



HISTORY OF CONSTRUCTION

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HISTORY OF CONSTRUCTION

**Bremo Power Station CCR Surface Impoundment:
West Ash Pond**



Submitted To: Bremo Power Station
1038 Bremo Bluff Road
Bremo Bluff, VA 23022

Submitted By: Golder Associates Inc.
2108 W. Laburnum Avenue, Suite 200
Richmond, VA 23227

April 2018

Project No. 15-20347





Table of Contents

1.0	Certification	1
2.0	Introduction	2
3.0	History of Construction.....	2
3.1	CCR Unit	2
3.2	Watershed.....	3
3.3	Foundation and Abutments.....	3
3.4	Construction Details	4
3.5	Engineering Drawings.....	5
3.6	Instrumentation	5
3.7	Stage-Storage Capacity Curve	5
3.8	Diversion and Spillway Details.....	6
3.9	Surveillance, Maintenance, and Repair	7
3.10	Structural Instability.....	7

Tables

Table 1	Summary of Primary Geotechnical Testing Data
Table 2	Summary of Secondary Geotechnical Data
Table 3	Stage-Storage Capacity

Figures

Figure 1	Stage-Storage Capacity Curve
Figure 2	Outlet Structure Rating

Appendices

Appendix A	Site Location Map
Appendix B	West Ash Pond Historical Record Drawings
Appendix C	West Ash Pond Existing Conditions Drawings

1.0 CERTIFICATION

This History of Construction for the Bremo Power Station's West Ash Pond was prepared by Golder Associates Inc. (Golder). The document and Certification/Statement of Professional Opinion are based on and limited to information that Golder has relied on from Dominion Energy and others, but not independently verified, as well as work products produced by Golder.

On the basis of and subject to the foregoing, it is my professional opinion as a Professional Engineer licensed in the Commonwealth of Virginia that this document has been prepared in accordance with good and accepted engineering practices as exercised by other engineers practicing in the same discipline(s), under similar circumstances, at the same time, and in the same locale. It is my professional opinion that the document was prepared consistent with the requirements in §257.73(c) of the United States Environmental Protection Agency's (EPA's) "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" published in the Federal Register on April 17, 2015 with an effective date of October 19, 2015 [40 CFR §257.73(c)], as well as with the requirements in §257.100 resulting from the EPA's "Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; Extension of Compliance Deadlines for Certain Inactive Surface Impoundments; Response to Partial Vacatur" published in the Federal Register on August 5, 2016 with an effective date of October 4, 2016 (40 CFR §257.100).

The use of the word "certification" and/or "certify" in this document shall be interpreted and construed as a Statement of Professional Opinion, and is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

Daniel McGrath

Print Name

Associate and Senior Consultant

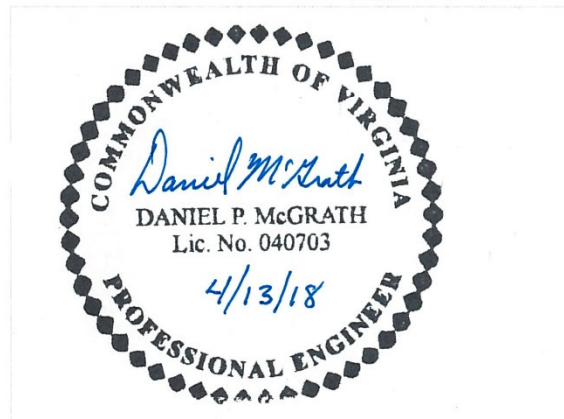
Title

Daniel McGrath

Signature

4/13/18

Date



2.0 INTRODUCTION

This History of Construction was prepared for the Bremo Power Station's (Station) inactive Coal Combustion Residuals (CCR) surface impoundment, the West Ash Pond (WAP). This History of Construction was prepared in accordance with 40 CFR Part §257, Subpart D and is consistent with the requirements of 40 CFR §257.73(c) and 40 CFR §257.100(e)(3)(iv).

The Station, owned and operated by Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion), is located in Fluvanna County at 1038 Bremo Road, east of Route 15 (James Madison Highway) and north of the James River. The Station includes an inactive CCR surface impoundment, the WAP, as defined by the Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule and Direct Final Rule (40 CFR §257; the CCR rule). All elevations noted in this report are in feet relative to the North American Vertical Datum of 1988 (NAVD-88).

3.0 HISTORY OF CONSTRUCTION

3.1 CCR Unit

The WAP is located at the Station, as shown in the attached 2013 United States Geological Survey (USGS) 7½-minute topographic quadrangle map (Appendix A). The WAP is owned and operated by Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion). Dominion's address, as well as contact information for the Station, are provided below.

Virginia Electric and Power Company
5000 Dominion Boulevard
Glen Allen, VA 23060

Mr. David A. Craymer
Vice President, Power Generation System Operations
Virginia Electric and Power Company
5000 Dominion Boulevard
Glen Allen, VA 23060

The WAP was used as a water treatment pond to settle and manage low-volume wastewaters including CCR. In 2014, the Station converted from a coal-fired power plant to a natural gas-fired power plant. No new CCR has been placed in the WAP after the conversion.

The WAP surface impoundment is regulated under the following permits:

- Virginia Department of Environmental Quality (DEQ) Virginia Pollutant Discharge Elimination System (VPDES) Permit No. VA0004138
- DEQ VPDES Construction General Permit No. VAR10H875
- Virginia Department of Conservation and Recreation (DCR) Operations and Maintenance Certificate, Inventory No. 06511

The long-term management of the WAP, which includes closure and groundwater monitoring, will be governed by the Virginia DEQ Solid Waste Management Regulations (VSWMR) Permit No. 618, once issued. Embankments remaining after closure activities will continue to be regulated by DCR under the Impounding Structure Regulations (4VAC50-20 *et seq.*) if required based on final height and impounded volume.

3.2 Watershed

The WAP is located within the Middle James – Buffalo Watershed (USGS Hydrologic Unit Code 02080203), which is approximately 1,273,600 acres. The WAP has a contributing drainage area of approximately 17.1 acres.

3.3 Foundation and Abutments

The WAP was constructed by excavating into the alluvial terrace and using the excavated material to construct the pond embankments. In the alluvial terrace around the pond, alluvial soils generally consisting of clayey silts were encountered, and appear to occur in thicknesses ranging up to about 20 feet where not removed from the excavated areas. A few borings encountered rounded gravel in what was interpreted to be the bottom of the alluvial deposit. Borrow activities for the pond may have thinned the clayey silts and/or locally exposed underlying gravel channels or residual materials. The clayey silts would generally be of relatively low permeability compared to other materials, especially zones of alluvial gravel, fractured rock, or disintegrated rock. The natural soil material from the pond footprint, used for the embankment fill, consists of low-plasticity fines (CL and ML) with increasing amounts of sand with fines (SM and SC). The WAP dikes were generally observed to contain well compacted materials.

The WAP embankment soil fill material properties were interpreted based on subsurface data and site reconnaissance taken from previous Golder investigations, analyses, and reports included in Golder's March 2017 Virginia Department of Conservation and Recreation (DCR) Impounding Structure Geotechnical Design Report Supporting Documents (Golder 2017), and are presented in Tables 1 and 2 below.

Table 1: Summary of Primary Geotechnical Testing Data

Property	No. Tests	Min.	Max.	Avg.	Median
Depth Range (ft)	-	9.5	34.5	22.3	22.9
Water Content (%)	6	22	26	24	23
Gravel (> 4.75 mm) (%)	2	0	0	0	0
Sand (%)	2	11	32	21	21
Fines (< 0.075 mm) (%)	4	59	90	75	75
Specific Gravity	1	2.72	2.72	2.72	2.72
Liquid Limit (LL) (%)	5	28	41	34	35
Plastic Limit (PL) (%)	5	19	25	22	23
Plasticity Index (PI)	5	8	17	11	11
Non-plastic Results	0	0 of 5			

Table 2: Summary of Secondary Geotechnical Data

Property		No. of Points	Min.	Max.	Avg.	Median
Drilling	SPT N (bpf)	17	4	25	11	9
CPT Based	Peak ϕ' ($^{\circ}$)	1213	26.0	47.5	34.8	34.3
	Su (tsf)		0.4	4.7	1.7	1.7
	SPT N_{60} (bpf)		3	23	10	10
	Norm. CPT Tip (Qtn)		5.8	520.0	58.3	33.1
Secondary Laboratory Testing Data						
Sample ID & Depth (ft)	Sample Description		Effective Strength		Total Strength	
WB-01 UD-1 20.6-21.9 ft	Dike Fill, (ML) CLAYEY SILT		$\phi' = 28.3^{\circ}$ $c' = 0.7$ psi		$\phi = 23.2^{\circ}$ $c = 0.0$ psi	

3.4 Construction Details

The WAP was constructed in the late 1970's by excavating into the alluvial terrace and using the excavated material from within the pond footprint to construct the pond embankments. The natural terrace elevation was approximately 220 feet north of the pond and sloped to approximately 217 feet south of the pond. The pond was excavated roughly 6 feet below grade, in the elevation range of 209 to 214 feet. The WAP dike crest elevation is approximately 234 feet. The dikes were constructed at a slope of approximately 2 horizontal to 1 vertical (2H:1V). The Station has typically used the WAP to store CCR materials for a few years, and then dredge and hydraulically convey the CCR to the North Ash Pond, an existing CCR surface impoundment located at the Station. Detailed documentation of dredging is not available; however, dredging operations may have removed some natural bottom materials leaving the bottom of the pond deeper and more irregular than indicated on historic drawings.

The primary spillway system is further discussed in Section 3.8. Historical record drawings for the construction of the WAP are provided in Appendix B.

3.5 Engineering Drawings

Current detailed dimensional drawings of the WAP's existing conditions, extracted from Golder 2017, are provided in Appendix C.

3.6 Instrumentation

A groundwater monitoring network of eight wells is installed around the pond.

3.7 Stage-Storage Capacity Curve

The WAP storage volume was computed based on the existing conditions, as surveyed in December 2017. The ash has been excavated, and available water storage was based on the post-excavation surface contours. The maximum available storage in the pond is 421.6 acre-feet at elevation 234.0. The WAP stage-storage capacity data are provided in Table 3 and Figure 1, below.

Table 3: Stage-Storage Capacity

Elevation	Area, square feet (sf)	Incremental Volume, cubic feet (ft ³)	Incremental Volume, Ac-Ft	Cumulative Volume, Ac-Ft
234	742,645	1,473,741	33.83	421.57
232	731,113	1,449,186	33.27	387.74
230	718,094	1,423,290	32.67	354.47
228	705,217	1,397,739	32.09	321.80
226	692,543	1,372,217	31.50	289.71
224	679,695	1,345,650	30.89	258.21
222	665,980	1,316,395	30.22	227.32
220	650,447	1,283,098	29.46	197.10
218	632,693	1,247,287	28.63	167.64
216	614,639	1,203,397	27.63	139.01
214	588,851	1,132,122	25.99	111.38
212	543,574	1,047,627	24.05	85.39
210	504,299	960,339	22.05	61.34
208	456,439	860,369	19.75	39.29
206	404,455	615,056	14.12	19.54
204	219,901	203,963	4.68	5.42
202	19,897	32,245	0.74	0.74
200	12,623	0	0	0

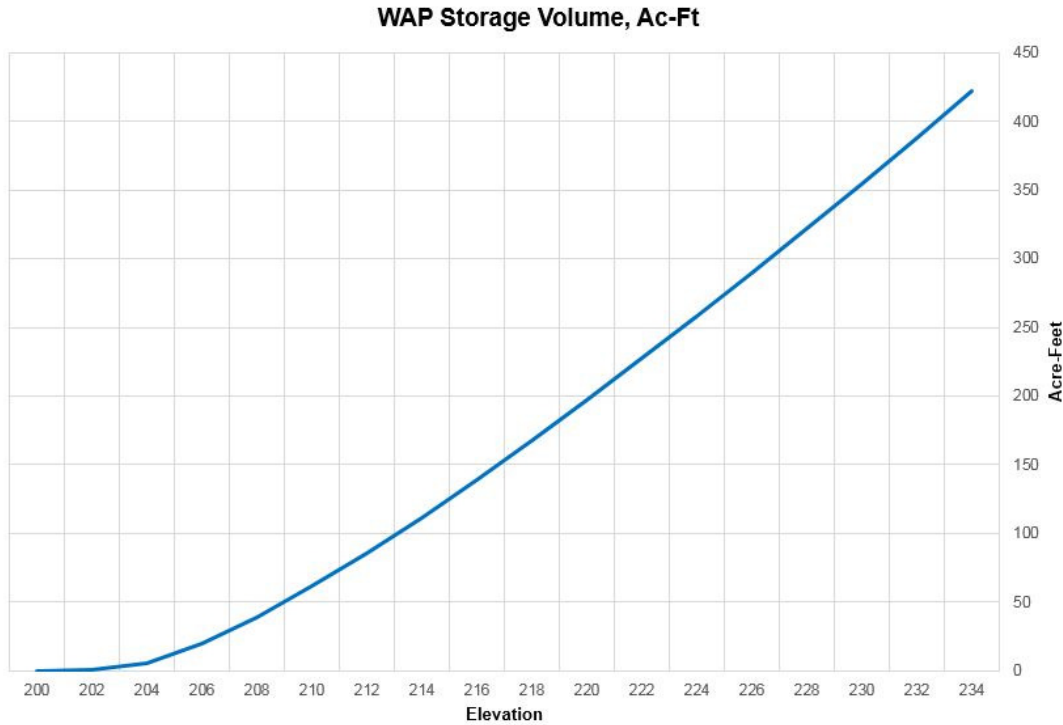


Figure 1: Stage-Storage Capacity Curve

3.8 Diversion and Spillway Details

The WAP was constructed by excavating into the alluvial terrace and using the excavated material from within the pond footprint to construct the pond embankments. The dikes are generally 14 to 19 feet in height. Outside of the dikes, no additional diversions are in place.

Prior to closure activities, the primary spillway, a concrete intake tower and 42-inch diameter corrugated metal pipe, regulated the WAP pool elevation. The intake tower, in the southeast corner of the impoundment area at approximately 30 feet in height, is constructed of concrete and regulated by wooden baffles. A 42-inch diameter pipe extends from the structure under the WAP dike to a manhole and ultimately through a permitted outfall. As of mid-2016, the WAP was dewatered for closure activities and the water level maintained well below the lowest weir crest elevation of 226.0. Accumulated surface water from the WAP is pumped to the on-site CSWTS for treatment and discharge. There is no auxiliary spillway. The analysis of the spillway capacity is included in Appendix B of the Inflow Design Flood Control System Plan.

Elevation, ft	Structure Rating, CFS
226	0.00
226.5	3.92
227	14.48
227.5	28.79
228	46.04
228.5	65.80
229	87.79
229.5	111.79
230	137.64
230.5	165.24
231	194.46
231.5	211.90
232	214.50
232.5	217.00
233	219.50
233.5	222.00
234	224.40

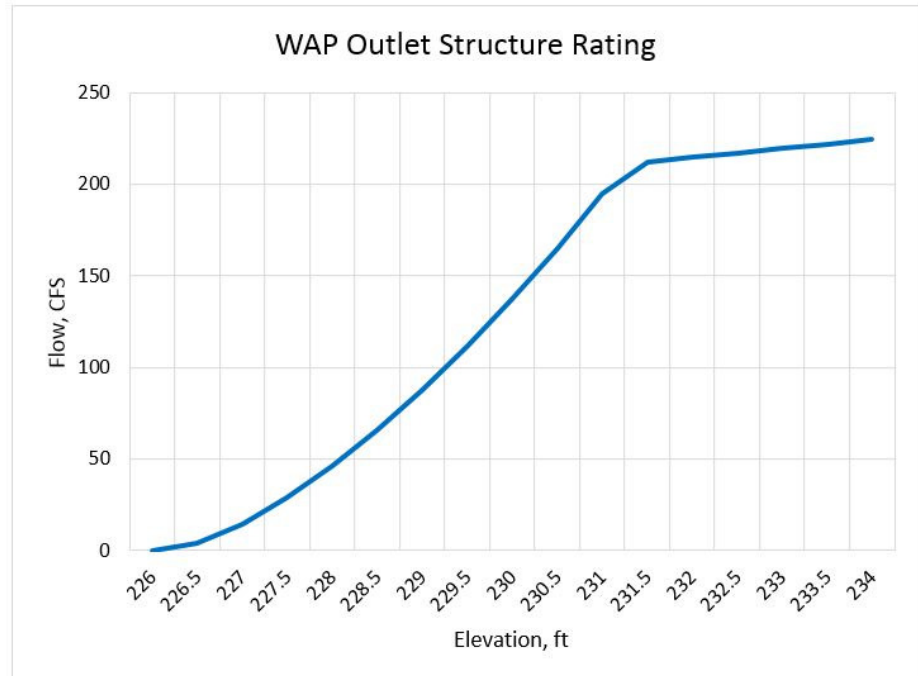


Figure 2: Outlet Structure Rating

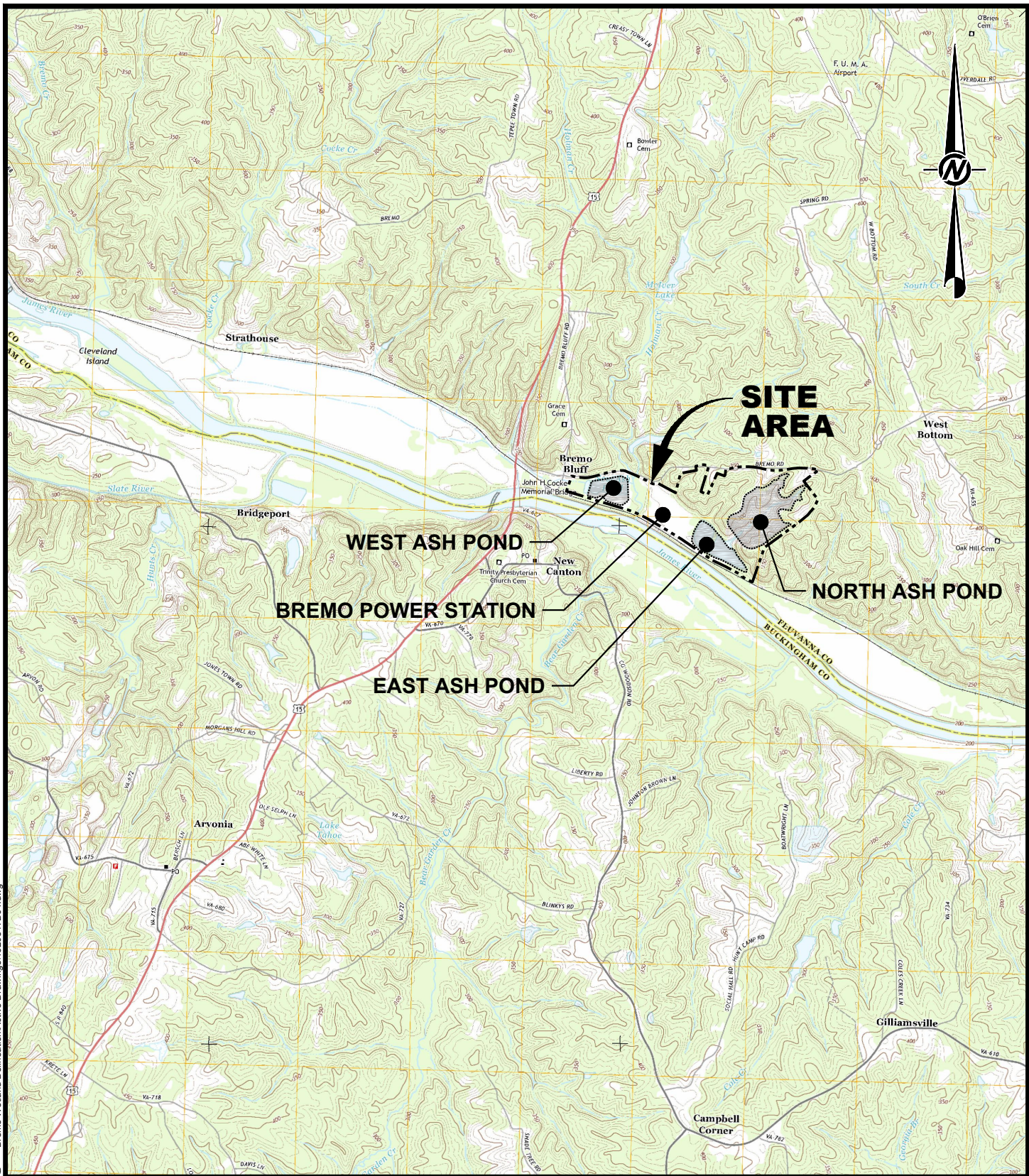
3.9 Surveillance, Maintenance, and Repair

Inspections and maintenance are currently conducted in accordance with 40 CFR §257.83. General construction specifications and provisions for future surveillance, maintenance, and repair of the WAP are included in the Closure Plan. Annual inspections by a Professional Engineer are conducted to satisfy the requirements of the DCR Dam Safety Regulations.

3.10 Structural Instability

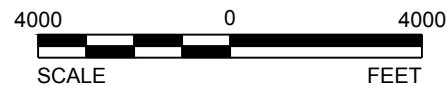
In August 2017, following the excavation of CCR from the WAP, small tension cracks developed parallel to the embankment in at least three locations. These identified cracks have been evaluated by a licensed professional engineer and marked for continued observation. No failures have resulted from the cracking, and their condition is observed and documented during the weekly inspections.

APPENDIX A
Site Location Map



REFERENCE

BASE MAP CONSISTS OF 7.5-MINUTE USGS TOPOGRAPHIC QUADRANGLE NAMED ARVONIA, VIRGINIA, DATED 2013.



G:\Plan Production Data Files\Drawing Data Files\15-20347B - Breomo Weiland Delineation\Active Drawings\1520347B01.dwg



DATE	09/28/16
DESIGN	ATN
CADD	ATN
CHECK	SDRM
REVIEW	JRD

TITLE

SITE LOCATION MAP

PROJECT No.	15-20347
SCALE	AS SHOWN
REV.	0

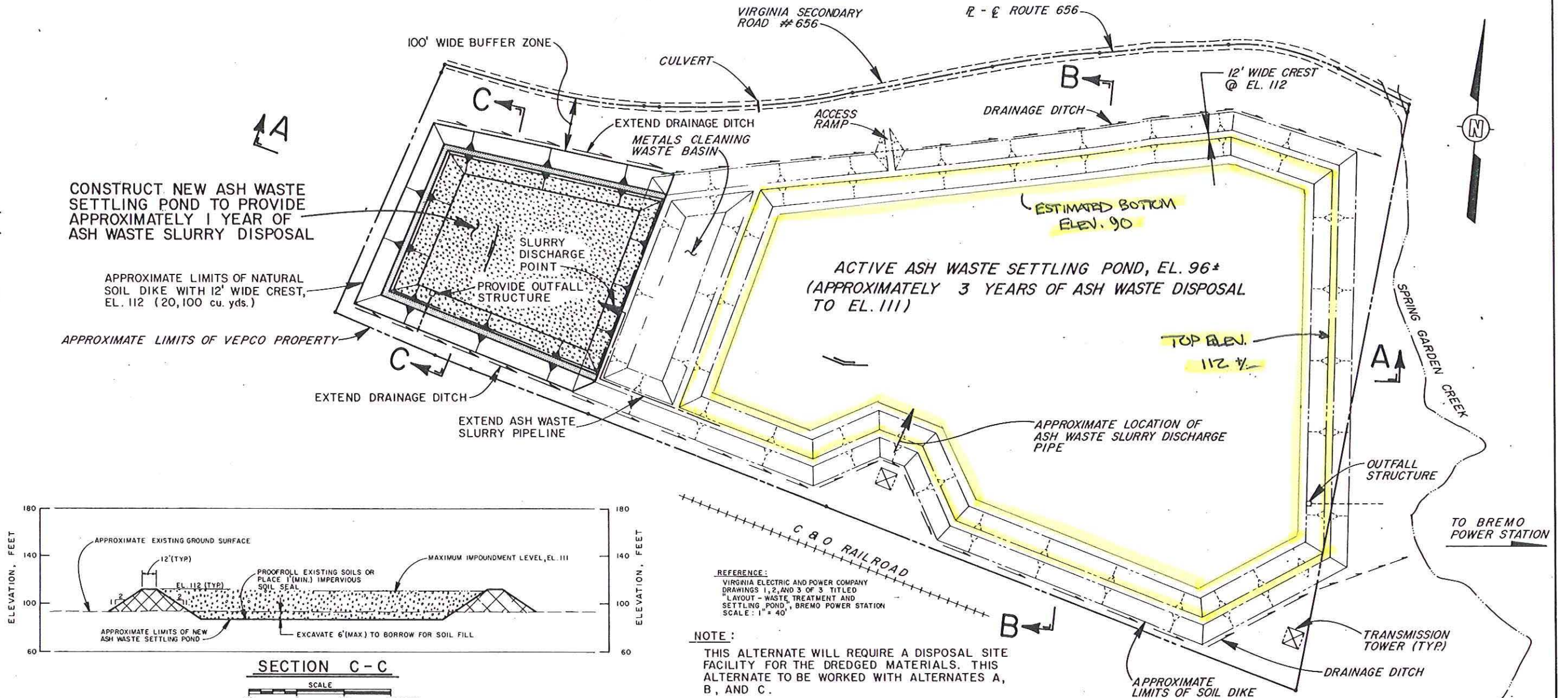
DOMINION, BREOMO POWER STATION

FIGURE 1

APPENDIX B

West Ash Pond Historical Record Drawings

DRAWING NUMBER SE79-549-E5
 CHECKED BY [Signature]
 APPROVED BY [Signature]
 RGN 5-6-80
 DRAWN BY [Signature]



CONSTRUCT NEW ASH WASTE SETTLING POND TO PROVIDE APPROXIMATELY 1 YEAR OF ASH WASTE SLURRY DISPOSAL

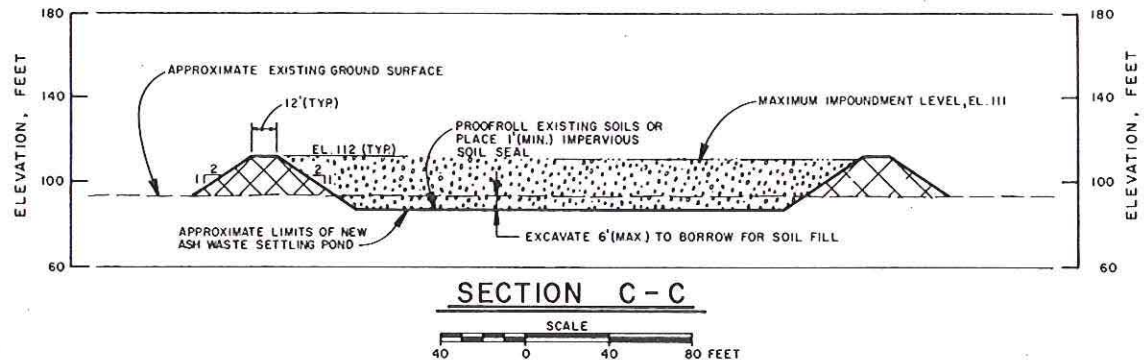
APPROXIMATE LIMITS OF NATURAL SOIL DIKE WITH 12' WIDE CREST, EL. 112 (20,100 cu. yds.)

APPROXIMATE LIMITS OF VEPCO PROPERTY

ACTIVE ASH WASTE SETTLING POND, EL. 96* (APPROXIMATELY 3 YEARS OF ASH WASTE DISPOSAL TO EL. 111)

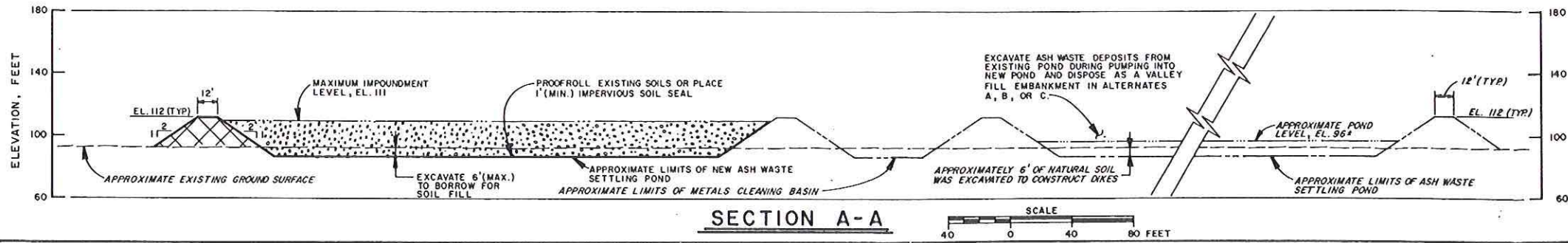
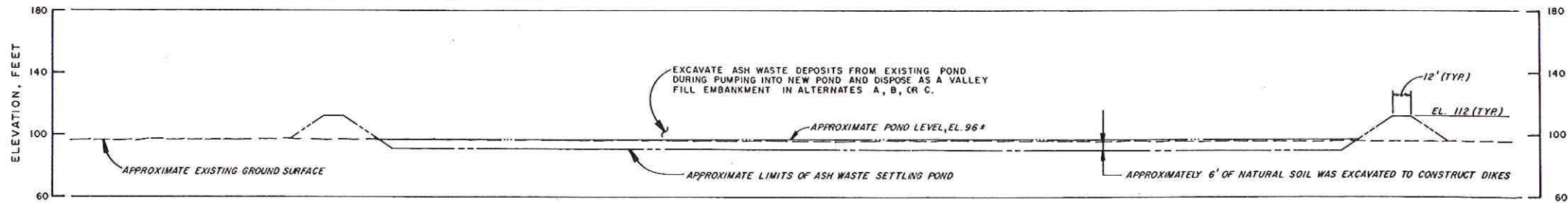
ESTIMATED BOTTOM ELEV. 90

TOP ELEV. 112 1/2



REFERENCE:
 VIRGINIA ELECTRIC AND POWER COMPANY DRAWINGS 1, 2, AND 3 OF 3 TITLED "LAYOUT - WASTE TREATMENT AND SETTLING POND", BREMO POWER STATION SCALE: 1" = 40'

NOTE:
 THIS ALTERNATE WILL REQUIRE A DISPOSAL SITE FACILITY FOR THE DREDGED MATERIALS. THIS ALTERNATE TO BE WORKED WITH ALTERNATES A, B, AND C.



DRAWING NO. SE79-549-E5	SHEET NO.	FIGURE NO. 2
----------------------------	-----------	-----------------

ALTERNATE I
 NEW POND CONSTRUCTION ON VEPCO PROPERTY
 ACTIVE ASH WASTE SETTLING POND
 BREMO POWER STATION
 VIRGINIA ELECTRIC AND POWER COMPANY
 BREMO BLUFF, FLUVANNA COUNTY, VIRGINIA
 PREPARED FOR

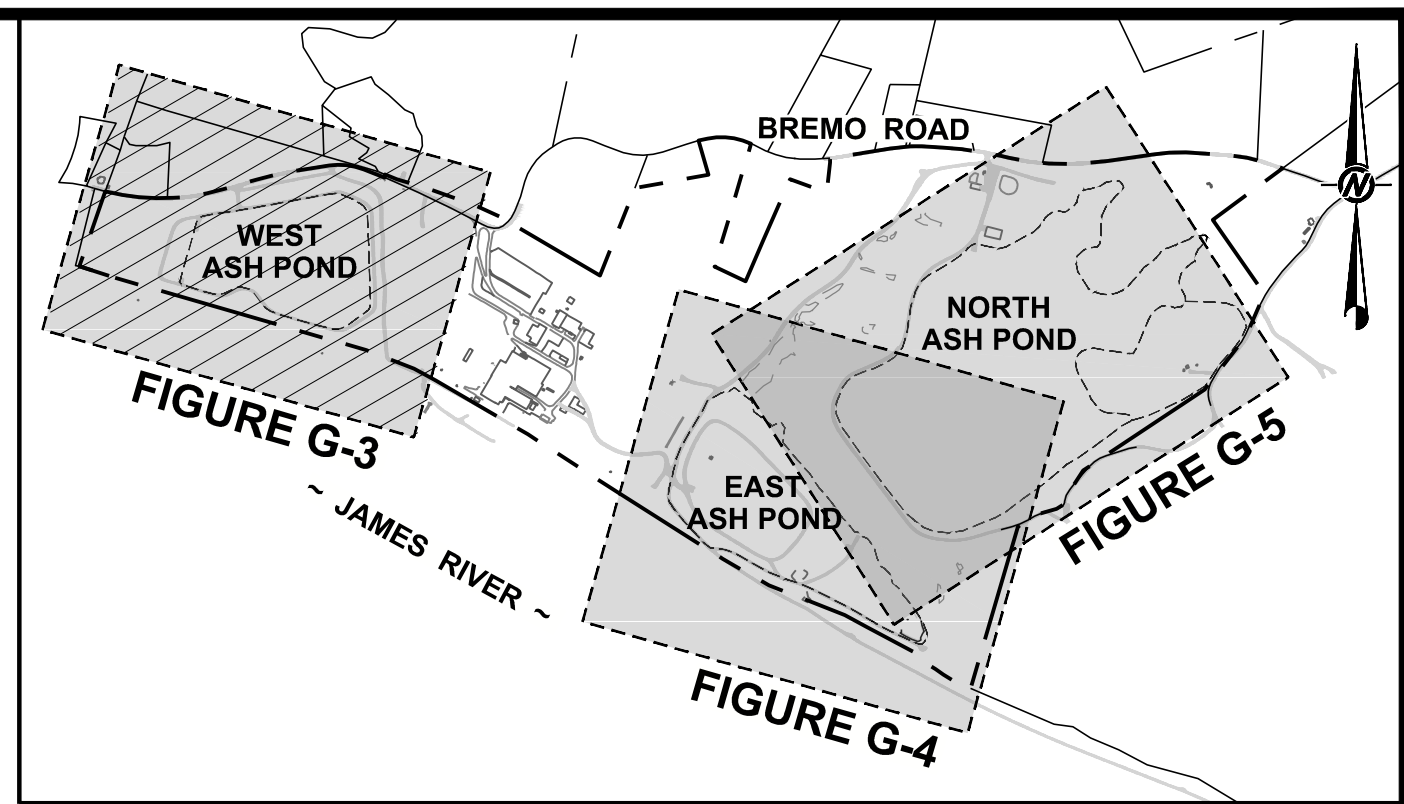
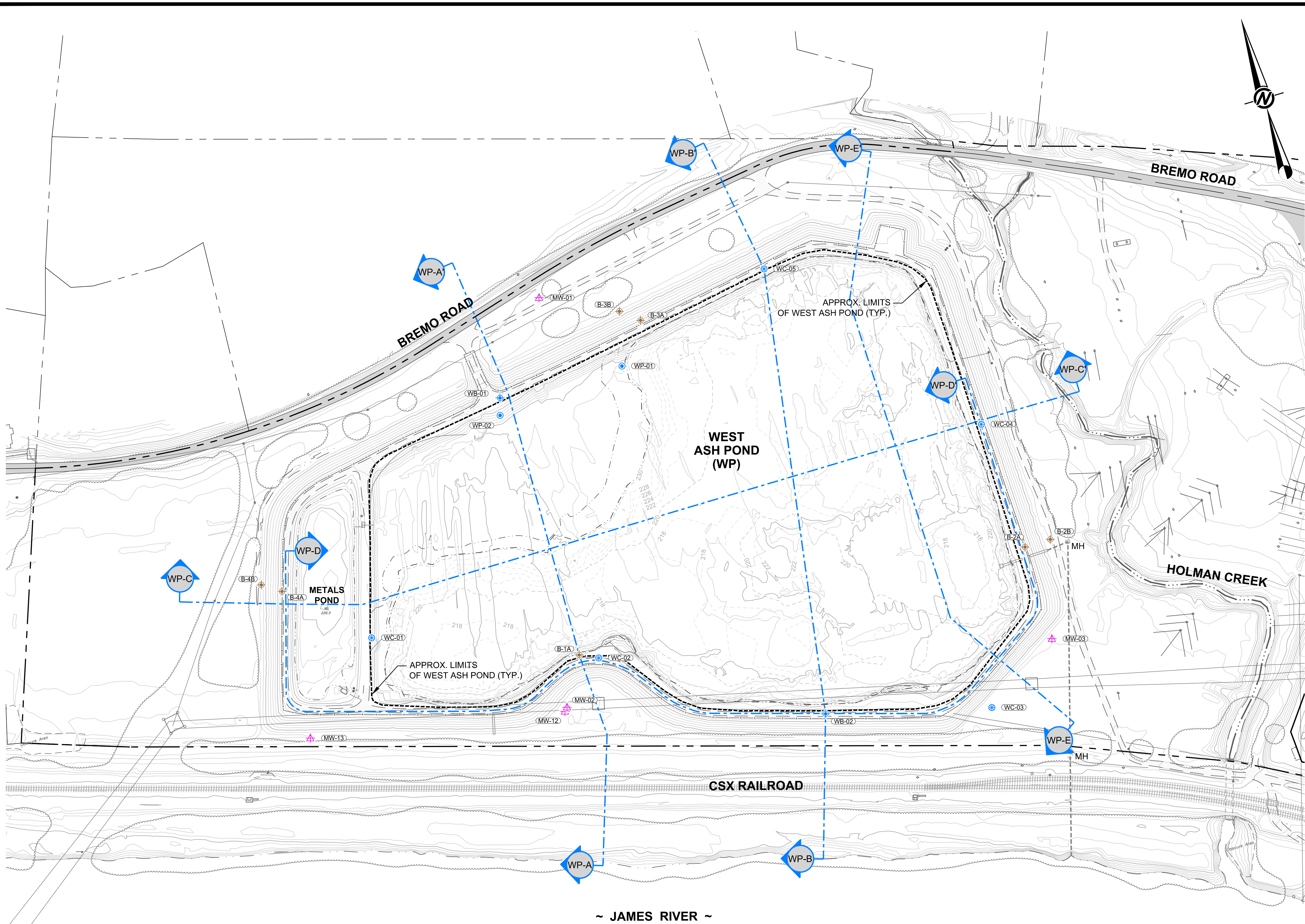
VIRGINIA ELECTRIC AND POWER COMPANY
 RICHMOND, VIRGINIA

D'APPOLONIA

APPENDIX C

West Ash Pond Existing Condition Drawings

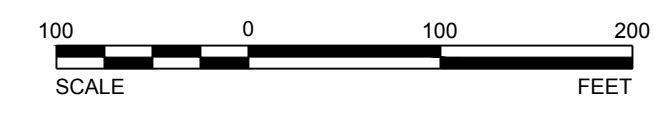
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SITE KEY NOT TO SCALE

LEGEND

	DOMINION PROPERTY BOUNDARY
	ADJACENT PROPERTY BOUNDARY
	APPROXIMATE LIMITS OF PRE-CLOSURE ASH PONDS
	LIMITS OF BATHYMETRIC SURVEYS
	PRE-CLOSURE TOPOGRAPHIC CONTOURS (2' INTERVALS)
	PRE-CLOSURE BATHYMETRIC SURFACE CONTOURS (2' INTERVALS) (FEB 2015)
	PRE-CLOSURE PAVED ROAD
	PRE-CLOSURE UNPAVED ROAD
	PRE-CLOSURE RAILROAD
	CREEK CENTERLINE
	APPROXIMATE EDGE OF SURFACE WATER
	PRE-CLOSURE TREE LINE
	PRE-CLOSURE FENCE
	PRE-CLOSURE OVERHEAD ELECTRIC LINE
	PRE-CLOSURE MANHOLE
	DENOTES AREAS OF TOPOGRAPHY THAT DO NOT MEET MINIMUM ACCURACY STANDARDS FOR AERIAL SURVEYING
	SCHNABEL BORING (1982)
	SCHNABEL BORING (2010)
	GES MONITORING WELL (2013)
	HALEY AND ALDRICH BORING (2015)
	GOLDER BORING
	GOLDER PIEZOMETER
	GOLDER CONE PENETRATION TEST (CPT)
	GOLDER PROBE HOLE
	GOLDER HAND AUGER



04/13/16	UPDATE NOTATION	-	JJP	JGM	GLH	
10/15/15	UPDATED SECTION LOCATIONS	-	SEP	JGM	GLH	
REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RWW

PROJECT
 DOMINION
 BREMO POWER STATION
 CCR IMPOUNDMENT CLOSURE
 FLUVANNA COUNTY, VIRGINIA

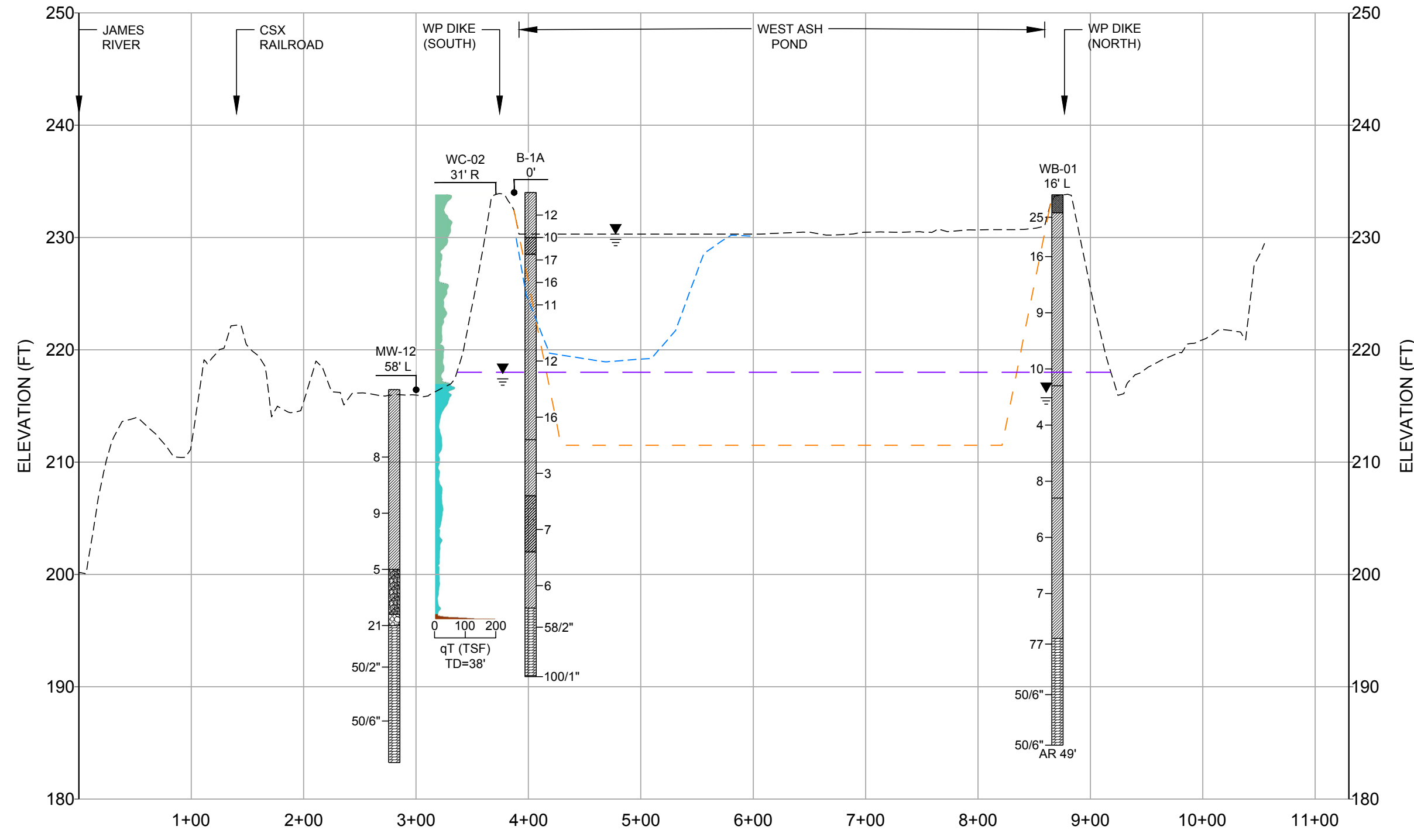
TITLE
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 GEOTECHNICAL EXPLORATION PLAN
 (WEST POND)**

PROJECT No.	15-20347	FILE No.	1520347AD02-05
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CADD	SEP	11/11/16	
CHECK	JGM	11/11/16	
REVIEW	GLH	11/11/16	

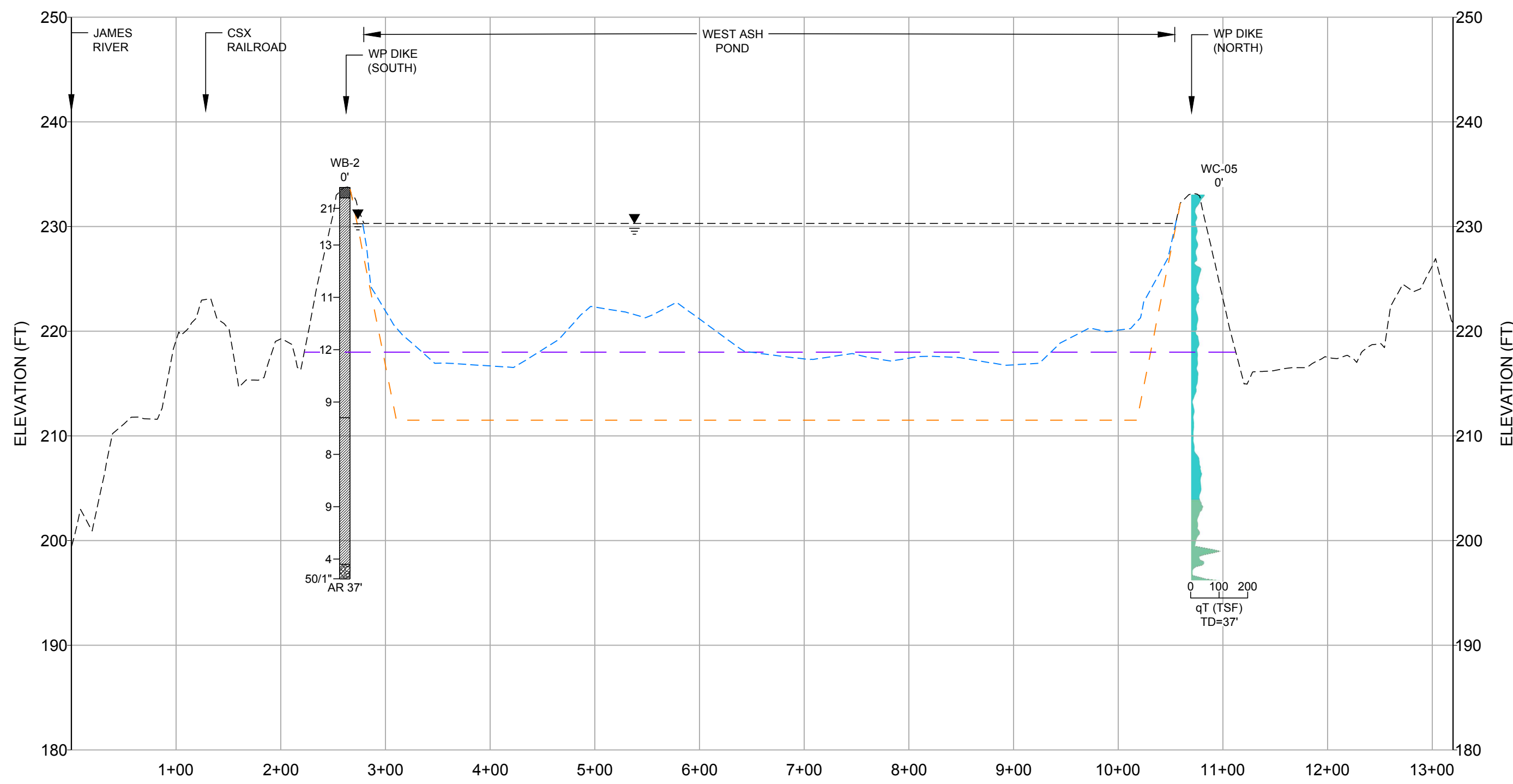


FIGURE G-3

C:\Plan Production Data Files\Drawing Data Files\15-20347A - BreMO Pond Closure (Conceptual Plan)\Active Drawings\Geotech\Oct 20 16 15:20:37\AG06-20.dwg | Layout: WP SECTIONS A&B | Modified: SPRechoa 11/15/2016 4:46 PM | Project: SPRechoa 11/15/2016



SECTION WP A - A'



SECTION WP B - B'

BOREHOLE LOGS LEGEND

- CH - CLAY
- CL - SILTY CLAY
- CL-ML - SILTY CLAY-CLAYEY SILT
- GC - CLAYEY GRAVEL
- ML - SILT AND CLAYEY SILT
- SC - CLAYEY SAND
- SM - SAND AND GRAVEL
- SM - SILTY SAND
- SP-SM - POORLY-GRADED SAND WITH SILT
- BOULDERS AND COBBLES
- TOPSOIL
- FILL
- BEDROCK
- DISINTEGRATED ROCK
- COAL COMBUSTION RESIDUALS (CCR)
- WATER

CPT LEGEND

- SANDY SILTY CLAY
- SANDY SILT / SILTY SAND
- SANDY SILT
- SILTY SAND
- CLAY
- CCR / CLAY MIX
- CCR
- COMPACTED CCR
- PWR / GRAVEL ALLUVIUM
- ALLUVIUM, SILTY SAND
- ALLUVIUM, SILT

ABBREVIATION LEGEND

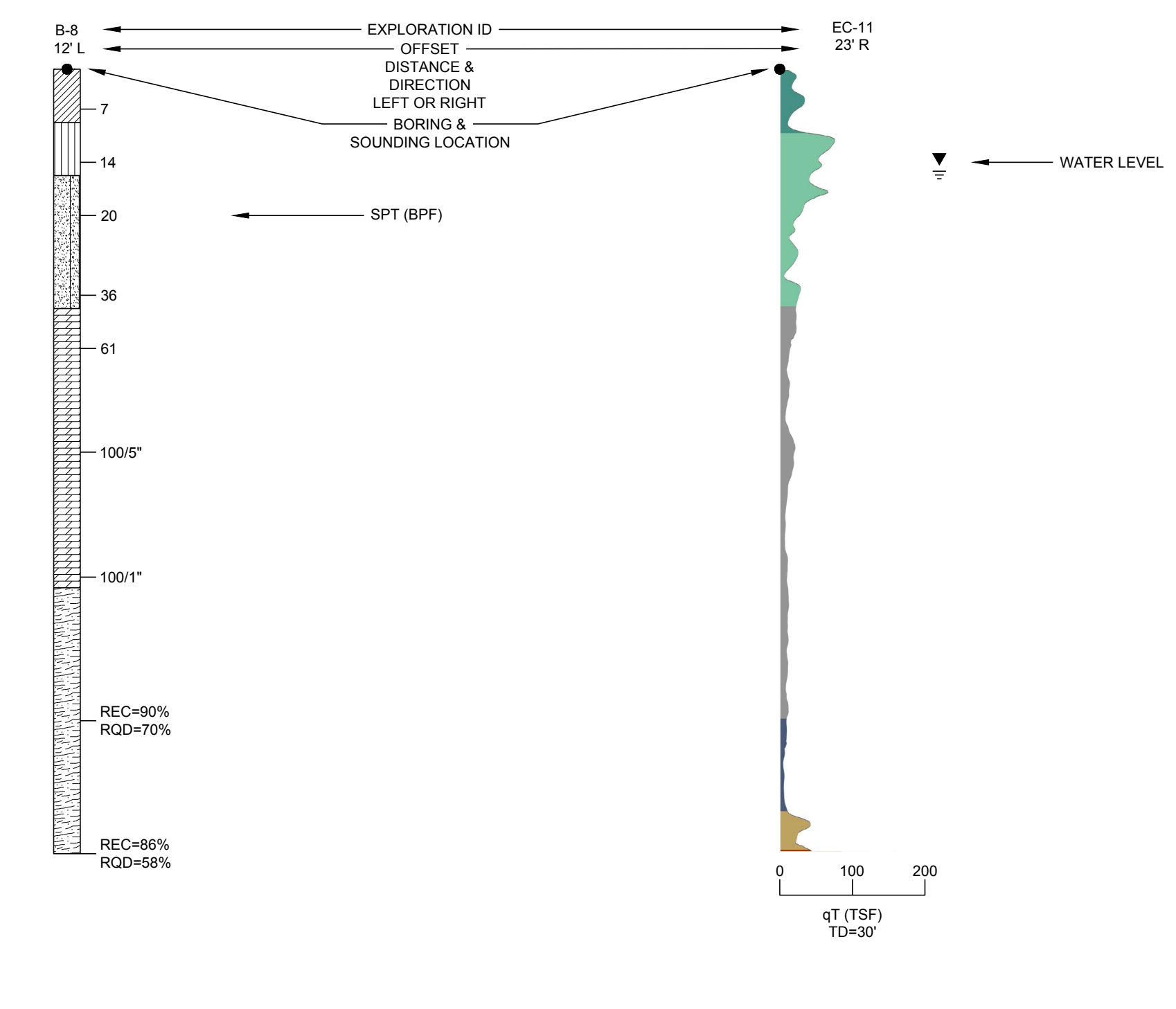
- qt CPT TIP STRESS
- TC TEST CPT
- REC RECOVERY
- RQD ROCK QUALITY DESIGNATION
- TD TERMINATION DEPTH
- AR AUGER REFUSAL
- TSF TONS PER SQUARE FOOT
- CPT CONE PENETRATION TEST
- SPT STANDARD PENETRATION TEST
- BPF BLOWS PER FOOT
- B BORING
- E EAST ASH POND
- W WEST ASH POND
- N NORTH ASH POND
- C CPT
- HA HAND AUGER
- G GOLDR
- P PROBE HOLE

LINE WORK LEGEND

- PRE-CLOSURE GRADES
- PROPOSED GRADES
- PROPOSED EXCAVATION GRADES
- BATHYMETRY CONTOURS (FEB 2015)
- HISTORICAL BOTTOM GRADES (WAP AND EAP)
- ESTIMATED BOTTOM OF ASH GRADES (NAP)
- 1967 USGS TOPOGRAPHY

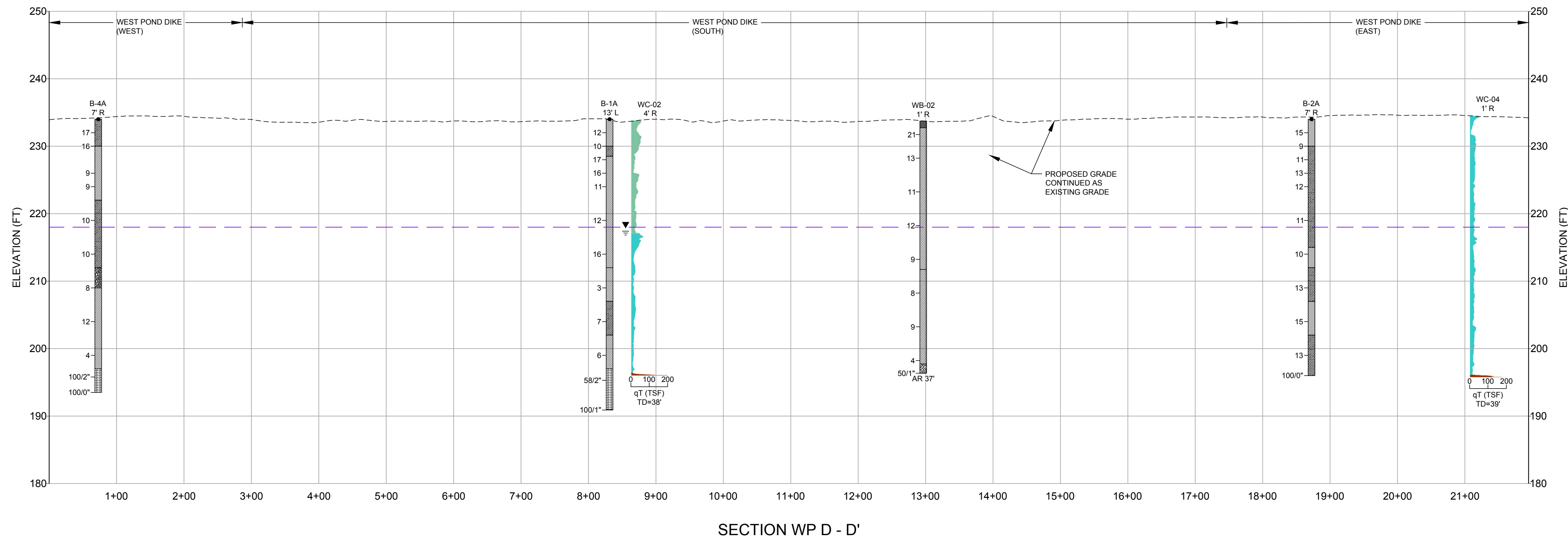
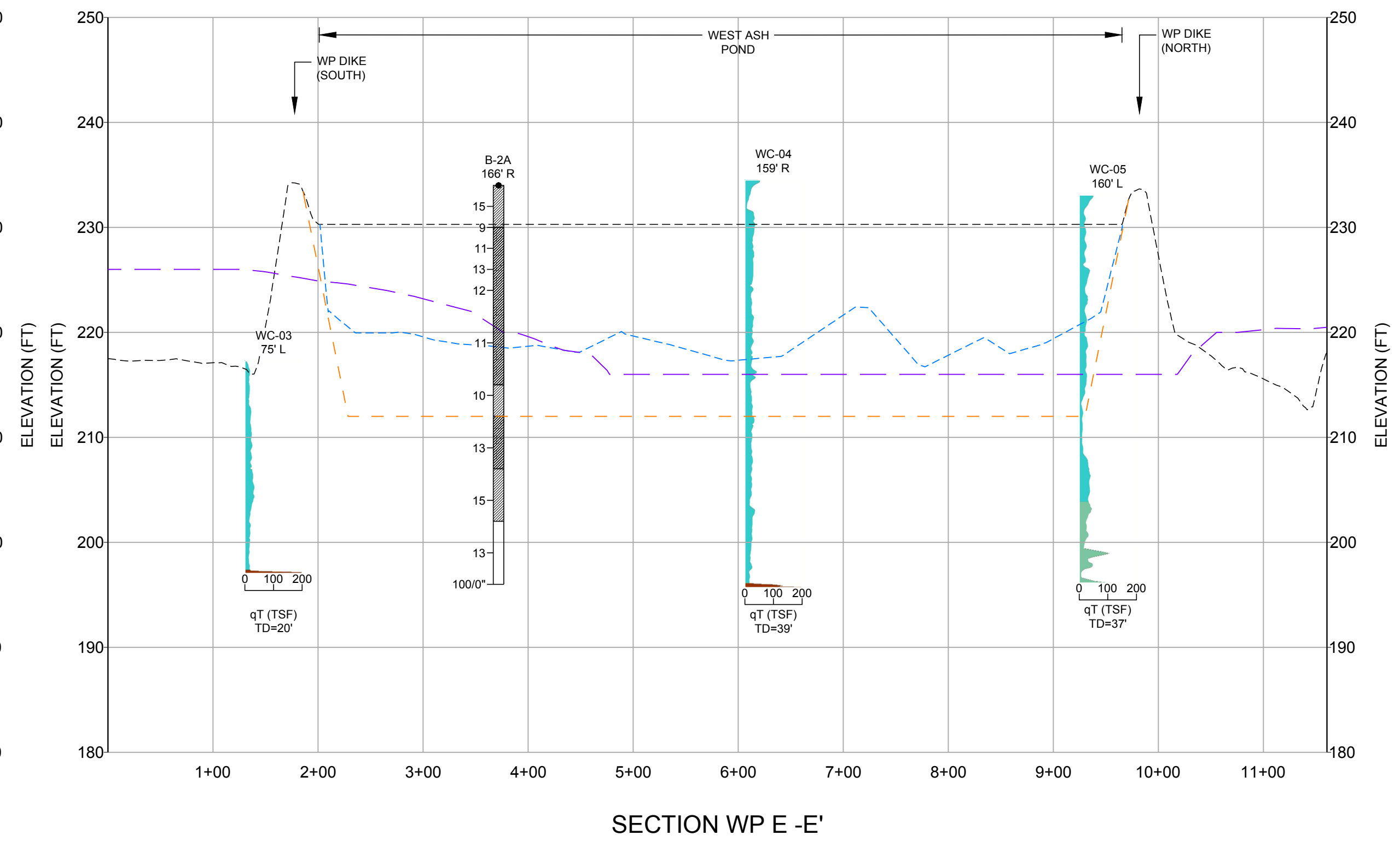
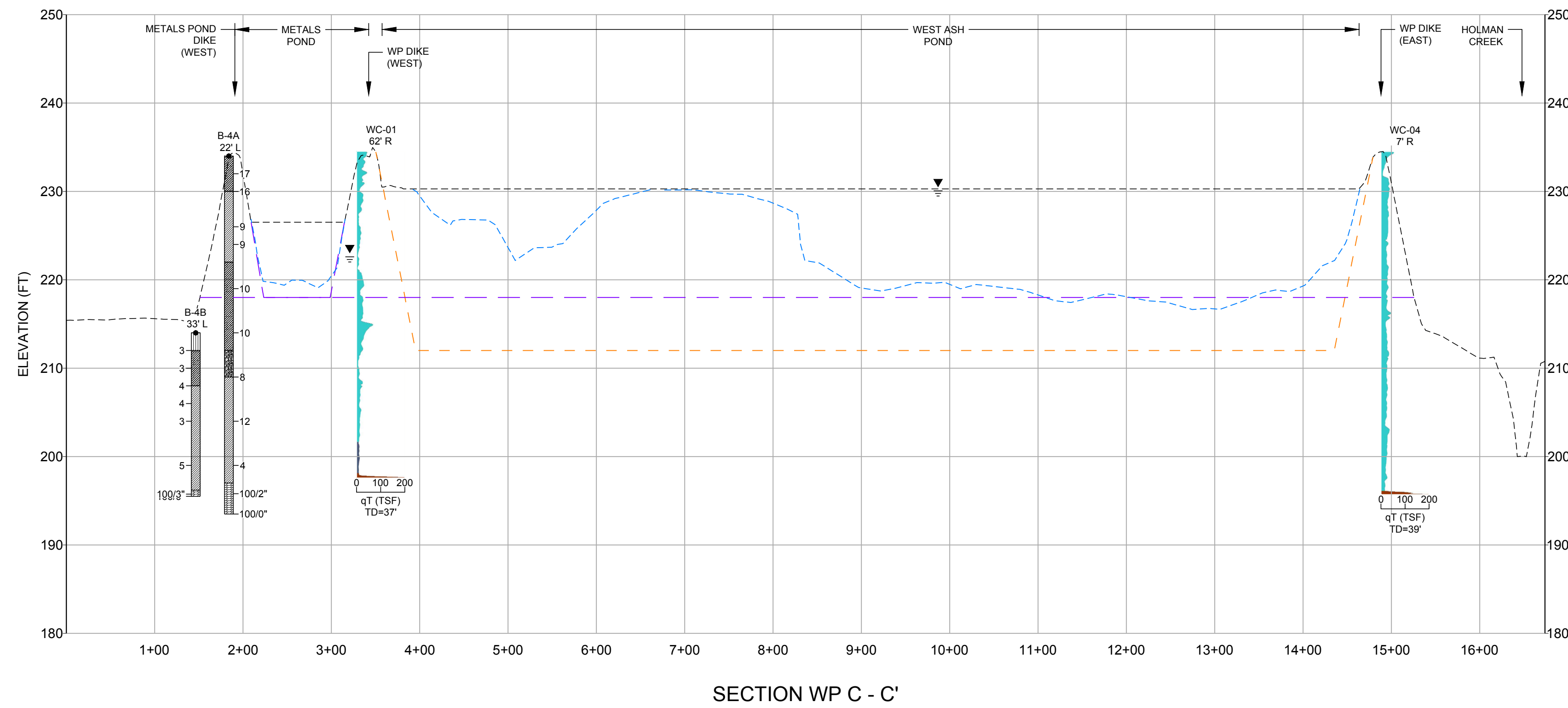
NOTES

1. REFER TO FIGURE G-1 FOR GENERAL NOTES AND REFERENCES.
2. REFER TO FIGURE G-6 FOR LEGEND INFORMATION.



REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
<p>PROJECT: DOMINION BREMO POWER STATION CCR IMPOUNDMENT CLOSURE FLUVANNA COUNTY, VIRGINIA</p> <p>TITLE: GEOTECHNICAL EXPLORATION SECTIONS (WEST POND 1 OF 2)</p>						
PROJECT No. 15-20347		FILE No. 1520347AG06-20	SCALE AS SHOWN			
DESIGN	-	-	SCALE AS SHOWN			
CADD	CCP	11/11/16				
CHECK	JGM	11/11/16				
REVIEW	GLH	11/11/16				
			FIGURE G-6			

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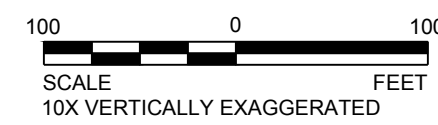


LINE WORK LEGEND

- PRE-CLOSURE GRADES
- PROPOSED GRADES
- PROPOSED EXCAVATION GRADES
- BATHYMETRY CONTOURS (FEB 2015)
- HISTORICAL BOTTOM GRADES
- 1967 USGS TOPOGRAPHY

NOTES

1. REFER TO FIGURE G-1 FOR GENERAL NOTES AND REFERENCES.
2. REFER TO FIGURE G-6 FOR LEGEND INFORMATION.



REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RWW
PROJECT DOMINION BREMO POWER STATION CCR IMPOUNDMENT CLOSURE FLUVANNA COUNTY, VIRGINIA						
TITLE GEOTECHNICAL EXPLORATION SECTIONS (WEST POND 2 OF 2)						
PROJECT No.		15-20347	FILE No.		1520347AG06-20	
DESIGN	-	-	SCALE		AS SHOWN	
CADD	CCP	11/11/16				
CHECK	JGM	11/11/16				
REVIEW	GLH	11/11/16				



FIGURE G-7

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Inc.
2108 W. Laburnum Avenue, Suite 200
Richmond, VA 23227 USA
Tel: (804) 358-7900
Fax: (804) 358-2900



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