



**Sludge Sedimentation Basins
Initial Inflow Design Flood Control System Plan**

**Clover Power Station
Clover, Virginia**

October 2016



Sludge Sedimentation Basins Initial Inflow Design Flood Control System Plan

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Clover, Virginia**

October 2016

*Prepared For
Virginia Electric and Power Company*


Jonathan Hotstream

Senior Scientist



R. Kent Nilsson, P.E.

Senior Engineer

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Revision History

REVISION NUMBER	REVISION DATE	SECTION REVISED	SUMMARY OF REVISIONS

Section 1

Background

Virginia Electric and Power Company d/b/a Dominion Virginia Power (Dominion) owns¹ and operates the Clover Power Station. The purpose of this Inflow Design Flood Control System Plan (Plan) is to present the designed and constructed flood control features of the two existing and future retrofitted sludge sedimentation basins at the Clover Power Station. These two basins will be managed in a manner that controls the inflow design flood, as required by the United States Environmental Protection Agency's (USEPA) final coal combustion residuals (CCR) rule, Title 40 Code of Federal Regulations (40 CFR) Parts 257 and 261 Subpart D- "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments." The basins are considered existing surface impoundments according to the CCR rule (40 CFR 257.53).

¹ Old Dominion Electric Cooperative owns a 50% undivided interest in the Clover Power Station.

Section 2

Inflow Design Flood Control

Hydrologic and hydraulic capacity requirements for CCR surface impoundments are set forth in 40 CFR 257.82. The sludge sedimentation basins are classified as Low Hazard in accordance with 40 CFR 57.73 and 40 CFR 257.74. Based on the Low Hazard potential classification, the CCR unit must adequately manage flow into the unit during and following the peak discharge of the 100-year flood (40 CFR 257.82(a)(3)(iii)).

The sludge sedimentation basins were designed in accordance with 40 CFR 257.82(a)(1), (2) and (3), requiring the CCR units to adequately manage inflows during and following peak discharge and to manage outflows to collect and control peak discharge for a 100 year flood due to the Low Hazard classification.

The Flood Insurance Rate Map for the Clover Power Station (National Flood Insurance Program 2009) indicates that the basins are located in an area determined to be outside the 0.2% annual chance flood, refer to Appendix A. Figures 1 and 2 show the extents of the 100 year flood. The basins are located in an area that is above the 100 year flood elevation; therefore, the basins will not experience inflow during the design flood event. The basins have been designed with several inflow features presented in the sections below to mitigate and control floods.

2.1 Basin Operation

The sludge sedimentation basins are utilized for dewatering solids from process wastewater only in the circumstance that the primary discharge for each system is unavailable for service. The basins are operated in parallel. One basin is active and available to receive wastewater from the station, while the other basin is in standby. As needed, when the basins are in standby, solids are dewatered and removed. Based on this use pattern, only one basin is at the design water level at any time. The basins were designed to operate with 2 feet of freeboard, height difference from the top of the berm to the design water level.

The water level in the active basin is monitored by level transmitters located in the pump station wet well. The pump system is programmed to remove water from the basin based on high and low level switches. In addition to level switches, there are high and low level alarms that notify station control operators in the power station of needed action.

The following control measures are implemented during basin operation to control the water levels in the basins:

- Operate one basin at a time with the ability to divert flow to the standby basin if water levels become higher than anticipated.
- Operate pumps as needed to control the basin water levels.
- Regularly check and maintain grades surrounding the basins to minimize the area contributing to storm water run-on.

2.2 Run-on Control

The basins were designed to control the storm water run-on from a 100 year, 24 hour storm event based upon the Precipitation Frequency Estimates from the National Oceanic and Atmospheric Administration. The basins were designed to operate with at least two feet of freeboard, height from the design water elevation to the top of berm elevation. The storm water run-on volume calculated for the design storm was compared to the storage capacity above the basins design operating elevation. The evaluation determined that there is sufficient capacity in the basins when operating with two feet of freeboard to accept run-on volume from a 100 year, 24 hour storm event, refer to Appendix B.

2.3 Pumping Capacity

The pump station is equipped with two Lawrence VPL3200 pumps with a rated pumping capacity of 410 gallons per minute (gpm) at 110 feet of head. The two pump configuration provides a duty pump and a backup pump in the event of malfunction, maintenance, or repair of the duty pump. A calculation was performed to determine the length of time required to remove the anticipated run-on due to a 100 year, 24 hour storm event, refer to Appendix B. The calculation was performed using only the capacity of the duty pump and resulted in a required time of 51 hours or approximately 2 days to remove the anticipated storm water run-on from both basins. This calculation assumes that both basins will be at the design water level which is worst case scenario. This calculation shows that pumping rates are sufficient in controlling water levels in the basins.

2.4 Conclusions

The existing basins and designed retrofit meet the requirements of 40 CFR 257.82 of adequately controlling the inflows and outflows of peak discharge at the Clover Power Station for the following reasons:

- The basins are located above the 100 year floodplain.
- The basins were adequately designed to withstand a 100 year, 24 hour storm event.
- The pumping rates are sufficient to control the water levels in both basins.

Section 3

Amendment and Periodic Plan Revision

This Plan was been completed in compliance with the requirements set forth in 40 CFR 257.82. This document has been placed in the Station's CCR operating record, posted to the publically accessible CCR website, and government notifications provided.

A periodic inflow design flood control system plan must be prepared every 5 years from the completion date of this Plan.

The Plan must be amended whenever the periodic review period is reached or if changes in site conditions occur that will sustainably affect the current written plan.

Section 4

References

TRC Engineers, Inc. 2016. Initial Hazard Potential Classification – Sludge Sedimentation Basins Clover Power Station. October 2016.

National Flood Insurance Program. 2009. Flood Insurance Rate Map: Halifax County Virginia Panel 350 of 625. Map Number 51083C0350D. Effective Date October 16, 2009. Federal Emergency Management Agency. Washington, D.C.

Section 5 Certification

I, the undersigned Virginia Professional Engineer, hereby certify that I am familiar with the technical requirements of 40 CFR 257 Subpart D. I also certify that it is my professional opinion that, to the best of my knowledge, information, and belief, that the information in this demonstration is in accordance with current good and accepted engineering practice(s) and standard(s) and meets the requirements of paragraph (a) of in 40 CFR 257.82.

For the purpose of this document, “certify” and “certification” shall be interpreted and construed to be a “statement of professional opinion.” The certification is understood and intended to be an expression of my professional opinion as a Virginia Licensed Professional Engineer, based upon knowledge, information, and belief. The statement(s) of professional opinion are not and shall not be interpreted or construed to be a guarantee or a warranty of the analysis herein.

R. Kent Nilsson, P.E.

Printed Name of Professional Engineer

026477

Commonwealth of Virginia License Number



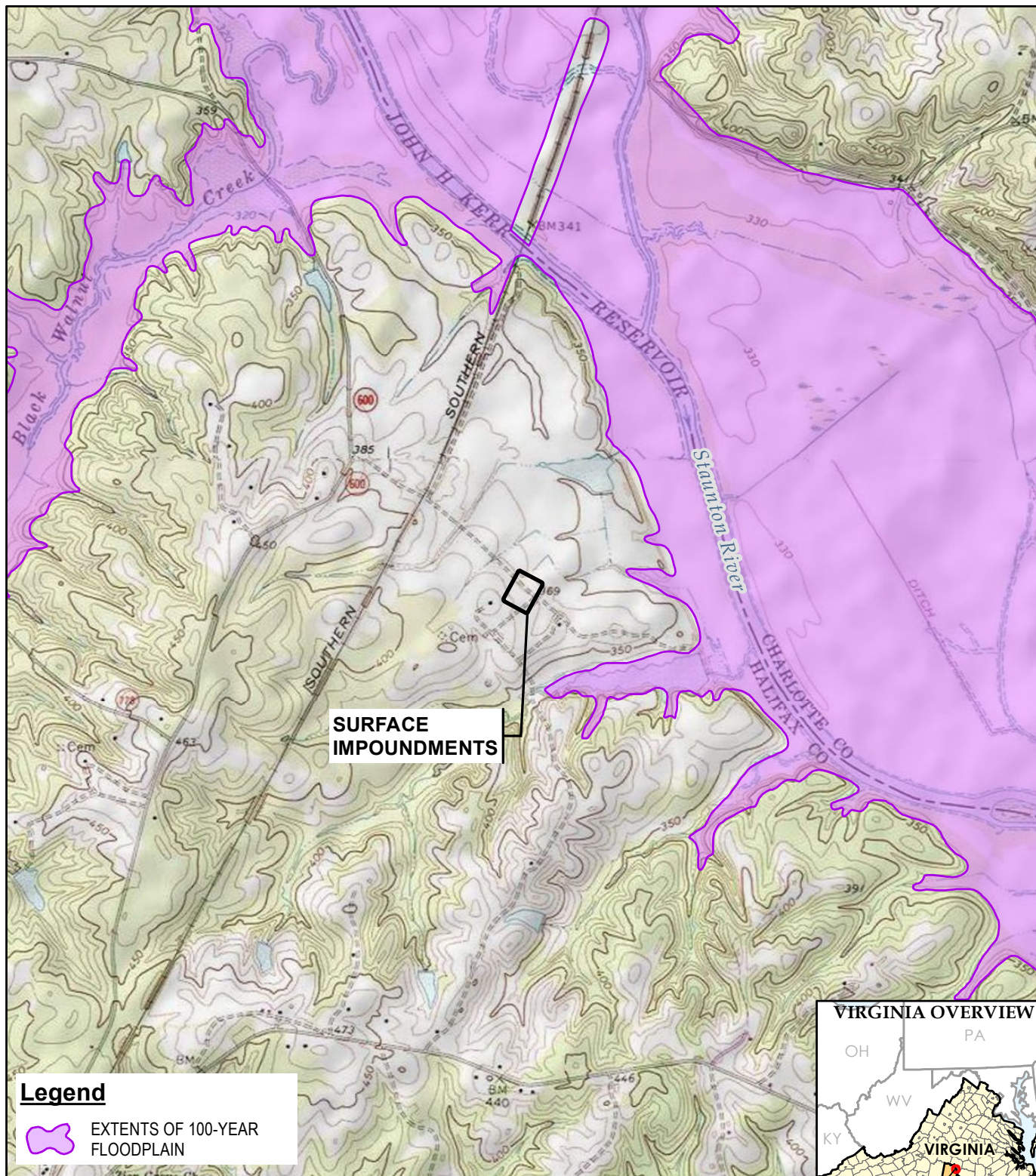
Signature of Professional Engineer

October 3, 2016

Date



TRC - GIS



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES, 1982.



Patewood Plaza One, Suite 300
30 Patewood Drive
Greenville, SC 29615
Phone: 864.281.0030

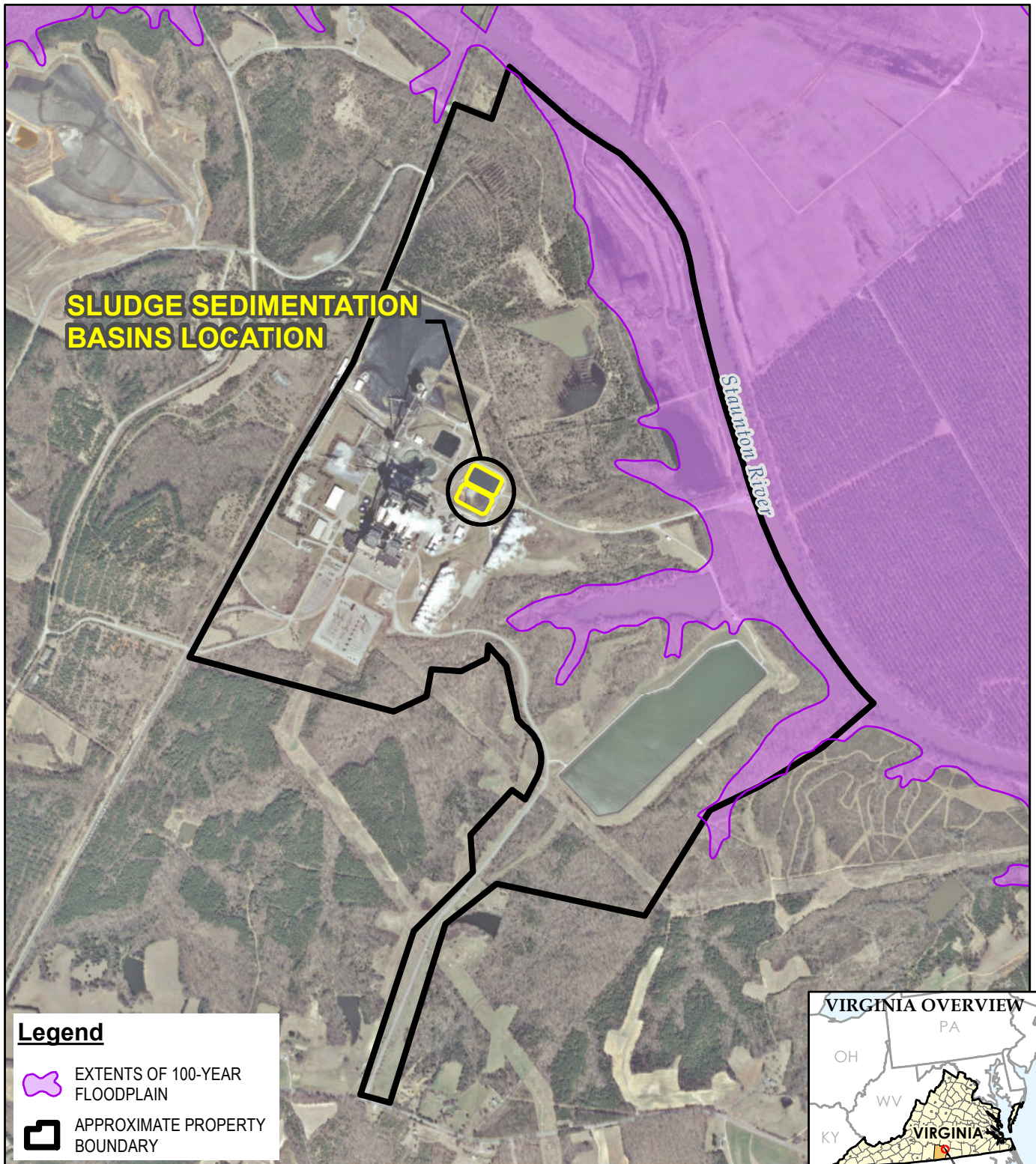
DOMINION RESOURCES SERVICES, INC.
CLOVER POWER STATION
CLOVER, HALIFAX COUNTY, VIRGINIA

INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
SITE LOCATION MAP

DRAWN BY:	R. SUEMNICHT
APPROVED BY:	R. K. NILSSON
PROJECT NO:	232002
FILE NO.	232002-008slm.mxd
DATE:	AUGUST 2016

FIGURE 1

TRC - GIS



-BASE MAP FROM COMMONWEALTH OF VIRGINIA ORTHOPHOTOGRAPHY, 2013.
-FLOOD DATA ACQUIRED FROM FEMA NATIONAL FLOOD HAZARD LAYER (NFHL).



Patewood Plaza One, Suite 300
30 Patewood Drive
Greenville, SC 29615
Phone: 864.281.0030

DOMINION RESOURCES SERVICES, INC.
CLOVER POWER STATION
CLOVER, HALIFAX COUNTY, VIRGINIA

INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN
SITE DETAIL

	R. SUENNICHT
APPROVED BY:	R. K. NILSSON
PROJECT NO:	232002
FILE NO.	232002-009.mxd
DATE:	AUGUST 2016

FIGURE 2

Appendix A

Selected Retrofit Design Drawings

CLOVER POWER STATION

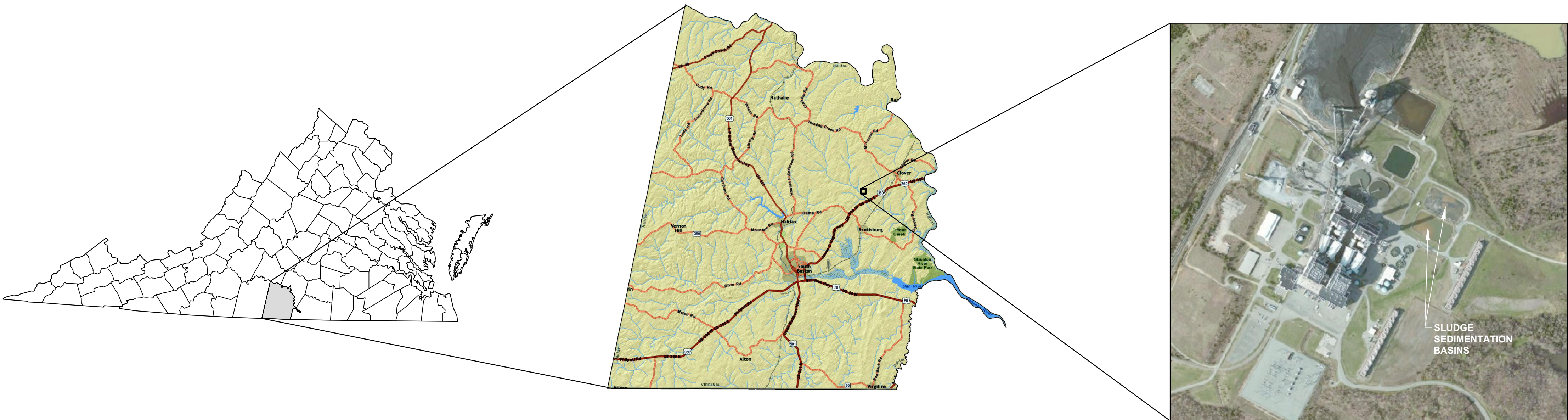
RETROFIT - SLUDGE SEDIMENTATION BASINS

ISSUED FOR BID

PREPARED FOR: DOMINION RESOURCES SERVICES, INC.
CLOVER POWER STATION
CLOVER, VIRGINIA

PREPARED BY: TRC ENGINEERS, INC.
GREENVILLE, SOUTH CAROLINA

DATE: APRIL 2016



VIRGINIA

HALIFAX COUNTY

SITE LOCATOR

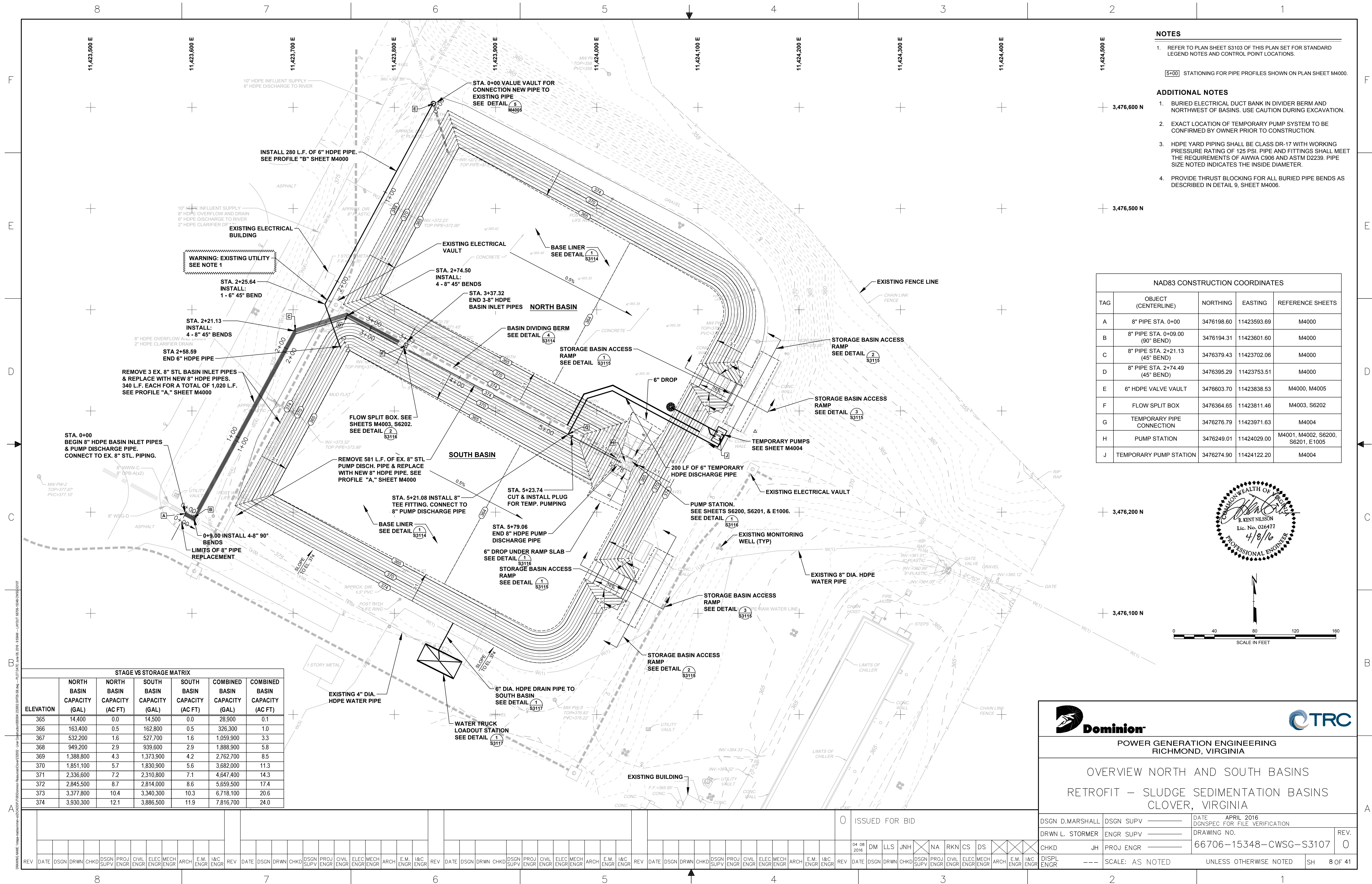
1" = 600'



SHEET INDEX	
SHEET NUMBER	SHEET TITLE
66706-15348-CWSG-S3100	TITLE SHEET
66706-15348-CWSG-S3101	GENERAL NOTES - CIVIL, MECHANICAL, STRUCTURAL
66706-15348-CWSG-S3102	GENERAL NOTES - CIVIL, MECHANICAL, STRUCTURAL
66706-15348-CWSG-S3103	CIVIL STANDARD LEGEND
66706-15348-CWSG-S3104	EXISTING CONDITIONS
66706-15348-CWSG-S3105	SUGGESTED CONSTRUCTION SEQUENCE PLAN
66706-15348-CWSG-S3106	EROSION AND SEDIMENT CONTROL PLAN
66706-15348-CWSG-S3107	OVERVIEW NORTH AND SOUTH BASINS
66706-15348-CWSG-M4000	YARD PIPING PROFILES
66706-15348-CWSG-S3108	NORTH BASIN LINER SUBBASE GRADES
66706-15348-CWSG-S3109	NORTH BASIN BASE AND PAVING
66706-15348-CWSG-S3110	NORTH BASIN CROSS SECTIONS
66706-15348-CWSG-S3111	SOUTH BASIN LINER SUBBASE GRADES
66706-15348-CWSG-S3112	SOUTH BASIN BASE AND PAVING
66706-15348-CWSG-S3113	SOUTH BASIN CROSS SECTIONS
66706-15348-CWSG-S3114	CIVIL DETAILS - NORTH AND SOUTH BASINS
66706-15348-CWSG-S3115	CIVIL DETAILS - NORTH AND SOUTH BASINS
66706-15348-CWSG-S3116	CIVIL DETAILS - SOUTH BASIN
66706-15348-CWSG-S3117	CIVIL DETAILS - SOUTH BASIN
66706-15348-CWSG-S3118	CIVIL DETAILS
66706-15348-CWSG-S3119	CIVIL DETAILS - EROSION AND SEDIMENT CONTROL
66706-15348-CWSG-M2647	MECHANICAL P&ID
66706-15348-CWSG-M4001	PUMP STATION PLAN VIEW
66706-15348-CWSG-M4002	PUMP STATION SECTION VIEWS
66706-15348-CWSG-M4003	FLOW SPLIT BOX PLAN AND SECTIONS
66706-15348-CWSG-M4004	TEMPORARY PUMP STATION PLAN
66706-15348-CWSG-M4005	MECHANICAL DETAILS 1
66706-15348-CWSG-M4006	MECHANICAL DETAILS 2
66706-15348-CWSG-S6200	STRUCTURAL - SLUDGE PUMP STATION
66706-15348-CWSG-S6201	STRUCTURAL - SLUDGE PUMP STATION
66706-15348-CWSG-S6202	STRUCTURAL - FLOW SPLIT BOX
66706-15348-CWSG-S6203	STRUCTURAL - TYPICAL SECTIONS AND DETAILS
66706-15348-CWSG-S6204	STRUCTURAL/ARCHITECTURAL - SECTIONS & DETAILS
66706-15348-CWSG-E1001	ELECTRICAL SYMBOLS AND ABBREVIATIONS
66706-15348-CWSG-E1002	ELECTRICAL SITE PLAN - DEMO
66706-15348-CWSG-E1003	ELECTRICAL SITE PLAN - PROPOSED
66706-15348-CWSG-E1004	ELECTRICAL ONELINE
66706-15348-CWSG-E1005	ELECTRICAL DETAILS AND ENLARGED PLANS
66706-15348-CWSG-E1006	ELECTRICAL DETAILS
66706-15348-CWSG-E1007	ELECTRICAL DETAILS AND RACEWAY SCHEDULE
66706-15348-CWSG-E1008	CABLE AND PANEL SCHEDULE

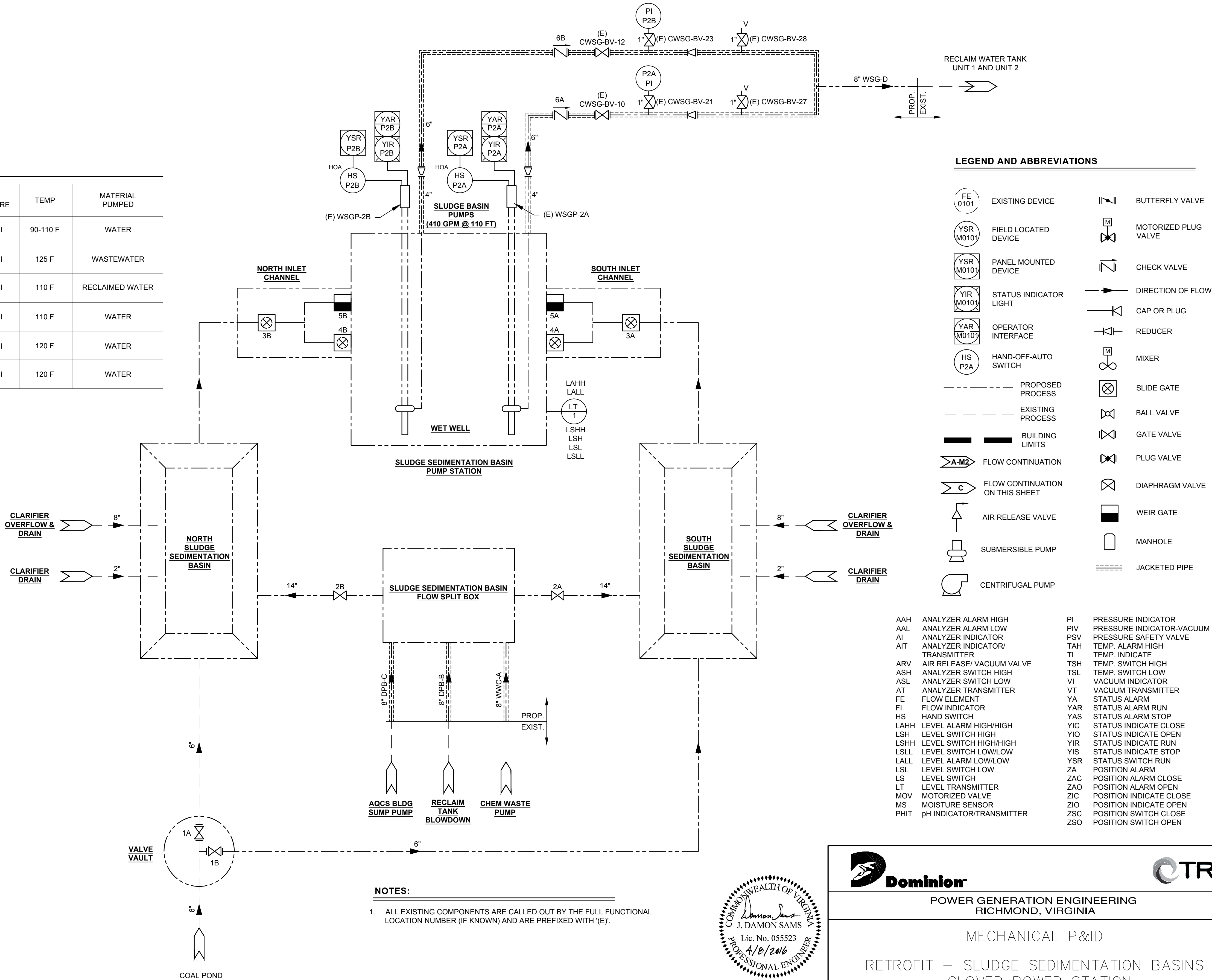


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LINE LIST:

LINE ID	DESC	DIA	PIPE MATERIAL	WORKING PRESSURE	DESIGN PRESSURE	TEST PRESSURE	TEMP	MATERIAL PUMPED
	FROM COAL POND TO SOUTH SLUDGE POND	6	HDPE	50 PSI	100 PSI	150 PSI	90-110 F	WATER
WWC-A	FROM CHEMICAL WASTE	8	HDPE	50 PSI	100 PSI	150 PSI	125 F	WASTEWATER
DPB-B	RECLAIM TANK BLOWDOWN	8	HDPE	70 PSI	100 PSI	150 PSI	110 F	RECLAIMED WATER
DPB-C	AQC BLDG SUMP PUMP DISCH	8	HDPE	60 PSI	100 PSI	150 PSI	110 F	WATER
WSG-D	SLUDGE STORAGE POND PUMP DISCHARGE (ABOVE GROUND)	4/6	DI	50 PSI	100 PSI	150 PSI	120 F	WATER
WSG-D	SLUDGE STORAGE POND PUMP DISCHARGE (BURIED)	8	HDPE	50 PSI	100 PSI	150 PSI	120 F	WATER



Dominion

POWER GENERATION ENGINEERING

RICHMOND, VIRGINIA

MECHANICAL P&ID

RETROFIT – SLUDGE SEDIMENTATION BASINS

CLOVER POWER STATION

DSGN

DSAMS

DSGN SUPV

DATE

APRIL 2016

DRWN

DSAMS

ENGR SUPV

DGNSPEC FOR FILE VERIFICATION

DRAWING NO.

CHKD

CBELL

PROJ ENGR

66706-15348-CWSG-M2647

REV.

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DISPL ENGR

XXX

SCALE: AS NOTED

UNLESS OTHERWISE NOTED

SH 22 OF 41

04 08 2016

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TRC

HCB

NA

RKN

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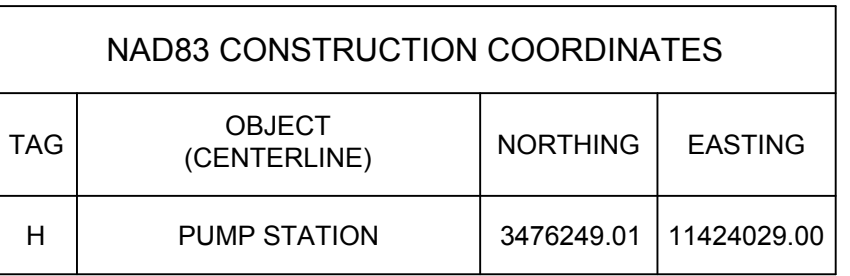
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E.M. ENGR

I&C ENGR

ISSUED FOR BID

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Appendix B

Flood Insurance Rate Map

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. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0 foot North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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 National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Virginia State Plane South zone. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA/NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was provided in digital format by the Commonwealth of Virginia, through the Virginia Geographic Network Division of its Department of Technology Planning (VGIN). These data were produced at scales of 1:2,400 and 1:4,800 from one-foot and two-foot resolution digital orthoimagery flown in Spring 2002.

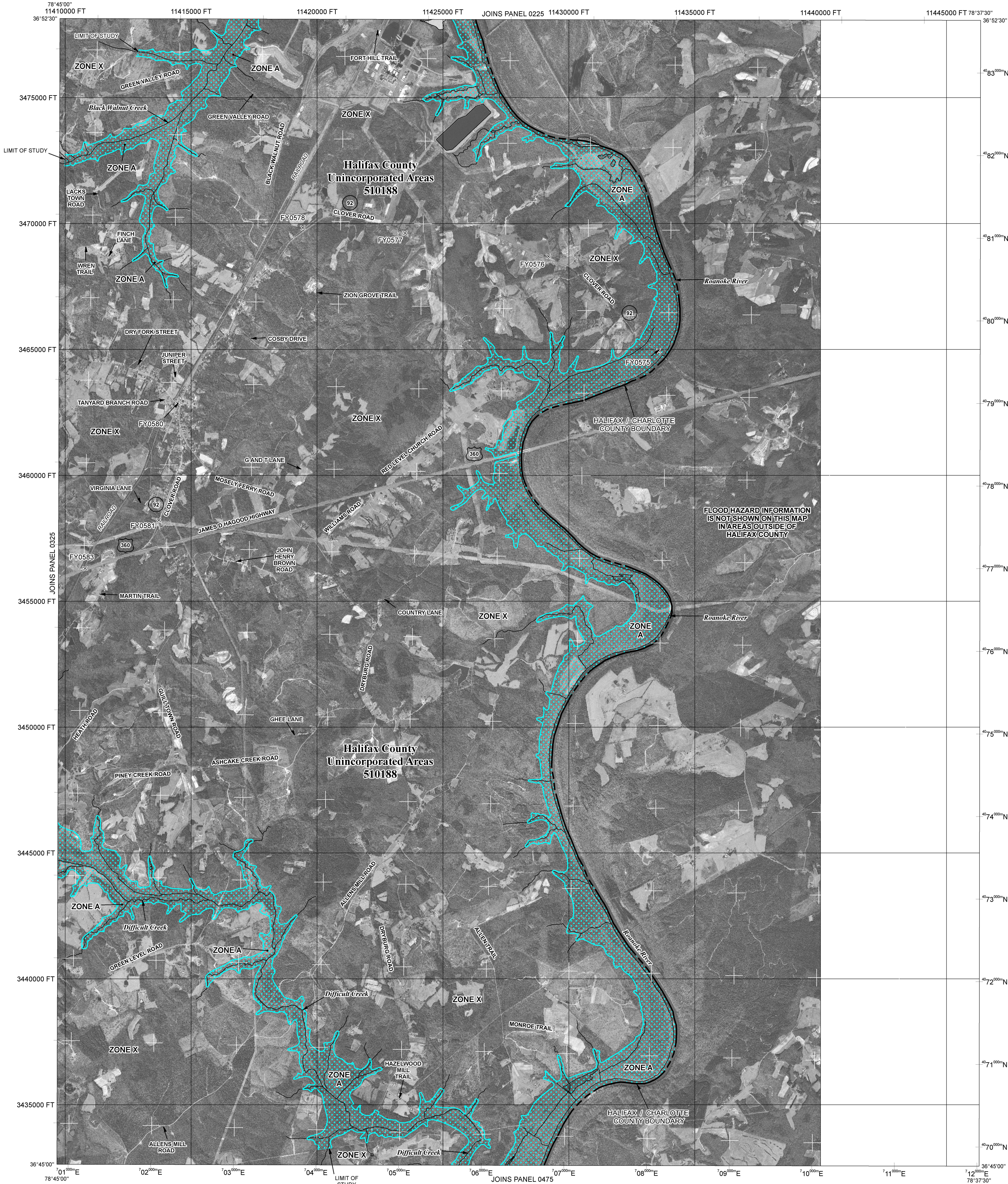
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at <http://msc.fema.gov>.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfp>.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance 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 AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently deteriorated. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
Base Flood Elevation line and value; elevation in feet*
Base Flood Elevation value where uniform within zone; elevation in feet*
* Referenced to the North American Vertical Datum of 1988

Cross section line
Transect line
Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
1000-meter Universal Transverse Mercator grid values, zone 17
5000-foot grid ticks: Virginia State Plane coordinate system, South zone (FIPSZONE 4502), Lambert Conformal Conic projection
Bench mark (see explanation in Notes to Users section of this FIRM panel)
River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
October 16, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'
1000 0 2000 4000 FEET
600 0 600 1200 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0350D

FIRM
FLOOD INSURANCE RATE MAP

HALIFAX COUNTY, VIRGINIA AND INCORPORATED AREAS

PANEL 350 OF 625
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HALIFAX COUNTY	510188	0350	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
51083C0350D

EFFECTIVE DATE
OCTOBER 16, 2009

Federal Emergency Management Agency

Appendix C

Storm Water Calculations

Table of Contents

- Storm Water Run-On Estimate
- Pumping Time Estimate

Storm Water Run-On Estimate



PROJECT / LOCATION: Clover Power Station - Clover, Virginia		PROJECT / PROPOSAL NO.
SUBJECT: Storm Water Capacity of North and South Basins		232002.0000
PREPARED BY: S. Sellner	DATE: 8/15/2016	FINAL ☐
CHECKED BY: J. Hotstream	DATE: 8/19/2016	REVISION ☐

Purpose: Determine if 2 feet of freeboard is capable of containing the runoff volume from the 100 year, 24 hour storm event

Methodology:

- 1.) Determine the storage capacity of 2 feet Freeboard

- Storage Capacity to ELE 374 - Storage Capacity from ELE 372

S_{374} Storage Volume at ELE 374
 S_{372} Storage Volume at ELE 372
 S_{FB} Storage Volume at Freeboard

Freeboard Storage Capacity (Volumes are from the Civil 3D model, refer to attached sheets)

$S_{374} = 47,883 \text{ cy}$
 $S_{372} = 36,358 \text{ cy}$
 $S_{FB} = 11,525 \text{ cy}$

- Adjust Freeboard Capacity to remove liner thickness volume and backfill around pump station

Adj. S_{FB} Adjusted Storage Volume at Freeboard
 S_{FB} Storage Volume at Freeboard
 V_T Total Volume of both Ponds
 t Liner Thickness
 A_{374} Area of Pond at ELE 374
 A_{372} Area of Pond at ELE 372
 V_B Volume of Backfill around Pump Station

$t = 1.5 \text{ ft}$
 $A_{374} = 3.78 \text{ ac}$
 $A_{372} = 3.43 \text{ ac}$
 $V_B = 836 \text{ cy}$

$V_T = t * (A_{374} - A_{372})$
 Adj. $S_{FB} = S_{FB} - V_T - V_B$
 Adj. $S_{FB} = 9,842 \text{ cy}$



PROJECT / LOCATION: Clover Power Station - Clover, Virginia		PROJECT / PROPOSAL NO.
SUBJECT: Estimated Pump Down Time		232002.0000
PREPARED BY: S. Sellner	DATE: 8/16/2016	FINAL ☐
CHECKED BY: J. Hotstream	DATE: 8/19/2016	REVISION ☐

Purpose: Determine the amount of time needed a Lawrence VPL3200 Pump to remove the storm water collected during the 100 year, 24 hour storm event to design operation elevation (ELE 372)

Methodology:

- 1.) Use the Adjusted Freeboard Capacity (Adj. S_{FB}) from the Freeboard Volume Calculation (Refer to attached calculation sheet)

- Adjust Freeboard Capacity removes liner thickness volume

$$\text{Adj. } S_{FB} = 6,186 \text{ cy}$$

- 2.) Use pump capacity rating to determine amount of time to lower the water level in both basins to ELE 372

- Assume only one pump is operational for both ponds

$$\text{Pump Rate} = 410 \text{ gallons per minute (gpm)}$$

$$\text{Adj. } S_{FB} = 6,186 \text{ cy}$$

$$\text{Adj. } S_{FB} = 1,249,411 \text{ gal}$$

$$\text{Time} = \frac{\text{Adj. } S_{FB}}{\text{Pump Rate}}$$

$$\begin{aligned} \text{Time} &= 3047 \text{ min} \\ &= 50.8 \text{ hr} \\ &= 2.1 \text{ days} \end{aligned}$$

Conclusion: It will take approximately 2 days to pump out the storm water to reestablish freeboard after the 100 year, 24 hour storm event.

This calculation assumes that only one pump will be in operation to remove stormwater.

PROJECT / LOCATION: Clover Power Station - Clover, Virginia		PROJECT / PROPOSAL NO.	
SUBJECT: Storm Water Capacity of North and South Basins		232002.0000	
PREPARED BY: S. Sellner	DATE: 8/15/2016	FINAL	☐
CHECKED BY: J. Hotstream	DATE: 8/19/2016	REVISION	☐

2.) Determine the storm water runoff volume that flows into the basins from the 100 year, 24 hour storm event

$$V_R = \text{Volume of Runoff}$$

$$\text{Area} = 5.78 \text{ ac}$$

Rainfall

$$\text{Rate} = 7.96 \text{ in/ac} \quad \text{Design storm data from NOAA, refer to attached sheets}$$

$$V_R = \text{Area} * \text{Rainfall Rate}$$

$$V_R = 6,186 \text{ cy}$$

3.) Compare Freeboard Capacity to Volume of Runoff to determine if the Freeboard is capable of containing 100 year/24 hour storm event.

- If Adjusted $S_{FB} > V_R$, then the Freeboard design is OK

$$\text{Adj. } S_{FB} = 9,842 \text{ cy}$$

$$V_R = 6,186 \text{ cy}$$

$$\text{Adj. } S_{FB} > V_R$$

Conclusion: Because the Adjusted $S_{FB} > V_R$, the 2 feet of freeboard is capable of containing the runoff volume of the 100 year, 24 hour storm event

PROJECT / LOCATION: Clover Power Station - Clover, Virginia		PROJECT / PROPOSAL NO.	
SUBJECT: Storm Water Capacity of North and South Basins		232002.0000	
PREPARED BY: S. Sellner	DATE: 8/15/2016	FINAL	☐
CHECKED BY: J. Hotstream	DATE: 8/19/2016	REVISION	☐

ATTACHMENTS

Cut/Fill Report

CAPACITY OF BOTH
PONDS TO ELEV. 374.
AND 372.

Generated: 2015-11-16 13:31:11

By user: EOlsen

Drawing: J:\Dominion Resources\Clover\232002 - Civil Design\000004
\DTM\Volumes\J:\Dominion Resources\Clover\232002 - Civil Design\000004
\DTM\Volumes\Storage Capacity.dwg

Volume Summary							
Name	Type	Cut Factor	Fill Factor	2d Area (acres)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Storage Capacity 30% Output - Clover TO ELE 374	full	1.000	1.000	3.78	0.09	47883.61	47883.53<Fill>
Storage Capacity to ELE 372	full	1.000	1.000	3.43	0.06	36358.56	36358.50<Fill>

Totals				
	2d Area (acres)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Total	7.21	0.15	84242.17	84242.03<Fill>

* Value adjusted by cut or fill factor other than 1.0

03

Cut/Fill Report

BACKFILL OF BERM
AROUND PUMPSTATION

Generated: 2015-10-15 15:07:36

By user: lstormer

Drawing: J:\Dominion Resources\Clover\232002 - Civil Design\000004
 \DTM\J:\Dominion Resources\Clover\232002 - Civil Design\000004
 \DTM\Backfill.dwg

Volume Summary							
Name	Type	Cut Factor	Fill Factor	2d Area (acres)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Backfill around Pump Station	full	1.000	1.000	0.10	0.00	835.69	835.69<Fill>

Totals				
	2d Area (acres)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Total	0.10	0.00	835.69	835.69<Fill>

* Value adjusted by cut or fill factor other than 1.0

- BACKFILL FROM SUBBASE GRADES TO BERM SUBBASE GRADES
- INCLUDES PUMP STATION VOLUME

04



NOAA Atlas 14, Volume 2, Version 3
Location name: Clover, Virginia, US*
Latitude: 36.8389°, Longitude: -78.7628°
Elevation: 463 ft*
 * source: Google Maps



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.365 (0.327-0.407)	0.432 (0.387-0.481)	0.506 (0.453-0.563)	0.565 (0.506-0.628)	0.632 (0.563-0.701)	0.680 (0.603-0.753)	0.725 (0.640-0.803)	0.764 (0.671-0.848)	0.810 (0.707-0.901)	0.846 (0.733-0.940)
10-min	0.583 (0.522-0.650)	0.690 (0.619-0.770)	0.810 (0.725-0.902)	0.904 (0.809-1.00)	1.01 (0.897-1.12)	1.08 (0.960-1.20)	1.15 (1.02-1.28)	1.21 (1.06-1.34)	1.28 (1.12-1.43)	1.33 (1.15-1.48)
15-min	0.728 (0.652-0.812)	0.868 (0.778-0.968)	1.02 (0.917-1.14)	1.14 (1.02-1.27)	1.28 (1.14-1.42)	1.37 (1.22-1.52)	1.46 (1.29-1.61)	1.53 (1.34-1.70)	1.61 (1.41-1.79)	1.67 (1.45-1.86)
30-min	0.998 (0.894-1.11)	1.20 (1.07-1.34)	1.46 (1.30-1.62)	1.66 (1.48-1.84)	1.89 (1.68-2.10)	2.06 (1.83-2.29)	2.23 (1.97-2.47)	2.38 (2.09-2.64)	2.57 (2.24-2.85)	2.71 (2.35-3.01)
60-min	1.25 (1.11-1.39)	1.50 (1.35-1.68)	1.87 (1.67-2.08)	2.16 (1.93-2.40)	2.52 (2.24-2.79)	2.80 (2.48-3.10)	3.07 (2.71-3.40)	3.34 (2.93-3.70)	3.68 (3.21-4.09)	3.95 (3.42-4.39)
2-hr	1.47 (1.31-1.65)	1.78 (1.59-1.99)	2.22 (1.98-2.48)	2.59 (2.31-2.89)	3.07 (2.71-3.41)	3.46 (3.04-3.84)	3.85 (3.36-4.27)	4.25 (3.69-4.71)	4.78 (4.11-5.30)	5.21 (4.44-5.78)
3-hr	1.57 (1.40-1.76)	1.90 (1.70-2.13)	2.37 (2.12-2.66)	2.77 (2.47-3.10)	3.29 (2.91-3.67)	3.71 (3.26-4.13)	4.13 (3.61-4.59)	4.55 (3.96-5.06)	5.13 (4.41-5.70)	5.58 (4.76-6.21)
6-hr	1.92 (1.71-2.16)	2.31 (2.06-2.60)	2.88 (2.57-3.24)	3.39 (3.01-3.80)	4.06 (3.58-4.54)	4.63 (4.05-5.16)	5.21 (4.53-5.81)	5.83 (5.01-6.47)	6.68 (5.67-7.41)	7.39 (6.20-8.19)
12-hr	2.30 (2.08-2.58)	2.77 (2.50-3.11)	3.48 (3.13-3.89)	4.11 (3.68-4.60)	4.99 (4.43-5.55)	5.75 (5.06-6.36)	6.56 (5.72-7.22)	7.42 (6.40-8.17)	8.67 (7.35-9.53)	9.74 (8.12-10.7)
24-hr	2.68 (2.45-2.94)	3.24 (2.97-3.56)	4.13 (3.78-4.55)	4.88 (4.45-5.36)	5.99 (5.42-6.55)	6.93 (6.24-7.57)	7.96 (7.11-8.69)	9.09 (8.05-9.91)	10.7 (9.39-11.7)	12.2 (10.5-13.3)
2-day	3.15 (2.89-3.45)	3.81 (3.51-4.17)	4.83 (4.43-5.28)	5.66 (5.19-6.19)	6.87 (6.26-7.49)	7.87 (7.14-8.59)	8.95 (8.06-9.77)	10.1 (9.03-11.0)	11.8 (10.4-12.9)	13.2 (11.5-14.5)
3-day	3.33 (3.06-3.65)	4.03 (3.70-4.42)	5.10 (4.68-5.58)	5.98 (5.48-6.55)	7.25 (6.60-7.92)	8.31 (7.53-9.07)	9.44 (8.50-10.3)	10.7 (9.52-11.7)	12.4 (11.0-13.6)	13.9 (12.1-15.3)
4-day	3.51 (3.22-3.85)	4.25 (3.90-4.66)	5.38 (4.93-5.89)	6.30 (5.76-6.91)	7.63 (6.95-8.35)	8.74 (7.92-9.55)	9.93 (8.94-10.9)	11.2 (10.0-12.3)	13.1 (11.5-14.3)	14.6 (12.8-16.0)
7-day	4.05 (3.72-4.43)	4.87 (4.47-5.32)	6.06 (5.57-6.62)	7.04 (6.45-7.69)	8.44 (7.70-9.21)	9.60 (8.71-10.5)	10.8 (9.77-11.8)	12.1 (10.9-13.2)	14.0 (12.4-15.3)	15.6 (13.6-17.1)
10-day	4.59 (4.25-5.00)	5.50 (5.09-5.98)	6.78 (6.26-7.37)	7.81 (7.20-8.49)	9.27 (8.50-10.1)	10.4 (9.55-11.3)	11.7 (10.6-12.7)	13.0 (11.7-14.1)	14.8 (13.3-16.1)	16.3 (14.5-17.8)
20-day	6.21 (5.78-6.69)	7.40 (6.89-7.96)	8.93 (8.30-9.61)	10.1 (9.40-10.9)	11.8 (10.9-12.6)	13.1 (12.0-14.0)	14.4 (13.2-15.4)	15.7 (14.3-16.9)	17.5 (15.8-18.8)	18.9 (17.0-20.3)
30-day	7.68 (7.20-8.18)	9.09 (8.53-9.67)	10.7 (10.1-11.4)	12.0 (11.2-12.7)	13.6 (12.7-14.5)	14.9 (13.8-15.8)	16.1 (14.9-17.1)	17.3 (16.0-18.4)	18.8 (17.3-20.0)	19.9 (18.3-21.3)
45-day	9.68 (9.12-10.3)	11.4 (10.8-12.1)	13.3 (12.5-14.1)	14.8 (13.9-15.6)	16.6 (15.6-17.6)	18.0 (16.8-19.0)	19.3 (18.0-20.4)	20.5 (19.1-21.8)	22.1 (20.5-23.6)	23.3 (21.5-24.8)
60-day	11.6 (10.9-12.2)	13.6 (12.8-14.3)	15.7 (14.8-16.5)	17.2 (16.2-18.2)	19.2 (18.1-20.3)	20.6 (19.4-21.8)	22.0 (20.7-23.3)	23.3 (21.9-24.7)	25.0 (23.3-26.5)	26.1 (24.3-27.8)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

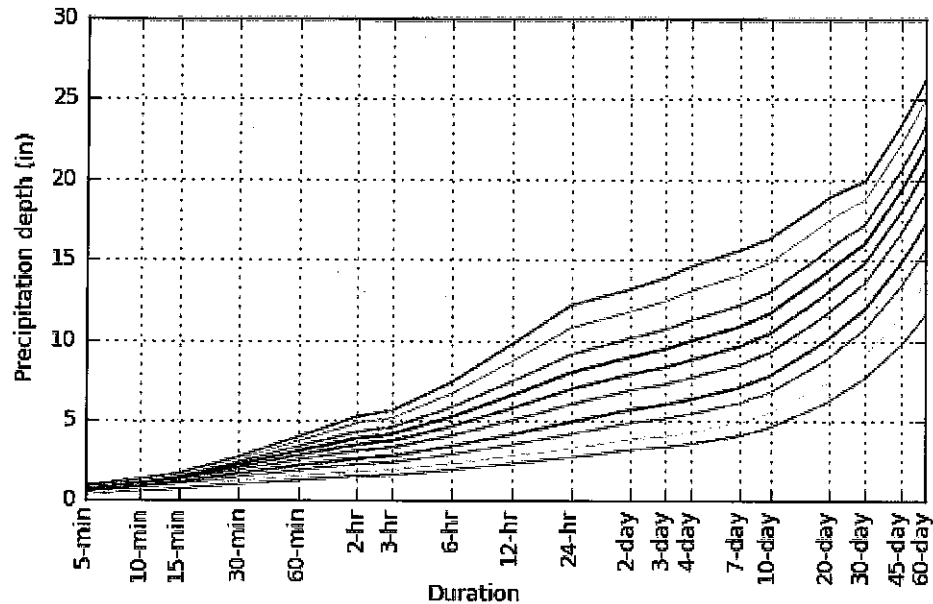
[Back to Top](#)

PF graphical

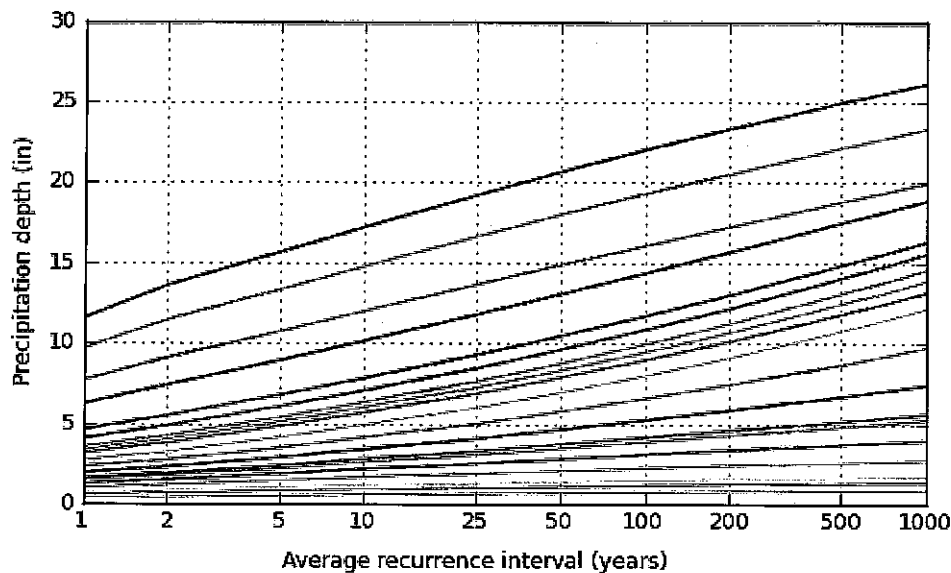
05

PDS-based depth-duration-frequency (DDF) curves

Latitude: 36.8389°, Longitude: -78.7628°



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



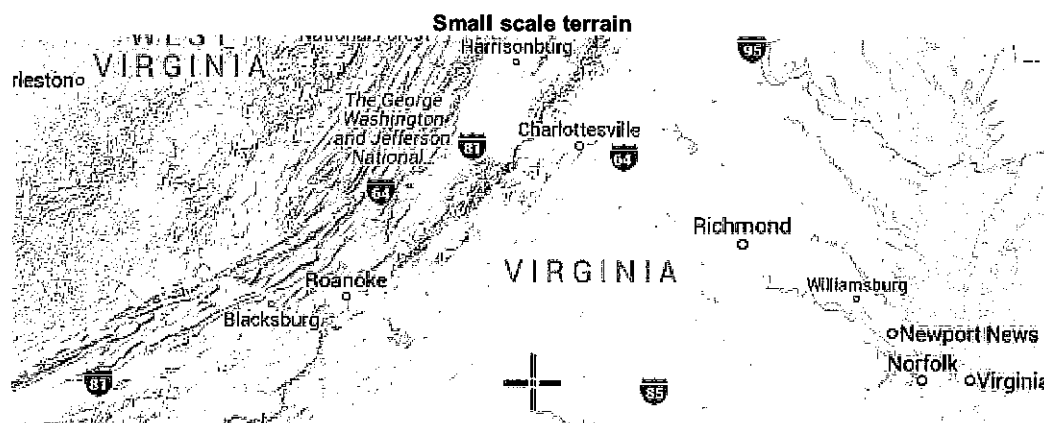
Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

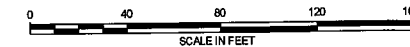
NOAA Atlas 14, Volume 2, Version 3

Created (GMT): Mon Nov 16 17:19:33 2015

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Maps & aeriels





TITLE: **STORMWATER DRAINAGE AREA**

Pumping Time Estimate



PROJECT / LOCATION: Clover Power Station - Clover, Virginia		PROJECT / PROPOSAL NO.
SUBJECT: Estimated Pump Down Time		232002.0000
PREPARED BY: S. Sellner	DATE: 8/16/2016	FINAL ☐
CHECKED BY: J. Hotstream	DATE: 8/19/2016	REVISION ☐

Purpose: Determine the amount of time needed a Lawrence VPL3200 Pump to remove the storm water collected during the 100 year, 24 hour storm event to design operation elevation (ELE 372)

Methodology:

- 1.) Use the Adjusted Freeboard Capacity (Adj. S_{FB}) from the Freeboard Volume Calculation (Refer to attached calculation sheet)

- Adjust Freeboard Capacity removes liner thickness volume

$$\text{Adj. } S_{FB} = 6,186 \text{ cy}$$

- 2.) Use pump capacity rating to determine amount of time to lower the water level in both basins to ELE 372

- Assume only one pump is operational for both ponds

$$\text{Pump Rate} = 410 \text{ gallons per minute (gpm)}$$

$$\text{Adj. } S_{FB} = 6,186 \text{ cy}$$

$$\text{Adj. } S_{FB} = 1,249,411 \text{ gal}$$

$$\text{Time} = \frac{\text{Adj. } S_{FB}}{\text{Pump Rate}}$$

$$\begin{aligned} \text{Time} &= 3047 \text{ min} \\ &= 50.8 \text{ hr} \\ &= 2.1 \text{ days} \end{aligned}$$

Conclusion: It will take approximately 2 days to pump out the storm water to reestablish freeboard after the 100 year, 24 hour storm event.
This calculation assumes that only one pump will be in operation to remove stormwater.