



**PRELIMINARY DRAINAGE STUDY  
FOREST HILL AVENUE**

HATHAWAY ROAD TO POWHITE PARKWAY  
*(Project 000-127-155, PE105)*  
*City of Richmond, Virginia*

*December 15, 2009*

*Stantec Project No. 171000608*

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# **SECTION 1**

## **PRELIMINARY DRAINAGE NARRATIVE**

## PRELIMINARY DRAINAGE STUDY

### FOREST HILL AVENUE WIDENING PROJECT (PROJECT 000-127-155, PE100) HATHAWAY RD. TO POWHITE PARKWAY CITY OF RICHMOND, VA

#### PROJECT DESCRIPTION

The project provides for the widening of 0.62 miles of Forest Hill Avenue from approximately 400' east of Hathaway Road to the west end of the bridge over Powhite Parkway. The existing roadway is a 4-lane, undivided roadway section with shoulders and roadside ditches (*Fig. 1.1*). This project will include widening Forest Hill Avenue to a 4-lane, divided section with a raised median, sidewalks, street lighting, landscaping, curbs and gutters, and storm sewer (*Fig. 1.2*).



Figure 1.1 - Existing Forest Hill Avenue

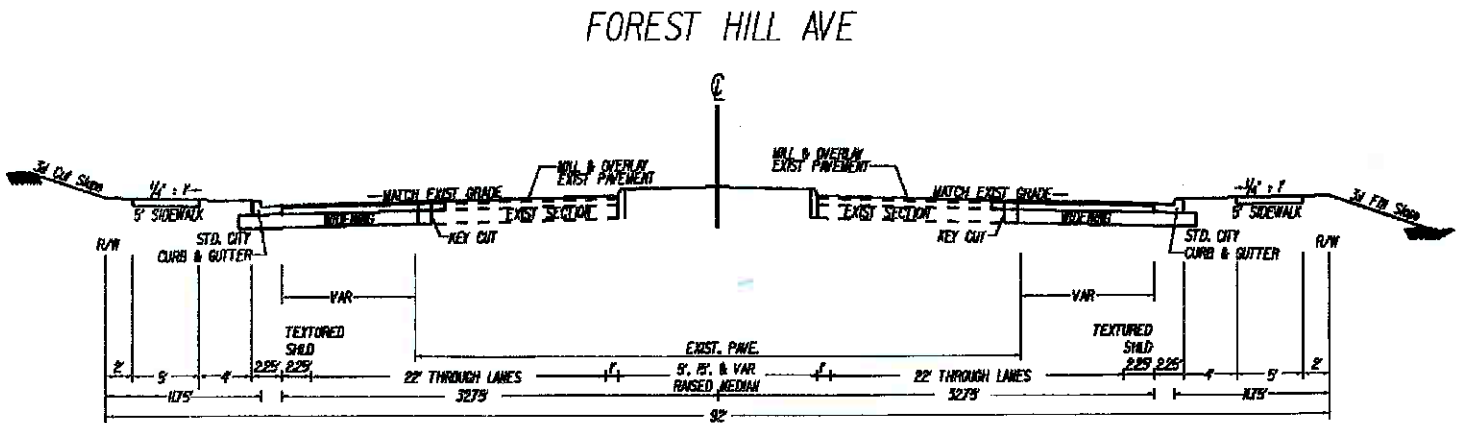


Figure 1.2 - Proposed Forest Hill Avenue Typical Section

### **EXISTING DRAINAGE AREA CONDITIONS**

This project falls within the James River watershed. Existing drainage along the roadway outfalls to two major basins: the Powhite Creek Basin and Willow Oaks Basin (see *Figure 1.4*). Between Hathaway Road and Powhite Parkway, existing networks of drainage channels fall within the neighborhoods on both the north and south sides of Forest Hill Avenue. As depicted in the *Figure 1.4*, portions of Forest Hill Avenue fall within designated Resource Protection Areas (RPAs) and Resource Management Area (RMAs)

In many areas, the drainage channels within these neighborhoods are inadequate under existing conditions (see *Figure 1.3*). Through field observation and discussions with City Public Utilities and Public Works staff, many of the channel banks are severely undercut or are experiencing severe erosion problems. In addition, the channel banks are routinely breached during large storms, causing flooding on adjacent properties.



**Figure 1.3 – Existing Channel**

As shown in the enclosed map, titled “**Forest Hill Avenue Existing (Pre) Drainage Areas**”, the existing roadway drainage between Melbourne Drive (the approximate western project limit) and Heartwood Road outfalls on the north side of Forest Hill Avenue, to the Willow Oaks Basin. An existing 18” reinforced concrete pipe, located between Norcross Road and Rettig Road, conveys the roadside drainage from the south side of Forest Hill to the north side. With the absence of well-defined roadside ditches between Windsorview Road and Rettig road, much of the drainage on the north side of Forest Hill Avenue drains to undefined outfalls. Defined outfall points occur at Windsorview Road and the existing 18” culvert (*Figure 1.5*).



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**SECTION 1**

**PRELIMINARY DRAINAGE  
NARRATIVE**



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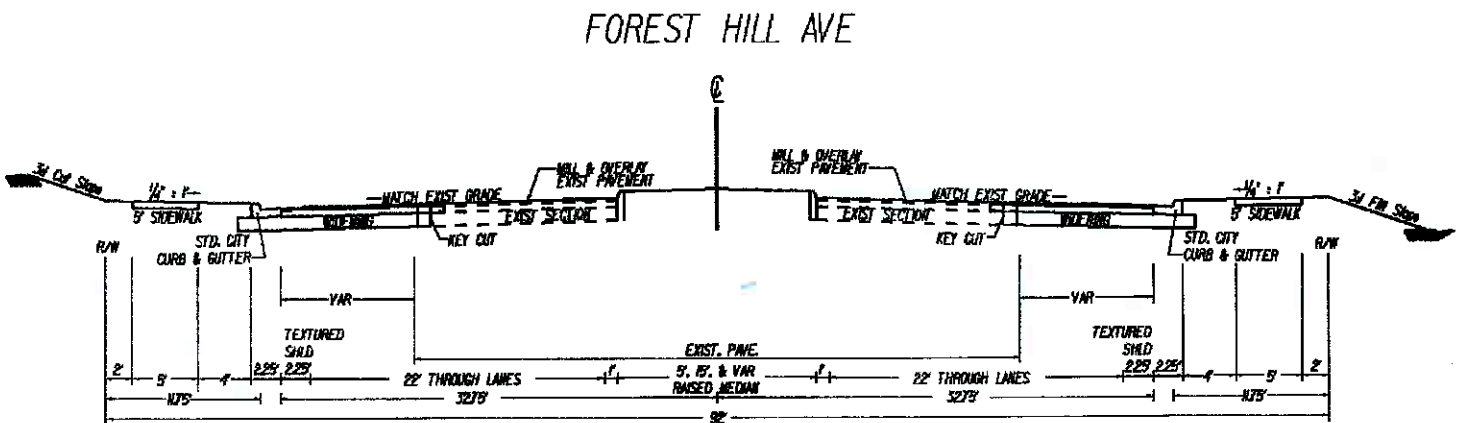


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(Not to Scale)

Figure 1.4 - Chesapeake Bay Preservation Areas

Source:  
 City of Richmond  
 Ord. # 2004-331-321  
 Passed 12/13/04



**Figure 1.5 – Existing 18” Outfall**

Drainage to the west of Heartwood Road flows to the Powhite Creek Basin. A tributary to the James River, Powhite Creek has a contributing drainage area of 12.09 square miles at its mouth. Forest Hill Avenue lies approximately 2,800 feet above the mouth of the creek. The estimates contributing drainage area of Powhite Creek at Forest Hill Avenue is at least 10 square miles.

Most of the existing drainage along Forest Hill Avenue west of Heartwood Road flows to an existing outfall, labeled “Powhite Creek Outfall” in the enclosed map, through an existing 42” concrete pipe. This outfall’s contributing area includes about 9.3 acres of off-site drainage from the Willow Oaks Country Club property, as well as

*Table 1.1* summarizes several of the defined existing outfalls along Forest Hill Avenue:

Exist. Basin No.	Area (Ac.)	C	Tc (min.)	I <sub>2</sub> (in/hr)	I <sub>10</sub> (in/hr)	Q <sub>2</sub> (cfs)	Q <sub>10</sub> (cfs)	Description
1	1.09	0.75	5	5.32	7.07	4.35	5.78	Windsorview Dr. – west roadside ditch
2,3	3.90	0.52	5	5.32	7.07	10.78	14.34	Outfall 18” RCP
9	0.10	0.85	5	5.32	7.07	0.45	0.60	Windsorview Dr. – east roadside ditch
4,6,7,8	16.19	0.44	15	3.56	4.82	25.36	34.34	Outfall 42” RCP at Powhite Creek
5	1.48	0.35	5	5.32	7.07	2.76	3.66	Powhite Creek

**Table 1.1 - Existing Outfalls along Forest Hill Avenue**

**PROPOSED PROJECT DESIGN APPROACH**

Based on discussions with City staff, as well as field observations, it was determined that there are no well-defined receiving channels along Forest Hill Avenue between Hathaway Road and Powhite Parkway. Well-defined channels do exist within the adjacent neighborhoods; however, these channels are highly inadequate to receive additional drainage. Providing a stormwater detention facility (or facilities) to control discharge into these channels would require substantial property/easement acquisitions.

A proposed approach to handle the project stormwater is to direct the drainage to the eastern limit of the project, at which a stormwater management facility could possibly be constructed in an area currently occupied by three empty parcels on the south side of Forest Hill Avenue. At that point, the stormwater could be released under control into Powhite Creek. A preliminary proposed drainage design layout is shown in the enclosed map, titled “**Forest Hill Avenue Proposed (Post) Drainage Areas**”.

This project will be constructed under heavy traffic, therefore maintenance of traffic and construction sequencing will be a critical element of this project. The proposed storm sewer layout shows trunk lines running down both sides of Forest Hill Avenue. This layout was selected as the preliminary layout in order to minimize traffic impacts and facilitate construction. Since the system is split, smaller pipes can be used. Also the depth of pipe installation would be less, thus helping to minimize temporary construction impacts to adjacent properties.

**OUTFALL INFORMATION**

Powhite Creek has an Existing Contributing Drainage Area of approximately **10 square miles** (at least) at Forest Hill Avenue. The Proposed Contributing Project Drainage Area is approximately **6.92 acres**.

<u>Powhite Creek</u> Total Existing Contributing Drainage Area @ F-H Ave.		Proposed Contributing Project Drainage Area	Prop. Contrib. Project Drain. Area / Total Exist. Contrib. Drain. Area.
(square miles)	(acres)	(acres)	%
A	B	C	(C / B) x 100
10	6,400	6.92	*0.11

\*The project will be contributing less than 1% of the total contributing drainage area of Powhite Creek at the point of discharge.

**Table 1.2 - % Prop. Contrib. Project Drain. Area / Total Exist. Contrib. Drain. Area**

**WATER QUALITY CALCUTATIONS**

Total Project Area = 8.74 Acres

Total Existing Impervious Area (IEXIST) = 4.57 Acres

% Existing Impervious Area = (4.57 / 8.74) x 100 = 52 %

Total Proposed Impervious Area (IPROP) = 6.19 Acres

Total New Impervious Area (INEW) = 6.19 – 4.57 = 1.62 Acres

% Total Proposed Impervious Area = (6.19 / 8.74) x 100 = 71%

Water Quality Volume (WQV) = 0.5” x INEW = (0.5/12) x 1.62 x 43,560 = 2,940 cu. ft.

## **SECTION 2**

# **EXISTING DRAINAGE AREA MAP**

## **SECTION 3**

# **PROPOSED DRAINAGE AREA MAP**

## **SECTION 4**

# **PRELIMINARY DRAINAGE COMPUTATIONS**



# 4.1 - PRELIMINARY STORM SEWER CALCULATIONS

ROUTE: Federal Hill Avenue      PROJ: 171006908  
 COUNTY: City of Richmond      DISTRICT: Richmond  
 DESCRIPTION: Highway Drive to Powhite Place

LD-229      STORM SEWER DESIGN COMPUTATIONS  
 PRELIMINARY LAYOUT

BY: MSD      DATE: 7/29/09  
 CHK:      DATE:

FROM POINT	TO POINT	AREA DRAIN ACRES	RUN-OFF COEF	CA	INLET TIME MIN.	RAIN FALL IN/HR	RUN-OFF Q CFS	INVERT ELEVATIONS		SLOPE FT/FT	DIA IN	CAPA CITY CFS	VEL FPS	FLOW TIME MINUTES	REMARKS
								UPPER END	LOWER END						
1A	1	0.274 0.216 0.4	0.9	0.288	5.0	7.07	274	183.34	181.48	0.014	15	7.5	4.5	0.51	Top = 187.32, H=3.92', DI=3
1	2	0.111 0.083 0.4	0.9	0.133	5.5	6.90	230	181.38	180.44	0.016	15	8.0	5.0	0.20	Top = 186.30, H=3.92', DI=3
2	5	0.071 0.035 0.4	0.9	0.078	5.7	6.83	141	180.34	174.24	0.021	15	9.2	5.9	0.94	Top = 184.26, H=4.02', DI=3
4	5	0.003 0.048 0.4	0.9	0.022	5.0	7.07	616	174.41	174.24	0.024	15	9.8	1.3	0.09	Top = 177.61, H=3.20', DI=7
5	8	0.091 0.112 0.4	0.9	0.126	6.6	6.55	434	174.14	169.27	0.022	15	9.4	7.3	0.50	Top = 178.08, H=3.92', DI=3
8	11	0.165 0.025 0.4	0.9	0.159	7.1	6.41	577	169.17	167.40	0.017	15	8.3	7.3	0.23	Top = 173.09, H=4.02', DI=3
11	14	0.066 0.035 0.4	0.9	0.073	7.3	6.35	344	167.30	165.67	0.009	16	9.9	5.0	0.51	Top = 171.50, H=4.20', DI=3
14	17			0.147	7.8	6.22	638	165.57	165.16	0.005	18	7.3	4.5	0.30	Top = 169.77, H=4.20', DI=3
17	18			0.033	8.1	6.14	650	165.06	164.72	0.005	18	7.3	4.7	0.24	Top = 169.43, H=4.37', DI=3
18	21			0.057	8.3	6.08	678	164.62	160.83	0.016	18	13.0	7.1	0.55	Top = 169.08, H=4.40', DI=3
21	24			0.412	8.9	5.95	309	160.73	159.46	0.013	18	11.7	7.3	0.22	Top = 164.93, H=4.20', DI=3
24	27			0.163	9.1	5.90	348	159.36	157.60	0.010	18	10.3	6.8	0.45	Top = 165.56, H=4.20', DI=3
27	30			0.596	9.6	6.49	1109	157.46	156.84	0.003	24	16.4	4.4	0.03	Top = 164.84, H=4.47', DI=3
CROSS F H AVE	30			0.25	5.0	7.01	378	157.95	157.21	0.005	15	4.5	3.0	0.62	Top = 161.87, H=4.92', DI=3
33	35			0.188	5.8	6.79	304	157.11	156.52	0.006	15	4.5	3.7	0.54	Top = 162.67, H=5.56', DI=3

# 4.1 - PRELIMINARY STORM SEWER CALCULATIONS

ROUTE: East Hill Avenue PROJ: 171000600  
 COUNTY: City of Richmond DISTRICT: Richmond  
 DESCRIPTION: Highway Drive to Powhite Plwy

STORM SEWER DESIGN  
 COMPUTATIONS

PRELIMINARY LAYOUT

BY: MSD DATE: 7/29/09  
 CHK: \_\_\_\_\_ DATE: \_\_\_\_\_

FROM POINT	TO POINT	AREA DRAIN ACRES	RUN OFF COEF C	CA	INLET TIME MIN	RAIN FALL IN/HR	RUN OFF Q CFS	INVERT ELEVATIONS		LENGTH FT	SLOPE FT/FT	DIA IN	CAPACITY CFS	VEL FPS	FLOW TIME MINUTES	REMARKS
								UPPER END	LOWER END							
36	39				6.4	6.61	156.42	155.87	110	0.005	15	4.5	4.2	0.44	8.80	Top = 103.14, H = 6.72, DI=3
39	44				5.8	6.49	155.76	155.12	132	0.005	15	4.5	4.0	0.55	7.34	Top = 103.03, H = 7.25, DI=3
42	43				15.0	4.82	157.69	155.09	27	0.059	15	15.4	8.1	0.09	15.06	Top = 162.89, H = 6.00, DI=7
43	44				15.1	4.81	155.99	155.12	28	0.031	15	11.2	7.8	0.08	15.12	Top = 159.98, H = 4.00, DI=7
44	47				15.1	4.81	155.02	154.32	140	0.005	24	15.7	5.0	0.47	15.99	Top = 102.32, H = 7.30, DI=3
47	50				15.6	4.74	154.22	150.83	123	0.028	24	37.1	8.7	0.21	15.80	Top = 100.03, H = 5.81, DI=3
50	54				15.8	4.71	150.73	134.06	286	0.063	24	55.7	11.8	0.36	16.17	Top = 158.40, H = 6.7, DI=3
53	54				15.0	4.82	134.11	134.06	9	0.005	15	4.9	4.1	0.04	0.04	Top = 137.50, H = 3.39, DI=7
54	55				18.2	4.66	133.43	131.50	119	0.016	30	59.8	11.2	0.18	16.35	Top = 138.63, H = 6.20, DI=3
55	56				16.5	4.82	132.66	131.90	26	0.028	15	16.5	6.8	0.08	5.06	Top = 137.86, H = 4.07, DI=3
58	59				5.1	7.05	131.80	131.60	55	0.005	15	4.5	3.3	0.28	5.34	Top = 135.8, H = 3.39, DI=3
59	55				16.4	4.63	131.40	131.20	14	0.014	30	47.6	10.7	0.02	16.39	Top = 137.20, H = 4.13, MH
56	57				16.4	4.63	131.10	130.90	41	0.015	30	48.2	10.7	0.06	16.46	
7	7				5.0	7.01	172.59	172.59	294	0.024	15	9.8	5.3	0.92	5.82	Top = 183.86, H = 3.92, DI=3
6	7				5.0	7.01	173.46	172.59	28	0.031	15	11.2	5.8	0.08	0.08	Top = 177.38, H = 3.92
7	10				5.9	6.76	172.49	168.87	196	0.018	15	8.5	6.1	0.53	6.45	Top = 176.41, H = 3.92
10	13				6.5	6.60	168.77	167.76	107	0.008	15	6.0	5.7	0.31	6.76	Top = 172.89, H = 3.92, DI=3