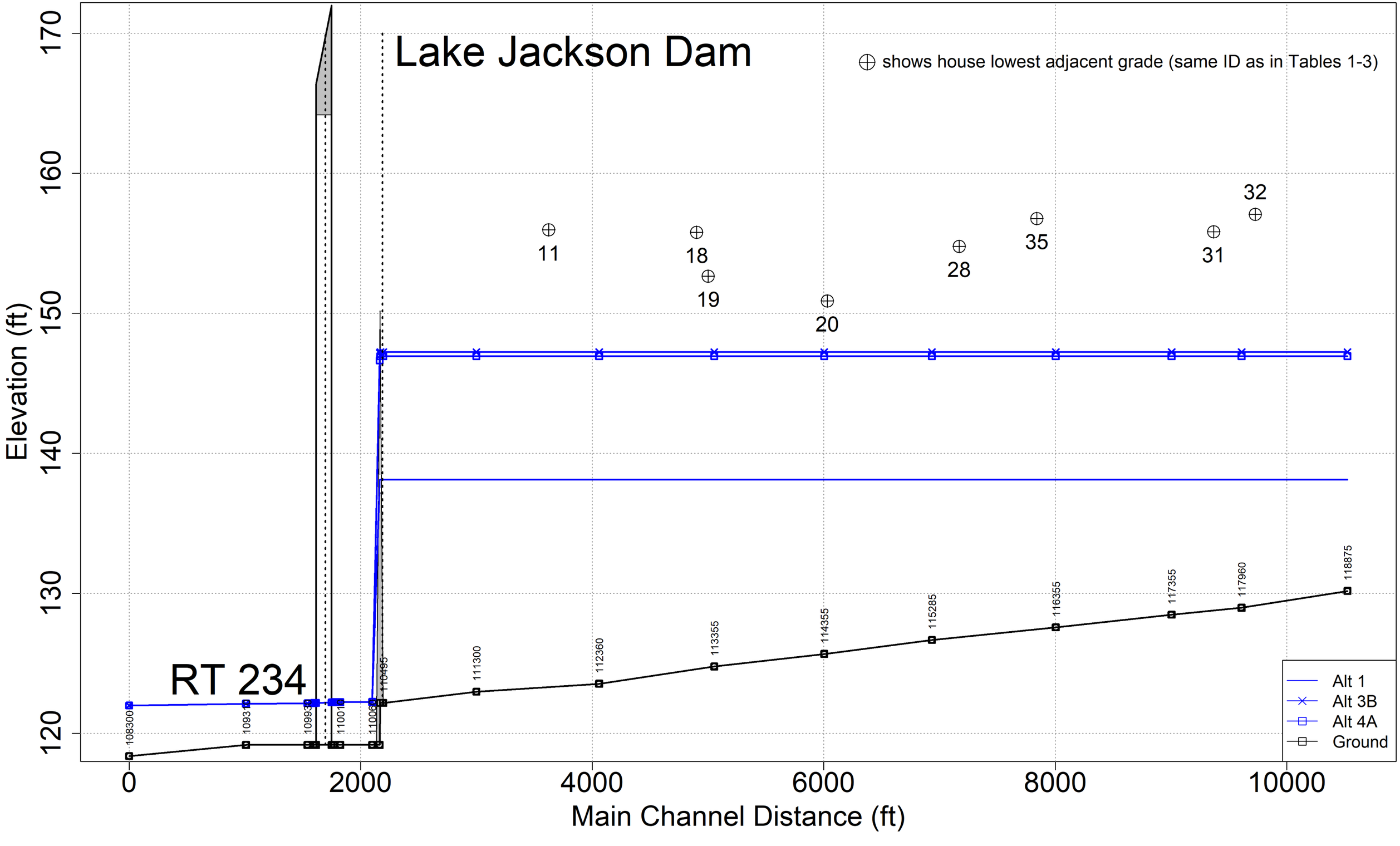
Alt 3B Profile



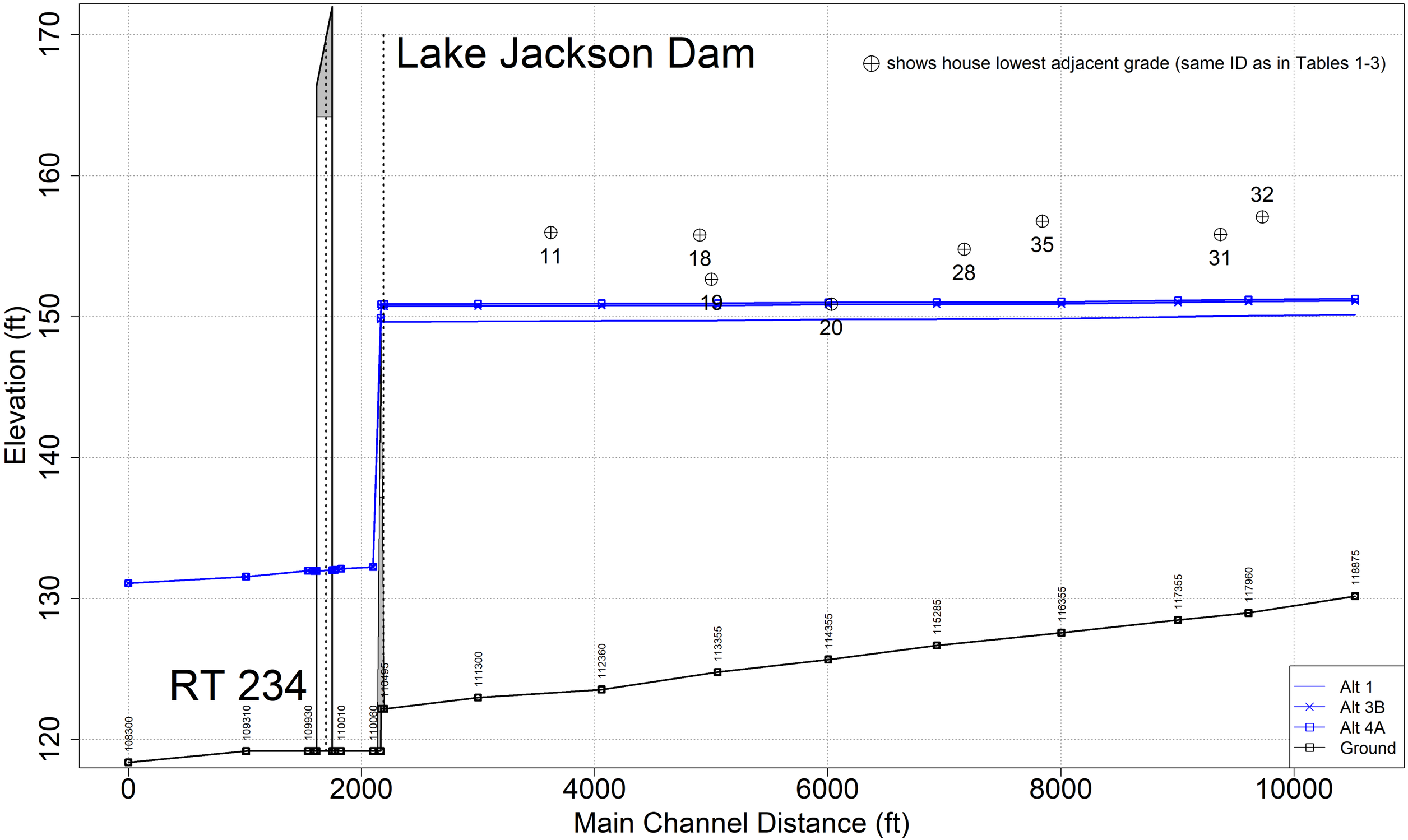
Alt 4A Profile



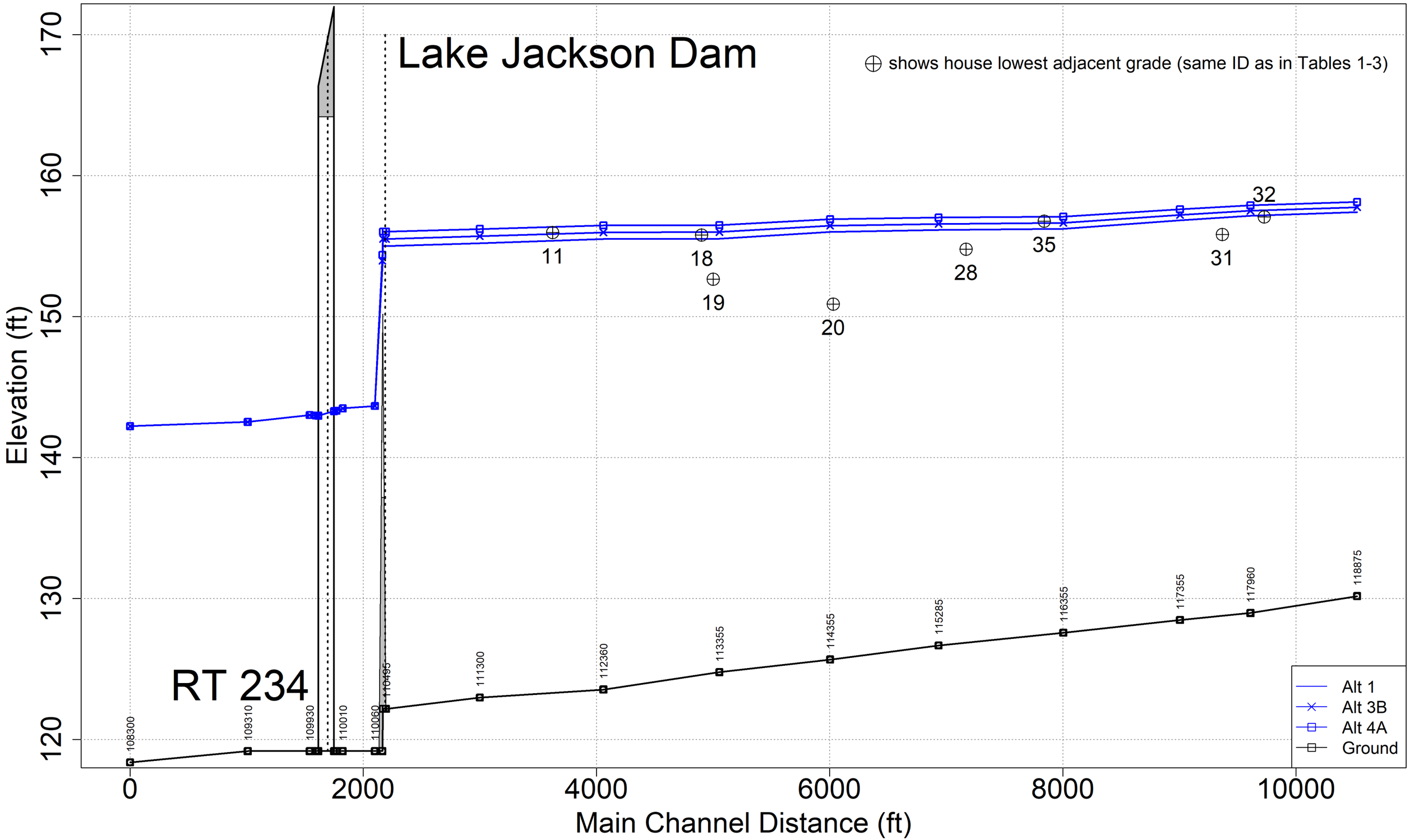
BASE Storm Profiles



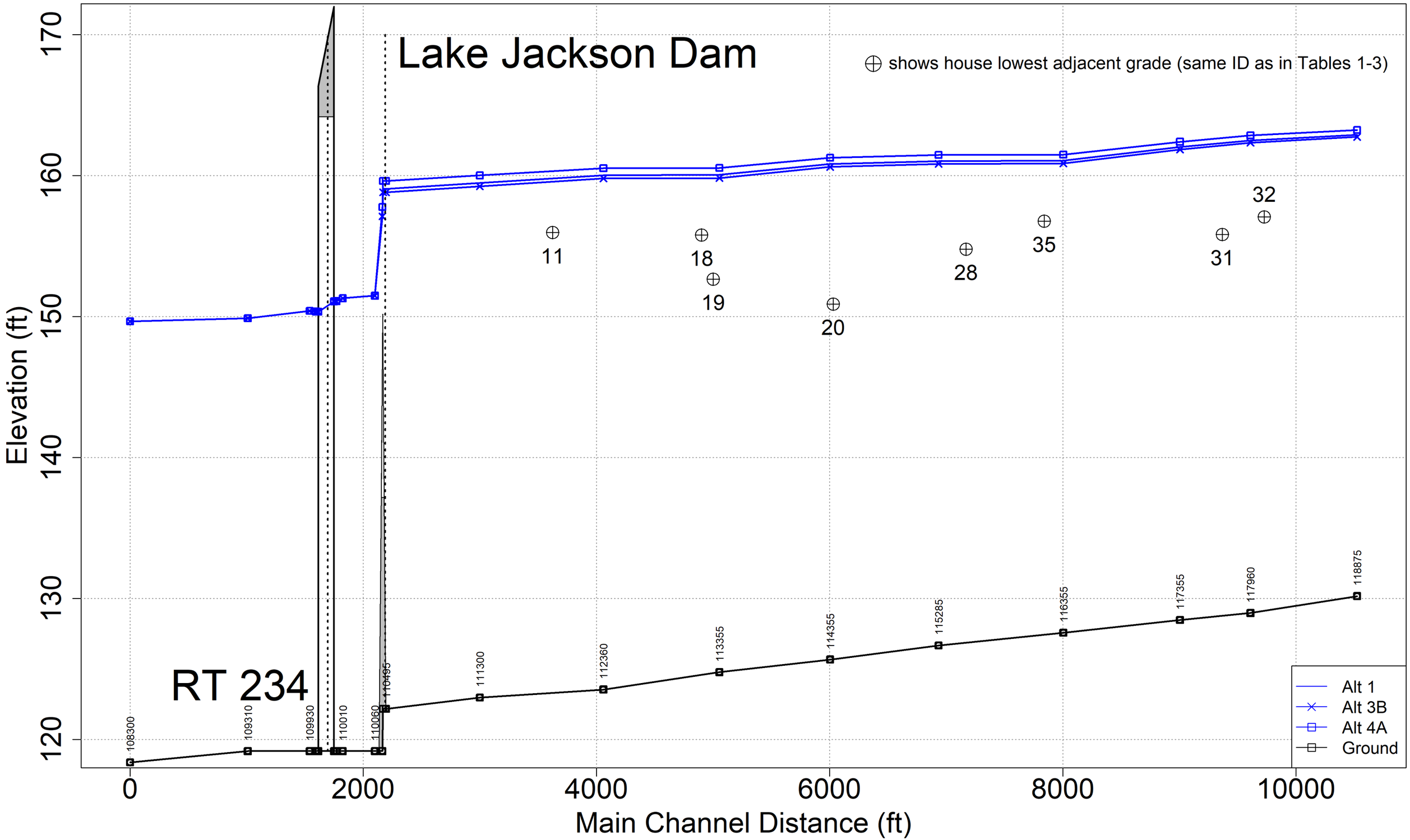
2-YR Storm Profiles



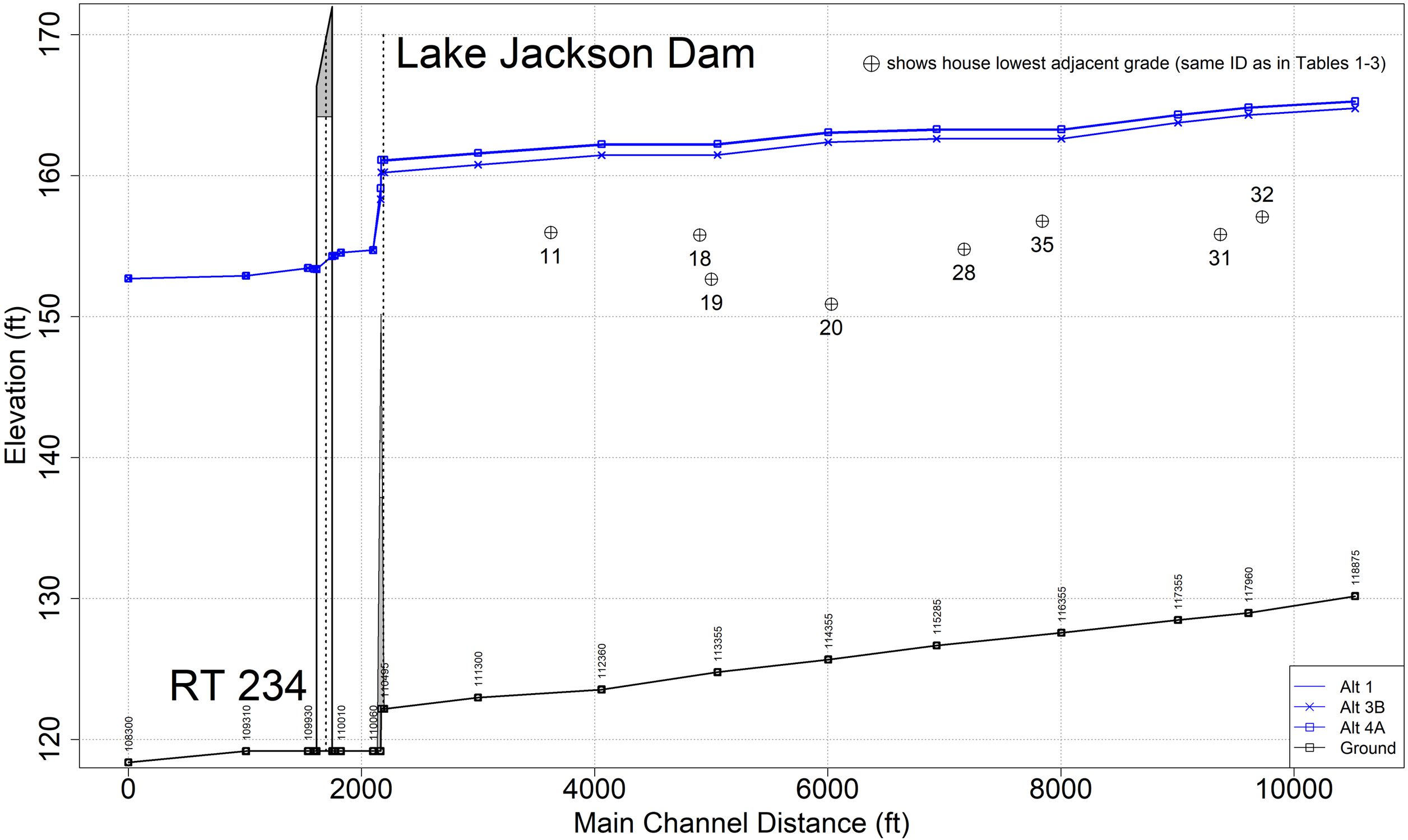
10-YR Storm Profiles



50-YR Storm Profiles



100-YR Storm Profiles



Appendix G

HEC-RAS Output

HEC-RAS: Base Flow Output Table

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: BASE

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	118875	BASE	EX_Gate_Open	68.00	130.18	138.12	131.51	138.12	0.000002	0.13	520.25	130.99	0.01
Reach-1	118875	BASE	EX_Gate_Closed	68.00	130.18	147.27	131.51	147.27	0.000000	0.03	2375.54	406.66	0.00
Reach-1	118875	BASE	Alt_3A	68.00	130.18	147.24	131.51	147.24	0.000000	0.03	2363.80	405.58	0.00
Reach-1	118875	BASE	Alt_3B	68.00	130.18	147.24	131.51	147.24	0.000000	0.03	2361.99	405.42	0.00
Reach-1	118875	BASE	Alt_4A	68.00	130.18	146.94		146.94	0.000000	0.03	2243.97	392.20	0.00
Reach-1	117960	BASE	EX_Gate_Open	68.00	128.98	138.12	130.26	138.12	0.000001	0.09	760.43	166.35	0.01
Reach-1	117960	BASE	EX_Gate_Closed	68.00	128.98	147.27	130.26	147.27	0.000000	0.03	2838.99	281.33	0.00
Reach-1	117960	BASE	Alt_3A	68.00	128.98	147.24	130.26	147.24	0.000000	0.03	2830.87	280.78	0.00
Reach-1	117960	BASE	Alt_3B	68.00	128.98	147.24	130.26	147.24	0.000000	0.03	2829.62	280.69	0.00
Reach-1	117960	BASE	Alt_4A	68.00	128.98	146.94		146.94	0.000000	0.03	2747.49	275.24	0.00
Reach-1	117355	BASE	EX_Gate_Open	68.00	128.48	138.12	129.95	138.12	0.000001	0.11	595.10	123.44	0.01
Reach-1	117355	BASE	EX_Gate_Closed	68.00	128.48	147.27	129.95	147.27	0.000000	0.03	2656.26	327.46	0.00
Reach-1	117355	BASE	Alt_3A	68.00	128.48	147.24	129.95	147.24	0.000000	0.03	2646.80	326.93	0.00
Reach-1	117355	BASE	Alt_3B	68.00	128.48	147.24	129.95	147.24	0.000000	0.03	2645.34	326.84	0.00
Reach-1	117355	BASE	Alt_4A	68.00	128.48	146.94		146.94	0.000000	0.03	2549.96	318.69	0.00
Reach-1	116355	BASE	EX_Gate_Open	68.00	127.58	138.12	129.11	138.12	0.000001	0.11	638.19	121.09	0.01
Reach-1	116355	BASE	EX_Gate_Closed	68.00	127.58	147.27	129.11	147.27	0.000000	0.03	2338.93	276.74	0.00
Reach-1	116355	BASE	Alt_3A	68.00	127.58	147.24	129.11	147.24	0.000000	0.03	2330.94	276.04	0.00
Reach-1	116355	BASE	Alt_3B	68.00	127.58	147.24	129.11	147.24	0.000000	0.03	2329.71	275.93	0.00
Reach-1	116355	BASE	Alt_4A	68.00	127.58	146.94		146.94	0.000000	0.04	2249.23	268.78	0.00
Reach-1	115285	BASE	EX_Gate_Open	68.00	126.68	138.12	127.98	138.12	0.000000	0.06	1132.05	197.91	0.00
Reach-1	115285	BASE	EX_Gate_Closed	68.00	126.68	147.27	127.98	147.27	0.000000	0.02	4321.01	482.87	0.00
Reach-1	115285	BASE	Alt_3A	68.00	126.68	147.24	127.98	147.24	0.000000	0.02	4307.05	482.78	0.00
Reach-1	115285	BASE	Alt_3B	68.00	126.68	147.24	127.98	147.24	0.000000	0.02	4304.90	482.76	0.00
Reach-1	115285	BASE	Alt_4A	68.00	126.68	146.94		146.94	0.000000	0.02	4162.38	481.80	0.00
Reach-1	114355	BASE	EX_Gate_Open	68.00	125.68	138.12	126.93	138.12	0.000000	0.05	1474.26	237.02	0.00
Reach-1	114355	BASE	EX_Gate_Closed	68.00	125.68	147.27	126.93	147.27	0.000000	0.02	4362.56	402.16	0.00
Reach-1	114355	BASE	Alt_3A	68.00	125.68	147.24	126.93	147.24	0.000000	0.02	4350.94	401.67	0.00
Reach-1	114355	BASE	Alt_3B	68.00	125.68	147.24	126.93	147.24	0.000000	0.02	4349.15	401.60	0.00
Reach-1	114355	BASE	Alt_4A	68.00	125.68	146.94		146.94	0.000000	0.02	4231.20	396.64	0.00
Reach-1	113355	BASE	EX_Gate_Open	68.00	124.78	138.12	126.38	138.12	0.000000	0.07	912.50	136.81	0.01
Reach-1	113355	BASE	EX_Gate_Closed	68.00	124.78	147.27	126.38	147.27	0.000000	0.03	2688.59	260.81	0.00
Reach-1	113355	BASE	Alt_3A	68.00	124.78	147.24	126.38	147.24	0.000000	0.03	2681.06	260.14	0.00
Reach-1	113355	BASE	Alt_3B	68.00	124.78	147.24	126.38	147.24	0.000000	0.03	2679.90	260.03	0.00
Reach-1	113355	BASE	Alt_4A	68.00	124.78	146.94		146.94	0.000000	0.03	2604.08	253.12	0.00
Reach-1	112360	BASE	EX_Gate_Open	68.00	123.55	138.12	124.84	138.12	0.000000	0.04	1867.03	256.29	0.00
Reach-1	112360	BASE	EX_Gate_Closed	68.00	123.55	147.27	124.84	147.27	0.000000	0.01	5248.41	465.97	0.00
Reach-1	112360	BASE	Alt_3A	68.00	123.55	147.24	124.84	147.24	0.000000	0.01	5234.94	465.81	0.00
Reach-1	112360	BASE	Alt_3B	68.00	123.55	147.24	124.84	147.24	0.000000	0.01	5232.87	465.78	0.00
Reach-1	112360	BASE	Alt_4A	68.00	123.55	146.94		146.94	0.000000	0.02	5095.47	464.06	0.00
Reach-1	111300	BASE	EX_Gate_Open	68.00	122.98	138.12	124.44	138.12	0.000000	0.05	1494.74	197.46	0.00
Reach-1	111300	BASE	EX_Gate_Closed	68.00	122.98	147.27	124.44	147.27	0.000000	0.02	3931.39	333.77	0.00
Reach-1	111300	BASE	Alt_3A	68.00	122.98	147.24	124.44	147.24	0.000000	0.02	3921.74	333.65	0.00
Reach-1	111300	BASE	Alt_3B	68.00	122.98	147.24	124.44	147.24	0.000000	0.02	3920.25	333.63	0.00
Reach-1	111300	BASE	Alt_4A	68.00	122.98	146.94		146.94	0.000000	0.02	3821.84	332.40	0.00
Reach-1	110495	BASE	EX_Gate_Open	68.00	122.18	138.12	123.64	138.12	0.000000	0.04	1636.32	205.34	0.00
Reach-1	110495	BASE	EX_Gate_Closed	68.00	122.18	147.27	123.64	147.27	0.000000	0.02	3700.20	280.09	0.00
Reach-1	110495	BASE	Alt_3A	68.00	122.18	147.24	123.64	147.24	0.000000	0.02	3693.10	280.00	0.00
Reach-1	110495	BASE	Alt_3B	68.00	122.18	147.24	123.64	147.24	0.000000	0.02	3692.01	279.99	0.00
Reach-1	110495	BASE	Alt_4A	68.00	122.18	146.94	123.64	146.94	0.000000	0.02	3619.50	279.09	0.00
Reach-1	110490			Inl Struct									
Reach-1	110400	BASE	EX_Gate_Open	68.00	119.18	122.25	120.10	122.25	0.000050	0.35	194.58	126.85	0.05
Reach-1	110400	BASE	EX_Gate_Closed	68.00	119.18	122.25	120.10	122.25	0.000050	0.35	194.58	126.85	0.05
Reach-1	110400	BASE	Alt_3A	68.00	119.18	122.25	120.10	122.25	0.000050	0.35	194.58	126.85	0.05
Reach-1	110400	BASE	Alt_3B	68.00	119.18	122.25	120.10	122.25	0.000050	0.35	194.58	126.85	0.05
Reach-1	110400	BASE	Alt_4A	68.00	119.18	122.25		122.25	0.000050	0.35	194.58	126.85	0.05
Reach-1	110060	BASE	EX_Gate_Open	68.00	119.18	122.23	120.16	122.23	0.000072	0.42	162.64	106.63	0.06
Reach-1	110060	BASE	EX_Gate_Closed	68.00	119.18	122.23	120.16	122.23	0.000072	0.42	162.64	106.63	0.06
Reach-1	110060	BASE	Alt_3A	68.00	119.18	122.23	120.16	122.23	0.000072	0.42	162.64	106.63	0.06
Reach-1	110060	BASE	Alt_3B	68.00	119.18	122.23	120.16	122.23	0.000072	0.42	162.64	106.63	0.06
Reach-1	110060	BASE	Alt_4A	68.00	119.18	122.23		122.23	0.000072	0.42	162.64	106.63	0.06
Reach-1	110010	BASE	EX_Gate_Open	68.00	119.18	122.23	120.21	122.23	0.000090	0.47	145.74	95.71	0.07
Reach-1	110010	BASE	EX_Gate_Closed	68.00	119.18	122.23	120.21	122.23	0.000090	0.47	145.74	95.71	0.07
Reach-1	110010	BASE	Alt_3A	68.00	119.18	122.23	120.21	122.23	0.000090	0.47	145.74	95.71	0.07
Reach-1	110010	BASE	Alt_3B	68.00	119.18	122.23	120.21	122.23	0.000090	0.47	145.74	95.71	0.07
Reach-1	110010	BASE	Alt_4A	68.00	119.18	122.23	120.21	122.23	0.000090	0.47	145.74	95.71	0.07

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: BASE (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	109995			Bridge									
Reach-1	109980	BASE	EX_Gate_Open	68.00	119.18	122.17	120.63	122.19	0.000688	1.13	60.24	47.90	0.18
Reach-1	109980	BASE	EX_Gate_Closed	68.00	119.18	122.17	120.63	122.19	0.000688	1.13	60.24	47.90	0.18
Reach-1	109980	BASE	Alt_3A	68.00	119.18	122.17	120.63	122.19	0.000688	1.13	60.24	47.90	0.18
Reach-1	109980	BASE	Alt_3B	68.00	119.18	122.17	120.63	122.19	0.000688	1.13	60.24	47.90	0.18
Reach-1	109980	BASE	Alt_4A	68.00	119.18	122.17	120.63	122.19	0.000688	1.13	60.24	47.90	0.18
Reach-1	109930	BASE	EX_Gate_Open	68.00	119.18	122.16	119.97	122.16	0.000026	0.25	269.33	173.70	0.04
Reach-1	109930	BASE	EX_Gate_Closed	68.00	119.18	122.16	119.97	122.16	0.000026	0.25	269.33	173.70	0.04
Reach-1	109930	BASE	Alt_3A	68.00	119.18	122.16	119.97	122.16	0.000026	0.25	269.33	173.70	0.04
Reach-1	109930	BASE	Alt_3B	68.00	119.18	122.16	119.97	122.16	0.000026	0.25	269.33	173.70	0.04
Reach-1	109930	BASE	Alt_4A	68.00	119.18	122.16	119.97	122.16	0.000026	0.25	269.33	173.70	0.04
Reach-1	109310	BASE	EX_Gate_Open	68.00	119.18	122.12	120.39	122.13	0.000252	0.76	89.38	60.73	0.11
Reach-1	109310	BASE	EX_Gate_Closed	68.00	119.18	122.12	120.39	122.13	0.000252	0.76	89.38	60.73	0.11
Reach-1	109310	BASE	Alt_3A	68.00	119.18	122.12	120.39	122.13	0.000252	0.76	89.38	60.73	0.11
Reach-1	109310	BASE	Alt_3B	68.00	119.18	122.12	120.39	122.13	0.000252	0.76	89.38	60.73	0.11
Reach-1	109310	BASE	Alt_4A	68.00	119.18	122.12		122.13	0.000252	0.76	89.38	60.73	0.11
Reach-1	108300	BASE	EX_Gate_Open	68.00	118.38	122.00	118.93	122.00	0.000004	0.17	426.20	146.94	0.02
Reach-1	108300	BASE	EX_Gate_Closed	68.00	118.38	122.00	118.93	122.00	0.000004	0.17	426.20	146.94	0.02
Reach-1	108300	BASE	Alt_3A	68.00	118.38	122.00	118.93	122.00	0.000004	0.17	426.20	146.94	0.02
Reach-1	108300	BASE	Alt_3B	68.00	118.38	122.00	118.93	122.00	0.000004	0.17	426.20	146.94	0.02
Reach-1	108300	BASE	Alt_4A	68.00	118.38	122.00	118.93	122.00	0.000004	0.17	426.20	146.94	0.02

HEC-RAS: 2-YR Output Table

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: 2-YR

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	118875	2-YR	EX_Gate_Open	6100.00	130.18	150.13	138.24	150.21	0.000106	2.31	3609.24	442.61	0.11
Reach-1	118875	2-YR	EX_Gate_Closed	6100.00	130.18	151.68	138.24	151.74	0.000072	2.03	4299.93	450.01	0.09
Reach-1	118875	2-YR	Alt_3A	6100.00	130.18	151.20	138.24	151.27	0.000080	2.11	4086.80	447.74	0.09
Reach-1	118875	2-YR	Alt_3B	6100.00	130.18	151.13	138.24	151.19	0.000082	2.13	4052.15	447.37	0.09
Reach-1	118875	2-YR	Alt_4A	6100.00	130.18	151.27		151.33	0.000079	2.10	4114.69	448.04	0.09
Reach-1	117960	2-YR	EX_Gate_Open	6100.00	128.98	150.07	136.73	150.12	0.000067	1.89	3669.66	306.45	0.08
Reach-1	117960	2-YR	EX_Gate_Closed	6100.00	128.98	151.63	136.73	151.68	0.000048	1.70	4162.04	324.58	0.07
Reach-1	117960	2-YR	Alt_3A	6100.00	128.98	151.15	136.73	151.20	0.000053	1.76	4008.06	317.62	0.08
Reach-1	117960	2-YR	Alt_3B	6100.00	128.98	151.07	136.73	151.12	0.000054	1.77	3983.25	316.43	0.08
Reach-1	117960	2-YR	Alt_4A	6100.00	128.98	151.22		151.26	0.000052	1.75	4028.07	318.57	0.08
Reach-1	117355	2-YR	EX_Gate_Open	6100.00	128.48	149.99	137.39	150.07	0.000103	2.35	3584.38	351.10	0.10
Reach-1	117355	2-YR	EX_Gate_Closed	6100.00	128.48	151.58	137.39	151.64	0.000072	2.09	4149.01	359.86	0.09
Reach-1	117355	2-YR	Alt_3A	6100.00	128.48	151.09	137.39	151.16	0.000080	2.16	3975.00	357.29	0.09
Reach-1	117355	2-YR	Alt_3B	6100.00	128.48	151.02	137.39	151.08	0.000081	2.17	3946.69	356.87	0.09
Reach-1	117355	2-YR	Alt_4A	6100.00	128.48	151.16		151.22	0.000079	2.15	3997.78	357.62	0.09
Reach-1	116355	2-YR	EX_Gate_Open	6100.00	127.58	149.87	136.89	149.96	0.000114	2.50	3096.50	299.35	0.11
Reach-1	116355	2-YR	EX_Gate_Closed	6100.00	127.58	151.49	136.89	151.56	0.000079	2.23	3589.44	308.04	0.09
Reach-1	116355	2-YR	Alt_3A	6100.00	127.58	151.00	136.89	151.08	0.000088	2.30	3437.79	305.38	0.10
Reach-1	116355	2-YR	Alt_3B	6100.00	127.58	150.92	136.89	151.00	0.000090	2.31	3413.10	304.95	0.10
Reach-1	116355	2-YR	Alt_4A	6100.00	127.58	151.06		151.14	0.000087	2.29	3457.66	305.73	0.10
Reach-1	115285	2-YR	EX_Gate_Open	6100.00	126.68	149.83	134.58	149.86	0.000037	1.46	5567.28	491.23	0.06
Reach-1	115285	2-YR	EX_Gate_Closed	6100.00	126.68	151.47	134.58	151.49	0.000026	1.30	6376.28	496.30	0.05
Reach-1	115285	2-YR	Alt_3A	6100.00	126.68	150.97	134.58	151.00	0.000029	1.34	6129.37	494.96	0.06
Reach-1	115285	2-YR	Alt_3B	6100.00	126.68	150.89	134.58	150.92	0.000029	1.35	6089.00	494.69	0.06
Reach-1	115285	2-YR	Alt_4A	6100.00	126.68	151.04		151.06	0.000028	1.34	6161.81	495.17	0.06
Reach-1	114355	2-YR	EX_Gate_Open	6100.00	125.68	149.81	133.28	149.83	0.000027	1.28	5433.99	446.18	0.05
Reach-1	114355	2-YR	EX_Gate_Closed	6100.00	125.68	151.45	133.28	151.47	0.000020	1.15	6177.40	456.92	0.05
Reach-1	114355	2-YR	Alt_3A	6100.00	125.68	150.95	133.28	150.97	0.000022	1.19	5949.67	453.78	0.05
Reach-1	114355	2-YR	Alt_3B	6100.00	125.68	150.87	133.28	150.89	0.000022	1.20	5912.51	453.27	0.05
Reach-1	114355	2-YR	Alt_4A	6100.00	125.68	151.02		151.04	0.000021	1.19	5979.54	454.20	0.05
Reach-1	113355	2-YR	EX_Gate_Open	6100.00	124.78	149.72	134.51	149.79	0.000077	2.14	3603.35	434.34	0.09
Reach-1	113355	2-YR	EX_Gate_Closed	6100.00	124.78	151.39	134.51	151.44	0.000053	1.90	4345.70	454.58	0.08
Reach-1	113355	2-YR	Alt_3A	6100.00	124.78	150.88	134.51	150.94	0.000060	1.97	4117.20	448.43	0.08
Reach-1	113355	2-YR	Alt_3B	6100.00	124.78	150.80	134.51	150.86	0.000061	1.98	4080.02	447.53	0.08
Reach-1	113355	2-YR	Alt_4A	6100.00	124.78	150.95		151.01	0.000059	1.96	4147.12	449.15	0.08
Reach-1	112360	2-YR	EX_Gate_Open	6100.00	123.55	149.71	131.40	149.72	0.000020	1.12	6397.15	477.74	0.05
Reach-1	112360	2-YR	EX_Gate_Closed	6100.00	123.55	151.38	131.40	151.40	0.000014	1.02	7203.19	484.85	0.04
Reach-1	112360	2-YR	Alt_3A	6100.00	123.55	150.87	131.40	150.89	0.000016	1.05	6957.58	482.72	0.04
Reach-1	112360	2-YR	Alt_3B	6100.00	123.55	150.79	131.40	150.81	0.000016	1.05	6917.41	482.37	0.04
Reach-1	112360	2-YR	Alt_4A	6100.00	123.55	150.94		150.96	0.000015	1.04	6989.87	483.00	0.04
Reach-1	111300	2-YR	EX_Gate_Open	6100.00	122.98	149.67	131.80	149.70	0.000033	1.46	4741.71	343.74	0.06
Reach-1	111300	2-YR	EX_Gate_Closed	6100.00	122.98	151.35	131.80	151.38	0.000024	1.33	5327.57	352.39	0.05
Reach-1	111300	2-YR	Alt_3A	6100.00	122.98	150.84	131.80	150.87	0.000026	1.37	5148.49	349.58	0.05
Reach-1	111300	2-YR	Alt_3B	6100.00	122.98	150.76	131.80	150.78	0.000027	1.37	5119.25	349.12	0.06
Reach-1	111300	2-YR	Alt_4A	6100.00	122.98	150.91		150.93	0.000026	1.36	5171.99	349.95	0.05
Reach-1	110495	2-YR	EX_Gate_Open	6100.00	122.18	149.64	131.05	149.67	0.000031	1.48	4281.84	287.28	0.06
Reach-1	110495	2-YR	EX_Gate_Closed	6100.00	122.18	151.33	131.05	151.36	0.000024	1.35	4697.71	295.81	0.05
Reach-1	110495	2-YR	Alt_3A	6100.00	122.18	150.82	131.05	150.85	0.000026	1.39	4571.78	291.62	0.05
Reach-1	110495	2-YR	Alt_3B	6100.00	122.18	150.73	131.05	150.76	0.000026	1.39	4551.12	290.94	0.05
Reach-1	110495	2-YR	Alt_4A	6100.00	122.18	150.88	131.07	150.91	0.000025	1.38	4588.37	292.17	0.05
Reach-1	110490			Inl Struct									
Reach-1	110400	2-YR	EX_Gate_Open	5900.00	119.18	132.24	124.62	132.34	0.000209	2.54	2406.70	249.99	0.14
Reach-1	110400	2-YR	EX_Gate_Closed	5900.00	119.18	132.24	124.62	132.34	0.000209	2.54	2406.70	249.99	0.14
Reach-1	110400	2-YR	Alt_3A	5900.00	119.18	132.24	124.62	132.34	0.000209	2.54	2406.70	249.99	0.14
Reach-1	110400	2-YR	Alt_3B	5900.00	119.18	132.24	124.62	132.34	0.000209	2.54	2406.70	249.99	0.14
Reach-1	110400	2-YR	Alt_4A	5900.00	119.18	132.24		132.34	0.000209	2.54	2406.70	249.99	0.14
Reach-1	110060	2-YR	EX_Gate_Open	5900.00	119.18	132.12	124.94	132.27	0.000318	3.18	2177.47	274.90	0.17
Reach-1	110060	2-YR	EX_Gate_Closed	5900.00	119.18	132.12	124.94	132.27	0.000318	3.18	2177.47	274.90	0.17
Reach-1	110060	2-YR	Alt_3A	5900.00	119.18	132.12	124.94	132.27	0.000318	3.18	2177.47	274.90	0.17
Reach-1	110060	2-YR	Alt_3B	5900.00	119.18	132.12	124.94	132.27	0.000318	3.18	2177.47	274.90	0.17
Reach-1	110060	2-YR	Alt_4A	5900.00	119.18	132.12		132.27	0.000318	3.18	2177.47	274.90	0.17
Reach-1	110010	2-YR	EX_Gate_Open	5900.00	119.18	132.04	125.22	132.24	0.000417	3.62	1838.77	233.45	0.20
Reach-1	110010	2-YR	EX_Gate_Closed	5900.00	119.18	132.04	125.22	132.24	0.000417	3.62	1838.77	233.45	0.20
Reach-1	110010	2-YR	Alt_3A	5900.00	119.18	132.04	125.22	132.24	0.000417	3.62	1838.77	233.45	0.20
Reach-1	110010	2-YR	Alt_3B	5900.00	119.18	132.04	125.22	132.24	0.000417	3.62	1838.77	233.45	0.20
Reach-1	110010	2-YR	Alt_4A	5900.00	119.18	132.04	125.22	132.24	0.000417	3.62	1838.77	233.45	0.20

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: 2-YR (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	109995			Bridge									
Reach-1	109980	2-YR	EX_Gate_Open	5900.00	119.18	131.96	125.60	132.13	0.000395	3.32	1914.85	228.90	0.19
Reach-1	109980	2-YR	EX_Gate_Closed	5900.00	119.18	131.96	125.60	132.13	0.000395	3.32	1914.85	228.90	0.19
Reach-1	109980	2-YR	Alt_3A	5900.00	119.18	131.96	125.60	132.13	0.000395	3.32	1914.85	228.90	0.19
Reach-1	109980	2-YR	Alt_3B	5900.00	119.18	131.96	125.60	132.13	0.000395	3.32	1914.85	228.90	0.19
Reach-1	109980	2-YR	Alt_4A	5900.00	119.18	131.96	125.60	132.13	0.000395	3.32	1914.85	228.90	0.19
Reach-1	109930	2-YR	EX_Gate_Open	5900.00	119.18	131.98	123.92	132.09	0.000215	2.71	2305.21	238.31	0.14
Reach-1	109930	2-YR	EX_Gate_Closed	5900.00	119.18	131.98	123.92	132.09	0.000215	2.71	2305.21	238.31	0.14
Reach-1	109930	2-YR	Alt_3A	5900.00	119.18	131.98	123.92	132.09	0.000215	2.71	2305.21	238.31	0.14
Reach-1	109930	2-YR	Alt_3B	5900.00	119.18	131.98	123.92	132.09	0.000215	2.71	2305.21	238.31	0.14
Reach-1	109930	2-YR	Alt_4A	5900.00	119.18	131.98	123.92	132.09	0.000215	2.71	2305.21	238.31	0.14
Reach-1	109310	2-YR	EX_Gate_Open	5900.00	119.18	131.56	126.38	131.88	0.000841	4.97	1799.13	289.48	0.28
Reach-1	109310	2-YR	EX_Gate_Closed	5900.00	119.18	131.56	126.38	131.88	0.000841	4.97	1799.13	289.48	0.28
Reach-1	109310	2-YR	Alt_3A	5900.00	119.18	131.56	126.38	131.88	0.000841	4.97	1799.13	289.48	0.28
Reach-1	109310	2-YR	Alt_3B	5900.00	119.18	131.56	126.38	131.88	0.000841	4.97	1799.13	289.48	0.28
Reach-1	109310	2-YR	Alt_4A	5900.00	119.18	131.56		131.88	0.000841	4.97	1799.13	289.48	0.28
Reach-1	108300	2-YR	EX_Gate_Open	5900.00	118.38	131.10	122.93	131.26	0.000300	3.43	2620.53	384.75	0.17
Reach-1	108300	2-YR	EX_Gate_Closed	5900.00	118.38	131.10	122.93	131.26	0.000300	3.43	2620.53	384.75	0.17
Reach-1	108300	2-YR	Alt_3A	5900.00	118.38	131.10	122.93	131.26	0.000300	3.43	2620.53	384.75	0.17
Reach-1	108300	2-YR	Alt_3B	5900.00	118.38	131.10	122.93	131.26	0.000300	3.43	2620.53	384.75	0.17
Reach-1	108300	2-YR	Alt_4A	5900.00	118.38	131.10	122.93	131.26	0.000300	3.43	2620.53	384.75	0.17

HEC-RAS: 10-YR Output Table

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: 10-YR

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	118875	10-YR	EX_Gate_Open	24000.00	130.18	157.42	143.95	157.80	0.000342	5.42	6967.35	478.38	0.20
Reach-1	118875	10-YR	EX_Gate_Closed	24000.00	130.18	158.59	143.95	158.92	0.000280	5.07	7532.46	483.50	0.18
Reach-1	118875	10-YR	Alt_3A	24000.00	130.18	157.90	143.95	158.25	0.000315	5.27	7197.62	480.47	0.19
Reach-1	118875	10-YR	Alt_3B	24000.00	130.18	157.77	143.95	158.13	0.000322	5.31	7133.77	479.89	0.20
Reach-1	118875	10-YR	Alt_4A	24000.00	130.18	158.14		158.48	0.000302	5.20	7311.48	481.50	0.19
Reach-1	117960	10-YR	EX_Gate_Open	24000.00	128.98	157.15	142.11	157.50	0.000274	4.91	6203.31	393.53	0.18
Reach-1	117960	10-YR	EX_Gate_Closed	24000.00	128.98	158.37	142.11	158.68	0.000227	4.62	6687.66	401.27	0.17
Reach-1	117960	10-YR	Alt_3A	24000.00	128.98	157.65	142.11	157.98	0.000253	4.79	6400.75	396.46	0.18
Reach-1	117960	10-YR	Alt_3B	24000.00	128.98	157.51	142.11	157.85	0.000259	4.82	6346.03	395.65	0.18
Reach-1	117960	10-YR	Alt_4A	24000.00	128.98	157.90		158.22	0.000244	4.73	6498.31	397.90	0.17
Reach-1	117355	10-YR	EX_Gate_Open	24000.00	128.48	156.84	143.85	157.29	0.000405	5.93	6107.73	383.61	0.22
Reach-1	117355	10-YR	EX_Gate_Closed	24000.00	128.48	158.11	143.85	158.51	0.000329	5.54	6600.27	388.18	0.20
Reach-1	117355	10-YR	Alt_3A	24000.00	128.48	157.36	143.85	157.79	0.000372	5.77	6309.65	385.49	0.21
Reach-1	117355	10-YR	Alt_3B	24000.00	128.48	157.22	143.85	157.65	0.000381	5.81	6253.85	384.97	0.21
Reach-1	117355	10-YR	Alt_4A	24000.00	128.48	157.62		158.04	0.000356	5.69	6408.83	386.41	0.21
Reach-1	116355	10-YR	EX_Gate_Open	24000.00	127.58	156.24	143.49	156.84	0.000506	6.58	5110.40	331.65	0.24
Reach-1	116355	10-YR	EX_Gate_Closed	24000.00	127.58	157.63	143.49	158.14	0.000405	6.13	5575.54	338.37	0.22
Reach-1	116355	10-YR	Alt_3A	24000.00	127.58	156.82	143.49	157.37	0.000460	6.39	5301.98	334.44	0.23
Reach-1	116355	10-YR	Alt_3B	24000.00	127.58	156.66	143.49	157.23	0.000472	6.44	5249.17	333.67	0.24
Reach-1	116355	10-YR	Alt_4A	24000.00	127.58	157.10		157.64	0.000440	6.29	5395.59	335.79	0.23
Reach-1	115285	10-YR	EX_Gate_Open	24000.00	126.68	156.15	140.26	156.36	0.000171	3.89	8730.83	509.33	0.14
Reach-1	115285	10-YR	EX_Gate_Closed	24000.00	126.68	157.57	140.26	157.75	0.000137	3.62	9457.57	513.33	0.13
Reach-1	115285	10-YR	Alt_3A	24000.00	126.68	156.74	140.26	156.93	0.000155	3.77	9032.02	510.99	0.14
Reach-1	115285	10-YR	Alt_3B	24000.00	126.68	156.58	140.26	156.77	0.000159	3.80	8949.26	510.54	0.14
Reach-1	115285	10-YR	Alt_4A	24000.00	126.68	157.03		157.21	0.000148	3.72	9178.21	511.79	0.13
Reach-1	114355	10-YR	EX_Gate_Open	24000.00	125.68	156.02	138.82	156.20	0.000141	3.57	8402.43	536.68	0.13
Reach-1	114355	10-YR	EX_Gate_Closed	24000.00	125.68	157.47	138.82	157.63	0.000113	3.33	9191.20	552.39	0.12
Reach-1	114355	10-YR	Alt_3A	24000.00	125.68	156.62	138.82	156.80	0.000128	3.46	8727.83	543.20	0.13
Reach-1	114355	10-YR	Alt_3B	24000.00	125.68	156.46	138.82	156.63	0.000131	3.49	8638.20	541.41	0.13
Reach-1	114355	10-YR	Alt_4A	24000.00	125.68	156.91		157.08	0.000122	3.41	8886.52	546.35	0.12
Reach-1	113355	10-YR	EX_Gate_Open	24000.00	124.78	155.54	141.49	155.99	0.000377	5.76	6331.27	518.60	0.21
Reach-1	113355	10-YR	EX_Gate_Closed	24000.00	124.78	157.09	141.49	157.46	0.000290	5.28	7154.66	542.46	0.19
Reach-1	113355	10-YR	Alt_3A	24000.00	124.78	156.18	141.49	156.60	0.000338	5.55	6671.19	530.09	0.20
Reach-1	113355	10-YR	Alt_3B	24000.00	124.78	156.01	141.49	156.44	0.000348	5.61	6577.52	527.17	0.20
Reach-1	113355	10-YR	Alt_4A	24000.00	124.78	156.50		156.90	0.000320	5.45	6837.07	534.44	0.20
Reach-1	112360	10-YR	EX_Gate_Open	24000.00	123.55	155.50	137.13	155.65	0.000112	3.23	9246.55	505.54	0.12
Reach-1	112360	10-YR	EX_Gate_Closed	24000.00	123.55	157.07	137.13	157.20	0.000089	3.01	10041.37	512.03	0.11
Reach-1	112360	10-YR	Alt_3A	24000.00	123.55	156.16	137.13	156.30	0.000101	3.13	9578.13	508.26	0.11
Reach-1	112360	10-YR	Alt_3B	24000.00	123.55	155.98	137.13	156.12	0.000104	3.16	9487.36	507.52	0.11
Reach-1	112360	10-YR	Alt_4A	24000.00	123.55	156.47		156.61	0.000097	3.09	9737.95	509.56	0.11
Reach-1	111300	10-YR	EX_Gate_Open	24000.00	122.98	155.22	138.28	155.49	0.000199	4.30	6731.61	373.24	0.16
Reach-1	111300	10-YR	EX_Gate_Closed	24000.00	122.98	156.83	138.28	157.06	0.000158	4.00	7341.51	384.28	0.14
Reach-1	111300	10-YR	Alt_3A	24000.00	122.98	155.90	138.28	156.15	0.000180	4.16	6985.54	377.18	0.15
Reach-1	111300	10-YR	Alt_3B	24000.00	122.98	155.71	138.29	155.97	0.000185	4.20	6915.99	376.09	0.15
Reach-1	111300	10-YR	Alt_4A	24000.00	122.98	156.22		156.47	0.000172	4.11	7108.07	379.51	0.15
Reach-1	110495	10-YR	EX_Gate_Open	24000.00	122.18	155.01	137.53	155.32	0.000210	4.50	5604.11	322.79	0.16
Reach-1	110495	10-YR	EX_Gate_Closed	24000.00	122.18	156.66	137.53	156.93	0.000168	4.20	6009.25	331.00	0.15
Reach-1	110495	10-YR	Alt_3A	24000.00	122.18	155.71	137.53	156.00	0.000191	4.37	5774.49	326.76	0.15
Reach-1	110495	10-YR	Alt_3B	24000.00	122.18	155.52	137.53	155.81	0.000196	4.40	5728.05	325.68	0.16
Reach-1	110495	10-YR	Alt_4A	24000.00	122.18	156.04	137.55	156.32	0.000182	4.31	5855.88	328.59	0.15
Reach-1	110490			Inl Struct									
Reach-1	110400	10-YR	EX_Gate_Open	22700.00	119.18	143.67	128.79	143.98	0.000246	4.53	5538.72	292.59	0.17
Reach-1	110400	10-YR	EX_Gate_Closed	22700.00	119.18	143.67	128.79	143.98	0.000246	4.53	5538.72	292.59	0.17
Reach-1	110400	10-YR	Alt_3A	22700.00	119.18	143.67	128.79	143.98	0.000246	4.53	5538.72	292.59	0.17
Reach-1	110400	10-YR	Alt_3B	22700.00	119.18	143.67	128.79	143.98	0.000246	4.53	5538.72	292.59	0.17
Reach-1	110400	10-YR	Alt_4A	22700.00	119.18	143.67		143.98	0.000246	4.53	5538.72	292.59	0.17
Reach-1	110060	10-YR	EX_Gate_Open	22700.00	119.18	143.50	129.90	143.89	0.000342	5.37	5812.33	354.50	0.20
Reach-1	110060	10-YR	EX_Gate_Closed	22700.00	119.18	143.50	129.90	143.89	0.000342	5.37	5812.33	354.50	0.20
Reach-1	110060	10-YR	Alt_3A	22700.00	119.18	143.50	129.90	143.89	0.000342	5.37	5812.33	354.50	0.20
Reach-1	110060	10-YR	Alt_3B	22700.00	119.18	143.50	129.90	143.89	0.000342	5.37	5812.33	354.50	0.20
Reach-1	110060	10-YR	Alt_4A	22700.00	119.18	143.50		143.89	0.000342	5.37	5812.33	354.50	0.20
Reach-1	110010	10-YR	EX_Gate_Open	22700.00	119.18	143.33	130.40	143.84	0.000443	6.08	5201.18	345.59	0.23
Reach-1	110010	10-YR	EX_Gate_Closed	22700.00	119.18	143.33	130.40	143.84	0.000443	6.08	5201.18	345.59	0.23
Reach-1	110010	10-YR	Alt_3A	22700.00	119.18	143.33	130.40	143.84	0.000443	6.08	5201.18	345.59	0.23
Reach-1	110010	10-YR	Alt_3B	22700.00	119.18	143.33	130.40	143.84	0.000443	6.08	5201.18	345.59	0.23
Reach-1	110010	10-YR	Alt_4A	22700.00	119.18	143.33	130.40	143.84	0.000443	6.08	5201.18	345.59	0.23

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: 10-YR (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	109995			Bridge									
Reach-1	109980	10-YR	EX_Gate_Open	22700.00	119.18	142.98	130.25	143.41	0.000395	5.53	5440.94	392.01	0.21
Reach-1	109980	10-YR	EX_Gate_Closed	22700.00	119.18	142.98	130.25	143.41	0.000395	5.53	5440.94	392.01	0.21
Reach-1	109980	10-YR	Alt_3A	22700.00	119.18	142.98	130.25	143.41	0.000395	5.53	5440.94	392.01	0.21
Reach-1	109980	10-YR	Alt_3B	22700.00	119.18	142.98	130.25	143.41	0.000395	5.53	5440.94	392.01	0.21
Reach-1	109980	10-YR	Alt_4A	22700.00	119.18	142.98	130.25	143.41	0.000395	5.53	5440.94	392.01	0.21
Reach-1	109930	10-YR	EX_Gate_Open	22700.00	119.18	143.02	128.42	143.34	0.000266	4.77	6507.40	453.43	0.18
Reach-1	109930	10-YR	EX_Gate_Closed	22700.00	119.18	143.02	128.42	143.34	0.000266	4.77	6507.40	453.43	0.18
Reach-1	109930	10-YR	Alt_3A	22700.00	119.18	143.02	128.42	143.34	0.000266	4.77	6507.40	453.43	0.18
Reach-1	109930	10-YR	Alt_3B	22700.00	119.18	143.02	128.42	143.34	0.000266	4.77	6507.40	453.43	0.18
Reach-1	109930	10-YR	Alt_4A	22700.00	119.18	143.02	128.42	143.34	0.000266	4.77	6507.40	453.43	0.18
Reach-1	109310	10-YR	EX_Gate_Open	22700.00	119.18	142.53	132.37	143.11	0.000671	7.29	5859.82	422.29	0.28
Reach-1	109310	10-YR	EX_Gate_Closed	22700.00	119.18	142.53	132.37	143.11	0.000671	7.29	5859.82	422.29	0.28
Reach-1	109310	10-YR	Alt_3A	22700.00	119.18	142.53	132.37	143.11	0.000671	7.29	5859.82	422.29	0.28
Reach-1	109310	10-YR	Alt_3B	22700.00	119.18	142.53	132.37	143.11	0.000671	7.29	5859.82	422.29	0.28
Reach-1	109310	10-YR	Alt_4A	22700.00	119.18	142.53		143.11	0.000671	7.29	5859.82	422.29	0.28
Reach-1	108300	10-YR	EX_Gate_Open	22700.00	118.38	142.23	128.85	142.53	0.000305	5.31	8527.63	602.74	0.19
Reach-1	108300	10-YR	EX_Gate_Closed	22700.00	118.38	142.23	128.85	142.53	0.000305	5.31	8527.63	602.74	0.19
Reach-1	108300	10-YR	Alt_3A	22700.00	118.38	142.23	128.85	142.53	0.000305	5.31	8527.63	602.74	0.19
Reach-1	108300	10-YR	Alt_3B	22700.00	118.38	142.23	128.85	142.53	0.000305	5.31	8527.63	602.74	0.19
Reach-1	108300	10-YR	Alt_4A	22700.00	118.38	142.23	128.89	142.53	0.000305	5.31	8527.63	602.74	0.19

HEC-RAS: 50-YR Output Table

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: 50-YR

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	118875	50-YR	EX_Gate_Open	42000.00	130.18	162.91	148.74	163.53	0.000444	7.15	9657.25	501.37	0.24
Reach-1	118875	50-YR	EX_Gate_Closed	42000.00	130.18	163.65	148.74	164.23	0.000401	6.92	10031.73	504.33	0.23
Reach-1	118875	50-YR	Alt_3A	42000.00	130.18	162.91	148.74	163.54	0.000444	7.15	9660.49	501.40	0.24
Reach-1	118875	50-YR	Alt_3B	42000.00	130.18	162.75	148.74	163.39	0.000454	7.20	9580.78	500.77	0.24
Reach-1	118875	50-YR	Alt_4A	42000.00	130.18	163.24		163.84	0.000424	7.04	9825.79	502.71	0.23
Reach-1	117960	50-YR	EX_Gate_Open	42000.00	128.98	162.51	145.60	163.14	0.000388	6.72	8398.48	424.66	0.22
Reach-1	117960	50-YR	EX_Gate_Closed	42000.00	128.98	163.28	145.60	163.88	0.000351	6.51	8731.23	429.34	0.21
Reach-1	117960	50-YR	Alt_3A	42000.00	128.98	162.51	145.60	163.15	0.000387	6.72	8401.36	424.70	0.22
Reach-1	117960	50-YR	Alt_3B	42000.00	128.98	162.34	145.60	162.99	0.000396	6.76	8330.49	423.70	0.23
Reach-1	117960	50-YR	Alt_4A	42000.00	128.98	162.86		163.47	0.000370	6.62	8548.26	426.77	0.22
Reach-1	117355	50-YR	EX_Gate_Open	42000.00	128.48	162.03	148.03	162.84	0.000570	8.07	8148.27	402.15	0.27
Reach-1	117355	50-YR	EX_Gate_Closed	42000.00	128.48	162.86	148.03	163.61	0.000511	7.79	8481.90	405.27	0.26
Reach-1	117355	50-YR	Alt_3A	42000.00	128.48	162.04	148.03	162.85	0.000569	8.07	8151.17	402.18	0.27
Reach-1	117355	50-YR	Alt_3B	42000.00	128.48	161.86	148.03	162.69	0.000583	8.13	8079.68	401.54	0.27
Reach-1	117355	50-YR	Alt_4A	42000.00	128.48	162.40		163.19	0.000542	7.94	8299.01	403.57	0.26
Reach-1	116355	50-YR	EX_Gate_Open	42000.00	127.58	161.07	148.19	162.18	0.000751	9.13	6775.57	359.08	0.31
Reach-1	116355	50-YR	EX_Gate_Closed	42000.00	127.58	162.00	148.19	163.02	0.000663	8.77	7112.70	364.32	0.29
Reach-1	116355	50-YR	Alt_3A	42000.00	127.58	161.08	148.19	162.19	0.000751	9.13	6778.52	359.13	0.31
Reach-1	116355	50-YR	Alt_3B	42000.00	127.58	160.88	148.19	162.01	0.000772	9.21	6705.70	357.98	0.31
Reach-1	116355	50-YR	Alt_4A	42000.00	127.58	161.50		162.56	0.000709	8.97	6928.53	361.47	0.30
Reach-1	115285	50-YR	EX_Gate_Open	42000.00	126.68	161.04	143.89	161.42	0.000256	5.42	11257.38	526.36	0.18
Reach-1	115285	50-YR	EX_Gate_Closed	42000.00	126.68	161.99	143.89	162.34	0.000227	5.21	11760.56	530.07	0.17
Reach-1	115285	50-YR	Alt_3A	42000.00	126.68	161.05	143.89	161.43	0.000256	5.42	11261.80	526.39	0.18
Reach-1	115285	50-YR	Alt_3B	42000.00	126.68	160.84	143.89	161.23	0.000263	5.47	11152.26	525.58	0.18
Reach-1	115285	50-YR	Alt_4A	42000.00	126.68	161.47		161.84	0.000242	5.32	11486.48	528.05	0.18
Reach-1	114355	50-YR	EX_Gate_Open	42000.00	125.68	160.83	141.89	161.19	0.000217	5.02	11107.74	600.54	0.17
Reach-1	114355	50-YR	EX_Gate_Closed	42000.00	125.68	161.81	141.89	162.14	0.000192	4.84	11709.84	628.84	0.16
Reach-1	114355	50-YR	Alt_3A	42000.00	125.68	160.84	141.89	161.20	0.000217	5.02	11112.93	600.81	0.17
Reach-1	114355	50-YR	Alt_3B	42000.00	125.68	160.63	141.89	160.99	0.000222	5.06	10985.21	594.12	0.17
Reach-1	114355	50-YR	Alt_4A	42000.00	125.68	161.28		161.62	0.000205	4.94	11378.94	617.18	0.16
Reach-1	113355	50-YR	EX_Gate_Open	42000.00	124.78	160.06	145.66	160.87	0.000560	7.91	8826.86	589.11	0.27
Reach-1	113355	50-YR	EX_Gate_Closed	42000.00	124.78	161.14	145.66	161.86	0.000478	7.50	9473.93	605.43	0.25
Reach-1	113355	50-YR	Alt_3A	42000.00	124.78	160.07	145.66	160.88	0.000559	7.91	8832.52	589.30	0.27
Reach-1	113355	50-YR	Alt_3B	42000.00	124.78	159.84	145.66	160.66	0.000577	7.99	8695.05	580.20	0.27
Reach-1	113355	50-YR	Alt_4A	42000.00	124.78	160.55		161.32	0.000521	7.72	9120.49	598.72	0.26
Reach-1	112360	50-YR	EX_Gate_Open	42000.00	123.55	160.04	140.43	160.34	0.000183	4.65	11583.13	526.13	0.15
Reach-1	112360	50-YR	EX_Gate_Closed	42000.00	123.55	161.12	140.43	161.41	0.000161	4.46	12161.37	537.10	0.15
Reach-1	112360	50-YR	Alt_3A	42000.00	123.55	160.05	140.43	160.35	0.000183	4.65	11588.23	526.23	0.15
Reach-1	112360	50-YR	Alt_3B	42000.00	123.55	159.81	140.43	160.12	0.000189	4.69	11463.00	524.85	0.16
Reach-1	112360	50-YR	Alt_4A	42000.00	123.55	160.54		160.83	0.000172	4.56	11846.45	531.22	0.15
Reach-1	111300	50-YR	EX_Gate_Open	42000.00	122.98	159.49	141.89	160.06	0.000341	6.28	8399.89	417.70	0.21
Reach-1	111300	50-YR	EX_Gate_Closed	42000.00	122.98	160.64	141.84	161.16	0.000295	6.00	8888.50	430.49	0.20
Reach-1	111300	50-YR	Alt_3A	42000.00	122.98	159.50	141.89	160.07	0.000340	6.27	8404.19	417.87	0.21
Reach-1	111300	50-YR	Alt_3B	42000.00	122.98	159.25	141.90	159.83	0.000352	6.34	8299.17	413.64	0.21
Reach-1	111300	50-YR	Alt_4A	42000.00	122.98	160.02		160.57	0.000319	6.15	8622.14	425.78	0.20
Reach-1	110495	50-YR	EX_Gate_Open	42000.00	122.18	159.08	141.13	159.76	0.000381	6.72	6603.44	340.35	0.22
Reach-1	110495	50-YR	EX_Gate_Closed	42000.00	122.18	160.27	141.13	160.90	0.000332	6.44	6896.74	346.08	0.21
Reach-1	110495	50-YR	Alt_3A	42000.00	122.18	159.09	141.13	159.77	0.000381	6.72	6606.08	340.39	0.22
Reach-1	110495	50-YR	Alt_3B	42000.00	122.18	158.82	141.13	159.52	0.000393	6.78	6541.23	339.37	0.22
Reach-1	110495	50-YR	Alt_4A	42000.00	122.18	159.62	141.12	160.29	0.000358	6.59	6738.30	342.72	0.22
Reach-1	110490			Inl Struct									
Reach-1	110400	50-YR	EX_Gate_Open	40000.00	119.18	151.49	131.89	151.99	0.000267	5.79	7892.82	309.46	0.19
Reach-1	110400	50-YR	EX_Gate_Closed	40000.00	119.18	151.49	131.89	151.99	0.000267	5.79	7892.82	309.46	0.19
Reach-1	110400	50-YR	Alt_3A	40000.00	119.18	151.49	131.89	151.99	0.000267	5.79	7892.82	309.46	0.19
Reach-1	110400	50-YR	Alt_3B	40000.00	119.18	151.49	131.89	151.99	0.000267	5.79	7892.82	309.46	0.19
Reach-1	110400	50-YR	Alt_4A	40000.00	119.18	151.49		151.99	0.000267	5.79	7892.82	309.46	0.19
Reach-1	110060	50-YR	EX_Gate_Open	40000.00	119.18	151.31	133.54	151.90	0.000354	6.69	8723.52	395.88	0.22
Reach-1	110060	50-YR	EX_Gate_Closed	40000.00	119.18	151.31	133.54	151.90	0.000354	6.69	8723.52	395.88	0.22
Reach-1	110060	50-YR	Alt_3A	40000.00	119.18	151.31	133.54	151.90	0.000354	6.69	8723.52	395.88	0.22
Reach-1	110060	50-YR	Alt_3B	40000.00	119.18	151.31	133.54	151.90	0.000354	6.69	8723.52	395.88	0.22
Reach-1	110060	50-YR	Alt_4A	40000.00	119.18	151.31		151.90	0.000354	6.69	8723.52	395.88	0.22
Reach-1	110010	50-YR	EX_Gate_Open	40000.00	119.18	151.10	134.60	151.83	0.000443	7.46	8023.60	381.70	0.24
Reach-1	110010	50-YR	EX_Gate_Closed	40000.00	119.18	151.10	134.60	151.83	0.000443	7.46	8023.60	381.70	0.24
Reach-1	110010	50-YR	Alt_3A	40000.00	119.18	151.10	134.60	151.83	0.000443	7.46	8023.60	381.70	0.24
Reach-1	110010	50-YR	Alt_3B	40000.00	119.18	151.10	134.60	151.83	0.000443	7.46	8023.60	381.70	0.24
Reach-1	110010	50-YR	Alt_4A	40000.00	119.18	151.10	134.60	151.83	0.000443	7.46	8023.60	381.70	0.24

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: 50-YR (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	109995			Bridge									
Reach-1	109980	50-YR	EX_Gate_Open	40000.00	119.18	150.36	133.69	150.98	0.000393	6.76	8525.09	441.08	0.23
Reach-1	109980	50-YR	EX_Gate_Closed	40000.00	119.18	150.36	133.69	150.98	0.000393	6.76	8525.09	441.08	0.23
Reach-1	109980	50-YR	Alt_3A	40000.00	119.18	150.36	133.69	150.98	0.000393	6.76	8525.09	441.08	0.23
Reach-1	109980	50-YR	Alt_3B	40000.00	119.18	150.36	133.69	150.98	0.000393	6.76	8525.09	441.08	0.23
Reach-1	109980	50-YR	Alt_4A	40000.00	119.18	150.36	133.69	150.98	0.000393	6.76	8525.09	441.08	0.23
Reach-1	109930	50-YR	EX_Gate_Open	40000.00	119.18	150.41	131.87	150.88	0.000281	5.93	10064.79	666.01	0.19
Reach-1	109930	50-YR	EX_Gate_Closed	40000.00	119.18	150.41	131.87	150.88	0.000281	5.93	10064.79	666.01	0.19
Reach-1	109930	50-YR	Alt_3A	40000.00	119.18	150.41	131.87	150.88	0.000281	5.93	10064.79	666.01	0.19
Reach-1	109930	50-YR	Alt_3B	40000.00	119.18	150.41	131.87	150.88	0.000281	5.93	10064.79	666.01	0.19
Reach-1	109930	50-YR	Alt_4A	40000.00	119.18	150.41	131.87	150.88	0.000281	5.93	10064.79	666.01	0.19
Reach-1	109310	50-YR	EX_Gate_Open	40000.00	119.18	149.89	136.33	150.64	0.000640	8.70	9197.77	483.98	0.29
Reach-1	109310	50-YR	EX_Gate_Closed	40000.00	119.18	149.89	136.33	150.64	0.000640	8.70	9197.77	483.98	0.29
Reach-1	109310	50-YR	Alt_3A	40000.00	119.18	149.89	136.33	150.64	0.000640	8.70	9197.77	483.98	0.29
Reach-1	109310	50-YR	Alt_3B	40000.00	119.18	149.89	136.33	150.64	0.000640	8.70	9197.77	483.98	0.29
Reach-1	109310	50-YR	Alt_4A	40000.00	119.18	149.89		150.64	0.000640	8.70	9197.77	483.98	0.29
Reach-1	108300	50-YR	EX_Gate_Open	40000.00	118.38	149.67	133.07	150.06	0.000299	6.32	13220.98	659.65	0.20
Reach-1	108300	50-YR	EX_Gate_Closed	40000.00	118.38	149.67	133.07	150.06	0.000299	6.32	13220.98	659.65	0.20
Reach-1	108300	50-YR	Alt_3A	40000.00	118.38	149.67	133.07	150.06	0.000299	6.32	13220.98	659.65	0.20
Reach-1	108300	50-YR	Alt_3B	40000.00	118.38	149.67	133.07	150.06	0.000299	6.32	13220.98	659.65	0.20
Reach-1	108300	50-YR	Alt_4A	40000.00	118.38	149.67	133.07	150.06	0.000299	6.32	13220.98	659.65	0.20

HEC-RAS: 100-YR Output Table

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: 100-YR

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	118875	100-YR	EX_Gate_Open	50000.00	130.18	165.25	150.08	165.96	0.000461	7.69	10844.14	511.02	0.25
Reach-1	118875	100-YR	EX_Gate_Closed	50000.00	130.18	165.68	150.08	166.36	0.000436	7.55	11063.53	512.84	0.24
Reach-1	118875	100-YR	Alt_3A	50000.00	130.18	164.94	150.08	165.67	0.000479	7.79	10686.81	509.72	0.25
Reach-1	118875	100-YR	Alt_3B	50000.00	130.18	164.78	150.08	165.52	0.000489	7.84	10604.57	509.03	0.25
Reach-1	118875	100-YR	Alt_4A	50000.00	130.18	165.29		166.00	0.000458	7.67	10865.09	511.20	0.25
Reach-1	117960	100-YR	EX_Gate_Open	50000.00	128.98	164.81	146.99	165.55	0.000412	7.30	9391.78	439.24	0.23
Reach-1	117960	100-YR	EX_Gate_Closed	50000.00	128.98	165.25	146.99	165.97	0.000391	7.18	9589.58	444.24	0.23
Reach-1	117960	100-YR	Alt_3A	50000.00	128.98	164.48	146.99	165.24	0.000428	7.39	9249.76	436.99	0.24
Reach-1	117960	100-YR	Alt_3B	50000.00	128.98	164.31	146.99	165.08	0.000437	7.44	9175.52	435.80	0.24
Reach-1	117960	100-YR	Alt_4A	50000.00	128.98	164.85		165.59	0.000410	7.29	9410.69	439.54	0.23
Reach-1	117355	100-YR	EX_Gate_Open	50000.00	128.48	164.29	149.43	165.23	0.000604	8.75	9066.10	410.64	0.28
Reach-1	117355	100-YR	EX_Gate_Closed	50000.00	128.48	164.77	149.43	165.67	0.000569	8.59	9262.29	412.34	0.27
Reach-1	117355	100-YR	Alt_3A	50000.00	128.48	163.94	149.43	164.91	0.000630	8.87	8924.12	409.37	0.29
Reach-1	117355	100-YR	Alt_3B	50000.00	128.48	163.76	149.43	164.75	0.000645	8.94	8849.65	408.68	0.29
Reach-1	117355	100-YR	Alt_4A	50000.00	128.48	164.33		165.27	0.000600	8.73	9084.91	410.80	0.28
Reach-1	116355	100-YR	EX_Gate_Open	50000.00	127.58	163.24	149.74	164.53	0.000800	9.92	7565.14	369.51	0.32
Reach-1	116355	100-YR	EX_Gate_Closed	50000.00	127.58	163.78	149.74	165.01	0.000747	9.70	7766.40	371.79	0.31
Reach-1	116355	100-YR	Alt_3A	50000.00	127.58	162.84	149.74	164.17	0.000842	10.08	7418.14	367.83	0.33
Reach-1	116355	100-YR	Alt_3B	50000.00	127.58	162.63	149.74	163.99	0.000866	10.17	7340.54	366.94	0.33
Reach-1	116355	100-YR	Alt_4A	50000.00	127.58	163.29		164.57	0.000795	9.89	7584.51	369.73	0.32
Reach-1	115285	100-YR	EX_Gate_Open	50000.00	126.68	163.25	145.25	163.70	0.000275	5.91	12428.97	534.66	0.19
Reach-1	115285	100-YR	EX_Gate_Closed	50000.00	126.68	163.80	145.25	164.23	0.000257	5.78	12725.05	536.68	0.18
Reach-1	115285	100-YR	Alt_3A	50000.00	126.68	162.84	145.25	163.30	0.000289	6.00	12211.77	533.17	0.19
Reach-1	115285	100-YR	Alt_3B	50000.00	126.68	162.62	145.25	163.10	0.000297	6.05	12096.76	532.38	0.20
Reach-1	115285	100-YR	Alt_4A	50000.00	126.68	163.30		163.75	0.000273	5.89	12457.54	534.86	0.19
Reach-1	114355	100-YR	EX_Gate_Open	50000.00	125.68	163.02	143.00	163.45	0.000234	5.49	12490.17	653.85	0.18
Reach-1	114355	100-YR	EX_Gate_Closed	50000.00	125.68	163.59	143.00	164.00	0.000218	5.37	12864.93	665.13	0.17
Reach-1	114355	100-YR	Alt_3A	50000.00	125.68	162.61	143.00	163.05	0.000246	5.58	12217.88	645.49	0.18
Reach-1	114355	100-YR	Alt_3B	50000.00	125.68	162.38	143.00	162.83	0.000253	5.63	12074.66	640.88	0.18
Reach-1	114355	100-YR	Alt_4A	50000.00	125.68	163.08		163.50	0.000232	5.48	12526.15	654.94	0.18
Reach-1	113355	100-YR	EX_Gate_Open	50000.00	124.78	162.20	146.96	163.11	0.000585	8.50	10120.70	621.27	0.28
Reach-1	113355	100-YR	EX_Gate_Closed	50000.00	124.78	162.83	146.96	163.68	0.000538	8.26	10515.43	635.16	0.26
Reach-1	113355	100-YR	Alt_3A	50000.00	124.78	161.73	146.96	162.68	0.000624	8.68	9831.28	612.83	0.28
Reach-1	113355	100-YR	Alt_3B	50000.00	124.78	161.48	146.96	162.46	0.000646	8.79	9677.39	609.25	0.29
Reach-1	113355	100-YR	Alt_4A	50000.00	124.78	162.26		163.16	0.000580	8.47	10158.61	622.72	0.27
Reach-1	112360	100-YR	EX_Gate_Open	50000.00	123.55	162.18	141.55	162.55	0.000201	5.11	12733.50	546.96	0.16
Reach-1	112360	100-YR	EX_Gate_Closed	50000.00	123.55	162.81	141.55	163.16	0.000187	4.99	13081.34	552.76	0.16
Reach-1	112360	100-YR	Alt_3A	50000.00	123.55	161.71	141.55	162.09	0.000212	5.20	12476.01	542.71	0.17
Reach-1	112360	100-YR	Alt_3B	50000.00	123.55	161.45	141.55	161.84	0.000219	5.24	12338.76	540.33	0.17
Reach-1	112360	100-YR	Alt_4A	50000.00	123.55	162.24		162.61	0.000199	5.10	12767.13	547.53	0.16
Reach-1	111300	100-YR	EX_Gate_Open	50000.00	122.98	161.55	143.17	162.24	0.000375	6.90	9284.58	438.49	0.22
Reach-1	111300	100-YR	EX_Gate_Closed	50000.00	122.98	162.23	143.22	162.88	0.000346	6.73	9581.62	446.21	0.21
Reach-1	111300	100-YR	Alt_3A	50000.00	122.98	161.05	143.24	161.76	0.000398	7.03	9064.63	433.57	0.23
Reach-1	111300	100-YR	Alt_3B	50000.00	122.98	160.78	143.21	161.51	0.000412	7.10	8946.93	431.51	0.23
Reach-1	111300	100-YR	Alt_4A	50000.00	122.98	161.62		162.30	0.000372	6.88	9313.27	439.23	0.22
Reach-1	110495	100-YR	EX_Gate_Open	50000.00	122.18	161.05	142.44	161.90	0.000431	7.46	7089.83	350.15	0.24
Reach-1	110495	100-YR	EX_Gate_Closed	50000.00	122.18	161.75	142.44	162.56	0.000399	7.29	7262.27	353.80	0.23
Reach-1	110495	100-YR	Alt_3A	50000.00	122.18	160.52	142.44	161.40	0.000457	7.60	6959.81	347.41	0.24
Reach-1	110495	100-YR	Alt_3B	50000.00	122.18	160.24	142.44	161.14	0.000472	7.68	6889.60	345.92	0.25
Reach-1	110495	100-YR	Alt_4A	50000.00	122.18	161.12	142.46	161.97	0.000427	7.45	7106.65	350.51	0.24
Reach-1	110490			Inl Struct									
Reach-1	110400	100-YR	EX_Gate_Open	48700.00	119.18	154.72	133.28	155.32	0.000278	6.33	8911.29	321.34	0.19
Reach-1	110400	100-YR	EX_Gate_Closed	48700.00	119.18	154.72	133.28	155.32	0.000278	6.33	8911.29	321.34	0.19
Reach-1	110400	100-YR	Alt_3A	48700.00	119.18	154.72	133.28	155.32	0.000278	6.33	8911.29	321.34	0.19
Reach-1	110400	100-YR	Alt_3B	48700.00	119.18	154.72	133.28	155.32	0.000278	6.33	8911.29	321.34	0.19
Reach-1	110400	100-YR	Alt_4A	48700.00	119.18	154.72		155.32	0.000278	6.33	8911.29	321.34	0.19
Reach-1	110060	100-YR	EX_Gate_Open	48700.00	119.18	154.54	135.06	155.22	0.000361	7.25	10039.74	417.07	0.22
Reach-1	110060	100-YR	EX_Gate_Closed	48700.00	119.18	154.54	135.06	155.22	0.000361	7.25	10039.74	417.07	0.22
Reach-1	110060	100-YR	Alt_3A	48700.00	119.18	154.54	135.06	155.22	0.000361	7.25	10039.74	417.07	0.22
Reach-1	110060	100-YR	Alt_3B	48700.00	119.18	154.54	135.06	155.22	0.000361	7.25	10039.74	417.07	0.22
Reach-1	110060	100-YR	Alt_4A	48700.00	119.18	154.54		155.22	0.000361	7.25	10039.74	417.07	0.22
Reach-1	110010	100-YR	EX_Gate_Open	48700.00	119.18	154.32	136.14	155.16	0.000448	8.04	9283.10	400.05	0.25
Reach-1	110010	100-YR	EX_Gate_Closed	48700.00	119.18	154.32	136.14	155.16	0.000448	8.04	9283.10	400.05	0.25
Reach-1	110010	100-YR	Alt_3A	48700.00	119.18	154.32	136.14	155.16	0.000448	8.04	9283.10	400.05	0.25
Reach-1	110010	100-YR	Alt_3B	48700.00	119.18	154.32	136.14	155.16	0.000448	8.04	9283.10	400.05	0.25
Reach-1	110010	100-YR	Alt_4A	48700.00	119.18	154.32	136.14	155.16	0.000448	8.04	9283.10	400.05	0.25

HEC-RAS River: RIVER-1 Reach: Reach-1 Profile: 100-YR (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	109995			Bridge									
Reach-1	109980	100-YR	EX_Gate_Open	48700.00	119.18	153.38	135.46	154.09	0.000396	7.28	9883.32	456.90	0.23
Reach-1	109980	100-YR	EX_Gate_Closed	48700.00	119.18	153.38	135.46	154.09	0.000396	7.28	9883.32	456.90	0.23
Reach-1	109980	100-YR	Alt_3A	48700.00	119.18	153.38	135.46	154.09	0.000396	7.28	9883.32	456.90	0.23
Reach-1	109980	100-YR	Alt_3B	48700.00	119.18	153.38	135.46	154.09	0.000396	7.28	9883.32	456.90	0.23
Reach-1	109980	100-YR	Alt_4A	48700.00	119.18	153.38	135.46	154.09	0.000396	7.28	9883.32	456.90	0.23
Reach-1	109930	100-YR	EX_Gate_Open	48700.00	119.18	153.45	133.37	153.98	0.000286	6.39	11673.44	882.39	0.20
Reach-1	109930	100-YR	EX_Gate_Closed	48700.00	119.18	153.45	133.37	153.98	0.000286	6.39	11673.44	882.39	0.20
Reach-1	109930	100-YR	Alt_3A	48700.00	119.18	153.45	133.37	153.98	0.000286	6.39	11673.44	882.39	0.20
Reach-1	109930	100-YR	Alt_3B	48700.00	119.18	153.45	133.37	153.98	0.000286	6.39	11673.44	882.39	0.20
Reach-1	109930	100-YR	Alt_4A	48700.00	119.18	153.45	133.37	153.98	0.000286	6.39	11673.44	882.39	0.20
Reach-1	109310	100-YR	EX_Gate_Open	48700.00	119.18	152.90	137.85	153.74	0.000638	9.29	10690.96	506.71	0.29
Reach-1	109310	100-YR	EX_Gate_Closed	48700.00	119.18	152.90	137.85	153.74	0.000638	9.29	10690.96	506.71	0.29
Reach-1	109310	100-YR	Alt_3A	48700.00	119.18	152.90	137.85	153.74	0.000638	9.29	10690.96	506.71	0.29
Reach-1	109310	100-YR	Alt_3B	48700.00	119.18	152.90	137.85	153.74	0.000638	9.29	10690.96	506.71	0.29
Reach-1	109310	100-YR	Alt_4A	48700.00	119.18	152.90		153.74	0.000638	9.29	10690.96	506.71	0.29
Reach-1	108300	100-YR	EX_Gate_Open	48700.00	118.38	152.71	134.76	153.14	0.000300	6.74	15251.26	676.06	0.20
Reach-1	108300	100-YR	EX_Gate_Closed	48700.00	118.38	152.71	134.76	153.14	0.000300	6.74	15251.26	676.06	0.20
Reach-1	108300	100-YR	Alt_3A	48700.00	118.38	152.71	134.76	153.14	0.000300	6.74	15251.26	676.06	0.20
Reach-1	108300	100-YR	Alt_3B	48700.00	118.38	152.71	134.76	153.14	0.000300	6.74	15251.26	676.06	0.20
Reach-1	108300	100-YR	Alt_4A	48700.00	118.38	152.71	134.76	153.14	0.000300	6.74	15251.26	676.06	0.20

Appendix H

Preliminary Statement of Probable Construction Cost

PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COST
LAKE JACKSON DAM ALTERNATIVE #1 - REPLACE EXISTING RADIAL GATE
Date: July 31, 2020

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	NOTES
1	EROSION & SEDIMENT CONTROL					
	A. MOBILIZATION*	LS	1	$ 14,100.00	$ 14,100.00	2020 FFX COUNTY UNIT PRICE LIST
	B. STAGING/ACCESS AREA	AC	0.75	$ 30,000.00	$ 22,500.00	ENGINEERS ESTIMATE
	C. DOWNSTREAM COFFERDAM					
	i. ONE YARD BULK BAG	EA	240	$ 20.00	$ 4,800.00	VENDORS ESTIMATE
	ii. SAND	CY	240	$ 33.00	$ 7,920.00	RSMEANS 2020
	iii. COFFERDAM PUMPS	DAY	60	$ 155.00	$ 9,300.00	RSMEANS 2020
	iv. DIRT BAGS	EA	20	$ 75.00	$ 1,500.00	VENDORS ESTIMATE
	TOTAL:				**$ 60,120.00**	
2	DEMOLITION (RADIAL GATE)					
	A. LABOR	EA	1	$ 6,982.20	$ 6,982.20	
	B. MATS	EA	1	$ 5,400.00	$ 5,400.00	CONTRACTORS ESTIMATE
	C. FUEL	EA	1	$ 2,700.00	$ 2,700.00	
	D. DISPOSAL - TRUCKING	LCY	130	$ 10.80	$ 1,404.00	RS MEANS - 20CY TRUCK; 30 MIN WAIT; 40 MPH AVG.; CYCLE 30 MILE
	E. DISPOSAL - TIPPING	TON	102	$ 65.00	$ 6,630.00	PWC STAFF ESTIMATE
	F. EXCAVATOR (INCL. MOBILIZATION)	EA	1	$ 4,032.00	$ 4,032.00	
	G. SAWCUTTING (INCL. CREW)	EA	1	$ 26,792.36	$ 26,792.36	CONTRACTORS ESTIMATE
	H. CRANE (INCL. OPERATOR)	EA	1	$ 11,414.70	$ 11,414.70	
	I. BARGE (INCL. CREW)	EA	1	$ 85,387.50	$ 85,387.50	
				TOTAL:	**$ 150,742.76**	
3	CONSTRUCTION					
	A. MOBILIZATION*	LS	1	$ 43,785.35	$ 43,785.35	2020 FFX COUNTY UNIT PRICE LIST
	B. RADIAL GATE (INCL. APPURTENANCES AND FREIGHT)	EA	1	$ 330,000.00	$ 330,000.00	VENDOR ESTIMATE
	C. RADIAL GATE INSTALLATION	EA	1	$ 330,000.00	$ 330,000.00	ENGINEERS ESTIMATE - ASSUME 100% OF GATE COST
	D. REMOTE RADIAL GATE MONITORING AND OPERATION SYSTEM	EA	1	$ 60,000.00	$ 60,000.00	VENDOR/ENGINEERS ESTIMATE
	E. RADIAL GATE MOTORHOUSE ENCLOSURE	SF	216	$ 26.50	$ 5,724.00	RSMEANS 2020 - STEEL CLEAR SPAN
	F. THRUST PIER REPAIR (ASSUME 20 CY CONCRETE PER PEIR)	CY	40	$ 1,500.00	$ 60,000.00	ENGINEERS ESTIMATE
	G. CRANE	DAY	15	$ 582.20	$ 8,733.00	RSMEANS 2020 - SELF-PROP 20 TON CAPACITY
	H. BARGE	MO	0.5	$ 148,500.00	$ 74,250.00	CONTRACTORS ESTIMATE
				TOTAL:	**$ 912,492.35**	
				NET TOTAL:	**$ 1,123,000.00**	
				20% FOR ENGINEERING AND PERMITTING	$ 225,000.00	
				35% FOR CONTINGENCIES	$ 393,000.00	
				TOTAL:	**$ 1,741,000.00**	

Assumptions

*Mobilization price based on minimum $14,100 for estimates up to $275,000 plus 5% of amount over $275,000.

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PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COST
LAKE JACKSON DAM ALTERNATIVE #3A - REMOVE RADIAL GATE & CATWALK PIERS
Date: July 16, 2020

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	NOTES
1	EROSION & SEDIMENT CONTROL					
	A. MOBILIZATION*	LS	1	$ 14,100.00	$ 14,100.00	2020 FFX COUNTY UNIT PRICE LIST
	B. STAGING/ACCESS AREA	AC	0.75	$ 30,000.00	$ 22,500.00	ENGINEERS ESTIMATE
	C. DOWNSTREAM COFFERDAM					
	i. ONE YARD BULK BAG	EA	240	$ 20.00	$ 4,800.00	VENDORS ESTIMATE
	ii. SAND	CY	240	$ 33.00	$ 7,920.00	RSMEANS 2020
	iii. COFFERDAM PUMPS	DAY	60	$ 155.00	$ 9,300.00	RSMEANS 2020
	iv. DIRT BAGS	EA	20	$ 75.00	$ 1,500.00	VENDORS ESTIMATE
	TOTAL:				**$ 60,120.00**	
2	LOW-LEVEL DRAIN ADDITION TO POWERHOUSE					
	A. MOBILIZATION*	LS	1	$ 14,967.08	$ 14,967.08	2020 FFX COUNTY UNIT PRICE LIST
	B. DREDGE AND DEWATER					
	i. TURBIDITY CURTAIN	LF	150	$ 28.00	$ 4,200.00	IOWA CONSTRUCTION SITE EC MANUAL
	ii. DREDGING					
	a. DREDGING UPSTREAM OF POWERHOUSE	CY	444	$ 16.10	$ 7,155.56	RSMEANS 2020
	b. DISPOSAL OF DREDGED MATERIAL	CY	444	$ 17.55	$ 7,800.00	RSMEANS 2020
	iii. UPSTREAM COFFERDAM 25'X10'X16'D	SF	720	$ 56.00	$ 40,320.00	RSMEANS 2020 - 23' - 35' DEPTH, TIMBER W/BRACING
	iv. COFFERDAM PUMPS	DAY	30	$ 155.00	$ 4,650.00	RSMEANS 2020
	v. DIRT BAGS	EA	10	$ 75.00	$ 750.00	VENDORS ESTIMATE
	C. REMOVE EXISTING TURBINES	LS	1	$ 10,000.00	$ 10,000.00	ENGINEERS ESTIMATE
	D. DISPOSE OF EXISTING TURBINES	LS	1	$ 10,000.00	$ 10,000.00	ENGINEERS ESTIMATE
	E. REPAIRS TO EXISTING POWERHOUSE (CONCRETE & STEEL)**	LS	1	$ 50,000.00	$ 50,000.00	ENGINEERS ESTIMATE
	F. REPLACE TRASH RACKS	EA	2	$ 10,000.00	$ 20,000.00	ENGINEERS ESTIMATE
	G. 36"X36" SLUICE GATES	EA	2	$ 30,000.00	$ 60,000.00	ENGINEERS ESTIMATE
	H. SLUICE GATE INSTALLATION	EA	2	$ 30,000.00	$ 60,000.00	ENGINEERS ESTIMATE - ASSUME 100% OF GATE COST
	I. CRANE	DAY	30	$ 582.20	$ 17,466.00	RSMEANS 2020 - SELF-PROP 20 TON CAPACITY
				TOTAL:	**$ 307,308.63**	
3	DEMOLITION (RADIAL GATE, CATWALK, MOTORHOUSE)					
	A. LABOR	EA	1	$ 15,128.10	$ 15,128.10	
	B. MATS	EA	1	$ 11,700.00	$ 11,700.00	CONTRACTORS ESTIMATE
	C. FUEL	EA	1	$ 5,850.00	$ 5,850.00	
	D. DISPOSAL - TRUCKING	LCY	300	$ 10.80	$ 3,240.00	RS MEANS - 20CY TRUCK; 30 MIN WAIT; 40 MPH AVG.; CYCLE 30 MILE
	E. DISPOSAL - TIPPING	TON	318	$ 65.00	$ 20,670.00	PWC STAFF ESTIMATE
	F. EXCAVATOR (INCL. MOBILIZATION)	EA	1	$ 8,736.00	$ 8,736.00	
	G. SAWCUTTING (INCL. CREW)	EA	1	$ 58,050.10	$ 58,050.10	CONTRACTORS ESTIMATE
	H. CRANE (INCL. OPERATOR)	EA	1	$ 24,731.85	$ 24,731.85	
	I. BARGE (INCL. CREW)	EA	1	$ 185,006.25	$ 185,006.25	
				TOTAL:	**$ 333,112.30**	
4	CONCRETE SURFACE PATCHING					
	A. MOBILIZATION*	LS	1	$ 19,568.30	$ 19,568.30	2020 FFX COUNTY UNIT PRICE LIST
	B. OGEE SPILLWAY SECTION (BUILD OVER EX. GATE CREST)	CY	213	$ 1,000.00	$ 213,000.00	ENGINEERS ESTIMATE
	C. PATCHING - CATWALK PIER FOOTINGS	SF	108	$ 50.00	$ 5,400.00	STRUCTURAL ENGINEERS ESTIMATE
	D. CRANE	DAY	30	$ 582.20	$ 17,466.00	RSMEANS 2020 - SELF-PROP 20 TON CAPACITY
	E. BARGE	MO	1	$ 148,500.00	$ 148,500.00	CONTRACTORS ESTIMATE
					$ 403,934.30	

PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COST
LAKE JACKSON DAM ALTERNATIVE #3A - REMOVE RADIAL GATE & CATWALK PIERS
Date: July 16, 2020

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	NOTES
5	MISCELLANEOUS					
	A. WARNING BUOYS	LS	1.00	$ 25,000.00	$ 25,000.00	PWC STAFF ESTIMATE
	TOTAL:				**$ 25,000.00**	
				NET TOTAL:	**$ 1,129,000.00**	
				20% FOR ENGINEERING AND PERMITTING	$ 226,000.00	
				35% FOR CONTINGENCIES	$ 395,000.00	
				TOTAL:	**$ 1,750,000.00**	

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Assumptions

*Mobilization price based on minimum $14,100 for estimates up to $275,000 plus 5% of amount over $275,000.

**Assumes that repairs are limited to issues identified during Powerhouse Inspection (2020). Add'n issues may be identified as dredging and repairs commence.

PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COST
LAKE JACKSON DAM ALTERNATIVE #3B - REMOVE RADIAL GATE, CATWALK PIERS, & THRUST PIERS
Date: July 16, 2020

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	NOTES
1	EROSION & SEDIMENT CONTROL					
	A. MOBILIZATION*	LS	1	$ 14,100.00	$ 14,100.00	2020 FFX COUNTY UNIT PRICE LIST
	B. STAGING/ACCESS AREA	AC	0.75	$ 30,000.00	$ 22,500.00	ENGINEERS ESTIMATE
	C. DOWNSTREAM COFFERDAM					
	i. ONE YARD BULK BAG	EA	240	$ 20.00	$ 4,800.00	VENDORS ESTIMATE
	ii. SAND	CY	240	$ 33.00	$ 7,920.00	RSMEANS 2020
	iii. COFFERDAM PUMPS	DAY	60	$ 155.00	$ 9,300.00	RSMEANS 2020
	iv. DIRT BAGS	EA	20	$ 75.00	$ 1,500.00	VENDORS ESTIMATE
	TOTAL:				**$ 60,120.00**	
2	LOW-LEVEL DRAIN ADDITION TO POWERHOUSE					
	A. MOBILIZATION*	LS	1	$ 14,967.08	$ 14,967.08	2020 FFX COUNTY UNIT PRICE LIST
	B. DREDGE AND DEWATER					
	i. TURBIDITY CURTAIN	LF	150	$ 28.00	$ 4,200.00	IOWA CONSTRUCTION SITE EC MANUAL
	ii. DREDGING					
	a. DREDGING UPSTREAM OF POWERHOUSE	CY	444	$ 16.10	$ 7,155.56	RSMEANS 2020
	b. DISPOSAL OF DREDGED MATERIAL	CY	444	$ 17.55	$ 7,800.00	RSMEANS 2020
	iii. UPSTREAM COFFERDAM 25'X10'X16'D	SF	720	$ 56.00	$ 40,320.00	RSMEANS 2020 - 23' - 35' DEPTH, TIMBER W/BRACING
	iv. COFFERDAM PUMPS	DAY	30	$ 155.00	$ 4,650.00	RSMEANS 2020
	v. DIRT BAGS	EA	10	$ 75.00	$ 750.00	VENDORS ESTIMATE
	C. REMOVE EXISTING TURBINES	LS	1	$ 10,000.00	$ 10,000.00	ENGINEERS ESTIMATE
	D. DISPOSE OF EXISTING TURBINES	LS	1	$ 10,000.00	$ 10,000.00	ENGINEERS ESTIMATE
	E. REPAIRS TO EXISTING POWERHOUSE (CONCRETE & STEEL)**	LS	1	$ 50,000.00	$ 50,000.00	ENGINEERS ESTIMATE
	F. REPLACE TRASH RACKS	EA	2	$ 10,000.00	$ 20,000.00	ENGINEERS ESTIMATE
	G. 36"X36" SLUICE GATES	EA	2	$ 30,000.00	$ 60,000.00	ENGINEERS ESTIMATE
	H. SLUICE GATE INSTALLATION	EA	2	$ 30,000.00	$ 60,000.00	ENGINEERS ESTIMATE - ASSUME 100% OF GATE COST
	I. CRANE	DAY	30	$ 582.20	$ 17,466.00	RSMEANS 2020 - SELF-PROP 20 TON CAPACITY
				TOTAL:	**$ 307,308.63**	
3	DEMOLITION (RADIAL GATE, CATWALK, MOTORHOUSE, THRUST PIERS)					
	A. LABOR	EA	1	$ 23,274.00	$ 23,274.00	CONTRACTORS ESTIMATE ASSUME 2 MONTH DURATION
	B. MATS	EA	1	$ 18,000.00	$ 18,000.00	
	C. FUEL	EA	1	$ 9,000.00	$ 9,000.00	
	D. DISPOSAL - TRUCKING	LCY	565	$ 10.80	$ 6,102.00	RS MEANS - 20CY TRUCK; 30 MIN WAIT; 40 MPH AVG.; CYCLE 30 MILE
	E. DISPOSAL - TIPPING	TON	703	$ 65.00	$ 45,695.00	PWC STAFF ESTIMATE
	F. EXCAVATOR (INCL. MOBILIZATION)	EA	1	$ 13,440.00	$ 13,440.00	CONTRACTORS ESTIMATE ASSUME 2 MONTH DURATION
	G. SAWCUTTING (INCL. CREW)	EA	1	$ 89,307.85	$ 89,307.85	
	H. CRANE (INCL. OPERATOR)	EA	1	$ 38,049.00	$ 38,049.00	
	I. BARGE (INCL. CREW)	EA	1	$ 284,625.00	$ 284,625.00	
				TOTAL:	**$ 527,492.85**	
4	CONCRETE SURFACE PATCHING					
	A. MOBILIZATION*	LS	1	$ 21,068.30	$ 21,068.30	2020 FFX COUNTY UNIT PRICE LIST
	B. OGEE SPILLWAY SECTION (BUILD OVER EX. GATE CREST)	CY	213	$ 1,000.00	$ 213,000.00	ENGINEERS ESTIMATE
	C. PATCHING - CATWALK PIER FOOTINGS	SF	108	$ 50.00	$ 5,400.00	STRUCTURAL ENGINEERS ESTIMATE
	D. PATCHING - THRUST PIER FOOTINGS	SF	600	$ 50.00	$ 30,000.00	STRUCTURAL ENGINEERS ESTIMATE
	E. CRANE	DAY	30	$ 582.20	$ 17,466.00	RSMEANS 2020 - SELF-PROP 20 TON CAPACITY
	F. BARGE	MO	1	$ 148,500.00	$ 148,500.00	CONTRACTORS ESTIMATE
					$ 435,434.30	

PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COST
LAKE JACKSON DAM ALTERNATIVE #3B - REMOVE RADIAL GATE, CATWALK PIERS, & THRUST PIERS
Date: July 16, 2020

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	NOTES
5	MISCELLANEOUS					
	A. WARNING BUOYS	LS	1.00	$ 25,000.00	$ 25,000.00	PWC STAFF ESTIMATE
	TOTAL:				**$ 25,000.00**	
				NET TOTAL:	**$ 1,355,000.00**	
				20% FOR ENGINEERING AND PERMITTING	$ 271,000.00	
				35% FOR CONTINGENCIES	$ 474,000.00	
				TOTAL:	**$ 2,100,000.00**	

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Assumptions

*Mobilization price based on minimum $14,100 for estimates up to $275,000 plus 5% of amount over $275,000.

**Assumes that repairs are limited to issues identified during Powerhouse Inspection (2020). Add'n issues may be identified as dredging and repairs commence.

PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COST
LAKE JACKSON DAM ALTERNATIVE #4A - REMOVE RADIAL GATE & REPLACE WITH WEIR
Date: July 16, 2020

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	NOTES
1	EROSION & SEDIMENT CONTROL					
	A. MOBILIZATION*	LS	1	$ 14,100.00	$ 14,100.00	2020 FFX COUNTY UNIT PRICE LIST
	B. STAGING/ACCESS AREA	AC	0.75	$ 30,000.00	$ 22,500.00	ENGINEERS ESTIMATE
	C. DOWNSTREAM COFFERDAM					
	i. ONE YARD BULK BAG	EA	240	$ 20.00	$ 4,800.00	VENDORS ESTIMATE
	ii. SAND	CY	240	$ 33.00	$ 7,920.00	RSMEANS 2020
	iii. COFFERDAM PUMPS	DAY	60	$ 155.00	$ 9,300.00	RSMEANS 2020
	iv. DIRT BAGS	EA	20	$ 75.00	$ 1,500.00	VENDORS ESTIMATE
	TOTAL:				**$ 60,120.00**	
2	LOW-LEVEL DRAIN ADDITION TO POWERHOUSE					
	A. MOBILIZATION*	LS	1	$ 14,967.08	$ 14,967.08	2020 FFX COUNTY UNIT PRICE LIST
	B. DREDGE AND DEWATER					
	i. TURBIDITY CURTAIN	LF	150	$ 28.00	$ 4,200.00	IOWA CONSTRUCTION SITE EC MANUAL
	ii. DREDGING					
	a. DREDGING UPSTREAM OF POWERHOUSE	CY	444	$ 16.10	$ 7,155.56	RSMEANS 2020
	b. DISPOSAL OF DREDGED MATERIAL	CY	444	$ 17.55	$ 7,800.00	RSMEANS 2020
	iii. UPSTREAM COFFERDAM 25'X10'X16'D	SF	720	$ 56.00	$ 40,320.00	RSMEANS 2020 - 23' - 35' DEPTH, TIMBER W/BRACING
	iv. COFFERDAM PUMPS	DAY	30	$ 155.00	$ 4,650.00	RSMEANS 2020
	v. DIRT BAGS	EA	10	$ 75.00	$ 750.00	VENDORS ESTIMATE
	C. REMOVE EXISTING TURBINES	LS	1	$ 10,000.00	$ 10,000.00	ENGINEERS ESTIMATE
	D. DISPOSE OF EXISTING TURBINES	LS	1	$ 10,000.00	$ 10,000.00	ENGINEERS ESTIMATE
	E. REPAIRS TO EXISTING POWERHOUSE (CONCRETE & STEEL)**	LS	1	$ 50,000.00	$ 50,000.00	ENGINEERS ESTIMATE
	F. REPLACE TRASH RACKS	EA	2	$ 10,000.00	$ 20,000.00	ENGINEERS ESTIMATE
	G. 36"X36" SLUICE GATES	EA	2	$ 30,000.00	$ 60,000.00	ENGINEERS ESTIMATE
	H. SLUICE GATE INSTALLATION	EA	2	$ 30,000.00	$ 60,000.00	ENGINEERS ESTIMATE - ASSUME 100% OF GATE COST
	I. CRANE	DAY	30	$ 582.20	$ 17,466.00	RSMEANS 2020 - SELF-PROP 20 TON CAPACITY
				TOTAL:	**$ 307,308.63**	
3	DEMOLITION (RADIAL GATE)					
	A. LABOR	EA	1	$ 6,982.20	$ 6,982.20	
	B. MATS	EA	1	$ 5,400.00	$ 5,400.00	CONTRACTORS ESTIMATE
	C. FUEL	EA	1	$ 2,700.00	$ 2,700.00	
	D. DISPOSAL - TRUCKING	LCY	130	$ 10.80	$ 1,404.00	RS MEANS - 20CY TRUCK; 30 MIN WAIT; 40 MPH AVG.; CYCLE 30 MILE
	E. DISPOSAL - TIPPING	TON	102	$ 65.00	$ 6,630.00	PWC STAFF ESTIMATE
	F. EXCAVATOR (INCL. MOBILIZATION)	EA	1	$ 4,032.00	$ 4,032.00	
	G. SAWCUTTING (INCL. CREW)	EA	1	$ 26,792.36	$ 26,792.36	CONTRACTORS ESTIMATE
	H. CRANE (INCL. OPERATOR)	EA	1	$ 11,414.70	$ 11,414.70	
	I. BARGE (INCL. CREW)	EA	1	$ 85,387.50	$ 85,387.50	
				TOTAL:	**$ 150,742.76**	
4	CONCRETE SURFACE PATCHING					
	A. MOBILIZATION*	LS	1	$ 14,100.00	$ 14,100.00	2020 FFX COUNTY UNIT PRICE LIST
	B. CONSTRUCT FIXED CREST WEIR (BUILD 1' BELOW EX. GATE CREST)	CY	8	$ 1,000.00	$ 8,333.33	ENGINEERS ESTIMATE - 25' x 9' x 1'
	E. THRUST PIER REPAIR (ASSUME 20 CY CONCRETE PER PEIR)	CY	40	$ 1,500.00	$ 60,000.00	ENGINEERS ESTIMATE
	C. CRANE	DAY	15	$ 582.20	$ 8,733.00	RSMEANS 2020 - SELF-PROP 20 TON CAPACITY
	D. BARGE	MO	0.5	$ 148,500.00	$ 74,250.00	CONTRACTORS ESTIMATE
					$ 165,416.33	

PRELIMINARY STATEMENT OF PROBABLE CONSTRUCTION COST
LAKE JACKSON DAM ALTERNATIVE #4A - REMOVE RADIAL GATE & REPLACE WITH WEIR
Date: July 16, 2020

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT	NOTES
5	MISCELLANEOUS					
	A. WARNING BUOYS	LS	1.00	$ 25,000.00	$ 25,000.00	PWC STAFF ESTIMATE
	TOTAL:				**$ 25,000.00**	
				NET TOTAL:	**$ 709,000.00**	
				20% FOR ENGINEERING AND PERMITTING	$ 142,000.00	
				35% FOR CONTINGENCIES	$ 248,000.00	
				TOTAL:	**$ 1,099,000.00**	

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Assumptions

*Mobilization price based on minimum $14,100 for estimates up to $275,000 plus 5% of amount over $275,000.

**Assumes that repairs are limited to issues identified during Powerhouse Inspection (2020). Add'n issues may be identified as dredging and repairs commence.

Appendix I

Estimated 40-Year Operations & Maintenance Costs of Manually-Operated Radial Gate

HISTORICAL AND PROJECTED OPERATIONS & MAINTENANCE COSTS
LAKE JACKSON DAM WITH MANUALLY-OPERATED RADIAL GATE
Date: September 14, 2020

ITEM NO.	ITEM DESCRIPTION	AMOUNT	NOTES
1	GATE OPERATION		
	FY20 (YTD)	$ 44,147	PWC HISTORICAL EXPENDITURES
	FY19	$ 176,118	
	FY18	$ 104,392	
	FY17	$ 43,784	
	OPERATIONS TOTAL:	$ 368,441	
	ANNUAL AVERAGE OPERATIONS COST:	$ 105,269	(STANDARD MEAN)
	40-YEAR PROJECTED TOTAL GATE OPERATION COST (NO INFLATION):	**$ 4,210,754**	
	40-YEAR PROJECTED TOTAL GATE OPERATION COST (2% ANN. INFLATION):	**$ 6,358,448**	
2	DAM MAINTENANCE		
	FY20 (YTD) - CONSULTANT SERVICES	$ 30,828	PWC HISTORICAL EXPENDITURES
	FY19 - SERVICE GATE TRUNNION BEARINGS, GATE CHAIN WORK	$ 100,291	
	FY18 - GATE STICKING, REPAIR CONCRETE AROUND GATE	$ 40,950	
	FY17 - CONSULTANT SERVICES	$ 2,125	
	FY14 - FILL DAM CHAMBERS WITH CONCRETE	$ 1,034,148	
	FY13 - CONSULTANT SERVICES	$ 112,321	
	FY12 - CONCRETE REPAIR, LEAKING GATE SEAL	$ 412,693	
	FY11 - CONCRETE REPAIR	$ 248,210	
	FY10 - CONSULTANT SERVICES	$ 13,381	
	MAINTENANCE TOTAL:	$ 1,994,947	
	ANNUAL AVERAGE MAINTENANCE COST:	$ 136,953	(MODIFIED MEAN*)
	40-YEAR PROJECTED TOTAL DAM MAINTENANCE COST (NO INFLATION):	**$ 5,478,137**	
	40-YEAR PROJECTED TOTAL DAM MAINTENANCE COST (2% INFLATION):	**$ 8,272,259**	

1 + 2	OPERATION & MAINTENANCE TOTAL:	$ 2,363,388	
	ANNUAL AVERAGE OPERATION & MAINTENANCE COST:	$ 242,222	
	40-YEAR PROJECTED TOTAL OPERATION & MAINTENANCE (NO INFLATION):	**$ 9,688,891**	
	40-YEAR PROJECTED TOTAL OPERATION & MAINTENANCE (2% ANN. INFLATION):	**$ 14,630,706**	

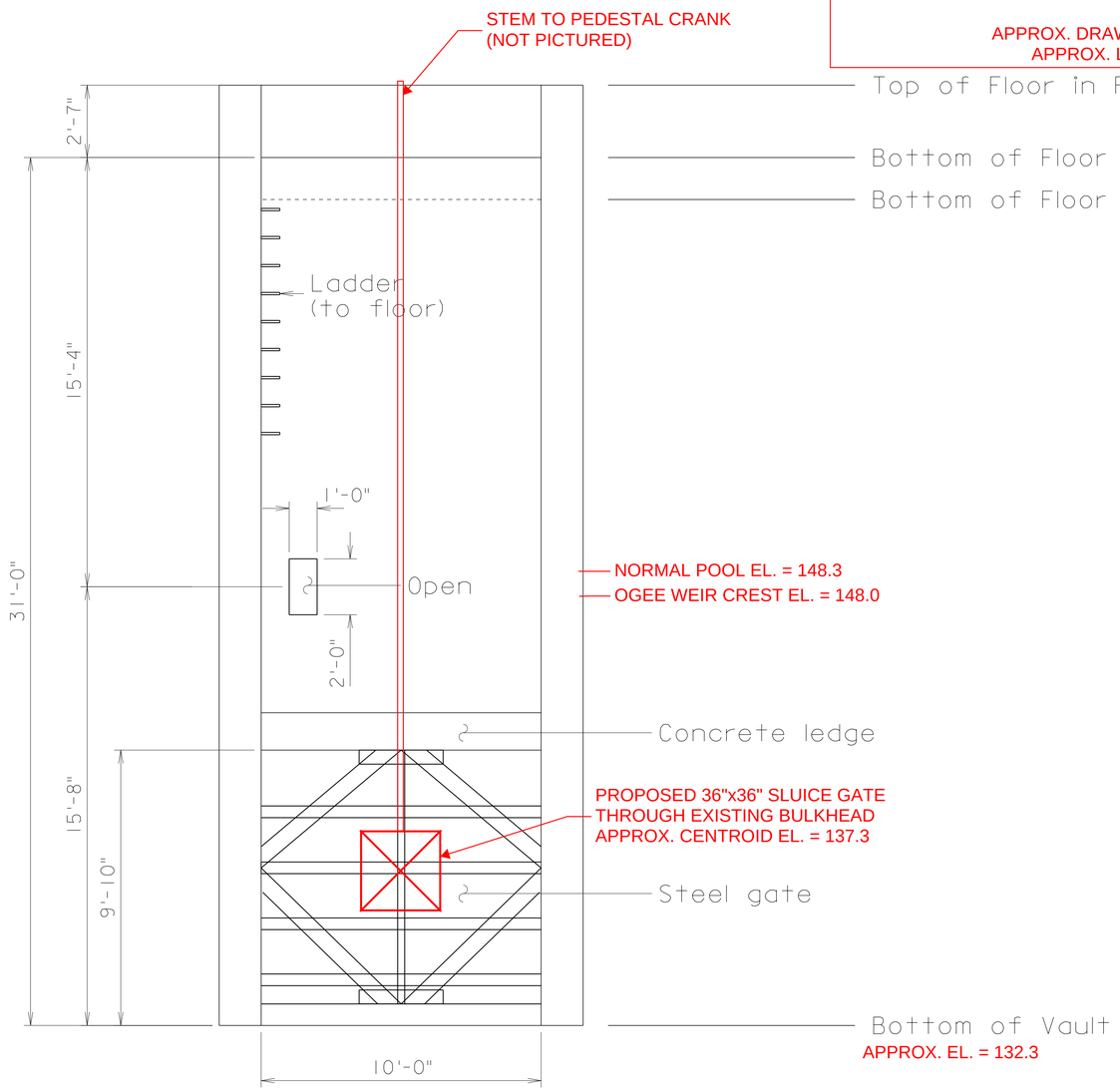
*Outliers removed from computation (highest value $1.034M and lowest value $2K).

Appendix J

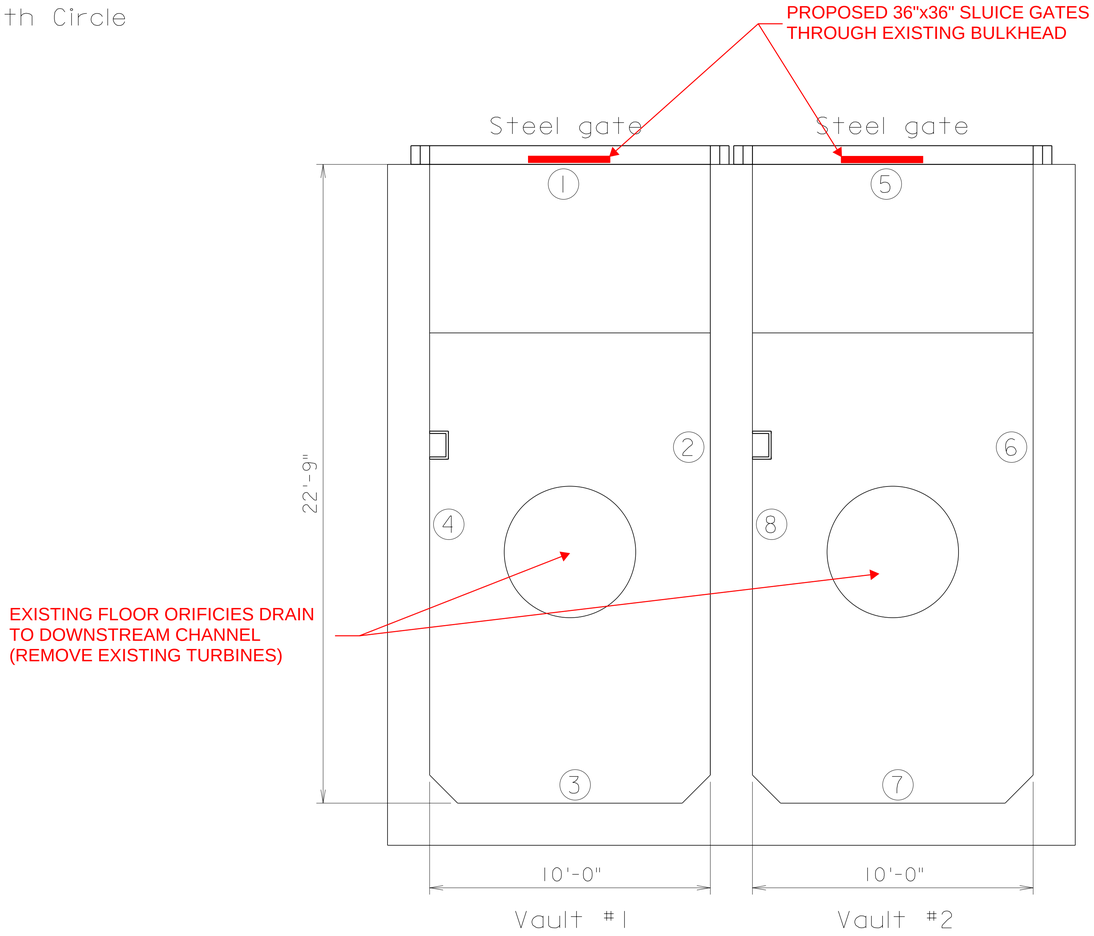
Low-Level Drain
Conceptual Details

LAKE JACKSON DAM PROPOSED LOW-LEVEL DRAIN
2 X 36" X 36" SLUICE GATES
INSTALLED ON EXISTING STEEL BULKHEADS ON POWERHOUSE

APPROX. DRAW DOWN TIME (BASE FLOW) = 7 DAYS
APPROX. LAKE LEVEL REDUCTION = 9.5 FT



SKETCH - GATE WALL ELEVATION



SKETCH - PLAN VIEW

Appendix K

Responses to Citizen Questions

The following questions were posed by the Lake Jackson Citizens Association. The responses are listed below and have also been incorporated into the technical memo narrative (sections 2, 3, and 6).

1. **How much impact does operation of the existing radial gate have on flood elevations?**
    a. Hydraulic modeling performed for this technical memo includes a scenario (No. 1) in which an upgraded radial gate is opened to its maximum height during storm events and a scenario (No. 2) in which the existing radial gate is left closed during storm events. The results of these two scenarios can be compared to provide an approximate measure of the impact of operation of the existing gate on flood elevations.
        i. For example, the 100-year flood elevation immediately upstream of the dam is 161.05' when the radial gate is fully opened during the 100-year storm, while the 100-year flood elevation is 161.75' when the radial gate is closed. Fully opening the radial gate lowers the 100-year flood elevation by approximately 8.4" (0.7') as compared to leaving the radial gate closed during the storm event.
        ii. Operation of the radial gate during smaller (higher-frequency) storm events has a proportionally greater impact when comparing the two scenarios. For example, the 2-year flood elevation immediately upstream of the dam is 149.64' when the radial gate is fully opened during the 2-year storm, while the 2-year flood elevation is 151.33' when the radial gate is closed. Fully opening the radial gate lowers the 2-year flood elevation by approximately 1.69' (20.3") as compared to leaving the radial gate closed during the storm event.
    b. Storms smaller than the 2-year storm were not modeled for this technical memo. However, operation of the existing radial gate would be expected to have proportionally greater impact as storm frequency increases.

2. **What impact will removal of the radial gate have on sediment accumulation upstream and downstream of the dam?**
    a. While the extent of existing sediment accumulation in Lake Jackson was not quantified for this study and analysis of sediment accumulation was not included in this technical memo, several assumptions might be made about the impact the removal of the radial gate could have on sediment accumulation.
        i. When the existing radial gate is opened, sediment that has built up in front of the gate is washed downstream. This flushing action presumably keeps a "middle channel" in Lake Jackson free from additional sediment accumulation, extending upstream of the gate for some limited distance.
        ii. Sediment accumulations located just upstream and below the existing radial gate crest and to the sides of the gate (towards the shorelines) are likely less affected by operation of the existing radial gate as those areas experience lower flow velocity and less flushing action when the gate is opened.
        iii. If operation of the existing radial gate ceased entirely or if the radial gate were replaced with a solid weir wall, sediment accumulation would be expected in

areas that were previously flushed out when the radial gate was opened. However, several alternatives described in this technical memo include provisions that would mitigate increased sediment accumulation to some extent.

1. In Scenario No. 2, the existing radial gate would no longer be raised during normal storm events, but it would be operated on a scheduled maintenance basis or during emergency storm events. The gate maintenance schedule could be based on both an annual test of the gate's functionality as well as an established frequency of gate operation to facilitate sediment flushing from Lake Jackson as it currently occurs. However, less frequent operation of the gate could result in a larger quantity of sediment being released downstream during each gate opening event, due to the longer time available for sediment deposition/accumulation. Therefore, opening the gate during a period of low flow, after an extended period of sediment accumulation, could result in detrimental environmental impacts downstream and should therefore be avoided.
2. In Scenario No. 4A, the existing radial gate would be removed and replaced with a fixed-crest concrete weir wall. The design of such a weir wall could include a low-level drain, such as a sluice gate, to permit lowering of the lake level during maintenance activities. The sluice gate could provide similar functionality for flushing sediment from the area immediately upstream of the gate. However, the sluice gate would be smaller than the existing radial gate and would therefore be expected to flush a smaller amount and/or footprint of accumulated sediment upstream of the dam.

b. A detailed sediment study of Lake Jackson, including a bathymetric survey of the lake bottom, sediment sampling and characterization, and hydraulic modeling of sediment transport through the lake, could be performed to confirm and better quantify the assumptions listed above.

3. What, if any, environmental impacts can be expected as a result of either complete removal of the radial gate or changes in its operation? In particular, what impacts will removal of the radial gate have on fish life within Lake Jackson?

a. In general, changes in gate operation are expected to have minimal impact on fish life within Lake Jackson, particularly in those areas further upstream from the dam. However, an ecological or biological professional, such as an ichthyologist, could be engaged to perform a detailed study of the Lake Jackson ecosystem and assess the potential impacts of changes in dam operation and maintenance on existing fish populations.

b. Informal discussions with Dewberry environmental permitting staff indicate that removal of the radial gate or changes in its operation would most likely be considered a maintenance activity that does not significantly impact the site's function. In this case, no environmental studies or permits would be required prior to construction.

4. How do you determine what lake level to establish when designing the crest of the spillway?

a. Alternatives 1 – 4A presented in this technical memo were selected with the primary goal of causing minimal change to the normal pool elevation of the lake. This minimizes adverse impacts to structures such as docks along the existing shoreline and maintains the aesthetic nature of the lake. Alternatives 1, 2, 3A and 3B maintain the normal pool level between elevation 147.2' and 147.3', which is consistent with the existing normal pool elevation. Alternative 4A results in a slight reduction (approximately 4") in the normal pool elevation from 147.27' to 146.94'.

5. What would the average rate of flow over the spillway be compared to the current average flow?

a. The alternatives presented in this technical memo would cause little or no change in the average annual flow or base flow over the dam. No flow would be diverted from or added to the lake before it reaches the spillway. Base flows out of Lake Jackson would continue to be conveyed over the dam at or near the current normal pool elevation.