

# HUGUENOT HILLS WATER & SEWER PRELIMINARY ENGINEERING REPORT



SEPTEMBER 17, 2021

## PREPARED FOR:

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## 1.0 Background

The Huguenot Hills neighborhood is in eastern Goochland County, Virginia, near the intersection of State Route 288 and Patterson Avenue. It is currently served by small diameter (2"-4") public waterlines and private septic drain fields. The County has identified the need to replace the existing public waterlines and extend public sewer service into the "General Project Area" as depicted in the County's Request for Proposals 2021-10. The aging polyethylene waterlines have become a maintenance issue due to multiple breaks and service calls in recent years. Additionally, the waterlines do not currently provide fire protection. The existing private septic systems have also experienced failures recently and an extension of the public sewer service into the neighborhood is the desired long-term solution.

The County of Goochland Department of Public Utilities (DPU) has tasked Timmons Group with preparing a Preliminary Engineering Report (PER) to study the replacement of public waterlines and the extension of public sewer service into the Huguenot Hills neighborhood.

This PER will evaluate several aspects of the water and sewer project including existing site features, topography, geotechnical information, hydraulics, easement requirements, adjacent projects by others, and estimated construction costs.



## 2.0 Water System

This section examines the projected flow demands, existing water system, hydraulic performance, and proposed improvements needed to meet the County’s goal of providing adequate domestic and fire flows to the General Project Area.

### 2.1 Water Flow Demands

The parcels within the subdivision consist mainly of residential properties with a few properties along Patterson Avenue zoned for business use. Flow demands were calculated using the Virginia Department of Health (VDH) Waterworks Regulations capacity guidelines as well as DPU Design & Construction Standards (Standards). For the purposes of this PER, a 100 gallons per day (GPD) per capita demand was used to determine the residential demand per lot. The 2020 Goochland County Utility Master Plan (UMP) approximates 2.9 persons per household in the Eastern Goochland Service area. Rounding to 3 persons per household results in a residential domestic demand of 300 GPD per lot. Properties zoned for business use were allocated an assumed water demand of 1,000 GPD per lot. Fire protection flows are expected to be a minimum of 1,500 gallons per minute (GPM) over a two-hour duration based on the UMP.

The General Project Area is comprised of sixty lots: there are 5 business lots, 52 residential lots, two alley lots, and one cemetery. The alley and cemetery lots were not included in the demand calculations. The following Table 1 summarizes the projected water demands. Max Day Demands were peaked by a factor of 1.8 and Peak Hour Demands were peaked by a factor of 2.75 in accordance with DPU Standards, Section 4 – Design Standards for Water Distribution Facilities.

Table 1: Water Demands

Type	# of Lots	GPD / Lot	Total (GPD)	Duration (hours)	Average Day Demand (GPM)	Max Day Demand (GPM)	Peak Hour Demand (GPM)
Residential	52	300	15600	24	10.8	19.5	29.8
Business	5	1000	5000	12	6.9	12.5	19.1

GPD = Gallons Per Day

GPM = Gallons Per Minute

### 2.2 Existing Water Utilities

Goochland County owns and operates the existing water system in the Huguenot Hills subdivision. Based on discussions with the County, the existing 4” waterline was recently connected to the newly constructed 12” waterline within the Oak Hill development. The 4” pipe reduces to a 2” line which extends approximately 1,600 feet south along Rochelle Road. The existing 2” and 4” public waterlines cannot provide consistently reliable domestic water pressures and lack the capacity for fire protection due to the small pipe diameter and aging infrastructure. A map of the existing utilities is shown in **Appendix A1**.

Goochland County’s public water system is divided into two service areas: the Courthouse Water System and the Eastern Goochland Water System (EGWS). The Huguenot Hills neighborhood is served by the EGWS which is divided into four pressure zones. This subdivision is part of the West Creek Pressure Zone which is supplied by three connections: two interconnections with Henrico’s water system at Patterson Avenue and Ridgefield Avenue, and the Route 288 pressure reducing valve (PRV) which provides a redundant water supply from the Centerville Pressure Zone during high flow events.

DPU requires a minimum residual pressure of 35 pounds per square inch (PSI) during domestic demands and a minimum residual pressure of 20 PSI during fire flow scenarios. A minimum fire flow demand of 1,500 GPM for a duration of two hours is the desired level of service. The UMP indicates that minimum pressures within Huguenot Hills fall below 35 PSI and the existing system cannot provide fire protection which justifies the need for this project. It should be noted that portions of the West Creek Pressure Zone adjacent to Huguenot Hills have a minimum pressure of approximately 65-85 PSI and fire flows of approximately 1,000-1,500 GPM. Therefore, upgrades to the existing water system are anticipated to greatly improve system pressure and flow.

### 2.3 Water System Hydraulic Analysis

A computer-simulated water model was created using Bentley's WaterGEMS to perform hydraulic calculations for the proposed water system improvements within the General Project Area. The selected pipe diameter was based on the minimum waterline size of 8" per the DPU Standards. This project will connect to the 12" waterline proposed for the Oak Hill Development to the north and the 16" waterline proposed for the Bristol Development to the south along Patterson Avenue. These waterlines, proposed by others, are under various stages of design and construction and are anticipated to be complete prior to starting construction on the Huguenot Hills Water and Sewer project. There also exists the potential to connect to the 8" waterline proposed for the Blufftons Development to the east, so this configuration is included in the analysis to reflect future buildout.

The boundary condition of the water model was determined by the available flow curve shown in the **County Flow Test Report** provided in **Appendix B1**. Projected flow demands for the Huguenot Hills subdivision were calculated as described in **Section 2.1**. Additional proposed water demands were provided by the County in the **Oak Hill Memo** shown in **Appendix B2**.

The hydraulic analysis concludes that the Huguenot Hills water system can provide adequate flow and pressure for the domestic and fire scenarios. The desired fire flow of 1,500 GPM can be met at each proposed hydrant during the maximum day demand scenario. The County's Standards require a 20 PSI minimum system residual pressure during fire flow scenarios and the calculated minimum residual pressure was approximately 24.7 PSI. The model parameters and results are shown in **Appendix B3**.

### 2.4 Proposed Water System Improvements

Domestic flow and pressure improvements and adequate fire protection within the General Project Area are proposed to be accomplished by installing two 8" waterlines that generally follow Rochelle Road and Ville Ponteaux Lane. These improvements will replace the existing waterline along Rochelle Road so existing water services will need to be transferred to the new waterlines. Refer to the Proposed Water Utilities Exhibit in **Appendix A2** for a conceptual layout of the new waterlines.

The preliminary design includes connections to the 12" Oak Hill Development waterline to the north, the proposed 8" Blufftons Development waterline to the north, and the proposed 16" Bristol Development waterline to the south along Patterson Avenue. Based on information provided by the County it is assumed that the proposed 16" waterline will be located on the north side of Patterson Avenue at both 8" waterline connection points and therefore road crossings are not required. Design of the waterline should include fire hydrants spaced at intervals required by DPU standards, isolation valves for future maintenance, air release valves at high points, and flushing hydrants at low points. The waterlines must also pass acceptance testing to include disinfection, bacteriological sampling, and pressure testing prior to being placed into service.

### 3.0 Sanitary Sewer System

This section evaluates potential alternative sewer configurations to replace the subdivision’s existing private drain fields. Consideration was given to topography, geotechnical information, hydraulics, finished floor elevations, and existing septic system locations when considering potential gravity and pressure sewer options.

#### 3.1 Sewer Flow rates

As mentioned in the water demand calculations in Section 2.1, The General Project Area is divided into sixty lots: there are 5 business lots, 52 residential lots, two alley lots, and one cemetery. The alley and cemetery lots were not included in the flow calculations. The residential wastewater flow rate was based on the 100 GPD per capita flow rate from the Virginia Department of Environmental Quality (DEQ) Sewage Collection and Treatment (SCAT) Regulations. Using the calculated average three persons per household from the UMP, an average flow of 300 GPD per lot was used. Wastewater flow from business lots was calculated based on an assumed 1,000 GPD per lot.

The following Table 2 is a summary of the calculated wastewater flow rates within the General Project Area in accordance with DEQ Regulations and DPU Standards. A peaking factor of 2.5 was used to calculate the peak flow.

Table 2: Sewer Flow Rates

Type	# of Lots	GPD/Lot	Total (GPD)	Duration (hours)	Average Flow (GPM)	Peak Flow (GPM)
Residential	52	300	15600	24	10.8	27.1
Business	5	1000	5000	12	6.9	17.4

GPD = Gallons Per Day  
GPM = Gallons Per Minute

#### 3.2 Existing Sewer Utilities

The residents of Huguenot Hills are currently on private septic systems and multiple homeowners have recently experienced failing drain fields. The closest available public sewer is an existing 8” gravity sewer along Charities Road, east of the subdivision. This sewer flows east and connects to the trunk sewer that follows Tuckahoe Creek, east of West Creek Parkway. Sewer flows are ultimately conveyed to the Eastern Goochland Pump Station (EGPS) which pumps into the Henrico County collection system. Wastewater treatment is currently provided for the Eastern Goochland Service Area (EGSA) by the City of Richmond and Henrico County. The UMP states the existing EGSA wastewater collection system can handle current demands with additional capacity for projected sewer flows until about 2035. Therefore, offsite capacity is assumed to be adequate for the proposed project.

Timmons Group conducted a field investigation on July 13<sup>th</sup>, 2021 to visually inspect the existing sanitary sewer infrastructure on Charities Road. Refer to the Existing Sewer Preliminary Investigation in **Appendix C**. The investigation began at the upstream end of the sewer at Manhole (MH) 6, the proposed connection point for the new Huguenot Hills sewer. The field investigation utilized an Envirosight Quickview Air HD zoomable pole camera to visually observe the condition of the manholes and pipes, to the extent that line of sight could be maintained. Several defects were noted, to include pipe sags, possible offset joints, a missing pipe stub and cap, and the subsequent collection of sediment and debris in the pipes and manholes. No defects were noted in any of the manhole structures.



Given the deteriorated condition of the existing sewer, it is recommended to further investigate the sewer using the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP). Alternatively, the County could elect to forego additional inspections and move forward with replacing all the existing pipes within the study area. This sewer is critical to serve the Huguenot Hills neighborhood as well as the Blufftons Development to the east. Based on the anticipated flows from these developments and the surveyed inverts of the existing manholes (by others), an 8" sanitary sewer replacement in kind should have adequate capacity. Repairs and/or replacement of this offsite sewer are currently beyond the scope of this project and therefore costs for these improvements are not included in this PER.

### 3.3 Sewer Hydraulic Analysis

The new public wastewater utilities will receive a peak flow of approximately 44 GPM at final build out, as calculated in Section 3.1. According to DPU Standards, new public gravity sewer must be a minimum of 8" diameter with a minimum slope of 0.4%. This results in a minimum pipe full capacity of approximately 350 GPM which is more than adequate to convey wastewater flows to the existing public sewer collection system.

Due to the prevailing topography and existing/future finished grade elevations, a pressure sewer system will be required to serve at least a portion of the General Project Area. Each residence served by the pressure system will need a private grinder pump station located on their property to connect to the small diameter public force main which will then discharge into the closest available manhole. There are also lots with access to the proposed gravity sewer that will still require a grinder pump station due to sewer depth limitations. Based on the conceptual sewer options, anywhere from 26-56 individual grinder pump stations may be needed which would result in a peak flow of approximately 55-77 GPM and require either a 2" or 3" force main to satisfy the velocity constraint of 2-8 feet per second (FPS). The receiving gravity sewer will have a minimum capacity of 350 GPM so again, 8" gravity sewer appears to be adequate for this project.

### 3.4 Proposed Sanitary Sewer System

The Huguenot Hills subdivision is predominantly underlain by a thin layer of fill and residual soils followed by stiff weathered rock at depths of 4-22 feet below grade which then transitions into what is believed to be bedrock. Refer to the Preliminary Geotechnical Report in **Appendix D**. Gravity sewer can often require installation depths of 5-20 feet or greater, so the existing subsurface conditions pose a significant risk of encountering rock during construction. Rock removal can be a long and expensive process especially for linear construction. The most effective method for removing rock is by controlled drilling and blasting with explosives. However, this approach is not advised near residences due to potentially destructive vibrations and undesirable noise. Timmons Group recommends designing the sewer to avoid encountering rock altogether.

This PER limited sewer depths to avoid placement within the approximate horizon of overly stiff weathered rock (50 blows per 4") and elevations where the geotechnical borings encountered auger refusal. The approximate rock elevation is shown on the profile drawings in **Appendices A3 and A4**. For each proposed option, gravity sewer was kept above the rock profile and extended as far as practicable to maintain minimum cover and/or beneficial use.

Placing the sewer above the rock profile considerably limits the number of lots that can be served by gravity sewer. To demonstrate this, Timmons Group calculated the potential sewer lateral invert



elevation for each lot and added them to the sewer profiles. Lateral inverts shown below the sewer pipe would likely require a grinder pump station. The results of this analysis are also summarized on the conceptual layout exhibits in **Appendices A3 and A4**, indicated by shading each lot that will require a private grinder pump station.

Timmons Group proposes three different options for extending sewer within the General Project Area. Gravity sewer is generally the preferred approach to designing new wastewater collection systems, however extensions into existing developments that were not originally designed for public utilities can present unique challenges that require an alternative method.

Options A and B are a combination of gravity sewer and pressure sewer whereas Option C is entirely pressure sewer. All three options propose connecting to the existing MH 6 located on Charities Road. Each option has advantages and disadvantages discussed below for the County's consideration before proceeding to the design phase.

### **Option A**

Option A includes approximately 2,435 linear feet (LF) of 8" gravity sewer and approximately 1,975 LF of 2" sewer force main. The northern and southern extents of Rochelle Road will require pressure sewer, as well as the northern extent of Ville Ponteaux Lane. The remaining project area could be served by the proposed gravity sewer network. Several lots that have frontage to gravity sewer will still require private grinder pump stations due to the depth limitations mentioned above combined with the location of permitted septic systems being in the backyard.

In order to serve the entire project area, the sewer will need to cross from Rochelle Drive over to Ville Ponteaux Lane. A natural ridge generally follows north to south along the rear lot lines between the two roads. Option A utilizes a "saddle" in the ridge as the crossing point which allows a shallower sewer installation when compared to Option B. However, the crossing is located on two vacant lots which will require an easement from each landowner.

This option minimizes the depth of gravity sewer, but has an increased length of pressure sewer when compared to Option B. Over half of the project area, approximately 33 lots, will require private grinder pump stations.

Due to the limited available right-of-way (ROW), presence of existing utilities, and the need to maintain separation from the water system, it is assumed the gravity sewer will be installed within the existing and future limits of pavement. This will require importing a significant amount of select backfill and offsite disposal of surplus excavated material. The existing pavement on Rochelle Road will also need to be restored to VDOT standards which will require pavement replacement within the trench as well as pavement milling and overlayment of the entire width of the road along the sewer installation. The small diameter force main is assumed to be located within the ROW and outside of the pavement.

Refer to **Appendix A3** for the conceptual sewer layout and profile drawings.

### **Option B**

Option B includes approximately 3,107 LF of 8" gravity sewer and approximately 1,217 LF of 2" sewer force main. Similarly to Option A, the northern and southern extents of Rochelle Road and the northern extent of Ville Ponteaux Lane will require pressure sewer. Several lots that have frontage to gravity



sewer will still require private grinder pump stations due to the depth limitations mentioned above combined with the location of permitted septic systems being in the backyard.

Like Option A, Option B will require the sewer to cross from Rochelle Road to Ville Ponteaux Lane. However, this option utilizes an existing privately owned alley as the crossing location. This requires only one easement from a single property owner and is assumed to be consistent with the intended use of the alley. This crossing location puts the gravity sewer near the local high point of the terrain and will result in greater excavation depths when compared to Option A.

Option B has a reduced amount of pressure sewer than Option A but will still require approximately 26 lots with private grinder pump stations. The drawback to less pressure sewer is a longer and deeper gravity sewer to accommodate the required invert elevations for most lots to connect via gravity.

Due to the limited available right-of-way (ROW), presence of existing utilities, and the need to maintain separation from the water system, it is assumed the gravity sewer will be installed within the existing and future limits of pavement. This will require importing a significant amount of select backfill and offsite disposal of surplus excavated material. The existing pavement on Rochelle Road will also need to be restored to VDOT standards which will require pavement replacement within the trench as well as pavement milling and overlayment of the entire width of the road along the sewer installation. The small diameter force main is assumed to be located within the ROW and outside of the pavement.

Refer to **Appendix A4** for the conceptual sewer layout and profile drawings.

### **Option C**

Option C consists entirely of pressure sewer, including approximately 4,290 LF of 3" sewer force main. This provides the most flexibility in routing the new sewer. The private alley was selected as the crossing location between Rochelle Road and Ville Ponteaux Lane; however, this could be located anywhere within the project area.

Other benefits of the pressure sewer option include the reduced installation depth of only 3.5' below grade. This greatly reduces the risk of encountering rock during construction. Pressure pipe can also utilize trenchless installation methods such as horizontal directional drilling to minimize the amount of disturbance and restoration requirements. Pavement restoration and the need for importing select backfill are virtually eliminated with this option.

The main disadvantage to pressure sewer systems is the need for private grinder pump stations on every lot; approximately 56 will be required for Option C. The private grinder pump stations will require maintenance in the future; however, studies have shown the operation and maintenance costs over the life of the pump are relatively low. One such study prepared in 2016 by Environment One Corporation titled, "An Evaluation of O&M Expenses" lists a conservative annual maintenance cost per pump of \$50/year with a mean time between service calls of 10 years. The useful life of major components is listed as 30 years or more and pump replacement is typically evaluated between 15-20 years.



#### 4.0 Easement Acquisition

Timmons Group evaluated the need for permanent utility and temporary construction easements for the Huguenot Hills Water and Sewer Project. The new utilities will not require easements in areas where they will be installed with the Virginia Department of Transportation (VDOT) right-of-way (ROW). Rochelle Road is located within a 50' wide public ROW from Patterson Avenue to approximately 1,300' north. This appears to be the only public ROW within the General Project Area. Utilities installed outside of the VDOT ROW will require permanent utility and temporary construction easements.

The northern portion of Rochelle Road that has not been constructed is contained within a private ROW. Ville Ponteaux Lane and Charities Road are also privately owned ROW and will require easements. The only other easement(s) anticipated for the project will depend on where the sewer will cross from Rochelle Road to Ville Ponteaux Lane which could be through a private alley or across residential lots.

Note that the Engineer's Opinion of Probable Cost (EOPC) in the following section does not include costs for easements and easement acquisition services. It is understood the County intends to request that landowners donate the easements for the benefit of the project and the community, as has been done previously on similar projects. A table of key easements and property owners is included below. This list is applicable to all options; however, the approximate easement area may differ.

Table 3: Anticipated Easements

GPIN	Zoning	Owner (N/F)	Location Address	Easement Area
				(Ac.)
7724-94-3415	RN	Singer Michael Ann Singer Clifford	0 Rochelle Road	0.46
7724-94-5323	RN	Bumgarner Jeffrey E	0 Rochelle Road / 0 Ville Ponteaux Lane	0.27
7734-04-3897	RN	West Creek Associates LLC	0 Ville Ponteaux Lane	1.74
7734-04-3271	RN	West Creek Associates LLC Riverstone Properties LLC	0 West Creek Parkway	0.002

1. Parcel information based on Goochland County GIS Database.

2. Easement Area accounts for water and sewer utilities and is approximate only.



## 5.0 Engineer's Opinion of Probable Cost

The Engineer's Opinion of Probable Costs (EOPC) are provided within this section. A combination of water and sewer options could be selected so each option is broken down individually. Also, costs for private grinder pump stations are provided separately in this section because it is currently unknown if the costs for the private utilities will be borne by the County or the property owner.

The addition of a private grinder pump station could represent an additional cost of \$10,000-\$15,000 for each parcel, depending on the model selected and site specific factors such as soil conditions, depth, electrical upgrades, and distance from the house and the public force main. The order of magnitude cost for private grinder pump stations for each option are summarized as follows:

### Sewer Option A

33 Private Grinder Pump Stations @ \$15,000 Ea. = \$495,000

### Sewer Option B

26 Private Grinder Pump Stations @ \$15,000 Ea. = \$390,000

### Sewer Option C

56 Private Grinder Pump Stations @ \$15,000 Ea. = \$840,000

The Engineer's OPCC is based on best judgment, experience, and being qualified professionals generally familiar with the construction industry. Reasonable assumptions were made as to how the authorities having jurisdiction will interpret and apply regulations, codes, ordinances, etc., but the actual project requirements determined during design by the authorities having jurisdiction may vary from the assumptions presented herein. Because the Engineer has no control over the cost of labor, materials, equipment, services furnished by others, or over competitive bidding or market conditions, the Engineer cannot guarantee that actual costs will not vary from the EOPC presented.

The EOPC provided do not include costs for financing, property or easement acquisition, connection fees, or environmental mitigation. Additionally, site specific features such as the depth and profile of subsurface rock can have a significant impact on construction costs. The following EOPC are presented in 2021 dollars and costs should be adjusted in subsequent years.

**Huguenot Hills Water and Sewer Improvements**

Engineer's Opinion of Probable Cost (EOPC)

Water Main

9/7/2021



Description	Quantity	Units	Unit \$	Total Cost	
Water Main					
General Conditions (Mobilization, Permits, etc.)	1	LS	\$50,000	\$50,000	
Clearing	1	LS	\$20,000	\$20,000	
Traffic Control	1	LS	\$25,000	\$25,000	
Rock Excavation	10	CY	\$500	\$5,000	
Erosion and Sediment Control Measures	1	LS	\$50,000	\$50,000	
8" C-900 PVC Water Main	3,960	LF	\$90	\$356,400	
Fire Hydrant Assembly	8	EA	\$7,500	\$60,000	
8" Gate Valve and Box	8	EA	\$4,000	\$32,000	
New Water Service Connection with Meter	56	EA	\$3,000	\$168,000	
Abandon Existing Water Main in Place	1	EA	\$5,000	\$5,000	
Connection to Existing Water System	5	EA	\$5,000	\$25,000	
Acceptance Testing	1	LS	\$10,000	\$10,000	
Driveway Restoration	21	EA	\$2,000	\$42,000	
Landscape Restoration Per Lot	30	EA	\$500	\$15,000	
			<b>Sub-total</b>	<b>\$863,400</b>	
			Construction Contingency 20%	\$172,680	
			<b>Total Probable Construction Cost</b>	<b>\$1,036,080</b>	
<b>Professional Services Prior to Construction</b>					
			Topographic Survey	1.5%	\$15,541
			Utility Location	1.0%	\$10,361
			Wetland Delineation	0.5%	\$5,180
			Geotechnical Engineering	2.0%	\$20,722
			Engineering Design	8.0%	\$82,886
			Permitting	2.0%	\$20,722
			<b>Sub-total</b>		<b>\$155,412</b>
<b>Professional Services During Construction</b>					
			Bid Phase Services	0.5%	\$5,180
			Construction Administration	2.0%	\$20,722
			Construction Inspection and Materials Testing	3.0%	\$31,082
			<b>Sub-total</b>		<b>\$56,984</b>
			<b>Total Probable Project Cost</b>		<b>\$1,248,476</b>

<b>Huguenot Hills Water and Sewer Improvements</b>				
<b>Engineer's Opinion of Probable Cost (EOPC)</b>				
<b>Sewer Option A</b>				
<b>9/7/2021</b>				
		 <b>TIMMONS GROUP</b> <small>YOUR VISION ACHIEVED THROUGH OURS.</small>		
<b>Description</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit \$</b>	<b>Total Cost</b>
<b>Sewer Option A</b>				
General Conditions (Mobilization, Permits, etc.)	1	LS	\$50,000	\$50,000
Clearing	1	LS	\$30,000	\$30,000
Traffic Control	1	LS	\$40,000	\$40,000
Rock Excavation	50	CY	\$500	\$25,000
Erosion and Sediment Control Measures	1	LS	\$50,000	\$50,000
2" HDPE IPS DR11 Force Main Pipe	1,975	LF	\$80	\$158,000
Pressure Service Connection	33	EA	\$2,000	\$66,000
8" PVC SDR26 Sewer Pipe	2,435	LF	\$60	\$146,100
Excavation & Backfill 8" 0'-6' Deep	9	LF	\$30	\$270
Excavation & Backfill 8" 6'-8' Deep	175	LF	\$35	\$6,125
Excavation & Backfill 8" 8'-10' Deep	405	LF	\$40	\$16,200
Excavation & Backfill 8" 10'-12' Deep	731	LF	\$50	\$36,550
Excavation & Backfill 8" 12'-14' Deep	666	LF	\$60	\$39,960
Excavation & Backfill 8" 14'-16' Deep	310	LF	\$70	\$21,700
Excavation & Backfill 8" 16'-18' Deep	82	LF	\$80	\$6,560
Excavation & Backfill 8" 18'-20' Deep	57	LF	\$90	\$5,130
Excavation & Backfill 8" 20'-22' Deep	0	LF	\$100	\$0
Select Backfill	4,000	CY	\$75	\$300,000
48" Standard Concrete Manhole	158	VF	\$750	\$118,500
Acid Resistant Coating of Manhole	32	VF	\$500	\$16,000
Standard Manhole Frame and Cover	13	EA	\$500	\$6,500
8" x 4" Tee - Sewer Service Connections	23	EA	\$500	\$11,500
4" Lateral and Cleanouts	23	EA	\$2,000	\$46,000
Connection to Existing Manhole	1	EA	\$2,000	\$2,000
Pavement Replacement Within Trench	250	SY	\$90	\$22,500
Pavement Milling and Overlayment	900	SY	\$35	\$31,500
			<b>Sub-total</b>	<b>\$1,252,100</b>
		Construction Contingency	20%	\$250,400
		<b>Total Probable Construction Cost</b>		<b>\$1,502,500</b>
<b>Professional Services Prior to Construction</b>				
		Topographic Survey	1.5%	\$22,538
		Utility Location	1.0%	\$15,025
		Wetland Delineation	0.5%	\$7,513
		Geotechnical Engineering	2.0%	\$30,050
		Engineering Design	8.0%	\$120,200
		Permitting	2.0%	\$30,050
		<b>Sub-total</b>		<b>\$225,375</b>
<b>Professional Services During Construction</b>				
		Bid Phase Services	0.5%	\$7,513
		Construction Administration	2.0%	\$30,050
		Construction Inspection and Materials Testing	3.0%	\$45,075
		<b>Sub-total</b>		<b>\$82,638</b>
<b>Total Probable Project Cost</b>				<b>\$1,810,513</b>
Note: The EOPC does not include costs for private grinder pump stations which is estimated to be \$495,000				

<b>Huguenot Hills Water and Sewer Improvements</b>				
<b>Engineer's Opinion of Probable Cost (EOPC)</b>				
<b>Sewer Option B</b>				
<b>9/7/2021</b>				
 <b>TIMMONS GROUP</b> YOUR VISION ACHIEVED THROUGH OURS.				
<b>Description</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit \$</b>	<b>Total Cost</b>
<b>Sewer Option B</b>				
General Conditions (Mobilization, Permits, etc.)	1	LS	\$50,000	\$50,000
Clearing	1	LS	\$30,000	\$30,000
Traffic Control	1	LS	\$40,000	\$40,000
Rock excavation	50	CY	\$500	\$25,000
Erosion and Sediment Control Measures	1	LS	\$50,000	\$50,000
2" HDPE IPS DR11 Force Main Pipe	1,217	LF	\$80	\$97,360
Pressure Service Connection	26	EA	\$2,000	\$52,000
8" PVC SDR26 Sewer Pipe	3,107	LF	\$60	\$186,420
Excavation & Backfill 8" 0'-6' Deep	0	LF	\$30	\$0
Excavation & Backfill 8" 6'-8' Deep	267	LF	\$35	\$9,345
Excavation & Backfill 8" 8'-10' Deep	687	LF	\$40	\$27,480
Excavation & Backfill 8" 10'-12' Deep	334	LF	\$50	\$16,700
Excavation & Backfill 8" 12'-14' Deep	548	LF	\$60	\$32,880
Excavation & Backfill 8" 14'-16' Deep	409	LF	\$70	\$28,630
Excavation & Backfill 8" 16'-18' Deep	304	LF	\$80	\$24,320
Excavation & Backfill 8" 18'-20' Deep	289	LF	\$90	\$26,010
Excavation & Backfill 8" 20'-22' Deep	269	LF	\$100	\$26,900
Select Backfill	6,500	CY	\$75	\$487,500
48" Standard Concrete Manhole	188	VF	\$750	\$141,000
Acid Resistant Coating of Manhole	35	VF	\$500	\$17,500
Standard Manhole Frame and Cover	14	EA	\$500	\$7,000
8" x 4" Tee - Sewer Service Connections	30	EA	\$500	\$15,000
4" Lateral and Cleanouts	30	EA	\$2,000	\$60,000
Connection to Existing Manhole	1	EA	\$2,000	\$2,000
Pavement Replacement Within Trench	300	SY	\$90	\$27,000
Pavement Milling and Overlayment	1,200	SY	\$35	\$42,000
			<b>Sub-total</b>	<b>\$1,522,000</b>
			Construction Contingency 20%	\$304,400
			<b>Total Probable Construction Cost</b>	<b>\$1,826,400</b>
<b>Professional Services Prior to Construction</b>				
			Topographic Survey	1.5% \$27,396
			Utility Location	1.0% \$18,264
			Wetland Delineation	0.5% \$9,132
			Geotechnical Engineering	2.0% \$36,528
			Engineering Design	8.0% \$146,112
			Permitting	2.0% \$36,528
			<b>Sub-total</b>	<b>\$273,960</b>
<b>Professional Services During Construction</b>				
			Bid Phase Services	0.5% \$9,132
			Construction Administration	2.0% \$36,528
			Construction Inspection and Materials Testing	3.0% \$54,792
			<b>Sub-total</b>	<b>\$100,452</b>
			<b>Total Probable Project Cost</b>	<b>\$2,200,812</b>

Note: The EOPC does not include costs for private grinder pump stations which is estimated to be \$390,000

<b>Huguenot Hills Water and Sewer Improvements</b>				
<b>Engineer's Opinion of Probable Cost (EOPC)</b>				
<b>Sewer Option C</b>				
<b>9/7/2021</b>				
 <b>TIMMONS GROUP</b> YOUR VISION ACHIEVED THROUGH OURS.				
<b>Description</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit \$</b>	<b>Total Cost</b>
<b>Sewer Option C</b>				
General Conditions (Mobilization, Permits, etc.)	1	LS	\$50,000	\$50,000
Clearing	1	LS	\$30,000	\$30,000
Traffic Control	1	LS	\$25,000	\$25,000
Rock excavation	10	CY	\$500	\$5,000
Erosion and Sediment Control Measures	1	LS	\$50,000	\$50,000
3" HDPE DR11 IPS Force Main	4,290	LF	\$100	\$429,000
Pressure Service Connection	56	EA	\$2,000	\$112,000
1" Combination Air Valve Assembly	4	EA	\$5,000	\$20,000
3" Plug Valve	9	EA	\$2,500	\$22,500
Connection to Existing Manhole	1	EA	\$2,000	\$2,000
Acid Resistant Coating of Manhole	14	VF	\$500	\$7,000
Select Backfill	20	CY	\$75	\$1,500
Driveway Restoration	21	EA	\$2,000	\$42,000
Landscape Restoration Per Lot	30	EA	\$500	\$15,000
Pavement Replacement Within Trench	11	SY	\$90	\$990
Pavement Milling and Overlayment	75	SY	\$35	\$2,625
			<b>Sub-total</b>	<b>\$814,600</b>
		Construction Contingency	20%	\$162,900
		<b>Total Probable Construction Cost</b>		<b>\$977,500</b>
<b>Professional Services Prior to Construction</b>				
		Topographic Survey	1.5%	\$14,663
		Utility Location	1.0%	\$9,775
		Wetland Delineation	0.5%	\$4,888
		Geotechnical Engineering	2.0%	\$19,550
		Engineering Design	8.0%	\$78,200
		Permitting	2.0%	\$19,550
		<b>Sub-total</b>		<b>\$146,625</b>
<b>Professional Services During Construction</b>				
		Bid Phase Services	0.5%	\$4,888
		Construction Administration	2.0%	\$19,550
		Construction Inspection and Materials Testing	3.0%	\$29,325
		<b>Sub-total</b>		<b>\$53,763</b>
		<b>Total Probable Project Cost</b>		<b>\$1,177,888</b>
Note: The EOPC does not include costs for private grinder pump stations which is estimated to be \$840,000				

## 6.0 Recommendations

This PER identifies the potential water and wastewater infrastructure improvements required to serve the General Project Area within the Huguenot Hills neighborhood and presents order of magnitude costs for these potential upgrades. The conclusions reached in this report are based on the current Goochland County water and wastewater system capacities and information provided by DPU. As capacities and usage will change, the results of this analysis may need to be updated in the future.

### 6.1 Water Utilities

Timmons Group Recommends installing new 8" waterlines along Rochelle Road and Ville Ponteaux Lane to provide adequate flow and pressure for domestic consumption and fire protection. The waterlines should be located within the existing public and private ROW, outside of the existing and future edge of pavement. It is understood that budget limitations may only allow for construction of either water or sewer initially. Consideration should be given during design as to which side of the road is selected for the new waterline, based on the desired sequence of construction.

For example, if DPU elects to construct the water option without sewer, then it would be recommended to locate the new waterline on the opposite side of the road from the existing waterline. This will reduce the risk of service interruptions caused by construction equipment damaging the existing pipe. It would also allow for a faster and potentially lower cost installation by reducing conflicts that may arise with existing utilities. If the sewer is installed first then it would need to be located on the opposite side of the road from the existing waterline in order to maintain the minimum 10' of horizontal separation and stay within the ROW. The new waterline would then likely need to be installed on the same side of the road as the existing waterline.

The new waterline connection points at the northern and southern ends of the project will need to be coordinated with the adjacent developments during design. There may be opportunities to optimize connection locations and water system looping to improve hydraulic performance.

### 6.2 Sewer Utilities

This PER considered three different options for extending sewer within the General Project Area including both gravity and pressure sewer. The Huguenot Hills neighborhood was not initially designed with a layout conducive to a future gravity sewer extension. Further, the prevailing topography within the General Project Area does not lend itself to flow naturally toward the available connection to the existing public sewer. Lastly, the geotechnical investigation identified shallow rock that significantly limits the sewer installation depth and therefore the ability to serve the entire project area with gravity sewer. Options A and B include gravity sewer that could serve a portion of the neighborhood, however not without elevated risks of encountering rock during installation of both the sewer main and sewer laterals to each lot.

Timmons Group recommends implementing Option C and installing pressure sewer within the General Project Area. This option provides the most flexibility in routing the proposed sewer. It has the lowest risk of encountering rock, less disturbance and restoration, and is the lowest cost option. The cost savings realized by selecting Option C may also allow DPU to install both water and sewer simultaneously, depending on the available budget, which would compound the County's savings by only administering one project. This scenario of combining the water and sewer projects also benefits the community by essentially cutting the construction duration and number of impacts in half.

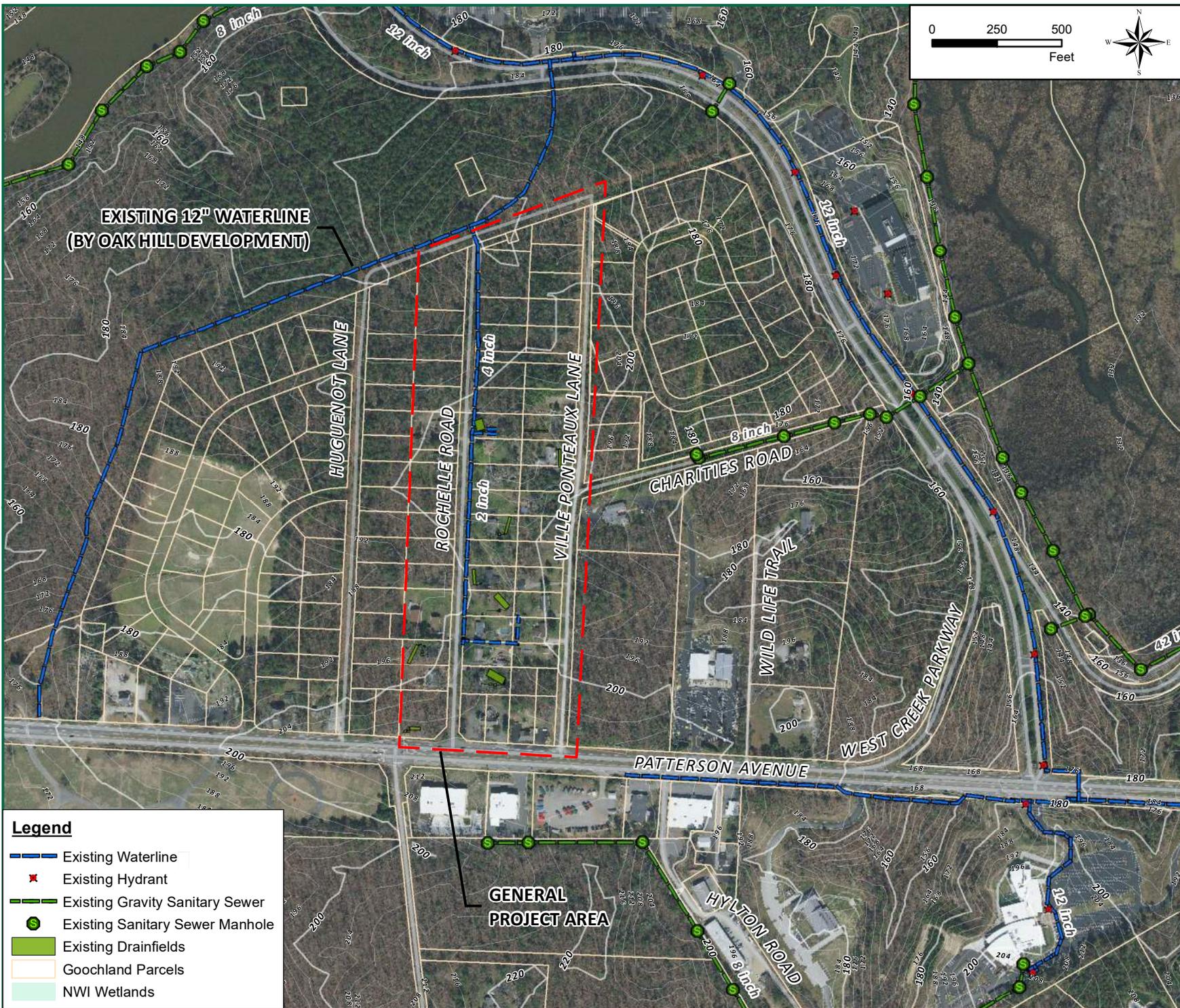


This PER has considered adjacent projects by others; however, the main focus was to recommend improvement options that are independent of private developments that may or may not be constructed. Timmons Group recognizes that opportunities exist to collaborate with adjacent projects that are in various stages of design and construction. We recommend further exploration of these possibilities during design of the Huguenot Hills Water and Sewer project. Assimilating with other projects could change the configurations and recommendations contained in this report. It should also be noted that changes to the project scope will also bring about changes to project risks and costs which should be revisited with each iteration. The overarching goal that should remain throughout is to deliver a holistic solution that best accomplishes the County's mission of facilitating access to public utilities while providing a high level of service to its customers.

# **APPENDIX A**

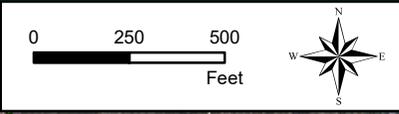
## **Exhibits**





**Legend**

- Existing Waterline
- ✖ Existing Hydrant
- Existing Gravity Sanitary Sewer
- Existing Sanitary Sewer Manhole
- Existing Drainfields
- Goochland Parcels
- NWI Wetlands



**TIMMONS GROUP**

HUGUENOT HILLS  
GOOCHLAND COUNTY, VIRGINIA

**EXISTING CONDITIONS**

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AUG 2021	DATE
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W. HUNNIUS	DESIGNED BY
B. STRICKLAND	CHECKED BY
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JOB NUMBER  
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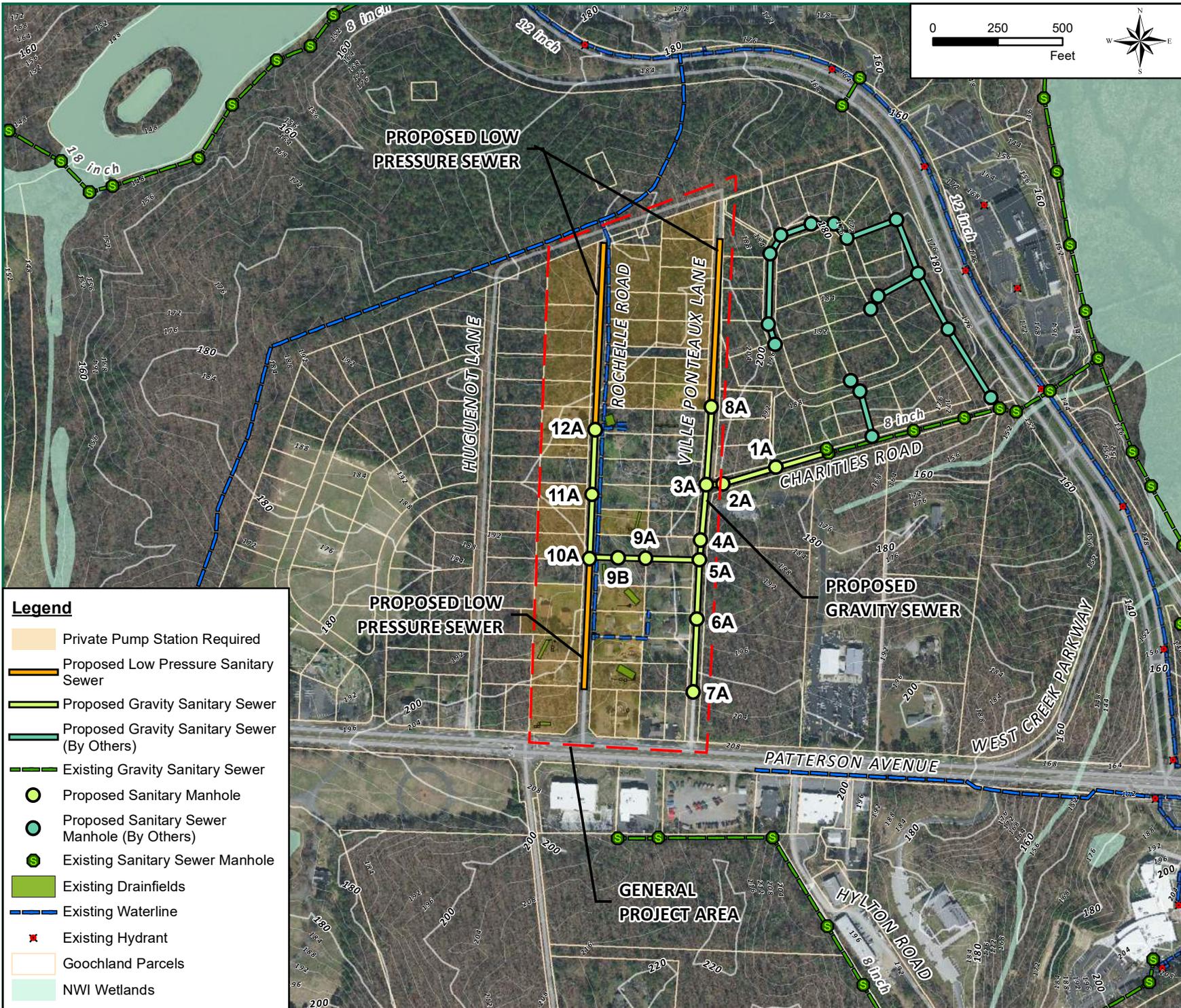
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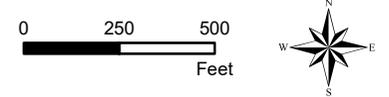






**Legend**

- Private Pump Station Required
- Proposed Low Pressure Sanitary Sewer
- Proposed Gravity Sanitary Sewer
- Proposed Gravity Sanitary Sewer (By Others)
- Existing Gravity Sanitary Sewer
- Proposed Sanitary Manhole
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- Existing Sanitary Sewer Manhole
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**B. STRICKLAND**

SCALE  
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 GOOCHLAND COUNTY, VIRGINIA

**UTILITIES MAP - PROPOSED SEWER - OPTION A**

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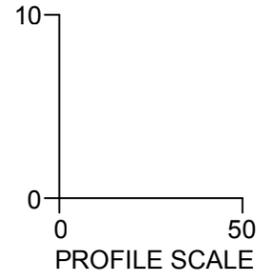
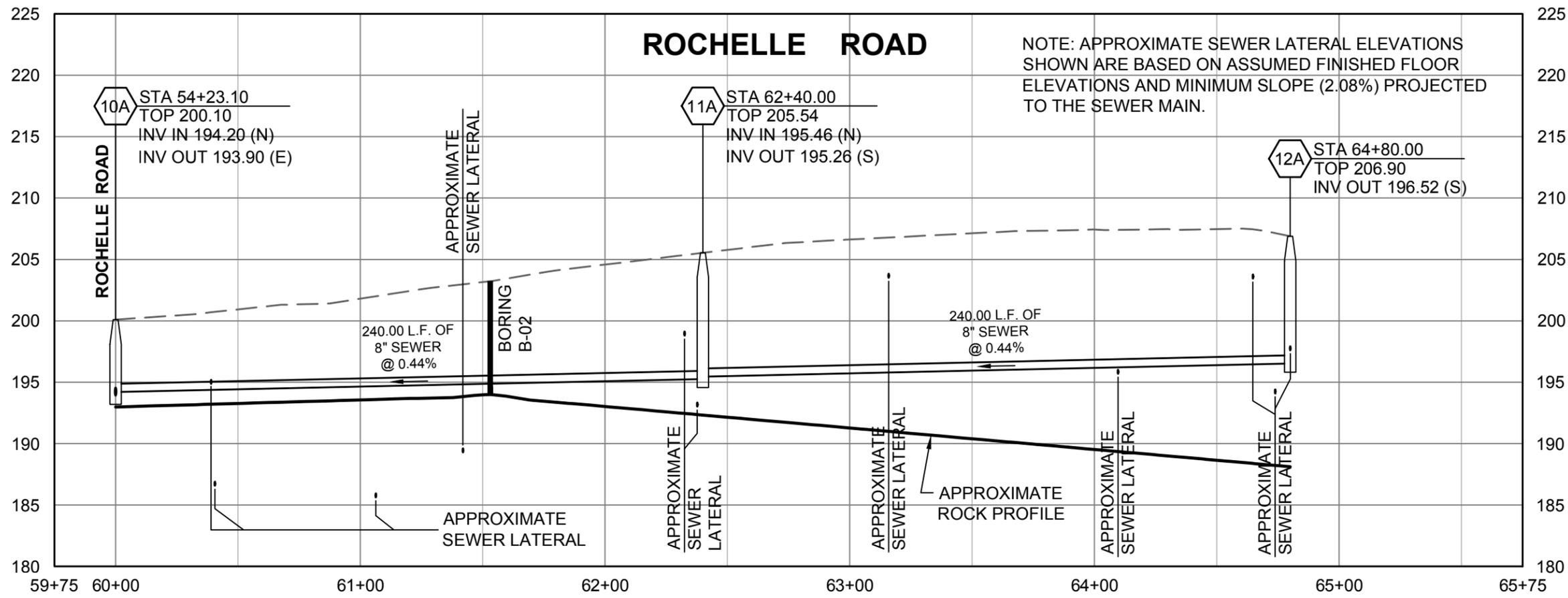
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**HUGUENOT HILLS**  
DOVER DISTRICT - GOOCHLAND COUNTY - VIRGINIA  
**SANITARY SEWER PROFILE - OPTION A**

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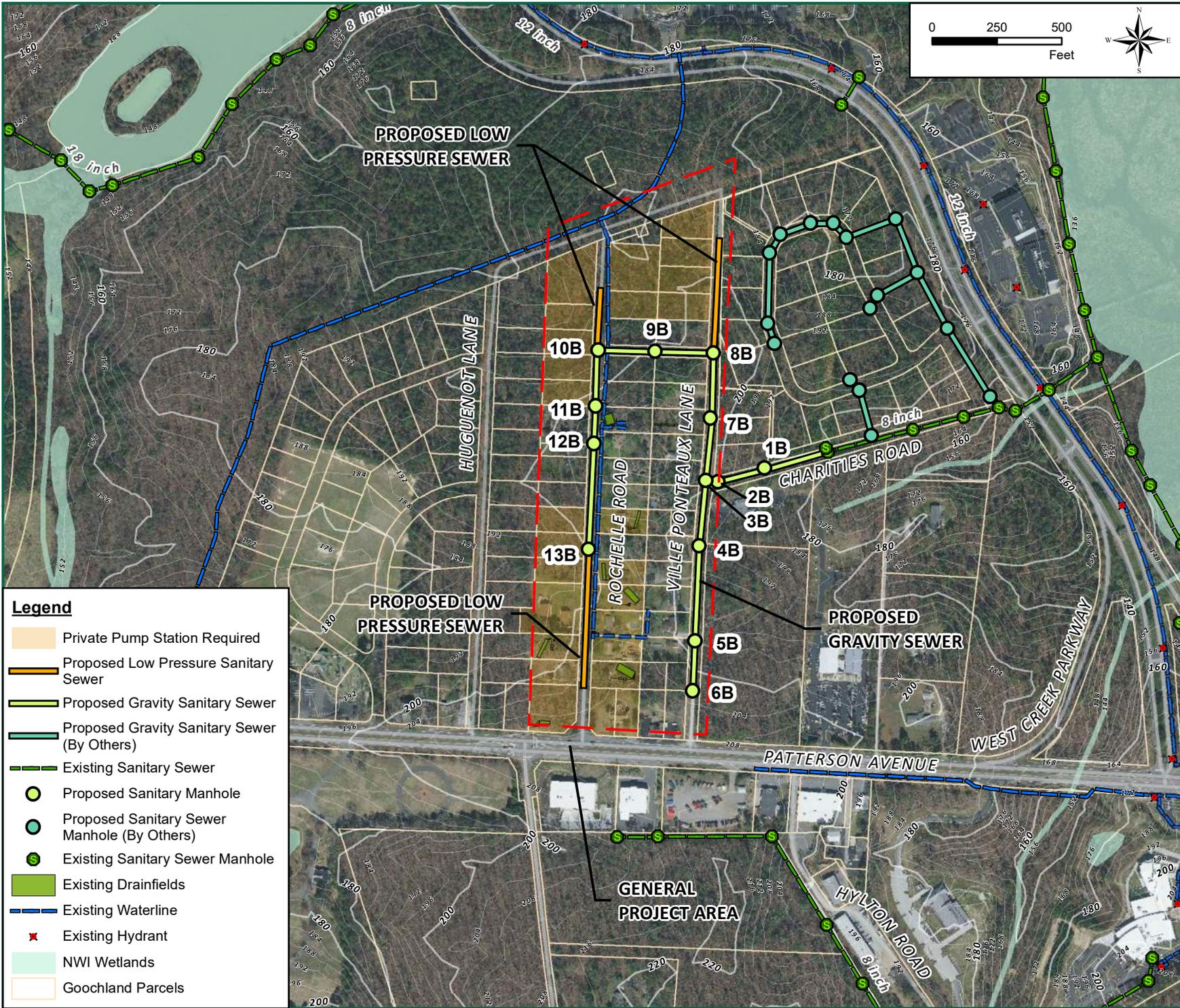
DATE  
SEPT, 2021  
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DESIGNED BY  
J. CARTER  
CHECKED BY  
B. STRICKLAND  
SCALE  
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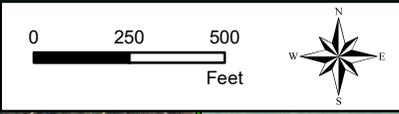
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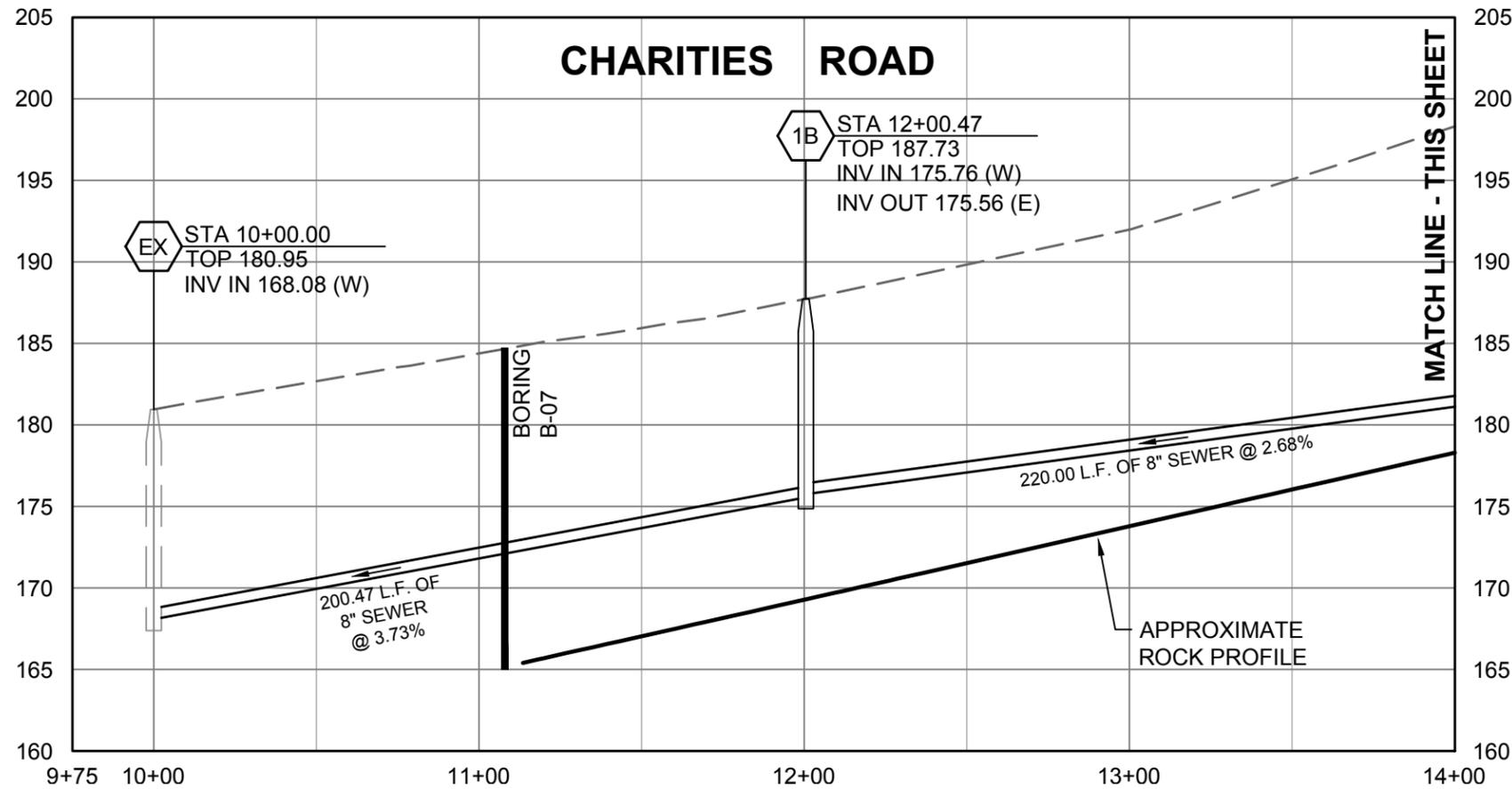
**UTILITIES MAP - PROPOSED SEWER - OPTION B**

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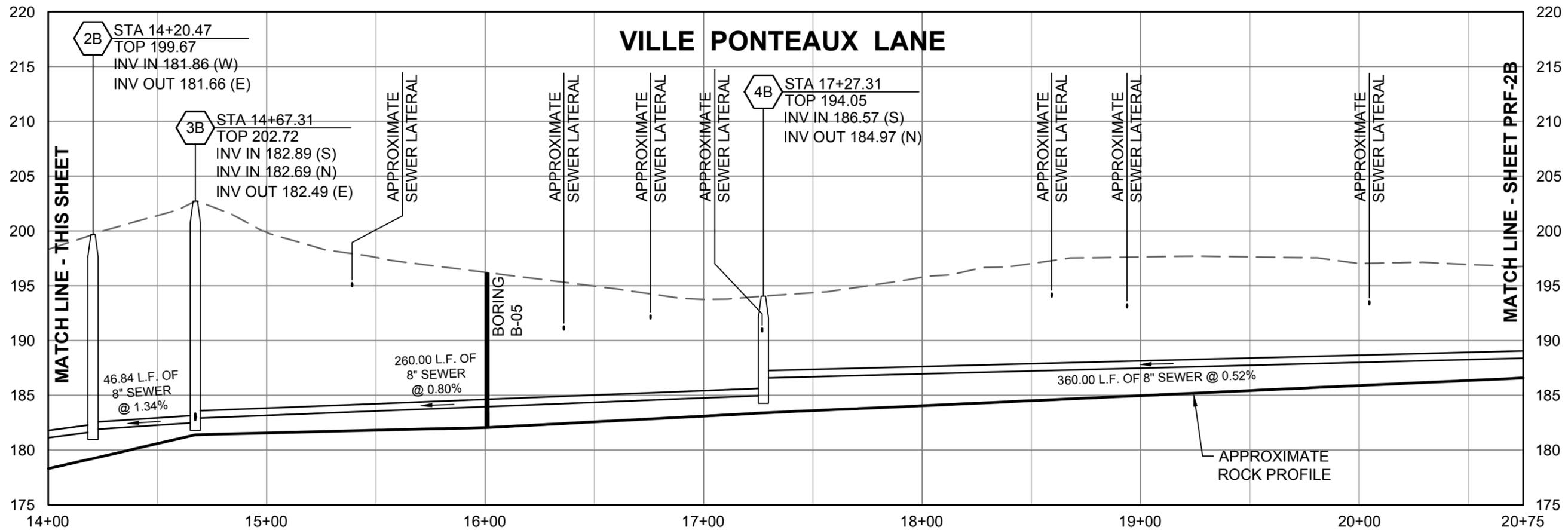
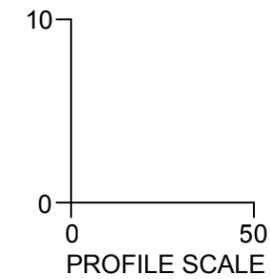
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NOTE: APPROXIMATE SEWER LATERAL ELEVATIONS SHOWN ARE BASED ON ASSUMED FINISHED FLOOR ELEVATIONS AND MINIMUM SLOPE (2.08%) PROJECTED TO THE SEWER MAIN.



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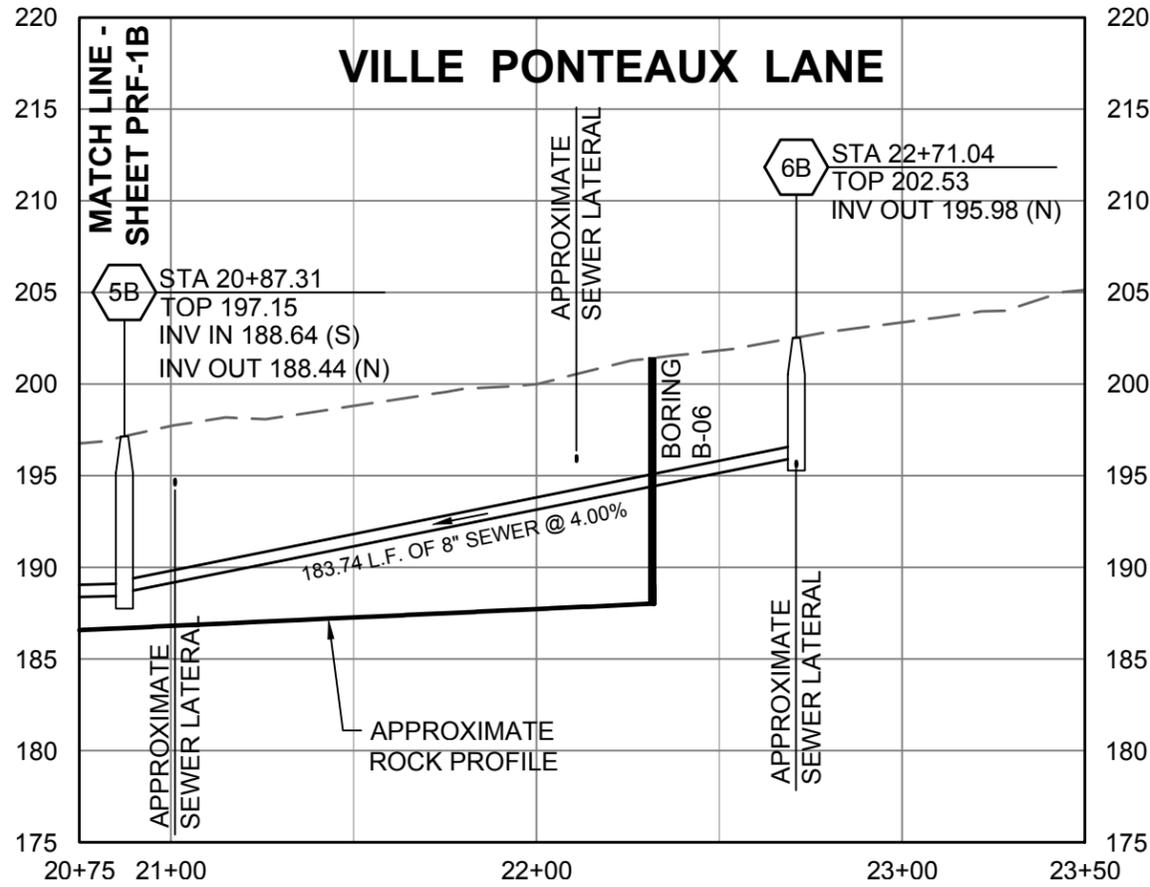
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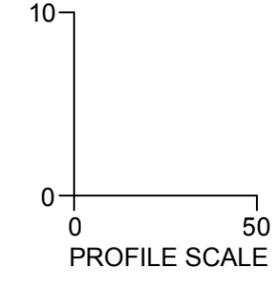
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SANITARY SEWER PROFILE - OPTION B

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**HUGUENOT HILLS**  
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**SANITARY SEWER PROFILE - OPTION B**

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**PRF-2B**

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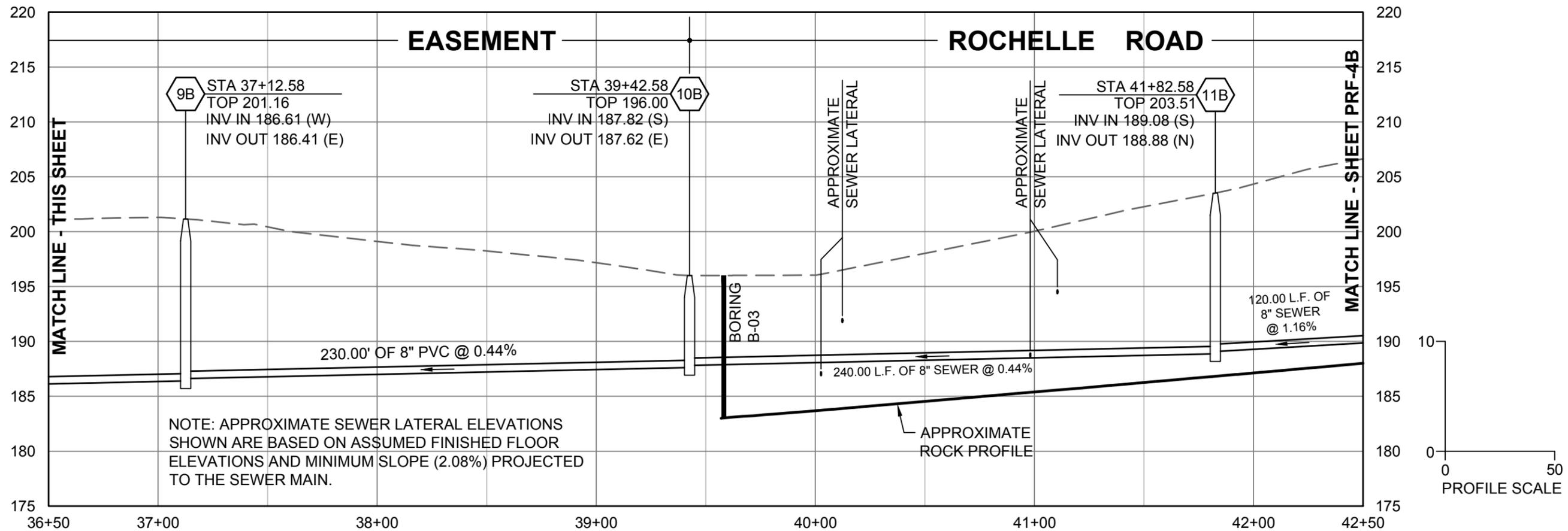
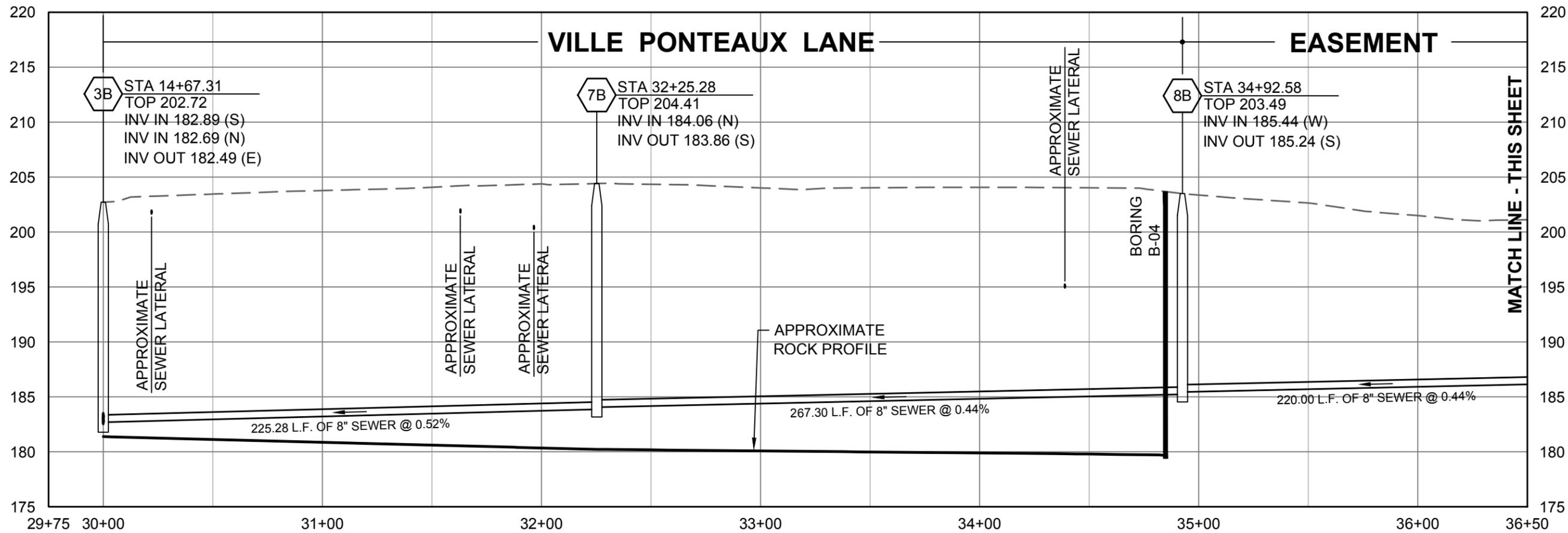
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J. CARTER  
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B. STRICKLAND  
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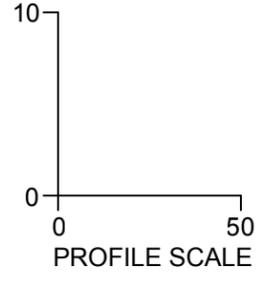
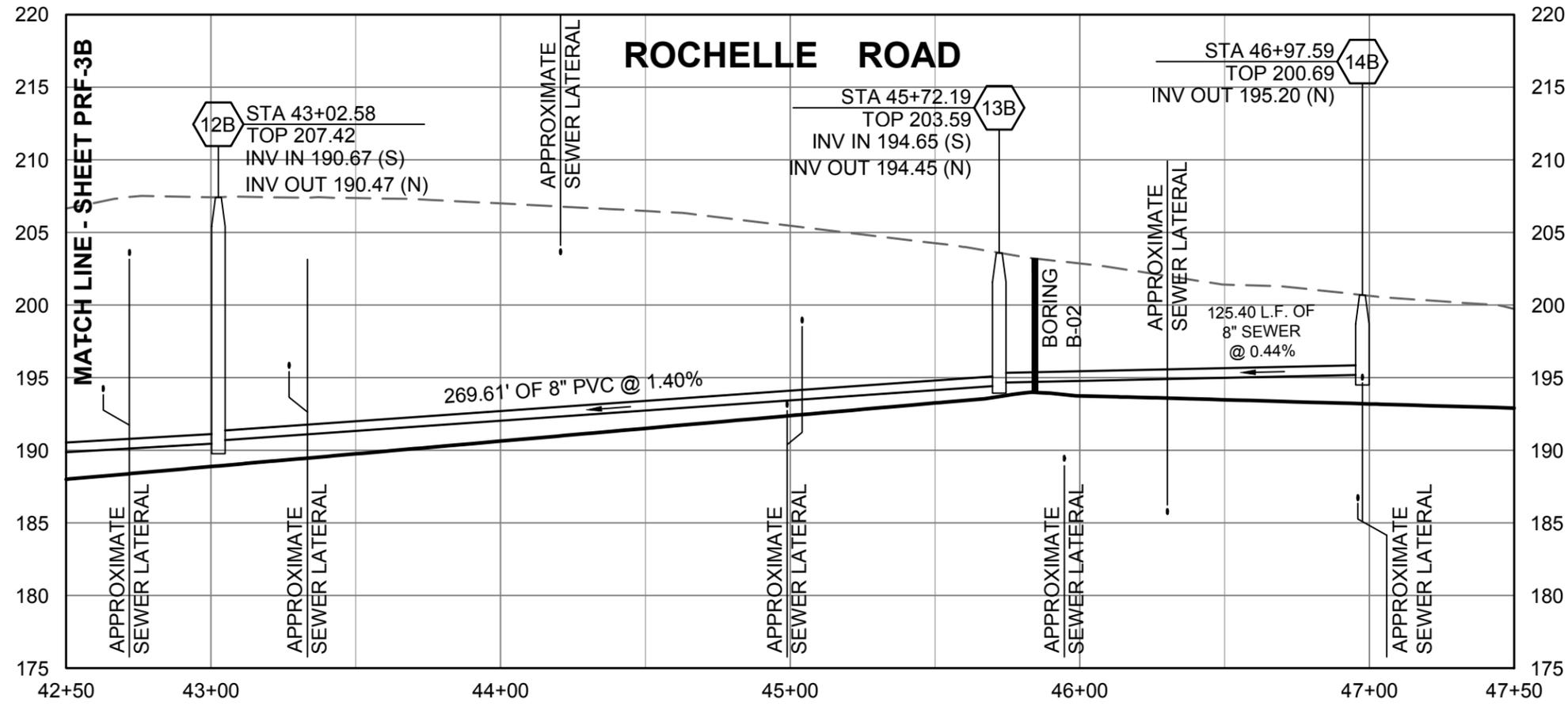
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**SANITARY SEWER PROFILE - OPTION B**

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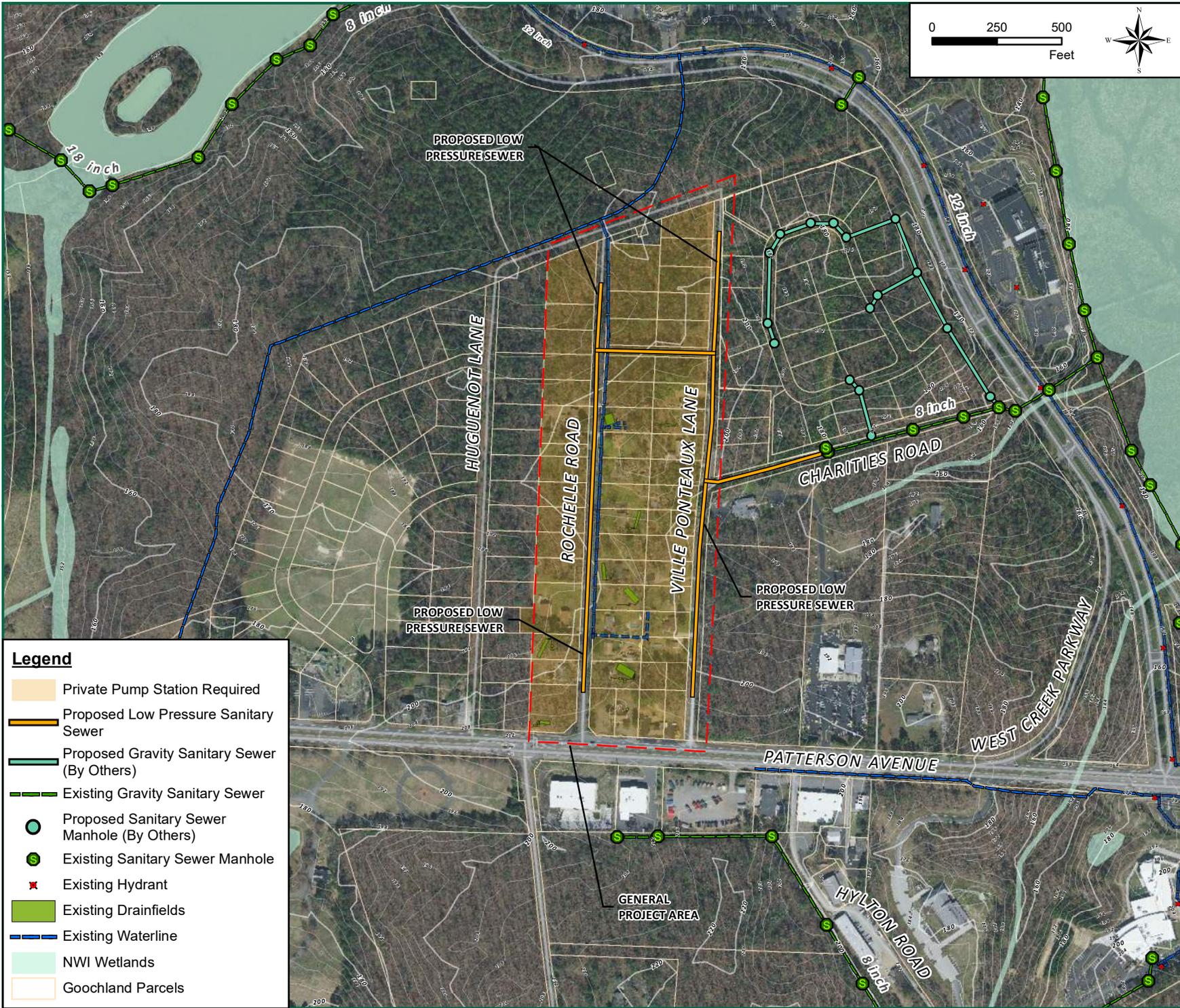
DATE	SEPT, 2021
DRAWN BY	J. CARTER
DESIGNED BY	J. CARTER
CHECKED BY	B. STRICKLAND
SCALE	H: --- V: 1" = 5'

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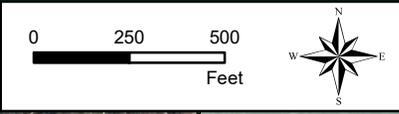
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**Legend**

- Private Pump Station Required
- Proposed Low Pressure Sanitary Sewer
- Proposed Gravity Sanitary Sewer (By Others)
- Existing Gravity Sanitary Sewer
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- S Existing Sanitary Sewer Manhole
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- Gochland Parcels



**TIMMONS GROUP**

HUGUENOT HILLS  
GOCHLAND COUNTY, VIRGINIA

**UTILITIES MAP - PROPOSED SEWER - OPTION C**

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# **APPENDIX B**

## **Water System Hydraulic Analysis**





**DEPARTMENT OF PUBLIC UTILITIES**

<b>Project Name</b> Oakhill Test 1		<b>UTL#</b>	
<b>Test Date &amp; Time</b> 9/13/2019 10:07		<b>Pressure Zone</b> Centerville Tank	<b>Waterline Size</b> 12" DI
<b>Locality</b> Goochland County		<b>Water Tower Level</b> Downstream Pressure at 288 PRV: 59.5 p.s.i.	
<b>County Attendees</b> T.Morris & B.McKinney		<b>Notes</b>	

**RESULTS:**

<b>Residual Hydrant</b> Static Pressure = _____ 79 _____ p.s.i. Residual Pressure = _____ 72 _____ p.s.i. @ _____ N/A _____ GPM	Location = _____	
	Residual	
	Elevation = _____	157'
	Hydrant No. = _____	
	N/A	
<b>Flow Hydrant</b> Pitot Pressure = _____ 63 _____ p.s.i. Equivalent Flow Rate = _____ 1230 _____ GPM	Location = _____	
	Flow	
	Elevation = _____	152'
	Hydrant No. = _____	
	N/A	

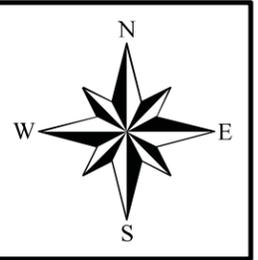
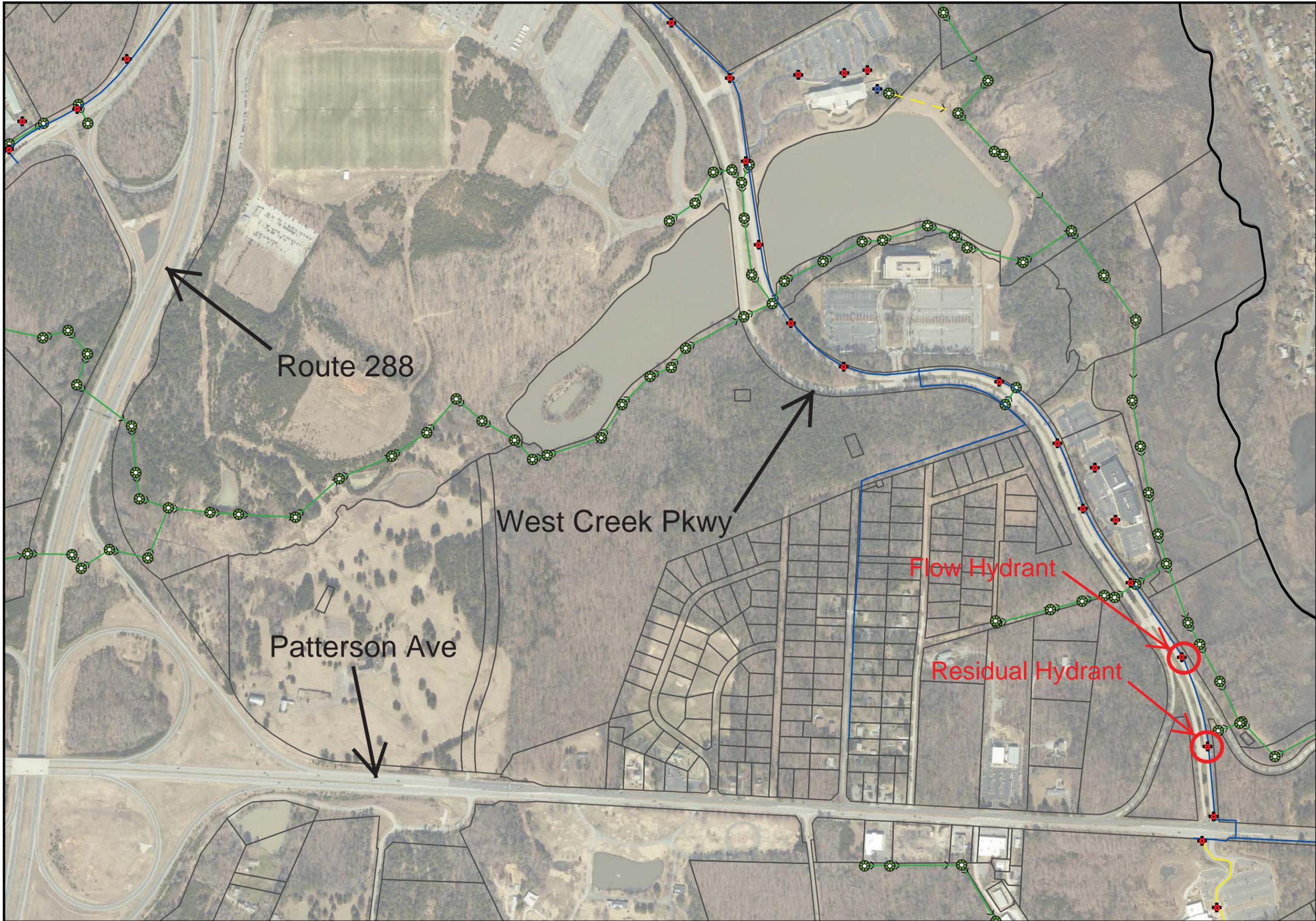
<b>Residual Hydrant</b> Static Pressure = _____ p.s.i. Residual Pressure = _____ p.s.i. @ _____ GPM	Location = _____	
	Elevation = _____	Hydrant Color = _____
	Hydrant No. = _____	

<b>Flow Hydrant</b> Pitot Pressure = _____ p.s.i. Equivalent Flow Rate = _____ GPM	Location = _____	
	Elevation = _____	Hydrant Color = _____
	Hydrant No. = _____	

<b>Residual Hydrant</b> Static Pressure = _____ p.s.i. Residual Pressure = _____ p.s.i. @ _____ GPM	Location = _____	
	Elevation = _____	Hydrant Color = _____
	Hydrant No. = _____	

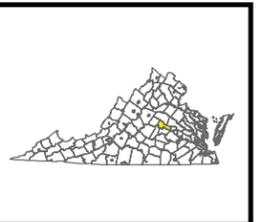
<b>Flow Hydrant</b> Pitot Pressure = _____ p.s.i. Equivalent Flow Rate = _____ GPM	Location = _____	
	Elevation = _____	Hydrant Color = _____
	Hydrant No. = _____	

**Goochland County Signature:**



- + wHydrant
- + wDryHydrant
- wMain**
- wMain\_Private
- wMain\_Public
- ⊗ ssManhole
- ssGravityMain**
- Ownership, LifecycleStatus**
- ssGravityMain\_Private
- ssGravityMain\_Public

0 0.0225045 0.09  
 Miles





## DISCHARGE TABLE FOR CIRCULAR OUTLETS (US)

### Outlet Pressure Measured by Pitot Gauge

Outlet Pressure in lbs. per sq. inch	Outlet Diameter in Inches			Outlet Pressure in lbs. per sq. inch	Outlet Diameter in Inches		
	2-1/2"	4"	4-1/2"		2-1/2"	4"	4-1/2"
	U.S. Gallons per Minute				U.S. Gallons per Minute		
1	160	390	500	34	920	1950	2470
2	220	550	700	36	950	2010	2540
3	280	640	810	38	970	2060	2610
4	320	720	910	40	1000	2120	2680
5	350	780	980	42	1020	2170	2750
6	390	830	1050	44	1050	2220	2810
7	420	890	1120	46	1070	2270	2870
8	450	950	1200	48	1090	2320	2940
9	480	1000	1270	50	1110	2370	3000
10	500	1060	1340	52	1140	2410	3060
11	520	1110	1410	54	1160	2460	3110
12	550	1160	1470	56	1180	2510	3170
13	570	1210	1530	58	1200	2550	3230
14	590	1250	1590	60	1220	2590	3280
15	610	1300	1640	62	1240	2640	3340
16	630	1340	1700	64	1260	2680	3390
17	650	1380	1750	66	1280	2720	3440
18	670	1420	1800	68	1300	2760	3490
19	690	1460	1850	70	1320	2800	3550
20	700	1500	1900	72	1340	2840	3600
21	720	1530	1940	74	1360	2880	3650
22	740	1570	1990	76	1370	2920	3690
23	760	1610	2030	78	1390	2960	3740
24	770	1640	2080	80	1410	3000	3790
26	800	1710	2160	85	1450	3090	3910
28	830	1770	2240	90	1500	3180	4020
30	860	1830	2320	95	1540	3260	4130
32	890	1890	2400	100	1580	3350	4240

2-1/2", 4" & 4-1/2" Computed with Coefficient C=.845, to nearest 10 gallons per minute  
 4" & 4-1/2" Correction Factors for large diameter outlets already figured in gpm's.

Large diameter openings do not flow solid water, the correction factor compensates for the voids.





# MEMORANDUM

DATE: November 19, 2020  
TO: Wayne Stephens, PE  
FROM: Richard Kincheloe, PE  
SUBJECT: Oak Hill Fire Flow Analysis Results

## Message

Per your request, Dewberry has completed the fire flow analysis for the Oak Hill Development, located near the intersection of Route 288 and Patterson Avenue in Goochland County. Attached is a figure showing the general vicinity of the proposed development, including the proposed waterline improvements. Dewberry utilized the existing conditions scenario of the recently updated and calibrated model to run an extended period simulation to analyze the system ability to sustain minimum system pressures during a 2 hour-1,500 gpm fire flow event.

### Scenario 1A – Patterson Loop Active:

1. Maximum day demands
2. Proposed Patterson Avenue Loop active
3. Patterson Avenue Interconnection active
4. Ridgefield Interconnection active
5. **Route 288 PRV active**
6. 2-hour 1,500 gpm fire flow at J4806

### Scenario 1B – Patterson Loop Active:

1. Maximum day demands
2. Proposed Patterson Avenue Loop active
3. Patterson Avenue Interconnection active
4. Ridgefield Interconnection active
5. **Route 288 PRV inactive**
6. 2-hour 1,500 gpm fire flow at J4806

### Scenario 2A – Patterson Loop Inactivate:

1. Maximum day demands
2. Proposed Patterson Avenue Loop active
3. Patterson Avenue Interconnection active
4. Ridgefield Interconnection active
5. **Route 288 PRV active**
6. 2-hour 1,500 gpm fire flow at J4806

### Scenario 2B – Patterson Loop Inactive:

1. Maximum day demands
2. Proposed Patterson Avenue Loop active
3. Patterson Avenue Interconnection active
4. Ridgefield Interconnection active
5. **Route 288 PRV inactive**
6. 2-hour 1,500 gpm fire flow at J4806

Proposed demands provided by RK&K were allocated to the following junctions:

Junction ID	Elevation (feet)	Commercial Demand (gpm)	Residential Demand (gpm)
J4810	181.46	108	0
J4814	184.00	500	0
J4818	192.00	108.4	0
J4822	179.21	108.4	12.5

Results for each scenario are as follows:

	Static Pressure at J4814	Residual Pressure at J4814	Critical Junction	Residual Pressure at Critical Junction
Scenario 1A	67.04	53.09	WHY-0208-7728	30.84
Scenario 1B	66.52	46.97	WHY-0058-7714	23.86
Scenario 2A	65.28	23.11	J4810	19.47
Scenario 2B	63.73	9.96	J4810	6.31

Please note:

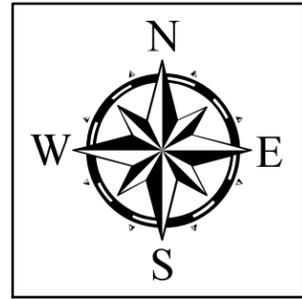
1. The results do not serve as a guarantee of service or availability of water.
2. The results are based on a hydraulic model and are not guaranteed to represent all field conditions.

## Attachments

1. Attachment A Figure 1 Conceptual Layout

**CC**

Matt Longshore, P.E.



**Legend**

- Demands\_Junctions
- - - Pipe\_Loop
- New\_Waterline
- Existing\_Waterline
- Parcel05

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCA, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

FIGURE NO.

1.0

TITLE  
CONCEPTUAL LAYOUT

SCALE  
1 inch = 600 feet

PROJECT

DATE  
11/2020

PROJ. NO.

OAK HILL FIREFLOW ANALYSIS



Dewberry Engineers Inc.  
4805 LAKE BROOK DRIVE, SUITE 200  
GLEN ALLEN, VIRGINIA 23060  
PHONE: 804.290.7957  
FAX: 804.290.7928





L:\2014\8806-Huguenot\_Hills\_PER/CADD/Water/Water\_Model\DWG\48806-WM1.dwg | Printed on 9/16/2021 11:11 AM by Scott Harvey



PIPE LEGEND

	NEW PIPE
	EXISTING PIPE

# TIMMONS GROUP

HUGUENOT HILLS  
GOCHLAND COUNTY - VIRGINIA

WATER SYSTEM HYDRAULIC ANALYSIS - LAYOUT

JOB NO.  
**48806**

SHEET NO.  
**WM1.0**

YOUR VISION ACHIEVED THROUGH OURS.

DATE	9/16/2021
DRAWN BY	S. HARVEY
DESIGNED BY	S. HARVEY
CHECKED BY	B. STRICKLAND
SCALE	N.T.S.

THIS DRAWING PREPARED AT THE  
**CORPORATE OFFICE**  
1001 Boulders Parkway, Suite 300 | Richmond, VA 23225  
TEL 804.200.6500 FAX 804.560.1016 www.timmons.com

REVISION DESCRIPTION	DATE

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# **APPENDIX C**

## **Existing Sewer Preliminary Investigation**



# Huguenot Hills Existing Sewer: Preliminary Investigation Report

**To:** Bruce Strickland, P.E. Timmons Group  
**From:** Chris Dommert, P.E. Timmons Group  
**Subject:** Huguenot Hills Existing Sewer: Preliminary Investigation Report  
**Date:** August 24, 2021

On July 13, 2021, Timmons Group conducted a field investigation to visually inspect the existing sanitary sewer infrastructure along Charities Road. The investigation began at the upstream extents of the sewer line at Manhole 6. Condition of the existing infrastructure was observed and documented using a zoomable pole camera. No defects were noted in any of the manhole structures; however, potential pipe defects were identified. The findings of the preliminary investigation are summarized below. Based on the defects observed, Timmons Group recommends a NASSCO PACP certified pipeline inspection using CCTV to thoroughly quantify and assess the severity of defects.

## **MANHOLE 6**

Manhole 6 was the uppermost manhole and had no upstream pipe connections. The structure contained an opening for a pipe in, but there was no pipe or plug in the upstream manhole boot, the rubber boot was deformed, and rocks and debris were visible in the boot. The downstream pipe out of Manhole 6 was partially crushed at the top. A sag was noted in the pipe near the connection to Manhole 5.

## **MANHOLE 5**

Sediment buildup was observed in the structure and a sag was visible in the downstream pipe connecting to Manhole 4.

## **MANHOLE 4**

Significant sediment accumulation was observed in Manhole 4. The upstream pipe was approximately 1/4 full, and the downstream pipe approximately 3/4 full, indicating the presence of a sag in each pipe.

## **MANHOLE 3**

A slight sag was observed in the upstream pipe. A sag was also visible in the downstream pipe.

## **MANHOLE 2**

A sag was visible in the upstream pipe to Manhole 3. The pipe did not fully extend into the structure, creating an obstruction in flow and a reduction in capacity.

## **MANHOLE 1**

A sag was noted in the upstream pipe to Manhole 2. The downstream invert out of Manhole 1 appeared to be approximately 4-6" higher than the Manhole bottom. Significant sediment accumulation was observed in the manhole sump.

### Attachments:

1. Existing Conditions Vicinity Map
2. Field Notes
3. Defect Photos



Meeting Memorandum

DESIGN  PHONE  C.A.

PROJECT: HUGUENOT HILLS 7-13-21

PROJECT NO.: 48806 DATE:

PARTICIPANTS: CHRIS D. JAMESC.

- SITE VISIT -

NOTES BY:

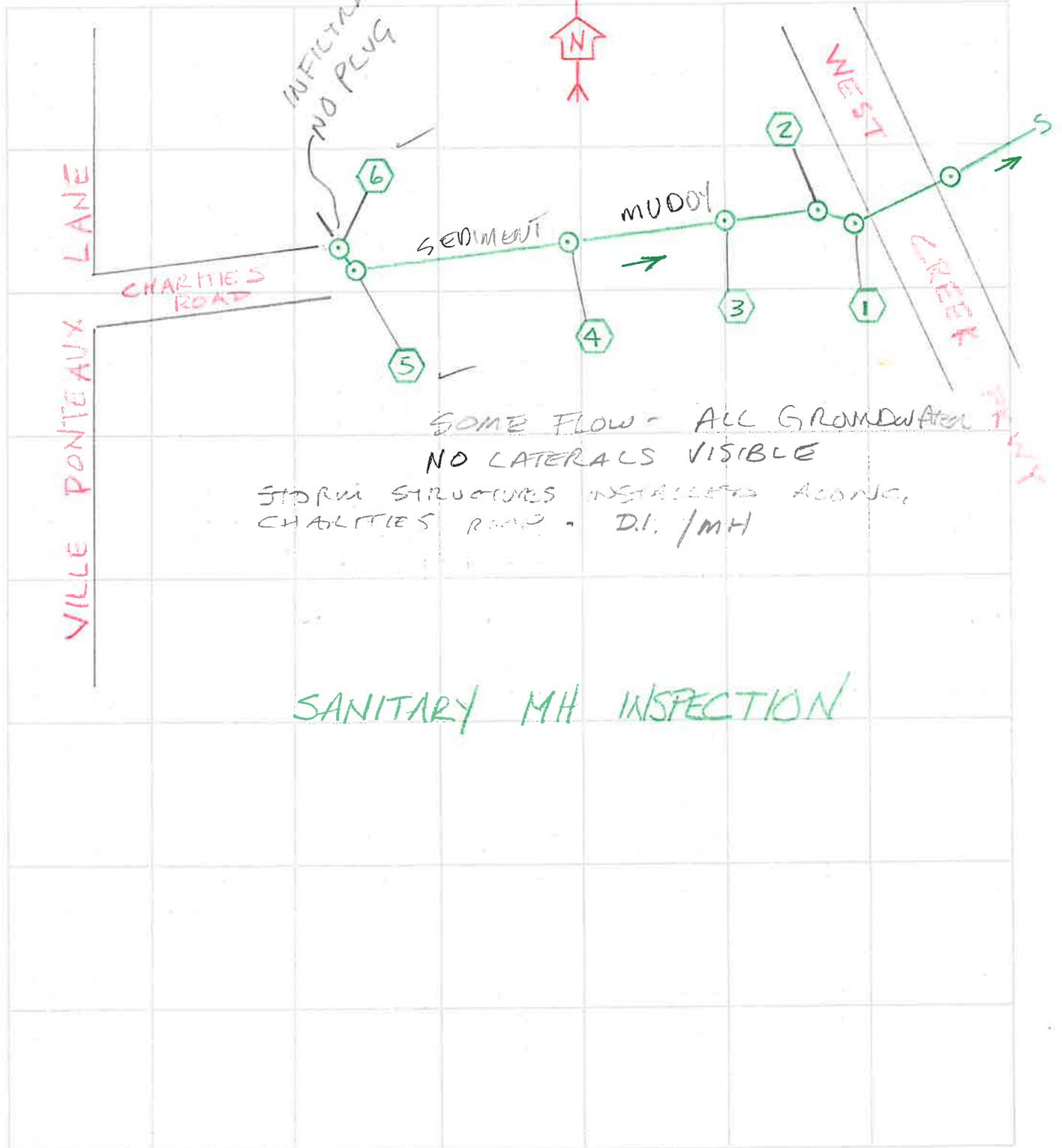


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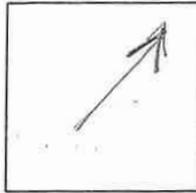
www.timmons.com



# MANHOLE 6

## SANITARY SEWER MANHOLE DATA SHEET

MINI SYSTEM H. HILLS  
 STREET CHARITIES ROAD UNIMP  
 MANHOLE # 6  
 DEPTH TO C/L TROUGH -12.70  
 MANHOLE DIAMETER 5'  
 MANHOLE MATERIAL CONC



NORTH

DATA: FOR EACH PIPE

1. INVERT
2. DIAMETER
3. MATERIAL
4. FLOW DIRECTION
5. UP/DOWN STREAM MH #

NOTES: NEW - GOOD SHAPE  
& STEPS

TOP OF PIPE IN MH  
IS CRUSHED 3/4

SOME INFLOW - INV. IN NOT  
CAPPED - ROCKS VISIBLE

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

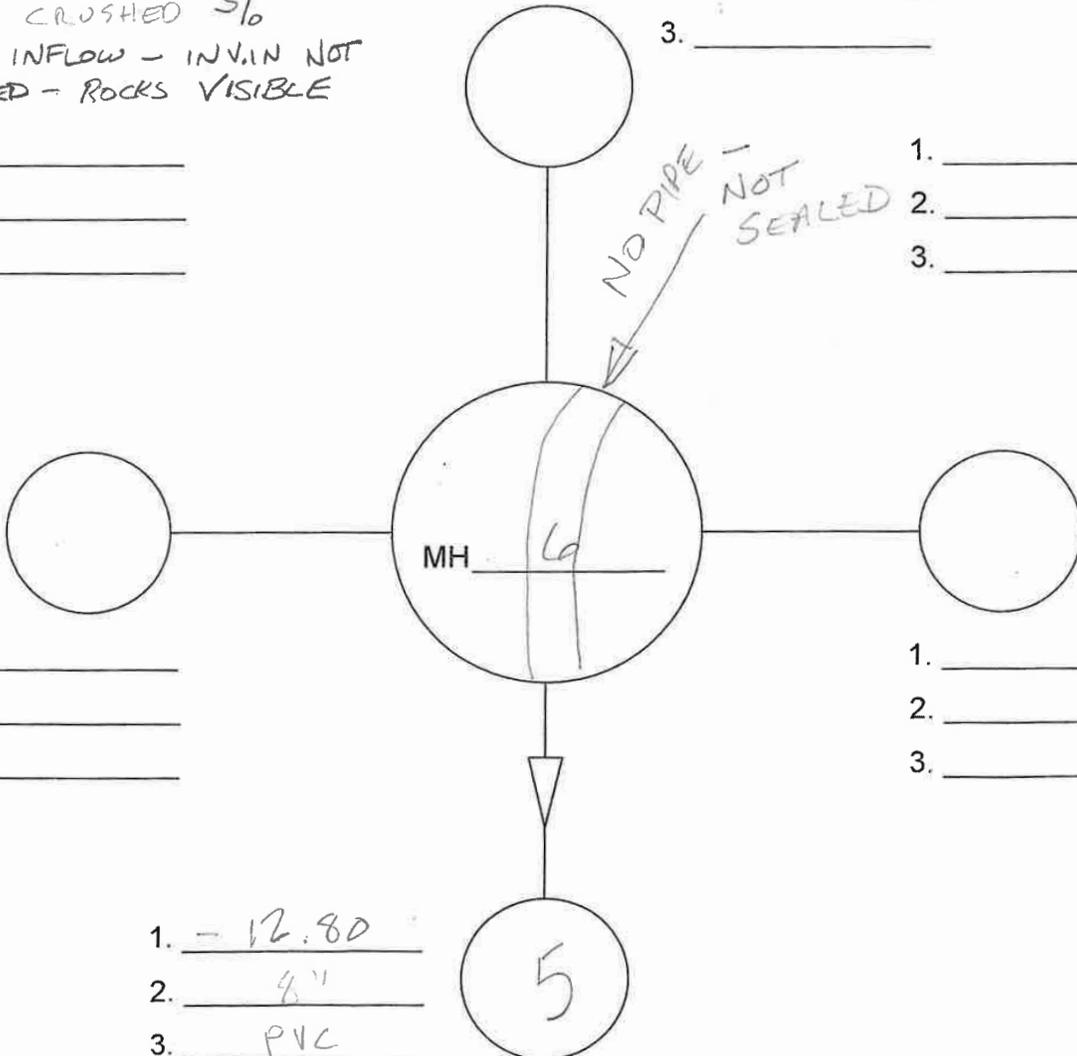
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. -12.80
2. 4"
3. PVC



TAKE PHOTO WITH INVERT OUT AT BOTTOM OF PHOTO



**Manhole 6 – Overhead View of Structure**



**Manhole 6 - View of Upstream Flexible Boot Without Pipe or Plug.**



TO MH 5  
HUGUENOT HILLS SEWER  
-  
07/13/2021 09:15 AM  
1.0X  
33P  
-2.2DEG  
DIST N/A  
-77.64648DEG W  
37.60231DEG N  
82.0FT

**Manhole 6 - View of Downstream Pipe, Partially Crushed at Top**



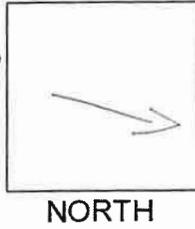
TO MH 5  
HUGUENOT HILLS SEWER  
-  
07/13/2021 09:16 AM  
2.9X  
8P  
-2.1DEG  
DIST N/A  
-77.64649DEG W  
37.60231DEG N  
82.0FT

**Manhole 6 - View of Sag in Downstream Pipe, Near Connection to Manhole 5**

# MANHOLE 5

## SANITARY SEWER MANHOLE DATA SHEET

MINI SYSTEM HUGUENOT HILLS  
 STREET CHARLITES ROAD UNIMP  
 MANHOLE # 5  
 DEPTH TO C/L TROUGH -12.75  
 MANHOLE DIAMETER 5"  
 MANHOLE MATERIAL CONC  
 NOTES: BENCH TROUGH NEW



- DATA: FOR EACH PIPE
1. INVERT
  2. DIAMETER
  3. MATERIAL
  4. FLOW DIRECTION
  5. UP/DOWN STREAM MH #

MH NEW - TRICKLE FLOW  
UPSTREAM TO 6 LOOKS LIKE  
LARGER BOOT/HOLE

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

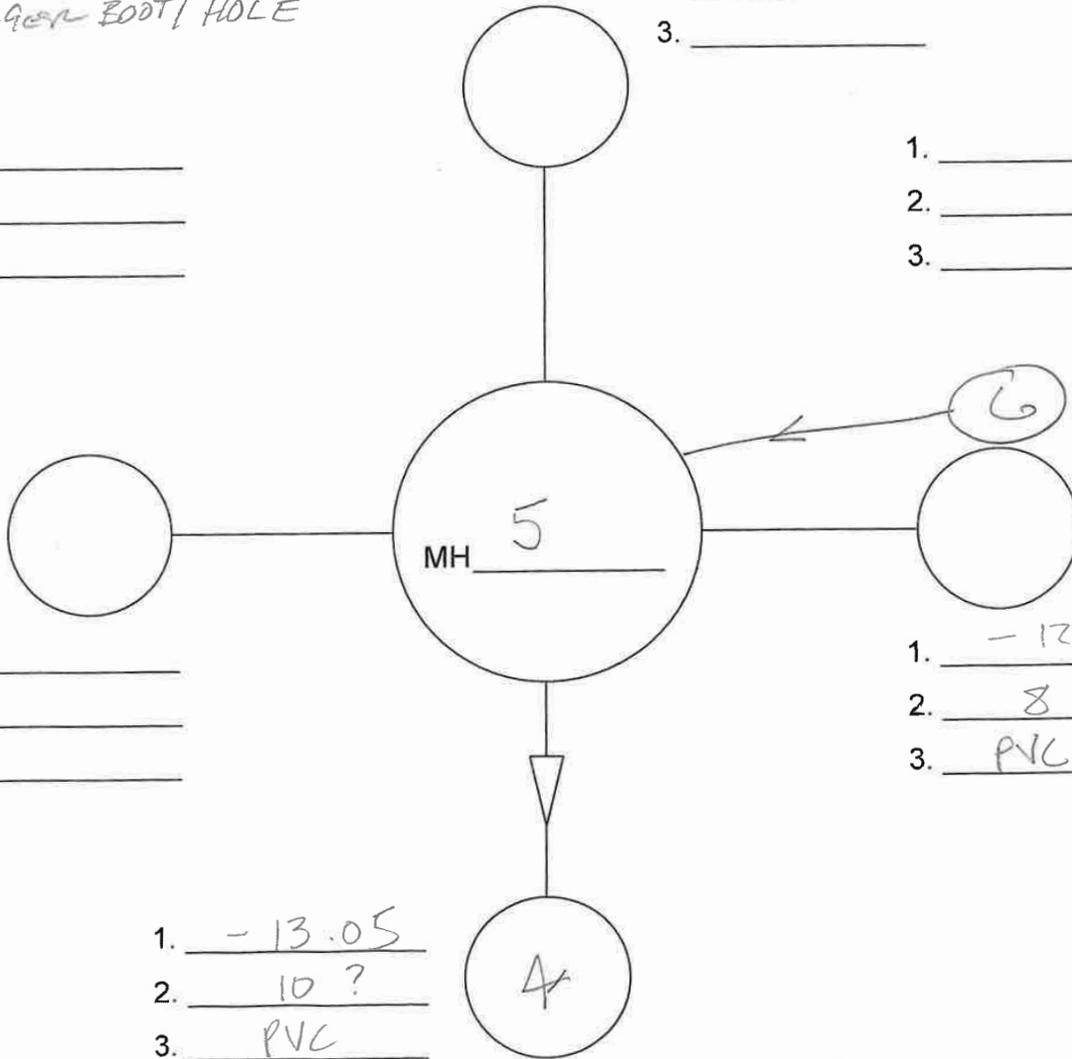
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. -12.85
2. 8
3. PVC

1. -13.05
2. 10 ?
3. PVC



TAKE PHOTO WITH INVERT OUT AT BOTTOM OF PHOTO



**Manhole 5 – Overhead View of Structure, Visible Sediment Buildup**

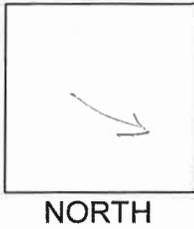


**Manhole 5 - View of Sag, Potential Offset Joint in Downstream Pipe**

# MANHOLE 4

## SANITARY SEWER MANHOLE DATA SHEET

MINI SYSTEM HUGUENOT HILLS  
 STREET CHARITIES ROAD UNIMP  
 MANHOLE # 4  
 DEPTH TO C/L TROUGH -13.8  
 MANHOLE DIAMETER 5'  
 MANHOLE MATERIAL CONC



- DATA: FOR EACH PIPE
1. INVERT
  2. DIAMETER
  3. MATERIAL
  4. FLOW DIRECTION
  5. UP/DOWN STREAM MH #

NOTES: NEW -  
STRAIGHT THRU  
TROUGH FULL OF MUD

1. -13.84
2. 8"
3. PVC

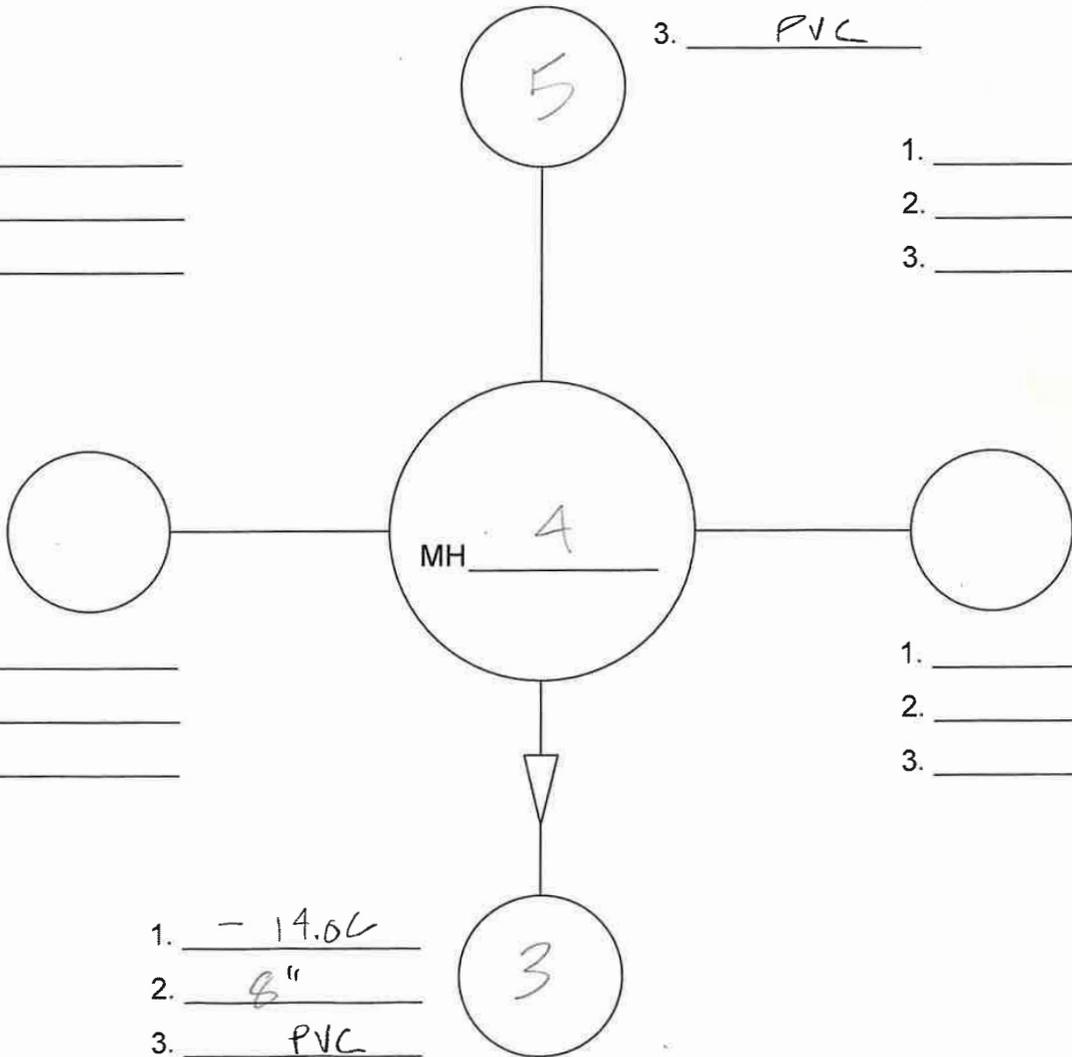
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. -14.06
2. 8"
3. PVC



TAKE PHOTO WITH INVERT OUT AT BOTTOM OF PHOTO



**Manhole 4 – Overhead View of Structure, Significant Sediment Buildup**



MH 4  
DOWNSTREAM TO MH 3  
HUGUENOT HILLS  
-  
07/13/2021 10:21 AM  
1.0X  
100P  
-1.4DEG  
DIST N/A  
-77.64534DEG W  
37.60249DEG N

**Manhole 4 – Downstream View of Backed Up Water Level**

MH 4  
UPSTREAM TO MH 5  
HUGUENOT HILLS

-  
07/13/2021 10:17 AM

30.1X

100P

1.3DEG

DIST N/A

-77.64532DEG W

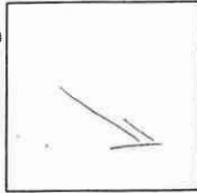
37.60251DEG N

**Manhole 4 – Upstream View of Backed Up Water Level**

# MANHOLE 3

## SANITARY SEWER MANHOLE DATA SHEET

MINI SYSTEM HUGUENOT HILLS  
 STREET CHARLOTTE ROAD UNIMP  
 MANHOLE # 3  
 DEPTH TO C/L TROUGH 11.20  
 MANHOLE DIAMETER 3'  
 MANHOLE MATERIAL CONC



NORTH

DATA: FOR EACH PIPE

1. INVERT
2. DIAMETER
3. MATERIAL
4. FLOW DIRECTION
5. UP/DOWN STREAM MH #

NOTES: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1. -11.10
2. 8"
3. PVC

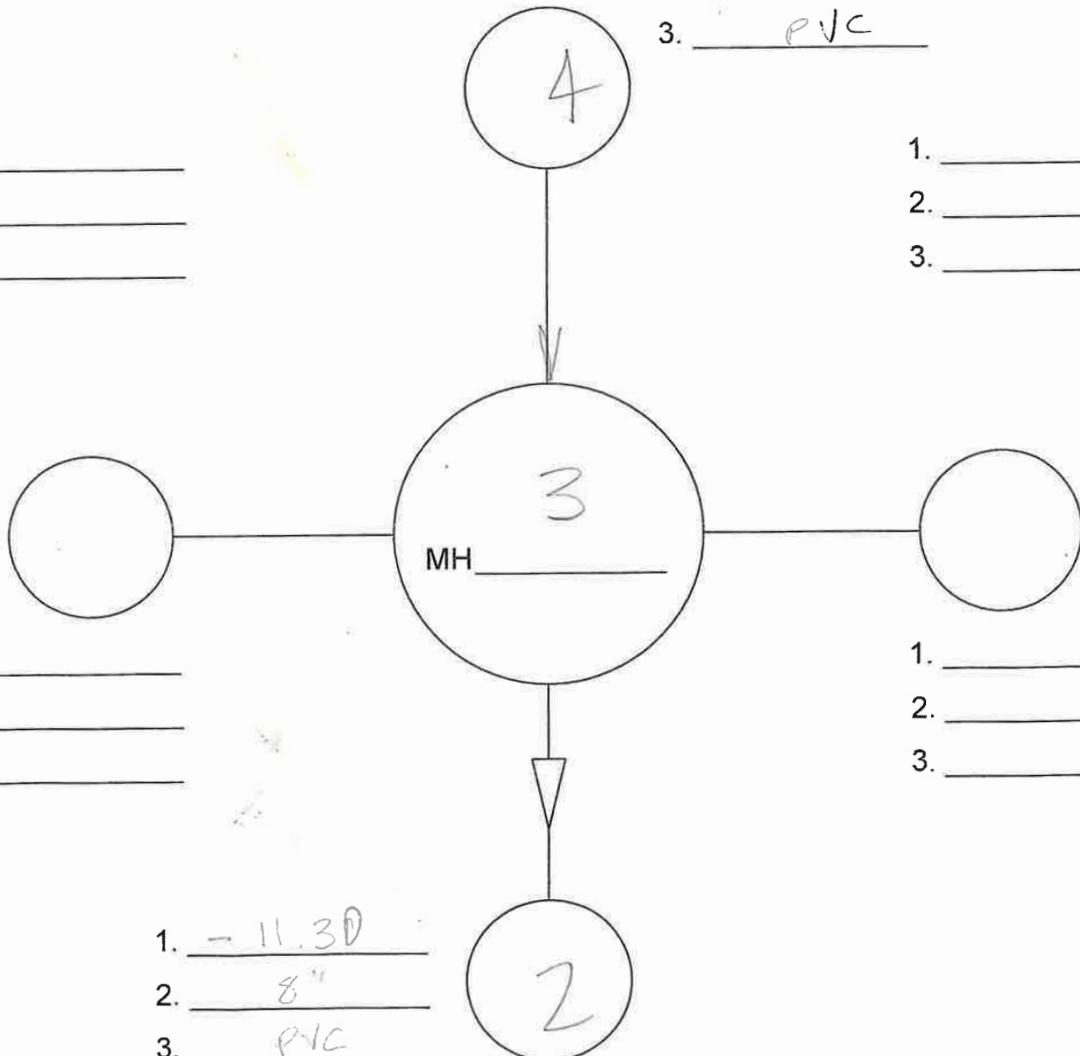
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. -11.30
2. 8"
3. PVC



TAKE PHOTO WITH INVERT OUT AT BOTTOM OF PHOTO



**Manhole 3 –Overhead View of Structure**



**Manhole 3 –View of Sag in Upstream Pipe**

MH 3  
DOWNSTREAM TO MH 2  
HUGUENOT HILLS

-  
07/13/2021 10:47 AM

5.9X

100P

-3.3DEG

DIST N/A

-77.64466DEG W

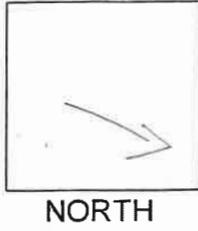
37.60259DEG N

**Manhole 3 –View of Sag in Downstream Pipe**

# MANHOLE 2

## SANITARY SEWER MANHOLE DATA SHEET

MINI SYSTEM HOAVENOT HILLS  
 STREET CHARITIES ROAD UNIMP  
 MANHOLE # 2  
 DEPTH TO C/L TROUGH -7.60  
 MANHOLE DIAMETER 4'  
 MANHOLE MATERIAL CONC



- DATA: FOR EACH PIPE
1. INVERT
  2. DIAMETER
  3. MATERIAL
  4. FLOW DIRECTION
  5. UP/DOWN STREAM MH #

NOTES: NEW - GOOD  
INV IN - PIPE IS BELOW  
TROUGH

1. -7.7
2. 8
3. PVC

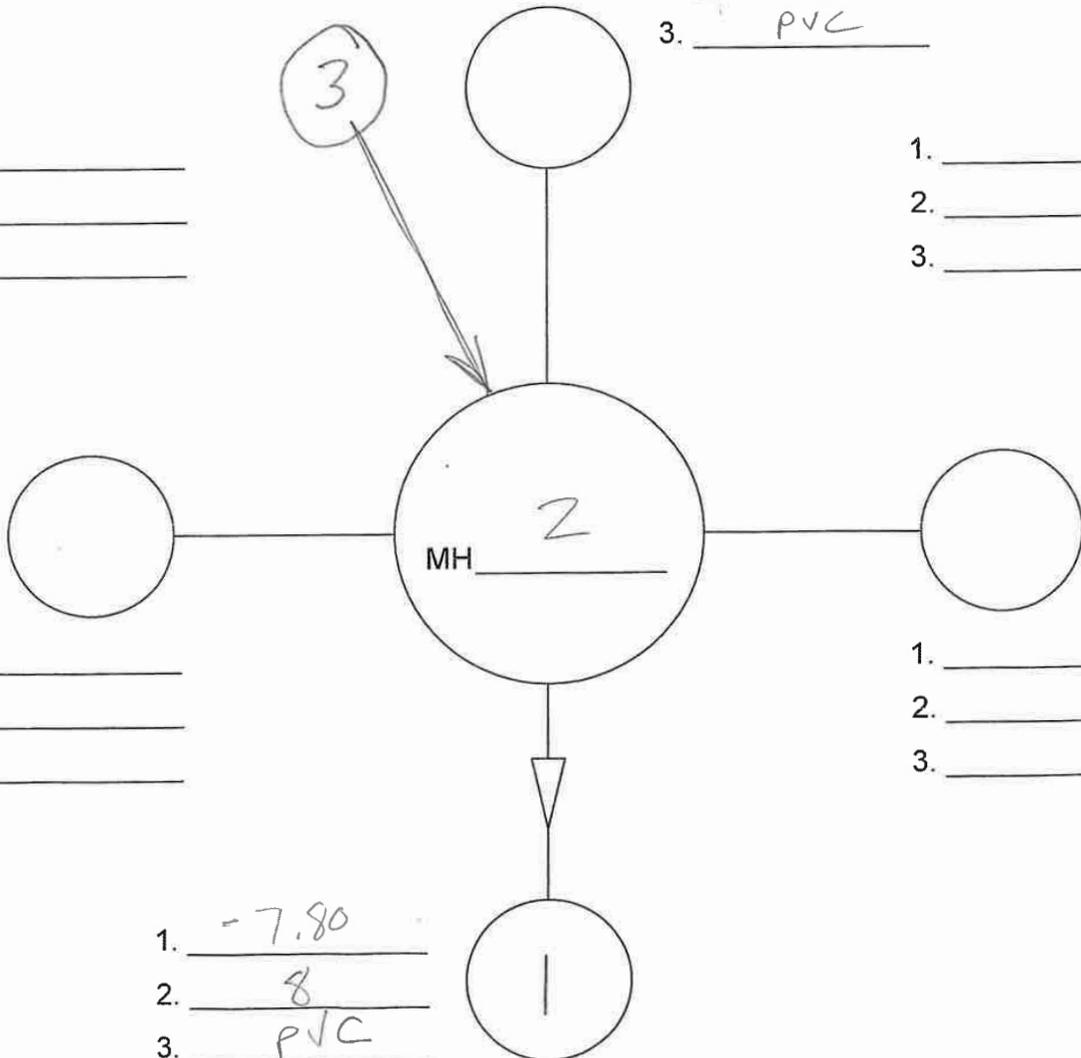
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. -7.80
2. 8
3. PVC



TAKE PHOTO WITH INVERT OUT AT BOTTOM OF PHOTO



**Manhole 2 –Overhead View of Structure**



**Manhole 2 –View of Sag in Upstream Pipe and Offset Connection into Structure**

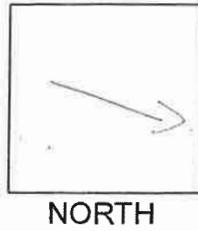


**Manhole 2 –Upstream View of Sag in Pipe**

# MANHOLE 1

## SANITARY SEWER MANHOLE DATA SHEET

MINI SYSTEM HAWKINS HILLS  
 STREET CHARITIES ROAD UNIMP  
 MANHOLE # 1  
 DEPTH TO C/L TROUGH -6.41  
 MANHOLE DIAMETER 4'  
 MANHOLE MATERIAL CONC



- DATA: FOR EACH PIPE
1. INVERT
  2. DIAMETER
  3. MATERIAL
  4. FLOW DIRECTION
  5. UP/DOWN STREAM MH #

NOTES: IN FROM 2 COMES  
IN HIGH - BOTTOM FULL  
OF MUD - RECOMMEND  
PAVEMENT INTERLACK

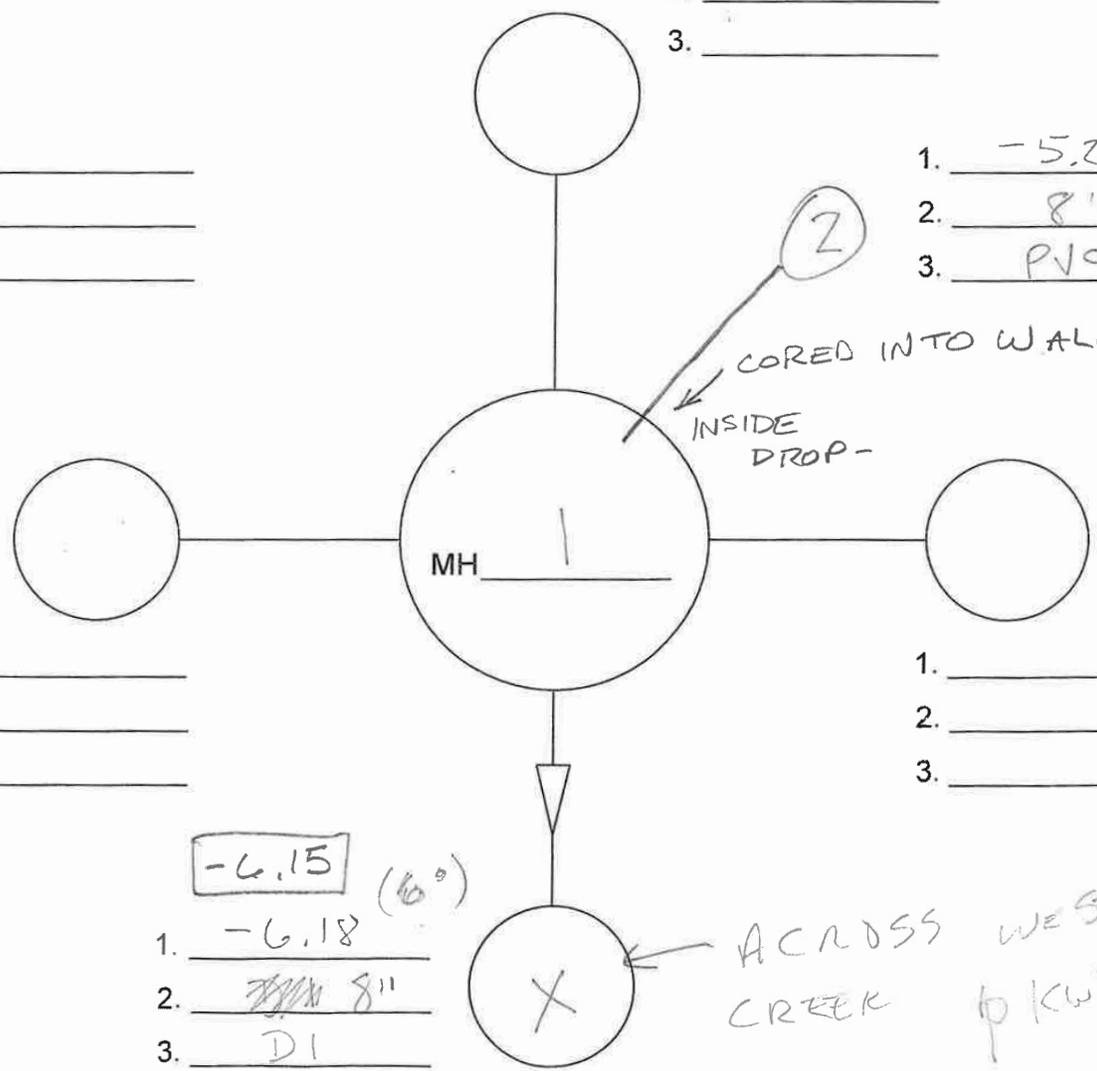
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. -5.26
2. 8"
3. PVC

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_



-6.15 (6°)  
 1. -6.18  
 2. 8"  
 3. DI

TAKE PHOTO WITH INVERT OUT AT BOTTOM OF PHOTO



**Manhole 1 –Overhead View of Structure, Sediment Accumulation in Manhole Sump**



**Manhole 1 –View of Sag in Upstream Pipe**

# **APPENDIX D**

## **Preliminary Geotechnical Exploration Report**

**PRELIMINARY GEOTECHNICAL EXPLORATION REPORT**

**HUGUENOT HILLS WATER AND SEWER DESIGN  
GOOCHLAND COUNTY, VIRGINIA**

**JOB NUMBER: 48806**

**PREPARED FOR:**

**GOOCHLAND COUNTY  
P.O. BOX 10  
GOOCHLAND COUNTY, VIRGINIA 23063**

**AUGUST 18, 2021**



**TIMMONS GROUP**

**YOUR VISION ACHIEVED THROUGH OURS.**

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## APPENDICES

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1001 Boulders Parkway  
Suite 300  
Richmond, VA 23225

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August 18, 2021

Goochland County  
P.O. Box 10  
Goochland County, Virginia 23063

Attention: Mr. Matt Longshore

Re: **Preliminary Geotechnical Exploration Report**  
Huguenot Hills Water and Sewer Design  
Goochland County, Virginia  
Timmons Group Project No. 48806

Mr. Longshore:

Timmons Group is pleased to submit this geotechnical exploration report for the referenced project. The objectives of our services were to explore subsurface conditions and summarize our findings.

## 1. PROJECT INFORMATION

The project is located along Rochelle Road and Ville Ponteaux Lane in Goochland County, Virginia. A Site Vicinity Map is shown on Figure 1. We understand that the project will consist of installing new underground sanitary sewer and water piping that will extend from Patterson Avenue to 1,500 feet to the north along Rochelle Road and Ville Ponteaux Lane. We assume that these utilities will be installed through open trench excavations.

## 2. FIELD EXPLORATION

The field exploration included a visual site reconnaissance by a representative of Timmons Group and the performance of seven soil test borings (B-01 through B-07). A summary of the boring exploration is provided below.

Boring locations were selected by Timmons Group. A representative of Timmons Group established boring locations in the field using GPS equipment. Approximate boring locations are shown on Figure 2 in Appendix A. Borings were performed to depths of approximately 9 to 24.3 feet below the existing ground surface with hollow stem auger drilling techniques. Split-spoon samples of subsurface soils were taken within soil test borings at approximate 2-foot intervals

above a depth of 10 feet and at 5-foot intervals below 10 feet. Standard Penetration Tests were conducted in conjunction with split-spoon sampling in general accordance with ASTM D 1586.

Water levels were measured in open boreholes at the time of drilling. Upon completion, boreholes were then backfilled up to the original ground surface with drill cuttings. Representative portions of split-spoon soil samples were returned to our laboratory for visual classification in general accordance with Unified Soil Classification System guidelines.

Boring logs and a generalized soil profile (Figures 3), which present specific information from the borings, are included in the Appendix. Stratification lines shown on the boring logs and profile are intended to represent approximate depths of changes in soil types. Naturally, transitional changes in soil types are often gradual and cannot be defined at particular depths. Ground surface elevations shown on these documents were interpolated from a GIS topographic plan and should be considered approximate.

### 3. SITE GEOLOGY

According to the 1993 Geologic Map of Virginia, the site is predominately located in the Piedmont Physiographic Province of Virginia. The Piedmont is characterized by low, rounded hills composed of saprolitic soils overlying folded metamorphic and igneous bedrock. Locally, the site appears to be underlain by the Newark Supergroup Triassic Sandstone. The majority of soils in the Piedmont were formed from the chemical weathering of parent bedrock and are termed “residual” soils.

### 4. SUBSURFACE CONDITIONS

The following is a summary of subsurface conditions encountered during the exploration.

#### 4.1 Ground Surface Cover

Borings B-01 and B-02 encountered 3 to 4 inches of surficial asphalt pavement. The remaining borings encountered approximately 3 to 6 inches of surficial topsoil (forest litter) or surficial gravel.

#### 4.2 Existing Fill Soils

Beneath the ground surface cover, existing fill soils were encountered in Borings B-02, B-05, and B-06 to depths of approximately 2 to 4 feet. These fill soils consisted of medium dense silty sand (SM). Standard Penetration Test (SPT) N-values within the fill ranged from 12 to 27 blows per foot (bpf).

### **4.3 Residual Soils**

Beneath the ground surface cover or fill soils in the previously mentioned locations, the majority of the borings encountered undisturbed residual soils to depths up to 22 feet below the ground surface. These soils consisted of medium stiff to hard highly plastic clay (CH), elastic silt (MH), low plasticity silt (ML), medium dense to dense clayey sand (SC), and silty sand (SM). SPT N-values within the soil profile ranged from 5 to 50 blows per foot (bpf).

### **4.4 Weathered Rock**

Weathered rock was encountered in all the borings at depths ranging from approximately 4 to 22 feet below the existing ground surface. Weathered rock is defined as a residual material having Standard Penetration Test N-values of 60 blows per foot or greater. Weathered rock was sampled as silty sand (SM), clayey sand (SC), elastic silt (MH), or low plasticity silt (ML).

### **4.5 Auger Refusal Materials**

Materials refusing auger advancement or spoon refusal were encountered in all of the borings, with the exception of B-04, at depths of approximately 9.0 to 19.1 feet below the ground surface. Auger refusal materials could represent competent bedrock, hard lenses within the weathered rock profile, or boulders.

### **4.6 Groundwater**

At the time of exploration, water was not encountered in the borings. It is important to realize that groundwater levels will fluctuate with changes in rainfall and evaporation rates. In addition, perched groundwater could be encountered within near-surface soils, particularly after rainfall.

## **5. CLOSURE**

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this report, or if we can be of further assistance, please contact us at (804) 200-6500.

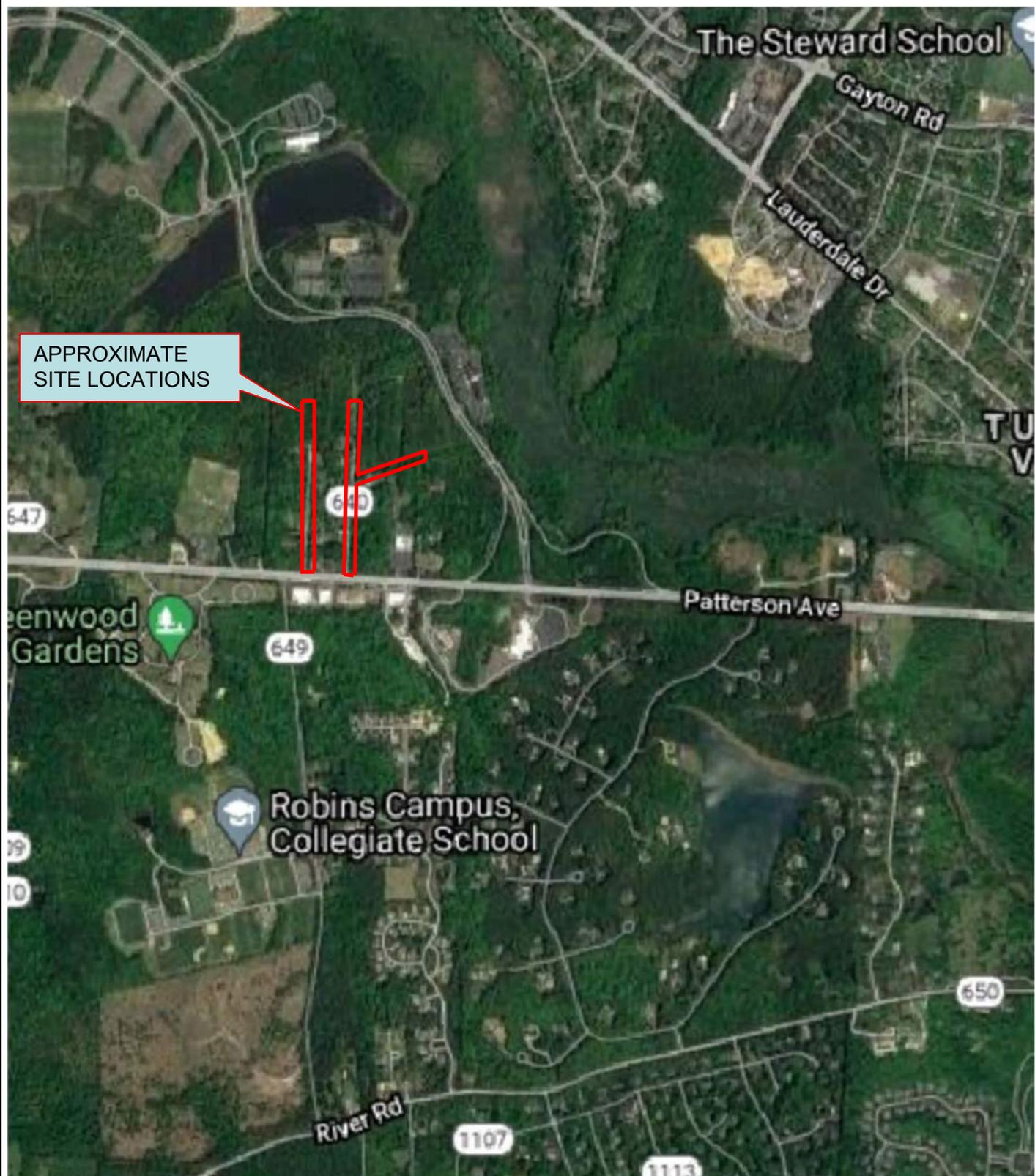
Respectfully submitted,  
**TIMMONS GROUP**



Julian M. Ruffin IV, P.E.  
Geotechnical Engineer

APPENDIX A  
FIGURES

NORTH ↑



Source: Google Maps

SCALE:	NTS
CHECKED BY:	JNR
PLOTTED BY:	JMR
DATE:	07-21-2021

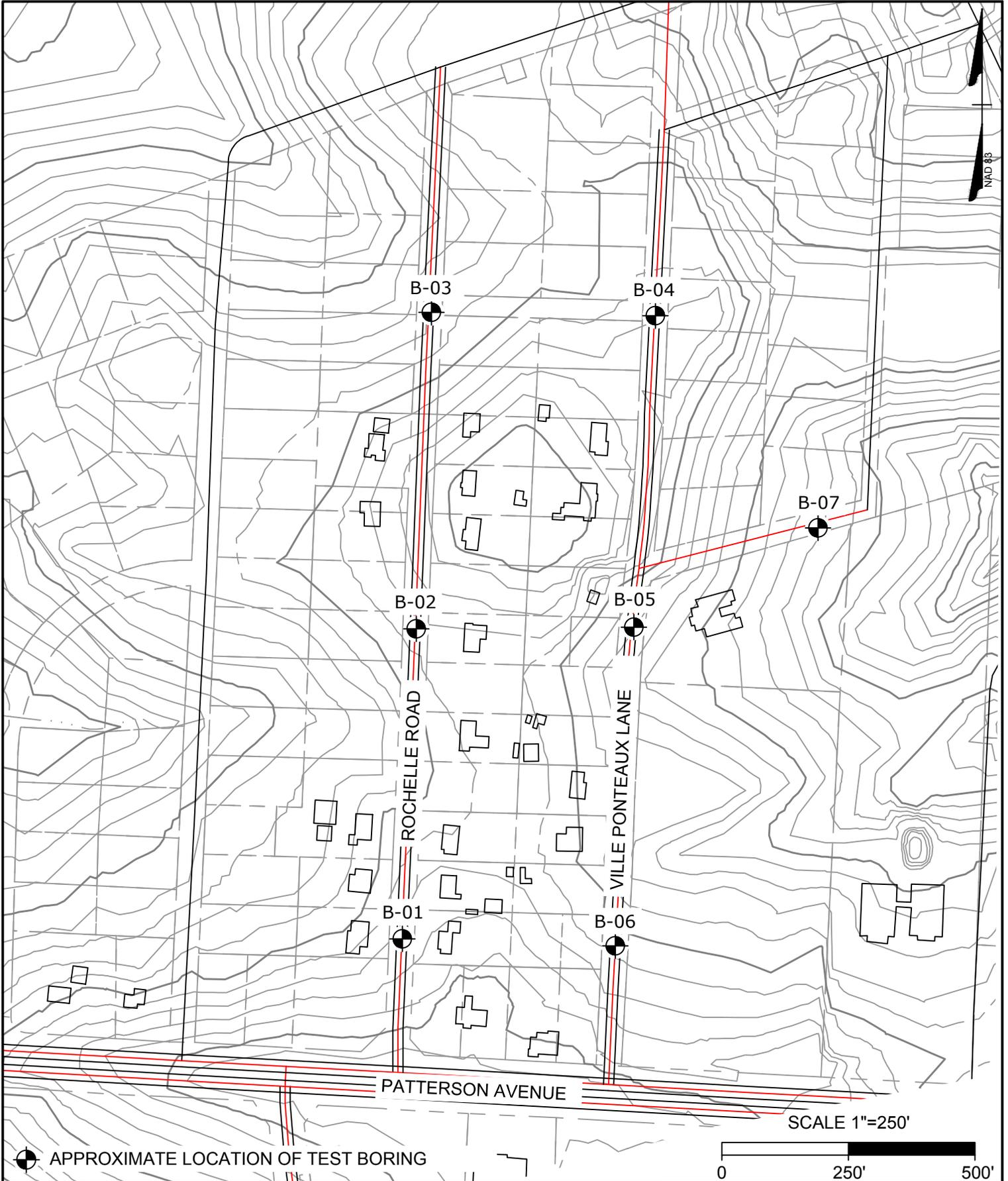


**TIMMONS GROUP**  
YOUR VISION ACHIEVED THROUGH OURS.

PROJECT NUMBER: 48806

**SITE VICINITY MAP**  
HUGUENOT HILLS  
WATER AND SEWER DESIGN  
GOOCHLAND COUNTY, VA

FIGURE  
**1**



**TIMMONS GROUP**

YOUR VISION ACHIEVED THROUGH OURS.

THIS DRAWING PREPARED AT THE  
Corporate Headquarters  
1001 Boulders Parkway | Richmond, VA 23225  
TEL 804-200-5500 FAX 804-560-1016 www.timmons.com

JOB NO. 48806	HUGUENOT HILLS WATER AND SEWER DESIGN				DATE	REVISION DESCRIPTION
	GOOCHLAND COUNTY - VIRGINIA					
SHEET NO. 2	BORING LOCATION PLAN				DATE	
	AS SHOWN	CHECKED BY J. RUFFIN	DESIGNED BY J. RUFFIN	DRAWN BY J. RUFFIN		

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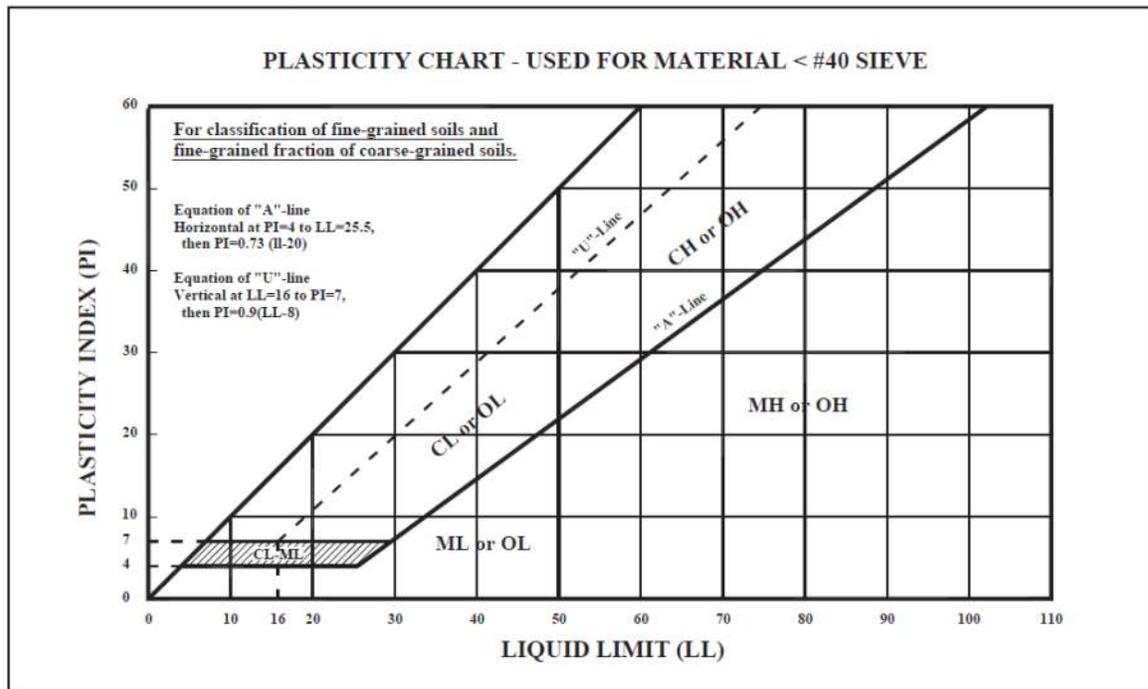


APPENDIX B  
BORING LOGS

### KEY TO BORING LOG TERMINOLOGY

Relative Density – Used for soils with less than 50% passing No. 200 sieve		Consistency – Used for soils with 50 percent or more passing No. 200 sieve	
Relative Density	SPT N-Value (blows/ft)	Consistency	SPT N-Value (blows/foot)
Very Loose	0 to 3	Very Soft	0 to 1
Loose	4 to 9	Soft	2 to 4
Medium Dense	10 to 29	Medium Stiff	5 to 8
Dense	30 to 50	Stiff	9 to 15
Very Dense	Greater than 50	Very Stiff	16 to 30
		Hard	31 to 50
		Very Hard	Greater than 50

Grain Size Terminology (U.S. Standard Sieves)		Natural Moisture Content	
Term	Particle Size		
Boulder	12 inches +	Dry	Very little apparent moisture, dusty
Cobble	3 to 12 inches		
Coarse Gravel	¾ to 3 inches	Moist	Damp, but no free water visible
Fine Gravel	#4 to ¾ inches		
Coarse Sand	#10 to #4		
Medium Sand	#40 to #10	Wet	Visible free water, or in cohesive soil, clearly saturated
Fine Sand	#200 to #40		
Silt and Clay	<#200		



# SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
<p><b>COARSE GRAINED SOILS</b></p> <p>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE</p>	<p><b>GRAVEL AND GRAVELLY SOILS</b></p>	<p>CLEAN GRAVELS</p> <p>(LITTLE OR NO FINES)</p>		<b>GW</b>	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		<b>GP</b>	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		<b>GM</b>	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	<p><b>SAND AND SANDY SOILS</b></p>	<p>CLEAN SANDS</p> <p>(LITTLE OR NO FINES)</p>		<b>SW</b>	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				<b>SP</b>	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		<b>SM</b>	SILTY SANDS, SAND - SILT MIXTURES
			<b>SC</b>	CLAYEY SANDS, SAND - CLAY MIXTURES	
	<p><b>FINE GRAINED SOILS</b></p> <p>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE</p>	<p><b>SILTS AND CLAYS</b></p> <p>LIQUID LIMIT LESS THAN 50</p>		<b>ML</b>	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				<b>CL</b>	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			<b>OL</b>	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
<p><b>SILTS AND CLAYS</b></p> <p>LIQUID LIMIT GREATER THAN 50</p>			<b>MH</b>	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS	
			<b>CH</b>	INORGANIC CLAYS OF HIGH PLASTICITY	
			<b>OH</b>	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
<p><b>HIGHLY ORGANIC SOILS</b></p>				<b>PT</b>	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS



Timmons Group, Inc.  
1001 Boulders Parkway Suite 300  
Richmond, VA 23225

**PROJECT NUMBER** 48806 **PROJECT NAME** Huguenot Hills Water and Sewer Design  
**CLIENT** Goochland County **PROJECT LOCATION** Goochland County  
**DATE STARTED** 7/23/21 **COMPLETED** 7/23/21 **GROUND ELEVATION** 204 ft **HOLE DEPTH** 13.5 feet  
**DRILLING CONTRACTOR** Ayers & Ayers, Inc. **BOREHOLE WATER LEVELS:**  
**DRILLING METHOD** Hollow Stem Auger **AT END OF DRILLING** --- not encountered  
**LOGGED BY** Julian Ruffin **CHECKED BY** J. Ruffin, P.E. **AT 24 HOURS DRILLING** ---  
**NOTES** \_\_\_\_\_ **CAVE DEPTH** \_\_\_\_\_

TG GEOTECH BH LOG V2.0 - GINT STD US LAB GDT - 7/28/21 14:06 - Y:\1801\GEOTECH\PROJECTS\2021\PROJECTS\48806.L01-0002 - HUGUENOT HILLS - GOOCHLAND COUNTY\LOGS\HUGUENOT.GPJ

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0		ASPHALT: (4 Inches)		S-1, SPT 7-6-6 (12)			
		SILTY SAND, (SM): brown and gray, fine to medium grained, moist, medium dense No Recovery		S-2, SPT 8-4-6 (10)			
5	200	CLAYEY SAND, (SC): light orangeish brown and gray, fine to coarse grained, moist, very dense, weathered decomposed rock		S-3, SPT 62/12"			
		SILT, (ML): light brown, moist, very hard, trace sand, weathered decomposed rock		S-4, SPT 11-24-38 (62)			
10	195			S-5, SPT 36-39-50 (89)			

Refusal at 13.5 feet.  
Bottom of borehole at 13.5 feet.

S-6, SPT  
50/0"



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Richmond, VA 23225

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**CLIENT** Goochland County      **PROJECT LOCATION** Goochland County  
**DATE STARTED** 7/23/21      **COMPLETED** 7/23/21      **GROUND ELEVATION** 203 ft      **HOLE DEPTH** 9 feet  
**DRILLING CONTRACTOR** Ayers & Ayers, Inc.      **BOREHOLE WATER LEVELS:**  
**DRILLING METHOD** Hollow Stem Auger      **AT END OF DRILLING** --- not encountered  
**LOGGED BY** Julian Ruffin      **CHECKED BY** J. Ruffin, P.E.      **AT 24 HOURS DRILLING** ---  
**NOTES** \_\_\_\_\_      **CAVE DEPTH** \_\_\_\_\_

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DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0		ASPHALT: (3 Inches)		S-1, SPT 8-6-6 (12)			
	200	SILTY SAND, (SM): gray, fine to coarse grained, moist, medium dense, fill Brown and gray, trace gravel		S-2, SPT 7-6-7 (13)			
5		SILTY SAND, (SM): brown and gray, fine to coarse grained, moist, very dense, trace mica, weathered decomposed rock		S-3, SPT 50/5"			
	195	SANDY SILT, (ML): orangeish brown and gray, moist, very hard, weathered decomposed rock		S-4, SPT 11-32-50 (82)			

Refusal at 9.0 feet.  
Bottom of borehole at 9.0 feet.

S-5, SPT  
50/0"



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 1001 Boulders Parkway Suite 300  
 Richmond, VA 23225

**PROJECT NUMBER** 48806 **PROJECT NAME** Huguenot Hills Water and Sewer Design  
**CLIENT** Goochland County **PROJECT LOCATION** Goochland County  
**DATE STARTED** 7/23/21 **COMPLETED** 7/23/21 **GROUND ELEVATION** 196 ft **HOLE DEPTH** 13 feet  
**DRILLING CONTRACTOR** Ayers & Ayers, Inc. **BOREHOLE WATER LEVELS:**  
**DRILLING METHOD** Hollow Stem Auger **AT END OF DRILLING** --- not encountered  
**LOGGED BY** Julian Ruffin **CHECKED BY** J. Ruffin, P.E. **AT 24 HOURS DRILLING** ---  
**NOTES** \_\_\_\_\_ **CAVE DEPTH** \_\_\_\_\_

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DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0							
	195	Topsoil, (4 Inches)		S-1, SPT 9-8-6 (14)			
		SILTY SAND, (SM): brown and gray, fine to coarse grained, moist, medium dense		S-2, SPT 6-6-8 (14)			
		ELASTIC SILT WITH SAND, (MH): orangeish brown and gray, moist, stiff		S-3, SPT 5-8-12 (20)			
5		Gray		S-4, SPT 7-18-32 (50)			
	190	Light brown and gray, hard		S-5, SPT 17-35-37 (72)			
10		SANDY SILT, (ML): brown, moist, very hard, weathered decomposed rock					
	185						

Refusal at 13.0 feet.  
 Bottom of borehole at 13.0 feet.

S-6, SPT  
50/0"



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Richmond, VA 23225

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**CLIENT** Goochland County **PROJECT LOCATION** Goochland County  
**DATE STARTED** 7/20/21 **COMPLETED** 7/20/21 **GROUND ELEVATION** 204 ft **HOLE DEPTH** 24.33 feet  
**DRILLING CONTRACTOR** Ayers & Ayers, Inc. **BOREHOLE WATER LEVELS:**  
**DRILLING METHOD** Hollow Stem Auger **AT END OF DRILLING** --- not encountered  
**LOGGED BY** Julian Ruffin **CHECKED BY** J. Ruffin, P.E. **AT 24 HOURS DRILLING** ---  
**NOTES** \_\_\_\_\_ **CAVE DEPTH** \_\_\_\_\_

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DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0							
		CRUSHED STONE: (3 Inches)		S-1, SPT 17-14-17 (31)			
		ELASTIC SILT WITH SAND, (MH): orangeish brown and gray, moist, hard Orangeish brown, stiff		S-2, SPT 5-7-8 (15)			
5	200	CLAYEY SAND, (SC): reddish brown and gray, fine to coarse grained, moist, medium dense		S-3, SPT 6-9-10 (19)			
				S-4, SPT 7-9-11 (20)			
10	195	SILTY SAND, (SM): light brown and gray, fine to coarse grained, moist, dense		S-5, SPT 10-20-20 (40)			
15	190	Medium dense		S-6, SPT 16-9-18 (27)			
20	185	ELASTIC SILT WITH SAND, (MH): brown and gray, moist, very stiff		S-7, SPT 5-10-12 (22)			
	180	ELASTIC SILT, (MH): brown and gray, moist, very hard, trace sand, weathered decomposed rock		S-8, SPT 68/10"			

Bottom of borehole at 24.3 feet.



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**CLIENT** Goochland County **PROJECT LOCATION** Goochland County  
**DATE STARTED** 7/20/21 **COMPLETED** 7/20/21 **GROUND ELEVATION** 196 ft **HOLE DEPTH** 19.1 feet  
**DRILLING CONTRACTOR** Ayers & Ayers, Inc. **BOREHOLE WATER LEVELS:**  
**DRILLING METHOD** Hollow Stem Auger **AT END OF DRILLING** --- not encountered  
**LOGGED BY** Julian Ruffin **CHECKED BY** J. Ruffin, P.E. **AT 24 HOURS DRILLING** ---  
**NOTES** \_\_\_\_\_ **CAVE DEPTH** \_\_\_\_\_

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DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0							
	195	CRUSHED STONE: (6 Inches)		S-1, SPT 14-13-11 (24)			
		SILTY SAND, (SM): gray and black, fine to coarse grained, moist, very dense, Contains gravel, fill		S-2, SPT 3-3-4 (7)			
		FAT CLAY, (CH): brown and gray, moist, medium stiff		S-3, SPT 7-17-25 (42)			
5		SILTY SAND, (SM): gray, fine to medium grained, moist, dense		S-4, SPT 80/9"			
	190	SILTY SAND, (SM): brown, fine to coarse grained, moist, very dense, weathered decomposed rock		S-5, SPT 76/10"			
10				S-6, SPT 50/4"			
	185						
15							
	180						

Refusal at 19.1 feet.  
Bottom of borehole at 19.1 feet.

S-7, SPT 50/1"



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**CLIENT** Goochland County **PROJECT LOCATION** Goochland County  
**DATE STARTED** 7/20/21 **COMPLETED** 7/20/21 **GROUND ELEVATION** 202 ft **HOLE DEPTH** 19.1 feet  
**DRILLING CONTRACTOR** Ayers & Ayers, Inc. **BOREHOLE WATER LEVELS:**  
**DRILLING METHOD** Hollow Stem Auger **AT END OF DRILLING** --- not encountered  
**LOGGED BY** Julian Ruffin **CHECKED BY** J. Ruffin, P.E. **AT 24 HOURS DRILLING** ---  
**NOTES** \_\_\_\_\_ **CAVE DEPTH** \_\_\_\_\_

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DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0							
	200	CRUSHED STONE: (4 Inches)		S-1, SPT 9-11-16 (27)			
		SILTY SAND, (SM): brown and gray, fine to medium grained, moist, medium dense, fill		S-2, SPT 3-3-3 (6)			
5		FAT CLAY WITH SAND, (CH): orangeish brown and gray, moist, medium stiff		S-3, SPT 2-2-3 (5)			
		Brown and gray					
	195	ELASTIC SILT WITH SAND, (MH): dark orangeish brown and gray, moist, very hard, weathered decomposed rock		S-4, SPT 5-10-50 (60)			
10		SANDY SILT, (ML): brown and gray, moist, very hard, Contains clay lenses, weathered decomposed rock		S-5, SPT 16-16-46 (62)			
	190						
		SILTY SAND, (SM): brown, fine to coarse grained, moist, very dense, weathered decomposed rock		S-6, SPT 50/4"			
15							
	185						

Refusal at 19.1 feet.  
Bottom of borehole at 19.1 feet.

S-7, SPT  
50/1"



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**CLIENT** Goochland County **PROJECT LOCATION** Goochland County  
**DATE STARTED** 7/20/21 **COMPLETED** 7/20/21 **GROUND ELEVATION** 184 ft **HOLE DEPTH** 19 feet  
**DRILLING CONTRACTOR** Ayers & Ayers, Inc. **BOREHOLE WATER LEVELS:**  
**DRILLING METHOD** Hollow Stem Auger **AT END OF DRILLING** --- not encountered  
**LOGGED BY** Julian Ruffin **CHECKED BY** J. Ruffin, P.E. **AT 24 HOURS DRILLING** ---  
**NOTES** \_\_\_\_\_ **CAVE DEPTH** \_\_\_\_\_

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DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0		TOPSOIL: (3 Inches)		S-1, SPT 4-4-5 (9)			
		FAT CLAY, (CH): orangeish brown and gray, moist, stiff		S-2, SPT 5-9-11 (20)			
5	180	ELASTIC SILT WITH SAND, (MH): brown and gray, moist, very stiff		S-3, SPT 6-9-14 (23)			
		SILT WITH SAND, (ML): black and dark gray, moist, hard		S-4, SPT 9-16-15 (31)			
10	175	SILT WITH SAND, (ML): brown and dark gray, moist, very hard, weathered decomposed rock		S-5, SPT 6-12-15 (27)			
15	170	Light brown		S-6, SPT 16-30-50 (80)			
	165						

Refusal at 19.0 feet.  
Bottom of borehole at 19.0 feet.

S-7, SPT  
50/0"