Floodplain Development Permit

Doddridge County, WV Floodplain Management

This permit gives approval for the development/ project listed that impacts the FEMA-designated floodplain and/or floodway of Doddridge County, WV, pursuant to the rules and regulations established by all applicable Federal, State and local laws and ordinances, including the Doddridge County Floodplain Ordinance. This permit must be posted at the site of work as to be clearly visible and must remain posted during entirety of development.

Permit: #18-531

Date Approved: November 5, 2018 **Expires: November 5, 2019**

Issued to: Dominion Energy **POC: Derrick Angle**

Company Address: 335 US Highway 33W Weston, WV 26452

Project Address: South Fork Hughes River Road

Firm: 54017C0225C **Lat/Long: 39.19744N, -80.76239W**

Purpose of Development: New Construction Maxwell Compressor

Issued by: George C. Eidel, CFM, OEM Director/Doddridge County FPM (*or designee*)

George C. Eidel

Date: November 5, 2018

For additional information regarding this permit, please contact Doddridge County Floodplain Manager at 304.873.2631, or via email at doddridgecountyfpm@gmail.com
118 East Court Street; West Union, WV 26456

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

I. L. (Ike) Morris
P.O. Box 397
Glenville, WV 26351

9590 9402 3685 7335 7557 77

2. Article Number *(Transfer from service label)*

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Jackie Swiger ☒ Agent ☐ Addressee

B. Received by *(Printed Name)* Jackie Swiger C. Date of Delivery 10-15-18

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
- ☐ Adult Signature
- ☐ Adult Signature Restricted Delivery
- ☐ Certified Mail®
- ☐ Certified Mail Restricted Delivery
- ☐ Collect on Delivery
- ☐ Collect on Delivery Restricted Delivery
- ☐ Insured Mail
- ☐ Insured Mail Restricted Delivery (over $500)
- ☐ Priority Mail Express®
- ☐ Registered Mail™
- ☐ Registered Mail Restricted Delivery
- ☐ Return Receipt for Merchandise
- ☐ Signature Confirmation™
- ☐ Signature Confirmation Restricted Delivery

PS Form 3811, July 2015 PSN 7530-02-000-9053 Domestic Return Receipt

7016 2070 0000 3170 2846

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Extra Services & Fees *(check box, add fee as appropriate)*
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- ☐ Adult Signature Required $
- ☐ Adult Signature Restricted Delivery $

Postage $ .50

Total Postage and Fees $ 6.70

Postmark Here

Sent To I. L. (Ike) Morris

Street and Apt. No., or PO Box No. P.O. BOX 397

City, State, ZIP+4® Glenville, WV 26351 18-531

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

COPY

FP# 8-531

COPY COPY COPY COPY

5062655

gai consultants, inc.
transforming ideas into reality

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Orlando, FL 32801

Citizens Bank®

EZShield™ Check Fraud Protection for Business

3-7615/360

CHECK DATE September 18, 2018

COPY COPY COPY COPY

PAY Three Hundred Ninety and 00/100 Dollars

AMOUNT 390.00

TO Doddridge County Commission
118 East Court St
West Union, WV 26456

COPY COPY COPY

AUTHORIZED SIGNATURE

Security features. Details on back.

COPY COPY

⑈5062655⑈ ⑆036076150⑆ 6101715535⑈

COPY COPY

FLOODPLAIN PERMIT #18-531

Dominion Energy, Maxwell Compressor Station New Building, S. Fork Hughes River Rd 39.17944N/-80.76239

TASK	COMPLETE (DATE)	NOTES
CHECK RECEIVED	10/10/2018	
US ARMY CORP. ENGINEERS (USACE)		
US FISH & WILDLIFE SERVICES (USFWS)		
WV DEPT. NATURAL RESOURCES (WVDNR)		
WV DEPT. ENVIROMENTAL PROTECTION (WVDEP)		
STATE HISTORIC & PRESERVATION OFFICE (SHPO)		
OFFICE of LAND & STREAM (OLS)		
DATE OF COMMISSION READING	10/16/2018	
DATE AVAILABLE TO BE GRANTED	11/5/2018	
PERMIT GRANTED		
COMPLETE		

7016 2070 0000 3170 2846

Doddridge County Floodplain Permits

(Week of October 15, 2018)

Please take notice that on the **(10th)** of **(October), 2018, Dominion Energy** filed an application for a Floodplain Permit **(#18-531)** to develop land located at or about **South Fork Hughes River Road; Coordinates: 39.17944 N, -80.76239 W**. The Application is on file with the Floodplain Manager of the County and may be inspected or copied during regular business hours in accordance to WV Code Chapter 29B Freedom of Information, Article 1 Public Records and county policy and procedures. Any interested persons who desire to comment shall present the same in writing by **(November 5, 2018)** (20 calendar days after the announcement at the regularly scheduled Doddridge County Commission Meeting) delivered to the Floodplain Manager of the County at 105 Court Street, Suite #3, West Union, WV 26456. **This project is for a new building at the Maxwell Compressor Station**

GEORGE C. EIDEL, CFM

Doddridge County Floodplain Manager

Dominion Energy Services, Inc.
5000 Dominion Boulevard, Glen Allen, Virginia 23060
DominionEnergy.com

Dominion Energy

BY OVERNIGHT (OR EXPRESS) MAIL

October 5, 2018

Mr. George Eidel
Doddridge County Commission
118 East Court Street
West Union, West Virginia 26456

OCT10 18 3:11PM

RE: Dominion Energy Transmission, Inc.
Maxwell Compressor Station – New Building
Doddridge County Floodplain Development Permit Application
Doddridge County, West Virginia

Dear Mr. Eidel:

Dominion Energy Transmission, Inc. (DETI) has enclosed for your review the Doddridge County Floodplain Permit Application for the Maxwell Compressor Station – New Building (Project), located in Doddridge County, West Virginia.

DETI is proposing to construct a new office building within the existing grassed and fenced lot of the Maxwell Compressor Station. The new building will be constructed within the Federal Emergency Management Agency (FEMA)-mapped 100-year floodplain of the South Fork Hughes River. The new building will be located near GPS coordinates 39.179435° N, -80.762363° W, off South Fork Hughes River Road (CR 40) in West Union, WV. The building will be constructed at existing grade (no fill) and will be approximately 20 feet wide by 20 feet long. The building will be located within a Zone A Special Flood Hazard Area per FEMA Flood Insurance Rate Map (FIRM) Number 54017C0225C, dated October 4, 2011.

We are requesting your review of the enclosed Permit Application (Enclosure 1) regarding the Doddridge County Floodplain Ordinance requiring a permit for the development and construction, substantial improvement, or relocation of any building or structure in a floodplain area. A Hydrologic & Hydraulic (H&H) Engineering Analysis Report has been included as Enclosure 2. This report includes the Hydrologic Engineering Centers River Analysis System (HEC-RAS) modeling results, as requested by the county. The H&H analysis establishes a design discharge (flood flow) and base flood elevation (BFEs) for both existing and proposed conditions along South Fork Hughes River in the reach of stream near the Project Site so that the impacts of the new development can be assessed.

A check in the amount of $390 for the permit application fee is also enclosed. This fee is based on an estimated cost of construction within the 100-year floodplain of $70,000.

DETI appreciates your timely review of this permit application package. Should you have any questions or require further information, please do not hesitate to contact Karl Kratzer at (804) 273-2914 or karl.r.kratzer@dominionenergy.com.

Sincerely,

Richard B. Gangle
Director Environmental Services

OCT10 18 3:11PM

Enclosures

cc: Karl Kratzer, Dominion Energy

Enclosure 1
Floodplain Permit Application

Attachment 1
Floodplain Development Permit Application

Permit# 18-531

Project Name: Maxwell Compressor Station - New Building

Permittees Name: Dominion Energy

OCT10 18 3:11PM

Doddridge County, WV

Floodplain Development Permit Application

This document is to be used for projects that impact/potentially impact the FEMA---designated floodplain and/or floodway of Doddridge County, WV pursuant to the rules and regulations established by all applicable Federal, State and local laws and ordinances, including the Doddridge County Floodplain Ordinance.

SECTION 1: GENERAL PROVISIONS (APPLICANT TO READ AND SIGN)

1. No work may start until a permit is issued.
2. The permit may be revoked if any false statements are made herein.
3. If revoked, all work must cease until permit is re-issued.
4. Development shall not be used or occupied until a Certificate of Compliance is issued.
5. The permit will expire if no work is commenced within six months of issuance.
6. Applicant is hereby informed that other permits may be required to fulfill local, state, and federal requirements.
7. Applicant hereby gives consent to the Floodplain Administrator/Manager or his/her representative to make inspections to verify compliance.
8. I THE APPLICANT CERTIFY THAT ALL STATEMENTS HEREIN AND IN ATTACHMENTS TO THIS APPLICATION ARE, TO THE BEST OF MY KNOWLEDGE, TRUE AND ACCURATE.

APPLICANT'S SIGNATURE _____

DATE 10-03-18

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Applicant Information:

Please provide all pertinent data.

Applicant Information		
Responsible Company Name: Dominion Energy Transmission, Inc.		
Corporate Mailing Address: 5000 Dominion Boulevard		
City: Glen Allen	**State:** VA	**Zip:** 23060
Corporate Point of Contact (POC): Karl Kratzer		
Corporate POC Title: Manager, Environmental Compliance		
Corporate POC Primary Phone: 804-273-2914		
Corporate POC Primary Email: Karl.R.Kratzer@dominionenergy.com		
Corporate FEIN: 55-0629203	**Corporate DUNS:**	
Corporate Website: www.dominionenergy.com		
Local Mailing Address: 335 US Highway 33W		
City: Weston	**State:** WV	**Zip:** 26452
Local Project Manager (PM): Derek Ingle		
Local PM Primary Phone: 304-269-6990		
Local PM Secondary Phone: 304-406-2562		
Local PM Primary Email: derek.r.ingle@dominionenergy.com		
Person Filing Application: Karl Kratzer		
Applicant Title: Manager, Environmental Compliance		
Applicant Primary Phone: 804-273-2914		
Applicant Secondary Phone:		
Applicant Primary Email: Karl.R.Kratzer@dominionenergy.com		

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Project Narrative:

Describe in detail the proposed development including project name/title, type of development, estimated start and completion timeline, and its potential impact on the floodplain. Use additional copies of this page as needed.

Project Narrative:
Dominion Energy Transmission, Inc. (DETI) is submitting a Doddridge County Floodplain Development Permit Application for the Maxwell Compressor Station (Project). The Project is located in Doddridge County, West Virginia (WV) and includes the construction of a new 20 foot wide by 20 foot long office building within the existing grassed and fenced lot of the Maxwell Compressor Station. The new building will be constructed within Zone A of the FEMA-mapped 100-year floodplain of the South Fork Hughes River.

Proposed Development:

Please check all elements of the proposed project thatapply.

DESCRIPTION OF WORK (CHECK ALL APPLICABLE BOXES)

A. STRUCTURAL DEVELOPMENT

	ACTIVITY		STRUCTURAL TYPE
[X]	New Structure	[]	Residential (1 – 4 Family)
[]	Addition	[]	Residential (more than 4 Family)
[]	Alteration	[]	Non-residential (floodproofing)
[]	Relocation	[]	Combined Use (res. & com.)
[]	Demolition	[]	Replacement
[]	Manufactured/Mobil Home	[X]	Industrial (Office Building)

B. OTHER DEVELOPLMENT ACTIVITIES:

[] Fill [] Mining [] Drilling [] Pipelining

[X] Grading

[] Excavation (except for STRUCTURAL DEVELOPMENT checked above)

[] Watercourse Alteration (including dredging and channel modification)

[] Drainage Improvements (including culvert work)

[] Road, Street, or Bridge Construction

[] Subdivision (including new expansion)

[] Individual Water or Sewer System

[] Other (please specify)

_____

_____

_____

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Development Site/Property Information:

Please provide physical description of the site/property, along with pertinent ownership (surface and mineral rights) data as applicable. Attach appropriate maps from the WV Flood Tool showing location of proposed development. Use additional copies of this page if development spans multiple property boundaries. Designate each property by number (i.e. Property 1 of 1, Property 2 of 7, etc.)

Property Designation: 1 of 1

Site/Property Information:		
Legal Description: 5.4 AC Southwest		
Physical Address/911 Address: South Fork of Hughes River Rd (CR 40) , West Union, WV 26456		
Decimal Latitude/Longitude: 39.179454, -80.762354		
DMS Latitude/Longitude: 39°10'46.0338" N, 80°45'44.4744" W		
District: 7	**Map:** 10	**Parcel:** 3
Land Book Description: 5.4 acres		
Deed Book Reference: 72/267		
Tax Map Reference: 07-10-03		
Existing Buildings/Use of Property: Compressor station		

Floodplain Location Data: ***(to be completed by Floodplain Manager or designee)***			
Community:	**Number:**	**Panel:**	**Suffix:**
Location (Lat/Long):		**Approximate Elevation:** **Estimated BFE:**	
Is the development in the floodway? ☐ **Yes** ☐ **No**		**Is the development in the floodplain?** ☐ **Yes** ☐ **No** **Zone:** _____	
Notes:			

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Property Owner Data:

Please provide data on current site/property landowner(s), both surface and mineral rights (as applicable). Use additional copies of this page as needed. Designate each page in relation to each property listed above.

Property Designation: 1 of 1

Property Owner Data: Parcel: 09-07-0010-0003-0000		
Name of Primary Owner (PO): CNG Transmission Corp; care of: Dominion Energy Transmission		
PO Address: 625 Liberty Ave Mail Drop 18-01		
City: Pittsburgh	**State:** PA	**Zip:** 15221
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Surface Rights Owner Data:		
Name of Primary Owner (PO): N/A		
PO Address:		
City:	**State:**	**Zip:**
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Mineral Rights Owner Data: ***(As Applicable)***		
Name of Primary Owner (PO): N/A		
PO Address:		
City:	**State:**	**Zip:**
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Contractor Data:

Please provide all pertinent data for contractors and sub---contractors that may be participating in this project. Use additional copies of this page as needed. Designate each page in relation to each property listed above.

Property Designation: 1 of 1

Contractor/Sub-Contractor (C/SC) Information:		
C/SC Company Name: To be determined		
C/SC WV License Number:		
C/SC FEIN:	**C/SC DUNS:**	
Local C/SC Point of Contact (POC):		
Local C/SC POC Title:		
C/SC Mailing Address:		
City:	**State:**	**Zip-Code:**
Local C/SC Office Phone:		
Local C/SC POC Phone:		
Local C/SC POC E-Mail:		

Engineer Firm Information:		
Engineer Firm Name: GAI Consultants		
Engineer WV License Number: COA No. C00208		
Engineer Firm FEIN: 25-1260999	**Engineer Firm DUNS:**	
Engineer Firm Primary Point of Contact (POC): Shane Fisher, P.E.		
Engineer Firm Primary POC Title: Assistant Engineering Manager		
Engineer Firm Mailing Address: 600 Marketplace Avenue		
City: Bridgeport	**State:** WV	**Zip-Code:** 26330
Engineer Firm Office Phone: 304-933-5203		
Engineer Firm Primary POC Phone: 304-627-9233		
Engineer Firm Primary POC E-Mail: s.fisher@gaiconsultants.com		

Adjacent and/or Affected Landowners Data

Please provide data for all adjacent and/or affected surface owners (both up and down stream) whose property may be impacted by proposed development as demonstrated by a floodplain study or survey. Use additional copies of this page as needed.

Adjacent Property Owner Data: Upstream (09-07-0010-0004-0000)		
Name of Primary Owner (PO): CNG Transmission Corp; care of: Dominion Energy Transmission		
Physical Address: South Fork of Hughes River Rd (CR 40)		
City: West Union	**State:** WV	**Zip:** 26456
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Adjacent Property Owner Data: Upstream (09-07-0010-0002-0000)		
Name of Primary Owner (PO): I.L (Ike) Morris		
Physical Address: PO Box 397		
City: Glenville	**State:** WV	**Zip:** 26351
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Adjacent Property Owner Data: Downstream		
Name of Primary Owner (PO):		
Physical Address:		
City:	**State:**	**Zip:**
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Adjacent Property Owner Data: Downstream		
Name of Primary Owner (PO):		
Physical Address:		
City:	**State:**	**Zip:**
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Applicant

Please read print name, sign and date below:

- I certify that I am authorized to submit this application for the primary project developer.
- I certify that the information included in this application is to the best of my knowledge true and complete.
- I certify that all required Federal, State, and local permits required by law and/or ordinance for the above described development of this project have been properly attained, are current and valid, and must be presented with this application before a Doddridge County Floodplain Permit may be issued.
- I understand that if in the course of the development project additional permits become required that were not needed during the initial proposal, the primary developer must notify the Doddridge County Floodplain Manager within 48 hours of such need, and that a "Stop Work" order may be issued for all project work directly impacting the floodplain or floodway, until such time the required additional permits are acquired.
- I understand that once the floodplain permit is submitted, the application will be entered into official public record at the next regularly scheduled Doddridge County Commission meeting after the date of submittal.
- I understand that from the date of submittal of the fully completed permit application, the Doddridge County Floodplain Manager has ninety (90) days to make a determination to either grant or deny said permit application. During this approval period, the Doddridge County Floodplain Manager may, at his or her discretion, conduct a review and/or additional study of provided documentation by means of an independent engineering firm. All costs associated with said review and/or study must be reimbursed to the County before issuance of approved permit.
- I understand that during the approval period, the Doddridge County Floodplain Manager of designee may at his or her discretion conduct site visits and document conditions of proposed development pursuant to the permit application.
- I understand that once the Floodplain Permit is granted, the permit will be entered into official public record at the next scheduled Doddridge County Commission meeting after the date of issuance. Appeals to the permit may be made no later than twenty (20) days after said issuance. If a valid appeal is submitted, as determined by the Doddridge County Floodplain Manager, a "Stop Work" order will be issued for all project development directly involving the floodplain or floodway. A public hearing by the Doddridge County Appeals Board will be scheduled no less than ten (10) days after the next regularly scheduled Doddridge County Commission meeting.
- I understand that all decisions of the Doddridge County Appeals Board shall be final.
- **I understand issuance of a Floodplain Permit authorizes me to proceed with construction as proposed. A Certificate of Compliance is required upon substantial completion of the project.**
- In signing this application, the primary developer hereby grants the Doddridge County Floodplain Manager or designee the right to enter onto the above---described location to inspect the development work proposed, in progress, and/or completed.
- I understand that if I do not follow exactly the site---plan submitted and approved by this permit that a "Stop Work" order may be issued by the Doddridge County Floodplain Manager and that I must stop all construction immediately until discrepancies of actual work vs. proposed work is resolved.

Applicant Signature: _____ Date: 10-05-18

Applicant Printed Name: Brian C. Sheppard

Attachment 2
WV Flood Tool Map

WV Flood Map

Flood Info Location *Map created on 9/13/2018*

User Notes:

LOMAs
- Incorporated
- Superseded
- Not incorporated
- No Revalidation Status
- Reevaluated

Contact Community for Revalidation Status

Cross Section (XS) Lines

Base Flood Elevation (BFE) Lines

Base Flood Elevation (BFE) Lines

FEMA Effective Floodplains
- Zone AE FLOODWAY
- Zone AE (AH, AO)
- Zone A
- DFIRM Panel Index

Flood Depth (Ft)

High : 864.11

Low : 0

LOMRs

Effective

Disclaimer:

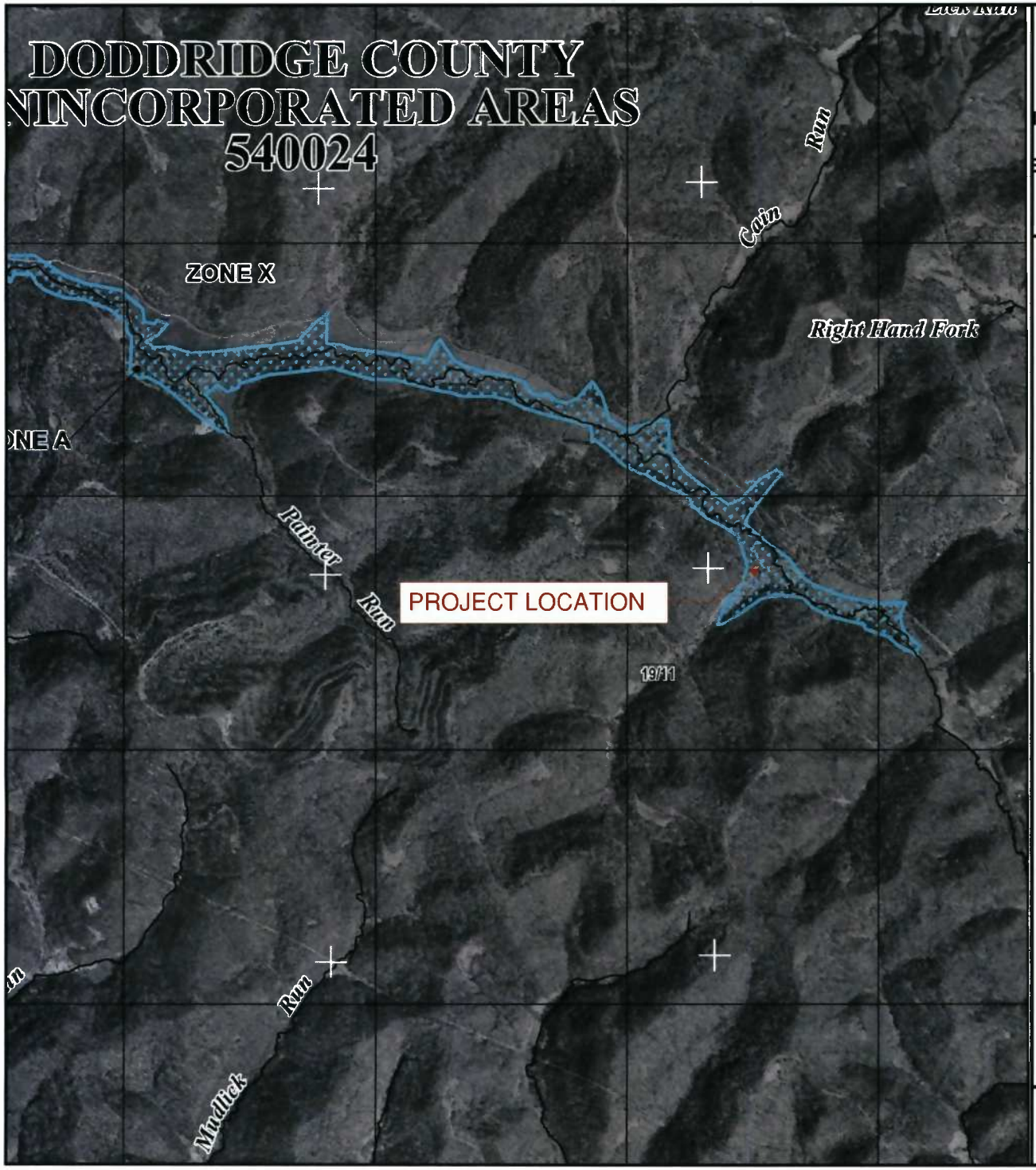
The online map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. Refer to the official Flood Insurance Study (FIS) for detailed flood elevation data in flood profiles and data tables. **WV Flood Tool (*https://www.MapWV.gov/flood*) is**

Flood Hazard Area:
Location is **WITHIN** the FEMA 100-year floodplain.

Flood Hazard Zone: A
Stream: Unnamed Tributary 9 to South Fork Hu
Watershed (HUC8): Little Kanawha (5030203)
Flood Height: N/A
Water Depth: N/A
Elevation: About 925 ft (Source: SAMS 2003)
Location (long, lat): (-80.762338, 39.179424)
Community&ID: Doddridge County (540024)

FEMA Flood Map: 54017C0225C **EFF:** 10/4/2011
Parcel Number: 09-07-0010-0002-0000
Address: multiple addresses

Attachment 3
FEMA Map



MAP SCALE 1" = 2000'

1000 0 2000 4000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0225C

FIRM

FLOOD INSURANCE RATE MAP

DODDRIDGE COUNTY, WEST VIRGINIA AND INCORPORATED AREAS

PANEL 225 OF 325

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DODDRIDGE COUNTY	540024	0225	C

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.

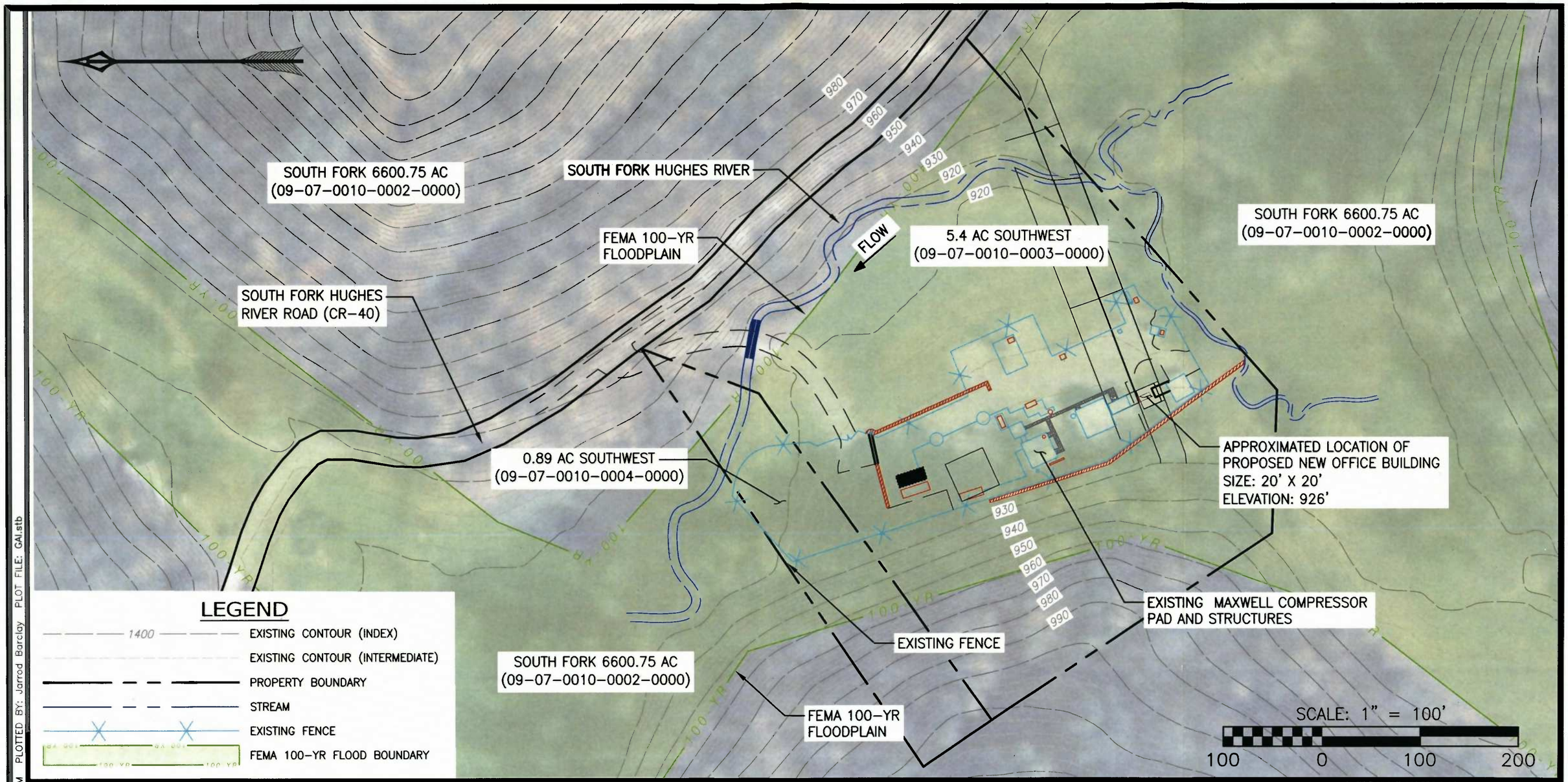
MAP NUMBER
54017C0225C

MAP REVISED
OCTOBER 4, 2011

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Attachment 4
Site Plan



NO.:	DATE:	DWN:	CHK:	APV:	DESCRIPTION:

REVISION RECORD

DRAWING TITLE

FIGURE 1 - SITE PLAN

PROJECT

MAXWELL COMPRESSOR STATION PROJECT
PROPSED NEW OFFICE BUILDING
DODDRIDGE COUNTY, WV

gai consultants

CLIENT

DOMINION ENERGY TRANSMISSION, INC.
5000 DOMINION BOULEVARD
GLEN ALLEN, VA 23060

DRAWN BY:	CHECKED BY:	APPROVED BY:
BARCLJA	FISHESA	GOODBD
REVISION	SCALE:	ISSUE DATE:
	AS SHOWN	09/14/2018
	SHEET NO.:	
	1 OF 1	

GAI FILE NUMBER:
Site Plan
GAI DRAWING NUMBER:
C180957-00-000-00-A2-001

This drawing was produced with computer aided drafting technology and is supported by electronic drawing files. Do not revise this drawing via manual drafting methods.

ISSUING OFFICE: Bridgeport | 600 Market Place Avenue, Suite 301, Bridgeport, WV 26330

GAI CAD FILE PATH: Z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\CAD\Worksheets\Site Plan.dwg

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PLOTTED ON: 9/17/2018 10:09:50 AM PLOTTED BY: Jarrod Barclay PLOT FILE: GAI.stb

Enclosure 2
H&H Engineering Analysis Report

gai consultants

60 years

Pittsburgh Office
385 East Waterfront Drive
Homestead, Pennsylvania 15120-5005

T 412.476.2000
F 412.476.2020

October 8, 2018

Project C180957.00, Task 002

Mr. Derek Ingle
Dominion Transmission, Inc
335 US Highway 33
Weston, West Virginia 26452

Hydrologic and Hydraulic Analysis
Floodplain Development Permit Application
Dominion Transmission, Inc.
Maxwell Compressor Station Project
Doddridge County, West Virginia

Dear Mr. Ingle:

GAI Consultants, Inc. (GAI) is submitting this Hydrologic and Hydraulic (H&H) Analysis to support a Floodplain Development Application (FDA) for construction of a new office building as part of the Maxwell Compressor Station Project (Project). The H&H Analysis presented herein has been developed from a previous analysis and FDA submittal that was prepared in July 2015 to support construction of a compressor building at the same facility. The compressor building has since been constructed, and the new office building is proposed to lie between two existing buildings within the fenced lot of the existing Maxwell Compressor Station (Station). The Station is located along the South Fork Hughes River, and the office building is proposed to be located near global positioning system coordinates 39.17944, -80.76239, off of South Fork Hughes River Road (County Route [CR] 40) in West Union, West Virginia (WV). The proposed office building will be constructed on existing grade (no fill) and will be approximately 20 feet wide by 20 feet long.

The Station is located within a Zone A Special Flood Hazard Area (SFHA) per the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Number 54017C0225C, dated October 4, 2011. The H&H Analysis for the Project presented herein estimates the impact (increase) to existing Base flood elevations (BFE) due to the proposed Project. This H&H Analysis will use the previously approved 100-year flood flow from 2015 for the South Fork Hughes River through the Project area to evaluate the impacts of the new office building on BFE.

Existing Site Conditions and Previous (2015) Analysis

GAI conducted a field visit on June 30, 2015 to collect site-specific data for use in the previously submitted H&H Analysis. Review of recent aerial imagery (2018 Google Maps) indicates that there have not been significant changes to the Site other than construction of the previously proposed compressor building. Thus, a new site visit was not conducted as part of the analysis. Photos and a description of the site can be found in Attachment A.

Proposed Project Description

The new office building is proposed to be constructed in a grassy area between the existing lawnmower shed and the auxiliary building, in the south end of the Station. The building will be constructed on existing grade (no fill) of approximate dimensions 20 feet wide by 20 feet long. The building is proposed to sit level with the existing grade. See Figure 1 for the approximate location of the proposed office building.

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Hydrologic Analysis

The drainage area to South Fork Hughes River at the crossing is approximately 1.82 square miles (1,165 acres), as shown on Figure 4 of Attachment A. The previously permitted analysis estimated that the 100-year peak discharge on South Fork Hughes River is approximately 1,192 cubic feet per second (cfs) through the Project area. There have not be any significant changes to land use in the Project watershed since the prior analysis, and thus the previous design flow was adopted for use in this analysis. Details of the hydrologic analysis are included in Attachment A.

Hydraulic Analysis

Analyses of South Fork Hughes River in the vicinity of the proposed Project location were conducted using the United States Army Corps of Engineers computer program "Hydrologic Engineering Center-River Analysis System" (HEC-RAS) Version 5.0.4. Since the previously permitted 2015 compressor building has been constructed, the previously approved 2015 proposed conditions hydraulic model (created in HEC-RAS version 4.1.0) was used as the basis for the existing conditions model for the proposed Project. The following changes were required to allow the existing conditions model to be accurately compared to proposed conditions:

- A new cross section (46467) was added to the existing conditions model to bound the location of the new office building;
- Cross section 46468 was moved approximately six feet upstream to be outside of the new office building's footprint; and
- The obstruction representative of a downstream building previously coded in Cross Section 46468 was moved to cross section 46467 to show that there are currently no structures in the location proposed for development.

These changes and running a newer version of the HEC-RAS software resulted in a very minor (0.02 feet) change in water surface elevation at cross section 46468. All other 100-year water surface elevations are identical to those previously presented in 2015.

The proposed conditions hydraulic model is identical to the existing conditions model in all locations except for the addition of an obstruction at cross section 46468 to represent the new office building. A Cross Section Location Map showing all cross sections, all existing structures, the proposed building, and the approximate 100-year water surface elevation is included in Attachment B.

Results

The table below shows the predicted 100-year flood elevations along South Fork Hughes River for the Existing and Proposed Project Models. The proposed office building is modeled in Cross Section 46468.

Predicted 100-Year Water Surface Elevations (feet, NGVD)

Cross Section	Existing Conditions	Proposed Conditions	Difference (Proposed - Existing)
45723.6	916.04	916.04	0.00
45851.4	920.10	920.10	0.00
46014.1	924.55	924.55	0.00
46080.0	Existing Culvert Crossing		
46087.4	925.52	925.52	0.00
46324.2	925.65	925.65	0.00
46405.6	925.63	925.63	0.00
46467.0	925.77	925.77	0.00
46468.0	925.84	925.84	0.00

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For the 100-year event, the Proposed Project Model does not predict an increase in water surface elevation or velocity above the Existing Conditions Model. This result can be reasonably expected as the calculated flood depths at the proposed building location are relatively shallow, and the proposed building is located between two existing buildings, each of larger dimensions.

Closure

Analyses have been performed to identify and quantify potential effects of the proposed Project on 100-year flood levels. The analyses indicate that the proposed Project will not increase 100-year flood levels by more than one foot, upstream, or downstream of the Project site in the studied reach. Thus, the Project is in compliance with Article IV, Section 4.4 of the Doddridge County Floodplain Ordinance. It should also be noted that the cumulative impact to BFE from the 2015 compressor building and this Project meet the requirements as well.

The analyses and findings presented in this letter are based on site topography (ten-foot contours derived from WV DEM [USGS and SAMB, 2005]), a GAI field view, and Project mapping provided by Dominion Transmission, Inc. GAI has relied upon this information to model the impact of the proposed Project on 100-year flood levels. Should conditions or the proposed work change from that described herein, GAI requests the opportunity to review, and if applicable, revise its findings.

GAI appreciates your review of this information. Should you have any questions or require additional information, please feel free to contact either Ms. Mary Beth Berkes at 412-399-5321 or Ms. Robin Weissert at 412-399-5204. We can also be reached via email at m.berkes@gaiconsultants.com or r.weissert@gaiconsultants.com.

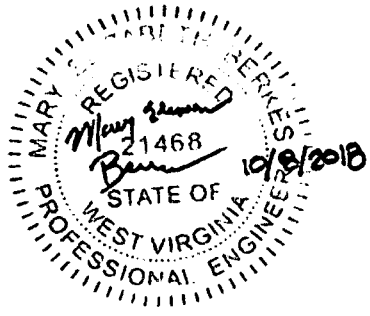
Sincerely,

GAI Consultants, Inc.

Mary Beth Berkes, P.E.
Assistant Civil Technical Leader

Digitally signed by Robin D. Weissert
DN: cn=Robin D. Weissert, email=R.Weissert@gaiconsultants.co
Date: 2018.10.08 13:45:15 -04'00'

Robin Weissert, CEP
Environmental Manager



MBB/jbm

Attachments: Attachment A (2015 H&H Analysis) and Attachment B (Hydraulic Calculations)

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October 8, 2018
Project C180975.00

ATTACHMENT A

2015 H&H ANALYSIS

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ATTACHMENT 1

H&H ENGINEERING ANALYSIS REPORT

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transforming ideas into reality

July 16, 2015

Project C141803.36, Task 001

Mr. Rob Jennings
Dominion Transmission, Inc
500 Dominion Boulevard
Glen Allen, Virginia 23060

Hydrologic and Hydraulic Analysis
Floodplain Development Permit Application
Dominion Transmission, Inc.
2015 Maxwell Compressor Station – New Building
Southwest District, Doddridge County, West Virginia

Dear Mr. Jennings:

GAI Consultants, Inc. (GAI) is submitting this Hydrologic and Hydraulic (H&H) Analysis as an attachment to the Floodplain Development Application for the 2015 Maxwell Compressor Station – New Building Project (Project) submitted to Doddridge County on May 19, 2015. This attachment was prepared based on email correspondence from the from the Doddridge County Floodplain Manager on June 12, 2015 which indicated that the County would require an H&H Analysis of the proposed Project's impact on the existing 100-year flood elevation in order to further process the application.

This H&H Analysis was prepared to support construction of one new compressor station building within the existing graveled and fenced lot of the existing Maxwell Compressor Station (Station). The Station is located along the South Fork Hughes River. The new building is needed for Dominion Transmission, Inc. (DTI) to house a new compressor engine, and it will be located near global positioning system coordinates 39.1797950367, -80.764598038, off of South Fork of Hughes River Road (County Route [CR] 40) in West Union, West Virginia (WV). Figure 1 shows the Project location (Attachment 1). The building will be constructed on existing grade (no fill) and will be approximately 42-feet wide by 42-feet long by 30-feet high. The building will be steel on a poured concrete slab that is five-feet thick.

The Station is located within a Zone A Special Flood Hazard Area per the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Number 54017C0225C, dated October 4, 2011. Figure 2 in Attachment 1 shows the FIRM. "Zone A" classification means the floodplain delineation has been established by approximate methods and base flood elevations (BFEs) have not been determined by FEMA. The design storm for a project located in FEMA Zone A is the 100-year (one percent annual chance) flood event. This H&H Analysis establishes a design discharge (flood flow) and BFEs for both existing and proposed conditions along South Fork Hughes River in the reach of stream near the Project Site so that the impacts of the new development can be assessed.

Current Site Conditions

South Fork Hughes River flows in a north westerly direction along CR 40 through the studied reach. As shown on Figure 3, which was developed using the WV Flood Tool, the area of the proposed Project is within the FEMA approximate 100-year floodplain.

GAI conducted a field visit on June 30, 2015 to collect site-specific data for use in this H&H Analysis. Along the Project Reach, the stream's right and left banks are two- to three-feet high and are heavily

vegetated (see Photograph 1). The left floodplain extends across a relatively flat area covered with thick brush for 100 to 200 feet before reaching the fenced-in compressor station (see Photograph 2). The compressor station is then bordered by a steep hillside (see Figure 5 and Photograph 3). The right floodplain varies in width from 10 to 50 feet and is vegetated with brush and trees. It is also bordered by a steep hillside. The bottom width of the channel throughout the Project Reach is approximately nine feet, with some sections of varying widths (eight to 10 feet). The stream bed material is a silty mud with some cobbles and larger stones present.

There is an existing access road and culvert crossing located approximately 300-feet downstream of the proposed building location. The crossing consists of two four-foot diameter corrugated metal pipe culverts as shown in Photograph 4. The culverts are approximately 40 feet in length with two to three feet of cover and two feet of spacing between them. Photograph 5 shows the stream reach downstream of the existing culvert crossing and proposed building location.

Proposed Project Description

There is currently an engine oil tank (approximate dimensions eight-feet wide by 23-feet long) at the proposed compressor building location (see Photograph 6). The tank and elevated fill will be removed and replaced with the proposed compressor building, constructed on existing grade (no fill) of approximate dimensions 42-feet wide by 42-feet long by 30-feet high. The building will be steel on a poured concrete slab that is five-feet thick.

Hydrologic Analysis

The drainage area to South Fork Hughes River at the crossing is approximately 1.82 square miles (1,165 acres). The drainage area at the Site is shown on Figure 4. No stream gages or controlled reservoirs exist on South Fork Hughes River. Peak flows for the current study were computed using the United States Geological Survey (USGS) Regression (SIR 2010-5033) and National Resources Conservation Service TR-55 methods in accordance with Section 4.3.4 of the *WV Division of Highways (WVDOH) Drainage Manual*. The computer program Hydraflow Hydrographs was used to estimate flow rates for the TR-55 method.

Per Section 4.4.4.2 of the WVDOH Manual, because the drainage area is less than 10 square miles, the USGS method is not recommended to be used for design. Thus, the USGS flows (with and without the suggested prediction error) are provided for comparison only. The TR-55 flows are within 10 percent of the USGS flows (adjusted for error), and are believed to be representative of site conditions. Thus, the TR-55 100-year peak discharge of 1,192 cubic feet per second (cfs) has been adopted for design. Hydrologic calculations are provided in Attachment 3.

No flood history of the site was available for calibration. However, the results presented in this analysis are presumed to be conservative based on the South Fork Hughes River model presented in the WV Flood Tool, which uses the USGS flows (without error). Additional changes were made to the WV Flood Tool model as described in the hydraulic modeling section.

Hydraulic Modeling Procedure

Analyses of South Fork Hughes River in the vicinity of the proposed Project location were conducted using the United States Army Corps of Engineers computer program "Hydrologic Engineering Center-River Analysis System" (HEC-RAS) Version 4.1.0.

A Hydrologic Engineering Centers River Analysis System (HEC-RAS) model for South Fork Hughes River was obtained from the WV Flood Tool Site. The model was reviewed, and it does not include the existing culvert crossing at the site entrance. Thus, the WV Flood Tool model was used for Reference to obtain

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the shape and approximate elevation of the floodplain in the Project area; however modifications were made to add additional detail as described below.

Seven cross-sections (two upstream of the proposed building location and five downstream) have been created for the existing conditions model. A cross section location map is provided in Attachment 4-Hydraulic Calculations. The general shape of each cross section was determined from ten foot contours derived from the WV Digital Elevation Models (DEM) and the WV Flood Tool model, and supplemented with field measurement of channel geometry. The water surface elevations of the existing and proposed models converge within the studied reach both upstream and downstream of the crossing.

The proposed model is identical to the existing conditions model in all locations except for the modifications to the obstructions at Section 46324.2. The proposed building, along with existing buildings and structures were modeled as obstructions in the HEC-RAS Geometry data. The existing culvert downstream of the proposed building was modeled using the culvert data editor.

Results

The table below shows the predicted 100-year flood elevations along South Fork Hughes River for the Existing and Proposed Project Models. The proposed building is modeled by the obstruction in Cross Section 46324.2.

Predicted 100-Year Water Surface Elevations (feet, NGVD)

Cross Section	Existing Conditions	Proposed Conditions	Difference (Proposed - Existing)
45723.6	916.04	916.04	0.00
45851.4	920.10	920.10	0.00
46014.1	924.55	924.55	0.00
46080.0	Existing Culvert Crossing		
46087.4	925.52	925.52	0.00
46324.2	925.65	925.65	0.00
46405.6	925.63	925.63	0.00
46468.0	925.82	925.82	0.00

For the 100-year event, the Proposed Project Model does not predict an increase in water surface elevation or velocity above the Existing Conditions Model. This result can be reasonably expected as the calculated flood depths at the proposed building location are relatively shallow, there is an existing obstruction to be replaced by the proposed building, and the proposed building is generally in the shadow of other station features with respect to flow direction.

Closure

Analyses have been performed to identify and quantify potential effects of the proposed Project on 100-year flood levels. The analyses indicate that the proposed Project will not increase 100-year flood levels by more than one foot, upstream, or downstream of the Project site in the studied reach. Thus, the Project is in compliance with Article IV, Section 4.3 of the Doddridge County Floodplain Ordinance.

The analyses and findings presented in this letter are based on site topography (ten-foot contours derived from WV DEM (USGS and SAMB, 2005)), a GAI field view, and Project mapping provided by DTI. GAI has relied upon this information to model the impact of the proposed Project on 100-year flood

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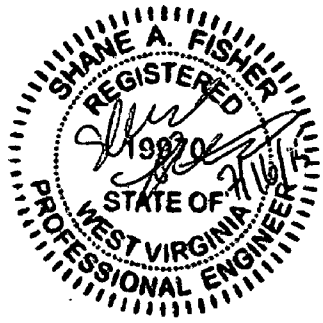
levels. Should conditions or the proposed work change from as described herein, GAI requests the opportunity to review, and if applicable, revise its findings.

GAI appreciates your review of this information. Should you have any questions or require additional information, please feel free to contact either Mr. Derek Medved or Mr. Shane Fisher at 412-476-2000, extension 1437 or 304-808-6680, extension 2306, respectively. We can also be reached via email at d.medved@gaiconsultants.com or s.fisher@gaiconsultants.com.

Sincerely,

GAI Consultants, Inc.

Derek L. Medved
Assistant Civil Technical Leader



Shane A. Fisher, P.E.
Assistant Engineering Manager

SAF/vev

Attachments: Attachment 1 (Figures), Attachment 2 (Photographs), Attachment 3 (Hydrologic Calculations), and Attachment 4 (Hydraulic Calculations)

cc: Derek Ingle, Neil Robinson, Karl Kratzer (DTI)

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July 16, 2015
Project C141803.36, Task 001

ATTACHMENT 1
Figures

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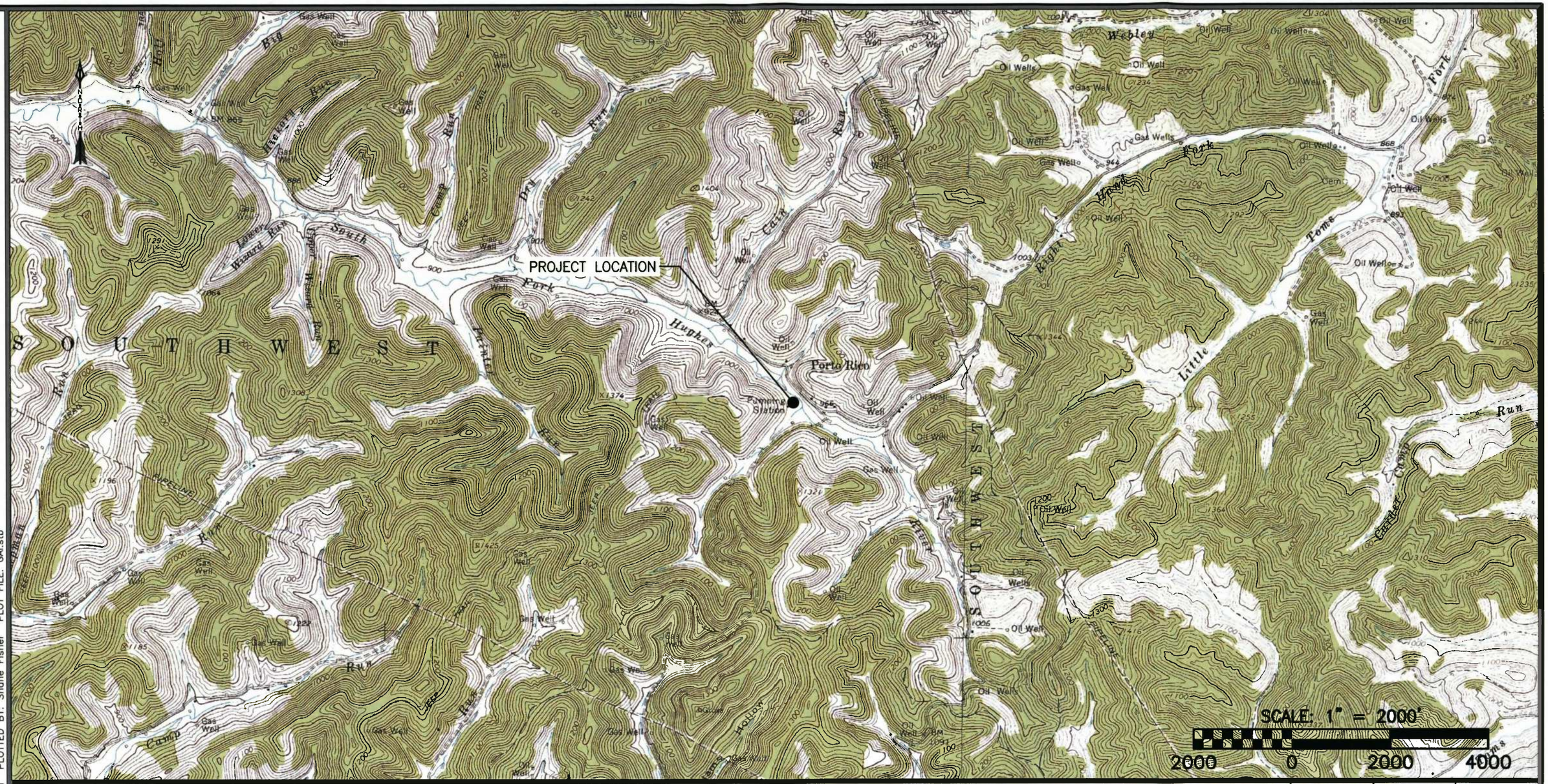

NO.:	DATE:	DWN:	CHK:	APV:	DESCRIPTION:

REVISION RECORD

DRAWING TITLE

FIGURE 1 - PROJECT LOCATION

PROJECT	CLIENT
2015 MAXWELL COMPRESSOR STATION **DODDRIDGE COUNTY, WV**	**DOMINION TRANSMISSION, INC.** **5000 DOMINION BOULEVARD** **GLEN ALLEN, VA 23060**

gai consultants

DRAWN BY:	CHECKED BY:	APPROVED BY:
VENDEVM	**THOMAMT**	**BERKEME**
REVISION	SCALE:	ISSUE DATE:
△	**AS SHOWN**	**07/17/2015**
	SHEET NO.:	
	001 OF 001	

GAI FILE NUMBER: **C141803-36-000-00-A2-003**

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N

MAP SCALE 1" = 2000'

1000 0 2000 4000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0225C

FIRM

FLOOD INSURANCE RATE MAP

DODDRIDGE COUNTY, WEST VIRGINIA AND INCORPORATED AREAS

PANEL 225 OF 325

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DODDRIDGE COUNTY	540024	0225	C

FIGURE 2
FEMA FIRM

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.

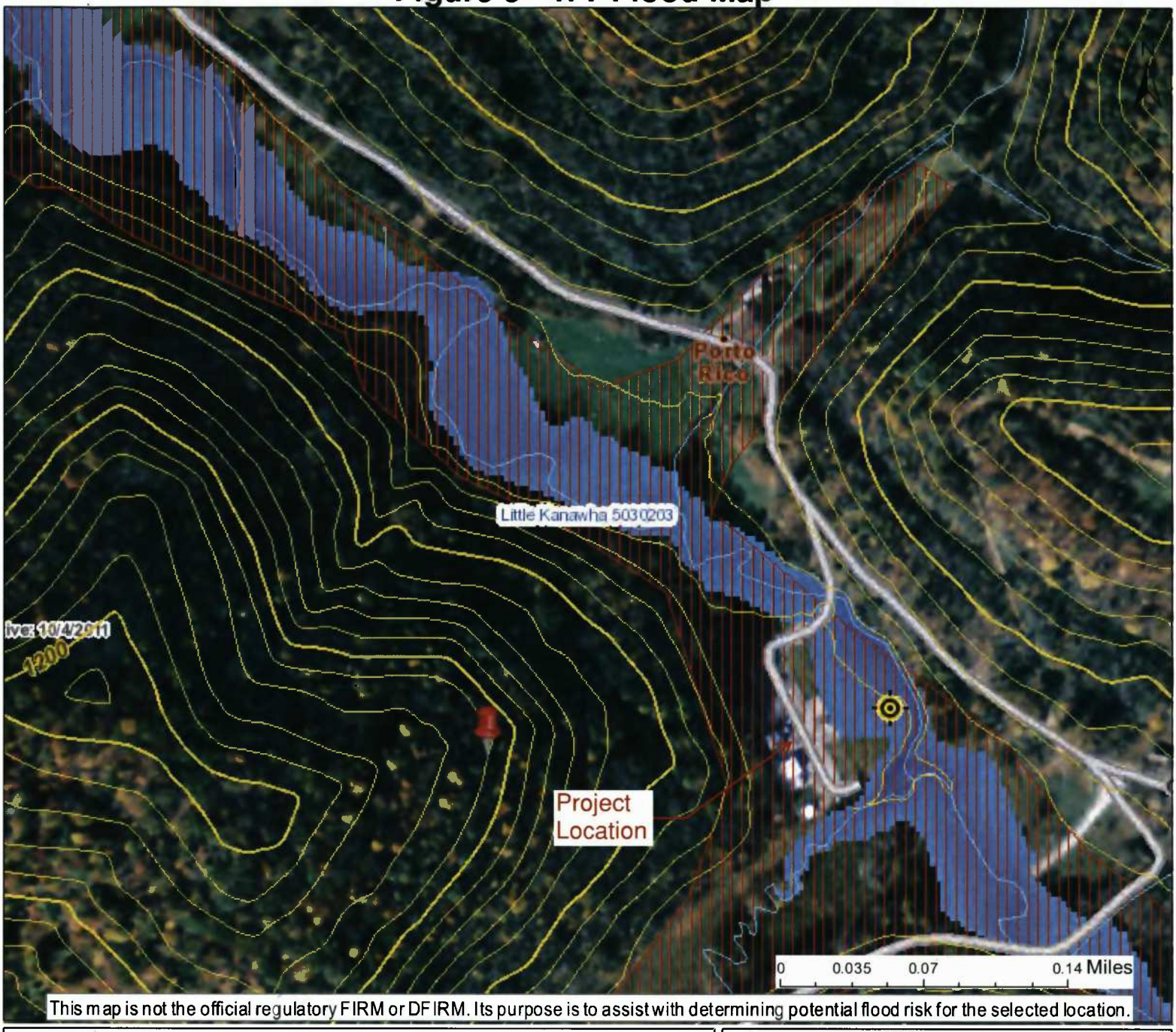
MAP NUMBER
54017C0225C

MAP REVISED
OCTOBER 4, 2011

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Figure 3 - WV Flood Map



Location of flood information

User Notes:
2015 Maxwell Compressor Station-New Building

Cross Section (XS) Lines

Base Flood Elevation (BFE) Lines

Floodway

Flood Hazard Zone

Approximate Study (Zone A)

Detailed Study (AE, AH, AO)

Disclaimer:
The online 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. To obtain more detailed information in areas where Base Flood Elevations have been determined, users are encouraged to consult the latest Flood Profile data contained in the official flood insurance study. These studies are available online at www.msc.fema.gov.
WV Flood Tool (http://www.MapWV.gov/flood) is supported by FEMA, WV NFIP Office, and WV GIS Technical Center.

Map created on July 13, 2015

Flood Hazard Area:
Flood Hazard Area: Location is WITHIN the FEMA 100-year floodplain.

Flood Hazard Zone:	A (Advisory A)
Stream:	South Fork Hughes River
FEMA Issued Flood Map:	54017C0225C
Watershed (HUC8):	Little Kanawha (5030203)
Advisory Flood Height:	About 923 ft
Water Depth:	About 2.2 ft (Source: HEC_R/
Elevation:	About 921 ft
Location (long, lat):	(80.761771 W,39.179945 N)
Location (UTM 17N):	(520577, 4336772)
Contacts:	Doddridge
CRS Information:	N/A
Flood Profile:	
HEC-RAS Model:	South Fork Hughes River
Parcel Number:	

LEGEND

- WOODS
- MEADOW
- DRAINAGE AREA
- HYDROLOGIC SOIL BOUNDARY
- TIME OF CONCENTRATION

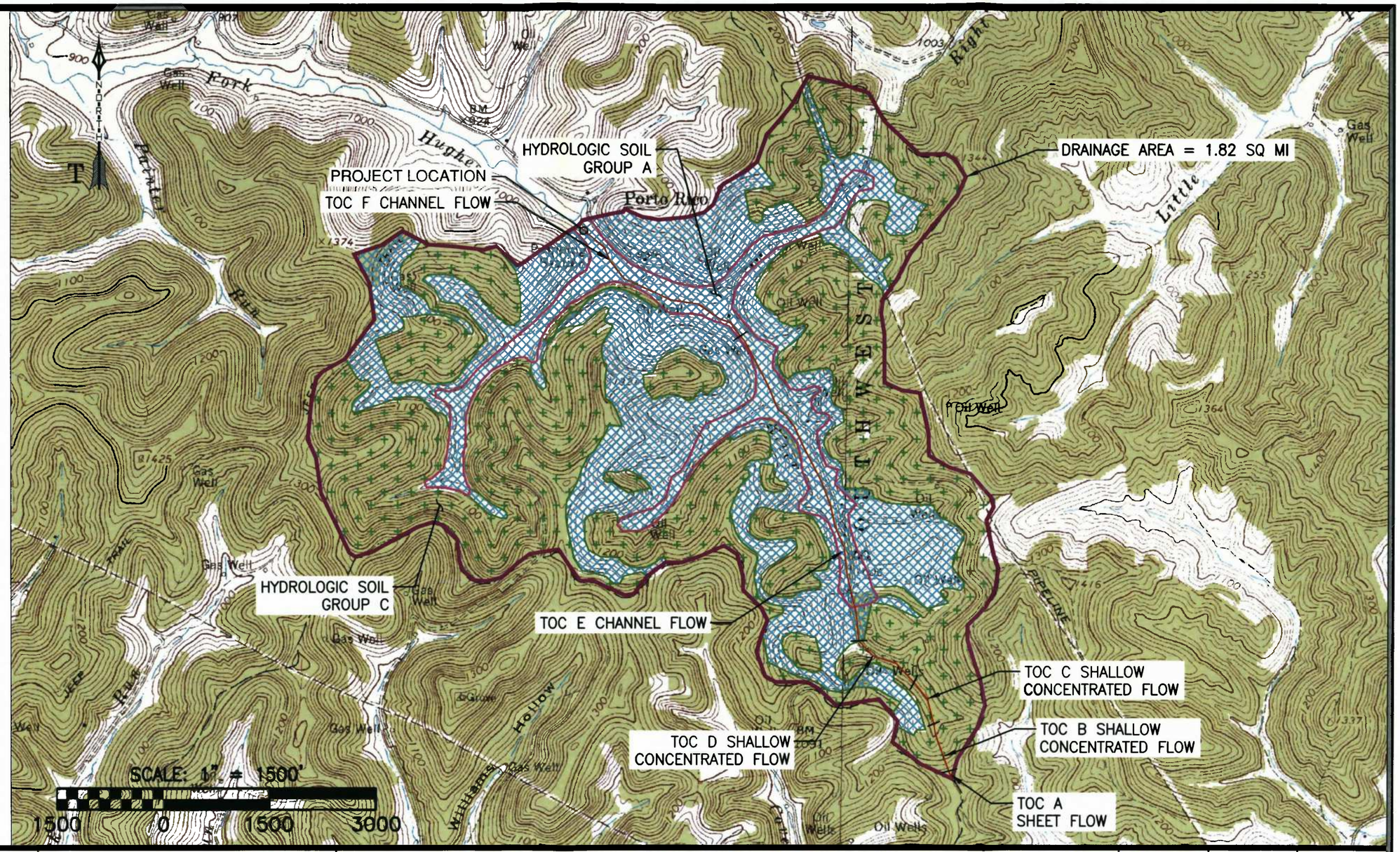


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FIGURE 4 - DRAINAGE AREA MAP

PROJECT

2015 MAXWELL COMPRESSOR STATION

DODDRIDGE COUNTY, WV

gai consultants

CLIENT

DOMINION TRANSMISSION, INC.

5000 DOMINION BOULEVARD

GLEN ALLEN, VA 23060

DRAWN BY:	CHECKED BY:	APPROVED BY:
VENDEVM	THOMAMT	BERKEME
REVISION	SCALE: AS SHOWN	ISSUE DATE: 07/17/2015
	SHEET NO.: 001 OF 001	

GAI FILE NUMBER: C141803-36-000-00-A2-001

GAI DRAWING NUMBER: C141803-36-000-00-A2-001

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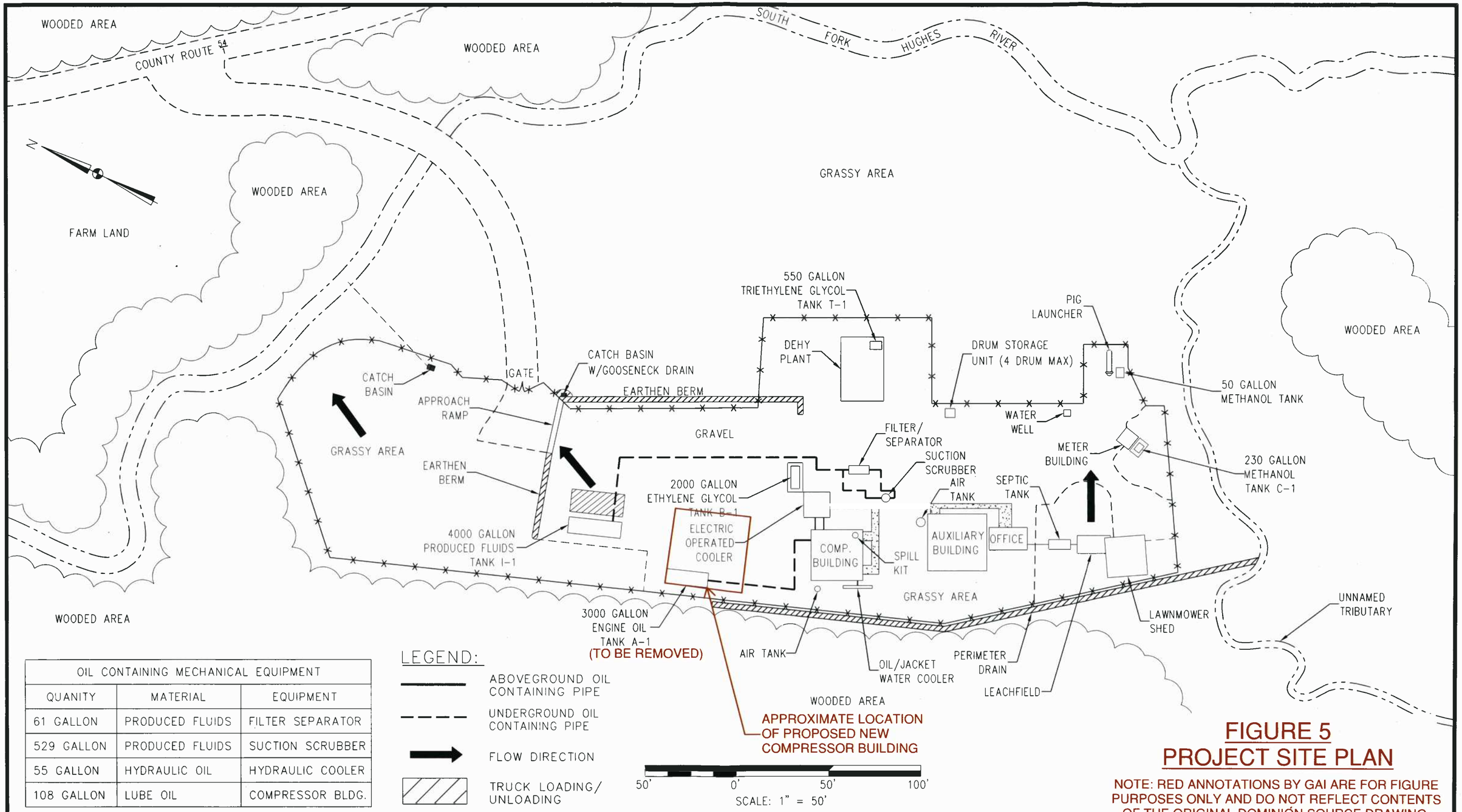

OIL CONTAINING MECHANICAL EQUIPMENT		
QUANITY	MATERIAL	EQUIPMENT
61 GALLON	PRODUCED FLUIDS	FILTER SEPARATOR
529 GALLON	PRODUCED FLUIDS	SUCTION SCRUBBER
55 GALLON	HYDRAULIC OIL	HYDRAULIC COOLER
108 GALLON	LUBE OIL	COMPRESSOR BLDG.

LEGEND:

- ABOVEGROUND OIL CONTAINING PIPE
- UNDERGROUND OIL CONTAINING PIPE
- FLOW DIRECTION
- TRUCK LOADING/ UNLOADING

FIGURE 5
PROJECT SITE PLAN

NOTE: RED ANNOTATIONS BY GAI ARE FOR FIGURE PURPOSES ONLY AND DO NOT REFLECT CONTENTS OF THE ORIGINAL DOMINION SOURCE DRAWING.

SYM.	DATE	BY	REVISION DESCRIPTION	PRJ/TSK	APP.
4	11/05/14	TBB	SCALED, ADDED BAR SCALE, ADDED ADJACENT PROPERTIES, & REVISED NORTH ARROW		
3	11/07/12	MPR	UPDATED PER TIM JACKSONS MARK UPS		
2	05/25/10	JDB	UPDATED PER RUSS EVANS MARK UPS		
1	04/16/10	JDB	UPDATED PER RUSS EVANS MARK UPS		

SCALE	1" = 50'	DATE
DRAWN	DJF	09/14/07
CHECKED	RRE/JSS	
APP. FOR BID		
APP. FOR CONST.		
TOWN:	OXFORD, WV	COUNTY: DODDRIDGE

Dominion Transmission, Inc.

445 West Main St. Clarksburg, West Virginia 26301 / Phone: (304) 623-8000

FOR:	MAXWELL COMPRESSOR STATION			
TITLE:	ENVIRONMENTAL EMERGENCY SITE PLAN			
DIR: DOCUMENTUM		GROUP	DWG. NO.	REV.
FILE:	PRJ/TSK:	PD	X3201A	4

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Project C141803.36, Task 001

ATTACHMENT 2
Photographs

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Photograph 1. Stream Reach in Project Area (Looking Upstream)

Photograph 2. Floodplain Separating Stream and Gravel Compressor Area, Stream Located in Trees on Left Side of Photograph (Looking Upstream)

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Photograph 3. Hillside beyond Station and Proposed Building Location

Photograph 4. Existing Culvert Crossing at Site Entrance (Looking Upstream)

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Photograph 5. Stream Reach Downstream of Culvert Crossing and Proposed Building Location (Looking Downstream)

Photograph 6. Proposed Building Location (Building will Replace Existing Tank)

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Project C141803.36, Task 001

ATTACHMENT 3
Hydrologic Calculations

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Subject: Dominion – 2015 Maxwell Compressor Station-Hydrologic Calculations
By: THOMAMT Date: 07/09/2015 Project #: C141803.36
Chkd By: BERKEME Date: 07/09/2015 Sheet #: _____ of _____

OBJECTIVE:

This analysis will estimate peak flow for the 100-year storm event for a floodplain analysis in Doddridge County, West Virginia.

REFERENCES:

1. West Virginia Department of Transportation, Division of Highways (WVDOH), Drainage Manual, 3rd Edition with May 2, 2012 Revisions.
2. United States Geological Survey (USGS), Scientific Investigations Report (SIR) 2010-5033. 2010.
3. United States Department of Agriculture, Natural Resources Conservation Service (NRCS), 1986. Technical Release 55 (TR-55), Urban Hydrology for Small Watersheds, Second Edition, June 1986.
4. NOAA Atlas 14, Volume 2, Version 3. Point Precipitation Frequency Estimates for Charleston, West Virginia, US. Latitude 39.1799, Longitude -80.7625.
5. United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey, Doddridge County West Virginia.
6. Hyrdaflow Hydrographs by InteliSOLVE, Version 8.0.0.3, 2004.

FLOOD INFORMATION:

The Project is located in Federal Emergency Management Agency (FEMA) Zone A, which is defined as an area where approximate methods are used to determine the 100-year flood boundaries and no detailed hydraulic analysis or Base Flood Elevations (BFEs) are determined.

HYDROLOGIC ANALYSIS:

The drainage area to South Fork Hughes River at the Crossing is approximately 1.82 square miles (1,163 acres). The drainage area and project site are shown on the Drainage Area Map (sheet 3).

No stream gages exist on South Fork Hughes River. Peak flows for the current study are computed using the USGS Regression (SIR 2010-5033) and NRCS TR-55 methods in accordance with Section 4.3.4 of the WVDOH Drainage Manual. The computer program Hydraflow Hydrographs was used to estimate flow rates for the TR-55 method.

The drainage area and time of concentration flow path are shown on Sheet 3 of this calculation set. Time of Concentration was determined using worksheet 3 from the TR-55 Manual.

INPUT DATA:

Rainfall (From NOAA Atlas 14):
2-yr, 24 hour = 2.57 in (for use in Time of Concentration Calculation)
100-yr, 24 hour = 5.17 in

Soil Types were determined to be Type A and C from the USDA Soil Map and information on Sheets 7-11. Land use was determined from the USDA mapping and aerial imagery and consists of woodlands.

Runoff Curve Number Coefficients (WVDOH Drainage Manual, Table 4-9 and 4-10)

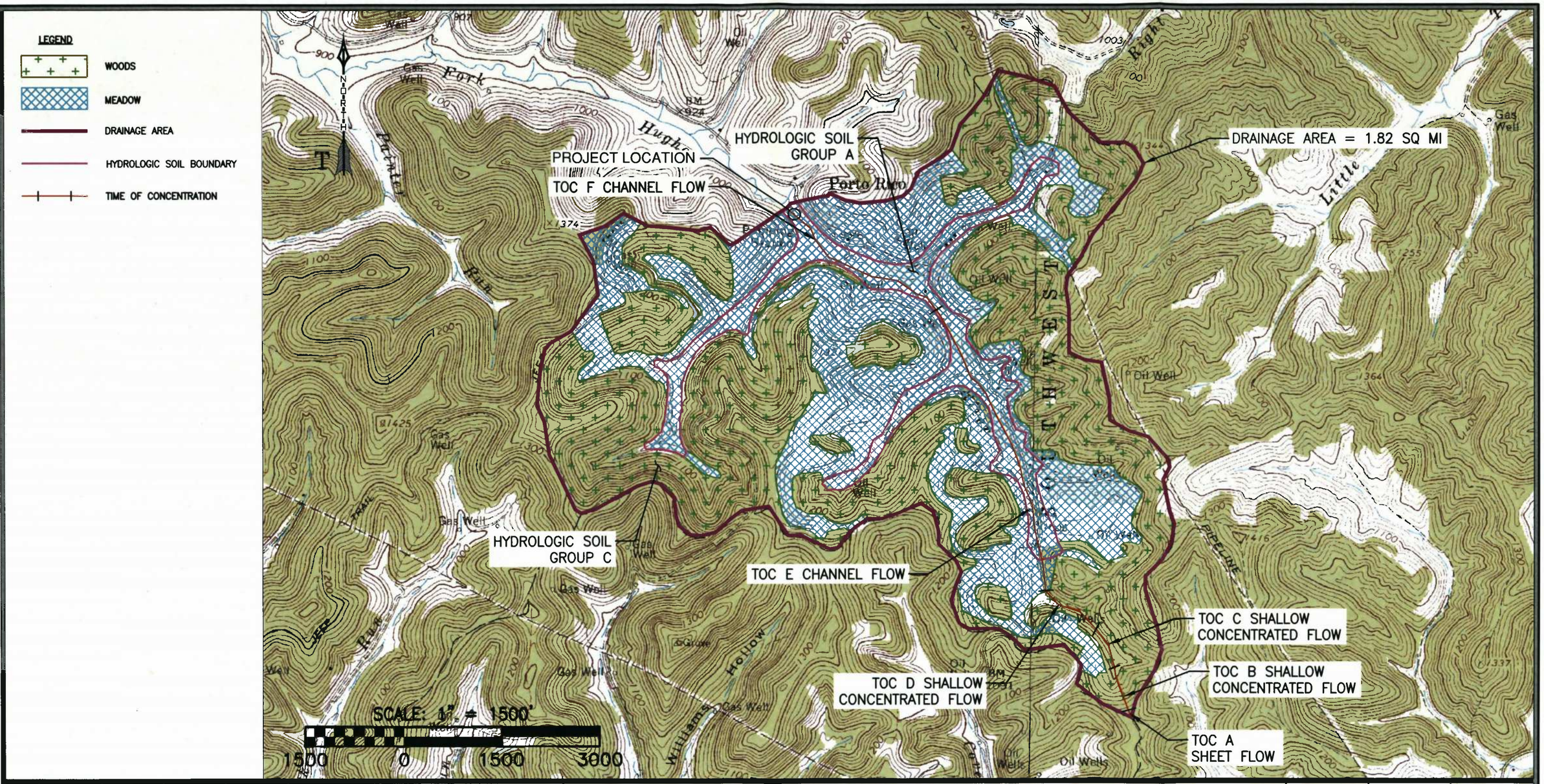
Woods Only (Good Condition), Type C Soils = 70
Meadow, Type C Soils = 71
Meadow, Type A Soils = 30

RESULTS:

The Table below summarizes the flow rates estimated using each method. The detailed analyses can be found in the following pages.

Method	PEAK FLOWS (cfs)
	100-year
USGS Regression (Unadjusted)	834
USGS Regression (Adjusted for Error)	1,096
TR-55	1,192

Per Section 4.4.4.2 of the WVDOH Manual, because the drainage area is less than 10 square miles, the USGS method is not recommended to be used for design. Thus, the USGS flows (with and without the suggested prediction error) are provided for comparison only. The TR-55 flows are within 10% of the USGS flows adjusted for error and have been adopted for design.



NO.:	DATE:	DWN:	CHK:	APV:	DESCRIPTION:

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FIGURE 4 - DRAINAGE AREA MAP

PROJECT

2015 MAXWELL COMPRESSOR STATION

DODDRIDGE COUNTY, WV

gai consultants

CLIENT

DOMINION TRANSMISSION, INC.

5000 DOMINION BOULEVARD

GLEN ALLEN, VA 23060

DRAWN BY:	CHECKED BY:	APPROVED BY:
VENDEVM	THOMAMT	BERKEME
REVISION	SCALE: AS SHOWN	ISSUE DATE: 07/17/2015
	SHEET NO.: 001 OF 001	

GAI FILE NUMBER: C141803-36-000-00-A2-001

GAI DRAWING NUMBER: C141803-36-000-00-A2-001

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Subject: Dominion – 2015 Maxwell Compressor Station-Hydrologic Calculations
By: THOMAMT Date: 07/09/2015 Project #: C141803.36
Chkd By: BERKEME Date: 07/09/2015 Sheet #: _____ of _____

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Rainfall Data

NOAA Atlas 14, Volume 2, Version 3
Location name: Pullman, West Virginia, US*
Latitude: 39.1799°, Longitude: -80.7625°
Elevation: 924 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_&_aerials

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	0.332 (0.301-0.366)	0.396 (0.360-0.438)	0.475 (0.431-0.524)	0.534 (0.485-0.589)	0.610 (0.550-0.670)	0.666 (0.600-0.732)	0.720 (0.645-0.789)	0.774 (0.691-0.847)	0.844 (0.750-0.922)	0.895 (0.792-0.976)
10-min	0.516 (0.468-0.568)	0.619 (0.562-0.684)	0.738 (0.670-0.814)	0.825 (0.748-0.909)	0.933 (0.842-1.03)	1.01 (0.909-1.11)	1.08 (0.972-1.19)	1.16 (1.03-1.26)	1.24 (1.10-1.36)	1.30 (1.15-1.42)
15-min	0.632 (0.573-0.696)	0.756 (0.688-0.836)	0.906 (0.822-0.999)	1.02 (0.920-1.12)	1.15 (1.04-1.27)	1.25 (1.13-1.37)	1.35 (1.21-1.48)	1.44 (1.28-1.57)	1.55 (1.38-1.69)	1.63 (1.44-1.78)
30-min	0.836 (0.758-0.921)	1.01 (0.920-1.12)	1.24 (1.13-1.37)	1.41 (1.28-1.55)	1.63 (1.47-1.79)	1.79 (1.61-1.96)	1.94 (1.74-2.13)	2.10 (1.87-2.29)	2.29 (2.04-2.51)	2.44 (2.16-2.66)
60-min	1.02 (0.926-1.13)	1.24 (1.13-1.37)	1.56 (1.41-1.72)	1.79 (1.63-1.98)	2.11 (1.90-2.32)	2.36 (2.12-2.59)	2.60 (2.33-2.85)	2.85 (2.54-3.11)	3.17 (2.82-3.47)	3.43 (3.03-3.74)
2-hr	1.19 (1.07-1.32)	1.44 (1.31-1.61)	1.80 (1.63-2.00)	2.08 (1.88-2.31)	2.47 (2.21-2.72)	2.77 (2.47-3.05)	3.08 (2.74-3.38)	3.39 (3.00-3.71)	3.82 (3.35-4.18)	4.15 (3.63-4.54)
3-hr	1.27 (1.15-1.41)	1.53 (1.38-1.71)	1.92 (1.73-2.13)	2.21 (1.99-2.46)	2.63 (2.35-2.91)	2.95 (2.63-3.26)	3.30 (2.92-3.63)	3.64 (3.21-4.00)	4.12 (3.60-4.51)	4.51 (3.91-4.93)
6-hr	1.52 (1.38-1.69)	1.83 (1.66-2.03)	2.27 (2.05-2.51)	2.62 (2.36-2.89)	3.11 (2.79-3.42)	3.50 (3.13-3.85)	3.92 (3.49-4.29)	4.35 (3.85-4.75)	4.96 (4.34-5.40)	5.44 (4.73-5.92)
12-hr	1.80 (1.64-1.99)	2.16 (1.97-2.38)	2.64 (2.40-2.91)	3.04 (2.76-3.35)	3.60 (3.26-3.96)	4.07 (3.66-4.45)	4.55 (4.07-4.97)	5.07 (4.50-5.52)	5.79 (5.08-6.28)	6.38 (5.55-6.91)
24-hr	2.16 (1.99-2.35)	2.57 (2.37-2.80)	3.11 (2.86-3.39)	3.55 (3.26-3.86)	4.16 (3.81-4.52)	4.66 (4.26-5.05)	5.17 (4.71-5.60)	5.71 (5.18-6.17)	6.45 (5.82-6.95)	7.03 (6.32-7.57)
2-day	2.54 (2.36-2.74)	3.01 (2.80-3.25)	3.60 (3.34-3.88)	4.08 (3.78-4.40)	4.74 (4.38-5.10)	5.26 (4.86-5.66)	5.80 (5.34-6.23)	6.34 (5.82-6.80)	7.08 (6.48-7.59)	7.66 (6.98-8.20)
3-day	2.73 (2.55-2.94)	3.24 (3.02-3.48)	3.86 (3.60-4.14)	4.35 (4.05-4.67)	5.02 (4.66-5.38)	5.55 (5.15-5.94)	6.09 (5.63-6.51)	6.63 (6.11-7.08)	7.35 (6.75-7.84)	7.91 (7.24-8.43)
4-day	2.93 (2.74-3.14)	3.46 (3.24-3.71)	4.11 (3.85-4.41)	4.63 (4.32-4.95)	5.31 (4.95-5.67)	5.85 (5.44-6.23)	6.38 (5.92-6.79)	6.91 (6.40-7.35)	7.62 (7.03-8.09)	8.15 (7.50-8.65)
7-day	3.58 (3.37-3.80)	4.22 (3.97-4.48)	4.95 (4.65-5.25)	5.51 (5.18-5.84)	6.23 (5.85-6.60)	6.79 (6.36-7.18)	7.33 (6.86-7.75)	7.86 (7.34-8.31)	8.53 (7.95-9.02)	9.03 (8.40-9.54)
10-day	4.13 (3.91-4.37)	4.87 (4.60-5.15)	5.64 (5.33-5.97)	6.24 (5.89-6.59)	7.00 (6.60-7.39)	7.57 (7.12-7.99)	8.12 (7.63-8.56)	8.64 (8.11-9.11)	9.30 (8.71-9.80)	9.77 (9.14-10.3)
20-day	5.86 (5.56-6.18)	6.87 (6.51-7.25)	7.86 (7.45-8.28)	8.59 (8.14-9.06)	9.52 (9.01-10.0)	10.2 (9.64-10.7)	10.8 (10.2-11.4)	11.4 (10.8-12.0)	12.1 (11.4-12.8)	12.7 (11.9-13.3)
30-day	7.43 (7.06-7.82)	8.68 (8.24-9.14)	9.81 (9.31-10.3)	10.7 (10.1-11.2)	11.7 (11.1-12.3)	12.4 (11.8-13.1)	13.1 (12.4-13.8)	13.8 (13.0-14.5)	14.5 (13.7-15.3)	15.0 (14.2-15.8)
45-day	9.56 (9.10-10.0)	11.1 (10.6-11.7)	12.4 (11.8-13.0)	13.4 (12.8-14.1)	14.6 (13.9-15.3)	15.4 (14.7-16.2)	16.2 (15.4-17.0)	16.9 (16.0-17.7)	17.7 (16.7-18.5)	18.2 (17.2-19.1)
60-day	11.6 (11.1-12.1)	13.4 (12.8-14.0)	14.9 (14.2-15.6)	16.0 (15.3-16.7)	17.3 (16.5-18.0)	18.2 (17.4-19.0)	19.0 (18.1-19.8)	19.7 (18.8-20.6)	20.5 (19.6-21.4)	21.1 (20.1-22.0)

[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.

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PF graphical

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Soil Data

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

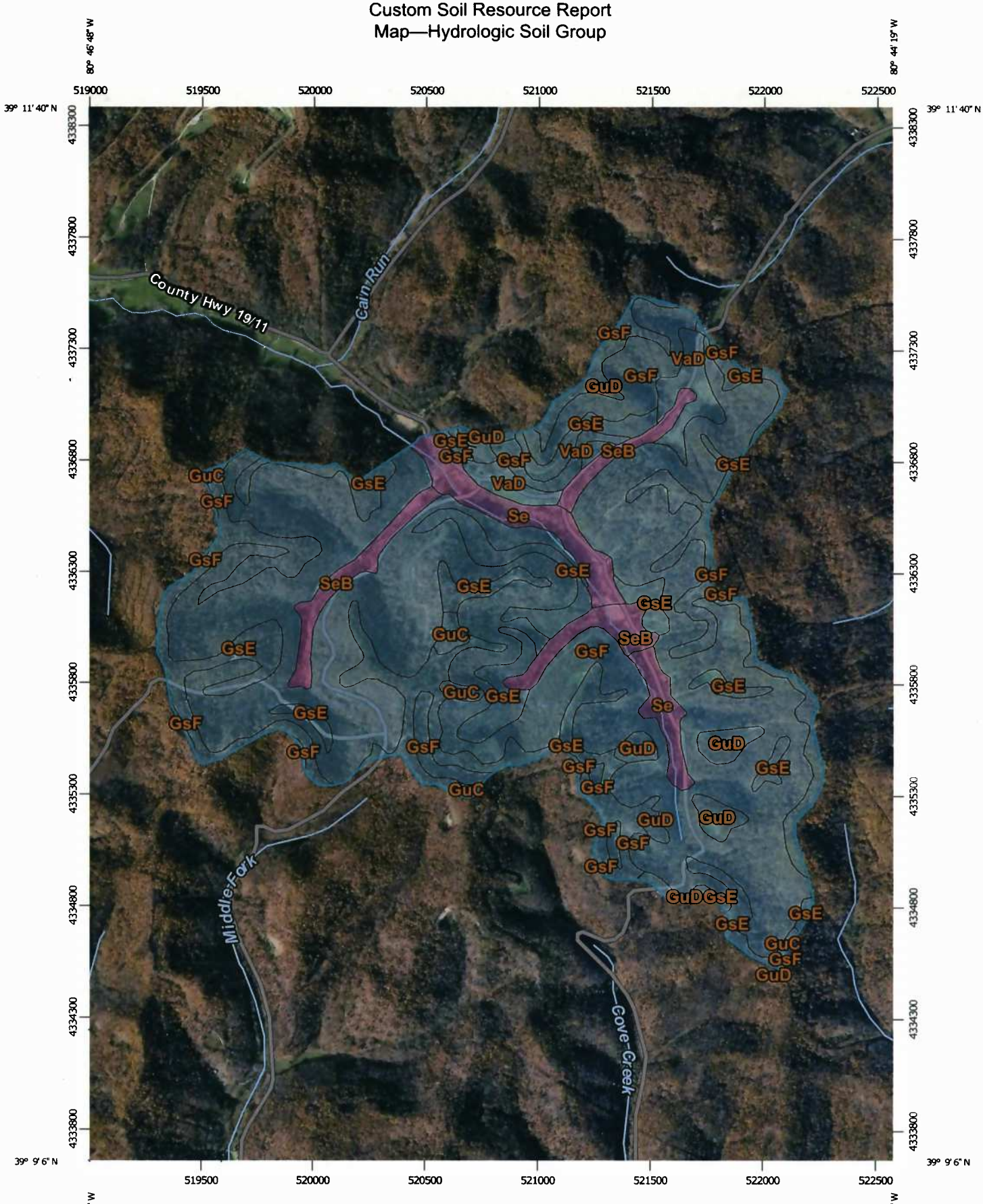
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:23,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 300 600 1200 1800

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 10, Sep 25, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsE	Gilpin-Peabody complex, 15 to 35 percent slopes, very stony	C	279.1	24.0%
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	697.2	59.9%
GuC	Gilpin-Upshur silt loams, 8 to 15 percent slopes	C	11.7	1.0%
GuD	Gilpin-Upshur silt loams, 15 to 25 percent slopes	C	43.8	3.8%
Se	Sensabaugh silt loam	A	50.8	4.4%
SeB	Sensabaugh silt loam, 3 to 8 percent slopes, rarely flooded	A	48.9	4.2%
VaD	Vandalia silt loam, 15 to 25 percent slopes	C	31.7	2.7%
Totals for Area of Interest			**1,163.3**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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USGS Method (SIR 2010-5033)

Project:	By:	Date:	
Dominion - 2015 Maxwell Compressor Station	THOMAMT	7/9/2015	gai consultants
Location:	Checked:	Date:	
Downstream of Proposed Structure	BERKEME	7/9/2015	

Method:

Use the United States Geological Survey (USGS) Regression Method to determine 100-year peak flow rates at the Project Site in Kanawha County, WV.

References:

1) West Virginia Department of Transportation, Division of Highways (WVDOH), Drainage Manual, 3rd Edition with May 2, 2012 Revisions.
2) United States Geological Survery (USGS) Scientific Investigations Report (SIR) 2010-5033 (2010).

Calculations:

Region		Drainage Area Limitations (sq. miles)
Eastern Panhandle		0.21 - 1,461
Central Mountains		0.10 - 1,619
Western Plateaus	X	0.13 - 1,516

Equations (Ref. 1, Table 4-14)

	Drainage Area (A) sq. miles
$Q100 = 557*A^{0.674}$	1.82

Flow (Q) cfs

100-year	834

*Add standard prediction error since watershed size is less than 10 sq. miles (Ref. 1)

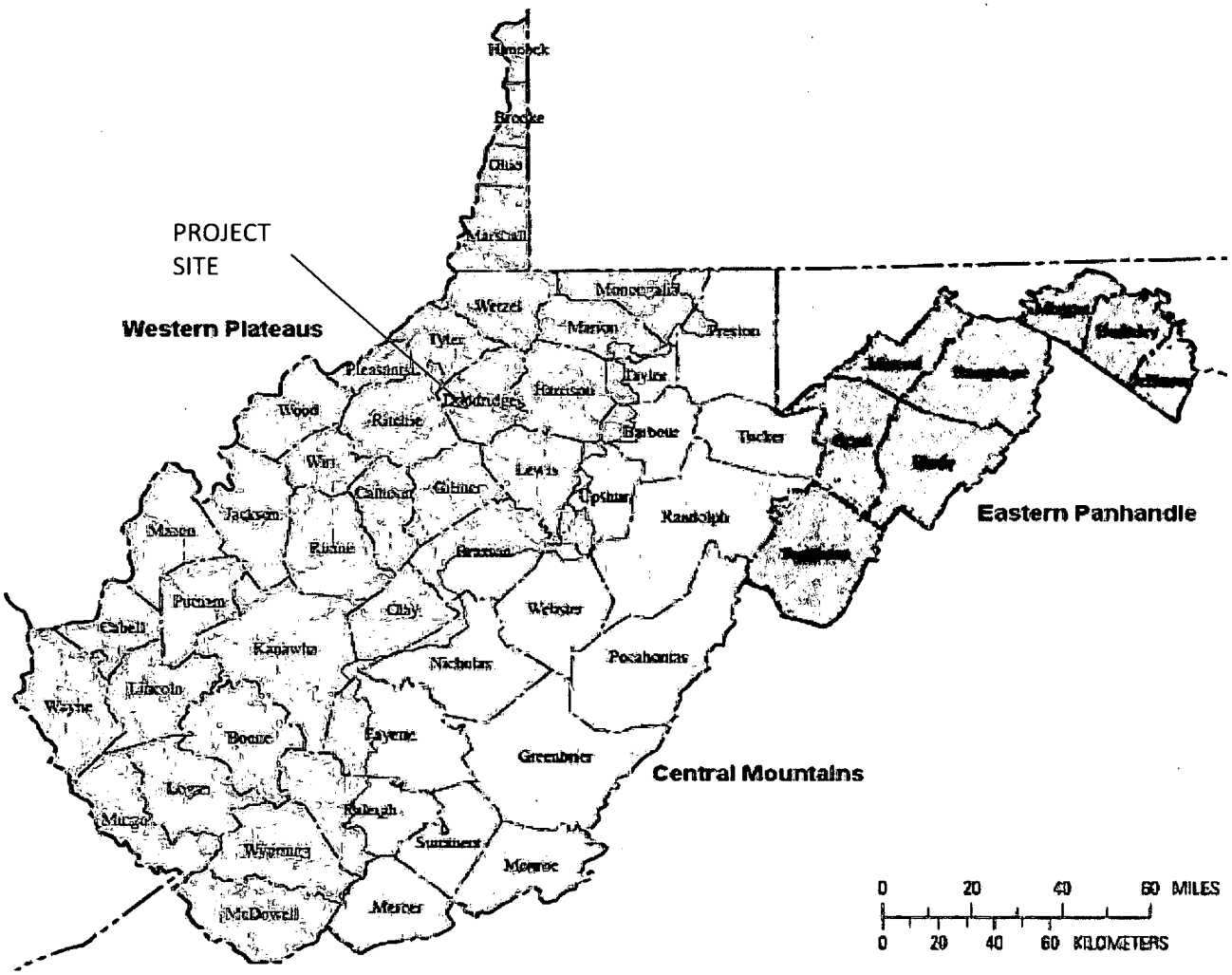
100-year Error: 31.4 (Ref. 1, Table 4-14)

Adjusted Flow (Q) cfs

100-year	1,096	Adjusted Flow (Q) cfs = Flow (Q) x 1.314

Project:	By:	Date:	
Dominion - 2015 Maxwell Compressor Station	THOMAMT	7/9/2015	gai consultants
Location:	Checked:	Date:	
Downstream of Proposed Structure	BERKEME	7/9/2015	

Map 4-10
Hydrologic Regions in West Virginia



Source: USGS Scientific Investigations Report 2010-5033 (2010)

Project:	By:	Date:	
Dominion - 2015 Maxwell Compressor Station	THOMAMT	7/9/2015	gai consultants
Location:	Checked:	Date:	
Downstream of Proposed Structure	BERKEME	7/9/2015	

Table 4-14

USGS Regional Regression Equations for Rural Areas (2010)

DRAINAGE AREA (A) IS IN SQUARE MILES
1 MILE ^{2} = 640 ACRES
1 MILE ^{2} = 27,878,400 SQUARE FEET

RECURRENCE INTERVAL OR RETURN PERIOD	EXCEEDENCE PROBABILITY OR FREQUENCY	REGRESSION EQUATION	STANDARD ERROR OF MODEL IN PERCENT	AVERAGE STANDARD ERROR OF SAMPLING IN	AVERAGE PREDICTION ERROR IN PERCENT
EASTERN PANHANDLE REGION					
1.1	90%	$29.6\,A^{0.818}$	43.4	10.3	44.8
1.5	67%	$46.4\,A^{0.828}$	35.7	8.9	36.9
2	50%	$59.8\,A^{0.832}$	32.1	8.6	33.4
5	20%	$105\,A^{0.838}$	25.6	8.9	27.2
10	10%	$145\,A^{0.842}$	22.5	9.5	24.5
25	4%	$204\,A^{0.848}$	19.7	10.3	22.4
50	2%	$254\,A^{0.852}$	18.6	11.1	21.7
100	1%	$307\,A^{0.855}$	18.3	11.6	21.7
200	0.50%	$365\,A^{0.859}$	18.4	12.4	22.4
500	0.20%	$447\,A^{0.864}$	19.4	13.5	23.8
CENTRAL MOUNTAINS REGION					
1.1	90%	$33.4\,A^{0.914}$	40.0	8.3	41.0
1.5	67%	$53.8\,A^{0.887}$	34.6	7.3	35.4
2	50%	$69.4\,A^{0.873}$	33.4	7.3	34.2
5	20%	$116\,A^{0.845}$	34.1	8.0	35.1
10	10%	$153\,A^{0.831}$	36.3	8.6	37.4
25	4%	$206\,A^{0.816}$	39.9	9.8	41.2
50	2%	$250\,A^{0.807}$	42.9	10.6	44.4
100	1%	$297\,A^{0.800}$	46.2	11.3	47.9
200	0.50%	$347\,A^{0.793}$	49.7	12.0	51.5
500	0.20%	$420\,A^{0.785}$	54.3	13.1	56.3
WESTERN PLATEAUS REGION					
1.1	90%	$56.9\,A^{0.763}$	38.2	7.6	39.1
1.5	67%	$97.8\,A^{0.741}$	33.4	6.5	34.1
2	50%	$129\,A^{0.730}$	31.6	6.1	32.2
5	20%	$221\,A^{0.710}$	29.3	6.5	30.0
10	10%	$292\,A^{0.699}$	28.9	6.5	29.7
25	4%	$391\,A^{0.688}$	29.4	7.3	30.3
50	2%	$472\,A^{0.681}$	30.2	7.6	31.3
100	1%	$557\,A^{0.674}$	31.4	8.0	32.5
200	0.50%	$647\,A^{0.668}$	32.7	8.3	33.9
500	0.20%	$775\,A^{0.661}$	34.8	8.9	36.1

Source: USGS SIR Report 2010-5033 (2010)

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TR-55 Method

Project:	By:	Date:
Maxwell Compressor Station Existing Conditions C141803.36	VENDEVM	7/9/2015
	Checked:	Date:
Location: Doddridge County, WV	THOMAMT	7/9/2015

Check one: ■ Present ❑ Developed

Hydrologic Group	Cover Description	CN			Area	Product of CN x Area
		Table 4-9*	Figure 2-3	Figure 2-4	■ Acres ❑ miles^2 ❑ %	
C	Forested- Woods Only (Good Condition)	70			671.2	46984.0
A	Meadow (Good Condition)	30			99.7	2991.0
C	Meadow (Good Condition)	71			392.4	27860.4
			TOTALS		**1163.3**	**77835.4**

CN (weighted) = Total Product / Total Area

CN	**67**

*From WVDOH "Drainage Manual", 2007 Edition, Addendum December 2012.

Return Period in years	100
24-hr Rainfall Depth, P in inches	5.17

Project:	By:	Date:	
Maxwell Compressor Station Existing Conditions	BERKEME	7/13/2015	
Location:	Checked:	Date:	gai consultants
Doddridge County, WV	THOMAMT	7/13/2015	

Check one: ■ Present ❑ Under Development ❑ Developed

Sheet Flow

Segment ID	A		
Surface Description	Woods		
Manning's Roughness Coefficient, n	0.6		(TR-55, Table 3-1)
Flow Length, L	100	ft	
Two-year 24-hour Rainfall, P_2	2.57	in	(NOAA Atlas 14)
Land Slope, s	0.100	ft/ft	
Travel Time, $T_t = (0.007*(n*L)^{0.8}) / (P_2^{0.5}*s^{0.4})$	**0.2902**	**hrs**	

Shallow Concentrated Flow

Segment ID	B	C	D	
Surface Description (Paved / Unpaved)	Unpaved	Unpaved	Unpaved	
Surface Description Coefficient, C	16.13	16.13	16.13	
Flow Length, L	708	667	1005	ft
Watercourse Slope, s	0.254	0.055	0.020	ft/ft
Average Velocity, $V = C*s^{0.5}$	8.14	3.78	2.28	ft/sec
Travel Time, $T_t = (L) / (3600*V)$	**0.024**	**0.049**	**0.122**	**hrs**

Channel Flow

Segment ID	E	F	
Section Base, b	8	10	ft
Section Depth, d	2.5	3	ft
Section Side Slope, z	2	2	
Cross Sectional Flow Area, $a = b*d + z*d^2$	32.5	48	sq ft
Wetted Perimeter, $p_w = b + (2*d)*(z^2 + 1)^{0.5}$	19.18	23.42	ft
Hydraulic Radius, $r = a / p_w$	1.69	2.05	ft
Channel Slope, s	0.016	0.007	ft/ft
Manning's Roughness Coefficient, n	0.045	0.045	
Average Velocity, $V = (1.49*r^{2/3}*s^{1/2}) / (n)$	5.96	4.56	ft/sec
Flow Length, L	4726	2866	ft
Travel Time, $T_t = (L) / (3600*V)$	**0.2201**	**0.1746**	**hrs**

Time of Concentration

Sheet Flow T_t	0.2902	hrs
Shallow Concentrated Flow T_t	0.1955	hrs
Channel Flow Tt	0.3947	hrs
Time of Concentration, T_c	**0.88**	**hrs**
	53	**mins**

Hydrograph Plot

Hydraflow Hydrographs by Intelisolve

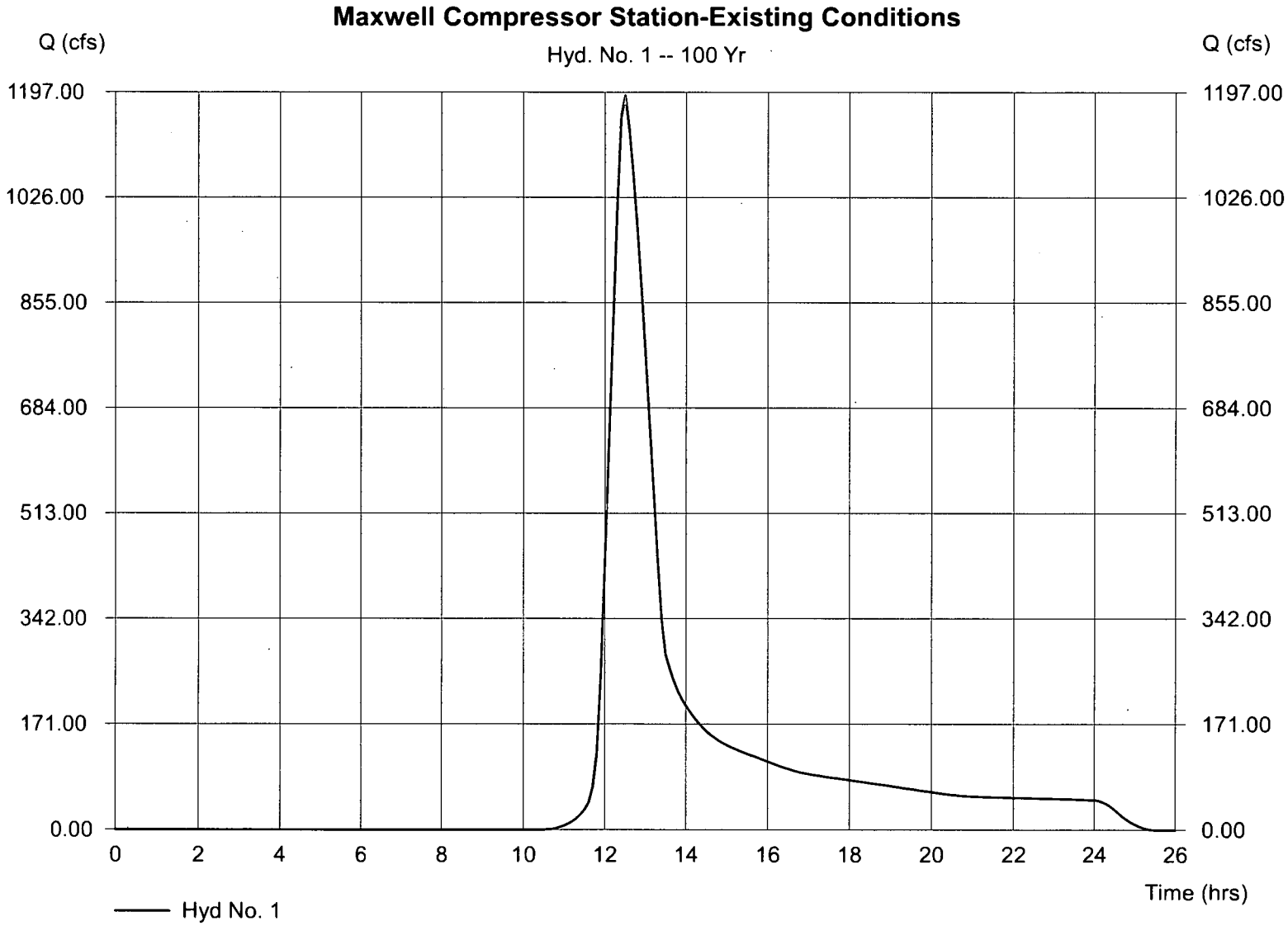
Monday, Jul 13 2015, 11:25 AM

Hyd. No. 1

Maxwell Compressor Station-Existing Conditions

Hydrograph type	= SCS Runoff	Peak discharge	= 1192.24 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 1163.000 ac	Curve number	= 67
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 53.00 min
Total precip.	= 5.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Volume = 8,115,735 cuft



July 16, 2015
Project C141803.36, Task 001

ATTACHMENT 4
Hydraulic Calculations

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gai consultants
transforming ideas into reality.

Subject: Dominion–2015 Maxwell Compressor Station – New Building, Doddridge County, WV
Hydraulic Calculations for Floodplain Development Application
By: BerkeME Date: 07/09/2015 Project #: C141803.36
Chkd By: ThomaMT Date: 07/13/2015 Sheet #: _____ of _____

gai consultants

OBJECTIVE:

Create the existing and proposed conditions hydraulic models in HEC-RAS for South Fork Hughes River upstream and downstream of the project area.

REFERENCES:

1. HEC-RAS Version 4.1.0, U.S. Army Corps of Engineers, January 2010.
2. Hydrology Calculations –Dominion- 2015 Maxwell Compressor Station- New Building
3. Project mapping and topographic information.
4. Field view notes, 06/30/2015.

METHOD:

HEC-RAS cross sections for the model are developed from a combination of project mapping and field measurement. Hydraulic conditions, including Manning's n values, contraction and expansion coefficients, stream cross section geometry, and culvert modeling methodologies were determined based on field observations, measurement, and engineering judgment and are summarized in this calculation set. Estimated flows are simulated in HEC-RAS and the existing and proposed water surface elevations and velocities are calculated at various locations around the project site.

CROSS SECTIONS:

Seven cross sections (two upstream of the proposed crossing location and five downstream) have been created for the existing conditions model. A cross section location map is provided on sheet 3. The general shape of each cross section was determined from contour interval mapping and field measurement. Locations of existing and proposed structures included in the model were based on mapping provided by Dominion and field verification.

HYDROLOGIC CONDITIONS:

Flow rates at the project site were evaluated using the United States Geological Survey (USGS) method, Scientific Investigations Report (SIR) 2010-5033 and the United States Department of Agriculture (USDA) National Resources Conservation Service (NRCS) TR-55 Method. The TR-55 100-year peak discharge of 1,192 cfs was adopted for the modeling.

BOUNDARY CONDITIONS:

The boundary condition selected for the model was a normal depth at the downstream limit of the reach. The slope was originally estimated to be the slope of the stream bed, and after the first iteration of the model it was adjusted to reflect the slope of the 100-year water surface elevation at the downstream modeling limit (approximately 0.02 ft/ft).

Subject: Dominion–2015 Maxwell Compressor Station – New Building, Doddridge County, WV
Hydraulic Calculations for Floodplain Development Application
By: BerkeME Date: 07/09/2015 Project #: C141803.36
Chkd By: ThomaMT Date: 07/13/2015 Sheet #: _____ of _____

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HYDRAULIC CONDITIONS:

Information concerning the hydraulic conditions was noted during the project's field view. The stream consists of silty mud. The banks are heavily vegetated and the stream has riffles, pools, and several small meanders throughout the reach. Based on observations taken in the field, Manning's n values were estimated to be approximately 0.045 for the channel. The floodplains were vegetated with heavy brush, and a Manning's n of 0.10 was selected for these areas. The existing compressor station is a fenced gravel area, and a Manning's n of 0.075 was selected for the fenced gravel areas due to the fence's ability to become blocked with debris. The existing buildings and structures shown on Figure 5 were modeled as obstructions in the cross section data editor.

The existing culverts (two 4-foot diameter Corrugated Metal Pipe Culverts) and access road crossing downstream of the proposed building was modeled using the HEC-RAS culvert data editor. In the HEC-RAS culvert data editor, an entrance coefficient of 0.9 was used to represent a pipe projecting from fill and Chart # 2 (Corrugated Metal Pipe Culvert) and Scale # 3 (Pipe Projecting from fill) were selected. Expansion contraction coefficients were increased to 0.3 and 0.5 at the upstream and downstream bounding sections, and ineffective flow areas were set to reflect the flow obstruction caused by the proposed access road. Stations for the ineffective flow areas were determined by using an expansion and contraction ratio of 1:1.

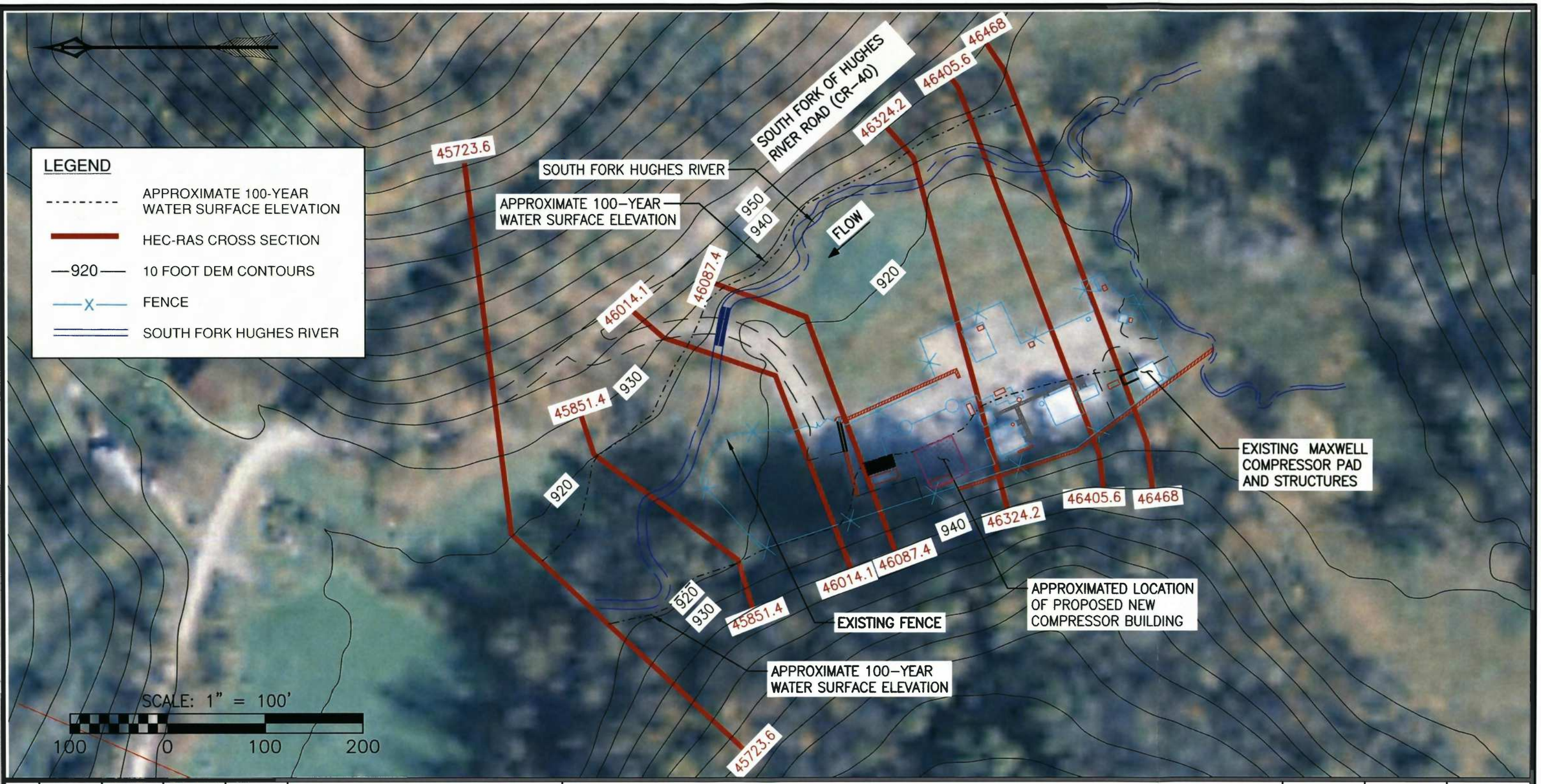
PROPOSED CONDITIONS:

There is currently an existing engine oil tank on fill, at the proposed compressor building location (See Figure 5 and Cross Section 46324.2). In the hydraulic model, the two smaller obstructions representing the existing tank and other structure were modified to represent one larger obstruction for the proposed 42' x 42' building. The Proposed Conditions hydraulic model is identical to the Existing Conditions model in all other locations.

RESULTS:

The results of the existing conditions HEC-RAS Hydraulic model are included at the end of this calculation. The proposed structure shows no increase in 100-year water surface elevations or velocity over existing conditions. Information provided includes the summary table, culvert output table, the profile of South Fork Hughes River within the studied reach, and the cross section plots for the entire model.

The HEC-RAS notes and warning messages for the model have been reviewed and considered. Input data has been checked for consistency with field conditions and design experience, as has the solutions provided by HEC-RAS.



PLOTTED ON: 7/15/2015 8:48:30 AM PLOTTED BY: Mary Beth Berkes PLOT FILE: GAI.stb

NO.:	DATE:	DWN:	CHK:	APV:	DESCRIPTION:

REVISION RECORD

DRAWING TITLE: CROSS SECTION LOCATION MAP

PROJECT: 2015 MAXWELL COMPRESSOR STATION
DODDRIDGE COUNTY, WV

gai consultants

CLIENT: DOMINION TRANSMISSION, INC.
5000 DOMINION BOULEVARD
GLEN ALLEN, VA 23060

DRAWN BY:	CHECKED BY:	APPROVED BY:
BERKEME	THOMAMT	MEDVEDL
REVISION	SCALE: AS SHOWN	ISSUE DATE: 07/17/2015
	SHEET NO.: 001 OF 001	

GAI FILE NUMBER: C141803-36-000-00-A2-002
GAI DRAWING NUMBER: C141803-36-000-00-A2-001

This drawing was produced with computer aided drafting technology and is supported by electronic drawing files. Do not revise this drawing via manual drafting methods.

ISSUING OFFICE: Pittsburgh | 385 E. Waterfront Drive, Homestead, PA 15120

GAI CAD FILE PATH: Z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\CAD\Production Drawings\C141803-36-000-00-A2-002.dwg

Subject: Dominion–2015 Maxwell Compressor Station – New Building, Doddridge County, WV
Hydraulic Calculations for Floodplain Development Application

By: BerkeME Date: 07/09/2015 Project #: C141803.36

Chkd By: ThomaMT Date: 07/13/2015 Sheet #: _____ of _____

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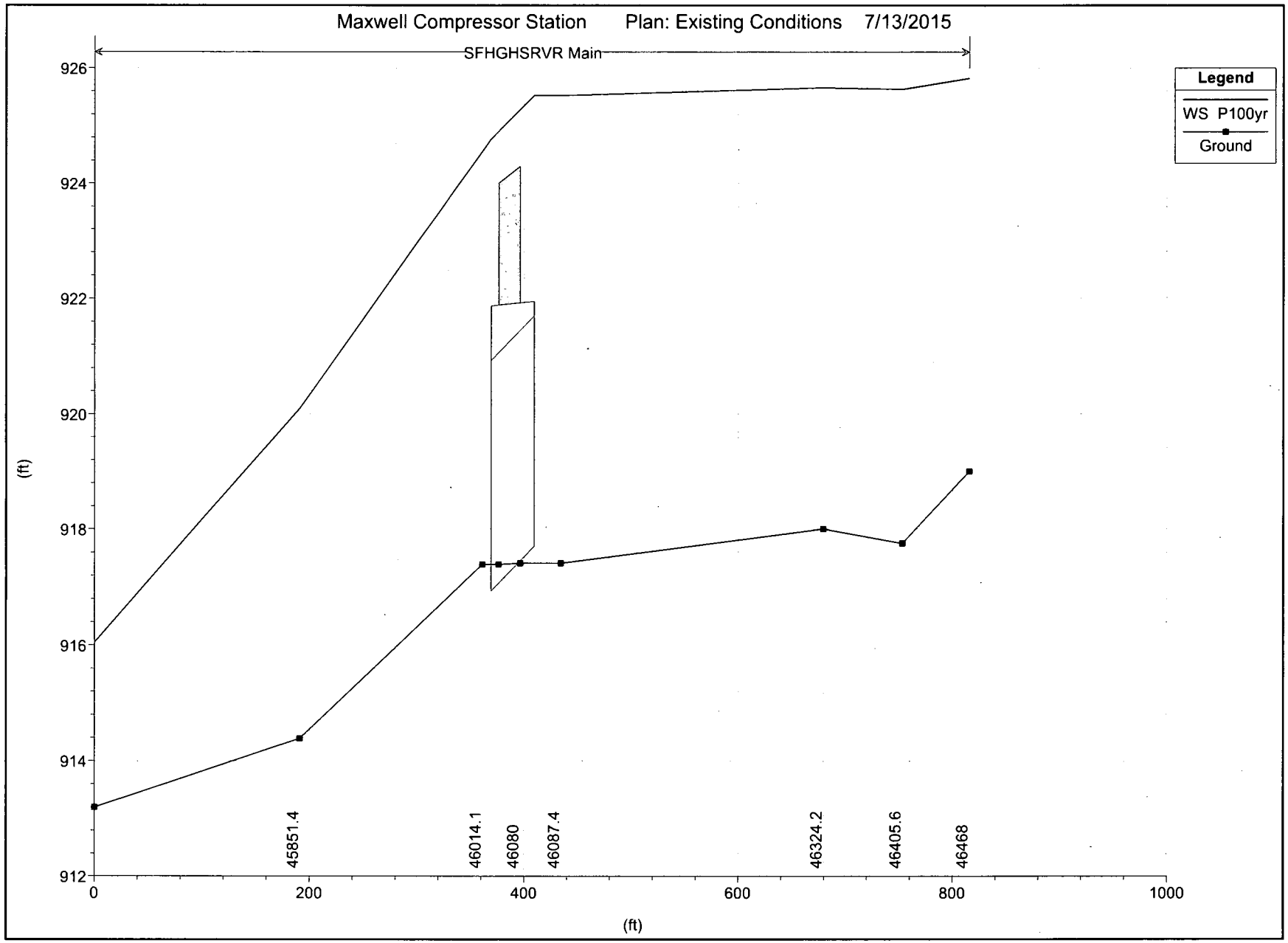
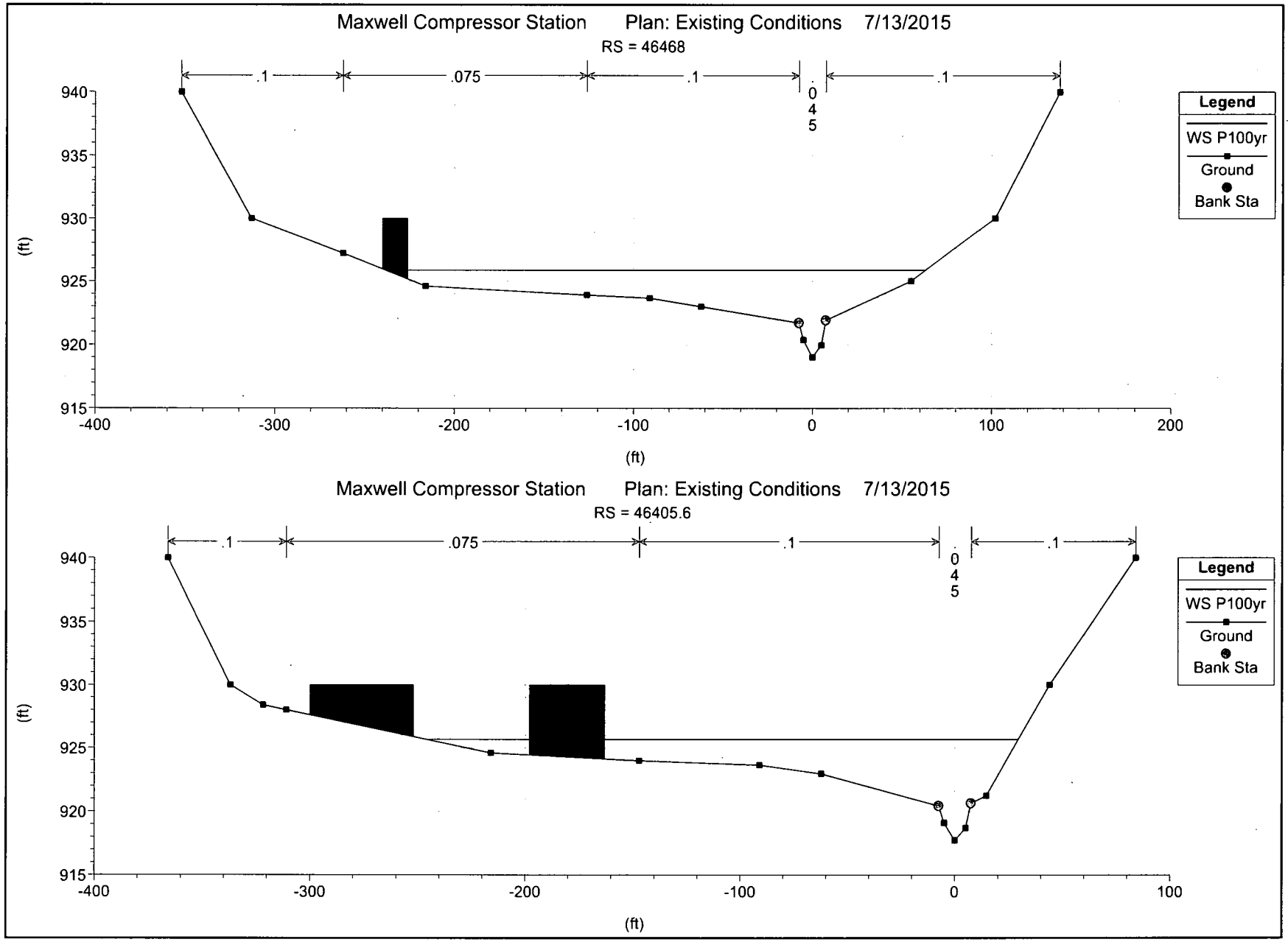
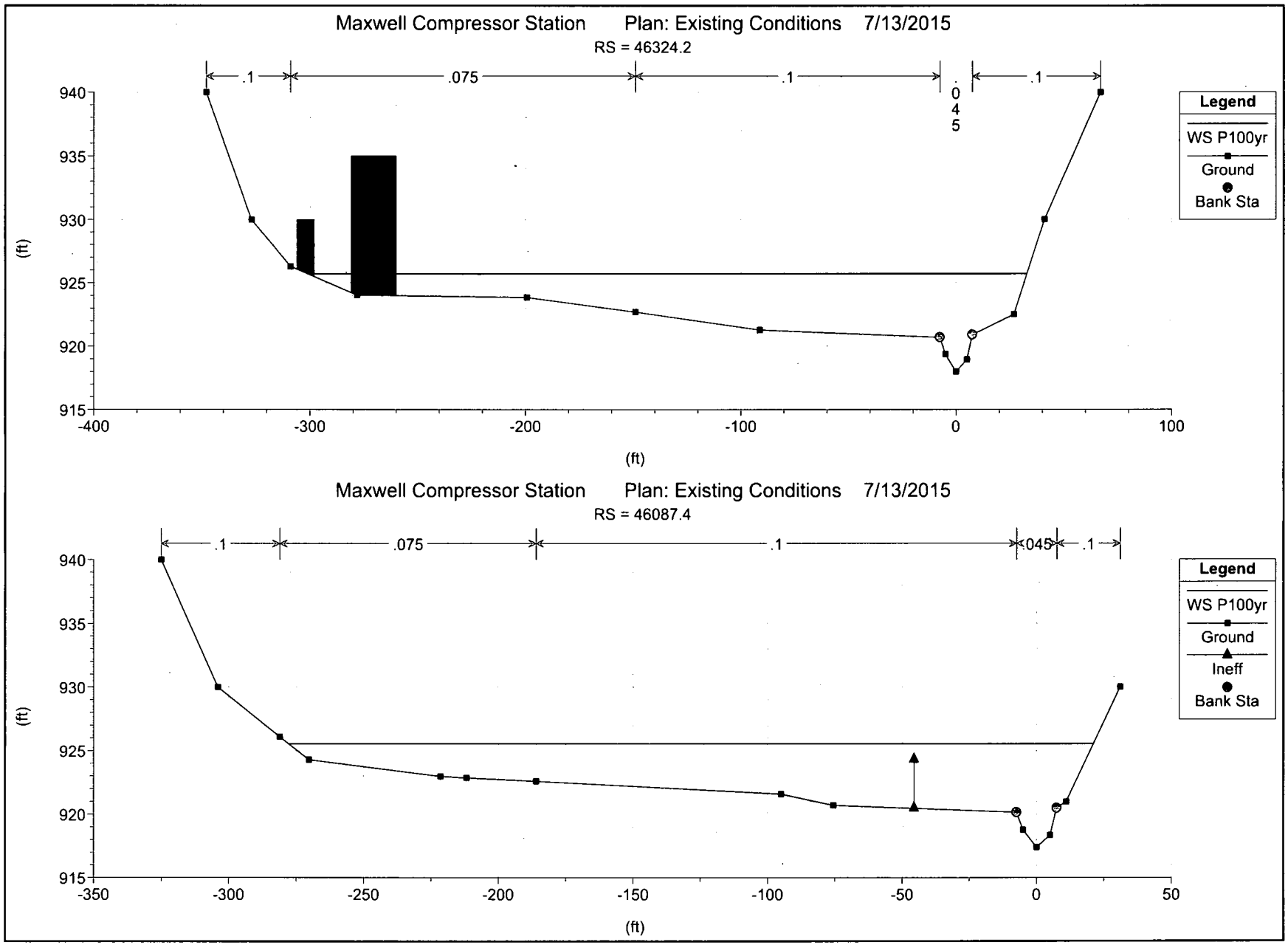
EXISTING CONDITIONS

HEC-RAS Plan: Existing River: SFHGHSRVR Reach: Main Profile: P100yr

Reach	River Sta	Profile	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)	
Main	45723.6	P100yr	1192.00	913.20	916.04	916.03	917.06	0.020026	8.43	176.28	99.16	0.95
Main	45851.4	P100yr	1192.00	914.39	920.10	920.10	920.88	0.011726	9.35	322.53	182.70	0.77
Main	46014.1	P100yr	1192.00	917.39	924.55	924.55	925.19	0.006028	8.05	417.74	310.76	0.57
Main	46080		Culvert									
Main	46087.4	P100yr	1192.00	917.41	925.52	922.96	925.56	0.000618	2.84	1079.31	298.55	0.19
Main	46324.2	P100yr	1192.00	918.00	925.65		925.70	0.000717	2.95	1025.70	309.83	0.20
Main	46405.6	P100yr	1192.00	917.75	925.63		925.83	0.002135	5.20	609.75	239.27	0.35
Main	46468	P100yr	1192.00	919.00	925.82		925.96	0.002211	4.73	687.43	288.70	0.35


Maxwell Compressor Station Plan: Existing Conditions 7/13/2015
SFHGHSRVR Main
Legend
WS P100yr
Ground
926
924
922
920
918
916
914
912
(ft)
45851.4
46014.1
46080
46087.4
46324.2
46405.6
46468
0
200
400
600
800
1000
(ft)


Maxwell Compressor Station Plan: Existing Conditions 7/13/2015
RS = 46468
.1
.075
.1
.045
.1
940
935
930
925
920
915
(ft)
-400
-300
-200
-100
0
100
200
(ft)
Legend
WS P100yr
Ground
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions 7/13/2015
RS = 46405.6
.1
.075
.1
.045
.1
940
935
930
925
920
915
(ft)
-400
-300
-200
-100
0
100
(ft)
Legend
WS P100yr
Ground
Bank Sta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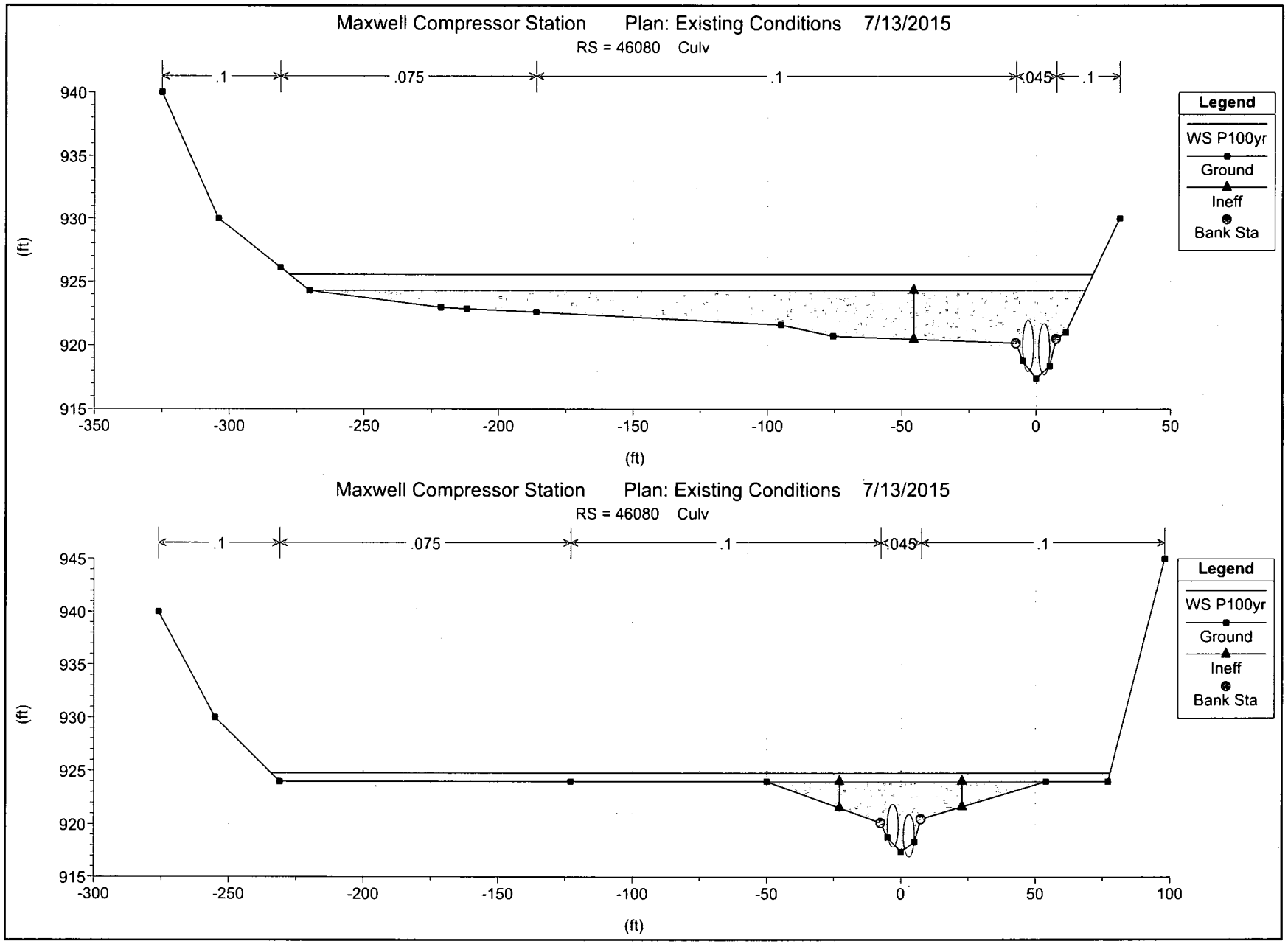
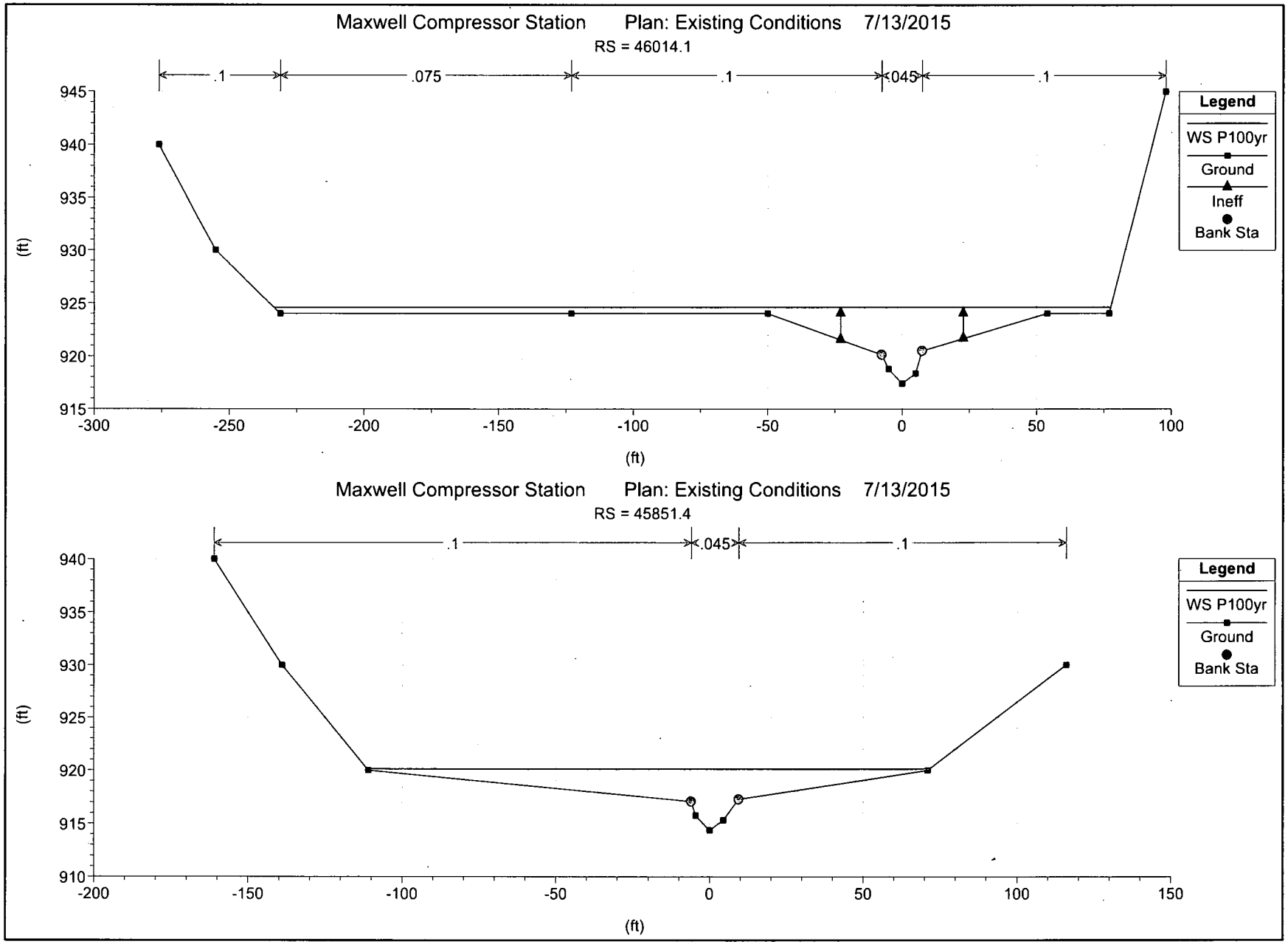
RS = 46324.2
.1
.075
.1
.045
.1
940
935
930
925
920
915
(ft)
-400
-300
-200
-100
0
100
(ft)
Legend
WS P100yr
Ground
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions 7/13/2015
RS = 46087.4
.1
.075
.1
.045
.1
940
935
930
925
920
915
(ft)
-350
-300
-250
-200
-150
-100
-50
0
50
(ft)
Legend
WS P100yr
Ground
Ineff
Bank Sta


Maxwell Compressor Station Plan: Existing Conditions 7/13/2015
RS = 46080 Culv
.1
.075
.1
.045
.1
940
935
930
925
920
915
(ft)
-350
-300
-250
-200
-150
-100
-50
0
50
(ft)
Legend
WS P100yr
Ground
Ineff
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions 7/13/2015
RS = 46080 Culv
.1
.075
.1
.045
.1
945
940
935
930
925
920
915
(ft)
-300
-250
-200
-150
-100
-50
0
50
100
(ft)
Legend
WS P100yr
Ground
Ineff
Bank Sta


Maxwell Compressor Station Plan: Existing Conditions 7/13/2015
RS = 46014.1
.1
.075
.1
.045
.1
945
940
935
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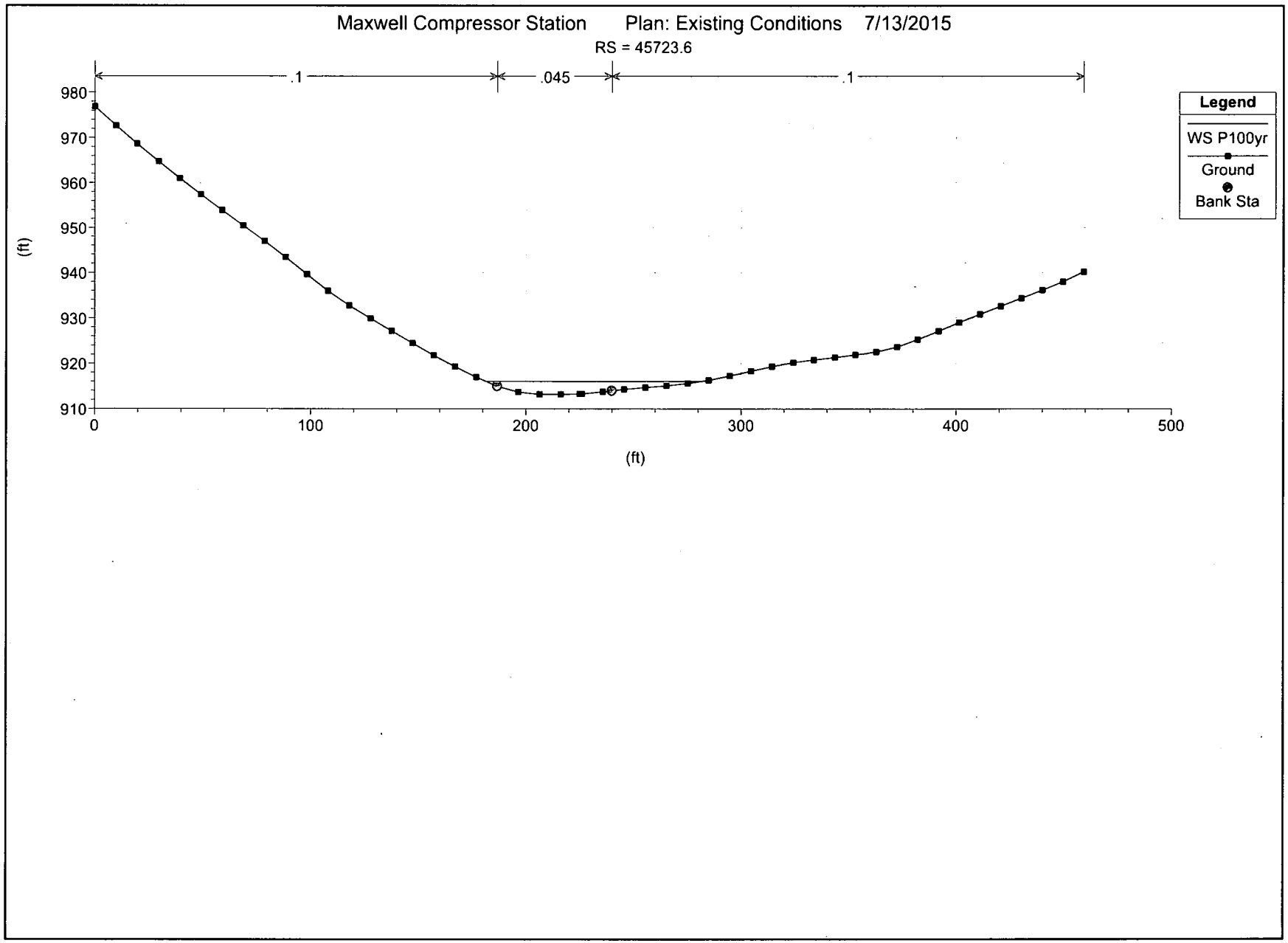
925
920
915
(ft)
-300
-250
-200
-150
-100
-50
0
50
100
(ft)
Legend
WS P100yr
Ground
Ineff
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions 7/13/2015
RS = 45851.4
.1
.045
.1
940
935
930
925
920
915
910
(ft)
-200
-150
-100
-50
0
50
100
150
(ft)
Legend
WS P100yr
Ground
Bank Sta


Maxwell Compressor Station Plan: Existing Conditions 7/13/2015
RS = 45723.6
.1
.045
.1
980
970
960
950
940
930
920
910
(ft)
0
100
200
300
400
500
(ft)
Legend
WS P100yr
Ground
Bank Sta

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X     X
X     X  X        X           X   X    X    X    X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
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PROJECT DATA
Project Title: Maxwell Compressor Station
Project File : SFHGHSRVR.prj
Run Date and Time: 7/13/2015 12:03:11 PM

Project in English units

PLAN DATA

Plan Title: Existing Conditions
Plan File : z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\Working Docs\Hydraulics\HEC-RAS\sfhghsrvr\sfhghsrvr_HEC_RAS\SFHGHSRVR.p02

Geometry Title: Existing Conditions
Geometry File : z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\Working Docs\Hydraulics\HEC-RAS\sfhghsrvr\sfhghsrvr_HEC_RAS\SFHGHSRVR.g02

Flow Title : TR-55 Flows
Flow File : z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\Working Docs\Hydraulics\HEC-RAS\sfhghsrvr\sfhghsrvr_HEC_RAS\SFHGHSRVR.f02

Plan Summary Information:
Number of: Cross Sections = 7 Multiple Openings = 0
Culverts = 1 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: TR-55 Flows
Flow File : z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\Working Docs\Hydraulics\HEC-RAS\sfhghsrvr\sfhghsrvr_HEC_RAS\SFHGHSRVR.f02

Flow Data (cfs)

River	Reach	RS	P100yr
SFHGHSRVR	Main	46468	1192

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
SFHGHSRVR	Main	P100yr		Normal S = 0.02

GEOMETRY DATA

Geometry Title: Existing Conditions
Geometry File : z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\Working

Docs\Hydraulics\HEC-RAS\sfhghsrvr\sfhghsrvr_HEC_RAS\SFHGHSRVR.g02

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46468

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-352	940	-313	930	-262	927.2	-216	924.59	-126	923.9
-91	923.65	-62.2	922.98	-7.5	921.7	-5	920.37	0	919
5	919.96	7.5	921.9	55	925	102	930	138	940

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-352	.1	-262	.075	-126	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	50	62.4	53	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
-240	-226	930

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46405.6

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-366	940	-337	930	-321.8	928.4	-311	928	-216	924.59
-147	924	-91	923.65	-62.2	922.98	-7.5	920.45	-5	919.13
0	917.75	5	918.71	7.5	920.65	14.7	921.25	44	930
84	940								

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-366	.1	-311	.075	-147	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	72	74	79	.1	.3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-300	-252	930	-198	-163	930

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46324.2

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-348	940	-327	930	-309	926.3	-278.1	924.03	-199.4	923.85
-149	922.7	-91.2	921.28	-7.5	920.7	-5	919.38	0	918
5	918.96	7.5	920.9	26.9	922.5	41	930	67	940

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-348	.1	-309	.075	-149	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	191	245	236	.1	.3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-306	-298	930	-281	-260	935

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46087.4

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-325	940	-304	930	-281	926.1	-270.2	924.3	-221.5	922.98
-211.8	922.87	-186	922.6	-95	921.6	-75.5	920.72	-7.5	920.16
-5	918.79	0	917.41	5	918.37	7.5	920.51	11	921

```
      31     930

Manning's n Values          num=        5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
    -325      .1    -281    .075    -186      .1    -7.5    .045     7.5      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.    Expan.
          -7.5     7.5                 68    73.3    68.7             .3       .5
Ineffective Flow      num=        1
   Sta L    Sta R     Elev  Permanent
    -325    -45.5    924.3        F

CULVERT


RIVER: SFHGHSRVR
REACH: Main                 RS: 46080

INPUT
Description:
Distance from Upstream XS =       38
Deck/Roadway Width        =       20
Weir Coefficient          =      2.6
Upstream  Deck/Roadway Coordinates
    num=        2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
  -270.2    924.3              100   924.3

Upstream Bridge Cross Section Data
Station Elevation Data     num=       16
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    -325      940     -304      930     -281    926.1   -270.2    924.3   -221.5   922.98
  -211.8   922.87     -186    922.6      -95    921.6    -75.5   920.72     -7.5   920.16
      -5   918.79        0   917.41        5   918.37      7.5   920.51       11      921
      31      930

Manning's n Values          num=        5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
    -325      .1    -281    .075    -186      .1    -7.5    .045     7.5      .1

Bank Sta: Left   Right    Coeff Contr.    Expan.
          -7.5     7.5              .3       .5
Ineffective Flow      num=        1
   Sta L    Sta R     Elev  Permanent
    -325    -45.5    924.3        F

Downstream  Deck/Roadway Coordinates
    num=        2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
     -50     924                71     924

Downstream Bridge Cross Section Data
Station Elevation Data     num=       13
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    -276      940     -255      930     -231      924     -123      924      -50      924
    -7.5   920.14       -5   918.77        0   917.39        5   918.35      7.5   920.49
      54      924       77      924       98      945

Manning's n Values          num=        5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
    -276      .1    -231    .075    -123      .1    -7.5    .045     7.5      .1

Bank Sta: Left   Right    Coeff Contr.    Expan.
          -7.5     7.5              .3       .5
Ineffective Flow      num=        2
   Sta L    Sta R     Elev  Permanent
    -276    -22.8      924        F
    22.8       98      924        F

Upstream Embankment side slope             =       0 horiz. to 1.0 vertical
Downstream Embankment side slope           =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins        =
Energy head used in spillway design        =
Spillway height used in design             =
Weir crest shape                           = Broad Crested

Number of Culverts =  2

Culvert Name      Shape      Rise    Span
Culvert #1       Circular      4
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 3 - Pipe projecting from fill
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                25      40     .022      .022        0                  .9                1
Upstream   Elevation =  917.95
           Centerline Station = -3
```

```
Downstream Elevation =  917.87
           Centerline Station = -3

Culvert Name      Shape      Rise    Span
Culvert #2       Circular      4
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 3 - Pipe projecting from fill
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 25      40     .022     .022        0                  .9                 1
Upstream   Elevation =  917.7
           Centerline Station =  3
Downstream Elevation =  916.93
           Centerline Station =  3

CULVERT OUTPUT  Profile #P100yr  Culv Group:  Culvert #1

  Q Culv Group (cfs)          50.44    Culv Full Len (ft)          40.00
  # Barrels                       1    Culv Vel US (ft/s)           4.01
  Q Barrel (cfs)              50.44    Culv Vel DS (ft/s)           4.01
  E.G. US. (ft)              925.56    Culv Inv El Up (ft)        917.95
  W.S. US. (ft)              925.52    Culv Inv El Dn (ft)        917.87
  E.G. DS (ft)               925.19    Culv Frctn Ls (ft)           0.15
  W.S. DS (ft)               924.55    Culv Exit Loss (ft)          0.00
  Delta EG (ft)                0.38    Culv Entr Loss (ft)          0.23
  Delta WS (ft)                0.97    Q Weir (cfs)              1089.90
  E.G. IC (ft)               921.32    Weir Sta Lft (ft)         -277.83
  E.G. OC (ft)               925.55    Weir Sta Rgt (ft)           21.16
  Culvert Control            Outlet    Weir Submerg                 0.20
  Culv WS Inlet (ft)         921.95    Weir Max Depth (ft)          1.27
  Culv WS Outlet (ft)        921.87    Weir Avg Depth (ft)          1.25
  Culv Nml Depth (ft)                  Weir Flow Area (sq ft)     373.64
  Culv Crt Depth (ft)          2.13    Min El Weir Flow (ft)      924.31


CULVERT OUTPUT  Profile #P100yr  Culv Group:  Culvert #2

  Q Culv Group (cfs)          51.67    Culv Full Len (ft)          40.00
  # Barrels                       1    Culv Vel US (ft/s)           4.11
  Q Barrel (cfs)              51.67    Culv Vel DS (ft/s)           4.11
  E.G. US. (ft)              925.56    Culv Inv El Up (ft)        917.70
  W.S. US. (ft)              925.52    Culv Inv El Dn (ft)        916.93
  E.G. DS (ft)               925.19    Culv Frctn Ls (ft)           0.14
  W.S. DS (ft)               924.55    Culv Exit Loss (ft)          0.00
  Delta EG (ft)                0.38    Culv Entr Loss (ft)          0.24
  Delta WS (ft)                0.97    Q Weir (cfs)              1089.90
  E.G. IC (ft)               921.09    Weir Sta Lft (ft)         -277.83
  E.G. OC (ft)               925.57    Weir Sta Rgt (ft)           21.16
  Culvert Control            Outlet    Weir Submerg                 0.20
  Culv WS Inlet (ft)         921.70    Weir Max Depth (ft)          1.27
  Culv WS Outlet (ft)        920.93    Weir Avg Depth (ft)          1.25
  Culv Nml Depth (ft)                  Weir Flow Area (sq ft)     373.64
  Culv Crt Depth (ft)          2.16    Min El Weir Flow (ft)      924.31


CROSS SECTION


RIVER: SFHGHSRVR
REACH: Main                RS: 46014.1

INPUT
Description:
Station Elevation Data    num=      13
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    -276      940     -255      930     -231      924     -123      924      -50      924
    -7.5   920.14       -5   918.77        0   917.39        5   918.35      7.5   920.49
      54      924       77      924       98      945

Manning's n Values        num=       5
     Sta    n Val      Sta    n Val      Sta    n Val      Sta    n Val      Sta    n Val
    -276       .1     -231     .075     -123       .1     -7.5     .045      7.5       .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -7.5     7.5              175     170     156              .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
    -276   -22.8     924       F
    22.8      98     924       F

CROSS SECTION


RIVER: SFHGHSRVR
REACH: Main                RS: 45851.4

INPUT
Description:
```

Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-161	940	-139	930	-111	920	-6	917.09	-4.5	915.77
0	914.39	4.5	915.35	9.5	917.29	71	920	116	930

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-161	.1	-6	.045	9.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-6	9.5	138	191	121	.1	.3

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 45723.6

INPUT
Description:
Station Elevation Data num= 50

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	976.89	9.8	972.73	19.6	968.69	29.5	964.78	39.3	961
49.1	957.4	59	953.91	68.8	950.47	78.6	947	88.4	943.4
98.3	939.69	108.1	936	117.9	932.81	127.8	929.94	137.6	927.23
147.4	924.5	157.2	921.83	167	919.37	176.9	917.01	186.7	915.02
196.5	913.77	206.4	913.24	216.2	913.2	225	913.31	226	913.32
235.8	913.81	240	914.03	245.7	914.32	255.5	914.73	265.3	915.1
275.2	915.64	285	916.34	294.8	917.3	304.6	918.32	314.4	919.32
324.3	920.23	333.9	920.81	343.6	921.37	353.2	921.91	362.8	922.58
372.5	923.68	382.1	925.3	391.8	927.16	401.4	929.04	411.1	930.85
420.7	932.63	430.3	934.4	440	936.19	449.6	938.04	459.3	940.19

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	186.7	.045	240	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
186.7	240	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:SFHGHSRVR

Reach	River Sta.	n1	n2	n3	n4	n5
Main	46468	.1	.075	.1	.045	.1
Main	46405.6	.1	.075	.1	.045	.1
Main	46324.2	.1	.075	.1	.045	.1
Main	46087.4	.1	.075	.1	.045	.1
Main	46080	Culvert				
Main	46014.1	.1	.075	.1	.045	.1
Main	45851.4	.1	.045	.1		
Main	45723.6	.1	.045	.1		

SUMMARY OF REACH LENGTHS

River: SFHGHSRVR

Reach	River Sta.	Left	Channel	Right
Main	46468	50	62.4	53
Main	46405.6	72	74	79
Main	46324.2	191	245	236
Main	46087.4	68	73.3	68.7
Main	46080	Culvert		
Main	46014.1	175	170	156
Main	45851.4	138	191	121
Main	45723.6	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: SFHGHSRVR

Reach	River Sta.	Contr.	Expan.
Main	46468	.1	.3
Main	46405.6	.1	.3
Main	46324.2	.1	.3
Main	46087.4	.3	.5

Main	46080	Culvert		
Main	46014.1	.3	.5	
Main	45851.4	.1	.3	
Main	45723.6	.1	.3	

Subject: Dominion–2015 Maxwell Compressor Station – New Building, Doddridge County, WV
Hydraulic Calculations for Floodplain Development Application

By: BerkeME Date: 07/09/2015 Project #: C141803.36

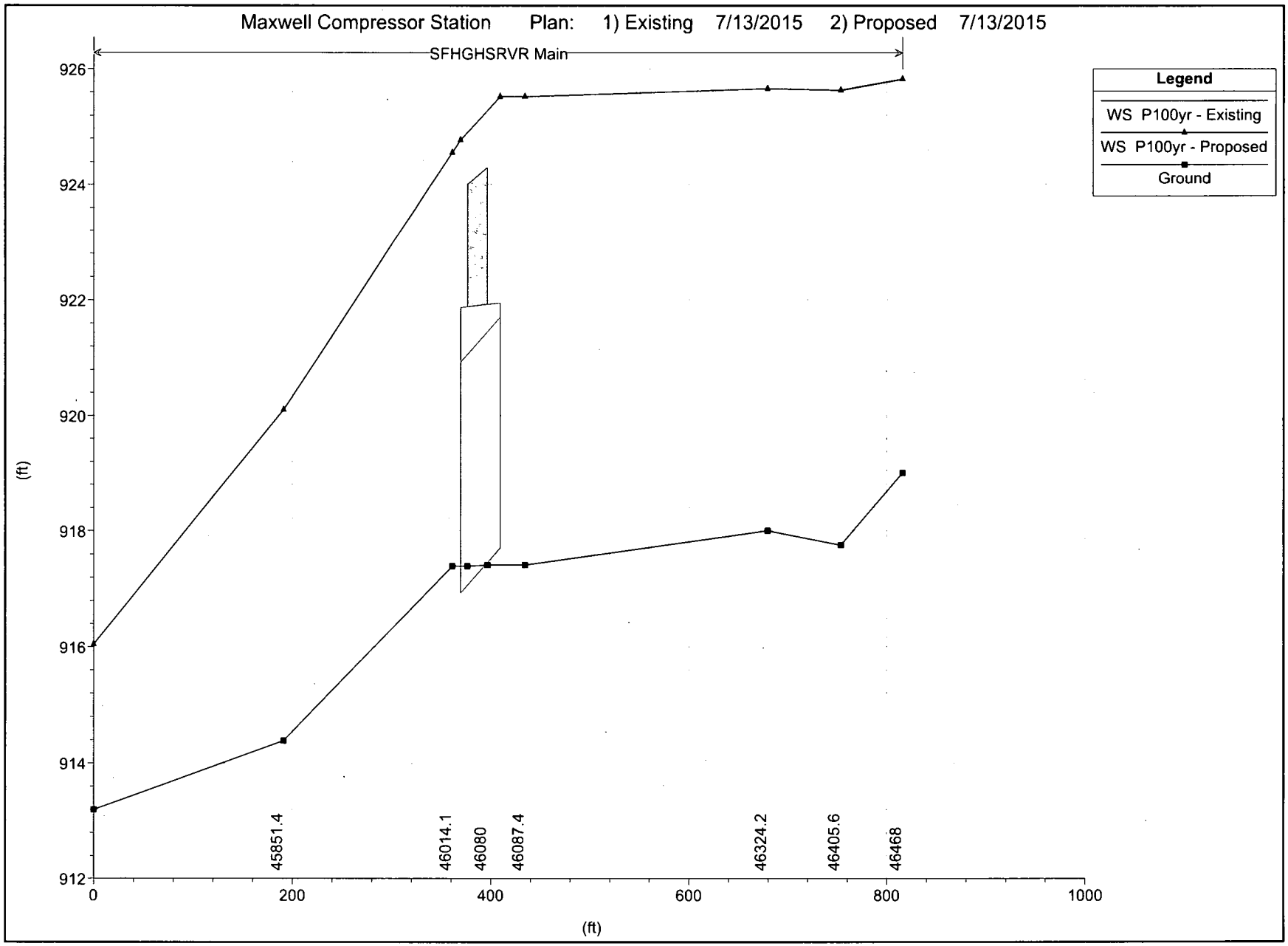
Chkd By: ThomaMT Date: 07/13/2015 Sheet #: _____ of _____

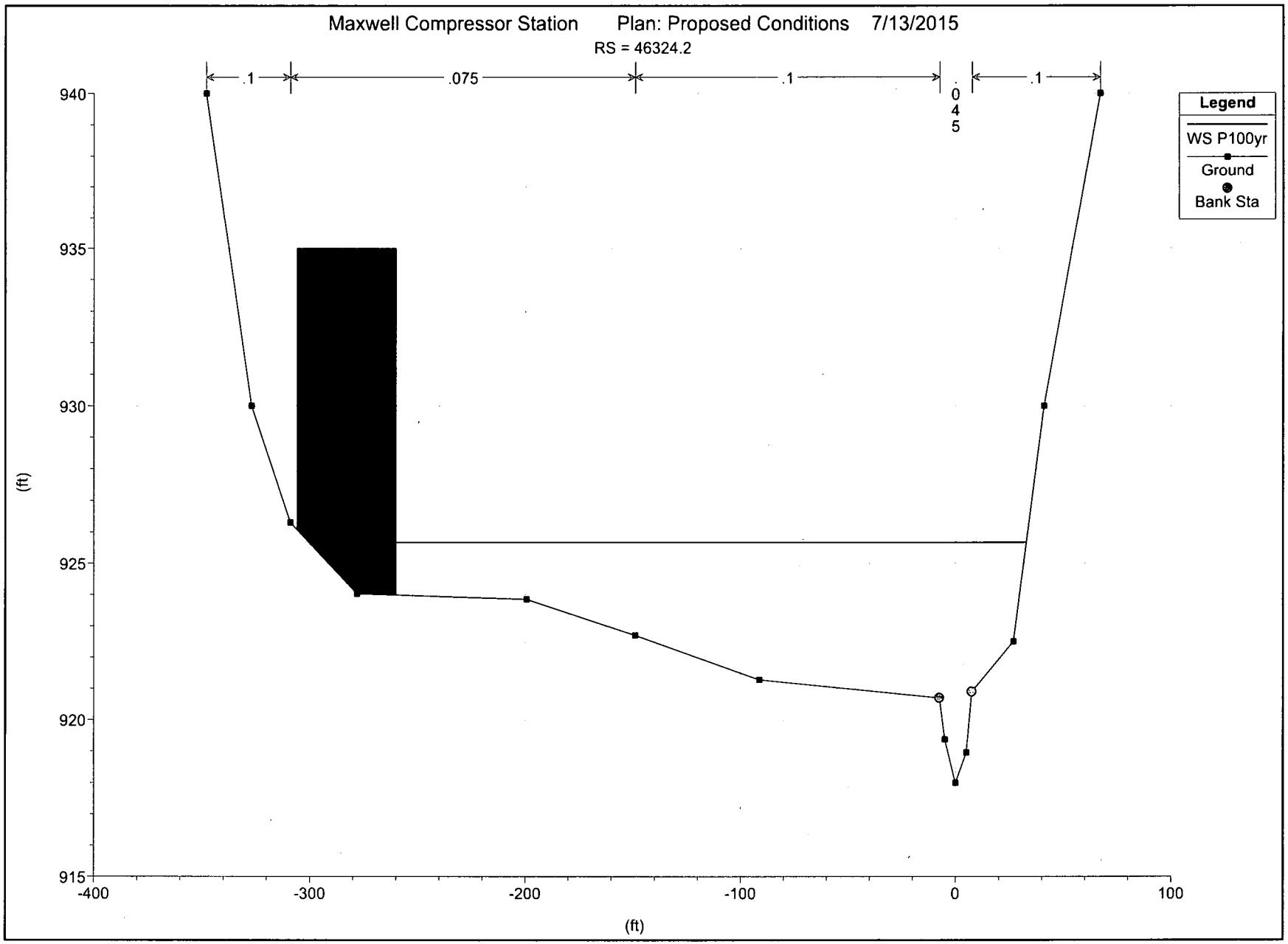
gai consultants

PROPOSED CONDITIONS

HEC-RAS River: SFHGHSRVR Reach: Main Profile: P100yr

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)	
Main	45723.6	P100yr	Existing	1192.00	913.20	916.04	916.03	917.06	0.020026	8.43	176.28	99.16	0.95
Main	45723.6	P100yr	Proposed	1192.00	913.20	916.04	916.03	917.06	0.020026	8.43	176.28	99.16	0.95
Main	45851.4	P100yr	Existing	1192.00	914.39	920.10	920.10	920.88	0.011726	9.35	322.53	182.70	0.77
Main	45851.4	P100yr	Proposed	1192.00	914.39	920.10	920.10	920.88	0.011726	9.35	322.53	182.70	0.77
Main	46014.1	P100yr	Existing	1192.00	917.39	924.55	924.55	925.19	0.006028	8.05	417.74	310.76	0.57
Main	46014.1	P100yr	Proposed	1192.00	917.39	924.55	924.55	925.19	0.006028	8.05	417.74	310.76	0.57
Main	46080			Culvert									
Main	46087.4	P100yr	Existing	1192.00	917.41	925.52	922.96	925.56	0.000618	2.84	1079.31	298.55	0.19
Main	46087.4	P100yr	Proposed	1192.00	917.41	925.52	922.96	925.56	0.000618	2.84	1079.31	298.55	0.19
Main	46324.2	P100yr	Existing	1192.00	918.00	925.65		925.70	0.000717	2.95	1025.70	309.83	0.20
Main	46324.2	P100yr	Proposed	1192.00	918.00	925.65		925.70	0.000724	2.96	1012.34	292.83	0.20
Main	46405.6	P100yr	Existing	1192.00	917.75	925.63		925.83	0.002135	5.20	609.75	239.27	0.35
Main	46405.6	P100yr	Proposed	1192.00	917.75	925.63		925.83	0.002133	5.20	610.04	239.31	0.35
Main	46468	P100yr	Existing	1192.00	919.00	925.82		925.96	0.002211	4.73	687.43	288.70	0.35
Main	46468	P100yr	Proposed	1192.00	919.00	925.82		925.96	0.002209	4.73	687.73	288.71	0.35


Maxwell Compressor Station Plan: 1) Existing 7/13/2015 2) Proposed 7/13/2015
SFHGHSRVR Main
Legend
WS P100yr - Existing
WS P100yr - Proposed
Ground
926
924
922
920
918
916
914
912
(ft)
45851.4
46014.1
46080
46087.4
46324.2
46405.6
46468
0
200
400
600
800
1000
(ft)


Maxwell Compressor Station Plan: Proposed Conditions 7/13/2015
RS = 46324.2
.1
.075
.1
.045
.1
940
935
930
925
920
915
(ft)
-400
-300
-200
-100
0
100
(ft)
Legend
WS P100yr
Ground
Bank Sta

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X     X
X     X  X        X           X   X     X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X      X    X       X
X     X  X        X    X      X   X     X    X       X
X     X  XXXXXX    XXXX       X    X    X    X   XXXXX
```

PROJECT DATA
Project Title: Maxwell Compressor Station
Project File : SFHGHSRVR.prj
Run Date and Time: 7/13/2015 1:13:09 PM

Project in English units

PLAN DATA

Plan Title: Proposed Conditions
Plan File : z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\Working Docs\Hydraulics\HEC-RAS\sfhghsrvr\sfhghsrvr_HEC_RAS\SFHGHSRVR.p03

Geometry Title: Proposed Conditions
Geometry File : z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\Working Docs\Hydraulics\HEC-RAS\sfhghsrvr\sfhghsrvr_HEC_RAS\SFHGHSRVR.g04

Flow Title : TR-55 Flows
Flow File : z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\Working Docs\Hydraulics\HEC-RAS\sfhghsrvr\sfhghsrvr_HEC_RAS\SFHGHSRVR.f02

Plan Summary Information:

Number of: Cross Sections	=	7	Multiple Openings	=	0
Culverts	=	1	Inline Structures	=	0
Bridges	=	0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	= 0.01
Critical depth calculation tolerance	= 0.01
Maximum number of iterations	= 20
Maximum difference tolerance	= 0.3
Flow tolerance factor	= 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: TR-55 Flows
Flow File : z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\Working Docs\Hydraulics\HEC-RAS\sfhghsrvr\sfhghsrvr_HEC_RAS\SFHGHSRVR.f02

Flow Data (cfs)

River	Reach	RS	P100yr
SFHGHSRVR	Main	46468	1192

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
SFHGHSRVR	Main	P100yr		Normal S = 0.02

GEOMETRY DATA

Geometry Title: Proposed Conditions
Geometry File : z:\Energy\2014\C141803.36 - Dom - Maxwell Station Hyd\Working

Docs\Hydraulics\HEC-RAS\sfhghsrvr\sfhghsrvr_HEC_RAS\SFHGHSRVR.g04

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46468

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-352	940	-313	930	-262	927.2	-216	924.59	-126	923.9
-91	923.65	-62.2	922.98	-7.5	921.7	-5	920.37	0	919
5	919.96	7.5	921.9	55	925	102	930	138	940

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-352	.1	-262	.075	-126	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	50	62.4	53	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
-240	-226	930

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46405.6

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-366	940	-337	930	-321.8	928.4	-311	928	-216	924.59
-147	924	-91	923.65	-62.2	922.98	-7.5	920.45	-5	919.13
0	917.75	5	918.71	7.5	920.65	14.7	921.25	44	930
84	940								

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-366	.1	-311	.075	-147	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	72	74	79	.1	.3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-300	-252	930	-198	-163	930

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46324.2

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-348	940	-327	930	-309	926.3	-278.1	924.03	-199.4	923.85
-149	922.7	-91.2	921.28	-7.5	920.7	-5	919.38	0	918
5	918.96	7.5	920.9	26.9	922.5	41	930	67	940

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-348	.1	-309	.075	-149	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	191	245	236	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
-306	-260	935

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46087.4

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-325	940	-304	930	-281	926.1	-270.2	924.3	-221.5	922.98
-211.8	922.87	-186	922.6	-95	921.6	-75.5	920.72	-7.5	920.16
-5	918.79	0	917.41	5	918.37	7.5	920.51	11	921

```
      31      930

Manning's n Values          num=        5
     Sta    n Val      Sta    n Val      Sta    n Val      Sta    n Val      Sta    n Val
    -325       .1     -281     .075     -186       .1     -7.5     .045      7.5       .1

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
          -7.5      7.5                 68     73.3     68.7               .3        .5
Ineffective Flow      num=        1
   Sta L    Sta R     Elev  Permanent
    -325    -45.5    924.3        F

CULVERT


RIVER: SFHGHSRVR
REACH: Main                 RS: 46080

INPUT
Description:
Distance from Upstream XS =       38
Deck/Roadway Width        =       20
Weir Coefficient          =      2.6
Upstream  Deck/Roadway Coordinates
    num=        2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
  -270.2   924.3              100   924.3

Upstream Bridge Cross Section Data
Station Elevation Data     num=       16
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    -325      940     -304      930     -281    926.1   -270.2    924.3   -221.5   922.98
  -211.8   922.87     -186    922.6      -95    921.6    -75.5   920.72     -7.5   920.16
      -5   918.79        0   917.41        5   918.37      7.5   920.51       11      921
      31      930

Manning's n Values          num=        5
     Sta    n Val      Sta    n Val      Sta    n Val      Sta    n Val      Sta    n Val
    -325       .1     -281     .075     -186       .1     -7.5     .045      7.5       .1

Bank Sta: Left    Right     Coeff Contr.    Expan.
          -7.5      7.5               .3        .5
Ineffective Flow      num=        1
   Sta L    Sta R     Elev  Permanent
    -325    -45.5    924.3        F

Downstream  Deck/Roadway Coordinates
    num=        2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
     -50      924               71      924

Downstream Bridge Cross Section Data
Station Elevation Data     num=       13
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    -276      940     -255      930     -231      924     -123      924      -50      924
    -7.5   920.14       -5   918.77        0   917.39        5   918.35      7.5   920.49
      54      924       77      924       98      945

Manning's n Values          num=        5
     Sta    n Val      Sta    n Val      Sta    n Val      Sta    n Val      Sta    n Val
    -276       .1     -231     .075     -123       .1     -7.5     .045      7.5       .1

Bank Sta: Left    Right     Coeff Contr.    Expan.
          -7.5      7.5               .3        .5
Ineffective Flow      num=        2
   Sta L    Sta R     Elev  Permanent
    -276    -22.8      924        F
    22.8       98      924        F

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  2

Culvert Name      Shape       Rise     Span
Culvert #1       Circular        4
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 3 - Pipe projecting from fill
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 25      40     .022      .022        0                   .9                1
Upstream   Elevation =  917.95
           Centerline Station = -3
```

```
Downstream Elevation =  917.87
           Centerline Station = -3

Culvert Name      Shape      Rise    Span
Culvert #2       Circular       4
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 3 - Pipe projecting from fill
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 25      40     .022     .022        0                   .9                 1
Upstream   Elevation =  917.7
           Centerline Station =  3
Downstream Elevation =  916.93
           Centerline Station =  3

CULVERT OUTPUT  Profile #P100yr  Culv Group:  Culvert #1

  Q Culv Group (cfs)          50.44    Culv Full Len (ft)          40.00
  # Barrels                       1    Culv Vel US (ft/s)           4.01
  Q Barrel (cfs)              50.44    Culv Vel DS (ft/s)           4.01
  E.G. US. (ft)              925.56    Culv Inv El Up (ft)        917.95
  W.S. US. (ft)              925.52    Culv Inv El Dn (ft)        917.87
  E.G. DS (ft)               925.19    Culv Frctn Ls (ft)           0.15
  W.S. DS (ft)               924.55    Culv Exit Loss (ft)          0.00
  Delta EG (ft)                0.38    Culv Entr Loss (ft)          0.23
  Delta WS (ft)                0.97    Q Weir (cfs)              1089.90
  E.G. IC (ft)               921.32    Weir Sta Lft (ft)         -277.83
  E.G. OC (ft)               925.55    Weir Sta Rgt (ft)           21.16
  Culvert Control            Outlet    Weir Submerg                 0.20
  Culv WS Inlet (ft)         921.95    Weir Max Depth (ft)          1.27
  Culv WS Outlet (ft)        921.87    Weir Avg Depth (ft)          1.25
  Culv Nml Depth (ft)                  Weir Flow Area (sq ft)     373.64
  Culv Crt Depth (ft)          2.13    Min El Weir Flow (ft)      924.31


CULVERT OUTPUT  Profile #P100yr  Culv Group:  Culvert #2

  Q Culv Group (cfs)          51.67    Culv Full Len (ft)          40.00
  # Barrels                       1    Culv Vel US (ft/s)           4.11
  Q Barrel (cfs)              51.67    Culv Vel DS (ft/s)           4.11
  E.G. US. (ft)              925.56    Culv Inv El Up (ft)        917.70
  W.S. US. (ft)              925.52    Culv Inv El Dn (ft)        916.93
  E.G. DS (ft)               925.19    Culv Frctn Ls (ft)           0.14
  W.S. DS (ft)               924.55    Culv Exit Loss (ft)          0.00
  Delta EG (ft)                0.38    Culv Entr Loss (ft)          0.24
  Delta WS (ft)                0.97    Q Weir (cfs)              1089.90
  E.G. IC (ft)               921.09    Weir Sta Lft (ft)         -277.83
  E.G. OC (ft)               925.57    Weir Sta Rgt (ft)           21.16
  Culvert Control            Outlet    Weir Submerg                 0.20
  Culv WS Inlet (ft)         921.70    Weir Max Depth (ft)          1.27
  Culv WS Outlet (ft)        920.93    Weir Avg Depth (ft)          1.25
  Culv Nml Depth (ft)                  Weir Flow Area (sq ft)     373.64
  Culv Crt Depth (ft)          2.16    Min El Weir Flow (ft)      924.31


CROSS SECTION


RIVER: SFHGHSRVR
REACH: Main                RS: 46014.1

INPUT
Description:
Station Elevation Data    num=      13
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
    -276      940    -255      930    -231      924    -123      924     -50      924
    -7.5   920.14      -5   918.77       0   917.39       5   918.35     7.5   920.49
      54      924      77      924      98      945

Manning's n Values        num=       5
     Sta    n Val     Sta    n Val     Sta    n Val     Sta    n Val     Sta    n Val
    -276       .1    -231     .075    -123       .1    -7.5     .045     7.5       .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -7.5     7.5              175     170     156              .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
    -276   -22.8     924       F
    22.8      98     924       F

CROSS SECTION


RIVER: SFHGHSRVR
REACH: Main                RS: 45851.4

INPUT
Description:
```

Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-161	940	-139	930	-111	920	-6	917.09	-4.5	915.77
0	914.39	4.5	915.35	9.5	917.29	71	920	116	930

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-161	.1	-6	.045	9.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-6	9.5	138	191	121	.1	.3

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 45723.6

INPUT
Description:
Station Elevation Data num= 50

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	976.89	9.8	972.73	19.6	968.69	29.5	964.78	39.3	961
49.1	957.4	59	953.91	68.8	950.47	78.6	947	88.4	943.4
98.3	939.69	108.1	936	117.9	932.81	127.8	929.94	137.6	927.23
147.4	924.5	157.2	921.83	167	919.37	176.9	917.01	186.7	915.02
196.5	913.77	206.4	913.24	216.2	913.2	225	913.31	226	913.32
235.8	913.81	240	914.03	245.7	914.32	255.5	914.73	265.3	915.1
275.2	915.64	285	916.34	294.8	917.3	304.6	918.32	314.4	919.32
324.3	920.23	333.9	920.81	343.6	921.37	353.2	921.91	362.8	922.58
372.5	923.68	382.1	925.3	391.8	927.16	401.4	929.04	411.1	930.85
420.7	932.63	430.3	934.4	440	936.19	449.6	938.04	459.3	940.19

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	186.7	.045	240	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
186.7	240	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:SFHGHSRVR

Reach	River Sta.	n1	n2	n3	n4	n5
Main	46468	.1	.075	.1	.045	.1
Main	46405.6	.1	.075	.1	.045	.1
Main	46324.2	.1	.075	.1	.045	.1
Main	46087.4	.1	.075	.1	.045	.1
Main	46080	Culvert				
Main	46014.1	.1	.075	.1	.045	.1
Main	45851.4	.1	.045	.1		
Main	45723.6	.1	.045	.1		

SUMMARY OF REACH LENGTHS

River: SFHGHSRVR

Reach	River Sta.	Left	Channel	Right
Main	46468	50	62.4	53
Main	46405.6	72	74	79
Main	46324.2	191	245	236
Main	46087.4	68	73.3	68.7
Main	46080	Culvert		
Main	46014.1	175	170	156
Main	45851.4	138	191	121
Main	45723.6	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: SFHGHSRVR

Reach	River Sta.	Contr.	Expan.
Main	46468	.1	.3
Main	46405.6	.1	.3
Main	46324.2	.1	.3
Main	46087.4	.3	.5

Main	46080	Culvert		
Main	46014.1		.3	.5
Main	45851.4		.1	.3
Main	45723.6		.1	.3

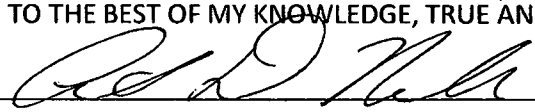
ATTACHMENT 2

DODDRIDGE COUNTY FLOODPLAIN DEVELOPMENT PERMIT APPLICATION

DODDRIDGE COUNTY
FLOODPLAIN DEVELOPMENT PERMIT APPLICATION

SECTION 1: GENERAL PROVISIONS (APPLICANT TO READ AND SIGN)

1. No work may start until a permit is issued.
2. The permit may be revoked if any false statements are made herein.
3. If revoked, all work must cease until permit is re-issued.
4. Development shall not be used or occupied until a Certificate of Compliance is issued.
5. The permit will expire if no work is commenced within six months of issuance.
6. Applicant is hereby informed that other permits may be required to fulfill local, state, and federal requirements.
7. Applicant hereby gives consent to the Floodplain Administrator/Manager or his/her representative to make inspections to verify compliance.
8. I THE APPLICANT CERTIFY THAT ALL STATEMENTS HEREIN AND IN ATTACHMENTS TO THIS APPLICATION ARE, TO THE BEST OF MY KNOWLEDGE, TRUE AND ACCURATE.

APPLICANT'S SIGNATURE 

DATE 5-20-15

SECTION 2: PROPOSED DEVELOPMENT (TO BE COMPLETED BY APPLICANT).

IF THE APPLICANT IS NOT A NATURAL PERSON, THE NAME, ADDRESS, AND TELEPHONE NUMBER OF A NATURAL PERSON WHO SHALL BE APPOINTED BY THE APPLICANT TO RECEIVE NOTICE PURSUANT TO ANY PROVISION OF THE CURRENT DODDRIDGE COUNTY FLOODPLAIN ORDINANCE.

APPLICANT'S NAME: Dominion Transmission, Inc.
ADDRESS: 5000 Dominion Boulevard, Glen Allen, VA 23060
TELEPHONE NUMBER: (804) 273-3737

CONTRACTOR NAME: LR Builds, Inc. – Sheldon E. Raber, VP
ADDRESS: One Railroad Street, Shinnston, WV 26431
TELEPHONE # (304) 592-2083
WV CONTRACTOR LICENCE # WV000081

ENGINEER'S NAME: Derek Ingle
ADDRESS: 335 US Highway 33W, Weston, WV 26452
TELEHONE NUMBER: (304) 269-6990

PROJECT LOCATION: GPS Coordinates: 39.1797950367, -80.7624598038
PHYSICAL ADDRESS: South Fork of Hughes River Road (CR 40) in West Union, West Virginia, 26456
NAME OF SURFACE OWNER/OWNERS (IF NOT THE APPLICANT): Dominion Transmission, Inc.
ADDRESS OF SURFACE OWNER/OWNERS (IF NOT THE APPLICANT):
445 West Main St, Clarksburg, WV 26301

DISTRICT: Southwest District
LAND BOOK DESCRIPTION: 5.4 acres & 0.89 acres
DEED BOOK REFERENCE: 5.4 acres – 83/272; 0.89 acres – 162/325

TAX MAP REFERENCE: Doddridge County – Southwest District – Map 10; Parcel Number Not Available
EXISTING BUILDINGS/USES OF PROPERTY: Existing DTI Compressor Station (Maxwell Station); One compressor building and associated above-ground facilities on-site
NAME OF AT LEAST ONE ADULT RESIDING IN EACH RESIDENCE LOCATED UPON THE SUBJECT PROPERTY N/A
ADDRESS OF AT LEAST ONE ADULT RESIDING IN EACH RESIDENCE LOCATED UPON THE SUBJECT PROPERTY N/A

To avoid delay in processing the application, please provide enough information to easily identify the project location.

DESCRIPTION OF WORK (CHECK ALL APPLICABLE BOXES)

A. STRUCTURAL DEVELOPMENT

ACTIVITY		STRUCTURAL TYPE	
[X]	***New Structure***	[]	Residential (1 – 4 Family)
[]	Addition	[]	Residential (more than 4 Family)
[]	Alteration	[]	Non-residential (floodproofing)
[]	Relocation	[]	Combined Use (res. & com.)
[]	Demolition	[]	Replacement
[]	Manufactured/Mobil Home	[X]	***Industrial (Compressor Station Building)***

B. OTHER DEVELOPMENT ACTIVITIES:

[] Fill [] Mining [] Drilling [] Pipelining

[X] ***Grading***
[] Excavation (except for STRUCTURAL DEVELOPMENT checked above)
[] Watercourse Alteration (including dredging and channel modification)
[] Drainage Improvements (including culvert work)
[] Road, Street, or Bridge Construction
[] Subdivision (including new expansion)
[] Individual Water or Sewer System
[] Other (please specify)

C. STANDARD SITE PLAN OR SKETCH

1. SUBMIT ALL STANDARD SITE PLANS, IF ANY HAVE BEEN PREPARED (ENGINEERING PLANS MUST BE SIGNED AND SEALED).
2. IF STANDARD SITE PLANS HAVE NOT BEEN PREPARED:
   SKETCH ON A SEPARATE 8 ½ X 11 INCH SHEET OF PAPER THE SHAPE AND LOCATION OF THE LOT. SHOW THE LOCATION OF THE INTENDED CONSTRUCTION OR LAND USE INDICATING BUILDING SETBACKS, SIZE & HEIGHT. IDENTIFY EXISTING BUILDINGS, STRUCTURES OR LAND USES ON THE PROPERTY.
3. SIGN AND DATE THE SKETCH.

ACTUAL TOTAL CONSTRUCTION COSTS OF THE COMPLETE DEVELOPMENT/ PROPOSED CONSTRUCTION PROJECT WITHIN THE FLOODPLAIN $ 245,055.00

D. ADJACENT AND/OR AFFECTED LANDOWNERS:

1. NAME AND ADDRESS OF ALL OWNERS OF SURFACE TRACTS ADJACENT TO THE AREA OF THE SURFACE TRACT (UP & DOWN STREAM) UPON WHICH THE PROPOSED ACTIVITY WILL OCCUR AND ALL OTHER SURFACE OWNERS UP & DOWN STREAM) WHO OWN PROPERTY THAT MAY BE AFFECTED BY FLOODING AS IS DEMONSTRATED BY A FLOODPLAIN STUDY OR SURVEY (IF ONE HAS BEEN COMPLETED).

NAME: I.L (Ike) Morris **ADDRESS:** P.O. Box 397, Glenville, WV 26351

2. NAME AND ADDRESS OF AT LEAST ONE ADULT RESIDING IN EACH RESIDENCE LOCATED UPON ANY ADJACENT PROPERTY AT THE TIME THE FLOODPLAIN PERMIT APPLICATION IS FILED AND THE NAME AND ADDRESS OF AT LEAST ONE ADULT RESIDING IN ANY HOME ON ANY PROPERTY THAT MAY BE AFFECTED BY FLOODING AS IS DEMONSTRATED BY A FLOODPLAIN STUDY OR SURVEY.

NAME: Same as Above NAME:_____
ADDRESS:_____ ADDRESS:_____
_____ _____

E. CONFIRMATION FORM

THE APPLICANT ACKNOWLEDGES, AGREES, AND CONFIRMS THAT HE/IT WILL PAY WITHIN 30 DAYS OF RECEIPT OF INVOICE BY THE COUNTY FOR ALL EXPENSES RELATIVE TO THE PERMIT APPLICATION PROCESS GREATER THAN THE REQUIRED DEPOSIT FOR EXPENSES INCLUDING:

(A) PERSONAL SERVICE OF PROCESS BY THE DODDRIDGE COUNTY SHERIFF AT THE RATES PERMITTED BY LAW FOR SUCH SERVICE.
(B) SERVICE BY CERTIFIED MAIL RETURN RECEIPT REQUESTED.
(C) PUBLICATION.
(D) COURT REPORTING SERVICES AT ANY HEARINGS REQUESTED BY THE APPLICANT.
(E) CONSULTANTS AND/OR HEARING EXPERTS UTILIZED BY DODDRIDGE COUNTY FLOODPLAIN ADMINISTRATOR/MANAGER OR FLOODPLAIN APPEALS BOARD FOR REVIEW OF MATERIALS AND/OR TESTIMONY REGARDING THE EFFICACY OF GRANTING OR DENYING THE APPLICANT'S FLOODPLAIN PERMIT.

NAME (PRINT):_____

SIGNATURE:_____ DATE:_____

After completing SECTION 2, APPLICANT should submit form and fees to Clerk of Doddridge County Court or his/her representative for review.

SECTION 3: FLOODPLAIN DETERMINATION (to be completed by Floodplain Administrator/Manager or his/her representative)

THE PROPOSED DEVELOPMENT:

THE PROPOSED DEVELOPMENT IS LOCATED ON:
FIRM Panel:_____
Dated:_____
_____

[] Is NOT located in a Specific Flood Hazard Area (Notify applicant that the application review is complete and NO FLOOPLAIN DEVELOPMENT PERMIT IS REQUIRED).

[] Is located in Special Flood Hazard Area.
FIRM zone designation_____
100-Year flood elevation is _____NGVD .
Stream name _____.
Profile # _____.

[] Unavailable

[] The proposed development is located in a floodway.

[] See section 4 for additional instructions.

SIGNED_____ DATE_____

SECTION 4: ADDITIONAL INFORMATION REQUIRED FOR DEVELOPMENT IN SPECIAL FLOOD HAZARD AREA (To be completed by Floodplain Administrator/Manager or his/her representative)

The applicant must submit the documents checked below before the application can be processed.

[] A plan showing the location of all existing structures, water bodies, adjacent roads and proposed development.

[] Development plans, drawn to scale, and specifications, including where applicable: details for anchoring structures, storage tanks, proposed elevation of lowest floor, (including basement or crawl space), types of water resistant materials used below the first floor, details of flood proofing of utilities located below the first floor and details of enclosures below the first floor. Also_____
_____

[] Subdivision or other development plans (If the subdivision or development exceeds 10 lots or 2 acres, whichever is the lesser, the applicant must provide 100-year flood elevations if they are not otherwise available).

[] Plans showing the extent of watercourse relocation and/or landform alterations.

[] Top of new fill elevation _____Ft. NGVD.
For floodproofing structures applicant must attach certification from registered engineer or architect.

[] Certification from a registered engineer that the proposed activity in a regulatory floodway will not result in any increase in the height of the 100-year flood. A copy of all data and calculations supporting this finding must also be submitted.

[] Manufactured homes located in a Flood Hazard Area must have a West Virginia Contractor's License and a Manufactured Home Installation License as required by the Federal Emergency Management Agency (FEMA).

[] Other:_____

SECTION 5: PERMIT DETERMINATION (To be completed by Floodplain Administrator/Manager or his/her representative)

I have determined that the proposed activity (type is or is not) in conformance with provisions of the Floodplain Ordinance adopted by the County Commission of Doddridge County on May 21, 2013. The permit is issued subject to the conditions attached to and made part of this permit.

SIGNED_____DATE_____

If the Floodplain Administrator/Manager found that the above was not in conformance with the provisions of the Doddridge County Floodplain Ordinance and/or denied that application, the applicant may appeal.

APPEALS: Appealed to the County Commission of Doddridge County? [] Yes {} No
Hearing Date:_____
County Commission Decision - Approved [] Yes [] No

CONDITIONS:_____
_____
_____

SECTION 6: AS-BUILT ELEVATIONS (To be submitted by APPLICANT before Certificate of Compliance is issued). ***As-Build Elevations will be provided after the building has been constructed.***

The following information must be provided for project structures. This section must be completed by a registered professional engineer or a licensed land surveyor (or attach a certification to this application).

COMPLETE 1 OR 2 BELOW:

1 Actual (As-Built) Elevation of the top of the lowest floor (including basement or crawl space is _____FT. NGVD.

2 Actual (As Built) elevation of floodproofing is _____FT. NGVD.
Note: Any work performed prior to submittal of the above information is at risk of the applicant.

SECTION 7: COMPLIANCE ACTION (To be completed by the Floodplain Administrator/Manager or his/her representative).

The Floodplain Administrator/Manager or his/her representative will complete this section as applicable based on inspection of the project to ensure compliance with the Doddridge County Floodplain Ordinance.

INSPECTIONS:

DATE:_____ BY:_____

DEFICIENCIES? Y/N

COMMENTS_____

_____

_____

_____

SECTION 8: CERTIFICATE OF COMPLIANCE (To be completed by Floodplain Administrator/Manager or his/her representative).

Certificate of Compliance issued: DATE:_____ BY:_____

CERTIFICATE OF COMPLIANCE
FOR DEVELOPMENT IN SPECIAL FLOOD HAZARD AREA (OWNER MUST RETAIN)

PERMIT NUMBER:_____
PERMIT DATE:_____

PURPOSE –

CONSTRUCTION LOCATION:_____

OWNER'S ADDRESS:_____

_____

_____

THE FOLLOWING MUST BE COMPLETED BY THE FLOODPLAIN ADMINISTRATOR/MANAGER OR HIS/HER AGENT.

COMPLIANCE IS HEREBY CERTIFIED WITH THE REQUIREMENT OF THE FLOODPLAIN ORDINANCE ADOPTED BY THE COUNTY COMMISSION OF DODDRIDGE COUNTY ON MAY 21, 2013.

SIGNED_____DATE_____

18125

Environment & Archaeology, LLC
221 Main Street
Florence, KY 41042
(859) 746-1778

CHASE
JPMorgan Chase Bank, N.A.
www.Chase.com
25-3-440

5/13/2015

PAY TO THE ORDER OF Doddridge County Commission

$ **1,730.00

One Thousand Seven Hundred Thirty and 00/100********** DOLLARS

Doddridge County Commission

MEMO

AUTHORIZED SIGNATURE

⑈018125⑈ ⑆044000037⑆ 617990304⑈

Environment & Archaeology, LLC

18125

Doddridge County Commission

5/13/2015

Date	Type	Reference	Original Amt.	Balance Due	Discount	Payment
5/13/2015	Bill		1,730.00	1,730.00		1,730.00
					Check Amount	1,730.00

ENCLOSURE 2

PROJECT MAPPING

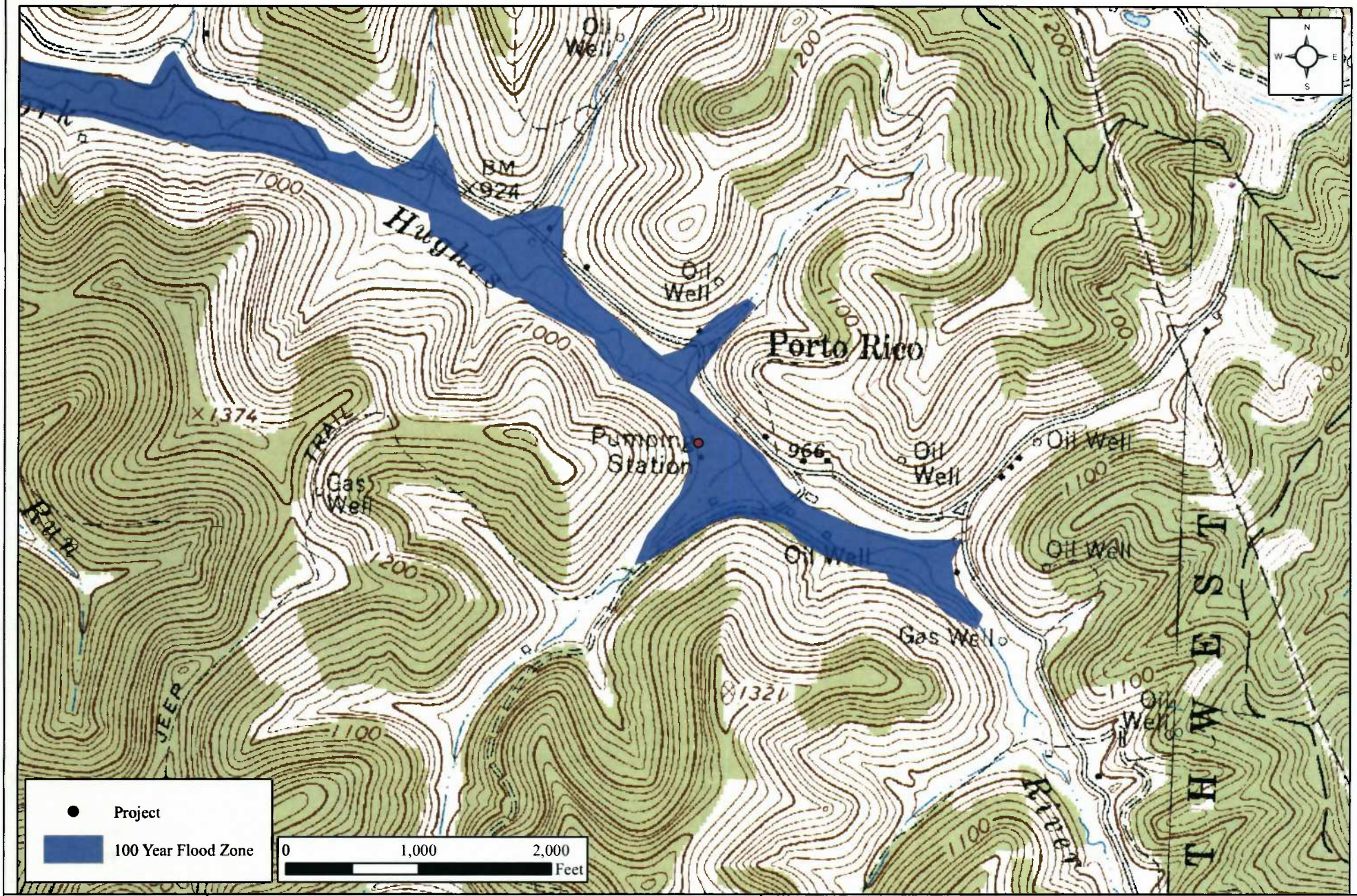


Figure 1

Dominion Transmission, Inc.
Maxwell Station Project
Doddridge County, West Virginia

USGS 7.5 Topographic Map with FEMA Overlay
Oxford, WV Quadrangle
1:12,000

Environment & Archaeology LLC

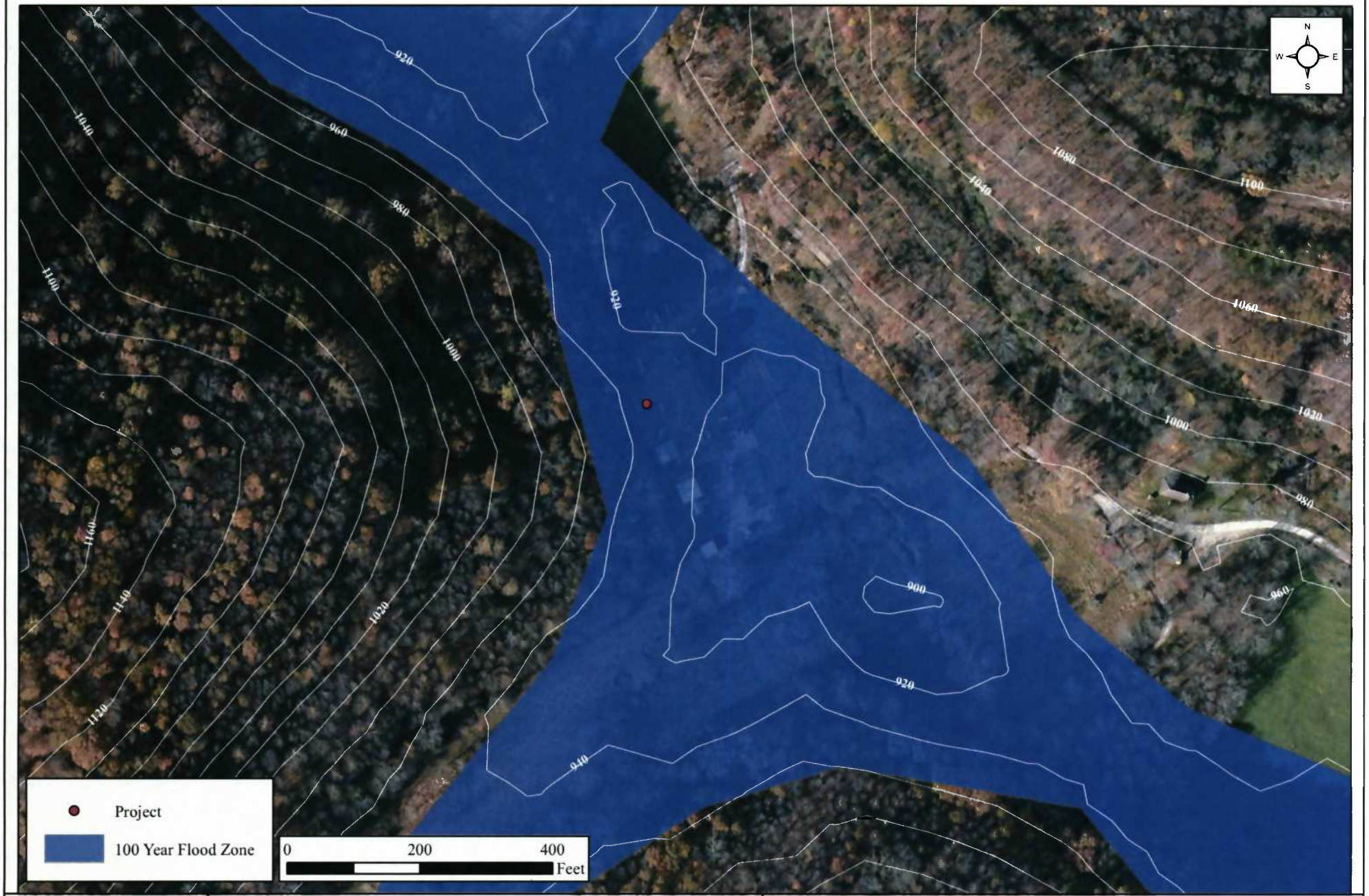


Figure 2

Dominion Transmission, Inc.
Maxwell Station Project
Doddridge County, West Virginia

Aerial Map
Aerial Provided by ESRI Map Services
1:2,400
Environment & Archaeology LLC

ENCLOSURE 3

SITE PHOTOGRAPHS

Photo: 1 Date: 4-28-2015 Comments: View of the existing gravel access drive and lot associated with the Maxwell Compressor Station, facing south.

Photo: 2 Date: 4-28-2015 Comments: View of proposed workspace associated with the new building installation, facing WSW.

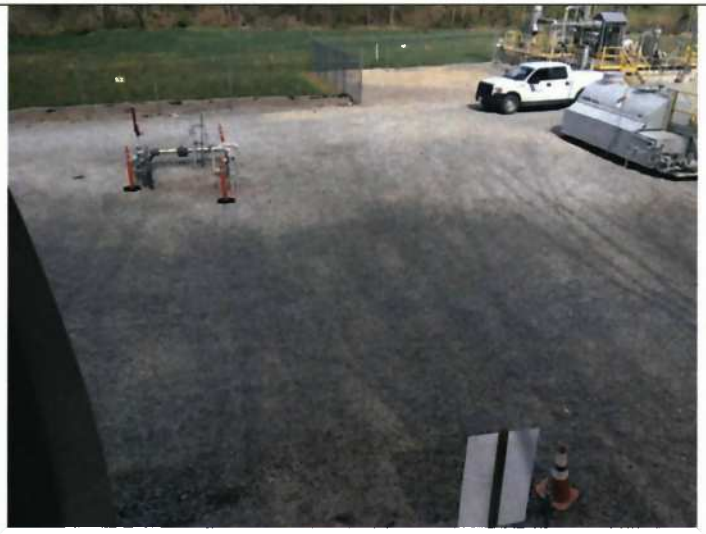


Photo: 3 Date: 4-28-2015 Comments: Overview of location of new compressor building, approximately 40 feet in front of the existing building, facing ENE.

Photo: 4 Date: 4-28-2015 Comments: View of existing compressor building, and location of proposed new building, facing east.

ATTACHMENT B

HYDRAULIC CALCULATIONS

© 2018 GAI Consultants, Inc.

Subject: Dominion–Maxwell Compressor Station – New Office Building
Hydraulic Calculations for Floodplain Development Application

By: BerkeME Date: 09/13/2018 Project #: C180957.00.002

Chkd By: JonesAR Date: 09/19/2018 Sheet #: _____ of _____

gai consultants

OBJECTIVE:

Create the existing and proposed conditions hydraulic models in HEC-RAS for South Fork Hughes River upstream and downstream of the project area.

REFERENCES:

1. HEC-RAS Version 5.0.4, U.S. Army Corps of Engineers, April 2018.
2. H&H Analysis for 2015 Maxwell Compressor Station – New Building, GAI Consultants, Inc., July 2015.

HYDROLOGIC CONDITIONS:

As with the previous analysis (Reference 2), the TR-55 100-year peak discharge of 1,192 cfs was adopted for the modeling.

METHOD AND EXISTING CONDITIONS MODEL:

The proposed conditions hydraulic model used in the previous analysis for the Project Site (described in Reference 2) was modified to create the existing conditions model for the current project. The following changes were made to the previous proposed conditions model to create the current existing conditions model:

- A new cross section (46467) was added to the existing conditions model to bound the new office building;
- Cross section 46468 was moved approximately 6 feet upstream to be outside of the new office building's footprint; and
- The obstruction previously coded in Cross Section 46468 was moved to cross section 46467 to show that there are currently no structures in the location proposed for development.

BOUNDARY CONDITIONS:

As with the previous modeling, the slope of the 100-year water surface elevation at the downstream cross sections (approximately 0.02 ft/ft) was used for the downstream boundary condition.

PROPOSED CONDITIONS:

There are currently no structures at the location proposed for construction of the new office building; however, the area lies between two larger existing buildings (See Figure 1 – Cross Section Location Map). An obstruction was added to cross section 46468 to represent the proposed building construction. The Proposed Conditions hydraulic model is identical to the Existing Conditions model in all other locations.

RESULTS:

The results of the existing and proposed conditions HEC-RAS Hydraulic models are included in this calculation. The proposed structure shows no increase in 100-year water surface elevations or velocity over existing conditions. Information provided includes the summary table, profile of South Fork Hughes River within the studied reach, and the cross section plots for the entire model.

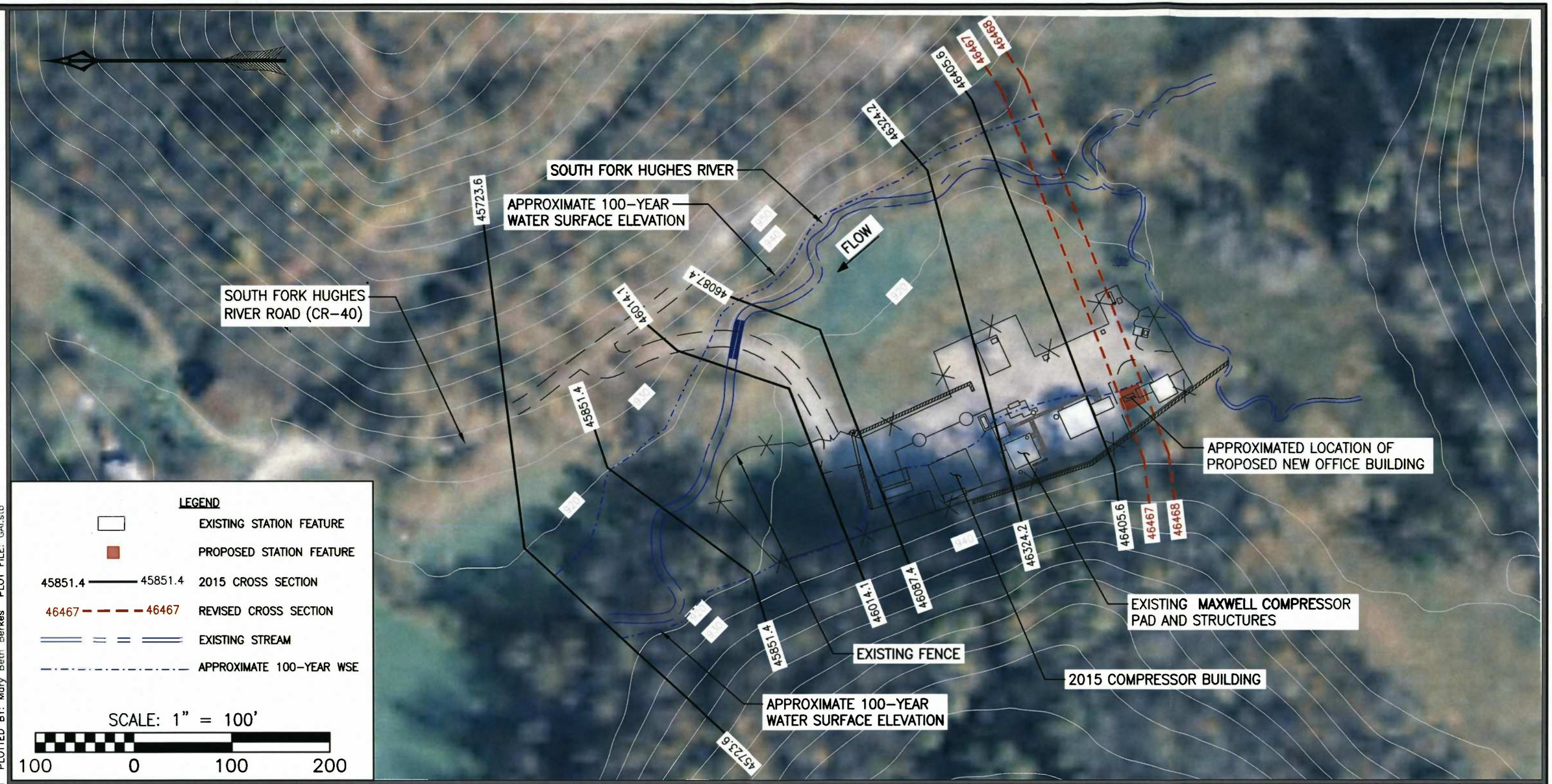
Subject: Dominion–Maxwell Compressor Station – New Office Building
Hydraulic Calculations for Floodplain Development Application

By: BerkeME Date: 09/13/2018 Project #: C180957.00.002

Chkd By: JonesAR Date: 09/19/2018 Sheet #: _____ of _____

gai consultants

CROSS SECTION LOCATION MAP



NO.:	DATE:	DWN:	CHK:	APV:	DESCRIPTION:

REVISION RECORD

DRAWING TITLE

FIGURE 1 - CROSS SECTION LOCATION MAP

PROJECT

MAXWELL COMPRESSOR STATION PROJECT
PROPOSED NEW OFFICE BUILDING
DODDRIDGE COUNTY, WV

gai consultants

CLIENT

DOMINION TRANSMISSION, INC.
5000 DOMINION BOULEVARD
GLEN ALLEN, VA 23060

DRAWN BY:	CHECKED BY:	APPROVED BY:
BERKEME	JONESAR	BERKEME
REVISION	SCALE:	ISSUE DATE:
	AS SHOWN	09/14/2018
	SHEET NO.:	
	001 OF 001	

GAI FILE NUMBER:
Cross Section Location Map
GAI DRAWING NUMBER:
C141803-36-000-00-A2-001

This drawing was produced with computer aided drafting technology and is supported by electronic drawing files. Do not revise this drawing via manual drafting methods.

ISSUING OFFICE: Pittsburgh | 385 E. Waterfront Drive, Homestead, PA 15120

GAI CAD FILE PATH: Z:\Energy\2018\C180957.00 – DOM-Maxwell CS Flood\CAD\Worksheets\Cross Section Location Map.dwg

PLOTTED ON: 9/20/2018 2:09:53 PM PLOTTED BY: Mary Beth Berkes PLOT FILE: GAI.stb

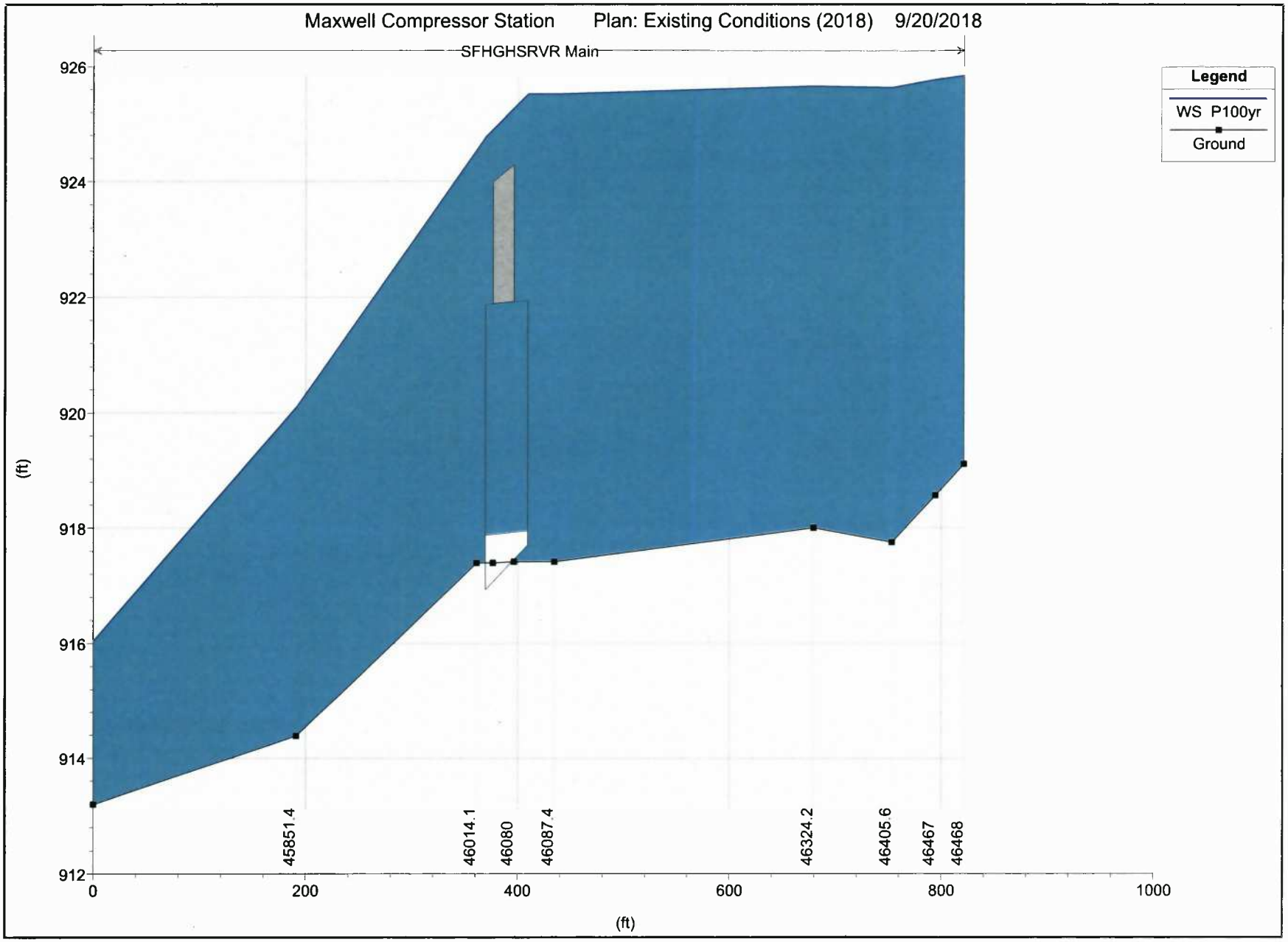
Subject: Dominion–Maxwell Compressor Station – New Office Building
Hydraulic Calculations for Floodplain Development Application

By: BerkeME Date: 09/13/2018 Project #: C180957.00.002

Chkd By: JonesAR Date: 09/19/2018 Sheet #: _____ of _____

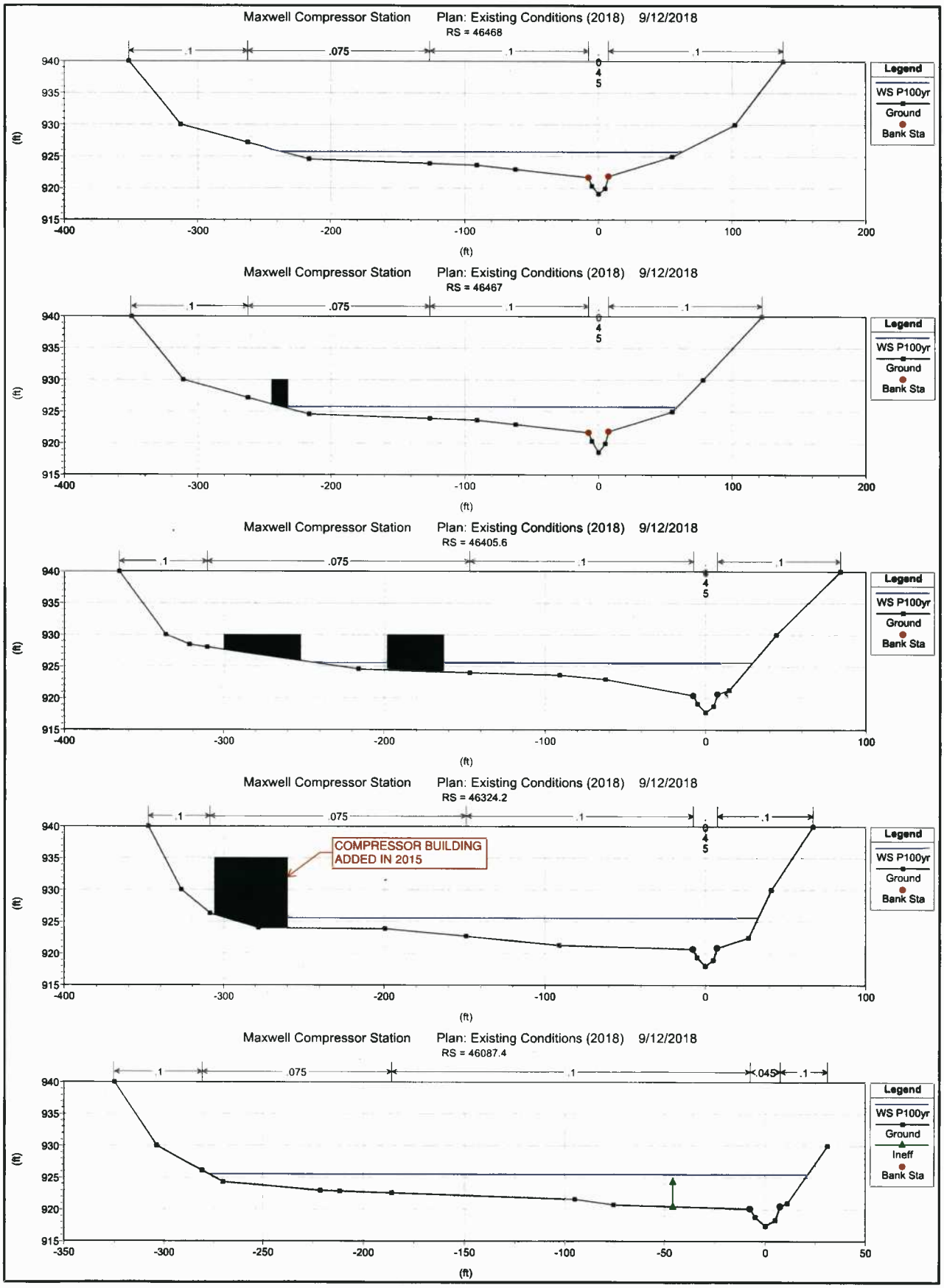
gai consultants

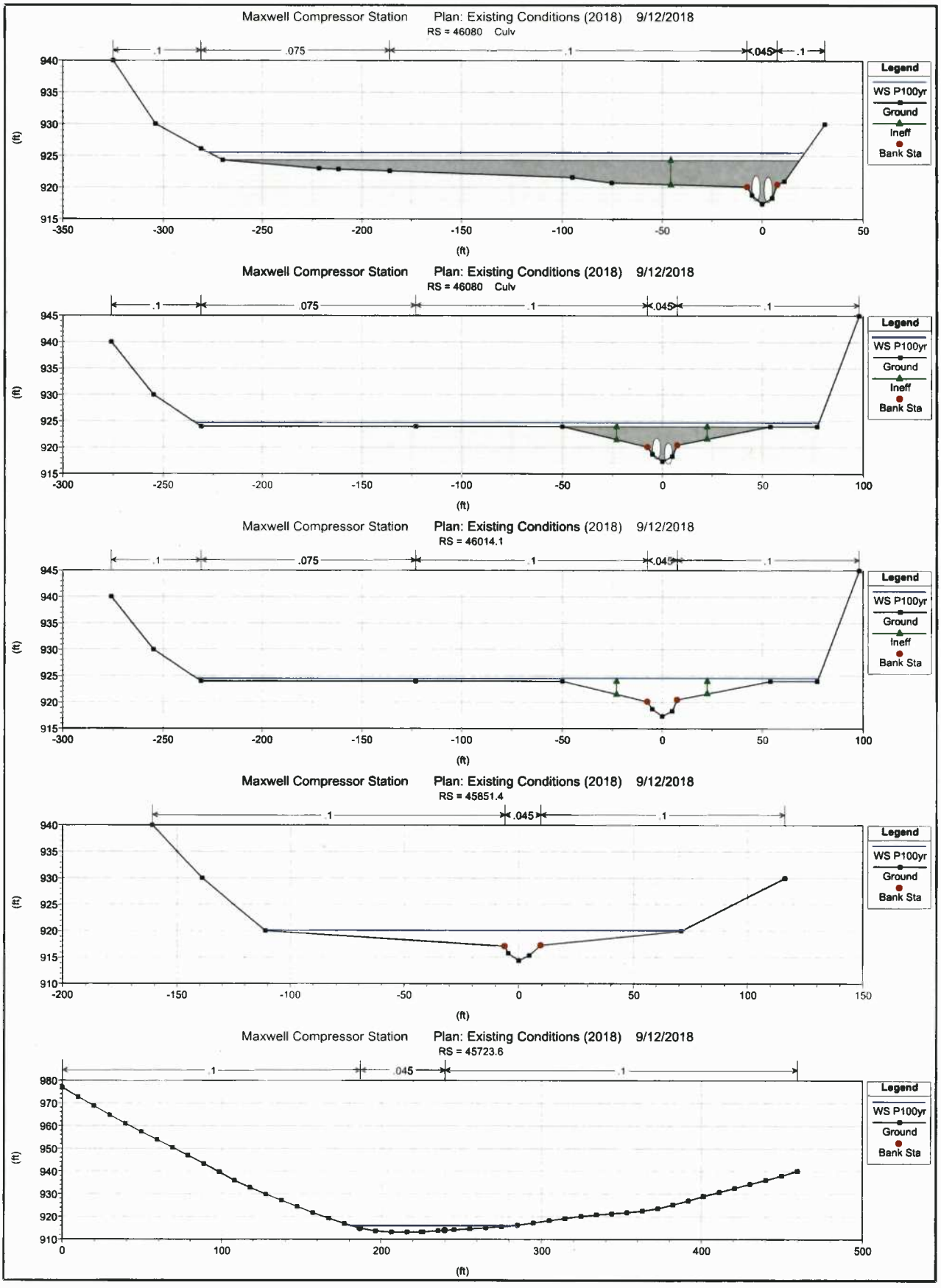
EXISTING CONDITIONS


Maxwell Compressor Station Plan: Existing Conditions (2018) 9/20/2018
SFHGHSRVR Main
Legend
WS P100yr
Ground
926
924
922
920
918
916
914
912
(ft)
0
200
400
600
800
1000
(ft)
45851.4
46014.1
46080
46087.4
46324.2
46405.6
46467
46468

HEC-RAS Plan: Existing (2018) River: SFHGHSRVR Reach: Main Profile: P100yr

Reach	River Sta	Profile	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	Shear Chan
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)
Main	46468	P100yr	1192.00	919.11	925.84		925.97	0.002197	4.72	696.19	300.86	0.35	0.73
Main	46467	P100yr	1192.00	918.57	925.77		925.91	0.002292	4.82	675.39	290.52	0.35	0.76
Main	46405.6	P100yr	1192.00	917.75	925.63		925.83	0.002139	5.20	609.31	239.21	0.35	0.84
Main	46324.2	P100yr	1192.00	918.00	925.65		925.70	0.000726	2.97	1011.50	292.82	0.20	0.28
Main	46087.4	P100yr	1192.00	917.41	925.52	922.96	925.56	0.000620	2.84	1078.35	298.53	0.19	0.25
Main	46080		Culvert										
Main	46014.1	P100yr	1192.00	917.39	924.55	924.55	925.19	0.006086	8.08	415.61	310.73	0.58	2.11
Main	45851.4	P100yr	1192.00	914.39	920.10	920.10	920.88	0.011717	9.35	322.63	182.70	0.77	3.09
Main	45723.8	P100yr	1192.00	913.20	916.04	916.03	917.06	0.020027	8.43	176.27	99.16	0.95	3.03


Maxwell Compressor Station Plan: Existing Conditions (2018) 9/12/2018
RS = 46468
.1
.075
.1
.1
0
4
5
940
935
930
925
920
915
(ft)
-400
-300
-200
-100
0
100
200
(ft)
Legend
WS P100yr
Ground
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions (2018) 9/12/2018
RS = 46467
.1
.075
.1
.1
0
4
5
940
935
930
925
920
915
(ft)
-400
-300
-200
-100
0
100
200
(ft)
Legend
WS P100yr
Ground
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions (2018) 9/12/2018
RS = 46405.6
.1
.075
.1
.1
4
5
940
935
930
925
920
915
(ft)
-400
-300
-200
-100
0
100
(ft)
Legend
WS P100yr
Ground
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions (2018) 9/12/2018
RS = 46324.2
.1
.075
.1
.1
0
4
5
COMPRESSOR BUILDING
ADDED IN 2015
940
935
930
925
920
915
(ft)
-400
-300
-200
-100
0
100
(ft)
Legend
WS P100yr
Ground
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions (2018) 9/12/2018
RS = 46087.4
.1
.075
.1
.045
.1
940
935
930
925
920
915
(ft)
-350
-300
-250
-200
-150
-100
-50
0
50
(ft)
Legend
WS P100yr
Ground
Ineff
Bank Sta


Maxwell Compressor Station Plan: Existing Conditions (2018) 9/12/2018
RS = 46080 Culv
.1
.075
.1
.045
.1
940
935
930
925
920
915
(ft)
-350
-300
-250
-200
-150
-100
-50
0
50
(ft)
Legend
WS P100yr
Ground
Ineff
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions (2018) 9/12/2018
RS = 46080 Culv
.1
.075
.1
.045
.1
945
940
935
930
925
920
915
(ft)
-300
-250
-200
-150
-100
-50
0
50
100
(ft)
Legend
WS P100yr
Ground
Ineff
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions (2018) 9/12/2018
RS = 46014.1
.1
.075
.1
.045
.1
945
940
935
930
925
920
915
(ft)
-300
-250
-200
-150
-100
-50
0
50
100
(ft)
Legend
WS P100yr
Ground
Ineff
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions (2018) 9/12/2018
RS = 45851.4
.1
.045
.1
940
935
930
925
920
915
910
(ft)
-200
-150
-100
-50
0
50
100
150
(ft)
Legend
WS P100yr
Ground
Bank Sta
Maxwell Compressor Station Plan: Existing Conditions (2018) 9/12/2018
RS = 45723.6
.1
.045
.1
980
970
960
950
940
930
920
910
(ft)
0
100
200
300
400
500
(ft)
Legend
WS P100yr
Ground
Bank Sta

MaxwellCS.rep

HEC-RAS HEC-RAS 5.0.4 April 2018
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X     X
X     X  X        X           X   X     X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X      X    X        X
X     X  X        X    X      X   X     X    X        X
X     X  XXXXXX    XXXX       X    X    X    X   XXXXX
```

PROJECT DATA
Project Title: Maxwell Compressor Station
Project File : MaxwellCS.prj
Run Date and Time: 9/20/2018 11:02:26 AM

Project in English units

PLAN DATA

Plan Title: Existing Conditions (2018)
Plan File : z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\Working Docs\H&H\HEC-RAS\MaxwellCS.p03

Geometry Title: Existing Conditions (2018)
Geometry File : z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\Working Docs\H&H\HEC-RAS\MaxwellCS.g04

Flow Title : TR-55 Flows
Flow File : z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\Working Docs\H&H\HEC-RAS\MaxwellCS.f02

Plan Summary Information:

Number of:	Cross Sections	= 8	Multiple Openings	=	0
	Culverts	= 1	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: TR-55 Flows
Flow File : z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\Working Docs\H&H\HEC-RAS\MaxwellCS.f02

Flow Data (cfs)

River	Reach	RS	P100yr
SFHGHSRVR	Main	46468	1192

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
SFHGHSRVR	Main	P100yr		Normal S = 0.02

GEOMETRY DATA

Geometry Title: Existing Conditions (2018)
Geometry File : z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\Working Docs\H&H\HEC-RAS\MaxwellCS.g04

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46468

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-352	940	-313	930	-262	927.2	-216	924.59	-126	923.9
-91	923.65	-62.2	922.98	-7.5	921.7	-5	920.37	0	919.11
5	919.96	7.5	921.9	55	925	102	930	138	940

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-352	.1	-262	.075	-126	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	26	27	26	.1	.3

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46467

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-350	940	-311	930	-262	927.2	-216	924.59	-126	923.9
-91	923.65	-62.2	922.98	-7.5	921.7	-5	920.37	0	918.57
5	919.96	7.5	921.9	55	925	78	930	122	940

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-350	.1	-262	.075	-126	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	31	41	31	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
-244	-232	930

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46405.6

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-366	940	-337	930	-321.8	928.4	-311	928	-216	924.59
-147	924	-91	923.65	-62.2	922.98	-7.5	920.45	-5	919.13
0	917.75	5	918.71	7.5	920.65	14.7	921.25	44	930
84	940								

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-366	.1	-311	.075	-147	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	72	74	79	.1	.3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-300	-252	930	-198	-163	930

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46324.2

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-348	940	-327	930	-309	926.3	-278.1	924.03	-199.4	923.85
-149	922.7	-91.2	921.28	-7.5	920.7	-5	919.38	0	918
5	918.96	7.5	920.9	26.9	922.5	41	930	67	940

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-348	.1	-309	.075	-149	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	191	245	236	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
-306	-260	935

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46087.4

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-325	940	-304	930	-281	926.1	-270.2	924.3	-221.5	922.98
-211.8	922.87	-186	922.6	-95	921.6	-75.5	920.72	-7.5	920.16
-5	918.79	0	917.41	5	918.37	7.5	920.51	11	921
31	930								

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-325	.1	-281	.075	-186	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	68	73.3	68.7	.3	.5

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
-325	-45.5	924.3	F

CULVERT

RIVER: SFHGHSRVR
REACH: Main RS: 46080

INPUT
Description:
Distance from Upstream XS = 38
Deck/Roadway Width = 20
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 2

Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord
-270.2	924.3	100	924.3

Upstream Bridge Cross Section Data
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-325	940	-304	930	-281	926.1	-270.2	924.3	-221.5	922.98
-211.8	922.87	-186	922.6	-95	921.6	-75.5	920.72	-7.5	920.16
-5	918.79	0	917.41	5	918.37	7.5	920.51	11	921
31	930								

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-325	.1	-281	.075	-186	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Coeff Contr.	Expan.
-7.5	7.5	.3	.5

Ineffective Flow num= 1

```
   Sta L   Sta R    Elev  Permanent
    -325   -45.5   924.3       F

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
     -50     924              71     924

Downstream Bridge Cross Section Data
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -276     940    -255     930    -231     924    -123     924     -50     924
    -7.5  920.14      -5  918.77       0  917.39       5  918.35     7.5  920.49
      54     924      77     924      98     945

Manning's n Values        num=       5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
    -276      .1    -231    .075    -123      .1    -7.5    .045     7.5      .1

Bank Sta: Left   Right    Coeff Contr.   Expan.
          -7.5     7.5             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
    -276   -22.8     924       F
    22.8      98     924       F

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  2

Culvert Name     Shape      Rise    Span
Culvert #1      Circular       4
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 3 - Pipe projecting from fill
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                25      40     .022      .022        0                  .9                1
Upstream   Elevation =  917.95
           Centerline Station = -3
Downstream Elevation =  917.87
           Centerline Station = -3

Culvert Name     Shape      Rise    Span
Culvert #2      Circular       4
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 3 - Pipe projecting from fill
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                25      40     .022      .022        0                  .9                1
Upstream   Elevation =  917.7
           Centerline Station =  3
Downstream Elevation =  916.93
           Centerline Station =  3

CROSS SECTION


RIVER: SFHGHSRVR
REACH: Main               RS: 46014.1

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -276     940    -255     930    -231     924    -123     924     -50     924
    -7.5  920.14      -5  918.77       0  917.39       5  918.35     7.5  920.49
      54     924      77     924      98     945

Manning's n Values        num=       5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
    -276      .1    -231    .075    -123      .1    -7.5    .045     7.5      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
```

-7.5	7.5		175	170	156	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-276	-22.8	924	F
22.8	98	924	F

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 45851.4

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-161	940	-139	930	-111	920	-6	917.09	-4.5	915.77
0	914.39	4.5	915.35	9.5	917.29	71	920	116	930

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-161	.1	-6	.045	9.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-6	9.5	138	191	121	.1	.3

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 45723.6

INPUT
Description:
Station Elevation Data num= 50

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	976.89	9.8	972.73	19.6	968.69	29.5	964.78	39.3	961
49.1	957.4	59	953.91	68.8	950.47	78.6	947	88.4	943.4
98.3	939.69	108.1	936	117.9	932.81	127.8	929.94	137.6	927.23
147.4	924.5	157.2	921.83	167	919.37	176.9	917.01	186.7	915.02
196.5	913.77	206.4	913.24	216.2	913.2	225	913.31	226	913.32
235.8	913.81	240	914.03	245.7	914.32	255.5	914.73	265.3	915.1
275.2	915.64	285	916.34	294.8	917.3	304.6	918.32	314.4	919.32
324.3	920.23	333.9	920.81	343.6	921.37	353.2	921.91	362.8	922.58
372.5	923.68	382.1	925.3	391.8	927.16	401.4	929.04	411.1	930.85
420.7	932.63	430.3	934.4	440	936.19	449.6	938.04	459.3	940.19

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	186.7	.045	240	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
186.7	240	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:SFHGHSRVR

Reach	River Sta.	n1	n2	n3	n4	n5
Main	46468	.1	.075	.1	.045	.1
Main	46467	.1	.075	.1	.045	.1
Main	46405.6	.1	.075	.1	.045	.1
Main	46324.2	.1	.075	.1	.045	.1
Main	46087.4	.1	.075	.1	.045	.1
Main	46080	Culvert				
Main	46014.1	.1	.075	.1	.045	.1
Main	45851.4	.1	.045	.1		
Main	45723.6	.1	.045	.1		

SUMMARY OF REACH LENGTHS

River: SFHGHSRVR

Reach	River Sta.	Left	Channel	Right
Main	46468	26	27	26
Main	46467	31	41	31
Main	46405.6	72	74	79
Main	46324.2	191	245	236
Main	46087.4	68	73.3	68.7
Main	46080	Culvert		
Main	46014.1	175	170	156
Main	45851.4	138	191	121
Main	45723.6	0	0	0

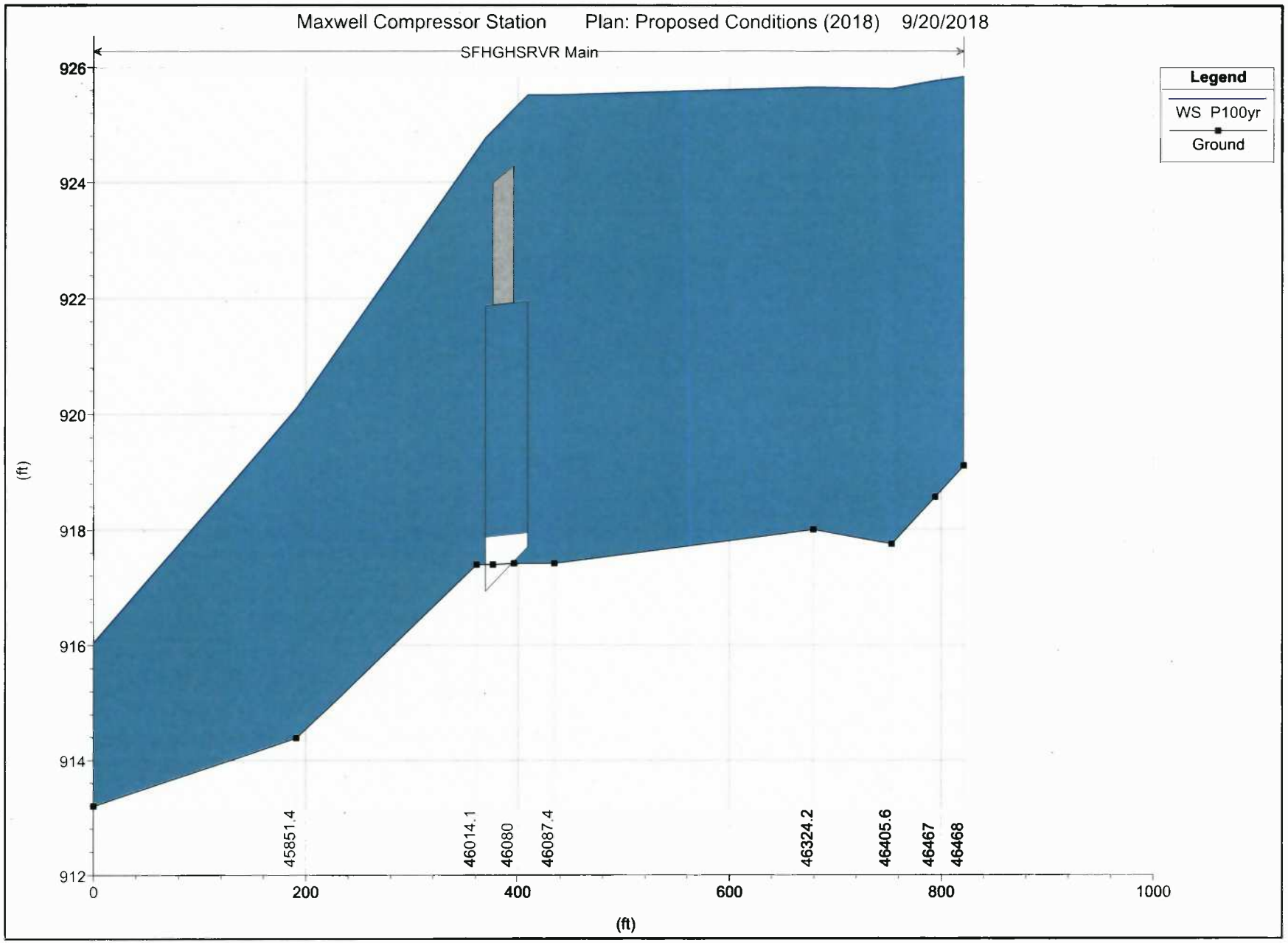
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: SFHGHSRVR

Reach	River Sta.	Contr.	Expan.
Main	46468	.1	.3
Main	46467	.1	.3
Main	46405.6	.1	.3
Main	46324.2	.1	.3
Main	46087.4	.3	.5
Main	46080	Culvert	
Main	46014.1	.3	.5
Main	45851.4	.1	.3
Main	45723.6	.1	.3

Subject: Dominion–Maxwell Compressor Station – New Office Building
Hydraulic Calculations for Floodplain Development Application
By: BerkeME Date: 09/13/2018 Project #: C180957.00.002
Chkd By: JonesAR Date: 09/19/2018 Sheet #: _____ of _____

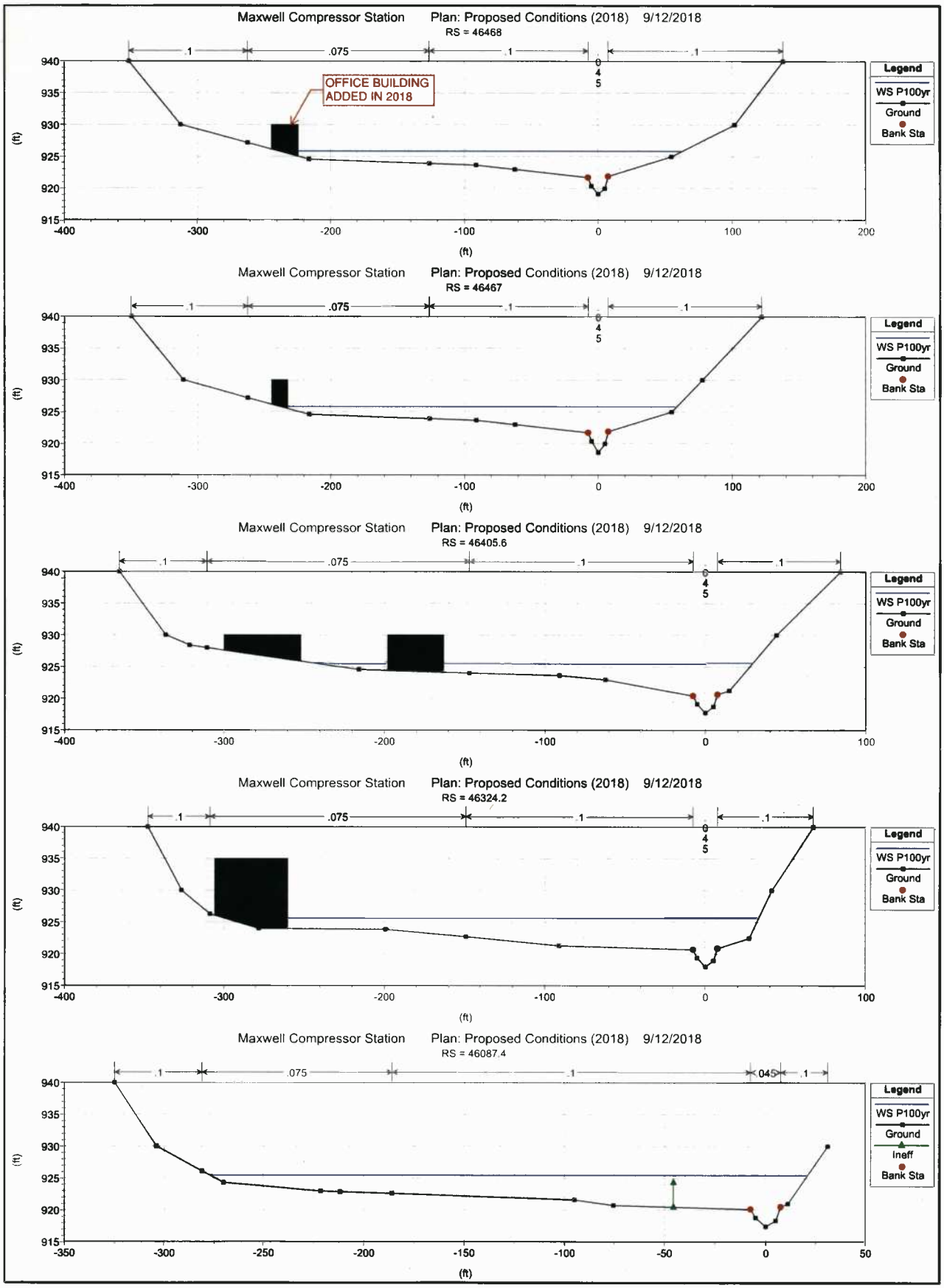
gai consultants

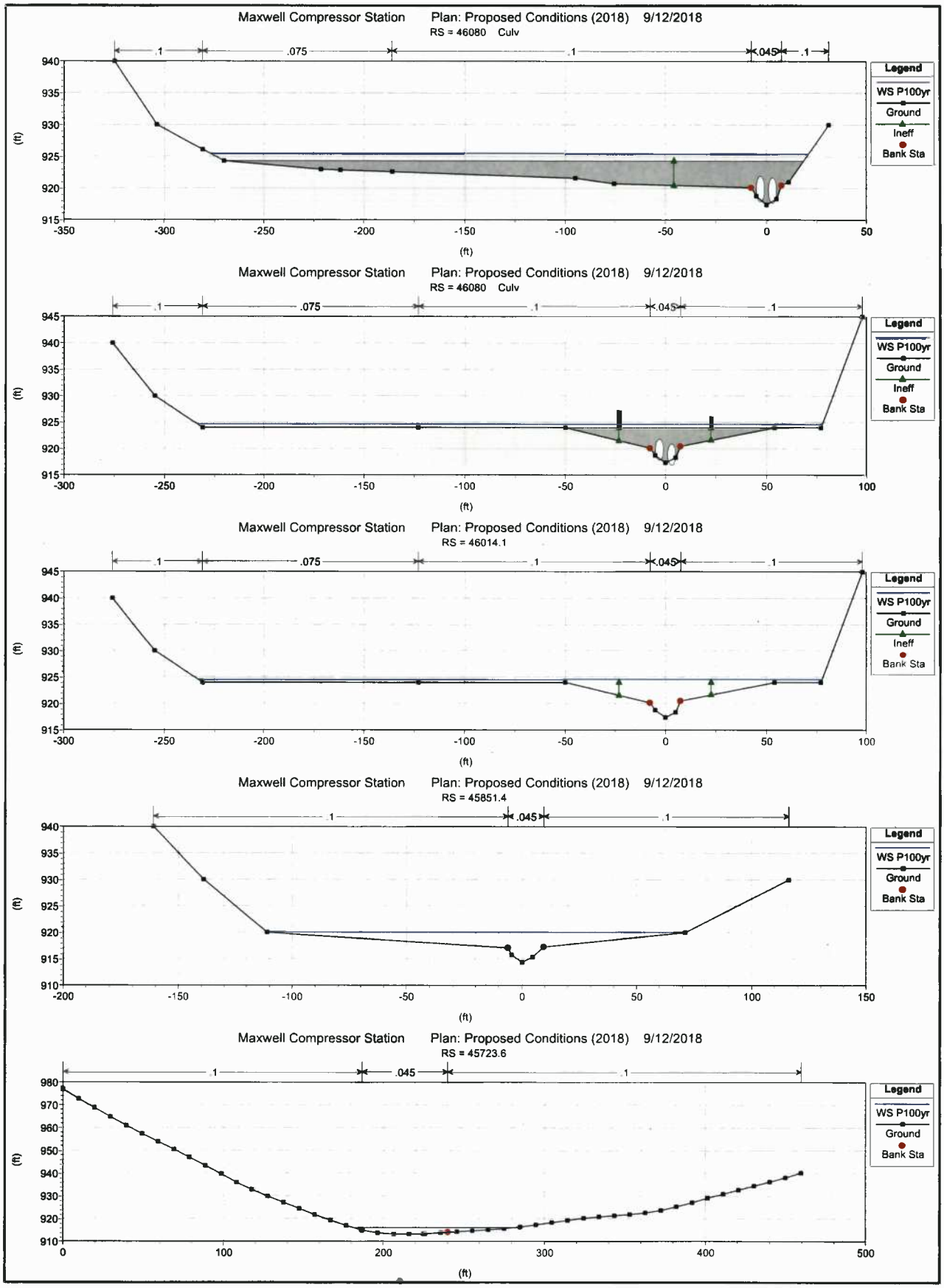
PROPOSED CONDITIONS


Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/20/2018
SFHGHSRVR Main
Legend
WS P100yr
Ground
926
924
922
920
918
916
914
912
(ft)
0
200
400
600
800
1000
(ft)
45851.4
46014.1
46080
46087.4
46324.2
46405.6
46467
46468

HEC-RAS Plan: Proposed River: SFHGHSRVR Reach: Main Profile: P100yr

Reach	River Sta	Profile	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	Shear Chan
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)
Main	46468	P100yr	1192.00	919.11	925.84		925.97	0.002179	4.70	690.88	286.88	0.35	0.72
Main	46467	P100yr	1192.00	918.57	925.77		925.91	0.002292	4.82	675.39	290.52	0.35	0.76
Main	46405.6	P100yr	1192.00	917.75	925.63		925.83	0.002139	5.20	609.31	239.21	0.35	0.84
Main	46324.2	P100yr	1192.00	918.00	925.65		925.70	0.000726	2.97	1011.50	292.82	0.20	0.28
Main	46087.4	P100yr	1192.00	917.41	925.52	922.96	925.56	0.000620	2.84	1078.35	298.53	0.19	0.25
Main	46080		Culvert										
Main	46014.1	P100yr	1192.00	917.39	924.55	924.55	925.19	0.006086	8.08	415.61	310.73	0.58	2.11
Main	45851.4	P100yr	1192.00	914.39	920.10	920.10	920.88	0.011717	9.35	322.63	182.70	0.77	3.09
Main	45723.6	P100yr	1192.00	913.20	916.04	916.03	917.06	0.020027	8.43	176.27	99.16	0.95	3.03


Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/12/2018
RS = 46468
OFFICE BUILDING ADDED IN 2018
Legend
WS P100yr
Ground
Bank Sta
(ft)
Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/12/2018
RS = 46467
Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/12/2018
RS = 46405.6
Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/12/2018
RS = 46324.2
Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/12/2018
RS = 46087.4
Ineff


Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/12/2018
RS = 46080 Culv
.1
.075
.1
.045
.1
Legend
WS P100yr
Ground
Ineff
Bank Sta
(ft)
Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/12/2018
RS = 46080 Culv
Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/12/2018
RS = 46014.1
Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/12/2018
RS = 45851.4
Maxwell Compressor Station Plan: Proposed Conditions (2018) 9/12/2018
RS = 45723.6

```
                    HEC-RAS HEC-RAS 5.0.4 April 2018
                      U.S. Army Corps of Engineers
                     Hydrologic Engineering Center
                           609 Second Street
                           Davis, California

          X     X  XXXXXX    XXXX        XXXX       XX      XXXX
          X     X  X        X    X       X   X     X  X    X
          X     X  X        X            X   X    X    X   X
          XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
          X     X  X        X            X  X     X    X        X
          X     X  X        X    X       X   X    X    X        X
          X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Maxwell Compressor Station
Project File : MaxwellCS.prj
Run Date and Time: 9/20/2018 11:05:38 AM

Project in English units

PLAN DATA

Plan Title: Proposed Conditions (2018)
Plan File : z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\Working Docs\H&H\HEC-RAS\MaxwellCS.p04

Geometry Title: Proposed Conditions (2018)
Geometry File : z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\Working Docs\H&H\HEC-RAS\MaxwellCS.g03

Flow Title : TR-55 Flows
Flow File : z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\Working Docs\H&H\HEC-RAS\MaxwellCS.f02

Plan Summary Information:

Number of:	Cross Sections =	8	Multiple Openings =	0
	Culverts =	1	Inline Structures =	0
	Bridges =	0	Lateral Structures =	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.3
Flow tolerance factor	=	0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: TR-55 Flows
Flow File : z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\Working Docs\H&H\HEC-RAS\MaxwellCS.f02

Flow Data (cfs)

River	Reach	RS	P100yr
SFHGHSRVR	Main	46468	1192

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
SFHGHSRVR	Main	P100yr		Normal S = 0.02

GEOMETRY DATA

Geometry Title: Proposed Conditions (2018)
Geometry File : z:\Energy\2018\C180957.00 - DOM-Maxwell CS Flood\Working Docs\H&H\HEC-RAS\MaxwellCS.g03

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46468

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-352	940	-313	930	-262	927.2	-216	924.59	-126	923.9
-91	923.65	-62.2	922.98	-7.5	921.7	-5	920.37	0	919.11
5	919.96	7.5	921.9	55	925	102	930	138	940

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-352	.1	-262	.075	-126	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	26	27	26	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
-244	-224	930

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46467

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-350	940	-311	930	-262	927.2	-216	924.59	-126	923.9
-91	923.65	-62.2	922.98	-7.5	921.7	-5	920.37	0	918.57
5	919.96	7.5	921.9	55	925	78	930	122	940

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-350	.1	-262	.075	-126	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	31	41	31	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
-244	-232	930

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 46405.6

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-366	940	-337	930	-321.8	928.4	-311	928	-216	924.59
-147	924	-91	923.65	-62.2	922.98	-7.5	920.45	-5	919.13
0	917.75	5	918.71	7.5	920.65	14.7	921.25	44	930
84	940								

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-366	.1	-311	.075	-147	.1	-7.5	.045	7.5	.1

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-7.5	7.5	72	74	79	.1	.3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev

```
    -300     -252      930     -198     -163      930

CROSS SECTION


RIVER: SFHGHSRVR
REACH: Main                 RS: 46324.2

INPUT
Description:
Station Elevation Data    num=      15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    -348      940     -327      930     -309    926.3  -278.1   924.03   -199.4   923.85
    -149    922.7    -91.2   921.28     -7.5    920.7      -5   919.38        0      918
       5   918.96      7.5    920.9     26.9    922.5      41      930       67      940

Manning's n Values        num=       5
     Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val
    -348      .1     -309    .075     -149      .1     -7.5    .045      7.5      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
          -7.5     7.5                191     245     236              .1       .3
Blocked Obstructions      num=       1
   Sta L   Sta R    Elev
    -306    -260     935

CROSS SECTION


RIVER: SFHGHSRVR
REACH: Main                 RS: 46087.4

INPUT
Description:
Station Elevation Data    num=      16
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    -325      940     -304      930     -281    926.1  -270.2    924.3   -221.5   922.98
  -211.8   922.87     -186    922.6      -95    921.6   -75.5   920.72     -7.5   920.16
      -5   918.79        0   917.41        5   918.37     7.5   920.51       11      921
      31      930

Manning's n Values        num=       5
     Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val
    -325      .1     -281    .075     -186      .1     -7.5    .045      7.5      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
          -7.5     7.5                 68    73.3    68.7              .3       .5
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
    -325   -45.5   924.3          F

CULVERT


RIVER: SFHGHSRVR
REACH: Main                 RS: 46080

INPUT
Description:
Distance from Upstream XS =       38
Deck/Roadway Width        =       20
Weir Coefficient          =      2.6
Upstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
  -270.2    924.3              100    924.3

Upstream Bridge Cross Section Data
Station Elevation Data    num=      16
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
    -325      940     -304      930     -281    926.1  -270.2    924.3   -221.5   922.98
  -211.8   922.87     -186    922.6      -95    921.6   -75.5   920.72     -7.5   920.16
      -5   918.79        0   917.41        5   918.37     7.5   920.51       11      921
      31      930

Manning's n Values        num=       5
     Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val
    -325      .1     -281    .075     -186      .1     -7.5    .045      7.5      .1
```

```
Bank Sta: Left   Right    Coeff Contr.    Expan.
          -7.5     7.5            .3        .5
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
    -325   -45.5   924.3       F

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
      -50     924              71     924

Downstream Bridge Cross Section Data
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -276     940    -255     930    -231     924    -123     924     -50     924
    -7.5  920.14      -5  918.77       0  917.39       5  918.35     7.5  920.49
      54     924      77     924      98     945

Manning's n Values        num=       5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
    -276      .1    -231    .075    -123      .1    -7.5    .045     7.5      .1

Bank Sta: Left   Right    Coeff Contr.    Expan.
          -7.5     7.5            .3        .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
    -276   -22.8     924       F
    22.8      98     924       F

Upstream Embankment side slope                =       0 horiz. to 1.0 vertical
Downstream Embankment side slope              =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins           =
Energy head used in spillway design           =
Spillway height used in design                =
Weir crest shape                              = Broad Crested

Number of Culverts =  2

Culvert Name      Shape      Rise    Span
Culvert #1      Circular       4
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 3 - Pipe projecting from fill
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 25      40     .022      .022        0                  .9              1
Upstream   Elevation =  917.95
           Centerline Station = -3
Downstream Elevation =  917.87
           Centerline Station = -3

Culvert Name      Shape      Rise    Span
Culvert #2      Circular       4
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 3 - Pipe projecting from fill
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 25      40     .022      .022        0                  .9              1
Upstream   Elevation =  917.7
           Centerline Station =  3
Downstream Elevation =  916.93
           Centerline Station =  3

CROSS SECTION


RIVER: SFHGHSRVR
REACH: Main               RS: 46014.1

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -276     940    -255     930    -231     924    -123     924     -50     924
    -7.5  920.14      -5  918.77       0  917.39       5  918.35     7.5  920.49
      54     924      77     924      98     945

Manning's n Values        num=       5
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
```

-276	.1	-231	.075	-123	.1	-7.5	.045	7.5	.1

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
-7.5 7.5 175 170 156 .3 .5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-276	-22.8	924	F
22.8	98	924	F

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 45851.4

INPUT
Description:
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-161	940	-139	930	-111	920	-6	917.09	-4.5	915.77
0	914.39	4.5	915.35	9.5	917.29	71	920	116	930

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-161	.1	-6	.045	9.5	.1

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
-6 9.5 138 191 121 .1 .3

CROSS SECTION

RIVER: SFHGHSRVR
REACH: Main RS: 45723.6

INPUT
Description:
Station Elevation Data num= 50

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	976.89	9.8	972.73	19.6	968.69	29.5	964.78	39.3	961
49.1	957.4	59	953.91	68.8	950.47	78.6	947	88.4	943.4
98.3	939.69	108.1	936	117.9	932.81	127.8	929.94	137.6	927.23
147.4	924.5	157.2	921.83	167	919.37	176.9	917.01	186.7	915.02
196.5	913.77	206.4	913.24	216.2	913.2	225	913.31	226	913.32
235.8	913.81	240	914.03	245.7	914.32	255.5	914.73	265.3	915.1
275.2	915.64	285	916.34	294.8	917.3	304.6	918.32	314.4	919.32
324.3	920.23	333.9	920.81	343.6	921.37	353.2	921.91	362.8	922.58
372.5	923.68	382.1	925.3	391.8	927.16	401.4	929.04	411.1	930.85
420.7	932.63	430.3	934.4	440	936.19	449.6	938.04	459.3	940.19

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	186.7	.045	240	.1

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
186.7 240 0 0 0 .1 .3

SUMMARY OF MANNING'S N VALUES

River:SFHGHSRVR

Reach	River Sta.	n1	n2	n3	n4	n5
Main	46468	.1	.075	.1	.045	.1
Main	46467	.1	.075	.1	.045	.1
Main	46405.6	.1	.075	.1	.045	.1
Main	46324.2	.1	.075	.1	.045	.1
Main	46087.4	.1	.075	.1	.045	.1
Main	46080	Culvert				
Main	46014.1	.1	.075	.1	.045	.1
Main	45851.4	.1	.045	.1		
Main	45723.6	.1	.045	.1		

SUMMARY OF REACH LENGTHS

River: SFHGHSRVR

Reach	River Sta.	Left	Channel	Right
Main	46468	26	27	26
Main	46467	31	41	31
Main	46405.6	72	74	79
Main	46324.2	191	245	236
Main	46087.4	68	73.3	68.7
Main	46080	Culvert		
Main	46014.1	175	170	156
Main	45851.4	138	191	121
Main	45723.6	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: SFHGHSRVR

Reach	River Sta.	Contr.	Expan.
Main	46468	.1	.3
Main	46467	.1	.3
Main	46405.6	.1	.3
Main	46324.2	.1	.3
Main	46087.4	.3	.5
Main	46080	Culvert	
Main	46014.1	.3	.5
Main	45851.4	.1	.3
Main	45723.6	.1	.3

The Doddridge Independent

The Doddridge Independent

PUBLISHER'S CERTIFICATE

I, Michael D. Zorn, Publisher of The Doddridge Independent, A newspaper of general circulation published in the town of West Union, Doddridge County, West Virginia, do hereby certify that:

Please take notice that on the (10th) of (October), 2018, Dominion Energy filed an application for a Floodplain Permit {#18-531) to develop land located at or about South Fork Hughes River Road; Coordinates: 39.17944 N, -80.76239 W. The Application is on file with the Floodplain Manager of the County and may be inspected or copied during regular business hours in accordance to WV Code Chapter 29B Freedom of Information, Article 1 Public Records and county policy and procedures. Any interested persons who desire to

was published in The Doddridge Independent
2 times commencing on Friday, October 12, 2018 and
Ending on Friday, October 19, 2018 at the request of:

George Eidel, Doddridge County Floodplain Manager& Doddridge County Commission

Given under my hand this Friday, October 19, 2018

The publisher's fee for said publication is:

$ 31.05 1st Run/$ 23.29 Subsequent Runs

This Legal Ad Total: $ 54.34

Michael D. Zorn
Publisher of The Doddridge Independent

Subscribed to and sworn to before me on
this date: 10 / 22 / 18

Notary Public in and for Doddridge County
My Commission expires on
The 17th day of May 2019

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA

Floodplain Public Notice • Legal Notice

Please take notice that on the ~~(10th) of~~ (October), 2018, Dominion Energy filed an application for a Floodplain Permit {#18-531) to develop land located at or about South Fork Hughes River Road; Coordinates: 39.17944 N, -80.76239 W. The Application is on file with the Floodplain Manager of the County and may be inspected or copied during regular business hours in accordance to WV Code Chapter 29B Freedom of Information, Article 1 Public Records and county policy and procedures. Any interested persons who desire to comment shall present the same in writing by (November 5, 2018) (20 calendar days after the announcement at the regularly scheduled Doddridge County Commission Meeting) delivered to the Floodplain Manager of the County at 105 Court Street, Suite #3, West Union,WV 2645. This project is for a new building at Maxwell Compressor Station C2 10/12 - 10/19