Waterworks Park Stream Restoration

City of Annapolis – South River Watershed

Design Development Report

July 2026











Biohabitats

The Stables Building
2081 Clipper Park Road
Baltimore, MD 21211

Table of Contents

Figures 3
Tables 3
Appendices 3
1.0 Introduction 4
1.1 Project Site Description 5
2.0 Watershed Description 5
2.1 Geology and Soils 5
2.2 Historic and Present Land Use 5
2.3 Hydrologic Assessment 6
3.0 Site Conditions Assessment 7
3.1 Site Assessment Summary 7
3.2 Wetland Delineation 7
3.3 Tree Inventory 7
3.4 Stream Geomorphology and Bank Stability Analysis and Erosion Estimates 8
3.5 Existing Hydraulic Analysis 9
3.5.1 Methodology and Input 9
3.5.2 Existing Hydraulics Results 11
4.0 Design Development 13
4.1 Restoration Approach and Channel Sizing 13
4.2 Plant Community Restoration 14
4.3 Proposed Hydraulic Analysis 15
5.0 Opinion of Probable Construction Cost 21
6.0 Summary 22
7.0 References 23
Appendices 25

© Biohabitats, Inc

Figures

Figure 1. Waterworks Park Stream Restoration Project site location
Figure 2: 1-D existing HEC-RAS cross-section locations
Figure 3: Existing channel velocity results in UT
Figure 4: Existing channel shear stress results in UT
Figure 5: Existing Water surface elevations along the UT
Figure 6: 1-D proposed HEC-RAS cross-section locations
Figure 7: Proposed channel velocities in UT
Figure 8: Proposed channel shear stresses in UT
Figure 9: Proposed water surface elevations along the UT

Tables

Table 1. NRCS model input data
Table 2. Peak discharge rates for the NRCS model at the downstream limit of each subwatershed
Table 3. Stream inflow rates (cfs) for the NRCS model for restoration reach extents
Table 4. TMDL pollutant reduction estimates
Table 5: Existing HEC-RAS results summary
Table 6: Proposed HEC-RAS results summary
Table 7: 100-year water surface elevation comparison
Table 8. Opinion of Probable Construction Cost

Appendices

Appendix A. Hydrologic Modeling Results
Appendix B. Wetland Delineation Memo
Appendix C. TMDL Pollutant Removal Computations
Appendix D. Existing and Proposed Conditions Hydraulic Modeling Output
Appendix E. Channel Sizing Worksheets
Appendix F. Design Development Plans

© Biohabitats, Inc

1.0 Introduction

Biohabitats, Inc. has been contracted by the Arundel Rivers Federation (ARF) to restore an unnamed tributary (UT) to Broad Creek (hereafter the UT) within the South River watershed in Annapolis, Maryland. The UT originates at an outfall from a stormwater retention pond just northwest of Housley Road (Figure 1).



Figure 1. Waterworks Park Stream Restoration Project site location

The purpose of this Design Development report is to identify and describe watershed and site resources, the cause and consequences of the impairments to both site watershed and stream reaches (see Harman and Starr 2011), detail proposed design strategies, and provide estimates of pollutant removal efficiencies. This stream restoration project entails detailed topographic surveys, on-site natural resources studies, desktop assessments, design, and permitting activities.

The primary stream restoration design goals are to:

- stabilize the UT stream bed and banks to arrest erosional processes;

© Biohabitats, Inc

- achieve floodplain reconnection;
- improve water quality;
- enhance wetland and upland plant communities, augmenting habitat for aquatic and terrestrial fauna;
- minimize impacts to site forest resources; and
- provide a stable downstream confluence with extensive riparian wetlands upstream of Broad Creek.

1.1 Project Site Description

The project site is located within Waterworks Park, which is owned by the City of Annapolis. The site originates at the outfall of a stormwater pond just southeast of the site across from Housley Road, which appears to manage a high degree of runoff from impervious surfaces in the upstream site watershed.

The site includes approximately 1,100 linear feet (lf) of a first-order UT (hereafter the UT) to Broad Creek, adjacent relict floodplain features in the downstream/northwestern portion of the site, jurisdictional wetlands, and high quality stands of mature upland forest flanking the UT. Riparian vegetation along the stream channel's extents within the project site is of moderate quality, reflecting species adapted to more mesic soil conditions due to stream channel incision and presumptive groundwater table lowering near the UT.

Biohabitats has identified relatively few physical constraints to proposed stream restoration work. There are no apparent subsurface utilities including sewer lines along the UT's alignment within the site. All work will be confined within a narrow limits of disturbance corridor to minimize impacts to forest resources, which upon revegetation is expected to augment existing aquatic and terrestrial habitat niches within the site.

2.0 Watershed Description

The site is located within the West Chesapeake Bay HUC8 (HUC 02131003) and the West Chesapeake Bay HUC12 watershed (HUC 021310030993). The UT does not extend to tidal waters per Maryland Department of the Environment (MDE) 1972 tidal spatial dataset, and is outside of the Chesapeake Bay Critical Area (CA).

2.1 Geology and Soils

The site is located within the Chesapeake Rolling Hills Environmental Protection Agency (EPA) Level IV ecoregion within the Atlantic Coastal Plain. This ecoregion is characterized by highly dissected uplands with defined stream valleys ultimately draining to tidal waters. Natural Resources Conservation (NRCS) soil mapping identifies two primary soil mapping units within the site: WBA, which consists of the Widewater and Issue series mapping along relatively flat alluvial landscapes along the UT itself and AsF, consisting of the Annapolis series along relatively steep adjacent sideslopes. These soils are characteristic of the site vicinity within the greater region, and generally consist of coarser marine and alluvial parent material sediments that facilitate groundwater infiltration, which is consistent with project design goals.

2.2 Historic and Present Land Use

Biohabitats assumes that like most land within the site region, the site was historically forested and cleared for agricultural cultivation during the time of European settlement. Landforms adjacent to the UT within Waterworks Park suggest this condition, with multiple gullies created during unsustainable agricultural practices since stabilized by successional forest cover. Aerial

© Biohabitats, Inc

photography of the site dating back to the mid-1980s suggests a forested condition has been established within the site at least since this timeframe.

Within its headwaters, the site watershed is predominated by intensive land development, including impervious surfaces such as roads, buildings, and parking lots associated with the Parole Growth Area. The downstream portion of the site watershed along proposed restoration extents is markedly different, consisting mainly of forested areas with lower and moderate density residential development along higher elevation locations delimiting the watershed.

2.3 Hydrologic Assessment

A total of 2 points of interest (POI) were selected for this hydrologic analysis. Subwatershed drainage areas to each POI were mapped using topographical and stormwater network data. Two (2) separate subwatersheds were delineated to represent the waterworks and tributary drainage areas that intersect at the first points of interest along the stream channel. A third subwatershed was delineated to represent the remaining drainage area that discharges from the first point of interest to the second point of interest (i.e., downstream restoration limits). The total drainage area to the downstream extent of proposed restoration activities is approximately 130 acres/0.2 square miles.

In accordance with TR55 methodology, a composite runoff curve number was computed for each subwatershed. Curve numbers were selected from the standard TR55 ground cover types based off of readily available GIS data for National Land Cover and Anne Arundel County zoning categories, and aerial imagery. Hydrologic soil group ratings were selected from readily available GIS data via Anne Arundel County. If an area had a missing hydrologic soil group, the nearest hydrologic soil group rating was used. Time of concentration (TC) paths were identified using Anne Arundel County GIS contour data and consisted of sheet flow, shallow concentrated flow, and channel flow. Watershed delineations, curve number analysis, and TC mapping were performed in ARCGIS PRO 3.0.3. No pond storage was considered in this model.

Hydrologic modeling was performed in HydroCAD Version 10.00. For this analysis, the SCS TR-20 runoff method was selected. A NOAA Type C rainfall distribution was selected and rainfall totals were pulled from NOAA Atlas 14, Volume 2, Version 3 for the project area.

Model input data is compiled in Table 1 and results are presented in Table 2 below. Hydrologic modeling exhibit maps and the HydroCAD output reports can be found Appendix A.

Table 1. NRCS model input data.

Subwatershed ID	Subwatershed Name	Subwatershed Drainage Area (acres)	Time of Concentration (min)	Curve Number
1S	Downstream	33.1	36.7	71
2S	Trib	43.8	24.0	75
3S	Waterworks	58.8	16.5	90

Table 2. Peak discharge rates for the NRCS model at the downstream limit of each subwatershed.

Subwatershed ID	Subwatershed Name	1-Year (cfs)	2-Year (cfs)	10-Year (cfs)	100-Year (cfs)
1S	Downstream	9.78	16.39	41.98	103.94

© Biohabitats, Inc

2S	Trib	22.98	35.58	81.51	186.77
3S	Waterworks	89.80	116.02	199.71	369.08

To calculate the stream flow rates along the UT, two reaches were input into the HydroCAD model to connect each subwatershed. The Waterworks (3S) and Tributary (2S) subwatersheds were connected via a reach (Reach 1). This reach captured 520 linear feet of the restoration reach before connecting with the second reach (Reach 2), which captures the remaining length of the restored UT. The downstream (1S) subwatershed was connected to the second reach to ensure all subwatershed areas were included to calculate the restore UT's flow rates. Table 3 provides the stream flow rates within each reach capturing the entire UT restoration reach length.

Table 3. Stream flow rates (cfs) for the NRCS model for restoration reach extents.

Subwatershed IDs	Subwatershed Names	Reach ID	1-Year	2-Year	10-Year	100-Year
2S & 3S	Trib & Waterworks	Reach 1	105.95	142.82	265.38	525.81
1S	Downstream	Reach 2	107.00	147.31	285.66	587.46

3.0 Site Conditions Assessment

3.1 Site Assessment Summary

On-site studies and desktop analyses were performed to identify distinct sub-reaches, characterize site vegetation, delineate wetlands, document existing channel and floodplain conditions, document causes and extent of instabilities, and qualitatively assess the potential to provide ecological uplift. These activities included the collection of site photos, the identification of stream channel geomorphic conditions, and assessments of predominate geomorphic phenomena affecting the UT and its riparian adjacency's stability.

3.2 Wetland Delineation

In accordance with the United States Army Corps of Engineers (USACE) 1987 Wetland Delineation Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0), Biohabitats performed a wetland delineation within the site along the restored extents of the UT, its riparian adjacency, and potential access areas off Housley Road. A summary Wetland Delineation Memo is provided in Appendix B.

Wetlands generally consisted of smaller features adjacent to the UT in the higher gradient portions of the project area. As the UT's slope decreases closer to the backwaters associated with Broad Creek in the downstream portion of the project area, riparian wetland areas were more extensive. Proposed stream restoration activities terminate upstream of these larger, continuous wetland features.

3.3 Tree Inventory

To minimize impacts to existing forest resources and comply with local Forest Conservation regulations and permitting, a tree survey was also performed as a component of the site conditions assessments. All trees greater than 12" in diameter at breast height (DBH, or 4.5 ft. measured from the ground surface elevation) within the proposed project limits were identified to species and evaluated for their general condition (e.g. Good, Fair, Poor).

© Biohabitats, Inc

Tree inventory data, including surveyed tree locations, are provided in Natural Resources Inventory/Forest Stand Delineation (NRI/FSD) sheets included in the Design Development plans.

3.4 Stream Geomorphology and Bank Stability Analysis and Erosion Estimates

Geomorphic assessments were performed to verify instability along the UT within the site limits. Site observations along the UT as verified with topographic survey data indicated that the UT is a highly incised system disconnected from its floodprone areas along adjacent land surfaces. This phenomenon results in higher energy, erosive stormflows confined within the existing channel banks, exacerbating bank erosion and associated nutrient exports downstream. Especially for the UT's riparian systems, this appears to have resulted in dehydration of historic wetland areas adjacent to the UT where channel incision has confined potential lateral hydrologic inputs of surface water within the existing channel's banks, resulting in significantly reduced riparian wetland habitat for native wildlife and plant communities.

Biohabitats performed bank stability analyses including Bank Erosion Hazard Index (BEHI) and accompanying Bank Assessment for Non-point Source Consequence of Sediment (BANCS) modeling. Biohabitats also performed soil sampling and the UT's riparian corridor to populate model inputs with site-specific soils data, which was used to summarize anticipated TMDL pollutant reductions. Table 4 summarizes the results of these analyses, which are further detailed in Appendix C including detailed field data. Please note that pollution reductions, which focus on Protocol 1, will be revised to reflect final design characteristics and assess the applicability of the other protocols.

Table 4. TMDL pollutant reduction estimates

Upper UT Reach

Protocol	EOS Load (lbs/yr)		
	TN	TP	TSS
1	26.82	274.81	240,535.41
2	-	-	-
3	-	-	-
4	-	-	-
5	-	-	-
Total	26.82	274.81	240,535.41

Lower UT Reach

Protocol	EOS Load (lbs/yr)		
	TN	TP	TSS
1	37.35	120.19	93,384.78
2	-	-	-
3	-	-	-
4	-	-	-
5	-	-	-
Total	37.35	120.19	93,384.78

© Biohabitats, Inc

3.5 Existing Hydraulic Analysis

To establish the existing floodplain along the project area and evaluate baseline velocity and shear stress within the system under current conditions, Biohabitats developed a one-dimensional model in HEC-RAS 6.6. HEC-RAS 6.6 is a model software developed by the United States Army Corps of Engineers (USACE) to estimate channel hydraulic variables including velocity, shear stress, and water surface elevation within the riverine environment. An existing condition model was performed to model the existing floodplain during the 1-, 2-, 10-, and 100-year storm events. Existing conditions hydraulic modeling results are provided in Appendix D.

3.5.1 Methodology and Input

Data used to develop the HEC-RAS model include cross-sections, Manning's n values, boundary conditions and peak flow rates. Before developing the HEC-RAS model, field visits were made to observe and photograph the conditions of the stream channel, overbanks, and the existing structures to visualize high flow scenarios and to determine flow distribution, effective, and ineffective flow areas.

An existing conditions topographic surface for the project reach was constructed within Civil3D by merging the topographic survey data within the project site with available GIS data along the edges of the total floodplain to create a composite surface of the entire site. This existing conditions surface was extracted as a digital elevation model (DEM) and imported into HEC-RAS 6.6 as a terrain to define elevation data for 1-D cross sections along the existing channel. All cross sections are oriented from left to right, looking downstream, and their locations are displayed in Figure 2 overtop the composite surface. Cross-section locations were determined based on proposed structure locations to best allow for future comparison between the existing and proposed conditions.

© Biohabitats, Inc

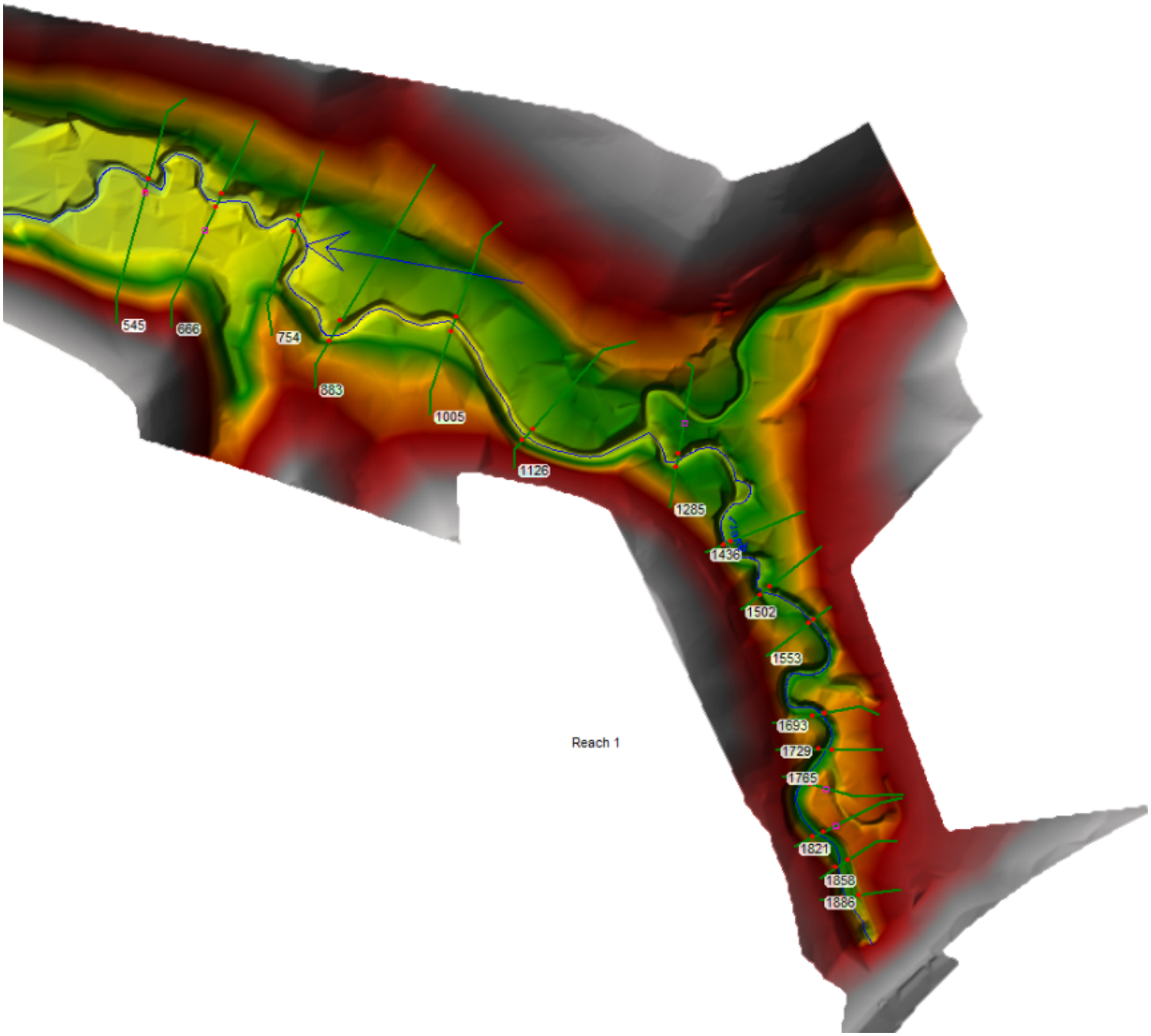


Figure 2: 1-D existing HEC-RAS cross-section locations

© Biohabitats, Inc

For the most conservative results, ineffective flow areas related to the upstream culvert and road crossing were not incorporated as part of the model. All peak flows are assumed to be present within the full project area and standard expansion and contraction coefficients of 0.1 and 0.3 were used throughout all cross sections.

Manning's "n" values were estimated based on the geomorphic cross sections, substrate material, and visual approximation of in-stream obstructions, vegetation, and cross sectional variability in accordance with the "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Floodplains" (Arcement and Schneider 1989). Manning's "n" values of 0.045 and 0.08 were modeled within the channel and the wooded floodplain, respectively throughout the model.

The boundary conditions used in the model utilize the normal depth based on slope for both upstream and downstream limits of the model. A reach slope of 0.5% reflecting the culvert slope was applied as the upstream boundary condition and a reach slope of 1.6% was applied as the downstream boundary condition. The hydraulic model was run using a mixed flow regime. Additional existing conditions model details including profile and cross section data in elevation view are included in Appendix D.

3.5.2 Existing Hydraulics Results

The existing 1-, 2-, 10-, and 100-year velocities, shear stresses, and water surface elevations are presented in Figures 3-5 below. The channel velocities and shear stresses are also summarized in Table 5.

Table 5: Existing HEC-RAS results summary

	Channel Velocity [ft/s]				Shear Stress [lbs/ft^2]			
	1-Year	2-Year	10-Year	100-Year	1-Year	2-Year	10-Year	100-Year
Min	3.02	3.58	4.62	6.43	0.41	0.50	0.76	1.35
Max	8.20	8.25	9.61	12.10	3.15	2.92	3.55	5.12
Ave	4.30	4.70	6.05	7.77	0.96	1.03	1.50	2.18

Channel velocities and shear stresses along the unnamed tributary for all storms generally peak at the same two HEC-RAS stations, STA 1436 and 1553, shown as 891 and 1008 ft main channel distance, respectively, on the graphics below. This location matches the observed erosion in this area of the project site as well as the extreme meanders within the existing channel's geometry. As one would expect, the downstream half of the project generally features lower channel velocities and shear stresses where the floodplain is more accessible and the overall valley slope drops significantly.

© Biohabitats, Inc

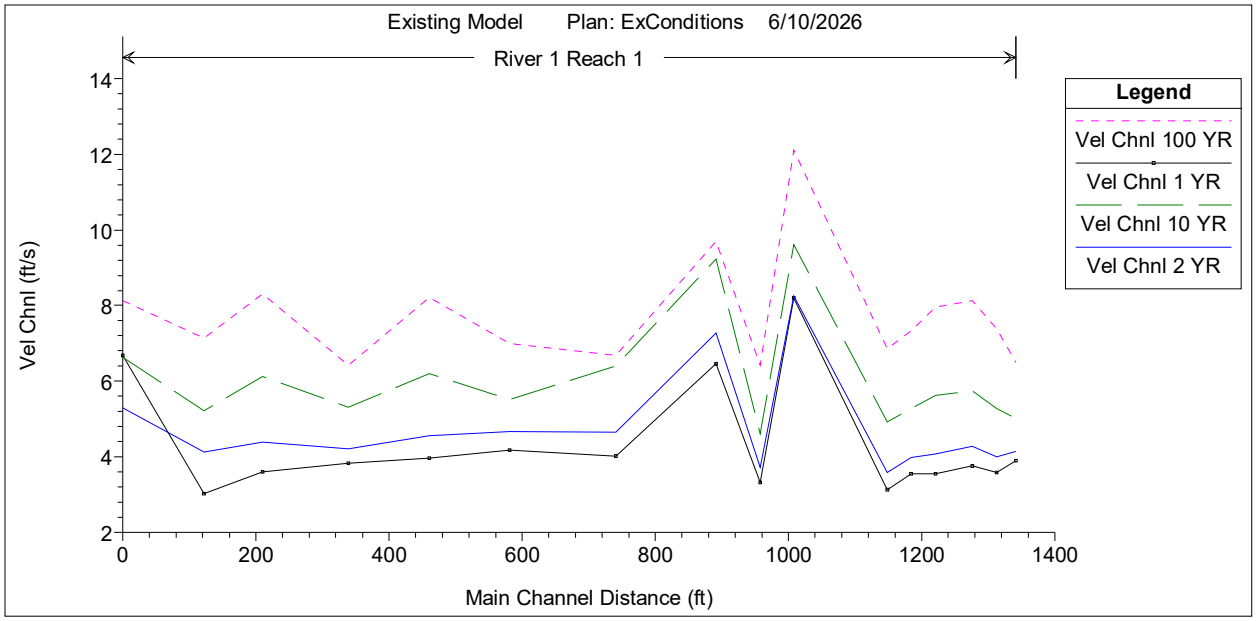


Figure 3: Existing channel velocity results in UT

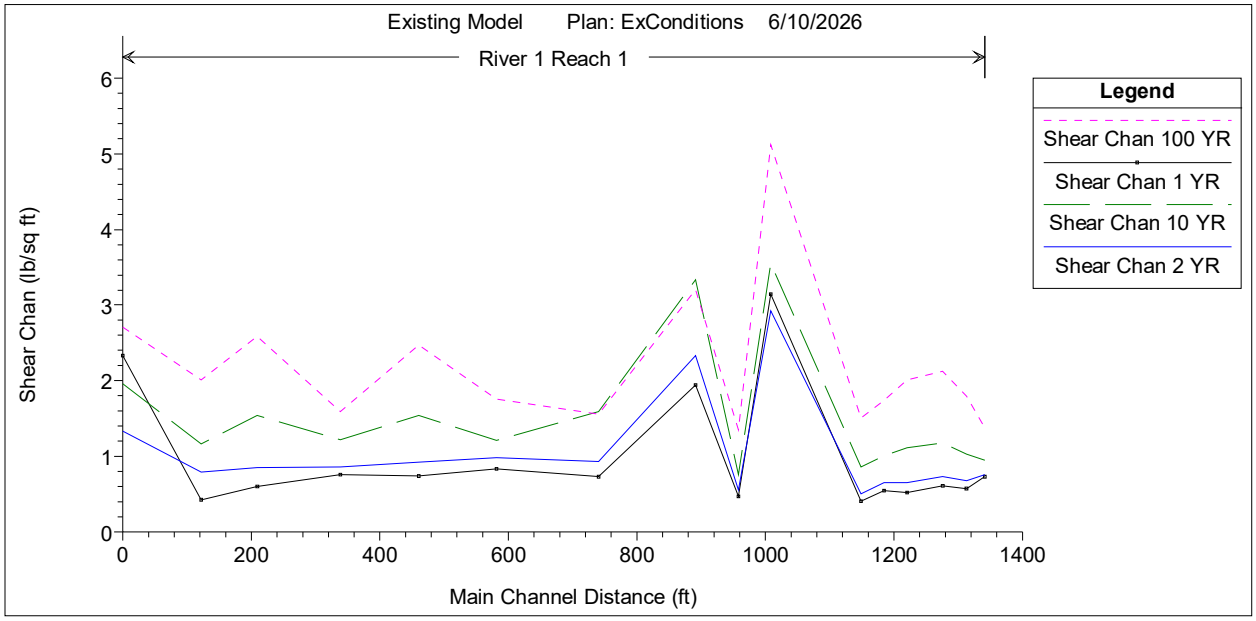


Figure 4: Existing channel shear stress results in UT

© Biohabitats, Inc

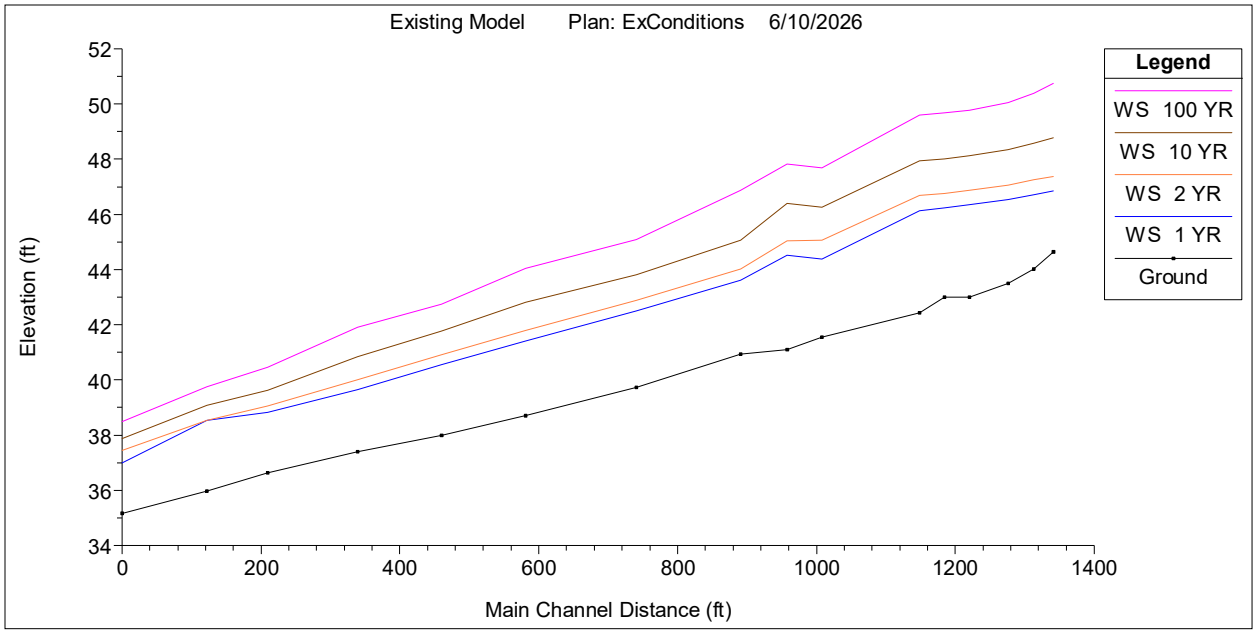


Figure 5: Existing water surface elevations along the UT

Based on the results of the HEC-RAS model, flow throughout the UT generally transitions from all modeled storms being full contained within the incised channel at the upstream limit of the project to a well-connected floodplain at the downstream limit of the project that is often able to be accessed even by the 1-year storm event.

4.0 Design Development

4.1 Restoration Approach and Channel Sizing

Biohabitats' proposed restoration strategy consists of two primary sub-reaches along the UT within the site: a step-pool stormwater conveyance (SPSC) situated mainly within the existing UT alignment from approximate sta. 0+00 to 4+75, and a valley-wide RSC in downstream portions of the site that will tie into existing wetland systems downstream of the project area from sta. 4+75 to 11+00.

The SPSC has been designed to stabilize the upstream channel bed and banks, reducing the sediment and nutrient loading to downstream waterways generated from channel enlargement, while also improving water quality through the filtering of the stormwater delivered to the outfall. An SPSC system uses a series of in-stream constructed riffles to form a series of aquatic pools to help maintain the channel bed at a higher elevation, while providing energy dissipation and large storm conveyance from the outfall to the downstream confluence point. These rock structures are built upon a sand/woodchip filter bed mix, installed as the underlying fill material within the existing enlarged outfall channel.

The valley-wide RSC restoration approach has been designed to reconnect the stream with its adjacent floodplain terrace and enhance wetland and upland habitats, supporting existing faunal populations and enhancing habitat extents and biodiversity. Valley-wide rock grade control structures, wood roughness elements, and supplemental native plantings have been incorporated into the design to achieve these goals, intended to enhance and restore lotic and terrestrial ecosystem functions. The limits of disturbance (LOD) for the work have been minimized to focus

© Biohabitats, Inc

along the UT alignment in order to minimize impacts to forested land and other natural resources assets.

It is important to note that during project scoping, Biohabitats indicated that the Maryland Department of Natural Resources (DNR) had identified Wetlands of Special State Concern (WSSC) within site limits along the UT based on available online resources. While the proposed design will temporarily impact some wetland areas, impacts have been minimized to the extent feasible, and Biohabitats believes that proposed restoration activities will ultimately result in enhanced wetland habitat for sensitive species within these areas. Furthermore, restoration reach extents have been reduced from Schematic Design plans per regulatory feedback to further minimize impacts.

Proposed restoration activities are summarized below; see Appendix E for channel sizing computations, Appendix D for proposed conditions hydraulics, and Appendix F for Design Development drawings.

From the stormwater pond outfall structure at Housley Road to sta. 4+75:

- Install in-stream SPSC with cobble riffle structures and shallow aquatic pools
- Install native forested wetland, coastal plain headwater forest, and upland successional oak-American beech plantings within uplands flanking the UT's riparian corridor

From Station 4+75 to Station 11+00:

- Install valley-wide RSC with stone sill features spanning the floodplain to enable restoration and creation of wetland areas
- Provide a hand-installed wattle structure at the downstream extent of the last valley-wide structure to achieve a stable tie-out condition with downstream wetland areas
- Provide native plantings consisting of hydrophytic species within existing and proposed wetland areas while vegetating adjacent upland forested areas with successional oak-American beech plantings

4.2 Plant Community Restoration

With proposed changes to site grades and hydrology, Biohabitats anticipates unique opportunities to restore native plant communities within the project LOD in a way that harmonizes with existing park forest resources. Designed plant community extents and species composition are provided in the Design Development plans (Appendix F). Plant community design takes into consideration habitat needs specific to WSSC areas.

Biohabitats has designed three native plant communities within the site:

- A mesic oak/beech coastal plain hardwood forest within uplands flanking the UT and its riparian fringe, which relate to the existing species composition within park uplands;
- An oak floodplain forest consisting of shade tolerant canopy and understory trees as well as riparian fringe plantings along the edge of the UT; and
- A floodplain pool wetland with dense perennial herbaceous vegetation within portions of and primarily at the downstream portion of the valley-wide SPSC to augment existing wetland vegetation.

While non-native invasive (NNI) is not prevalent within the site, Biohabitats will identify any NNI management recommendations in the Final Design (90%) phase.

© Biohabitats, Inc

4.3 Proposed Hydraulic Analysis

Hydraulic computations were performed for the proposed conditions for the 1-, 2-, 10-, 100-year storm events. The proposed hydraulic analysis was also performed using HEC-RAS 6.6. The same methodology applied to the existing conditions was applied to the proposed conditions, utilizing proposed topographic conditions developed in Civil 3D. Additional edits to the cross section data were also made by hand within HEC-RAS to best define the proposed site elevations. Sections were placed at the upstream limits of each proposed structure and generally match the locations used within the existing conditions model as shown below in Figure 6. There is one exception where the proposed conditions model has an additional section at a proposed structure location that does not align with the existing channel due to an extreme meander. A summary of the proposed 1-, 2-, 10-, and 100-year channel velocities and shear stresses is presented below in Table 6. Additional figures showing each graphically are also included in Figures 7-9.

© Biohabitats, Inc

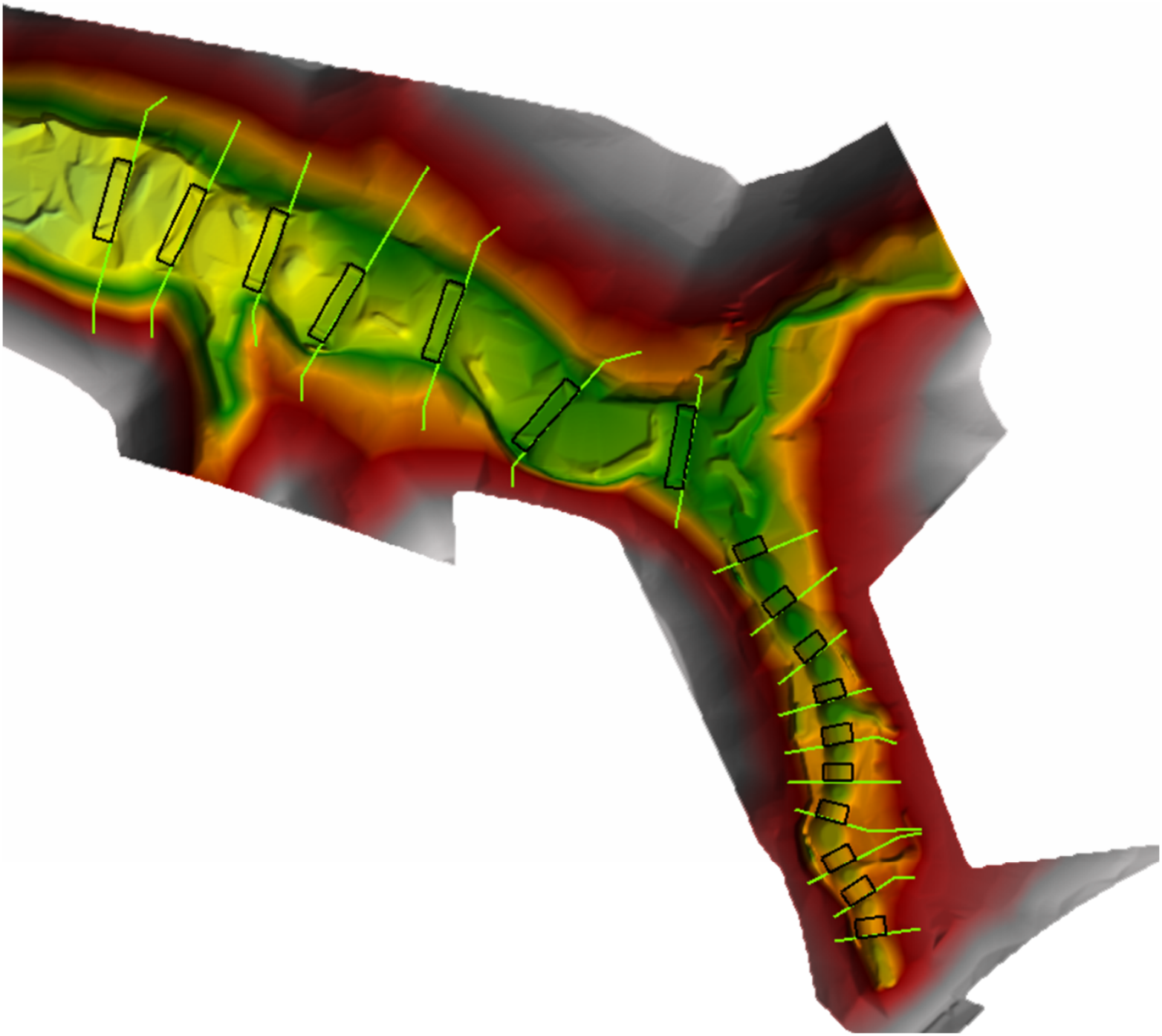


Figure 6: 1-D proposed HEC-RAS cross-section locations

© Biohabitats, Inc

Table 6: Proposed HEC-RAS results summary

	Channel Velocity [ft/s]				Shear Stress [lbs/ft^2]			
	1-Year	2-Year	10-Year	100-Year	1-Year	2-Year	10-Year	100-Year
Min	2.05	2.29	2.91	3.93	0.38	0.44	0.61	0.98
Max	5.17	5.97	7.30	8.32	1.52	1.94	2.61	2.83
Ave	3.50	3.91	4.87	6.21	0.80	0.95	1.33	1.88

The proposed HEC-RAS results show a consistent lowering in total throughout the full project area in both channel velocity and shear stress. Minimum, maximum, and average values for channel velocity and shear stress all show overall reductions across every modeled storm event. However, at a deeper glance, channel velocities and shear stresses show slight increases throughout Reach 1 within the SPSC riffles and then significant decreases throughout Reach 2 within the valley-wide riffles. The increases within Reach 1 are to be expected given that the structure typical sections are designed to convey the entire 100-year peak discharge. The structures themselves will feature large stone that is sized to remain stable during all modeled storm events and withstand the elevated velocities and shear stresses associated with the proposed design. Between the proposed sections will be pools designed for energy dissipation with drastically lower shear stresses and velocities than overtop the armored in-channel structures.

Due to the design techniques chosen and the level of vertical incision within the existing channel, the 100-year water surface elevation in the proposed model shows a consistent rise when compared to the existing conditions model. Table 7 displays the differences in 100-year water surface elevations at each existing section. Full results of the proposed hydraulics analysis can be found in Appendix D.

© Biohabitats, Inc

Table 7: 100-year water surface elevation comparison

Existing HEC-RAS STA	Proposed HEC-RAS STA	Existing WSEL (ft)	Proposed WSEL (ft)	Δ (ft)
1886	1751	50.74	52.65	1.91
1858	1718	50.39	52.19	1.8
1821	1686	50.04	51.67	1.63
1765	1644	49.78	51.18	1.4
1729	1611	49.67	50.55	0.88
1693	1579	49.6	50.17	0.57
	1541		50.14	N/A
1553	1500	47.67	49.63	1.96
1502	1453	47.81	48.75	0.94
1436	1402	46.87	48.04	1.17
1285	1286	45.09	46.54	1.45
1126	1124	44.05	45.33	1.28
1005	1005	42.74	44.46	1.72
883	881	41.9	43.47	1.57
754	756	40.46	42.25	1.79
666	668	39.74	41.34	1.6
545	546	38.48	39.9	1.42

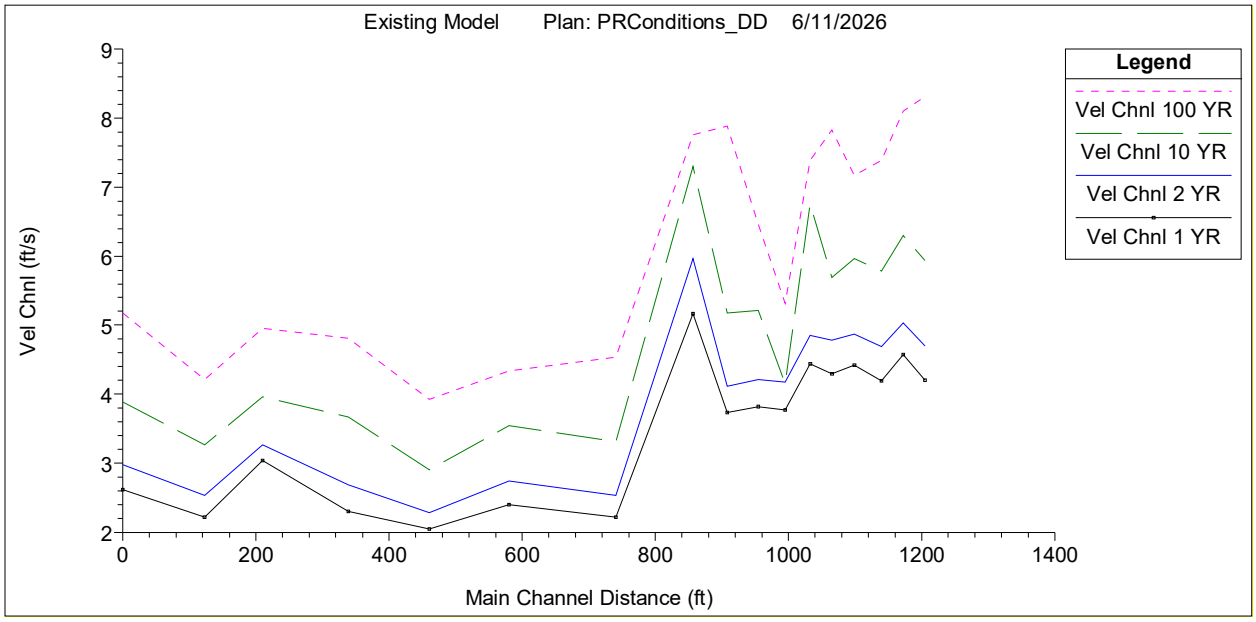


Figure 7: Proposed channel velocities in UT

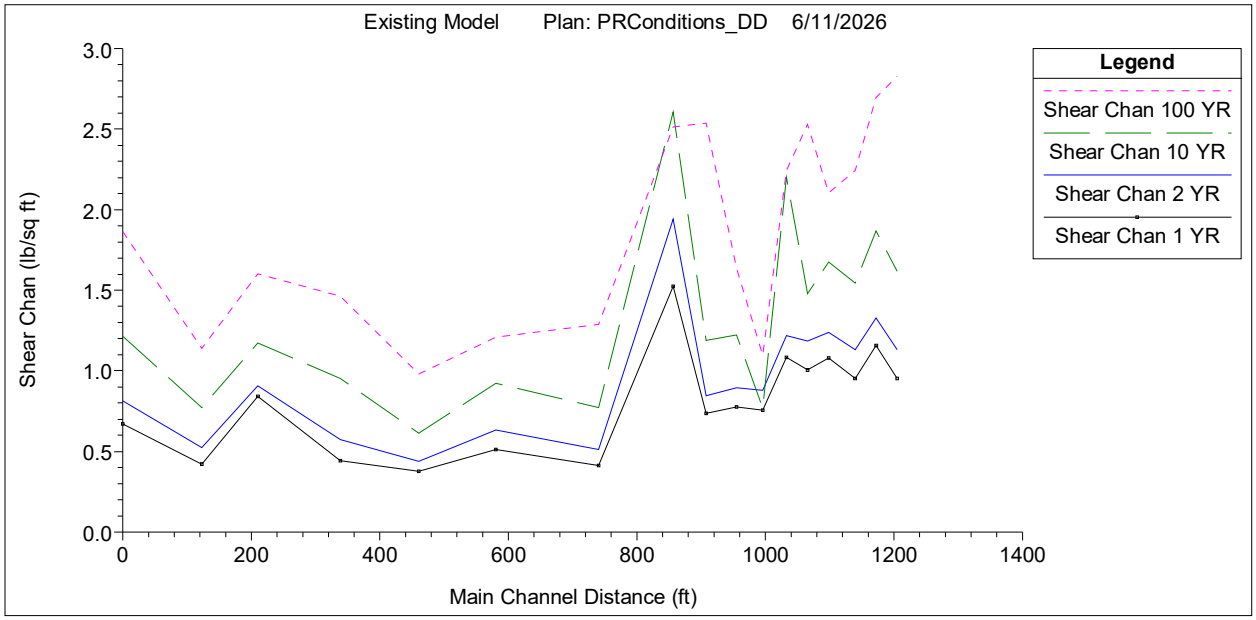


Figure 8: Proposed channel shear stresses in UT

© Biohabitats, Inc

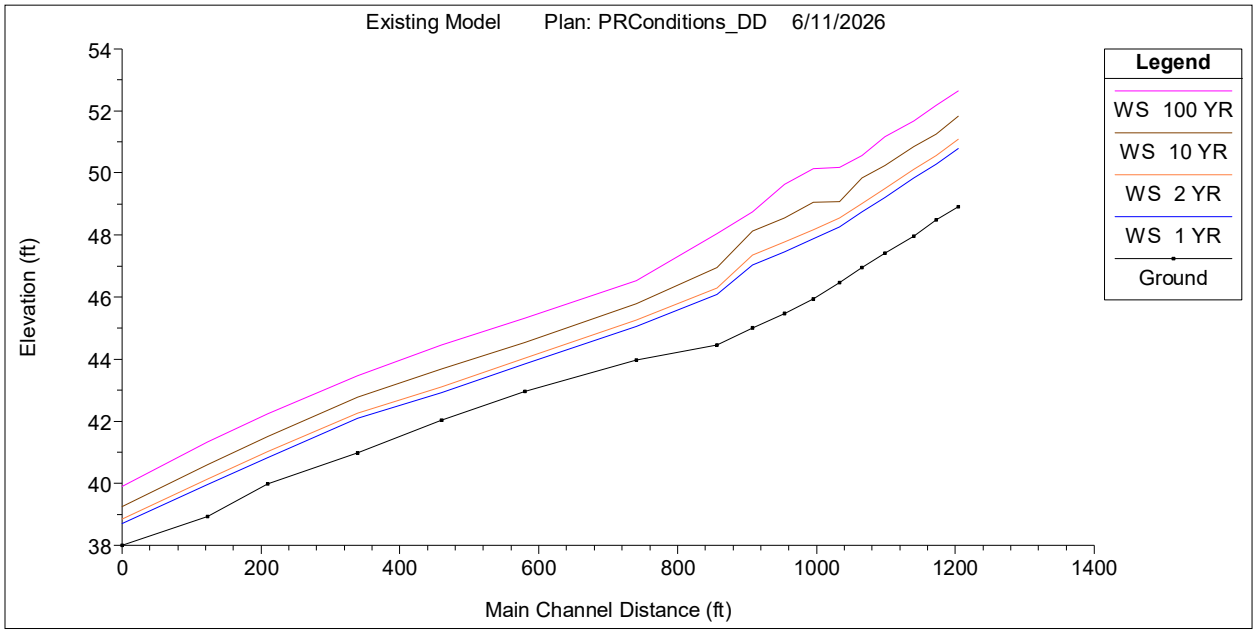


Figure 9: Proposed water surface elevations along the UT

© Biohabitats, Inc

5.0 Opinion of Probable Construction Cost

Biohabitats estimates the following anticipated construction costs associated with proposed restoration activities (Table 8). This estimate will be refined in final design as needed to reflect final quantities as refined by any design revisions, regulatory review, and stakeholder feedback

Table 8. Opinion of Probable Construction Cost

Biohabitats

Biohabitats, Inc.
2081 Clipper Park Road
Baltimore, MD 21211
Tel: 410.554.0156

DESIGN:	TB	DATE:	15-Jun-2026
CHECK:	DS	DATE:	30-Jun-2026
PROJECT:	ANNAPOLIS WATERWORKS PARK STREAM RESTORATION DESIGN DEVELOPMENT		

DESIGN DEVELOPMENT

ITEM #	DESCRIPTION	UNIT	UNIT PRICE	QUANTITY	TOTAL PRICE
1	CLEARING AND GRUBBING	LS	$ 29,000.00	1	$ 29,000.00
2	REMOVAL OF TREES GREATER THAN 12" DBH	EA	$ 3,000.00	22	$ 66,000.00
3	MAINTENANCE OF TRAFFIC	LS	$ 20,800.00	1	$ 20,800.00
4	CONSTRUCTION STAKEOUT	LS	$ 25,900.00	1	$ 25,900.00
5	CONSTRUCTION AS-BUILTS	LS	$ 25,900.00	1	$ 25,900.00
6	MOBILIZATION/DE-MOBILIZATION	LS	$ 77,700.00	1	$ 77,700.00
7	TREE PROTECTION PLANKING	EA	$ 400.00	60	$ 24,000.00
8	BLAZE ORANGE FENCE (TREE PROTECTION FENCE)	LF	$ 4.50	3,050	$ 13,730.00
9	CLASS 5 EXCAVATION	LS	$ 8,100.00	1	$ 8,100.00
10	REUSE & PLACEMENT OF EXCAVATED MATERIAL	CY	$ 10.00	450	$ 4,500.00
11	HAUL OFF	CY	$ 50.00	50	$ 2,500.00
12	CHANNEL FILL MATERIAL (FURNISHED SPSC CHANNEL FILL)	CY	$ 75.00	1,230	$ 92,250.00
13	CHANNEL FILL MATERIAL (FURNISHED STRUCTURAL CHANNEL FILL)	CY	$ 75.00	210	$ 15,750.00
14	CHANNEL FILL MATERIAL (FURNISHED COMMON BORROW FILL)	CY	$ 30.00	560	$ 16,800.00
15	RIFFLE MIX (D50 = 6") (RIFFLE)	CY	$ 211.00	360	$ 75,960.00
16	RIFFLE MIX (D50 = 6") (VALLEY WIDE RIFFLE)	CY	$ 156.00	660	$ 102,960.00
17	CLASS II RIPRAP (PLUNGE POOL)	CY	$ 162.00	100	$ 16,200.00
18	BEDDING STONE	CY	$ 90.00	140	$ 12,600.00
19	FURNISHED SAND AND GRAVEL	CY	$ 75.00	340	$ 25,500.00
20	SANDSTONE BOULDER (RIFFLE, CASCADE)	CY	$ 450.00	20	$ 9,000.00
21	WOODCHIPS FOR STABILIZATION	CY	$ 75.00	142	$ 10,650.00
22	STREAM VALLEY BOTTOM WOOD ROUGHNESS	SY	$ 20.00	3,111	$ 62,230.00
23	SPSC POOL WOOD	EA	$ 650.00	10	$ 6,500.00
24	STABILIZED CONSTRUCTION ENTRANCE	EA	$ 5,000.00	1	$ 5,000.00
25	18" FILTER LOG	LF	$ 13.50	200	$ 2,700.00
26	REINFORCED SILT FENCE	LF	$ 10.00	270	$ 2,700.00
27	MAINTENANCE OF STREAM FLOW	LS	$ 31,100.00	1	$ 31,100.00
28	CONSTRUCTION ACCESS ROAD	SY	$ 25.00	2,230	$ 55,750.00
29	HARDWOOD MAT	SY	$ 65.00	200	$ 13,000.00
30	PERMANENT SEEDING - RIPARIAN SEED MIX	LBS	$ 160.00	35	$ 5,600.00
31	PERMANENT SEEDING - TURFGRASS SEED	LBS	$ 90.00	85	$ 7,650.00
32	FURNISH AND PLACE TOPSOIL, 4" DEPTH	SY	$ 18.00	20	$ 360.00
33	TYPE D SOIL STABILIZATION MATTING	SY	$ 6.50	558	$ 3,630.00
34	TREES (#7 CONTAINER)	EA	$ 160.00	490	$ 78,400.00
35	TREES (BARE ROOT)	EA	$ 22.00	549	$ 12,080.00
36	SHRUBS (#3 CONTAINER)	EA	$ 65.00	1,445	$ 93,930.00
37	HERBACEOUS WETLAND PLANTINGS (SP4)	EA	$ 20.00	80	$ 1,600.00
38	TURGRASS	SY	$ 1.80	350	$ 630.00
39	LIVE STAKES	EA	$ 10.00	135	$ 1,350.00
40	WELDED WIRE HERBIVORY PROTECTION EXCLOSURES	EA	$ 700.00	224	$ 156,800.00
				TOTAL	$ 1,216,810.00
				15 % CONTINGENCY	$ 182,521.50
				GRAND TOTAL	**$ 1,399,331.50**

© Biohabitats, Inc

6.0 Summary

The Waterworks Park Stream Restoration project will stabilize, restore and enhance an existing unnamed tributary to Broad Creek within Waterworks Park, ultimately arresting a source of pollutants within the Chesapeake Bay watershed. The project is located on park property owned by the City of Annapolis.

The primary design goals for this project are to stabilize the stream bed and banks, improve water quality, enhance native plant communities including supporting sensitive WSSC areas, and achieve floodplain reconnection by way of in-stream and valley-wide SPSC design. The restoration approach has been designed to reconnect the UT with its adjacent floodplain and enhance wetland and upland habitats. In-stream wood and rock structures and supplemental native plantings have been incorporated into the design to achieve these goals.

© Biohabitats, Inc

7.0 References

Conservation Engineering Division, Natural Resources Conservation Service, United States Department of Agriculture. (1986). Urban Hydrology for Small Watersheds. Technical Release 55 (TR-55). Retrieved from https://www.hydrocad.net/pdf/TR-55%20Manual.pdf

Harman W, Starr R, Carter M, Tweedy L, Clemmons M, et al. 2012. A function-based framework for stream assessment and restoration projects. EPA 843-K-12-006, US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC.

McCandless, T. L. (2003). Maryland stream survey: Bankfull discharge and channel characteristics of streams in the Coastal Plain hydrologic region. US Fish and Wildlife Service, Chesapeake Bay Field Office, CBFO-S03-02.

Mecklenburg 2006. The Reference Reach Spreadsheet for Channel Survey Data Management. Ohio Department of Natural Resources.

National Weather Service, National Oceanic and Atmospheric Administration, United States Department of Commerce. (n.d.). Precipitation Frequency Data Server (PFDS). Retrieved from Hydrometeorological Design Studies Center: https://hdsc.nws.noaa.gov/pfds/

Roni, Phil & Beechie, Timothy. (2013). Stream and Watershed Restoration: A Guide to Restoring Riverine Processes and Habitats. 10.1002/9781118406618.

Rosgen, D.L. (2006b). Watershed Assessment of River Stability and Sediment Supply (WARSSS). Fort Collins, CO: Wildland Hydrology.

Rosgen, D.L. and H.L. Silvey. 1996. Applied River Morphology. Wildland Hydrology Books, Fort Collins, CO.

Schueler, Tom, and Stack, Bill. September 2014. Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. Chesapeake Stormwater Network

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture.;. (n.d.). Web Soil Survey. Retrieved from http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

Starr, R., Harman, W., and Davis, S. 2015. Final Draft Function Based Rapid Stream Assessment Methodology. Habitat Restoration Division, Chesapeake Bay Field Office, U.S. Fish and Wildlife Service. CAFÉ-S15-06.

Timothy J. Beechie, David A. Sear, Julian D. Olden, George R. Pess, John M. Buffington, Hamish Moir, Philip Roni, Michael M. Pollock, Process-based Principles for Restoring River Ecosystems, BioScience, Volume 60, Issue 3, March 2010, Pages 209–222, https://doi.org/10.1525/bio.2010.60.3.7

U.S. Fish & Wildlife, 2014. BEHI erosion rate curves, Excel file provided by Rich Starr, November.

© Biohabitats, Inc

Virginia Department of Conservation and Recreation, Division of Natural Heritage. Overview of the Physiography and Vegetation of Virginia, Ver. 2.0, March 2021

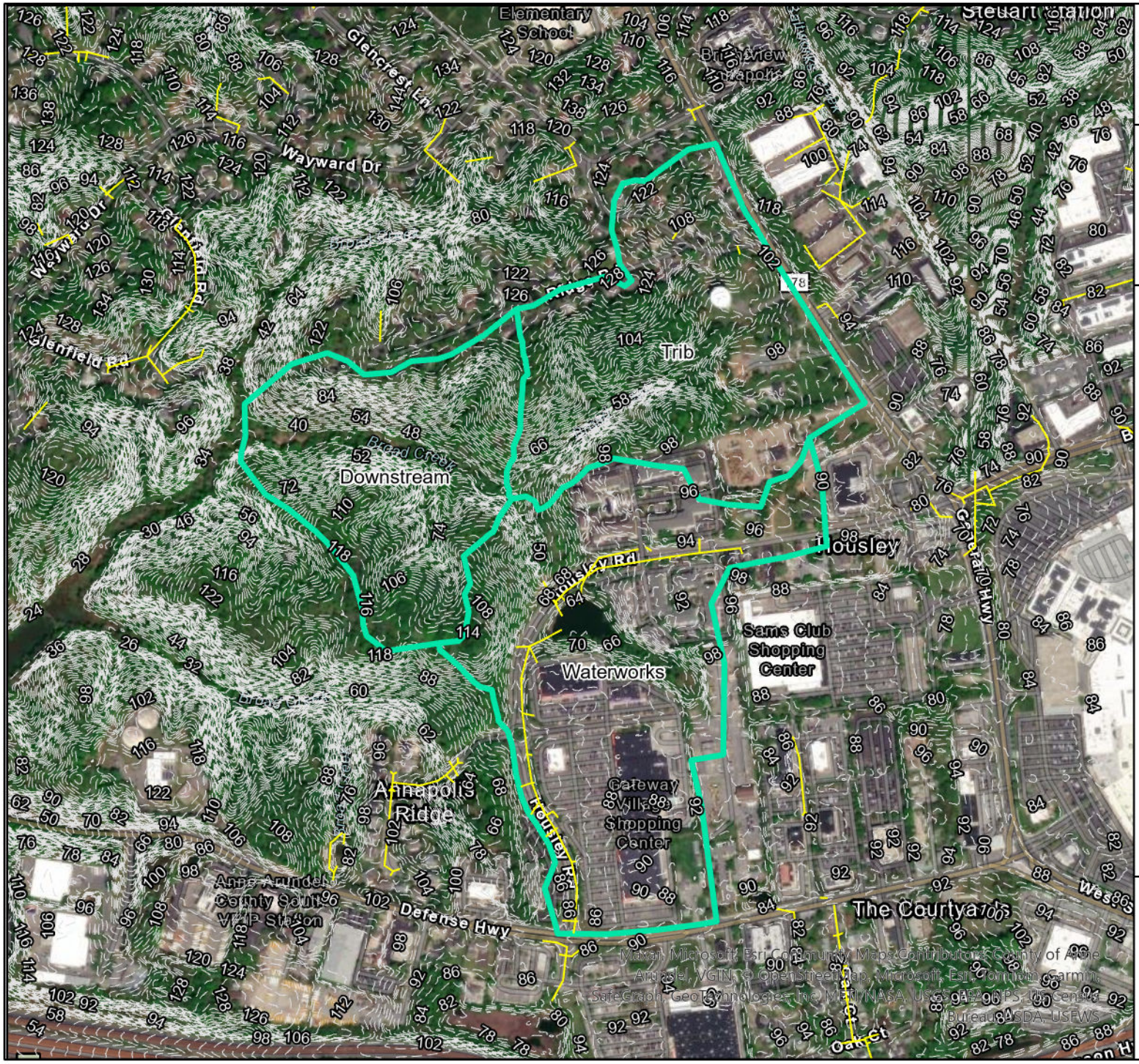
Wood, David, Schueler, Tom, Stack, Bill, 2021. A Unified Guide for Crediting Stream and Floodplain Restoration Projects in the Chesapeake Bay Watershed. September, 2021

© Biohabitats, Inc

Appendices

© Biohabitats, Inc.

Appendix A: Hydrologic Modeling Results



Annapolis Waterworks Stream Restoration

2607 Housley RD
Annapolis, MD 21401

DRAINAGE AREA MAP

Legend

- Storm Drain Pipes
- Drainage Area Boundary
- Contour_1ft

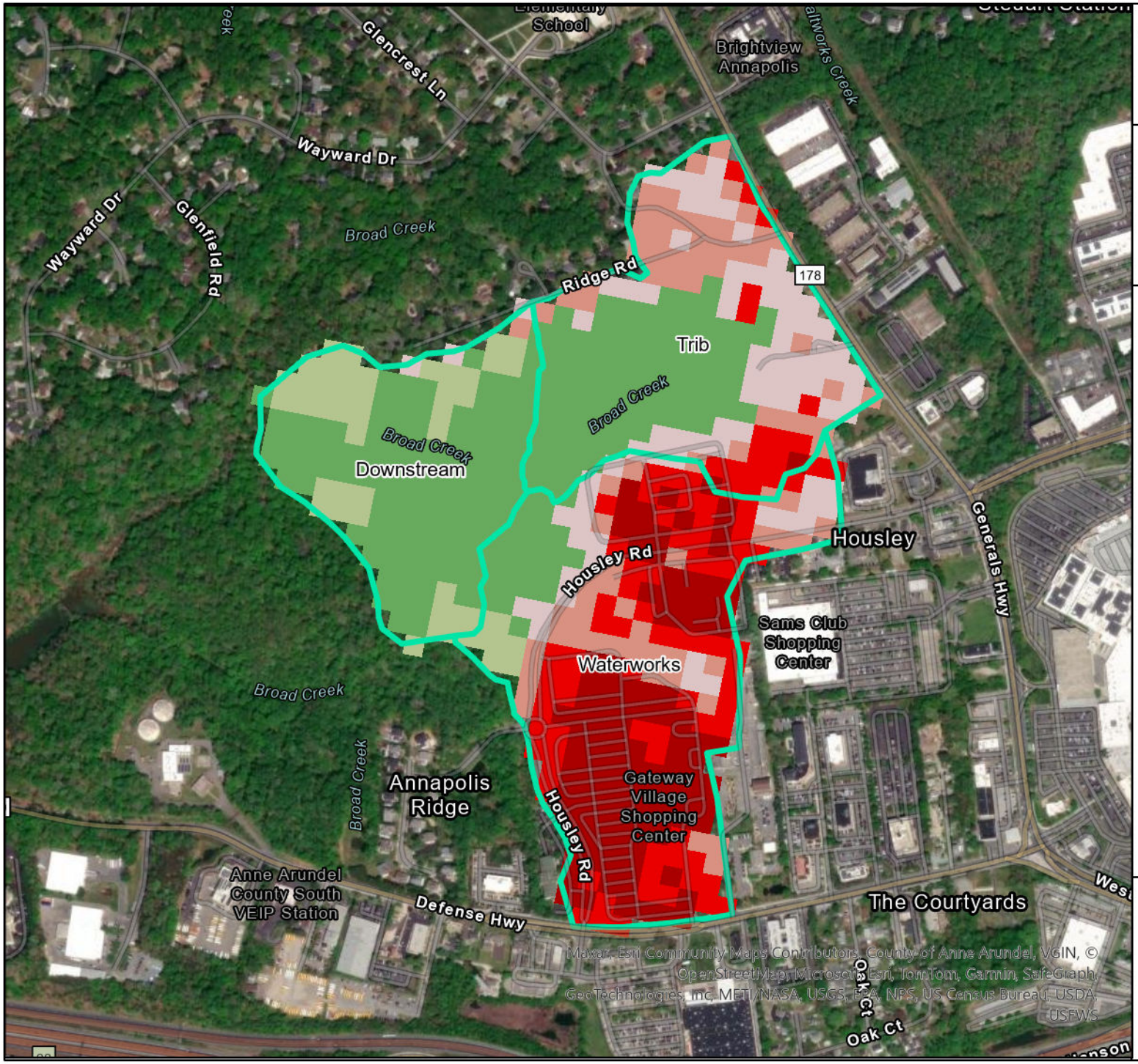
N

500 250 0 500
Feet

Biohabitats

December, 2024

Document Path: W:\GIS\PROJECTS\24015.01 Annapolis Waterworks Park Stream Restoration\Maps\Analysis\Waterworks_Hydrology_MG.aprx



Annapolis Waterworks Stream Restoration

2607 Housley RD
Annapolis, MD 21401

LAND USE MAP

Legend

- Drainage Area Boundary

NLCD_Land_Cover_Class

- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Deciduous Forest
- Mixed Forest

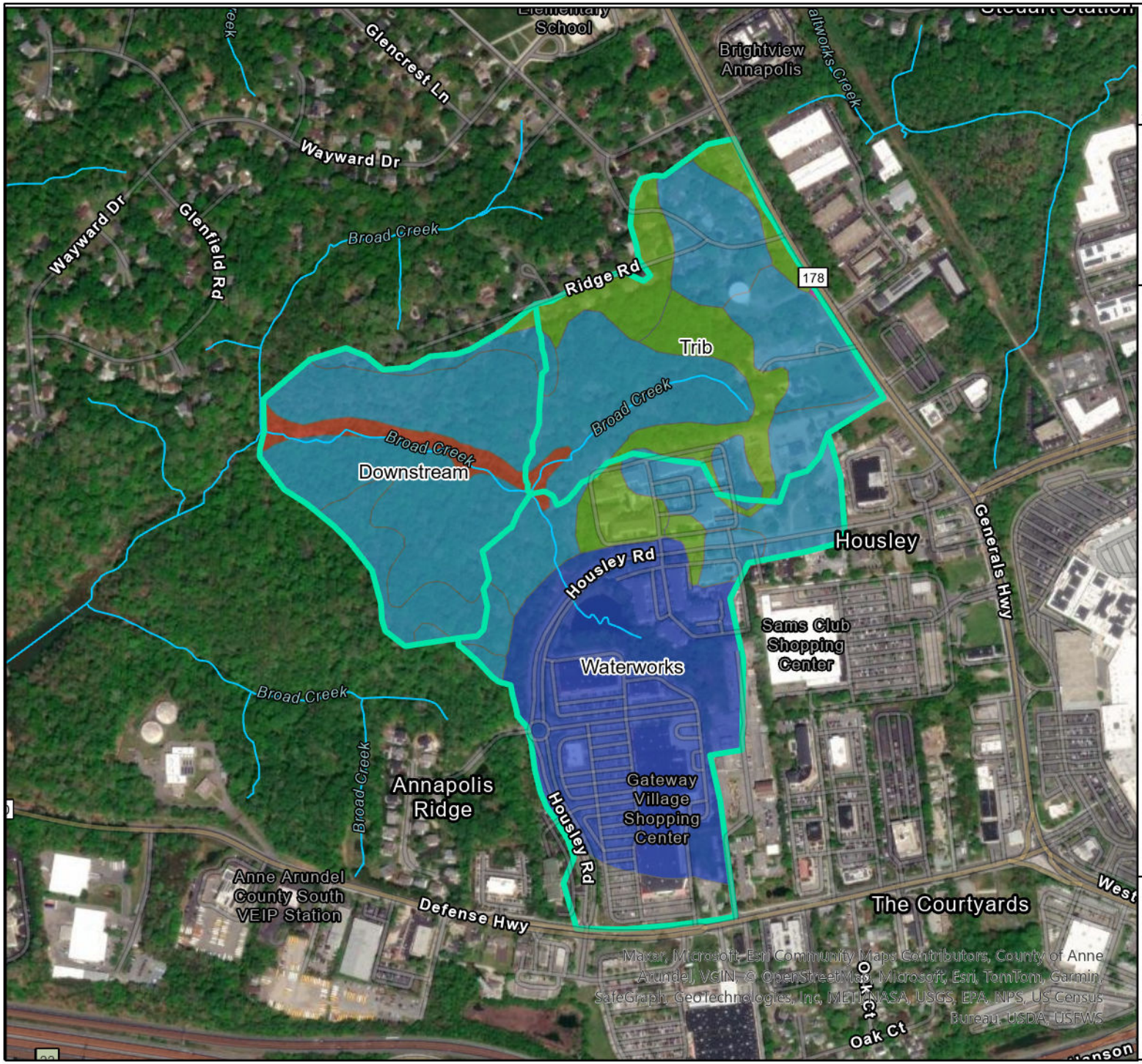
N

500 250 0 500
Feet

Biohabitats

December, 2024

Document Path: W:\GIS\PROJECTS\24015.01 Annapolis Waterworks Park Stream Restoration\Maps\Analysis\Waterworks_Hydrology_MG.aprx



Annapolis Waterworks Stream Restoration

2607 Housley RD
Annapolis, MD 21401

SOILS MAP

Legend

- Drainage Area Boundary
- Streams

Hydrologic Group - Dominant Condition

- A
- B
- C
- C/D
- D

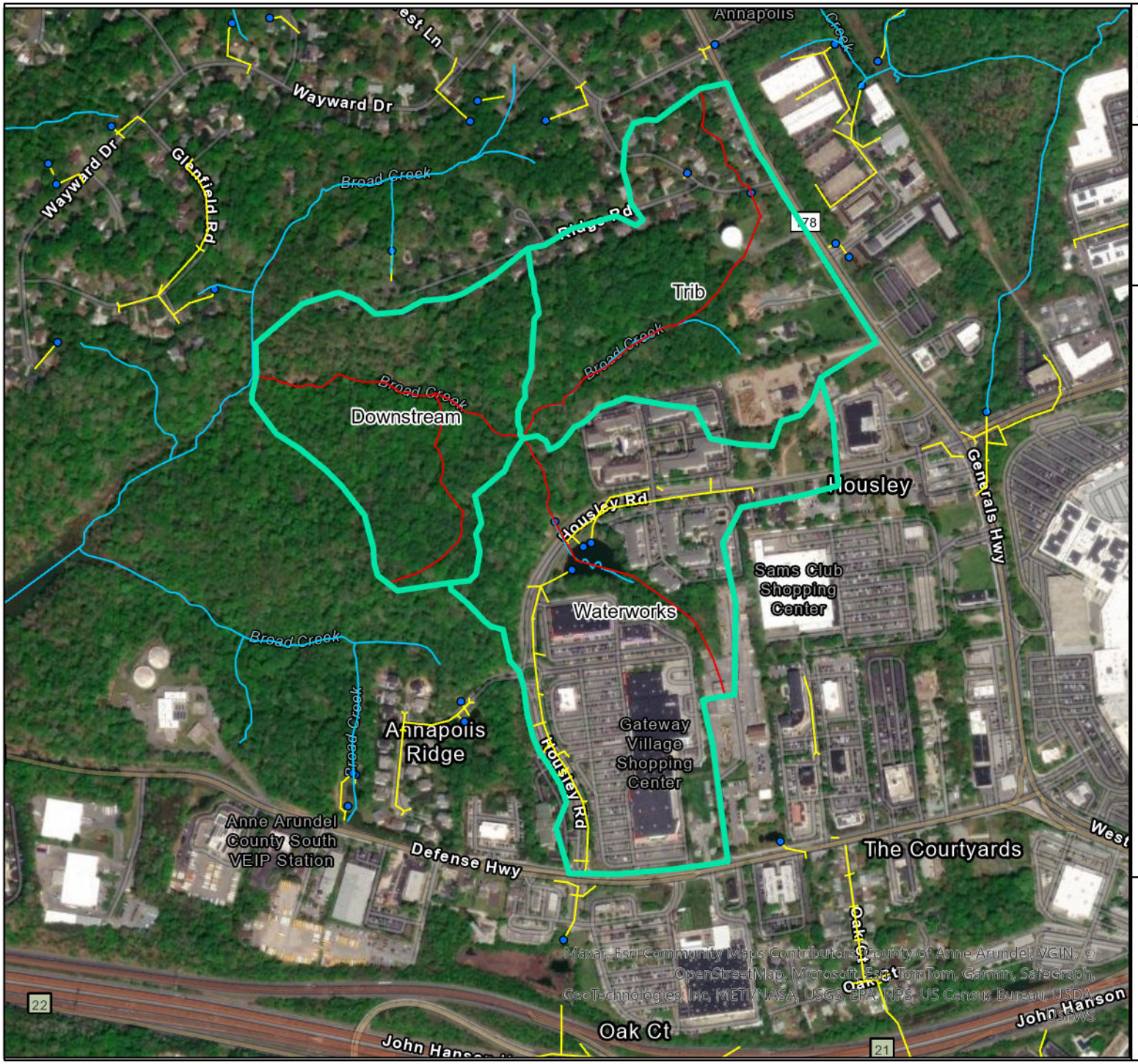
N

500 250 0 500
Feet

Biohabitats

December, 2024

Document Path: W:\GIS\PROJECTS\24015.01 Annapolis Waterworks Park Stream Restoration\Maps\Analysis\Waterworks_Hydrology_MG.aprx



Annapolis Waterworks Stream Restoration

2607 Housley RD

Annapolis, MD 21401

TC PATH MAP

Legend

- Drainage Area Boundary
- Time of Concentration (TC)
- Streams
- Storm Drain Outfalls
- Storm Drain Pipes

N

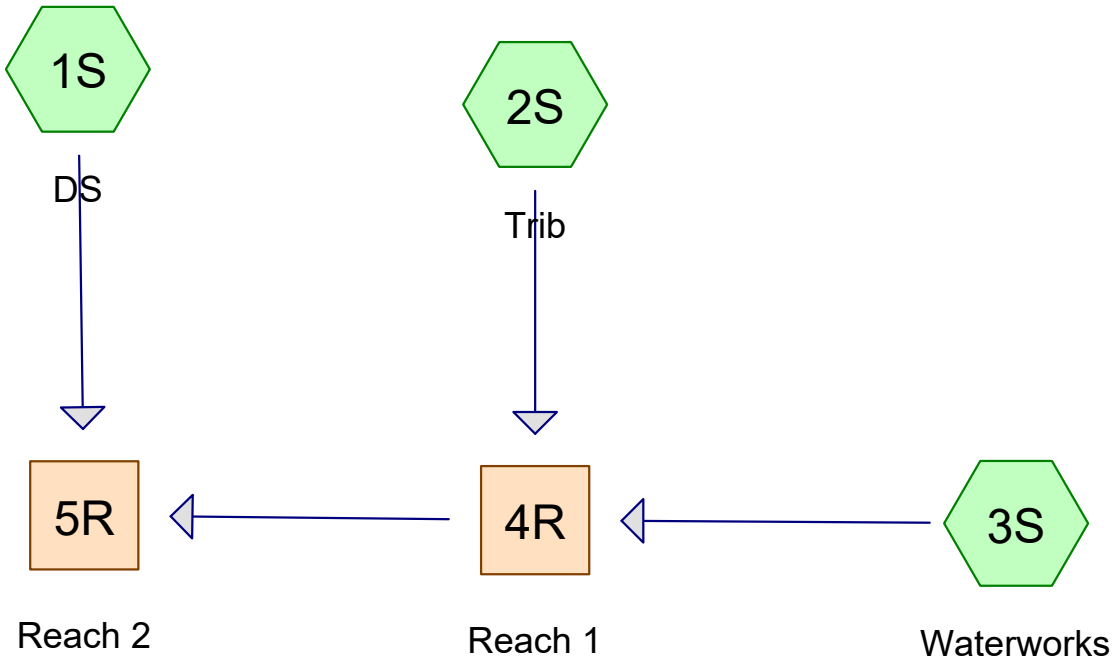
500 250 0 500

Feet

Biohabitats

December, 2024

Document Path: W:\GIS\PROJECTS\24015.01 Annapolis Waterworks Park Stream Restoration\Maps\Analysis\Waterworks_Hydrology_MG.aprx



Subcat Reach Pond Link

Routing Diagram for Annapolis Waterworks
Prepared by Biohabitats, Inc., Printed 8/29/2025
HydroCAD® 10.00-25 s/n 05603 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.676	75	1/4 acre lots, 38% imp, HSG B (1S, 2S)
7.354	83	1/4 acre lots, 38% imp, HSG C (1S, 2S, 3S)
6.253	87	1/4 acre lots, 38% imp, HSG D (3S)
0.747	85	1/8 acre lots, 65% imp, HSG B (2S)
0.058	49	50-75% Grass cover, Fair, HSG A (2S)
9.848	79	50-75% Grass cover, Fair, HSG C (2S, 3S)
2.427	84	50-75% Grass cover, Fair, HSG D (3S)
0.114	98	Paved parking, HSG B (3S)
0.075	98	Paved parking, HSG C (2S)
0.429	98	Roofs, HSG B (3S)
3.698	92	Urban commercial, 85% imp, HSG B (3S)
11.982	94	Urban commercial, 85% imp, HSG C (2S, 3S)
25.615	95	Urban commercial, 85% imp, HSG D (3S)
6.716	60	Woods, Fair, HSG B (2S)
19.307	73	Woods, Fair, HSG C (2S, 3S)
1.800	79	Woods, Fair, HSG D (2S, 3S)
29.644	70	Woods, Good, HSG C (1S)
2.995	77	Woods, Good, HSG D (1S)
135.738	**80**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.058	HSG A	2S
18.380	HSG B	1S, 2S, 3S
78.210	HSG C	1S, 2S, 3S
39.090	HSG D	1S, 2S, 3S
0.000	Other	
135.738		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	6.676	7.354	6.253	0.000	20.283	1/4 acre lots, 38% imp	1S, 2S, 3S
0.000	0.747	0.000	0.000	0.000	0.747	1/8 acre lots, 65% imp	2S
0.058	0.000	9.848	2.427	0.000	12.333	50-75% Grass cover, Fair	2S, 3S
0.000	0.114	0.075	0.000	0.000	0.189	Paved parking	2S, 3S
0.000	0.429	0.000	0.000	0.000	0.429	Roofs	3S
0.000	3.698	11.982	25.615	0.000	41.295	Urban commercial, 85% imp	2S, 3S
0.000	6.716	19.307	1.800	0.000	27.823	Woods, Fair	2S, 3S
0.000	0.000	29.644	2.995	0.000	32.639	Woods, Good	1S
0.058	**18.380**	**78.210**	**39.090**	**0.000**	**135.738**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	2S	0.00	0.00	36.0	0.0070	0.025	18.0	0.0	0.0
2	3S	0.00	0.00	188.0	0.0600	0.025	60.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: DS Runoff Area=33.100 ac 0.53% Impervious Runoff Depth>0.49"
Flow Length=1,226' Tc=36.7 min CN=71 Runoff=9.78 cfs 1.354 af

Subcatchment2S: Trib Runoff Area=43.807 ac 14.40% Impervious Runoff Depth>0.65"
Flow Length=2,471' Tc=24.0 min CN=75 Runoff=22.98 cfs 2.390 af

Subcatchment3S: Waterworks Runoff Area=58.831 ac 63.62% Impervious Runoff Depth>1.54"
Flow Length=1,755' Tc=16.5 min CN=90 Runoff=89.80 cfs 7.556 af

Reach 4R: Reach 1 Avg. Flow Depth=1.07' Max Vel=4.32 fps Inflow=108.57 cfs 9.946 af
n=0.035 L=520.0' S=0.0115 '/' Capacity=95.87 cfs Outflow=105.95 cfs 9.907 af

Reach 5R: Reach 2 Avg. Flow Depth=1.16' Max Vel=3.95 fps Inflow=111.74 cfs 11.261 af
n=0.035 L=956.0' S=0.0089 '/' Capacity=84.15 cfs Outflow=107.00 cfs 11.169 af

Total Runoff Area = 135.738 ac Runoff Volume = 11.300 af Average Runoff Depth = 1.00"
67.65% Pervious = 91.826 ac 32.35% Impervious = 43.912 ac

Summary for Subcatchment 1S: DS

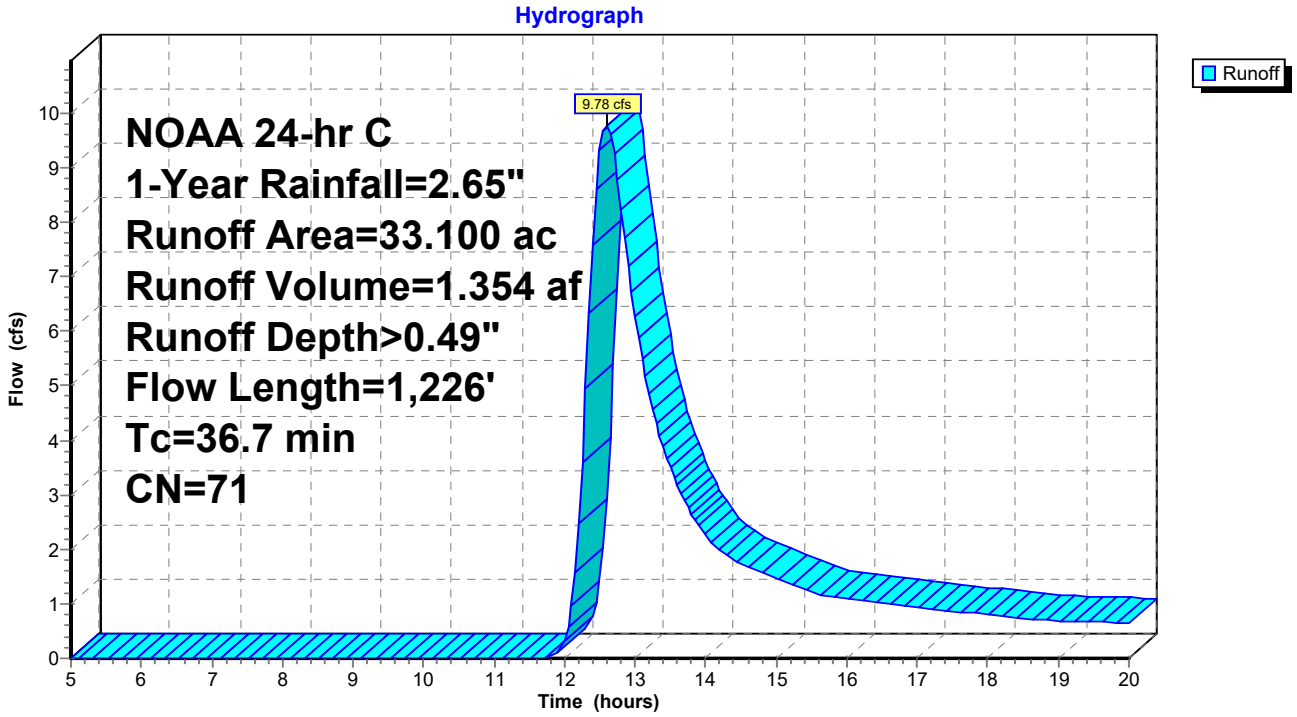
Runoff = 9.78 cfs @ 12.59 hrs, Volume= 1.354 af, Depth> 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.65"

Area (ac)	CN	Description
0.029	75	1/4 acre lots, 38% imp, HSG B
0.166	75	1/4 acre lots, 38% imp, HSG B
0.072	75	1/4 acre lots, 38% imp, HSG B
0.017	75	1/4 acre lots, 38% imp, HSG B
21.651	70	Woods, Good, HSG C
0.057	83	1/4 acre lots, 38% imp, HSG C
0.120	83	1/4 acre lots, 38% imp, HSG C
7.993	70	Woods, Good, HSG C
2.607	77	Woods, Good, HSG D
0.388	77	Woods, Good, HSG D
33.100	71	Weighted Average
32.925		99.47% Pervious Area
0.175		0.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	100	0.0100	0.06		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
7.3	635	0.0850	1.46		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.1	491	0.0650	7.46	61.56	**Trap/Vee/Rect Channel Flow, Channel Flow** Bot.W=15.00' D=0.50' Z= 3.0 '/' Top.W=18.00' n= 0.030 Earth, grassed & winding
36.7	1,226	Total			

Subcatchment 1S: DS



Summary for Subcatchment 2S: Trib

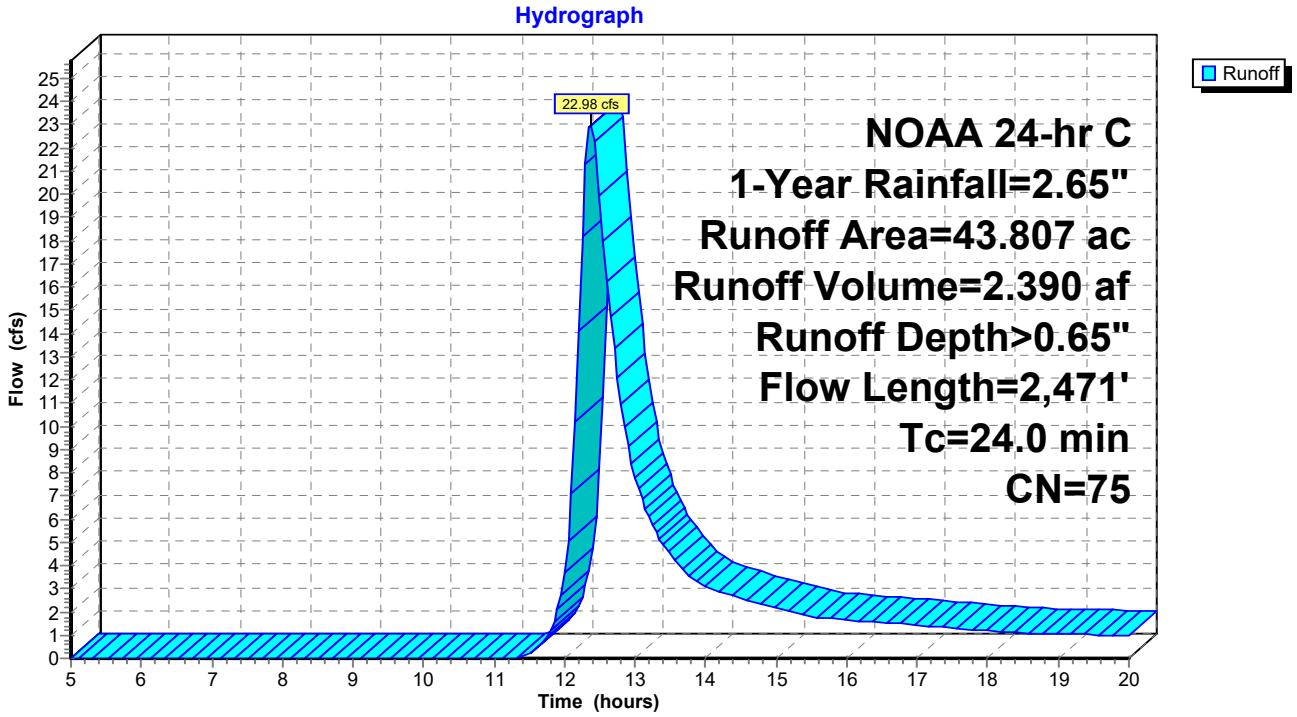
Runoff = 22.98 cfs @ 12.38 hrs, Volume= 2.390 af, Depth> 0.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.65"

Area (ac)	CN	Description
0.041	49	50-75% Grass cover, Fair, HSG A
0.017	49	50-75% Grass cover, Fair, HSG A
6.716	60	Woods, Fair, HSG B
4.199	75	1/4 acre lots, 38% imp, HSG B
0.747	85	1/8 acre lots, 65% imp, HSG B
2.193	75	1/4 acre lots, 38% imp, HSG B
14.096	73	Woods, Fair, HSG C
0.075	98	Paved parking, HSG C
5.144	83	1/4 acre lots, 38% imp, HSG C
1.606	94	Urban commercial, 85% imp, HSG C
8.431	79	50-75% Grass cover, Fair, HSG C
0.542	79	Woods, Fair, HSG D
43.807	75	Weighted Average
37.498		85.60% Pervious Area
6.309		14.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0400	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.20"
2.3	487	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.2	36	0.0070	2.59	4.57	**Pipe Channel, CMP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Earth, clean & winding
1.9	260	0.0200	2.28		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.3	47	0.0200	2.87		**Shallow Concentrated Flow, SC3** Paved Kv= 20.3 fps
0.7	101	0.0200	2.28		**Shallow Concentrated Flow, SC4** Unpaved Kv= 16.1 fps
5.4	425	0.0700	1.32		**Shallow Concentrated Flow, SC5** Woodland Kv= 5.0 fps
5.8	1,015	0.0120	2.94	9.54	**Trap/Vee/Rect Channel Flow, Stream** Bot.W=5.00' D=0.50' Z= 3.0 '/' Top.W=8.00' n= 0.030 Earth, grassed & winding
24.0	2,471	Total			

Subcatchment 2S: Trib



Summary for Subcatchment 3S: Waterworks

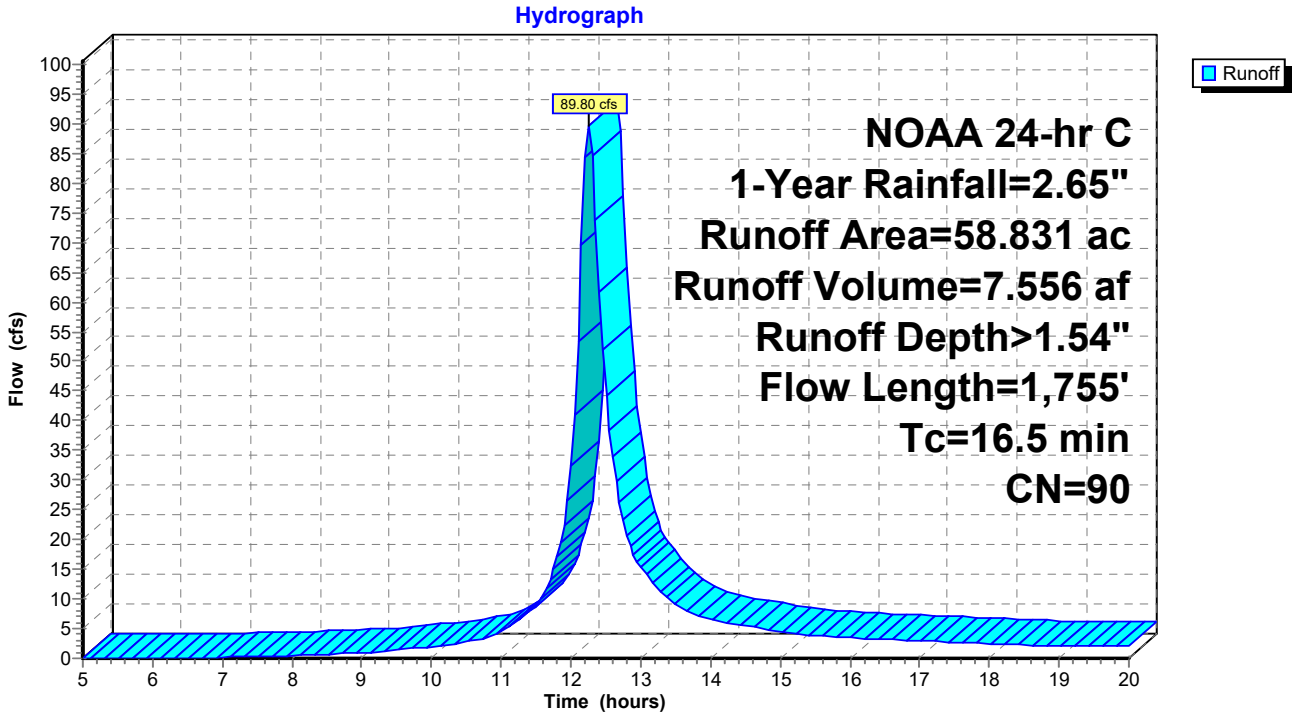
Runoff = 89.80 cfs @ 12.25 hrs, Volume= 7.556 af, Depth> 1.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 1-Year Rainfall=2.65"

Area (ac)	CN	Description
2.547	92	Urban commercial, 85% imp, HSG B
0.429	98	Roofs, HSG B
0.114	98	Paved parking, HSG B
1.151	92	Urban commercial, 85% imp, HSG B
4.165	73	Woods, Fair, HSG C
1.220	94	Urban commercial, 85% imp, HSG C
0.879	94	Urban commercial, 85% imp, HSG C
2.033	83	1/4 acre lots, 38% imp, HSG C
2.857	94	Urban commercial, 85% imp, HSG C
1.417	79	50-75% Grass cover, Fair, HSG C
1.046	73	Woods, Fair, HSG C
0.131	79	Woods, Fair, HSG D
0.848	79	Woods, Fair, HSG D
17.688	95	Urban commercial, 85% imp, HSG D
6.253	87	1/4 acre lots, 38% imp, HSG D
7.927	95	Urban commercial, 85% imp, HSG D
2.427	84	50-75% Grass cover, Fair, HSG D
0.279	79	Woods, Fair, HSG D
5.420	94	Urban commercial, 85% imp, HSG C
58.831	90	Weighted Average
21.404		36.38% Pervious Area
37.427		63.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.04		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.20"
0.4	90	0.0400	4.06		**Shallow Concentrated Flow, Shallow Concentrated Flow** Paved Kv= 20.3 fps
0.4	93	0.0540	3.74		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
10.5	546	0.0300	0.87		**Shallow Concentrated Flow, Shallow3** Woodland Kv= 5.0 fps
0.5	281		9.83		**Lake or Reservoir, Pond** Mean Depth= 3.00'
0.2	188	0.0600	16.90	331.73	**Pipe Channel, RCP_Round 60"** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.025 Earth, clean & winding
2.9	457	0.0100	2.62	7.20	**Trap/Vee/Rect Channel Flow, Stream** Bot.W=4.00' D=0.50' Z= 3.0 '/' Top.W=7.00' n= 0.030 Earth, grassed & winding
16.5	1,755	Total			

Subcatchment 3S: Waterworks



Summary for Reach 4R: Reach 1

[91] Warning: Storage range exceeded by 0.07'
[55] Hint: Peak inflow is 113% of Manning's capacity

Inflow Area = 102.638 ac, 42.61% Impervious, Inflow Depth > 1.16" for 1-Year event
Inflow = 108.57 cfs @ 12.27 hrs, Volume= 9.946 af
Outflow = 105.95 cfs @ 12.33 hrs, Volume= 9.907 af, Atten= 2%, Lag= 3.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.32 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 6.3 min

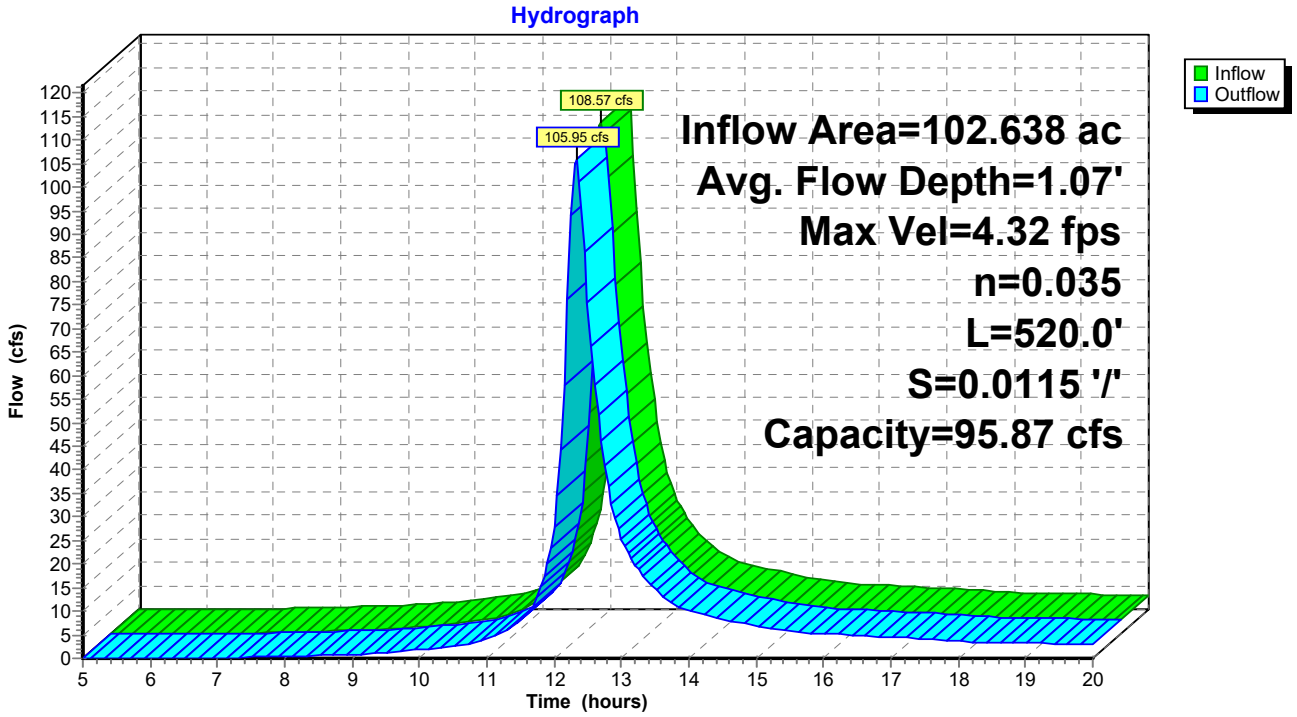
Peak Storage= 12,889 cf @ 12.29 hrs
Average Depth at Peak Storage= 1.07'
Bank-Full Depth= 1.00' Flow Area= 23.0 sf, Capacity= 95.87 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 520.0' Slope= 0.0115 '/'
Inlet Invert= 43.50', Outlet Invert= 37.50'



‡

Reach 4R: Reach 1



Summary for Reach 5R: Reach 2

[91] Warning: Storage range exceeded by 0.16'
[55] Hint: Peak inflow is 133% of Manning's capacity
[62] Hint: Exceeded Reach 4R OUTLET depth by 0.24' @ 12.50 hrs

Inflow Area = 135.738 ac, 32.35% Impervious, Inflow Depth > 1.00" for 1-Year event
Inflow = 111.74 cfs @ 12.33 hrs, Volume= 11.261 af
Outflow = 107.00 cfs @ 12.46 hrs, Volume= 11.169 af, Atten= 4%, Lag= 7.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.95 fps, Min. Travel Time= 4.0 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 12.1 min

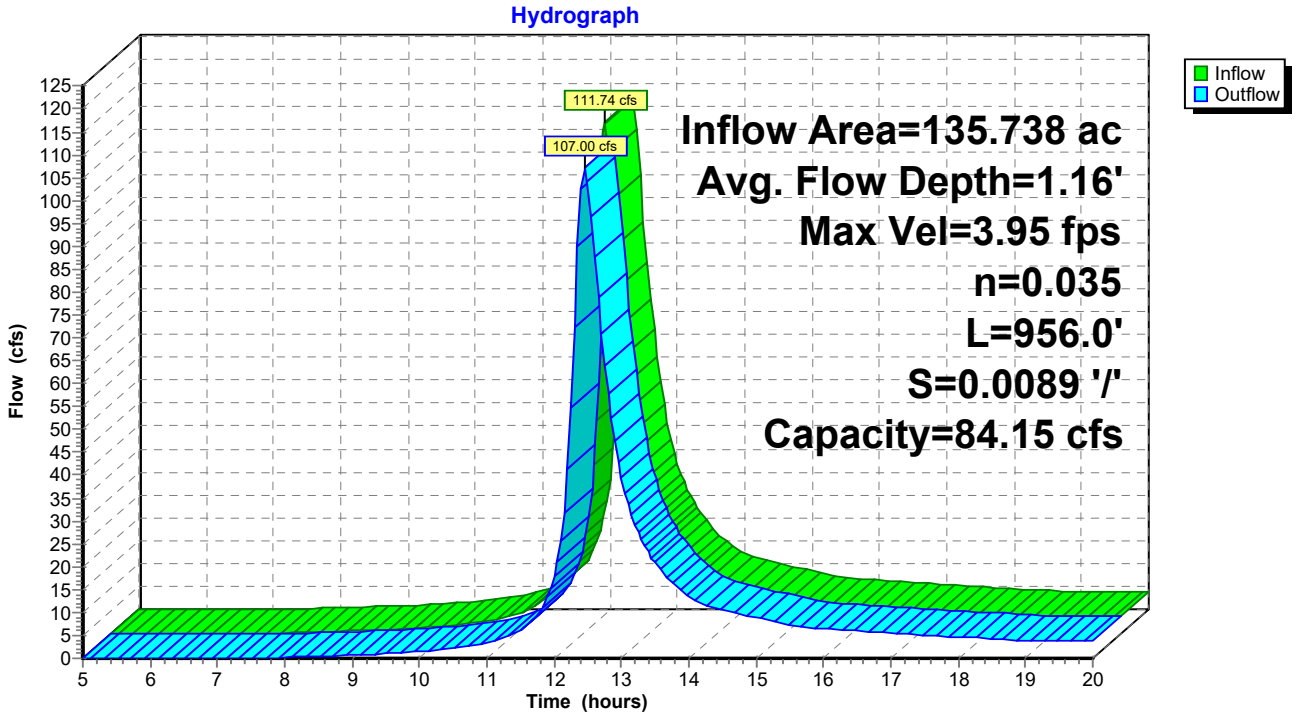
Peak Storage= 26,039 cf @ 12.39 hrs
Average Depth at Peak Storage= 1.16'
Bank-Full Depth= 1.00' Flow Area= 23.0 sf, Capacity= 84.15 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 956.0' Slope= 0.0089 '/'
Inlet Invert= 37.50', Outlet Invert= 29.00'



‡

Reach 5R: Reach 2



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: DS Runoff Area=33.100 ac 0.53% Impervious Runoff Depth>0.77"
Flow Length=1,226' Tc=36.7 min CN=71 Runoff=16.39 cfs 2.126 af

Subcatchment2S: Trib Runoff Area=43.807 ac 14.40% Impervious Runoff Depth>0.98"
Flow Length=2,471' Tc=24.0 min CN=75 Runoff=35.58 cfs 3.573 af

Subcatchment3S: Waterworks Runoff Area=58.831 ac 63.62% Impervious Runoff Depth>2.01"
Flow Length=1,755' Tc=16.5 min CN=90 Runoff=116.02 cfs 9.875 af

Reach 4R: Reach 1 Avg. Flow Depth=1.29' Max Vel=4.71 fps Inflow=146.00 cfs 13.449 af
n=0.035 L=520.0' S=0.0115 '/' Capacity=95.87 cfs Outflow=142.82 cfs 13.402 af

Reach 5R: Reach 2 Avg. Flow Depth=1.44' Max Vel=4.29 fps Inflow=153.24 cfs 15.529 af
n=0.035 L=956.0' S=0.0089 '/' Capacity=84.15 cfs Outflow=147.31 cfs 15.421 af

Total Runoff Area = 135.738 ac Runoff Volume = 15.575 af Average Runoff Depth = 1.38"
67.65% Pervious = 91.826 ac 32.35% Impervious = 43.912 ac

Summary for Subcatchment 1S: DS

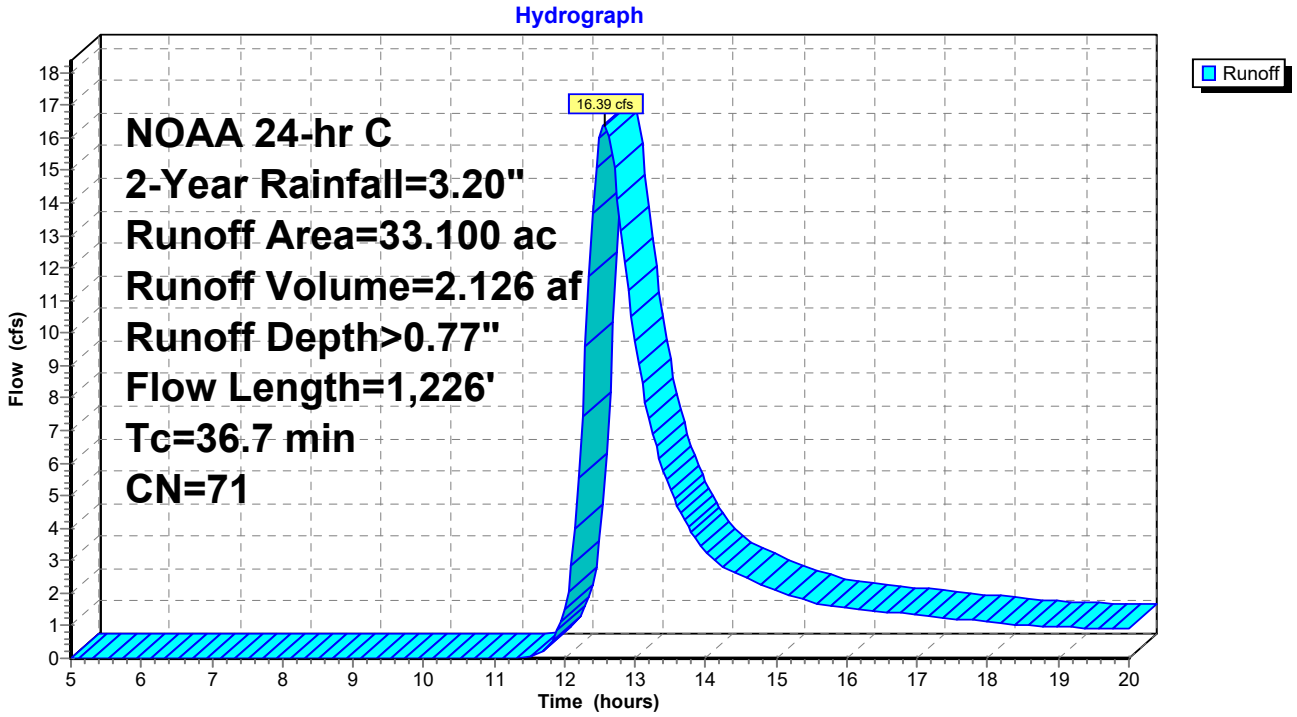
Runoff = 16.39 cfs @ 12.57 hrs, Volume= 2.126 af, Depth> 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.029	75	1/4 acre lots, 38% imp, HSG B
0.166	75	1/4 acre lots, 38% imp, HSG B
0.072	75	1/4 acre lots, 38% imp, HSG B
0.017	75	1/4 acre lots, 38% imp, HSG B
21.651	70	Woods, Good, HSG C
0.057	83	1/4 acre lots, 38% imp, HSG C
0.120	83	1/4 acre lots, 38% imp, HSG C
7.993	70	Woods, Good, HSG C
2.607	77	Woods, Good, HSG D
0.388	77	Woods, Good, HSG D
33.100	71	Weighted Average
32.925		99.47% Pervious Area
0.175		0.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	100	0.0100	0.06		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
7.3	635	0.0850	1.46		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.1	491	0.0650	7.46	61.56	**Trap/Vee/Rect Channel Flow, Channel Flow** Bot.W=15.00' D=0.50' Z= 3.0 '/' Top.W=18.00' n= 0.030 Earth, grassed & winding
36.7	1,226	Total			

Subcatchment 1S: DS



Summary for Subcatchment 2S: Trib

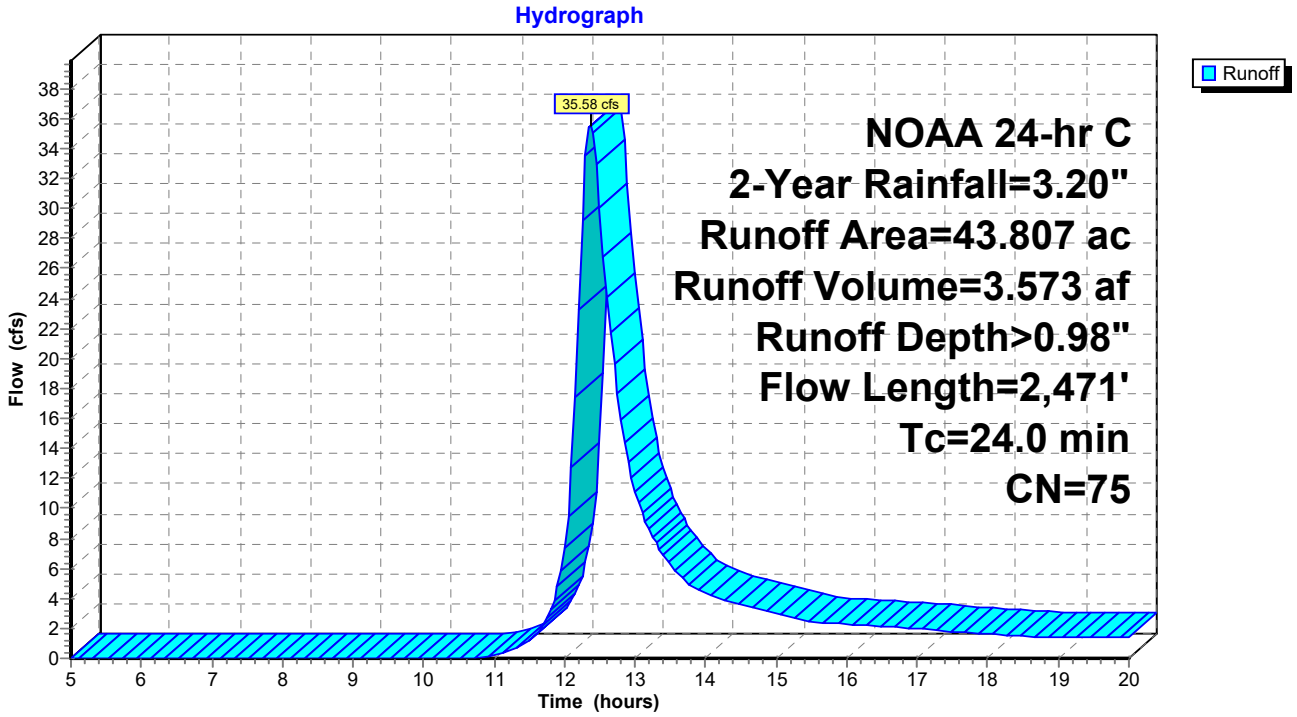
Runoff = 35.58 cfs @ 12.37 hrs, Volume= 3.573 af, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.20"

Area (ac)	CN	Description
0.041	49	50-75% Grass cover, Fair, HSG A
0.017	49	50-75% Grass cover, Fair, HSG A
6.716	60	Woods, Fair, HSG B
4.199	75	1/4 acre lots, 38% imp, HSG B
0.747	85	1/8 acre lots, 65% imp, HSG B
2.193	75	1/4 acre lots, 38% imp, HSG B
14.096	73	Woods, Fair, HSG C
0.075	98	Paved parking, HSG C
5.144	83	1/4 acre lots, 38% imp, HSG C
1.606	94	Urban commercial, 85% imp, HSG C
8.431	79	50-75% Grass cover, Fair, HSG C
0.542	79	Woods, Fair, HSG D
43.807	75	Weighted Average
37.498		85.60% Pervious Area
6.309		14.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0400	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.20"
2.3	487	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.2	36	0.0070	2.59	4.57	**Pipe Channel, CMP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Earth, clean & winding
1.9	260	0.0200	2.28		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.3	47	0.0200	2.87		**Shallow Concentrated Flow, SC3** Paved Kv= 20.3 fps
0.7	101	0.0200	2.28		**Shallow Concentrated Flow, SC4** Unpaved Kv= 16.1 fps
5.4	425	0.0700	1.32		**Shallow Concentrated Flow, SC5** Woodland Kv= 5.0 fps
5.8	1,015	0.0120	2.94	9.54	**Trap/Vee/Rect Channel Flow, Stream** Bot.W=5.00' D=0.50' Z= 3.0 '/' Top.W=8.00' n= 0.030 Earth, grassed & winding
24.0	2,471	Total			

Subcatchment 2S: Trib



Summary for Subcatchment 3S: Waterworks

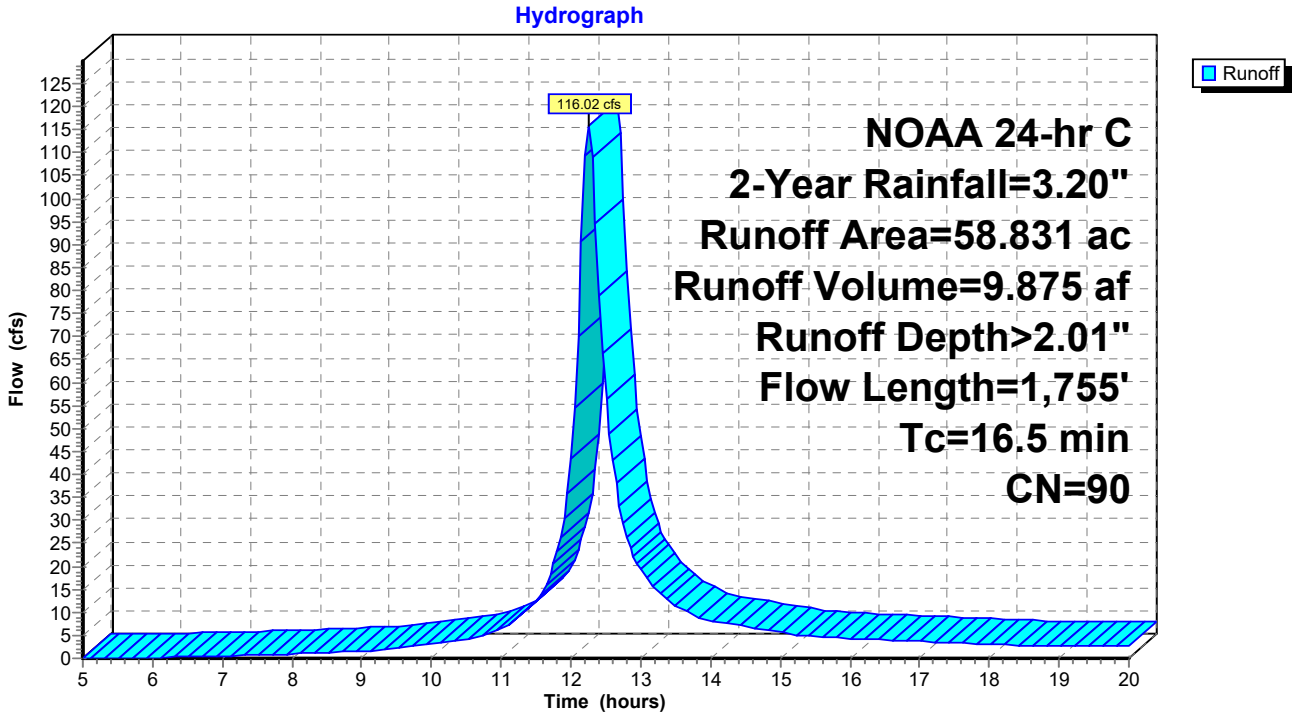
Runoff = 116.02 cfs @ 12.25 hrs, Volume= 9.875 af, Depth> 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 2-Year Rainfall=3.20"

Area (ac)	CN	Description
2.547	92	Urban commercial, 85% imp, HSG B
0.429	98	Roofs, HSG B
0.114	98	Paved parking, HSG B
1.151	92	Urban commercial, 85% imp, HSG B
4.165	73	Woods, Fair, HSG C
1.220	94	Urban commercial, 85% imp, HSG C
0.879	94	Urban commercial, 85% imp, HSG C
2.033	83	1/4 acre lots, 38% imp, HSG C
2.857	94	Urban commercial, 85% imp, HSG C
1.417	79	50-75% Grass cover, Fair, HSG C
1.046	73	Woods, Fair, HSG C
0.131	79	Woods, Fair, HSG D
0.848	79	Woods, Fair, HSG D
17.688	95	Urban commercial, 85% imp, HSG D
6.253	87	1/4 acre lots, 38% imp, HSG D
7.927	95	Urban commercial, 85% imp, HSG D
2.427	84	50-75% Grass cover, Fair, HSG D
0.279	79	Woods, Fair, HSG D
5.420	94	Urban commercial, 85% imp, HSG C
58.831	90	Weighted Average
21.404		36.38% Pervious Area
37.427		63.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.04		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.20"
0.4	90	0.0400	4.06		**Shallow Concentrated Flow, Shallow Concentrated Flow** Paved Kv= 20.3 fps
0.4	93	0.0540	3.74		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
10.5	546	0.0300	0.87		**Shallow Concentrated Flow, Shallow3** Woodland Kv= 5.0 fps
0.5	281		9.83		**Lake or Reservoir, Pond** Mean Depth= 3.00'
0.2	188	0.0600	16.90	331.73	**Pipe Channel, RCP_Round 60"** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.025 Earth, clean & winding
2.9	457	0.0100	2.62	7.20	**Trap/Vee/Rect Channel Flow, Stream** Bot.W=4.00' D=0.50' Z= 3.0 '/' Top.W=7.00' n= 0.030 Earth, grassed & winding
16.5	1,755	Total			

Subcatchment 3S: Waterworks



Summary for Reach 4R: Reach 1

[91] Warning: Storage range exceeded by 0.29'
[55] Hint: Peak inflow is 152% of Manning's capacity

Inflow Area = 102.638 ac, 42.61% Impervious, Inflow Depth > 1.57" for 2-Year event
Inflow = 146.00 cfs @ 12.27 hrs, Volume= 13.449 af
Outflow = 142.82 cfs @ 12.32 hrs, Volume= 13.402 af, Atten= 2%, Lag= 3.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.71 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.48 fps, Avg. Travel Time= 5.9 min

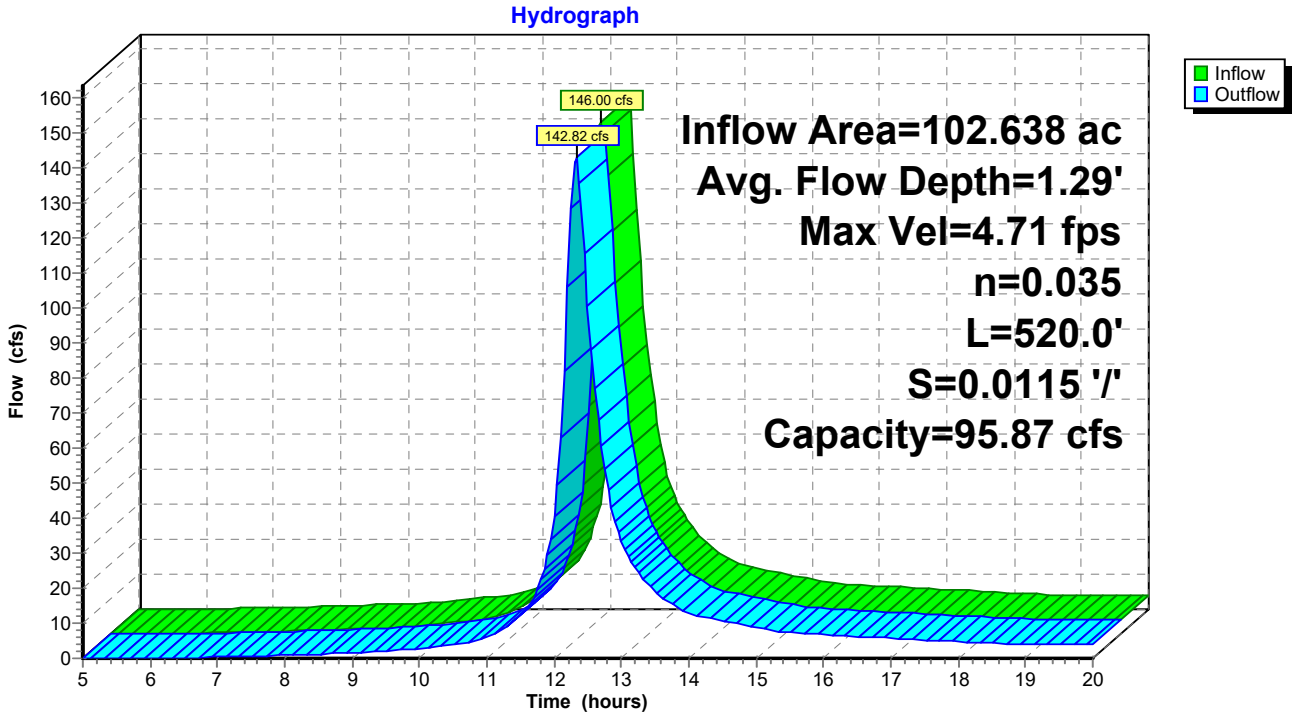
Peak Storage= 15,924 cf @ 12.29 hrs
Average Depth at Peak Storage= 1.29'
Bank-Full Depth= 1.00' Flow Area= 23.0 sf, Capacity= 95.87 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 520.0' Slope= 0.0115 '/'
Inlet Invert= 43.50', Outlet Invert= 37.50'



‡

Reach 4R: Reach 1



Summary for Reach 5R: Reach 2

[91] Warning: Storage range exceeded by 0.44'
[55] Hint: Peak inflow is 182% of Manning's capacity
[62] Hint: Exceeded Reach 4R OUTLET depth by 0.33' @ 12.50 hrs

Inflow Area = 135.738 ac, 32.35% Impervious, Inflow Depth > 1.37" for 2-Year event
Inflow = 153.24 cfs @ 12.33 hrs, Volume= 15.529 af
Outflow = 147.31 cfs @ 12.45 hrs, Volume= 15.421 af, Atten= 4%, Lag= 6.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.29 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 1.42 fps, Avg. Travel Time= 11.2 min

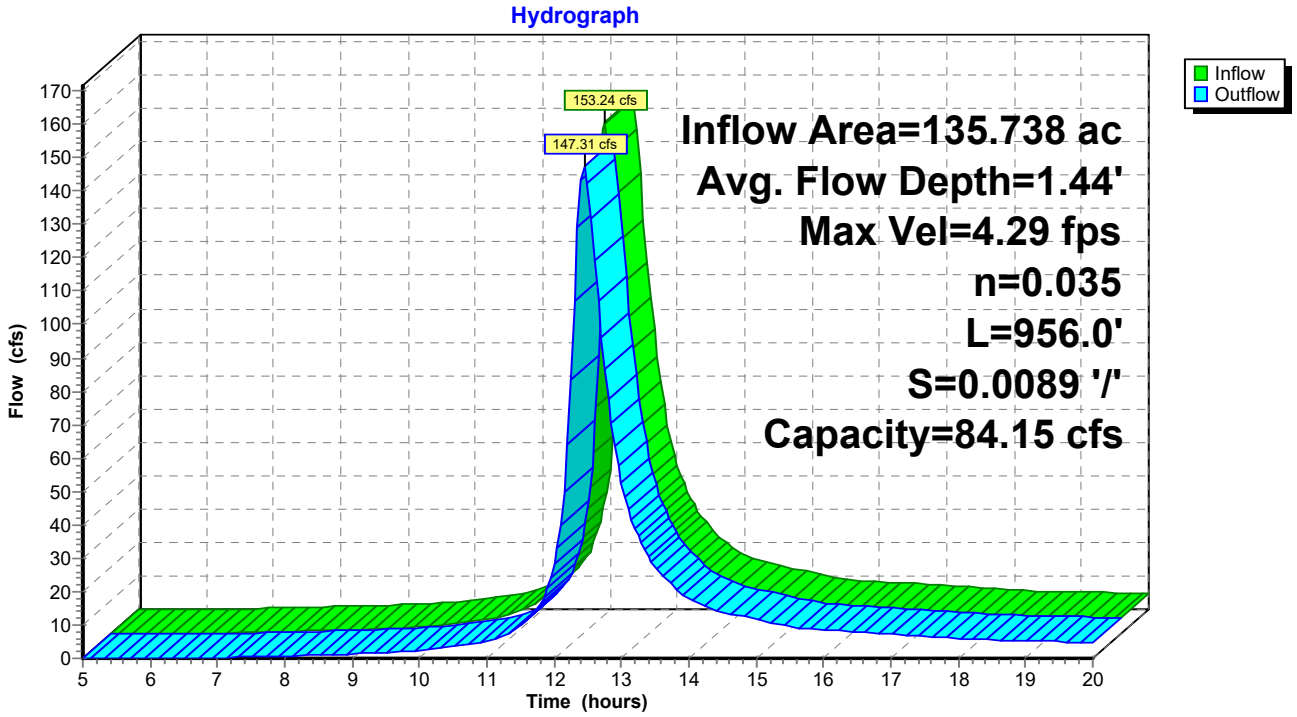
Peak Storage= 32,975 cf @ 12.38 hrs
Average Depth at Peak Storage= 1.44'
Bank-Full Depth= 1.00' Flow Area= 23.0 sf, Capacity= 84.15 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 956.0' Slope= 0.0089 '/'
Inlet Invert= 37.50', Outlet Invert= 29.00'



‡

Reach 5R: Reach 2



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: DS Runoff Area=33.100 ac 0.53% Impervious Runoff Depth>1.87"
Flow Length=1,226' Tc=36.7 min CN=71 Runoff=41.98 cfs 5.157 af

Subcatchment2S: Trib Runoff Area=43.807 ac 14.40% Impervious Runoff Depth>2.19"
Flow Length=2,471' Tc=24.0 min CN=75 Runoff=81.51 cfs 8.013 af

Subcatchment3S: Waterworks Runoff Area=58.831 ac 63.62% Impervious Runoff Depth>3.57"
Flow Length=1,755' Tc=16.5 min CN=90 Runoff=199.71 cfs 17.526 af

Reach 4R: Reach 1 Avg. Flow Depth=2.05' Max Vel=5.34 fps Inflow=271.19 cfs 25.539 af
n=0.035 L=520.0' S=0.0115 '/' Capacity=95.87 cfs Outflow=265.38 cfs 25.472 af

Reach 5R: Reach 2 Avg. Flow Depth=2.40' Max Vel=4.82 fps Inflow=295.56 cfs 30.629 af
n=0.035 L=956.0' S=0.0089 '/' Capacity=84.15 cfs Outflow=285.66 cfs 30.473 af

Total Runoff Area = 135.738 ac Runoff Volume = 30.696 af Average Runoff Depth = 2.71"
67.65% Pervious = 91.826 ac 32.35% Impervious = 43.912 ac

Summary for Subcatchment 1S: DS

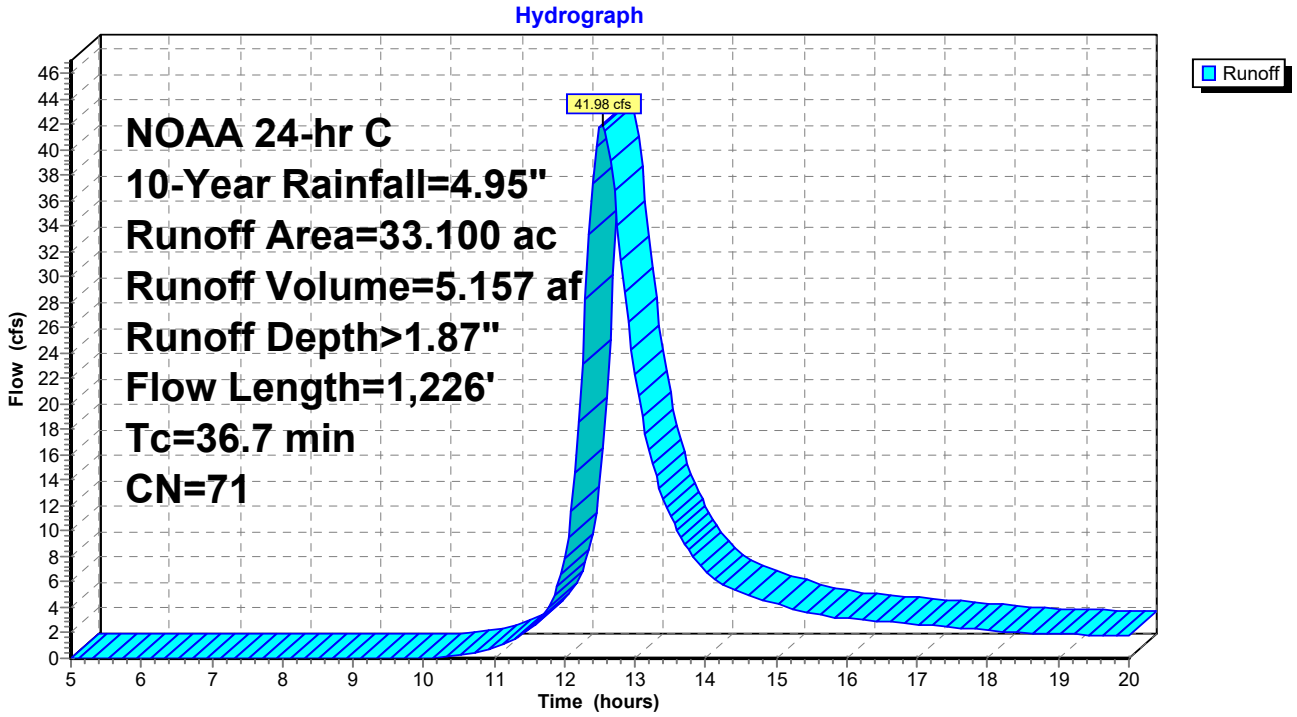
Runoff = 41.98 cfs @ 12.53 hrs, Volume= 5.157 af, Depth> 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.95"

Area (ac)	CN	Description
0.029	75	1/4 acre lots, 38% imp, HSG B
0.166	75	1/4 acre lots, 38% imp, HSG B
0.072	75	1/4 acre lots, 38% imp, HSG B
0.017	75	1/4 acre lots, 38% imp, HSG B
21.651	70	Woods, Good, HSG C
0.057	83	1/4 acre lots, 38% imp, HSG C
0.120	83	1/4 acre lots, 38% imp, HSG C
7.993	70	Woods, Good, HSG C
2.607	77	Woods, Good, HSG D
0.388	77	Woods, Good, HSG D
33.100	71	Weighted Average
32.925		99.47% Pervious Area
0.175		0.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	100	0.0100	0.06		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
7.3	635	0.0850	1.46		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.1	491	0.0650	7.46	61.56	**Trap/Vee/Rect Channel Flow, Channel Flow** Bot.W=15.00' D=0.50' Z= 3.0 '/' Top.W=18.00' n= 0.030 Earth, grassed & winding
36.7	1,226	Total			

Subcatchment 1S: DS



Summary for Subcatchment 2S: Trib

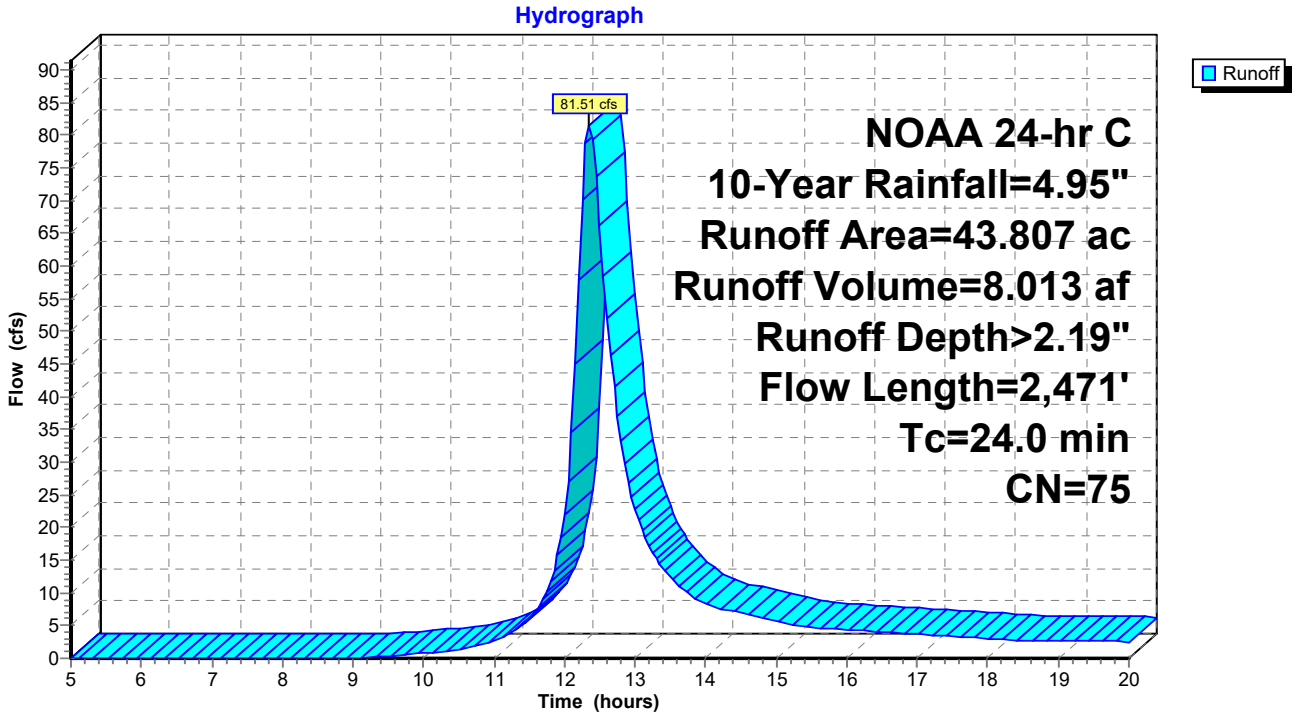
Runoff = 81.51 cfs @ 12.35 hrs, Volume= 8.013 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.95"

Area (ac)	CN	Description
0.041	49	50-75% Grass cover, Fair, HSG A
0.017	49	50-75% Grass cover, Fair, HSG A
6.716	60	Woods, Fair, HSG B
4.199	75	1/4 acre lots, 38% imp, HSG B
0.747	85	1/8 acre lots, 65% imp, HSG B
2.193	75	1/4 acre lots, 38% imp, HSG B
14.096	73	Woods, Fair, HSG C
0.075	98	Paved parking, HSG C
5.144	83	1/4 acre lots, 38% imp, HSG C
1.606	94	Urban commercial, 85% imp, HSG C
8.431	79	50-75% Grass cover, Fair, HSG C
0.542	79	Woods, Fair, HSG D
43.807	75	Weighted Average
37.498		85.60% Pervious Area
6.309		14.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0400	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.20"
2.3	487	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.2	36	0.0070	2.59	4.57	**Pipe Channel, CMP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Earth, clean & winding
1.9	260	0.0200	2.28		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.3	47	0.0200	2.87		**Shallow Concentrated Flow, SC3** Paved Kv= 20.3 fps
0.7	101	0.0200	2.28		**Shallow Concentrated Flow, SC4** Unpaved Kv= 16.1 fps
5.4	425	0.0700	1.32		**Shallow Concentrated Flow, SC5** Woodland Kv= 5.0 fps
5.8	1,015	0.0120	2.94	9.54	**Trap/Vee/Rect Channel Flow, Stream** Bot.W=5.00' D=0.50' Z= 3.0 '/' Top.W=8.00' n= 0.030 Earth, grassed & winding
24.0	2,471	Total			

Subcatchment 2S: Trib



Summary for Subcatchment 3S: Waterworks

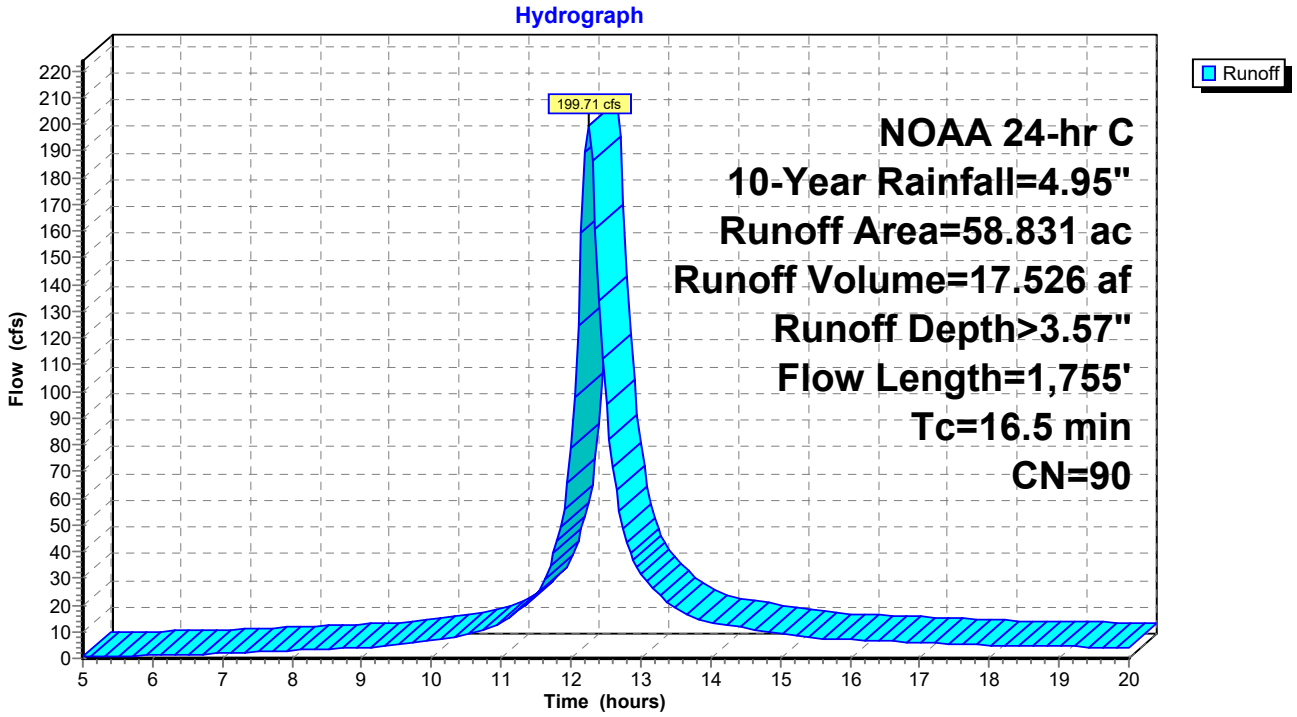
Runoff = 199.71 cfs @ 12.25 hrs, Volume= 17.526 af, Depth> 3.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 10-Year Rainfall=4.95"

Area (ac)	CN	Description
2.547	92	Urban commercial, 85% imp, HSG B
0.429	98	Roofs, HSG B
0.114	98	Paved parking, HSG B
1.151	92	Urban commercial, 85% imp, HSG B
4.165	73	Woods, Fair, HSG C
1.220	94	Urban commercial, 85% imp, HSG C
0.879	94	Urban commercial, 85% imp, HSG C
2.033	83	1/4 acre lots, 38% imp, HSG C
2.857	94	Urban commercial, 85% imp, HSG C
1.417	79	50-75% Grass cover, Fair, HSG C
1.046	73	Woods, Fair, HSG C
0.131	79	Woods, Fair, HSG D
0.848	79	Woods, Fair, HSG D
17.688	95	Urban commercial, 85% imp, HSG D
6.253	87	1/4 acre lots, 38% imp, HSG D
7.927	95	Urban commercial, 85% imp, HSG D
2.427	84	50-75% Grass cover, Fair, HSG D
0.279	79	Woods, Fair, HSG D
5.420	94	Urban commercial, 85% imp, HSG C
58.831	90	Weighted Average
21.404		36.38% Pervious Area
37.427		63.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.04		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.20"
0.4	90	0.0400	4.06		**Shallow Concentrated Flow, Shallow Concentrated Flow** Paved Kv= 20.3 fps
0.4	93	0.0540	3.74		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
10.5	546	0.0300	0.87		**Shallow Concentrated Flow, Shallow3** Woodland Kv= 5.0 fps
0.5	281		9.83		**Lake or Reservoir, Pond** Mean Depth= 3.00'
0.2	188	0.0600	16.90	331.73	**Pipe Channel, RCP_Round 60"** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.025 Earth, clean & winding
2.9	457	0.0100	2.62	7.20	**Trap/Vee/Rect Channel Flow, Stream** Bot.W=4.00' D=0.50' Z= 3.0 '/' Top.W=7.00' n= 0.030 Earth, grassed & winding
16.5	1,755	Total			

Subcatchment 3S: Waterworks



Summary for Reach 4R: Reach 1

[82] Warning: Early inflow requires earlier time span
[91] Warning: Storage range exceeded by 1.05'
[55] Hint: Peak inflow is 283% of Manning's capacity

Inflow Area = 102.638 ac, 42.61% Impervious, Inflow Depth > 2.99" for 10-Year event
Inflow = 271.19 cfs @ 12.27 hrs, Volume= 25.539 af
Outflow = 265.38 cfs @ 12.32 hrs, Volume= 25.472 af, Atten= 2%, Lag= 3.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.34 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.89 fps, Avg. Travel Time= 4.6 min

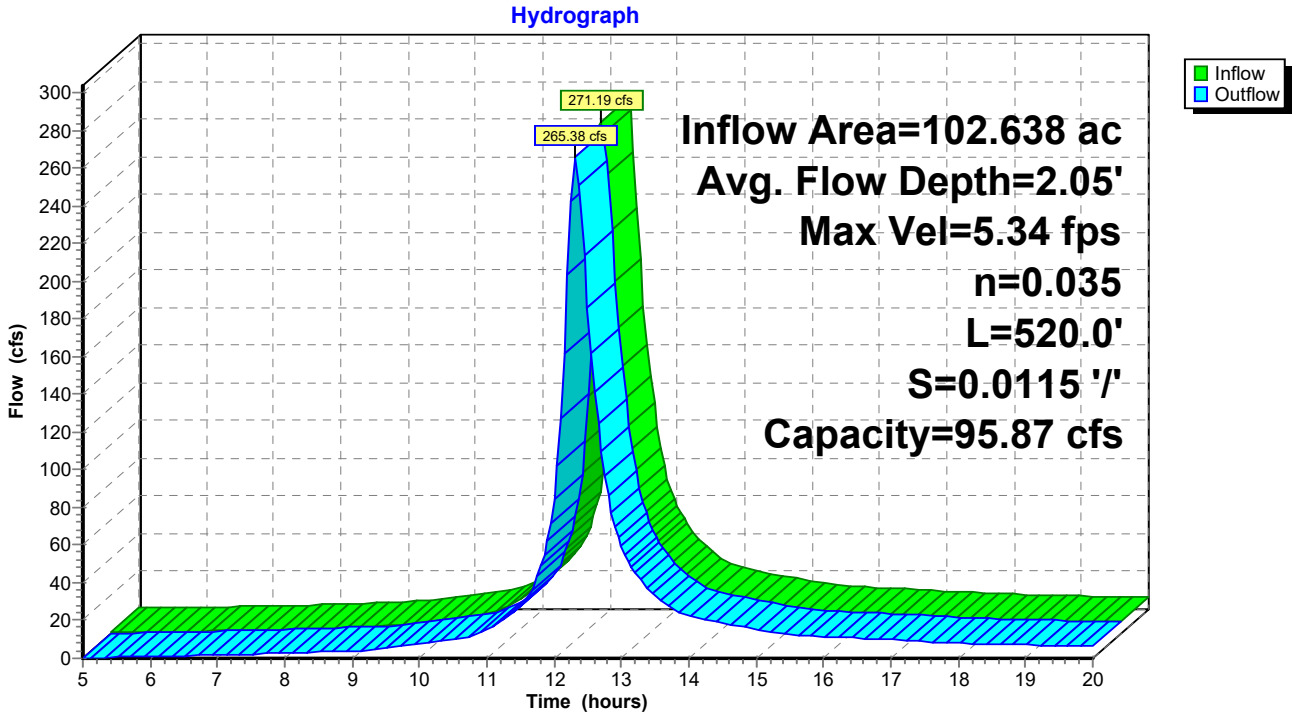
Peak Storage= 26,081 cf @ 12.29 hrs
Average Depth at Peak Storage= 2.05'
Bank-Full Depth= 1.00' Flow Area= 23.0 sf, Capacity= 95.87 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 520.0' Slope= 0.0115 '/'
Inlet Invert= 43.50', Outlet Invert= 37.50'



‡

Reach 4R: Reach 1



Summary for Reach 5R: Reach 2

[91] Warning: Storage range exceeded by 1.40'
[55] Hint: Peak inflow is 351% of Manning's capacity
[62] Hint: Exceeded Reach 4R OUTLET depth by 0.69' @ 12.50 hrs

Inflow Area = 135.738 ac, 32.35% Impervious, Inflow Depth > 2.71" for 10-Year event
Inflow = 295.56 cfs @ 12.33 hrs, Volume= 30.629 af
Outflow = 285.66 cfs @ 12.44 hrs, Volume= 30.473 af, Atten= 3%, Lag= 6.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.82 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 8.8 min

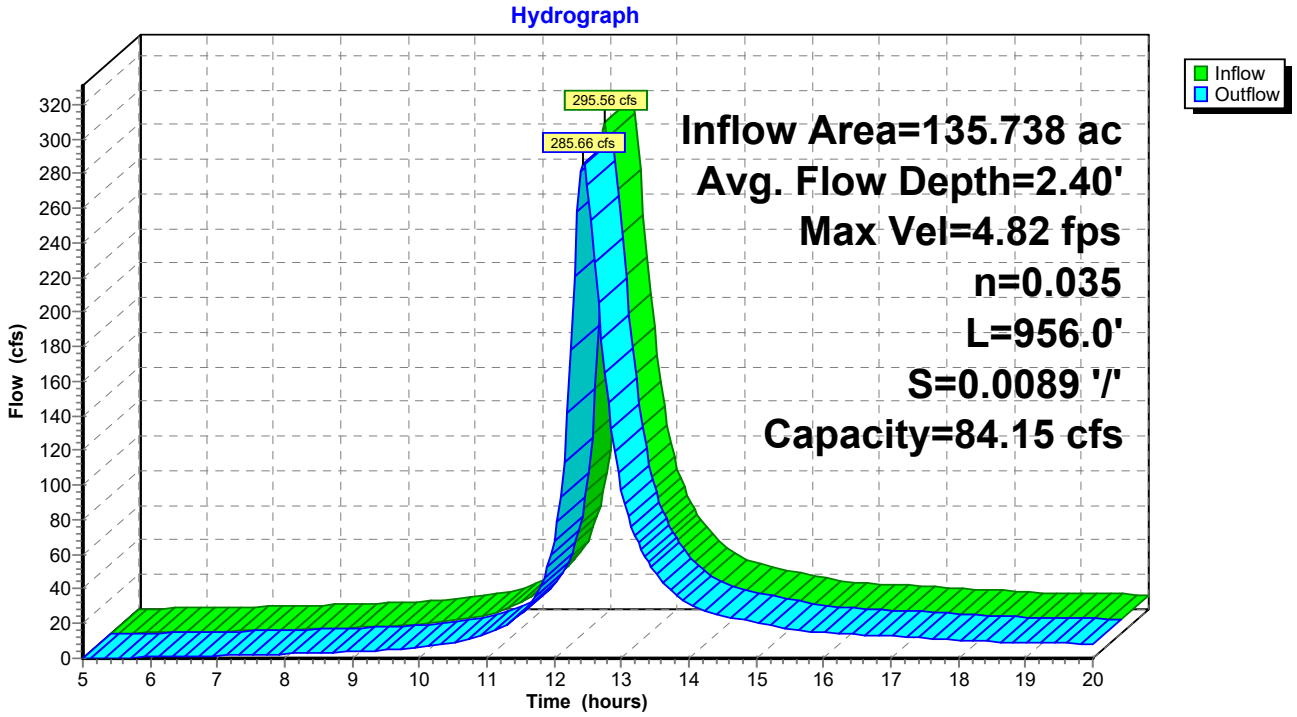
Peak Storage= 56,736 cf @ 12.38 hrs
Average Depth at Peak Storage= 2.40'
Bank-Full Depth= 1.00' Flow Area= 23.0 sf, Capacity= 84.15 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 956.0' Slope= 0.0089 '/'
Inlet Invert= 37.50', Outlet Invert= 29.00'



‡

Reach 5R: Reach 2



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: DS Runoff Area=33.100 ac 0.53% Impervious Runoff Depth>4.63"
Flow Length=1,226' Tc=36.7 min CN=71 Runoff=103.94 cfs 12.763 af

Subcatchment2S: Trib Runoff Area=43.807 ac 14.40% Impervious Runoff Depth>5.11"
Flow Length=2,471' Tc=24.0 min CN=75 Runoff=186.77 cfs 18.667 af

Subcatchment3S: Waterworks Runoff Area=58.831 ac 63.62% Impervious Runoff Depth>6.84"
Flow Length=1,755' Tc=16.5 min CN=90 Runoff=369.08 cfs 33.532 af

Reach 4R: Reach 1 Avg. Flow Depth=3.64' Max Vel=5.79 fps Inflow=537.02 cfs 52.199 af
n=0.035 L=520.0' S=0.0115 '/' Capacity=95.87 cfs Outflow=525.81 cfs 52.095 af

Reach 5R: Reach 2 Avg. Flow Depth=4.49' Max Vel=5.18 fps Inflow=605.55 cfs 64.857 af
n=0.035 L=956.0' S=0.0089 '/' Capacity=84.15 cfs Outflow=587.46 cfs 64.616 af

Total Runoff Area = 135.738 ac Runoff Volume = 64.962 af Average Runoff Depth = 5.74"
67.65% Pervious = 91.826 ac 32.35% Impervious = 43.912 ac

Summary for Subcatchment 1S: DS

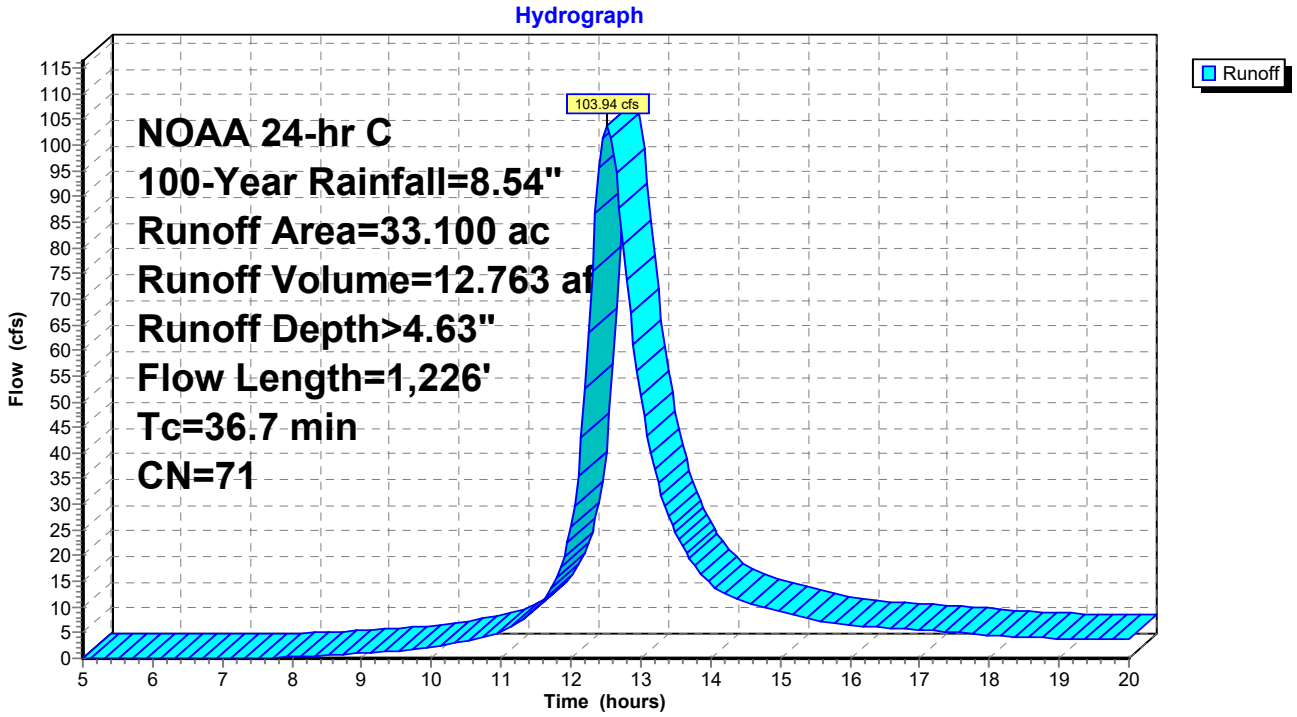
Runoff = 103.94 cfs @ 12.51 hrs, Volume= 12.763 af, Depth> 4.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.54"

Area (ac)	CN	Description
0.029	75	1/4 acre lots, 38% imp, HSG B
0.166	75	1/4 acre lots, 38% imp, HSG B
0.072	75	1/4 acre lots, 38% imp, HSG B
0.017	75	1/4 acre lots, 38% imp, HSG B
21.651	70	Woods, Good, HSG C
0.057	83	1/4 acre lots, 38% imp, HSG C
0.120	83	1/4 acre lots, 38% imp, HSG C
7.993	70	Woods, Good, HSG C
2.607	77	Woods, Good, HSG D
0.388	77	Woods, Good, HSG D
33.100	71	Weighted Average
32.925		99.47% Pervious Area
0.175		0.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	100	0.0100	0.06		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
7.3	635	0.0850	1.46		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.1	491	0.0650	7.46	61.56	**Trap/Vee/Rect Channel Flow, Channel Flow** Bot.W=15.00' D=0.50' Z= 3.0 '/' Top.W=18.00' n= 0.030 Earth, grassed & winding
36.7	1,226	Total			

Subcatchment 1S: DS



Summary for Subcatchment 2S: Trib

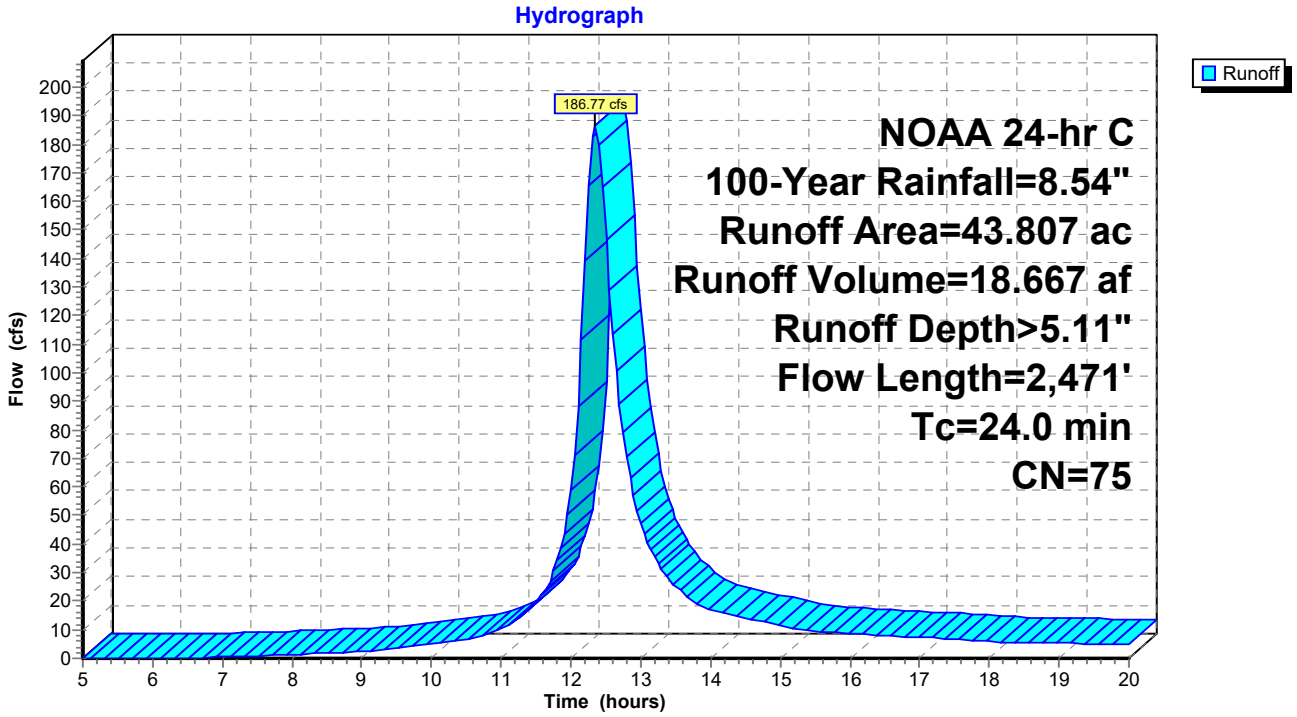
Runoff = 186.77 cfs @ 12.34 hrs, Volume= 18.667 af, Depth> 5.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.54"

Area (ac)	CN	Description
0.041	49	50-75% Grass cover, Fair, HSG A
0.017	49	50-75% Grass cover, Fair, HSG A
6.716	60	Woods, Fair, HSG B
4.199	75	1/4 acre lots, 38% imp, HSG B
0.747	85	1/8 acre lots, 65% imp, HSG B
2.193	75	1/4 acre lots, 38% imp, HSG B
14.096	73	Woods, Fair, HSG C
0.075	98	Paved parking, HSG C
5.144	83	1/4 acre lots, 38% imp, HSG C
1.606	94	Urban commercial, 85% imp, HSG C
8.431	79	50-75% Grass cover, Fair, HSG C
0.542	79	Woods, Fair, HSG D
43.807	75	Weighted Average
37.498		85.60% Pervious Area
6.309		14.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0400	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.20"
2.3	487	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.2	36	0.0070	2.59	4.57	**Pipe Channel, CMP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Earth, clean & winding
1.9	260	0.0200	2.28		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.3	47	0.0200	2.87		**Shallow Concentrated Flow, SC3** Paved Kv= 20.3 fps
0.7	101	0.0200	2.28		**Shallow Concentrated Flow, SC4** Unpaved Kv= 16.1 fps
5.4	425	0.0700	1.32		**Shallow Concentrated Flow, SC5** Woodland Kv= 5.0 fps
5.8	1,015	0.0120	2.94	9.54	**Trap/Vee/Rect Channel Flow, Stream** Bot.W=5.00' D=0.50' Z= 3.0 '/' Top.W=8.00' n= 0.030 Earth, grassed & winding
24.0	2,471	Total			

Subcatchment 2S: Trib



Summary for Subcatchment 3S: Waterworks

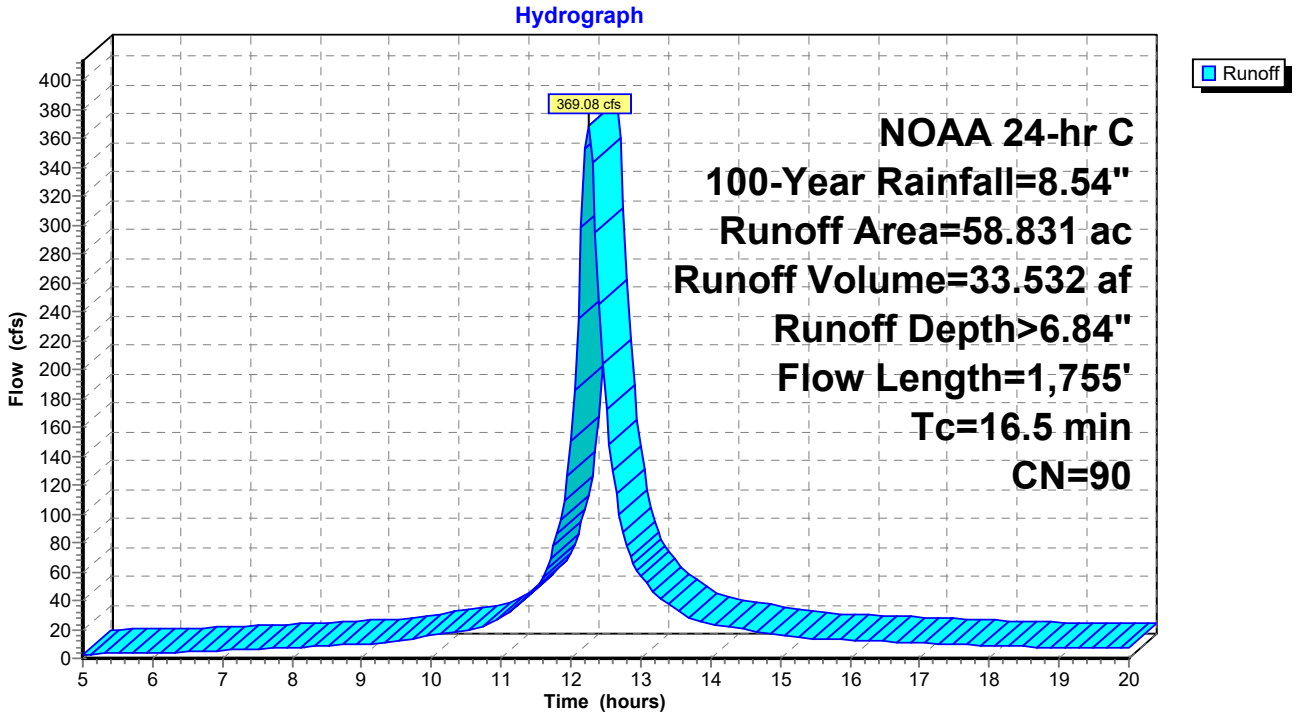
Runoff = 369.08 cfs @ 12.24 hrs, Volume= 33.532 af, Depth> 6.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C 100-Year Rainfall=8.54"

Area (ac)	CN	Description
2.547	92	Urban commercial, 85% imp, HSG B
0.429	98	Roofs, HSG B
0.114	98	Paved parking, HSG B
1.151	92	Urban commercial, 85% imp, HSG B
4.165	73	Woods, Fair, HSG C
1.220	94	Urban commercial, 85% imp, HSG C
0.879	94	Urban commercial, 85% imp, HSG C
2.033	83	1/4 acre lots, 38% imp, HSG C
2.857	94	Urban commercial, 85% imp, HSG C
1.417	79	50-75% Grass cover, Fair, HSG C
1.046	73	Woods, Fair, HSG C
0.131	79	Woods, Fair, HSG D
0.848	79	Woods, Fair, HSG D
17.688	95	Urban commercial, 85% imp, HSG D
6.253	87	1/4 acre lots, 38% imp, HSG D
7.927	95	Urban commercial, 85% imp, HSG D
2.427	84	50-75% Grass cover, Fair, HSG D
0.279	79	Woods, Fair, HSG D
5.420	94	Urban commercial, 85% imp, HSG C
58.831	90	Weighted Average
21.404		36.38% Pervious Area
37.427		63.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.04		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.20"
0.4	90	0.0400	4.06		**Shallow Concentrated Flow, Shallow Concentrated Flow** Paved Kv= 20.3 fps
0.4	93	0.0540	3.74		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
10.5	546	0.0300	0.87		**Shallow Concentrated Flow, Shallow3** Woodland Kv= 5.0 fps
0.5	281		9.83		**Lake or Reservoir, Pond** Mean Depth= 3.00'
0.2	188	0.0600	16.90	331.73	**Pipe Channel, RCP_Round 60"** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.025 Earth, clean & winding
2.9	457	0.0100	2.62	7.20	**Trap/Vee/Rect Channel Flow, Stream** Bot.W=4.00' D=0.50' Z= 3.0 '/' Top.W=7.00' n= 0.030 Earth, grassed & winding
16.5	1,755	Total			

Subcatchment 3S: Waterworks



Summary for Reach 4R: Reach 1

[82] Warning: Early inflow requires earlier time span
[91] Warning: Storage range exceeded by 2.64'
[55] Hint: Peak inflow is 560% of Manning's capacity

Inflow Area = 102.638 ac, 42.61% Impervious, Inflow Depth > 6.10" for 100-Year event
Inflow = 537.02 cfs @ 12.27 hrs, Volume= 52.199 af
Outflow = 525.81 cfs @ 12.32 hrs, Volume= 52.095 af, Atten= 2%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.79 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 2.49 fps, Avg. Travel Time= 3.5 min

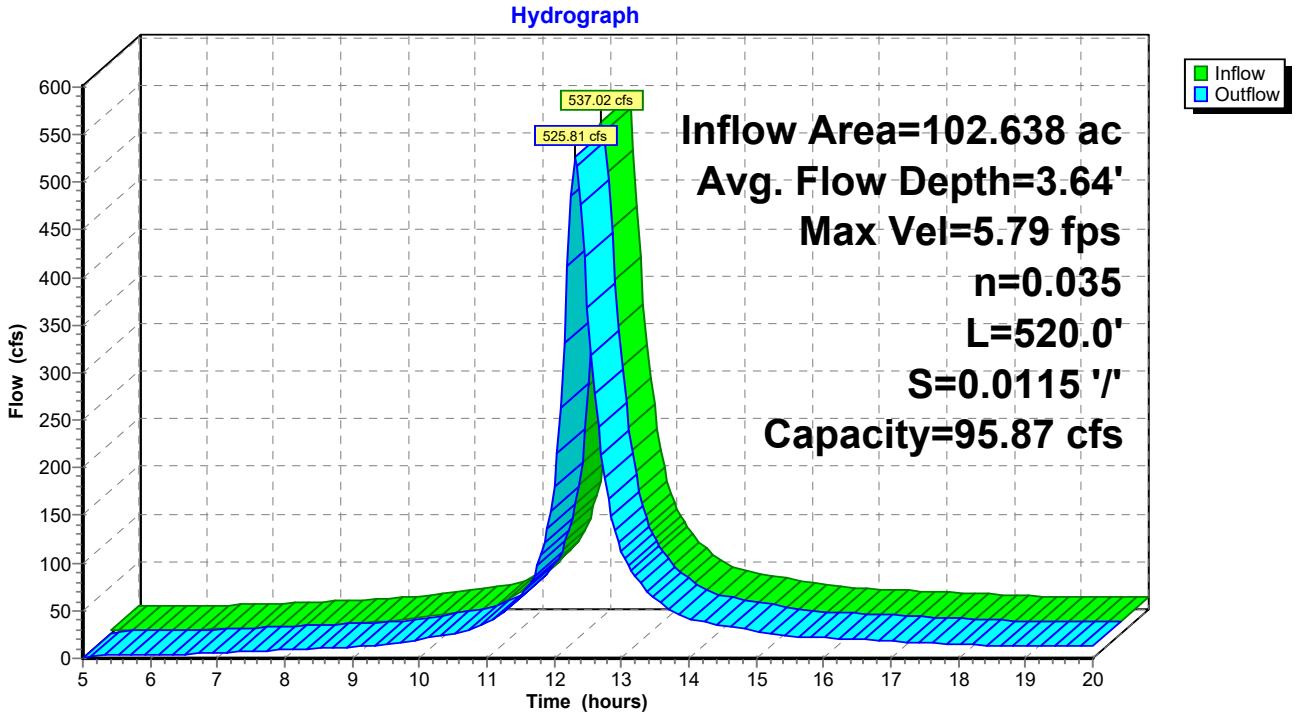
Peak Storage= 47,653 cf @ 12.29 hrs
Average Depth at Peak Storage= 3.64'
Bank-Full Depth= 1.00' Flow Area= 23.0 sf, Capacity= 95.87 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 520.0' Slope= 0.0115 '/'
Inlet Invert= 43.50', Outlet Invert= 37.50'



‡

Reach 4R: Reach 1



Summary for Reach 5R: Reach 2

[91] Warning: Storage range exceeded by 3.49'
[55] Hint: Peak inflow is 720% of Manning's capacity
[62] Hint: Exceeded Reach 4R OUTLET depth by 1.50' @ 12.50 hrs

Inflow Area = 135.738 ac, 32.35% Impervious, Inflow Depth > 5.73" for 100-Year event
Inflow = 605.55 cfs @ 12.33 hrs, Volume= 64.857 af
Outflow = 587.46 cfs @ 12.43 hrs, Volume= 64.616 af, Atten= 3%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.18 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 2.42 fps, Avg. Travel Time= 6.6 min

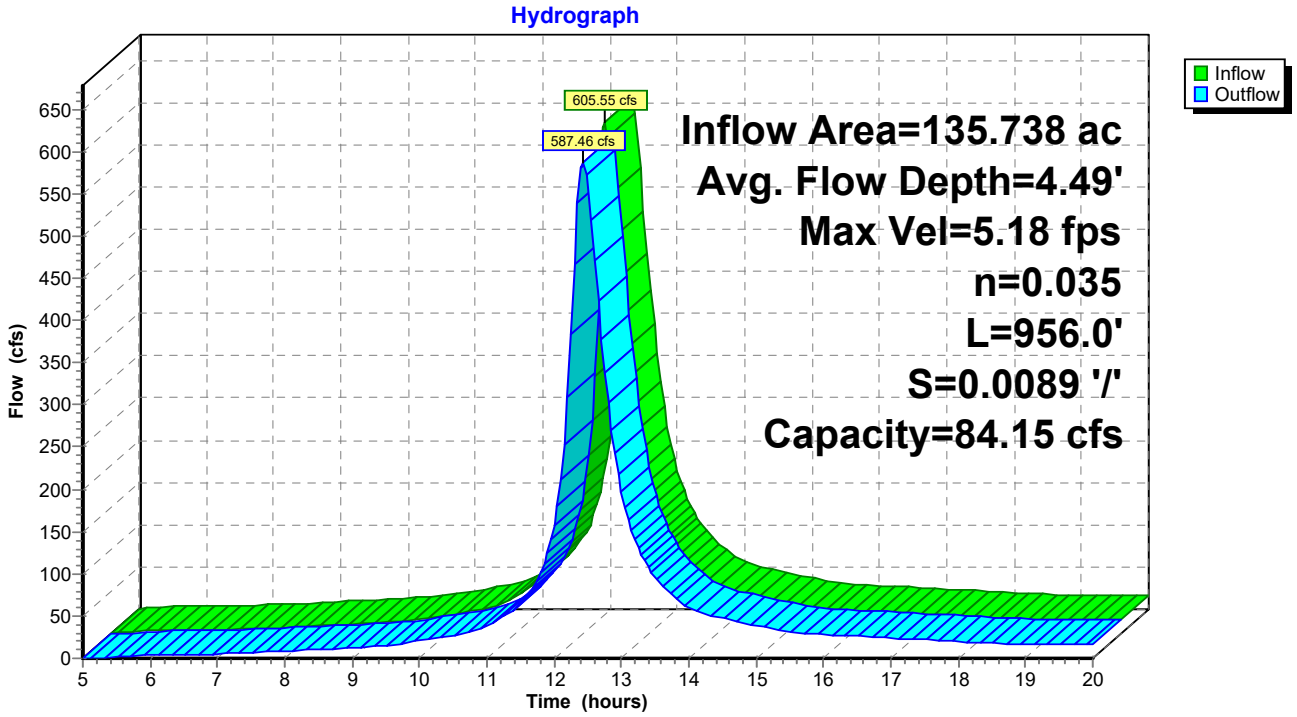
Peak Storage= 108,526 cf @ 12.38 hrs
Average Depth at Peak Storage= 4.49'
Bank-Full Depth= 1.00' Flow Area= 23.0 sf, Capacity= 84.15 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 956.0' Slope= 0.0089 '/'
Inlet Invert= 37.50', Outlet Invert= 29.00'



‡

Reach 5R: Reach 2



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: DS Runoff Area=33.100 ac 0.53% Impervious Runoff Depth>0.77"
Flow Length=1,226' Tc=36.7 min CN=71 Runoff=16.39 cfs 2.126 af

Subcatchment2S: Trib Runoff Area=43.807 ac 14.40% Impervious Runoff Depth>0.98"
Flow Length=2,471' Tc=24.0 min CN=75 Runoff=35.58 cfs 3.573 af

Subcatchment3S: Waterworks Runoff Area=58.831 ac 63.62% Impervious Runoff Depth>2.01"
Flow Length=1,755' Tc=16.5 min CN=90 Runoff=116.02 cfs 9.875 af

Reach 4R: Reach 1 Avg. Flow Depth=1.29' Max Vel=4.71 fps Inflow=146.00 cfs 13.449 af
n=0.035 L=520.0' S=0.0115 '/' Capacity=95.87 cfs Outflow=142.82 cfs 13.402 af

Reach 5R: Reach 2 Avg. Flow Depth=1.44' Max Vel=4.29 fps Inflow=153.24 cfs 15.529 af
n=0.035 L=956.0' S=0.0089 '/' Capacity=84.15 cfs Outflow=147.31 cfs 15.421 af

Total Runoff Area = 135.738 ac Runoff Volume = 15.575 af Average Runoff Depth = 1.38"
67.65% Pervious = 91.826 ac 32.35% Impervious = 43.912 ac

Summary for Subcatchment 1S: DS

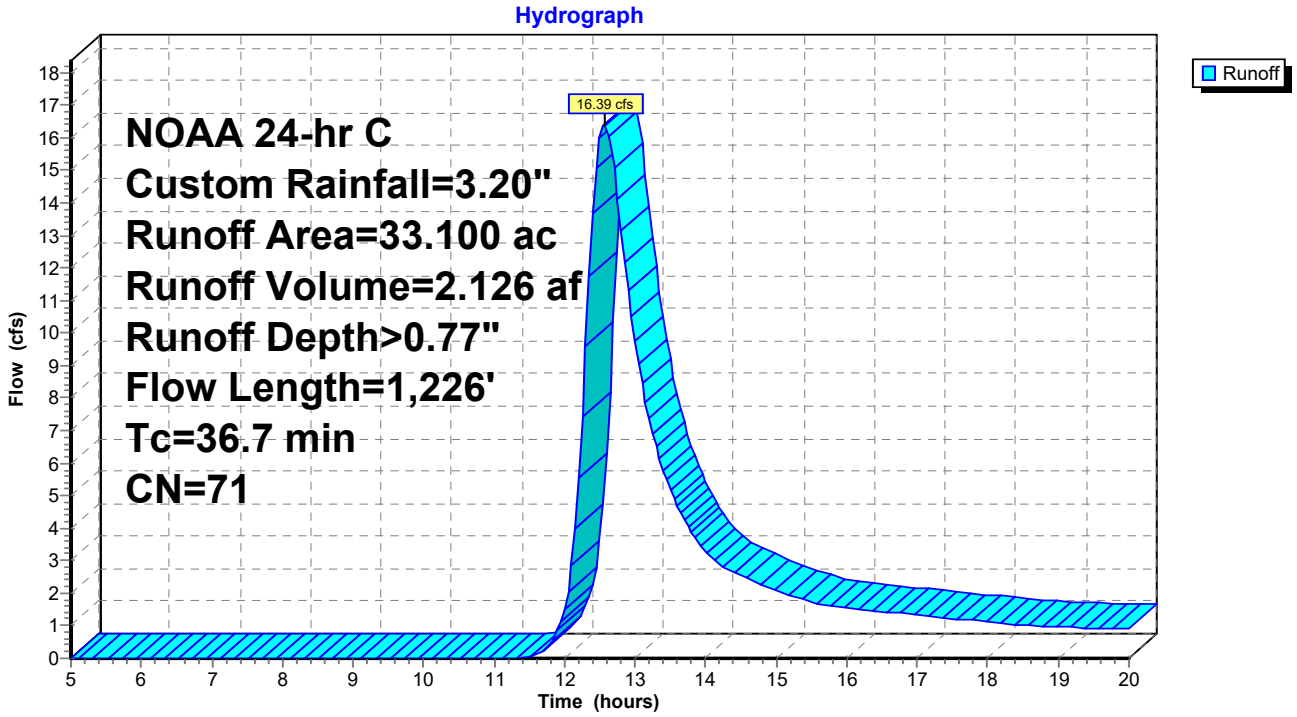
Runoff = 16.39 cfs @ 12.57 hrs, Volume= 2.126 af, Depth> 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C Custom Rainfall=3.20"

Area (ac)	CN	Description
0.029	75	1/4 acre lots, 38% imp, HSG B
0.166	75	1/4 acre lots, 38% imp, HSG B
0.072	75	1/4 acre lots, 38% imp, HSG B
0.017	75	1/4 acre lots, 38% imp, HSG B
21.651	70	Woods, Good, HSG C
0.057	83	1/4 acre lots, 38% imp, HSG C
0.120	83	1/4 acre lots, 38% imp, HSG C
7.993	70	Woods, Good, HSG C
2.607	77	Woods, Good, HSG D
0.388	77	Woods, Good, HSG D
33.100	71	Weighted Average
32.925		99.47% Pervious Area
0.175		0.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.3	100	0.0100	0.06		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
7.3	635	0.0850	1.46		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.1	491	0.0650	7.46	61.56	**Trap/Vee/Rect Channel Flow, Channel Flow** Bot.W=15.00' D=0.50' Z= 3.0 '/' Top.W=18.00' n= 0.030 Earth, grassed & winding
36.7	1,226	Total			

Subcatchment 1S: DS



Summary for Subcatchment 2S: Trib

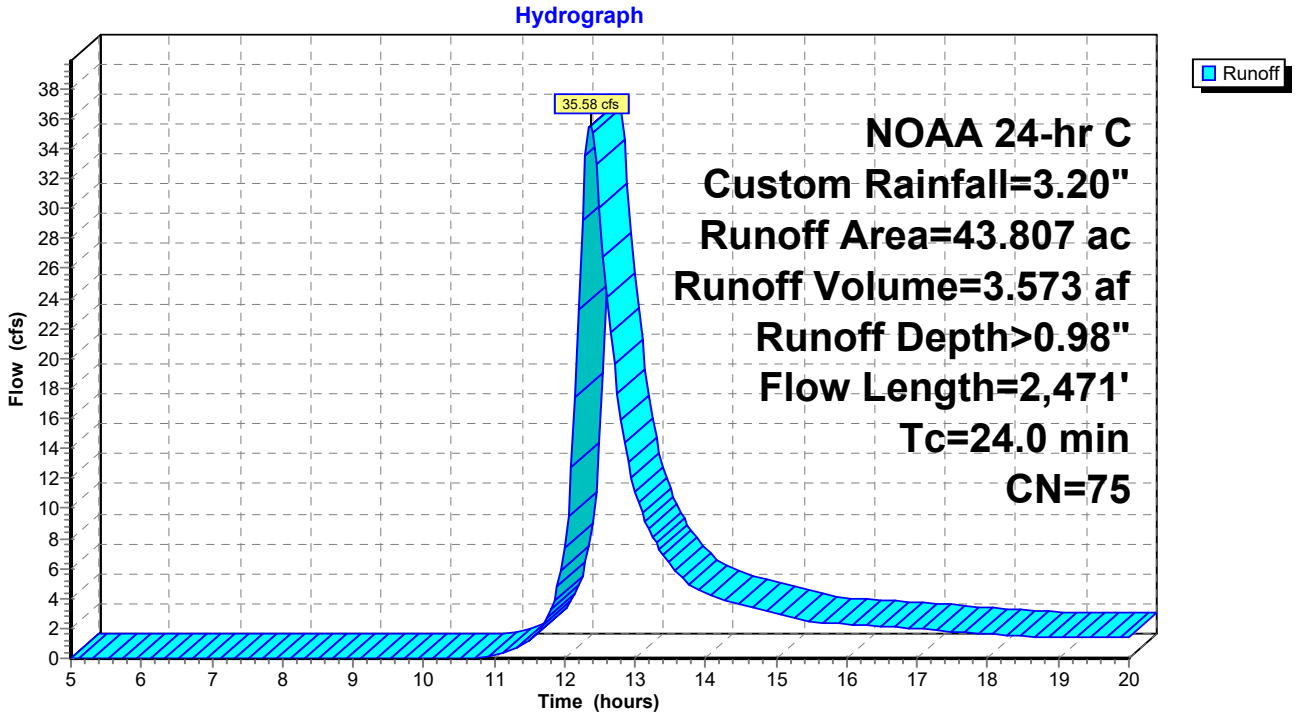
Runoff = 35.58 cfs @ 12.37 hrs, Volume= 3.573 af, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C Custom Rainfall=3.20"

Area (ac)	CN	Description
0.041	49	50-75% Grass cover, Fair, HSG A
0.017	49	50-75% Grass cover, Fair, HSG A
6.716	60	Woods, Fair, HSG B
4.199	75	1/4 acre lots, 38% imp, HSG B
0.747	85	1/8 acre lots, 65% imp, HSG B
2.193	75	1/4 acre lots, 38% imp, HSG B
14.096	73	Woods, Fair, HSG C
0.075	98	Paved parking, HSG C
5.144	83	1/4 acre lots, 38% imp, HSG C
1.606	94	Urban commercial, 85% imp, HSG C
8.431	79	50-75% Grass cover, Fair, HSG C
0.542	79	Woods, Fair, HSG D
43.807	75	Weighted Average
37.498		85.60% Pervious Area
6.309		14.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.4	100	0.0400	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.20"
2.3	487	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.2	36	0.0070	2.59	4.57	**Pipe Channel, CMP_Round 18"** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Earth, clean & winding
1.9	260	0.0200	2.28		**Shallow Concentrated Flow, SC2** Unpaved Kv= 16.1 fps
0.3	47	0.0200	2.87		**Shallow Concentrated Flow, SC3** Paved Kv= 20.3 fps
0.7	101	0.0200	2.28		**Shallow Concentrated Flow, SC4** Unpaved Kv= 16.1 fps
5.4	425	0.0700	1.32		**Shallow Concentrated Flow, SC5** Woodland Kv= 5.0 fps
5.8	1,015	0.0120	2.94	9.54	**Trap/Vee/Rect Channel Flow, Stream** Bot.W=5.00' D=0.50' Z= 3.0 '/' Top.W=8.00' n= 0.030 Earth, grassed & winding
24.0	2,471	Total			

Subcatchment 2S: Trib



Summary for Subcatchment 3S: Waterworks

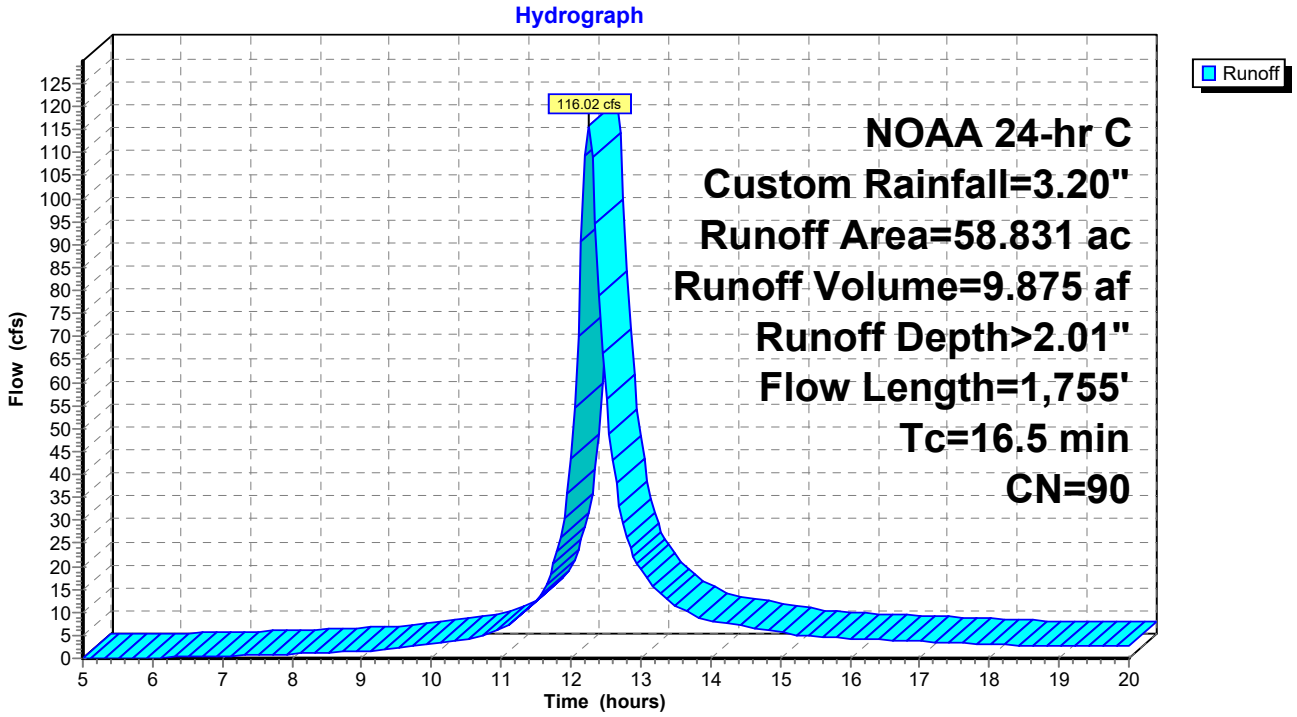
Runoff = 116.02 cfs @ 12.25 hrs, Volume= 9.875 af, Depth> 2.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
NOAA 24-hr C Custom Rainfall=3.20"

Area (ac)	CN	Description
2.547	92	Urban commercial, 85% imp, HSG B
0.429	98	Roofs, HSG B
0.114	98	Paved parking, HSG B
1.151	92	Urban commercial, 85% imp, HSG B
4.165	73	Woods, Fair, HSG C
1.220	94	Urban commercial, 85% imp, HSG C
0.879	94	Urban commercial, 85% imp, HSG C
2.033	83	1/4 acre lots, 38% imp, HSG C
2.857	94	Urban commercial, 85% imp, HSG C
1.417	79	50-75% Grass cover, Fair, HSG C
1.046	73	Woods, Fair, HSG C
0.131	79	Woods, Fair, HSG D
0.848	79	Woods, Fair, HSG D
17.688	95	Urban commercial, 85% imp, HSG D
6.253	87	1/4 acre lots, 38% imp, HSG D
7.927	95	Urban commercial, 85% imp, HSG D
2.427	84	50-75% Grass cover, Fair, HSG D
0.279	79	Woods, Fair, HSG D
5.420	94	Urban commercial, 85% imp, HSG C
58.831	90	Weighted Average
21.404		36.38% Pervious Area
37.427		63.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.04		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.20"
0.4	90	0.0400	4.06		**Shallow Concentrated Flow, Shallow Concentrated Flow** Paved Kv= 20.3 fps
0.4	93	0.0540	3.74		**Shallow Concentrated Flow, Shallow 2** Unpaved Kv= 16.1 fps
10.5	546	0.0300	0.87		**Shallow Concentrated Flow, Shallow3** Woodland Kv= 5.0 fps
0.5	281		9.83		**Lake or Reservoir, Pond** Mean Depth= 3.00'
0.2	188	0.0600	16.90	331.73	**Pipe Channel, RCP_Round 60"** 60.0" Round Area= 19.6 sf Perim= 15.7' r= 1.25' n= 0.025 Earth, clean & winding
2.9	457	0.0100	2.62	7.20	**Trap/Vee/Rect Channel Flow, Stream** Bot.W=4.00' D=0.50' Z= 3.0 '/' Top.W=7.00' n= 0.030 Earth, grassed & winding
16.5	1,755	Total			

Subcatchment 3S: Waterworks



Summary for Reach 4R: Reach 1

[91] Warning: Storage range exceeded by 0.29'
[55] Hint: Peak inflow is 152% of Manning's capacity

Inflow Area = 102.638 ac, 42.61% Impervious, Inflow Depth > 1.57" for Custom event
Inflow = 146.00 cfs @ 12.27 hrs, Volume= 13.449 af
Outflow = 142.82 cfs @ 12.32 hrs, Volume= 13.402 af, Atten= 2%, Lag= 3.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.71 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.48 fps, Avg. Travel Time= 5.9 min

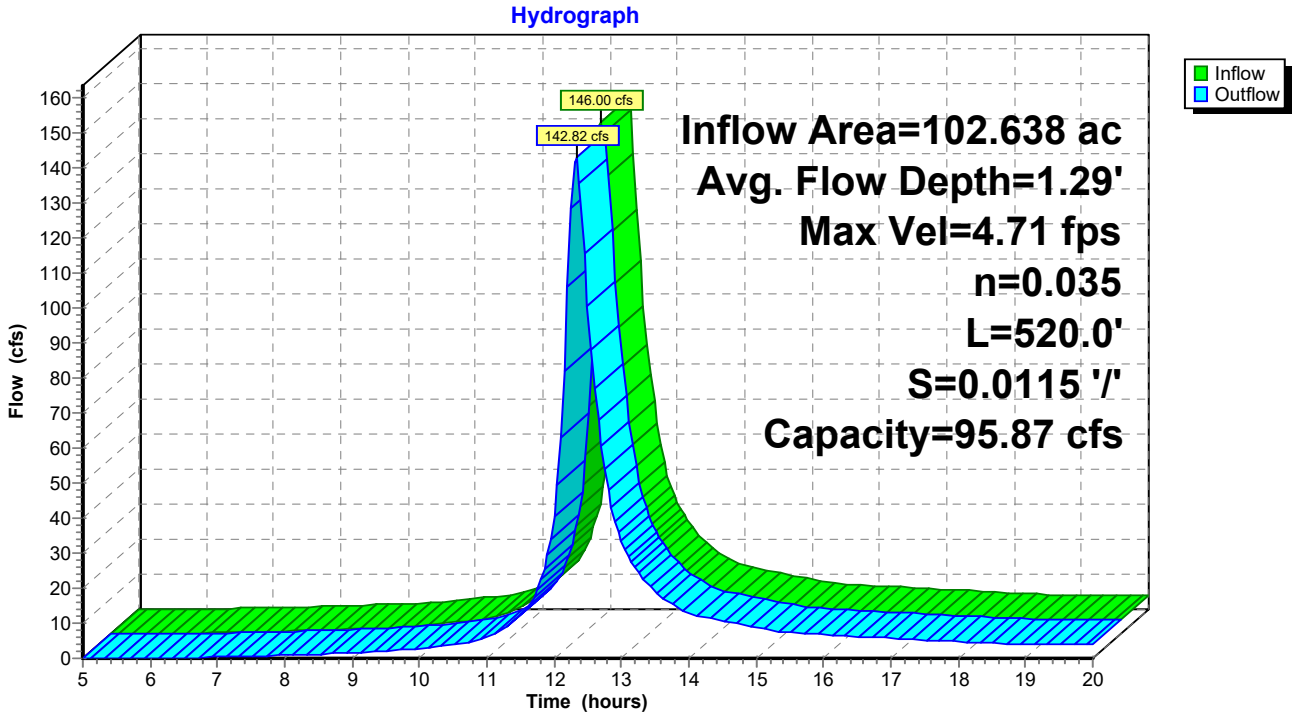
Peak Storage= 15,924 cf @ 12.29 hrs
Average Depth at Peak Storage= 1.29'
Bank-Full Depth= 1.00' Flow Area= 23.0 sf, Capacity= 95.87 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 520.0' Slope= 0.0115 '/'
Inlet Invert= 43.50', Outlet Invert= 37.50'



‡

Reach 4R: Reach 1



Summary for Reach 5R: Reach 2

[91] Warning: Storage range exceeded by 0.44'
[55] Hint: Peak inflow is 182% of Manning's capacity
[62] Hint: Exceeded Reach 4R OUTLET depth by 0.33' @ 12.50 hrs

Inflow Area = 135.738 ac, 32.35% Impervious, Inflow Depth > 1.37" for Custom event
Inflow = 153.24 cfs @ 12.33 hrs, Volume= 15.529 af
Outflow = 147.31 cfs @ 12.45 hrs, Volume= 15.421 af, Atten= 4%, Lag= 6.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.29 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 1.42 fps, Avg. Travel Time= 11.2 min

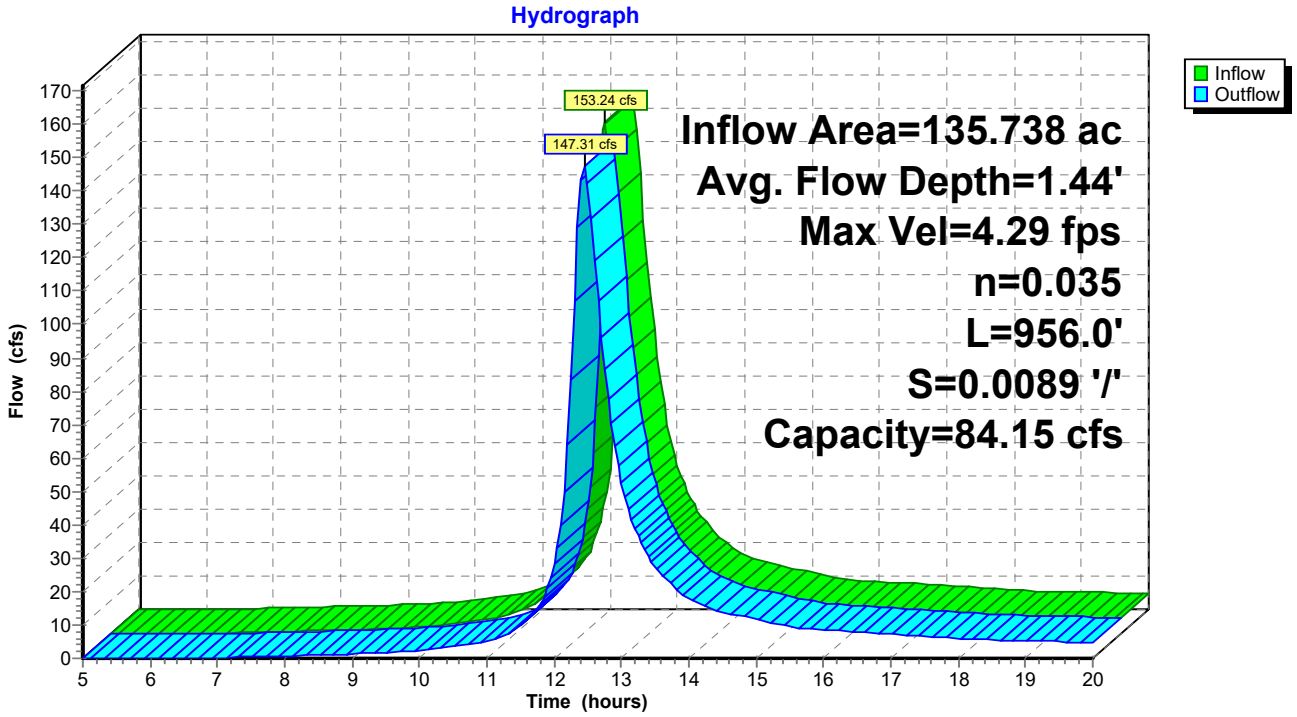
Peak Storage= 32,975 cf @ 12.38 hrs
Average Depth at Peak Storage= 1.44'
Bank-Full Depth= 1.00' Flow Area= 23.0 sf, Capacity= 84.15 cfs

20.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 956.0' Slope= 0.0089 '/'
Inlet Invert= 37.50', Outlet Invert= 29.00'



‡

Reach 5R: Reach 2



Appendix B: Wetland Delineation Memo

Biohabitats

The Stables Building
2081 Clipper Park Road
Baltimore, MD 21211
410.554.0156
www.biohabitats.com

MEMORANDUM

Date: October 15, 2024

To: Mallory Box, Arundel Rivers Federation

From: Tanaira Cullens and Jim Coper, Biohabitats, Inc.

RE: Annapolis Waterworks Park Stream Restoration
Subject: Wetland Delineation Memo

INTRODUCTION

This memorandum summarizes the findings of a wetland delineation conducted by Biohabitats in fall of 2024 for the Annapolis Waterworks Park Stream Restoration project in Annapolis, Maryland, for the Arundel Rivers Federation. The area of interest is approximately 1,430 lf of a first-order, unnamed tributary (the main tributary) to Broad Creek in Annapolis, Maryland. The main tributary originates at a stormwater pond outfall at Housley Road and flows northwest toward Broad Creek. The majority of the area of interest is classified as PFO1C while a smaller section at the western boundary of the limits of delineation is classified as PEM1C and includes wetlands of special state concern according to the National Wetlands Inventory (NWI) and Maryland Department of Natural Resources Maryland's Environmental Resources and Land Information Network (MERLIN). The primary goal of this project is alignment of the stream channel, its immediate riparian corridor extents consisting of an approximate area 30 ft. off each stream bank, confluences with other drainage features flowing into the main tributary, and adjacent uplands required to access restoration work areas, an area totaling approximately 3.5 acres.

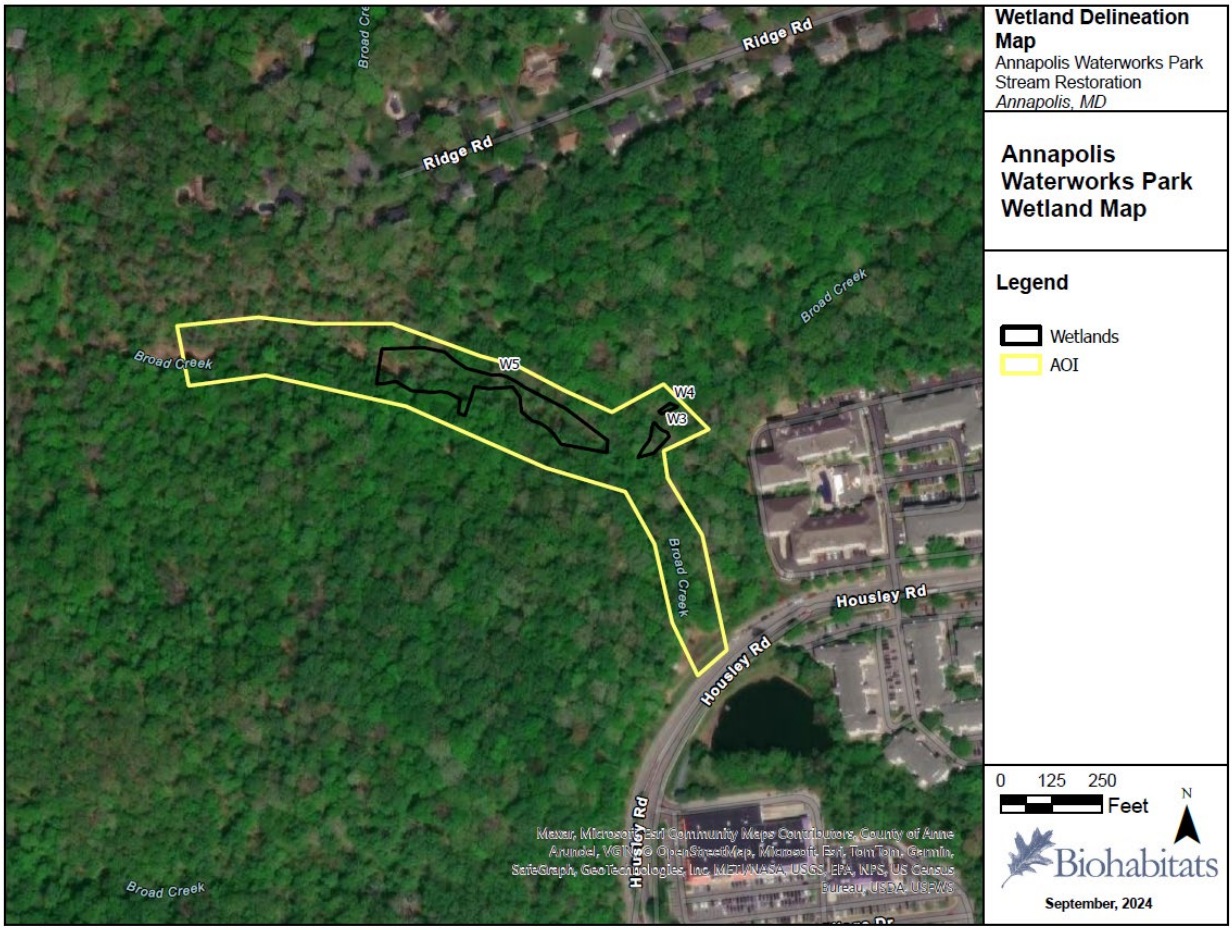


Figure 1. Annapolis Waterworks Limits of Delineation Map

METHODS

The wetland delineation field assessment was performed by Biohabitats environmental scientists over several site visits in fall of 2024, for the purpose of collecting and documenting field conditions and delineating wetlands along the approximate 1,430 linear feet corridor of the main tributary to Broad Creek in Annapolis, Maryland. The main tributary originates at a stormwater pond outfall at Housley Road and flows northwest toward Broad Creek The delineated wetland boundaries within the restoration project area referred to herein as limits of delineation were flagged in the field in September 2024 for subsequent survey.

Three nontidal wetlands were identified, delineated, and documented within the limits of delineation in compliance with applicable State and Federal regulations. The delineation was performed using the three-parameter approach; wetland hydrology, hydrophytic vegetation, and hydric soils in accordance with the 1987 Corps of Engineers Wetlands Delineation Manual - Technical Report 87-1 (USACE, 1987) and the 2012 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0).

The existing hydrology was evaluated at each sample location by documenting the presence of primary and secondary hydrologic indicators, which provides evidence as to whether a site has a continuing wetland hydrologic regime. For the hydrophytic vegetation determination, the abundance of each species within four strata – tree stratum, sapling/shrub stratum, herb stratum,

and woody vines – was sampled. The vegetative sample plots were measured in a 30ft radius across all strata. As needed, the shape of each plot may have been modified to adapt to site conditions. A wetland indicator status was applied to each identified plant species according to the 2020 National Wetland Plant List (NWPL). To determine if hydric soils were present, the soil profile at each sample location was characterized, focusing on the soil matric color and presence/absence of redoximorphic features.

WETLAND DELINEATION RESULTS

Three nontidal wetland areas (Wetlands 3, 4 and 5) were identified during onsite investigations on September 12 and September 13, 2024 (Attachment D). Three wetland delineation data forms were completed to confirm and document the presence and/or absence of wetland indicators observed (Attachment E). The following describes the Three nontidal wetlands delineated and additional areas investigated within the limits of delineation.

Wetlands 3 and 4

Wetlands 3 and 4 (W3 and W4) are classified as Palustrine Forested (PFO) and are located along floodplain benches along the UT to Broad Creek. Its wetland hydrology is supported by groundwater, surface runoff from the adjacent upland hillslopes, and overbank flows from the tributary. The dominant vegetation species in W3 and W4 are tulip poplar (*Liriodendron tulipifera*), beech (*Fagus grandifolia*) and Ironwood (*Carpinus caroliniana*) in both the tree stratum and sapling/shrub stratum, lady fern (*Anthurium felix femina)* and partridge berry (*Mitchella repens*) in the herbaceous stratum.

Wetland delineation data form W3 + W4 was completed to document the hydric soil (i.e. F3 Depleted Matrix), and wetland hydrology (i.e. A3 Saturation, B9 Water-Stained Leaves, B10 Drainage Patterns, C8 Crayfish Burrows and D2 Geomorphic Position) indicators met at Wetlands 3 and 4. While these wetlands do not meet the hydrophytic vegetation indicator, both wetlands are in close proximity of larger wetland 5 and vegetation likely represents the transitional zone. The non-wetland point for Wetlands 3 and 4 (data form NW1) was taken on a floodplain bench across from the Wetland 5 data point and did not meet any hydric soil, hydrology or hydrophytic vegetation indicators.

Wetland 5

Wetland 5 (W5) is classified as Palustrine Forested (PFO) and Palustrine Emergent, which continues to the west beyond the limits of the site. Its wetland hydrology is supported by groundwater, surface runoff from the adjacent upland hillslopes, and overbank flows from the main tributary. The dominant vegetation species in W5 are beech (*Fagus grandifolia*) and black gum (*Nyssa sylvatica*) in the tree stratum, red maple (*Acer rubrum*) in the shrub/sapling stratum and beech (*Fagus grandifolia*), japanese stilitgrass (*Microstegium vimineum*) and jack in the pulpit (*Arisaema tryphyllum*) in the herbaceous stratum. It is important to note that Wetland 5 boundaries may be extended further downstream to encompass the restoration tie-out area into existing conditions per project stakeholder comments.

Wetland delineation data form W5 was completed to document the hydrophytic vegetation (i.e. Dominance test is ≥50), hydric soil (i.e. F3 Depleted Matrix and F6 Redox Dark Surface), and wetland hydrology (i.e. A3 Saturation, B9 Water-Stained Leaves, B10 Drainage Patterns, C3 Oxidized Rhizospheres along Living Roots, C8 Crayfish Burrows and D2 Geomorphic Position)

indicators met at Wetland 5. The non-wetland point for Wetland 5 is represented by the same form (data form NW1) as Wetlands 3 and 4.

WATERS OF THE U.S. DELINEATION RESULTS

Two Waters of the U.S. (WOTUS), the main tributary (UT to Broad Creek) and a smaller reach (Tributary X) were delineated. The main tributary is 1,430 linear feet with a wetted width ranging from 2 feet to 15 feet and eroded banks throughout. Observations along the unnamed tributary suggest flow throughout the limits of delineation is perennial (i.e., typically has water flowing in them year-round) and is sustained by groundwater, with multiple surface inputs in the form of both sheet runoff along the land surface and concentrated flow through swales and at least one stormwater outfall. Since the stormwater outfall enters directly into the stream that would be inclusive of the main tributary's ordinary high water mark (OHWM), individual outfall channels were not delineated. The channel substrate of the main tributary consists primarily of silt, clay and coarse sands. The main tributary flows into Broad Creek then continues southeast, entering into the South River before eventually flowing into the Chesapeake Bay.

ANTECEDENT PRECIPITATION TOOL RESULTS

The Antecedent Precipitation Tool (APT) is used to assist in determining the jurisdictional status of certain waterbodies. The APT was developed by the US Army Corps of Engineers (USACE) "to streamline and automate evaluation of precipitation normalcy and other climatic variables to complete wetland delineations whenever an assessment of the following site-specific conditions is needed: 1) dry season, 2) drought conditions, 3) lower than normal antecedent precipitation, or 4) greater than normal antecedent precipitation. In addition to informing wetland delineations, the APT can also be used to assist in determining whether observations are representative of normal climatic conditions…." (EPA, 2021)

The APT was not able to be generated due to NOAA servers being down, however, there was no rainfall leading up to the field days on September 12 and 13th 2024.

SUMMARY

Three nontidal wetlands (Wetland 3, 4 and 5) were delineated within the site limits, which are displayed on wetland mapping in Attachment D. Table 1 summarizes the delineated wetland areas and the wetland characterization (based on Cowardin et al. 1979). Based on Biohabitats best professional judgement, it is anticipated the delineated wetland are jurisdictional under the CWA and will be regulated by the US Army Corps of Engineers (USACE) and Maryland Department of the Environment (MDE).

Table 2 summarizes the stream channels identified and delineated within the site limits. It is also anticipated that the main tributary (UT) and brief section of Tributary X that were identified and delineated are jurisdictional under the CWA and will be regulated by the USACE and MDE.

Table 1 Nontidal Wetland Summary

Wetland Name	Area Within Survey Limits		Classification (Cowardin et. al., 1979)
	Square Feet	Acres	
Wetland 3	549	0.01	PFO
Wetland 4	TBD	TBD	PFO
Wetland 5	TBD	TBD	PFO/PEM

Table 2 Waters of the US Summary

Stream Name	Length Within Survey Limits (linear feet)	Stream Flow Classification
Main Tributary (UT to Broad Creek)	1430	Perennial
Tributary X	TBD	

REFERENCES

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of Interior, Fish and Wildlife Service, Office of Biological Services.

U.S. Army Corps of Engineers 2020. National Wetland Plant List, version 3.5 http://wetland-plants.usace.army.mil/, U.S. Army Corps of Engineers, Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at the following link: http://websoilsurvey.sc.egov.usda.gov/. Accessed [September 12, 2024].

U.S. Army Corps of Engineers, 1987. Army Corps of Engineers Environmental Laboratory Corps of Engineers Wetlands Delineation Manual. Wetland Research Program. Technical Report 87-1. 100 pp and appendices.

U.S. Army Corps of Engineers. 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0). ERDC/EL TR-10-20. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

U.S. Department of Homeland Security. Federal Emergency Management Agency (FEMA). FEMA Flood Map Service Center. Available online at https://msc.fema.gov/portal/home. Accessed September 2024.

ATTACHMENTS

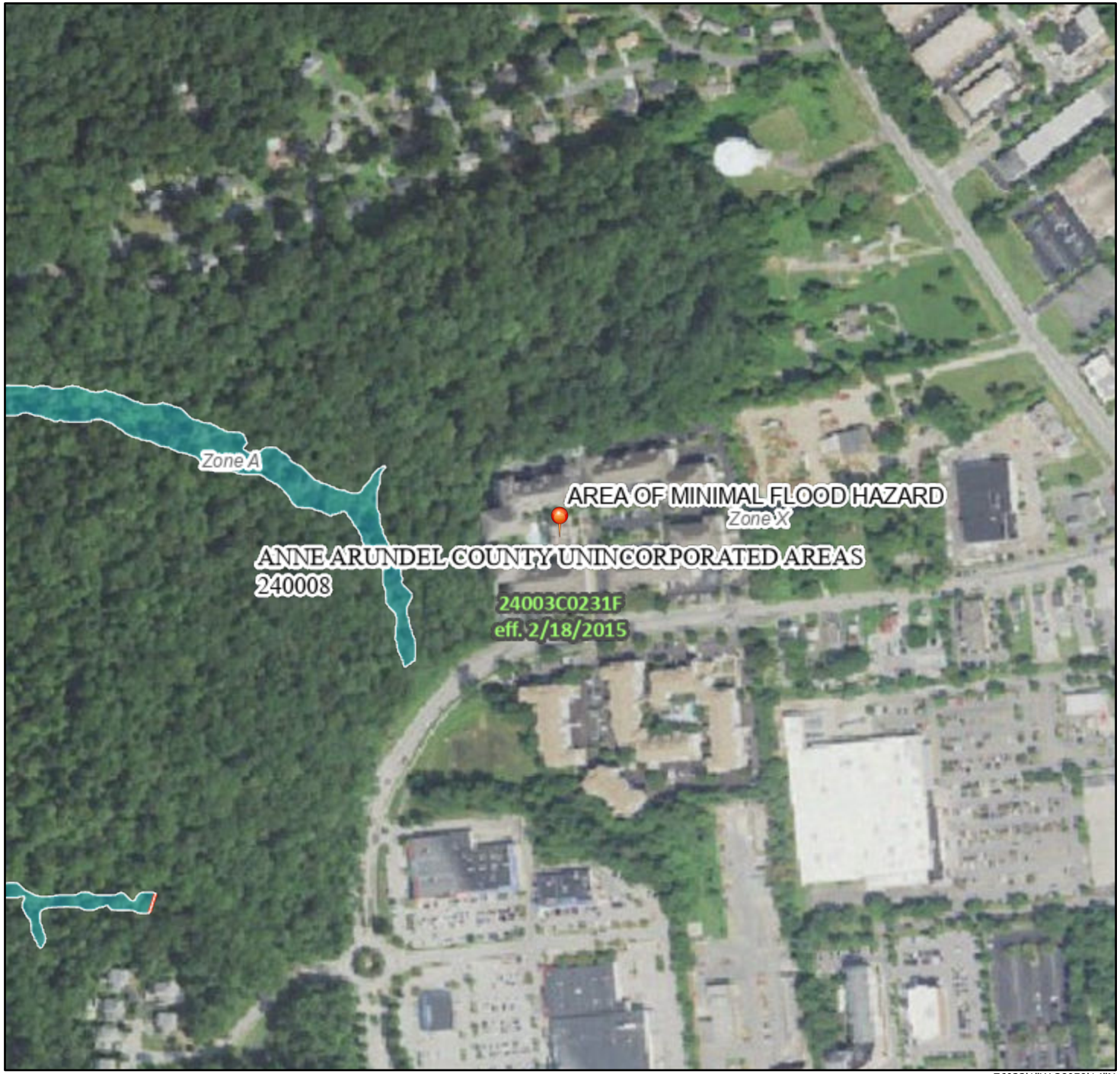
A. FEMA FIRMette Map
B. NWI & DNR Wetland Maps
C. NRCS Web Soil Survey Maps and Reporting
D. Wetland and Waters of the U.S. Delineation Map
E. Wetland Delineation Data Forms

ATTACHMENT A –
FEMA FIRMETTE MAP

National Flood Hazard Layer FIRMette

FEMA

76°33'38"W 38°59'42"N



76°33'1"W 38°59'14"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

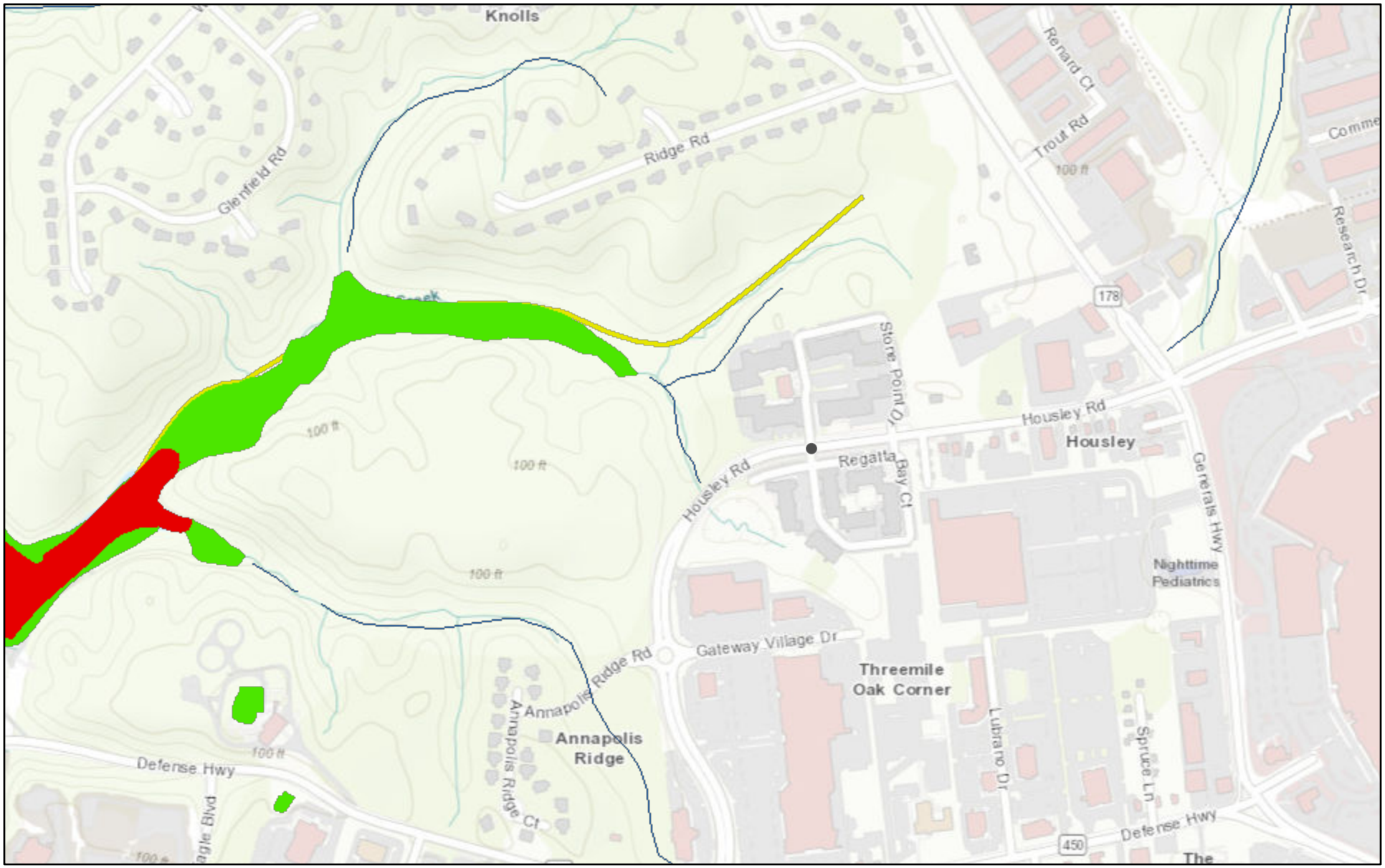
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/9/2024 at 3:15 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

ATTACHMENT B –
NWI & DNR WETLAND MAPS

MERLIN Onine



9/9/2024, 3:14:45 PM

1:9,028

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

State Boundary Mask

Wetlands - Linear - Special State Concern

Wetlands - Polygon - Special State Concern

Wetlands - National Wetlands Inventory

Estuarine

Lacustrine

Marine

Palustrine

Riverine

Wetlands - Polygon - Department of Natural Resources

Estuarine

Lacustrine

Marine

Palustrine

Riverine

Wetlands - Linear - Department of Natural Resources

Estuarine

Palustrine

Riverine

MD iMAP, DNR, USFW, County of Anne Arundel, VITA, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA, MD iMAP, ESRI

County of Anne Arundel, VITA, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, METI/NASA, EPA, USDA | MD iMAP | MD iMAP, DoIT | MD iMAP, USDA | MD iMAP, USGS | MD iMAP, COMMERCE, DHCD, MDP, MHT, MDOT, MDOT SHA, USDOT, FHWA, DoIT

ATTACHMENT C –
NRCS WEB SOIL SURVEY MAPS AND REPORTING

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Anne Arundel County, Maryland



September 9, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....8
Soil Map.....9
Legend.....10
Map Unit Legend.....11
Map Unit Descriptions.....11
Anne Arundel County, Maryland.....13
AsF—Annapolis fine sandy loam, 25 to 40 percent slopes.....13
MaB—Marr-Dodon complex, 2 to 5 percent slopes.....14
MaD—Marr-Dodon complex, 10 to 15 percent slopes.....16
Uz—Urban land.....18
WBA—Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded.....19
Soil Information for All Uses.....22
Suitabilities and Limitations for Use.....22
Land Classifications.....22
Hydric Rating by Map Unit.....22
Soil Properties and Qualities.....27
Soil Erosion Factors.....27
K Factor, Whole Soil.....27
Soil Qualities and Features.....30
Hydrologic Soil Group.....30
References.....35

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:3,390 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Anne Arundel County, Maryland
Survey Area Data: Version 22, Sep 12, 2023

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

Date(s) aerial images were photographed: Jun 20, 2022—Aug 13, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AsF	Annapolis fine sandy loam, 25 to 40 percent slopes	10.5	69.5%
MaB	Marr-Dodon complex, 2 to 5 percent slopes	0.0	0.2%
MaD	Marr-Dodon complex, 10 to 15 percent slopes	0.6	3.7%
Uz	Urban land	0.5	3.4%
WBA	Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded	3.5	23.2%
Totals for Area of Interest		**15.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Anne Arundel County, Maryland

AsF—Annapolis fine sandy loam, 25 to 40 percent slopes

Map Unit Setting

National map unit symbol: 4m9w
Elevation: 10 to 180 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Annapolis and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Annapolis

Setting

Landform: Interfluves, ravines
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Glauconitic loamy fluviomarine deposits

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bt - 8 to 27 inches: channery sandy clay loam
E and Bt - 27 to 61 inches: loamy sand
CB - 61 to 81 inches: loamy sand

Properties and qualities

Slope: 25 to 40 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: F149AY150MD - Well Drained Glauconitic Fine-Loamy Upland
Hydric soil rating: No

Minor Components

Collington

Percent of map unit: 10 percent
Landform: Interfluves, ravines

Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F149AY170MD - Well Drained Fine-Loamy Upland
Hydric soil rating: No

Howell

Percent of map unit: 5 percent
Landform: Ravines, interfluves
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F149AY160MD - Well Drained Clayey Upland
Hydric soil rating: No

Widewater

Percent of map unit: 5 percent
Landform: Flood plains, drainageways
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R149AY060DE - Wet Alluvial Floodplain
Hydric soil rating: Yes

Adelphia

Percent of map unit: 5 percent
Landform: Hillslopes, interfluves
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex, linear
Ecological site: F149AY130NJ - Moist Loamy Upland
Hydric soil rating: No

MaB—Marr-Dodon complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 4mcs
Elevation: 0 to 200 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Marr and similar soils: 45 percent
Dodon and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Marr

Setting

Landform: Knolls, interfluves
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 12 inches: fine sandy loam
Bt1 - 12 to 25 inches: fine sandy loam
Bt2 - 25 to 57 inches: sandy clay loam
BC - 57 to 76 inches: loamy fine sand

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F149AY170MD - Well Drained Fine-Loamy Upland
Hydric soil rating: No

Description of Dodon

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 9 inches: fine sandy loam
Bt - 9 to 36 inches: sandy clay loam
BC - 36 to 48 inches: sandy clay loam
CB - 48 to 64 inches: fine sandy loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 20 to 40 inches

Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: F149AY130NJ - Moist Loamy Upland
Hydric soil rating: No

Minor Components

Hambrook

Percent of map unit: 10 percent
Landform: Interfluves, fluviomarine terraces, broad interstream divides
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F149AY170MD - Well Drained Fine-Loamy Upland
Hydric soil rating: No

Liverpool

Percent of map unit: 10 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F153CY020MD - Moist Loess Upland
Hydric soil rating: No

MaD—Marr-Dodon complex, 10 to 15 percent slopes

Map Unit Setting

National map unit symbol: 4mcv
Elevation: 0 to 200 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Marr and similar soils: 45 percent
Dodon and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Marr

Setting

Landform: Interfluves, knolls
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy fluviomarine deposits

Typical profile

Ap - 0 to 12 inches: fine sandy loam
Bt1 - 12 to 25 inches: fine sandy loam
Bt2 - 25 to 57 inches: sandy clay loam
BC - 57 to 76 inches: loamy fine sand

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: F149AY170MD - Well Drained Fine-Loamy Upland
Hydric soil rating: No

Description of Dodon

Setting

Landform: Knolls, interfluves
Landform position (two-dimensional): Backslope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Loamy fluviomarine deposits

Typical profile

A - 0 to 5 inches: very fine sandy loam
E - 5 to 16 inches: very fine sandy loam
Bt - 16 to 47 inches: loam
BCtg - 47 to 73 inches: loam

Properties and qualities

Slope: 10 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 20 to 40 inches

Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 10.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: F149AY130NJ - Moist Loamy Upland
Hydric soil rating: No

Minor Components

Piccowaxen

Percent of map unit: 10 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Linear
Ecological site: F153CY020MD - Moist Loess Upland
Hydric soil rating: No

Howell

Percent of map unit: 5 percent
Landform: Knolls, interfluves
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: F149AY160MD - Well Drained Clayey Upland
Hydric soil rating: No

Uz—Urban land

Map Unit Setting

National map unit symbol: ngbx
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D

Hydric soil rating: No

WBA—Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 4m9c
Elevation: 0 to 600 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Widewater and similar soils: 41 percent
Issue and similar soils: 39 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Widewater

Setting

Landform: Drainageways, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

Ag - 0 to 4 inches: loam
Bg - 4 to 8 inches: fine sandy loam
BCg - 8 to 44 inches: loam
Agb - 44 to 67 inches: loam
Cg - 67 to 70 inches: clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 10 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Ecological site: R149AY060DE - Wet Alluvial Floodplain
Hydric soil rating: Yes

Description of Issue

Setting

Landform: Drainageways, drainhead complexes, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

Ap - 0 to 4 inches: silt loam
Bw - 4 to 19 inches: loam
Bg1 - 19 to 30 inches: fine sandy loam
Bg2 - 30 to 58 inches: fine sandy loam
Ab - 58 to 70 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 10 to 20 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Ecological site: R149AY070MD - Moist Alluvial Floodplain
Hydric soil rating: No

Minor Components

Zekiah

Percent of map unit: 10 percent
Landform: Drainageways, flood plains
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: R149AY060DE - Wet Alluvial Floodplain
Hydric soil rating: Yes

Longmarsh

Percent of map unit: 5 percent
Landform: Backswamps on flood plains, channels on flood plains
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: R149AY060DE - Wet Alluvial Floodplain
Hydric soil rating: Yes

Shrewsbury

Percent of map unit: 5 percent
Landform: Swales, drainhead complexes, drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear, concave
Ecological site: F149AY090NJ - Coastal Plain Hardwood Swamp
Hydric soil rating: Yes

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Land Classifications

Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Hydric Rating by Map Unit

This rating indicates the percentage of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is rated based on its respective components and the percentage of each component within the map unit.

The thematic map is color coded based on the composition of hydric components. The five color classes are separated as 100 percent hydric components, 66 to 99 percent hydric components, 33 to 65 percent hydric components, 1 to 32 percent hydric components, and less than one percent hydric components.

In Web Soil Survey, the Summary by Map Unit table that is displayed below the map pane contains a column named 'Rating'. In this column the percentage of each map unit that is classified as hydric is displayed.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

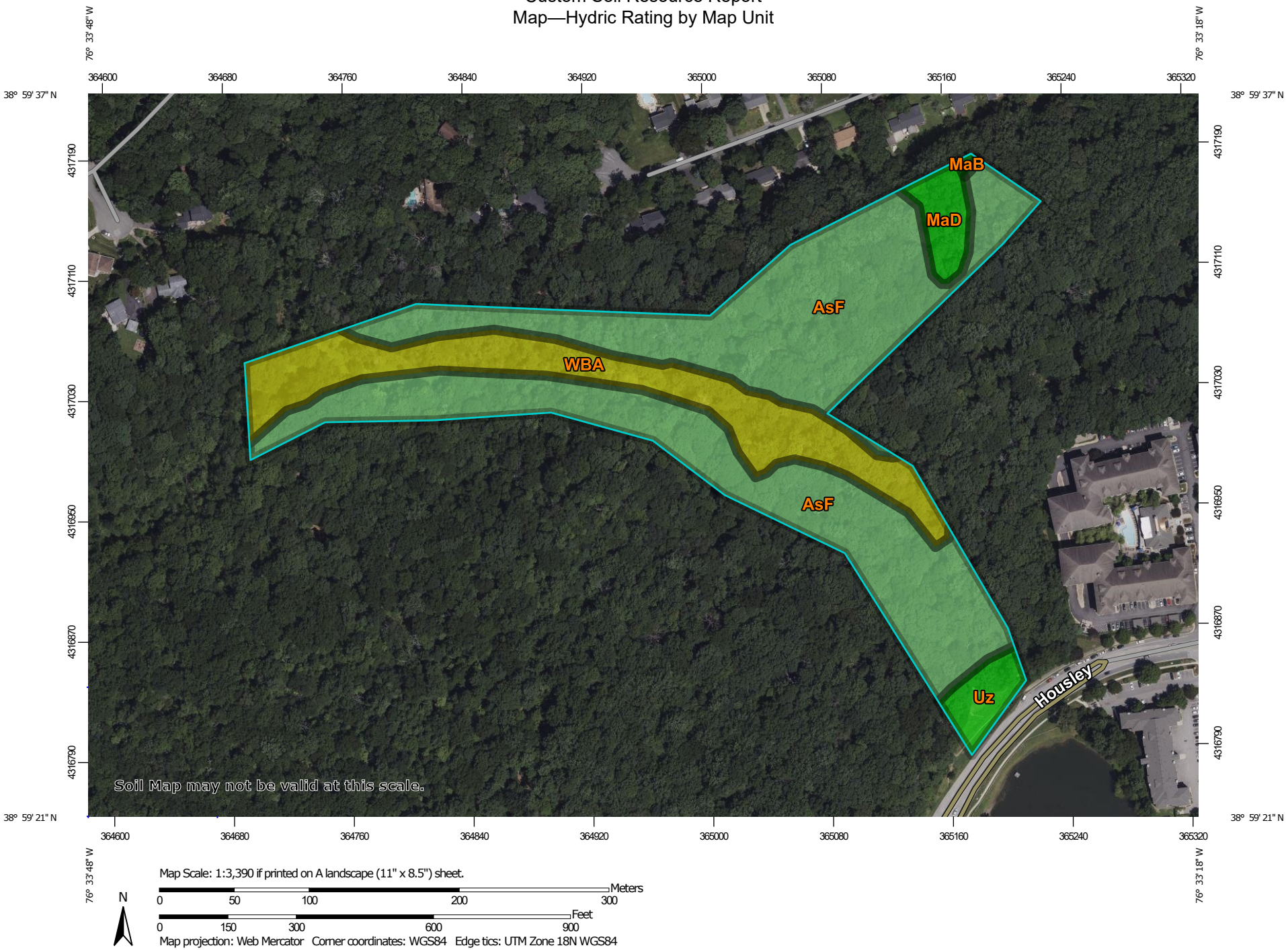
Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

Custom Soil Resource Report
Map—Hydric Rating by Map Unit



Map Scale: 1:3,390 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

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

Soils

Soil Rating Polygons
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Lines
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Points
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Anne Arundel County, Maryland
Survey Area Data: Version 22, Sep 12, 2023

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

Date(s) aerial images were photographed: Jun 20, 2022—Aug 13, 2022

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

Table—Hydric Rating by Map Unit

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AsF	Annapolis fine sandy loam, 25 to 40 percent slopes	5	10.5	69.5%
MaB	Marr-Dodon complex, 2 to 5 percent slopes	0	0.0	0.2%
MaD	Marr-Dodon complex, 10 to 15 percent slopes	0	0.6	3.7%
Uz	Urban land	0	0.5	3.4%
WBA	Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded	61	3.5	23.2%
Totals for Area of Interest			**15.1**	**100.0%**

Rating Options—Hydric Rating by Map Unit

Aggregation Method: Percent Present

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Soil Properties and Qualities

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

Soil Erosion Factors

Soil Erosion Factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

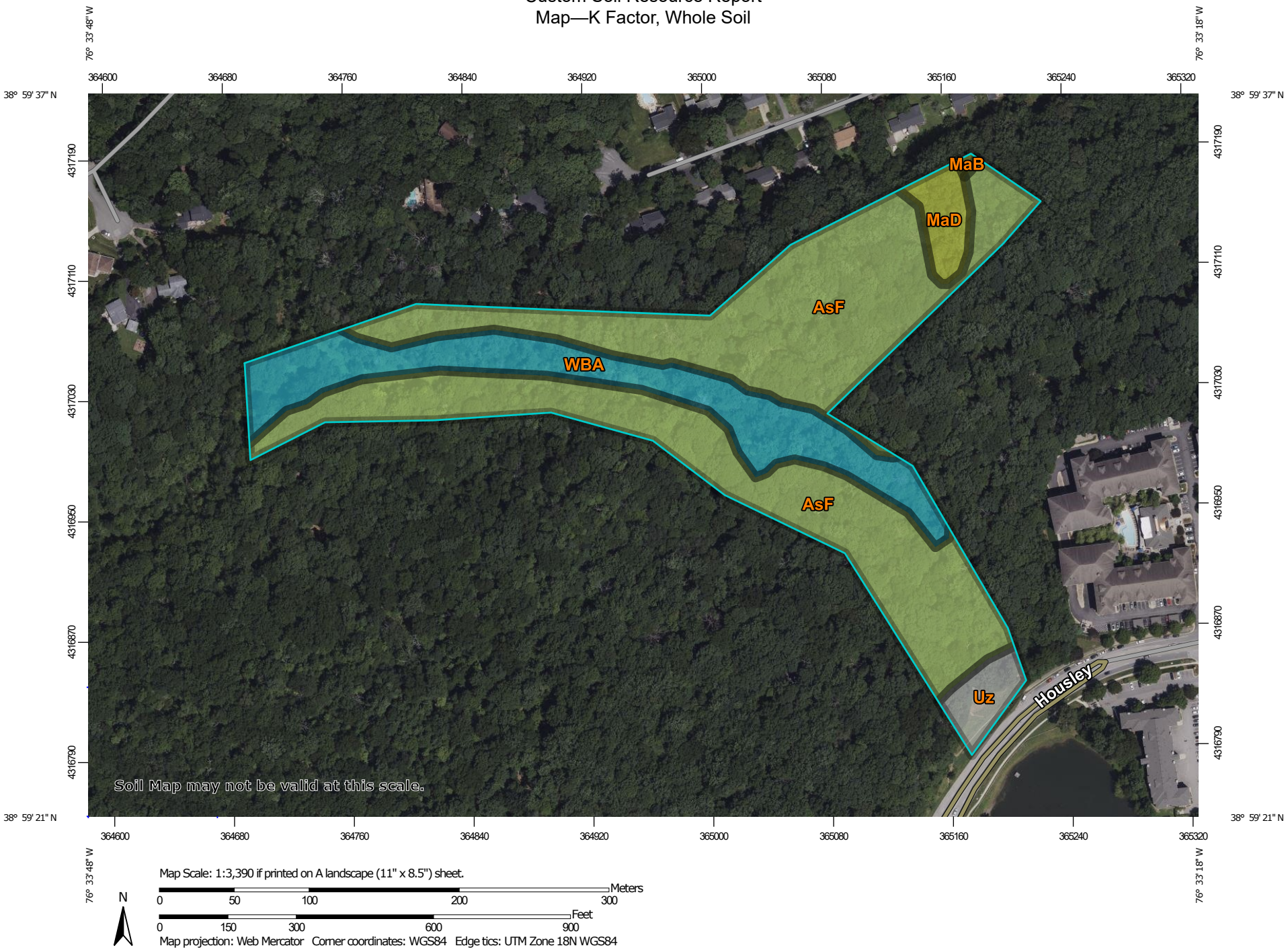
K Factor, Whole Soil

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Factor K does not apply to organic horizons and is not reported for those layers.

Custom Soil Resource Report
Map—K Factor, Whole Soil



Map Scale: 1:3,390 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Lines

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Points

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Anne Arundel County, Maryland
Survey Area Data: Version 22, Sep 12, 2023

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

Date(s) aerial images were photographed: Jun 20, 2022—Aug 13, 2022

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

Table—K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AsF	Annapolis fine sandy loam, 25 to 40 percent slopes	.24	10.5	69.5%
MaB	Marr-Dodon complex, 2 to 5 percent slopes	.20	0.0	0.2%
MaD	Marr-Dodon complex, 10 to 15 percent slopes	.20	0.6	3.7%
Uz	Urban land		0.5	3.4%
WBA	Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded	.37	3.5	23.2%
Totals for Area of Interest			**15.1**	**100.0%**

Rating Options—K Factor, Whole Soil

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Soil Qualities and Features

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

Hydrologic Soil Group

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

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

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

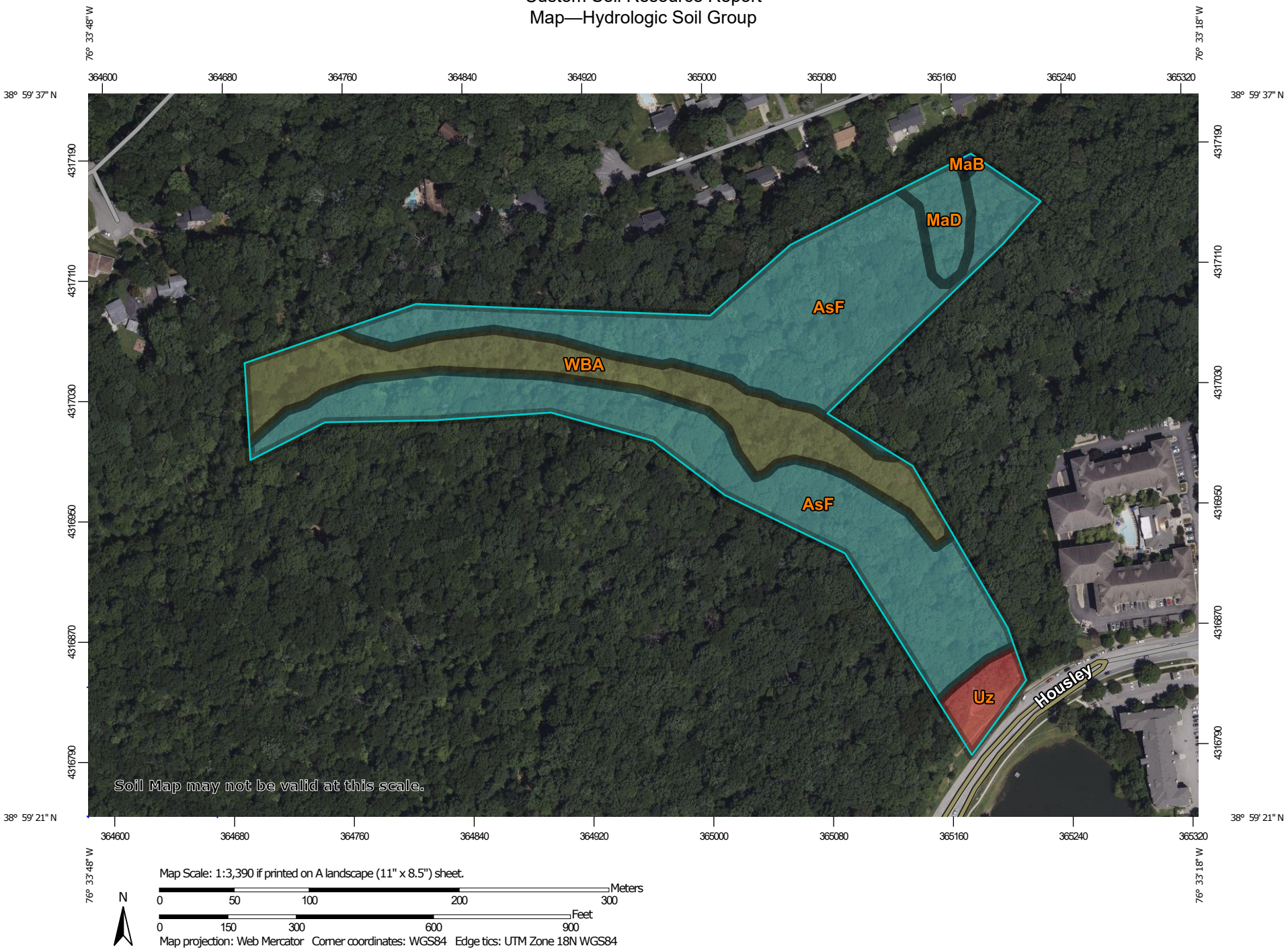
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:3,390 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Anne Arundel County, Maryland
Survey Area Data: Version 22, Sep 12, 2023

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

Date(s) aerial images were photographed: Jun 20, 2022—Aug 13, 2022

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AsF	Annapolis fine sandy loam, 25 to 40 percent slopes	C	10.5	69.5%
MaB	Marr-Dodon complex, 2 to 5 percent slopes	B	0.0	0.2%
MaD	Marr-Dodon complex, 10 to 15 percent slopes	C	0.6	3.7%
Uz	Urban land	D	0.5	3.4%
WBA	Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded	C/D	3.5	23.2%
Totals for Area of Interest			**15.1**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Custom Soil Resource Report
Soil Map



Map Scale: 1:3,390 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Anne Arundel County, Maryland
Survey Area Data: Version 22, Sep 12, 2023

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

Date(s) aerial images were photographed: Jun 20, 2022—Aug 13, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AsF	Annapolis fine sandy loam, 25 to 40 percent slopes	10.5	69.5%
MaB	Marr-Dodon complex, 2 to 5 percent slopes	0.0	0.2%
MaD	Marr-Dodon complex, 10 to 15 percent slopes	0.6	3.7%
Uz	Urban land	0.5	3.4%
WBA	Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded	3.5	23.2%
Totals for Area of Interest		**15.1**	**100.0%**

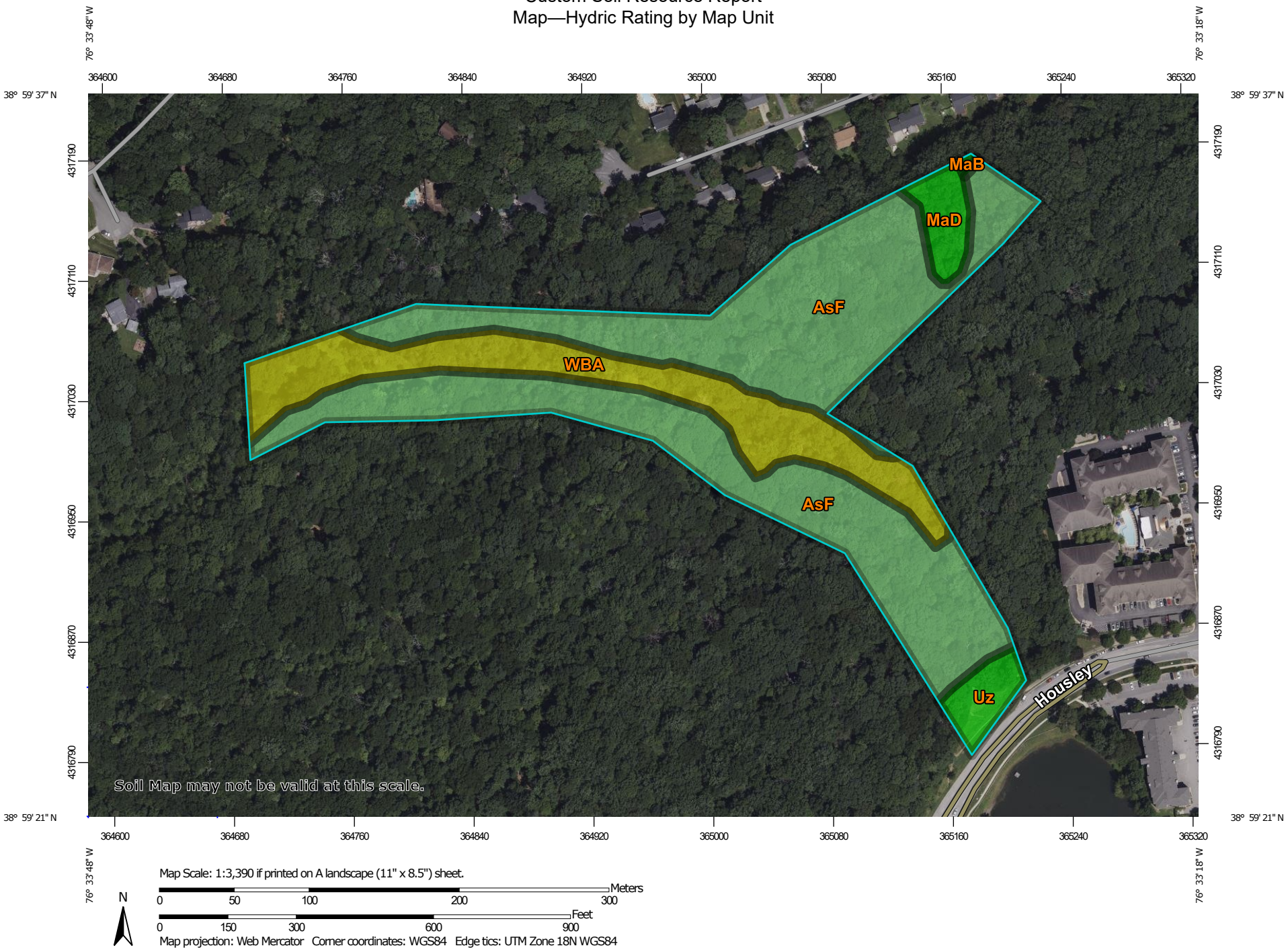
Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

Custom Soil Resource Report
Map—Hydric Rating by Map Unit



Map Scale: 1:3,390 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

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

Soils

Soil Rating Polygons
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Lines
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Points
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Anne Arundel County, Maryland
Survey Area Data: Version 22, Sep 12, 2023

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

Date(s) aerial images were photographed: Jun 20, 2022—Aug 13, 2022

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

Table—Hydric Rating by Map Unit

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AsF	Annapolis fine sandy loam, 25 to 40 percent slopes	5	10.5	69.5%
MaB	Marr-Dodon complex, 2 to 5 percent slopes	0	0.0	0.2%
MaD	Marr-Dodon complex, 10 to 15 percent slopes	0	0.6	3.7%
Uz	Urban land	0	0.5	3.4%
WBA	Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded	61	3.5	23.2%
Totals for Area of Interest			**15.1**	**100.0%**

Rating Options—Hydric Rating by Map Unit

Aggregation Method: Percent Present

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

ATTACHMENT D –
WETLAND AND WATERS OF THE UNITED STATES
DELINEATION MAP



Wetland Delineation Map
Annapolis Waterworks Park Stream Restoration
Annapolis, MD

Annapolis Waterworks Park Wetland Map

Legend

- Wetlands
- AOI

0 125 250
Feet

N

Biohabitats

September, 2024

ATTACHMENT E –
WETLAND DELINEATION DATA FORMS

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Annapolis Waterworks City/County: Annapolis Sampling Date: 2024/09/12

Applicant/Owner: Arundel Rivers Federation State: MD Sampling Point: W3 +W4

Investigator(s): TC/SW Section, Township, Range:

Landform (hillslope, terrace, etc.): Floodplain Bench Local relief (concave, convex, none): Slope (%):

Subregion (LRR or MLRA): Floodplain Bench Lat: 38.991239 Long: -76.557543 Datum: WGS 84

Soil Map Unit Name: Annapolis Fine Sandy Loam (ASF) NWI classification: PFO1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes [✔] No [ ] (If no, explain in Remarks.)

Are Vegetation [ ] Soil [ ] or Hydrology [ ] significantly disturbed? [ ] Are "Normal Circumstances" present? Yes [✔] No [ ]

Are Vegetation [ ] Soil [ ] or Hydrology [ ] naturally problematic? [ ] (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes [ ]	No [✔]	**Is the Sampled Area within a Wetland?** Yes [✔] No [ ]
Hydric Soil Present?	Yes [✔]	No [ ]	
Wetland Hydrology Present?	Yes [✔]	No [ ]	

Remarks:

Floodplain benches beginning at the confluence of Broad Creek and unknown tributary (left and right banks) W3-1 through W3-8 and W4-1 through W4-4

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- [ ] Surface Water (A1)
- [ ] High Water Table (A2)
- [✔] Saturation (A3)
- [ ] Water Marks (B1)
- [ ] Sediment Deposits (B2)
- [ ] Drift Deposits (B3)
- [ ] Algal Mat or Crust (B4)
- [ ] Iron Deposits (B5)
- [ ] Inundation Visible on Aerial Imagery (B7)
- [✔] Water-Stained Leaves (B9)
- [ ] Aquatic Fauna (B13)
- [ ] Marl Deposits (B15) **(LRR U)**
- [ ] Hydrogen Sulfide Odor (C1)
- [ ] Oxidized Rhizospheres along Living Roots (C3)
- [ ] Presence of Reduced Iron (C4)
- [ ] Recent Iron Reduction in Tilled Soils (C6)
- [ ] Thin Muck Surface (C7)
- [ ] Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- [ ] Surface Soil Cracks (B6)
- [ ] Sparsely Vegetated Concave Surface (B8)
- [✔] Drainage Patterns (B10)
- [ ] Moss Trim Lines (B16)
- [ ] Dry-Season Water Table (C2)
- [✔] Crayfish Burrows (C8)
- [ ] Saturation Visible on Aerial Imagery (C9)
- [✔] Geomorphic Position (D2)
- [ ] Shallow Aquitard (D3)
- [ ] FAC-Neutral Test (D5)
- [ ] Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes [ ]	No [✔]	Depth (inches):
Water Table Present?	Yes [✔]	No [ ]	Depth (inches): 18
Saturation Present? (includes capillary fringe)	Yes [✔]	No [ ]	Depth (inches): 6

Wetland Hydrology Present? Yes [✔] No [ ]

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Five Strata) – Use scientific names of plants.

Sampling Point: W3+W4

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Tulip Poplar	30	y	FACU
2. Beech	30	y	FACU
3. Ironwood	30	y	FAC
4.			
5.			
6.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Sapling Stratum (Plot size: 30')			
1. Ironwood	20	y	FAC
2. Beech	5	y	FACU
3.			
4.			
5.			
6.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Shrub Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	0 = Total Cover		

50% of total cover: 0 20% of total cover: 0

Herb Stratum (Plot size: 30')			
1. Greenbrier	5	n	FAC
2. American Holly	5	n	FAC
3. Lady Fern	30	y	FAC
4. Longleaf Summer Bluet	5	n	UPL
5. Partridge Berry	15	y	FACU
6. Japanese Stiltgrass	5	n	FAC
7.			
8.			
9.			
10.			
11.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		

50% of total cover: 0 20% of total cover: 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 40 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species	x 2 =	
FAC species	x 3 =	
FACU species	x 4 =	
UPL species	x 5 =	
Column Totals: (A)		(B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Five Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes ☐ No ☑

Remarks: (If observed, list morphological adaptations below).

SOIL

Sampling Point: W3+W4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	10yr 2/2	100					SL	
3-12	10yr 5/1	70	7.5yr 3/6	15	c	m	SL	
			2.5yr 5/8	15	c	m		
12-20	10yr 5/1	80					SL	
	10yr 7/6	20						
20-24	10yr 5/1	30					SL	
	10yr 5/6	15						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☑ No ☐

Remarks:

20-24 continued
10yr 4/6 15%
10yr 5/3 40%

WETLAND DETERMINATION DATA FORM – Atlantic and Gulf Coastal Plain Region

Project/Site: Annapolis Waterworks City/County: Annapolis Sampling Date: 2024/09/12

Applicant/Owner: Arundel Rivers Federation State: MD Sampling Point: W3 +W4

Investigator(s): TC/SW Section, Township, Range: _____

Landform (hillslope, terrace, etc.): Floodplain Bench Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR or MLRA): Floodplain Bench Lat: 38.991239 Long: -76.557543 Datum: WGS 84

Soil Map Unit Name: Annapolis Fine Sandy Loam (ASF) NWI classification: PFO1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes [✔] No [ ] (If no, explain in Remarks.)

Are Vegetation [ ] Soil [ ] or Hydrology [ ] significantly disturbed? [ ] Are "Normal Circumstances" present? Yes [✔] No [ ]

Are Vegetation [ ] Soil [ ] or Hydrology [ ] naturally problematic? [ ] (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes [ ]	No [✔]	**Is the Sampled Area within a Wetland?** Yes [✔] No [ ]
Hydric Soil Present?	Yes [✔]	No [ ]	
Wetland Hydrology Present?	Yes [✔]	No [ ]	

Remarks:

Floodplain benches beginning at the confluence of Broad Creek and unknown tributary (left and right banks) W3-1 through W3-8 and W4-1 through W4-4

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- [ ] Surface Water (A1)
- [ ] High Water Table (A2)
- [✔] Saturation (A3)
- [ ] Water Marks (B1)
- [ ] Sediment Deposits (B2)
- [ ] Drift Deposits (B3)
- [ ] Algal Mat or Crust (B4)
- [ ] Iron Deposits (B5)
- [ ] Inundation Visible on Aerial Imagery (B7)
- [✔] Water-Stained Leaves (B9)
- [ ] Aquatic Fauna (B13)
- [ ] Marl Deposits (B15) **(LRR U)**
- [ ] Hydrogen Sulfide Odor (C1)
- [ ] Oxidized Rhizospheres along Living Roots (C3)
- [ ] Presence of Reduced Iron (C4)
- [ ] Recent Iron Reduction in Tilled Soils (C6)
- [ ] Thin Muck Surface (C7)
- [ ] Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- [ ] Surface Soil Cracks (B6)
- [ ] Sparsely Vegetated Concave Surface (B8)
- [✔] Drainage Patterns (B10)
- [ ] Moss Trim Lines (B16)
- [ ] Dry-Season Water Table (C2)
- [✔] Crayfish Burrows (C8)
- [ ] Saturation Visible on Aerial Imagery (C9)
- [✔] Geomorphic Position (D2)
- [ ] Shallow Aquitard (D3)
- [ ] FAC-Neutral Test (D5)
- [ ] Sphagnum moss (D8) **(LRR T, U)**

Field Observations:

Surface Water Present?	Yes [ ]	No [✔]	Depth (inches): _____
Water Table Present?	Yes [✔]	No [ ]	Depth (inches): 18
Saturation Present? (includes capillary fringe)	Yes [✔]	No [ ]	Depth (inches): 6

Wetland Hydrology Present? Yes [✔] No [ ]

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Five Strata) – Use scientific names of plants.

Sampling Point: W3+W4

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Tulip Poplar	30	y	FACU
2. Beech	30	y	FACU
3. Ironwood	30	y	FAC
4.			
5.			
6.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Sapling Stratum (Plot size: 30')			
1. Ironwood	20	y	FAC
2. Beech	5	y	FACU
3.			
4.			
5.			
6.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Shrub Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	0 = Total Cover		

50% of total cover: 0 20% of total cover: 0

Herb Stratum (Plot size: 30')			
1. Greenbrier	5	n	FAC
2. American Holly	5	n	FAC
3. Lady Fern	30	y	FAC
4. Longleaf Summer Bluet	5	n	UPL
5. Partridge Berry	15	y	FACU
6. Japanese Stiltgrass	5	n	FAC
7.			
8.			
9.			
10.			
11.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		

50% of total cover: 0 20% of total cover: 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 40 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Five Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes ☐ No ☑

Remarks: (If observed, list morphological adaptations below).

SOIL

Sampling Point: W3+W4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	10yr 2/2	100					SL	
3-12	10yr 5/1	70	7.5yr 3/6	15	c	m	SL	
			2.5yr 5/8	15	c	m		
12-20	10yr 5/1	80					SL	
	10yr 7/6	20						
20-24	10yr 5/1	30					SL	
	10yr 5/6	15						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Organic Bodies (A6) **(LRR P, T, U)**
- ☐ 5 cm Mucky Mineral (A7) **(LRR P, T, U)**
- ☐ Muck Presence (A8) **(LRR U)**
- ☐ 1 cm Muck (A9) **(LRR P, T)**
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Coast Prairie Redox (A16) **(MLRA 150A)**
- ☐ Sandy Mucky Mineral (S1) **(LRR O, S)**
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) **(LRR P, S, T, U)**
- ☐ Polyvalue Below Surface (S8) **(LRR S, T, U)**
- ☐ Thin Dark Surface (S9) **(LRR S, T, U)**
- ☐ Loamy Mucky Mineral (F1) **(LRR O)**
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Marl (F10) **(LRR U)**
- ☐ Depleted Ochric (F11) **(MLRA 151)**
- ☐ Iron-Manganese Masses (F12) **(LRR O, P, T)**
- ☐ Umbric Surface (F13) **(LRR P, T, U)**
- ☐ Delta Ochric (F17) **(MLRA 151)**
- ☐ Reduced Vertic (F18) **(MLRA 150A, 150B)**
- ☐ Piedmont Floodplain Soils (F19) **(MLRA 149A)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 149A, 153C, 153D)**

Indicators for Problematic Hydric Soils[3]:

- ☐ 1 cm Muck (A9) **(LRR O)**
- ☐ 2 cm Muck (A10) **(LRR S)**
- ☐ Reduced Vertic (F18) **(outside MLRA 150A,B)**
- ☐ Piedmont Floodplain Soils (F19) **(LRR P, S, T)**
- ☐ Anomalous Bright Loamy Soils (F20) **(MLRA 153B)**
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☑ No ☐

Remarks:

20-24 continued
10yr 4/6 15%
10yr 5/3 40%

Appendix C: TMDL Pollutant Removal Computations

Biohabitats

Project: Annapolis Waterworks Park
Subject: Sediment Sample Results for Protocol 1 Credit Calculator
No: 24015.01
Date: 3/12/2026
Completed By: AV
QAQC By: GB

Average	BD (g/cc)	BD (lb/cf)	Nitrogen (%)	Nitrogen (lbs/ton)	Phosphorus (%)	Phosphorous (lbs/ton)
Entire Site	1.31	82.00	0.026	0.512	0.121	2.429
Reach 1	1.43	89.08	0.011	0.223	0.114	2.285
Reach 2	1.20	74.91	0.040	0.800	0.129	2.574
Reach 3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Note: adjust formulas for BD, N, and P to reference cells for the appropriate rea

Note: Add more lines if you have additional reaches.

Table: Soil Samples and Data

Reach ID	*Sample ID*	*Bulk Density (g/cc)*	*BD (lb/cf)*	*Nitrogen %*	*Nitrogen (lbs/ton)*	*Phosphorous (mg/kg)*	*Phosphorous (lbs/ton)*	*Relative % of Bank*	*Bank Height (ft)*	*Horizon Depth (ft)*
1	AWRB1A	1.2	74.9	0.02	0.40	431.68	0.86	23%	6.50	1.50
1	AWRB1B	1.4	87.4	0.01	0.20	96.38	0.19	77%	6.50	5.00
1	AWLB2A	1.5	93.6	0.01	0.20	2110.77	4.22	100%	4.50	4.50
2	AWLB3A	1.3	81.2	0.01	0.20	1999.80	4.00	100%	5.00	5.00
2	AWLB4A	1.1	68.7	0.07	1.40	574.37	1.15	100%	2.50	2.50

Stream Restoration MS4 Credit Calculator for TN, TP, TSS, and EIA
Version: 05/23/2022
Maryland Department of the Environment - Water and Sciences Administration

About the Calculator

1. This calculator estimates the pollutant load reductions and Equivalent Impervious Acre (EIA) credit for stream restoration projects.
2. The Minimum Qualifying Conditions tab outlines conditions that projects must meet to be eligible for credit. This criteria is found in the expert panel approved by CBP: http://chesapeakestormwater.net/bmp-resources/urban-stream-restoration/
3. The ***lookup*** *tab in this spreadsheet draws Aggregate Impervious and Turf loading rate information from a CAST 2010 No Action Scenario consistent with the 2020 MS4 Accounting Guidance document and Stream Bed and Bank loading rate information from a CAST 2019 Progress Scenario.*
4. EOS load in this spreadsheet is calculated following the protocols recommended by the expert panel approved by CBP.
5. EOT load in this spreadsheet is calculated using Chesapeake Bay Phase 6 watershed model No Action (No BMP) scenario delivery factors at the land-river segment scale. Delivery factors have
6. EIA credit is calculated using Forest-Impervious load deltas with Stream Bed and Bank (STB) Load. These deltas account for inconsistencies in load distribution between the Phase 5 and 6
7. Please populate the blue cells in this worksheet with applicable project data. The calculator will subsequently generate the TN, TP, and TSS load reduction and EIA credit for the project. Once finished, email this spreadsheet along with supporting documentation for Protocols 3 and 5 and to justify changing any default values to <<insert contact info>>.

Revision Record:

Date	Revision
08/04/21	1st Version
05/23/22	Corrected EOT load formula errors in summary tab; Corrected formulas in Protocol 1 Step 2; Protocol 2 adjusted to calculate lbs/yr and allow for scenario of multiple hyporheic boxes; Protocol 2 Step 4 revised to direct users to the CBP Modeling Team to assure that the 40% cap is not being exceeded; Protocol 3 Step 4 formulas corrected; Protocol 4 Runoff Volume Treated formula corrected and removal rate curve formula added

BASIC PROJECT INFORMATION

Populate blue cells with basic project information

Project Name	Annapolis Waterworks Stream Restoration Reach 1
County	Anne Arundel
Address	
Lat (XX.XXXXXX)	
Long (-XX.XXXXXX)	

WATERSHED INFORMATION

Populate blue cells below with information regarding Chesapeake Bay model geography. To determine the applicable geography, locate your project on MDE's interactive webmap at <<mde.state.md.us>>. Locate your project site and identify the segment-shed, MD 8 digit watershed, and land-river segment it is located in.

Segment-shed	SOUMH
MD 8digit	02131003
MD Land-River Segment	N24003WL0_4600_0000

STREAM RESTORATION CREDIT CALCULATOR

Indicate whether you will be using revised protocol calculations outlined in the 2020 Consensus Recommendations to Improve Protocols 2 and 3 for Defining Stream Restoration Pollutant Remova

Using Revised Protocols?	

Protocol	EOS Load (lbs/yr)			EOT Load (lbs/yr)			EIA Credit (lbs/ac/yr)
	TN	TP	TSS	TN	TP	TSS	
1	26.82	274.81	240,535.41	23.05	232.30	188,576.02	51.54
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
Total	26.82	274.81	240,535.41	23.05	232.30	188,576.02	51.54

Project		No	Date
Annapolis Waterworks		24015.01	3/27/2026
Subject		Completed By	QAQC By
BEHI Data & Erosion Calculator		KB	AV

Field Data										AA County Modified	
Bank ID	US STA	DS STA	Bank Side, looking DS	Bank Length	Bank Height	Bank Area	BEHI Rating	Near Bank Stress	Near Bank Stress	Erosion Rate	Erosion Subtotal
	(ft)	(ft)	(left/right)	(ft)	(ft)	(SF)	(adjective)	(adjective)	(rating)	(ft/yr)	(CF/yr)
R1			Right	29.99429558	5.7	170.96748	Low	Moderate	3	0.07	12.0
R2			Right	85.41656988	6.5	555.2077	High	High	4	1.00	555.2
R3			Right	67.30119855	6.5	437.45779	Moderate	Low	2	0.13	54.7
R4			Right	87.34260618	6.5	567.72694	High	Very High	5	1.75	993.5
R5			Right	29.799692	4.3	128.13868	Moderate	Low	2	0.13	16.0
R6			Right	129.7188097	6	778.31286	High	High	4	1.00	778.3
R7			Right	37.19179156	4.2	156.20552	Low	Moderate	3	0.07	10.9
R8			Right	33.51430472	5.3	177.62582	High	Very High	5	1.75	310.8
R9			Right	26.12162335	3	78.36487	Low	Low	2	0.03	2.4
R10			Right	50.30061053	3.5	176.05214	High	Very High	5	1.75	308.1
R11			Right	35.19252999	3.5	123.17385	Moderate	Moderate	3	0.30	37.0
R12			Right	43.59535541	4.2	183.10049	Moderate	High	4	0.80	146.5
L12			Left	42.88018966	3	128.64057	High	High	4	1.00	128.6
L13			Left	33.51882919	4	134.07532	Low	Low	2	0.03	4.0
L14			Left	55.94591707	4	223.78367	Moderate	Moderate	3	0.30	67.1
L15			Left	49.74884305	7.5	373.11632	Very High	High	4	1.00	373.1
L16			Left	28.35800491	2.6	73.730813	Low	Low	2	0.03	2.2
L17			Left	27.8635174	5	139.31759	High	High	4	1.00	139.3
L18			Left	41.38254208	2.7	111.73286	Low	Low	2	0.03	3.4
L19			Left	66.6803811	2.5	166.70095	Moderate	Moderate	3	0.30	50.0
L20			Left	62.99003195	6	377.94019	Very High	Very High	5	1.75	661.4
L21			Left	28.05030579	3.5	98.17607	Low	Low	2	0.03	2.9
L22			Left	30.54616173	3.5	106.91157	Moderate	Moderate	3	0.30	32.1
L23			Left	40.20471161	4.5	180.9212	High	Moderate	3	0.64	115.8
L24			Left	41.55008559	10.7	444.58592	Very High	High	4	1.00	444.6
L25			Left	25.61295803	4.3	110.13572	High	Moderate	3	0.64	70.5
L26			Left	53.98855329	4.2	226.75192	Moderate	Moderate	3	0.30	68.0
L27			Left	34.18098022	5	170.9049	Low	Moderate	3	0.07	12.0
					4.72	**6599.76**				**0.61**	**5400.4**
			Total Bank Length:	1318.9914	**ave**	**sum**				**Average**	**sum**
		Left Bank Total Length		663.5020127							
		Right Bank Total Length		655.4893874						**Total CF/yr=**	5400
		Project Length		659.4957						**Total CY/yr=**	200
										Total tons/yr=	260
										Total	0.394

Protocol 1: Credit for Prevented Sediment during Storm Flow

Please populate the blue cells in this sheet with applicable project data.

Step 1

Estimate stream sediment erosion rates and annual sediment loadings.

# of Reaches	50	
Estimated Project Erosion Rate	240.54	tons/year

Note: Bank Erosion Rates are from Regional Curve

Reach	Bulk Density of Soil C, lbs/ft3	Bank Erosion Rate R, ft/yr	Eroding Bank Area A, ft2	Sediment Load S, tons/yr
R1	89.08	170.97	0.07	0.53
R2	89.08	555.21	1.00	24.73
R3	89.08	437.46	0.13	2.44
R4	89.08	567.73	1.75	44.25
R5	89.08	128.14	0.13	0.71
R6	89.08	778.31	1.00	34.67
R7	89.08	156.21	0.07	0.49
R8	89.08	177.63	1.75	13.85
R9	89.08	78.36	0.03	0.10
R10	89.08	176.05	1.75	13.72
R11	89.08	123.17	0.30	1.65
R12	89.08	183.10	0.80	6.52
L12	89.08	128.64	1.00	5.73
L13	89.08	134.08	0.03	0.18
L14	89.08	223.78	0.30	2.99
L15	89.08	373.12	1.00	16.62
L16	89.08	73.73	0.03	0.10
L17	89.08	139.32	1.00	6.21
L18	89.08	111.73	0.03	0.15
L19	89.08	166.70	0.30	2.23
L20	89.08	377.94	1.75	29.46
L21	89.08	98.18	0.03	0.13
L22	89.08	106.91	0.30	1.43
L23	89.08	180.92	0.64	5.16
L24	89.08	444.59	1.00	19.80
L25	89.08	110.14	0.64	3.14
L26	89.08	226.75	0.30	3.03
L27	89.08	170.90	0.07	0.53
#VALUE!				0.00
#VALUE!				0.00
#VALUE!				0.00
#VALUE!				0.00
#VALUE!				0.00

Step 2

Convert stream bank erosion to nutrient loading.

Nutrient	lbs/ton sediment
Nitrogen	0.223
Phosphorus	2.285

Because of the high variability, samples from the project reach should be collected and analyzed for TN and TP concentrations.

Sediment	240.54	tons/year
Total Nitrogen	53.64	lbs/year
Total Phosphorus	549.62	lbs/year

Step 3

Estimate stream restoration efficiency - Justify efficiency with monitoring data or assume 50%

Efficiency	50	%
Sediment	120.27	tons/year
Total Nitrogen	26.82	lbs/year
Total Phosphorus	274.81	lbs/year

Stream Restoration MS4 Credit Calculator for TN, TP, TSS, and EIA
Version: 05/23/2022
Maryland Department of the Environment - Water and Sciences Administration

About the Calculator

1. This calculator estimates the pollutant load reductions and Equivalent Impervious Acre (EIA) credit for stream restoration projects.
2. The Minimum Qualifying Conditions tab outlines conditions that projects must meet to be eligible for credit. This criteria is found in the expert panel approved by CBP: http://chesapeakestormwater.net/bmp-resources/urban-stream-restoration/
3. The ***lookup*** *tab in this spreadsheet draws Aggregate Impervious and Turf loading rate information from a CAST 2010 No Action Scenario consistent with the 2020 MS4 Accounting Guidance document and Stream Bed and Bank loading rate information from a CAST 2019 Progress Scenario.*
4. EOS load in this spreadsheet is calculated following the protocols recommended by the expert panel approved by CBP.
5. EOT load in this spreadsheet is calculated using Chesapeake Bay Phase 6 watershed model No Action (No BMP) scenario delivery factors at the land-river segment scale. Delivery factors have
6. EIA credit is calculated using Forest-Impervious load deltas with Stream Bed and Bank (STB) Load. These deltas account for inconsistencies in load distribution between the Phase 5 and 6
7. Please populate the blue cells in this worksheet with applicable project data. The calculator will subsequently generate the TN, TP, and TSS load reduction and EIA credit for the project. Once finished, email this spreadsheet along with supporting documentation for Protocols 3 and 5 and to justify changing any default values to <<insert contact info>>.

Revision Record:

Date	Revision
08/04/21	1st Version
05/23/22	Corrected EOT load formula errors in summary tab; Corrected formulas in Protocol 1 Step 2; Protocol 2 adjusted to calculate lbs/yr and allow for scenario of multiple hyporheic boxes; Protocol 2 Step 4 revised to direct users to the CBP Modeling Team to assure that the 40% cap is not being exceeded; Protocol 3 Step 4 formulas corrected; Protocol 4 Runoff Volume Treated formula corrected and removal rate curve formula added

BASIC PROJECT INFORMATION

Populate blue cells with basic project information

Project Name	Annapolis Waterworks Stream Restoration Reach 2
County	Anne Arundel
Address	
Lat (XX.XXXXXX)	
Long (-XX.XXXXXX)	

WATERSHED INFORMATION

Populate blue cells below with information regarding Chesapeake Bay model geography. To determine the applicable geography, locate your project on MDE's interactive webmap at <<mde.state.md.us>>. Locate your project site and identify the segment-shed, MD 8 digit watershed, and land-river segment it is located in.

Segment-shed	SOUMH
MD 8digit	02131003
MD Land-River Segment	N24003WL0_4600_0000

STREAM RESTORATION CREDIT CALCULATOR

Indicate whether you will be using revised protocol calculations outlined in the 2020 Consensus Recommendations to Improve Protocols 2 and 3 for Defining Stream Restoration Pollutant Remova

Using Revised Protocols?	

Protocol	EOS Load (lbs/yr)			EOT Load (lbs/yr)			EIA Credit (lbs/ac/yr)
	TN	TP	TSS	TN	TP	TSS	
1	37.35	120.19	93,384.78	32.10	101.59	73,212.22	22.52
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
Total	37.35	120.19	93,384.78	32.10	101.59	73,212.22	22.52

Project		No	Date
Annapolis Waterworks		24015.01	3/27/2026
Subject		Completed By	QAQC By
BEHI Data & Erosion Calculator		KB	AV

Field Data										AA County Modified	
Bank ID	US STA	DS STA	Bank Side, looking DS	Bank Length	Bank Height	Bank Area	BEHI Rating	Near Bank Stress	Near Bank Stress	Erosion Rate	Erosion Subtotal
	(ft)	(ft)	(left/right)	(ft)	(ft)	(SF)	(adjective)	(adjective)	(rating)	(ft/yr)	(CF/yr)
R13			Right	52.21542941	3.2	167.08937	Low	Low	2	0.03	5.0
R14			Right	93.3443896	3.2	298.70205	Moderate	Moderate	3	0.30	89.6
R15			Right	103.934938	3.2	332.5918	Low	Low	2	0.03	10.0
R16			Right	28.1963839	2.9	81.769513	Moderate	Moderate	3	0.30	24.5
R17			Right	28.21877878	4	112.87512	High	High	4	1.00	112.9
R18			Right	45.31152405	3.7	167.65264	Moderate	Low	2	0.13	21.0
R19			Right	30.15170741	3.7	111.56132	Moderate	Moderate	3	0.30	33.5
R20			Right	123.3458487	3	370.03755	Low	Low	2	0.03	11.1
R21			Right	148.8226332	2.5	372.05658	Low	Moderate	3	0.07	26.0
R22			Right	48.03794221	5.6	269.01248	High	High	4	1.00	269.0
R23			Right	115.3259187	2.5	288.3148	Moderate	Moderate	3	0.30	86.5
L1			Left	119.1197054	2.7	321.6232	Moderate	Moderate	3	0.30	96.5
L2			Left	86.95358681	2.7	234.77468	Low	Low	2	0.03	7.0
L3			Left	115.0943031	2.7	310.75462	Low	Moderate	3	0.07	21.8
L4			Left	25.61231995	2.7	69.153264	Moderate	High	4	0.80	55.3
L5			Left	33.80164576	5	169.00823	Low	Low	2	0.03	5.1
L6			Left	40.08069395	9.3	372.75045	Very High	High	4	1.00	372.8
L7			Left	37.07887952	3.5	129.77608	Low	Low	2	0.03	3.9
L8			Left	102.794296	3.5	359.78004	Moderate	Moderate	3	0.30	107.9
L9			Left	55.16865452	5	275.84327	High	Moderate	3	0.64	176.5
L10			Left	118.868984	8	950.95187	Very High	High	4	1.00	951.0
L11			Left	42.82353854	5	214.11769	Low	Low	2	0.03	6.4
					3.98	**5980.20**				**0.35**	**2493.3**
		Total Bank Length:		1594.302101	**ave**	**sum**				**Average**	**sum**
		Left Bank Total Length		777.3966076							
		Right Bank Total Length		816.9054939						**Total CF/yr=**	2493
		Project Length		797.1510507						**Total CY/yr=**	92
										Total tons/yr=	120
										Total	0.151

Protocol 1: Credit for Prevented Sediment during Storm Flow

Please populate the blue cells in this sheet with applicable project data.

Step 1

Estimate stream sediment erosion rates and annual sediment loadings.

# of Reaches	50	
Estimated Project Erosion Rate	93.38	tons/year

Note: Bank Erosion Rates are from Regional Curve

Reach	Bulk Density of Soil C, lbs/ft3	Bank Erosion Rate R, ft/yr	Eroding Bank Area A, ft2	Sediment Load S, tons/yr
R13	74.91	167.09	0.03	0.19
R14	74.91	298.70	0.30	3.36
R15	74.91	332.59	0.03	0.37
R16	74.91	81.77	0.30	0.92
R17	74.91	112.88	1.00	4.23
R18	74.91	167.65	0.13	0.78
R19	74.91	111.56	0.30	1.25
R20	74.91	370.04	0.03	0.42
R21	74.91	372.06	0.07	0.98
R22	74.91	269.01	1.00	10.08
R23	74.91	288.31	0.30	3.24
L1	74.91	321.62	0.30	3.61
L2	74.91	234.77	0.03	0.26
L3	74.91	310.75	0.07	0.81
L4	74.91	69.15	0.80	2.07
L5	74.91	169.01	0.03	0.19
L6	74.91	372.75	1.00	13.96
L7	74.91	129.78	0.03	0.15
L8	74.91	359.78	0.30	4.04
L9	74.91	275.84	0.64	6.61
L10	74.91	950.95	1.00	35.62
L11	74.91	214.12	0.03	0.24
#REF!				0.00
#REF!				0.00
#REF!				0.00
#REF!				0.00
#REF!				0.00

Step 2

Convert stream bank erosion to nutrient loading.

Nutrient	lbs/ton sediment
Nitrogen	0.8
Phosphorus	2.574

Because of the high variability, samples from the project reach should be collected and analyzed for TN and TP concentrations.

Sediment	93.38	tons/year
Total Nitrogen	74.71	lbs/year
Total Phosphorus	240.37	lbs/year

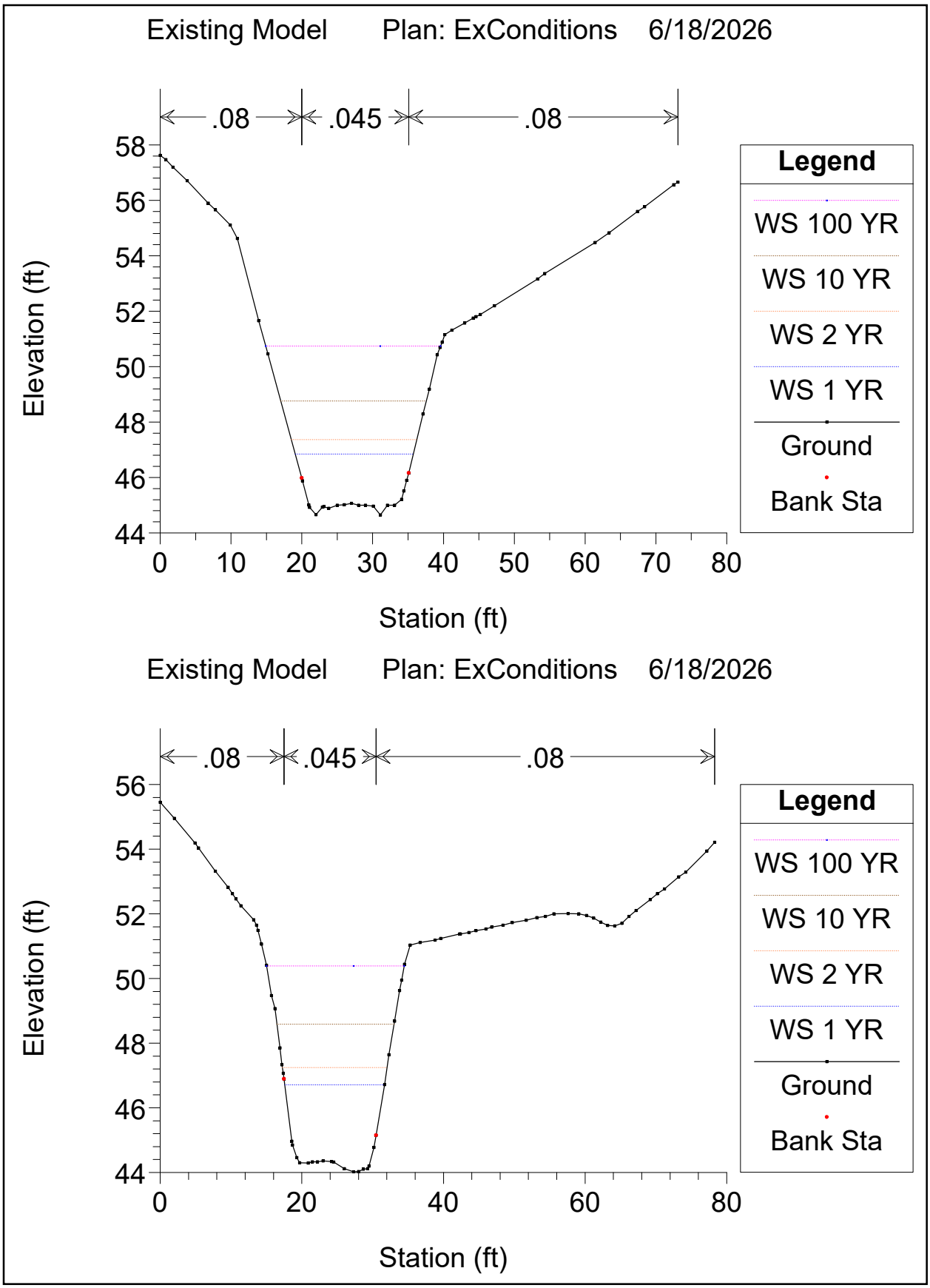
Step 3

Estimate stream restoration efficiency - Justify efficiency with monitoring data or assume 50%

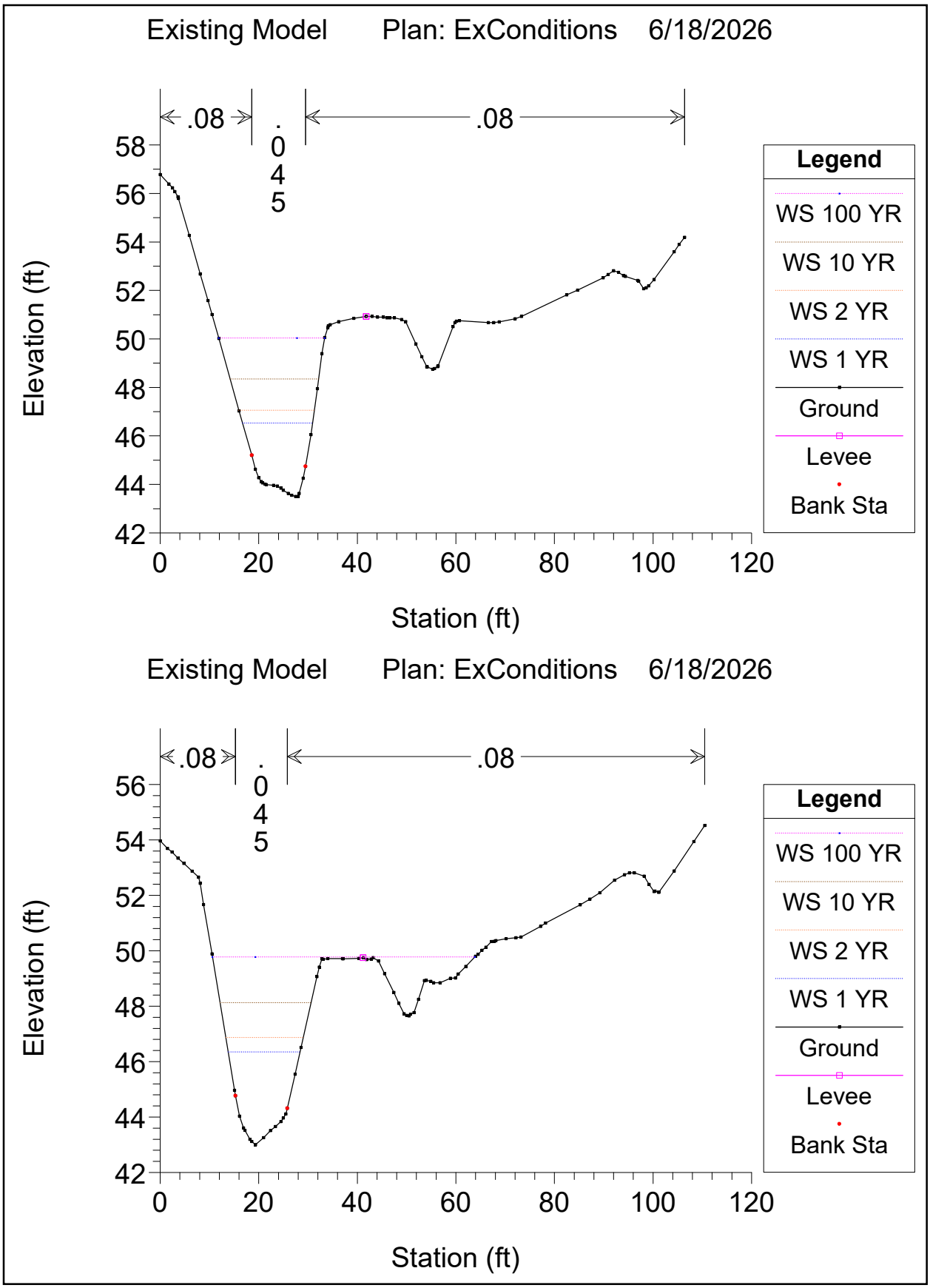
Efficiency	50	%
Sediment	46.69	tons/year
Total Nitrogen	37.35	lbs/year
Total Phosphorus	120.19	lbs/year

Appendix D: Existing and Proposed Conditions Hydraulic Modeling Output

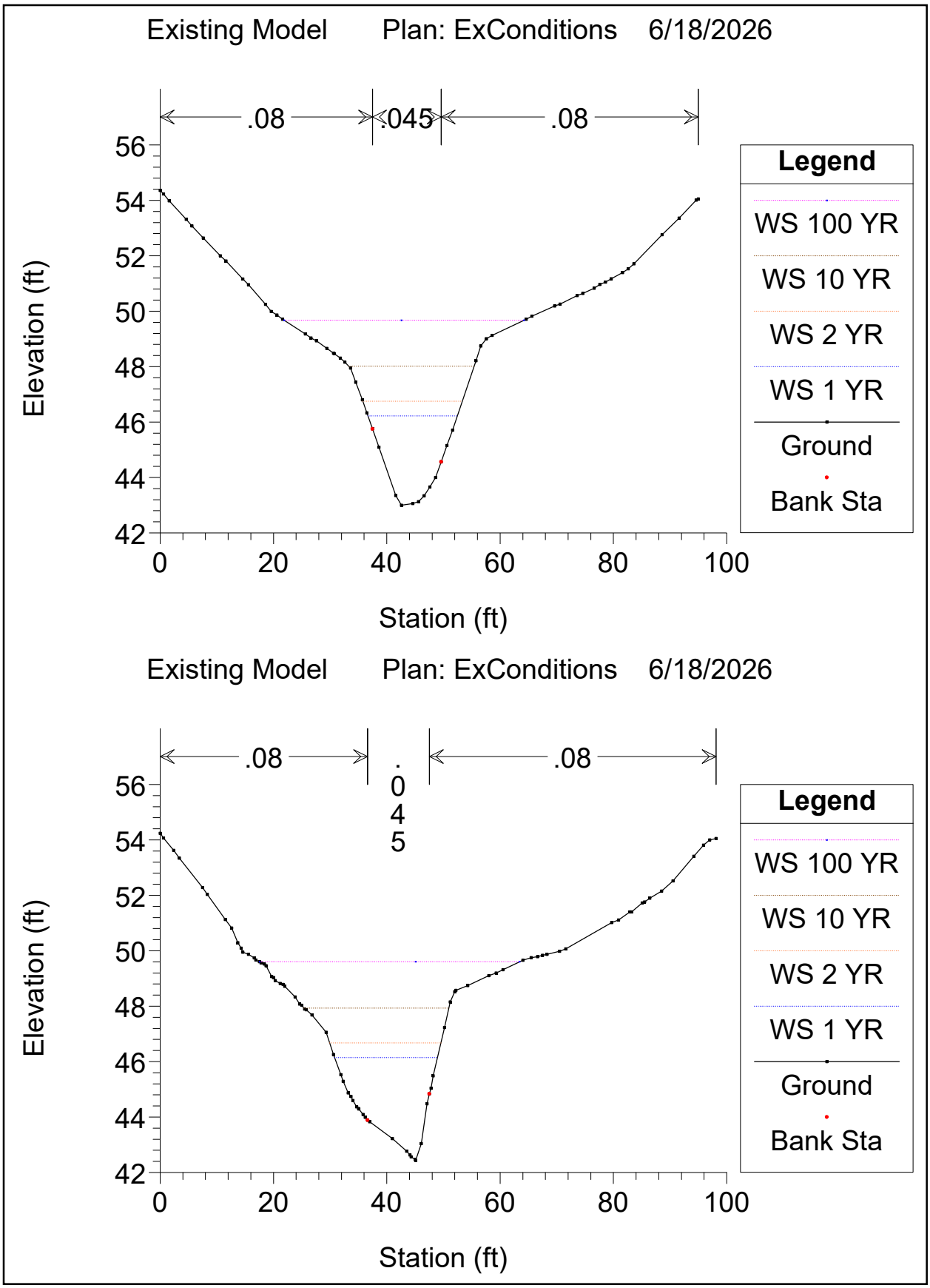
WATERWORKS EXISTING CONDITIONS CROSS SECTIONS



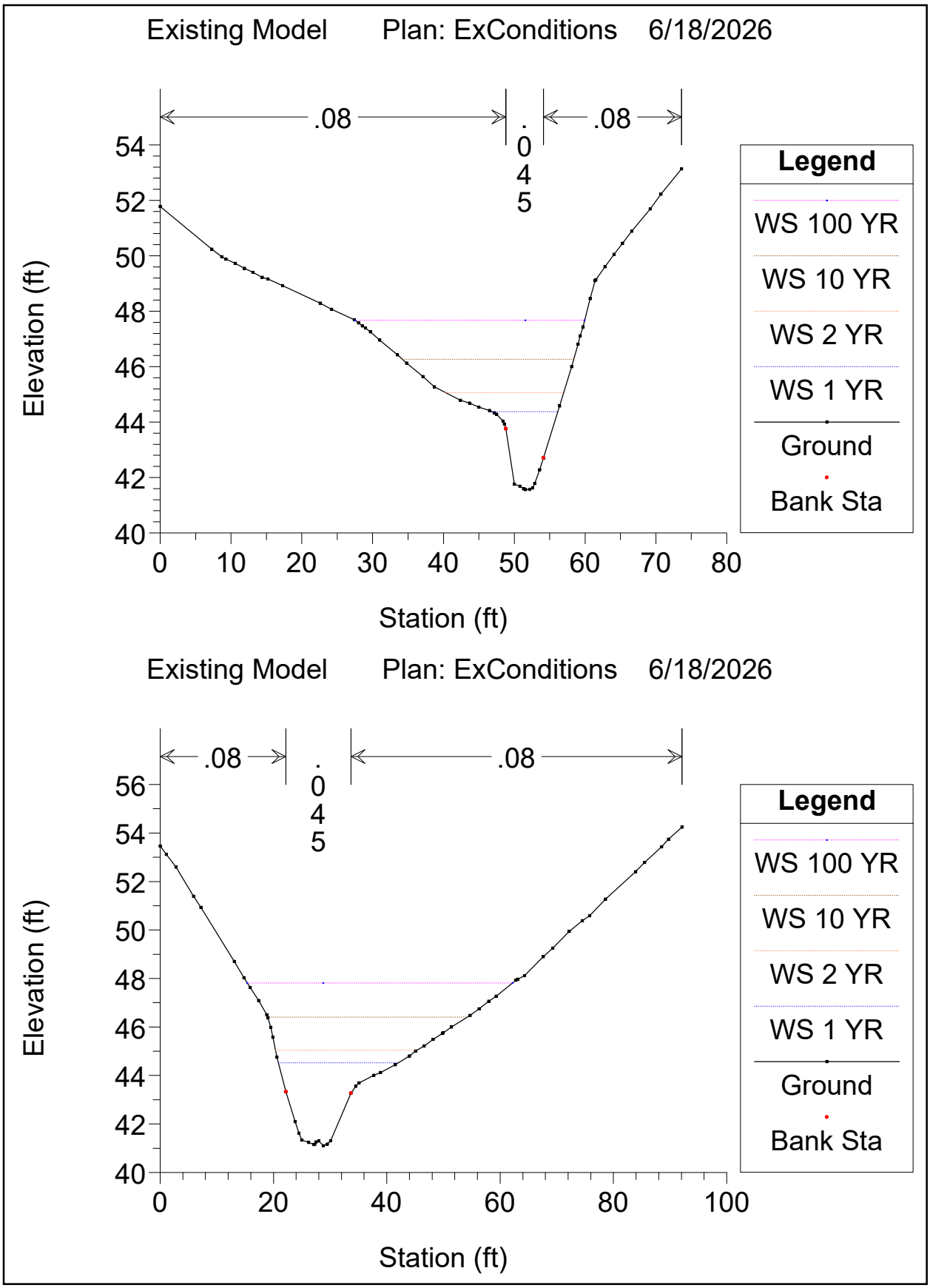
WATERWORKS EXISTING CONDITIONS CROSS SECTIONS



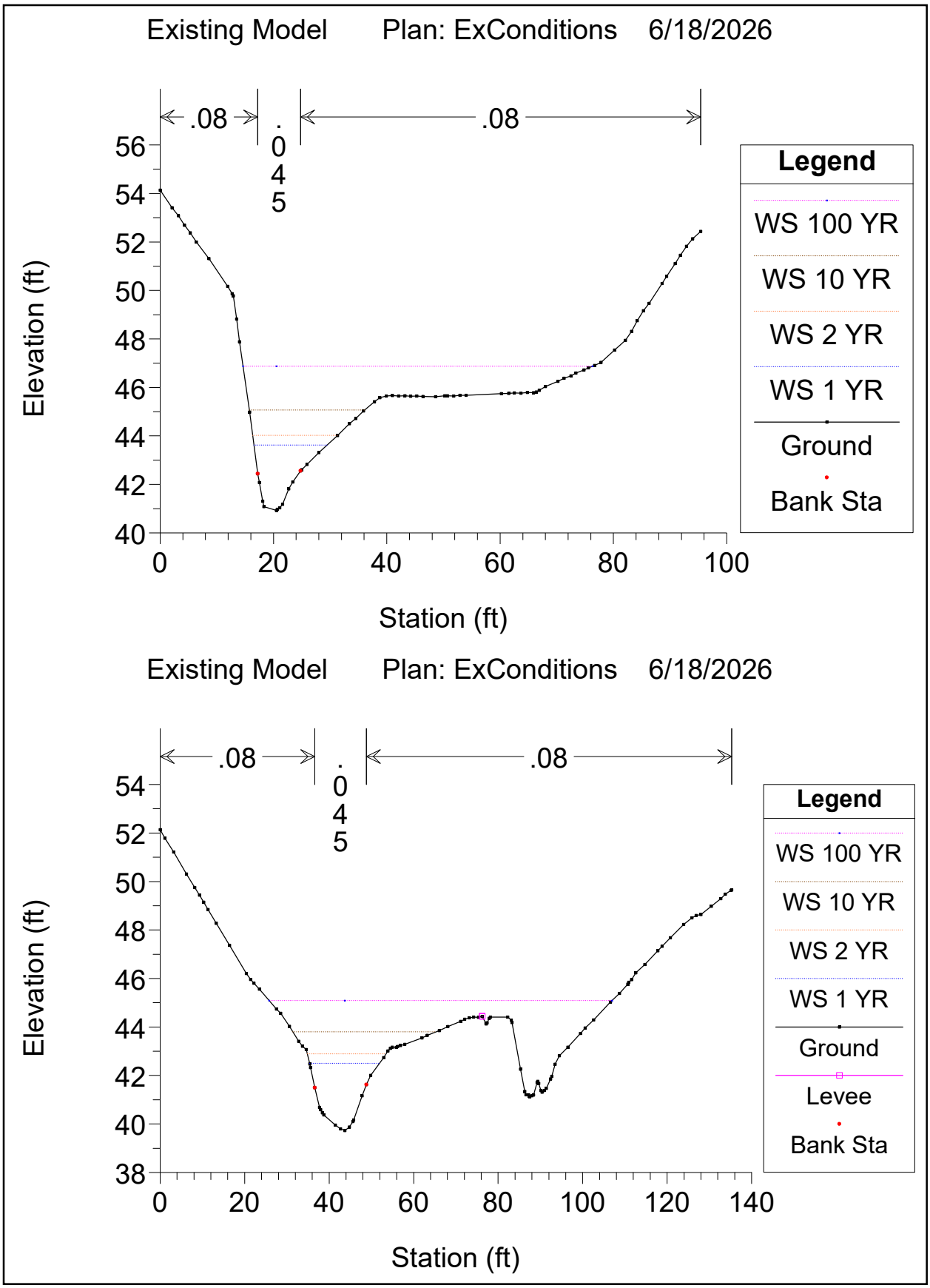
WATERWORKS EXISTING CONDITIONS CROSS SECTIONS



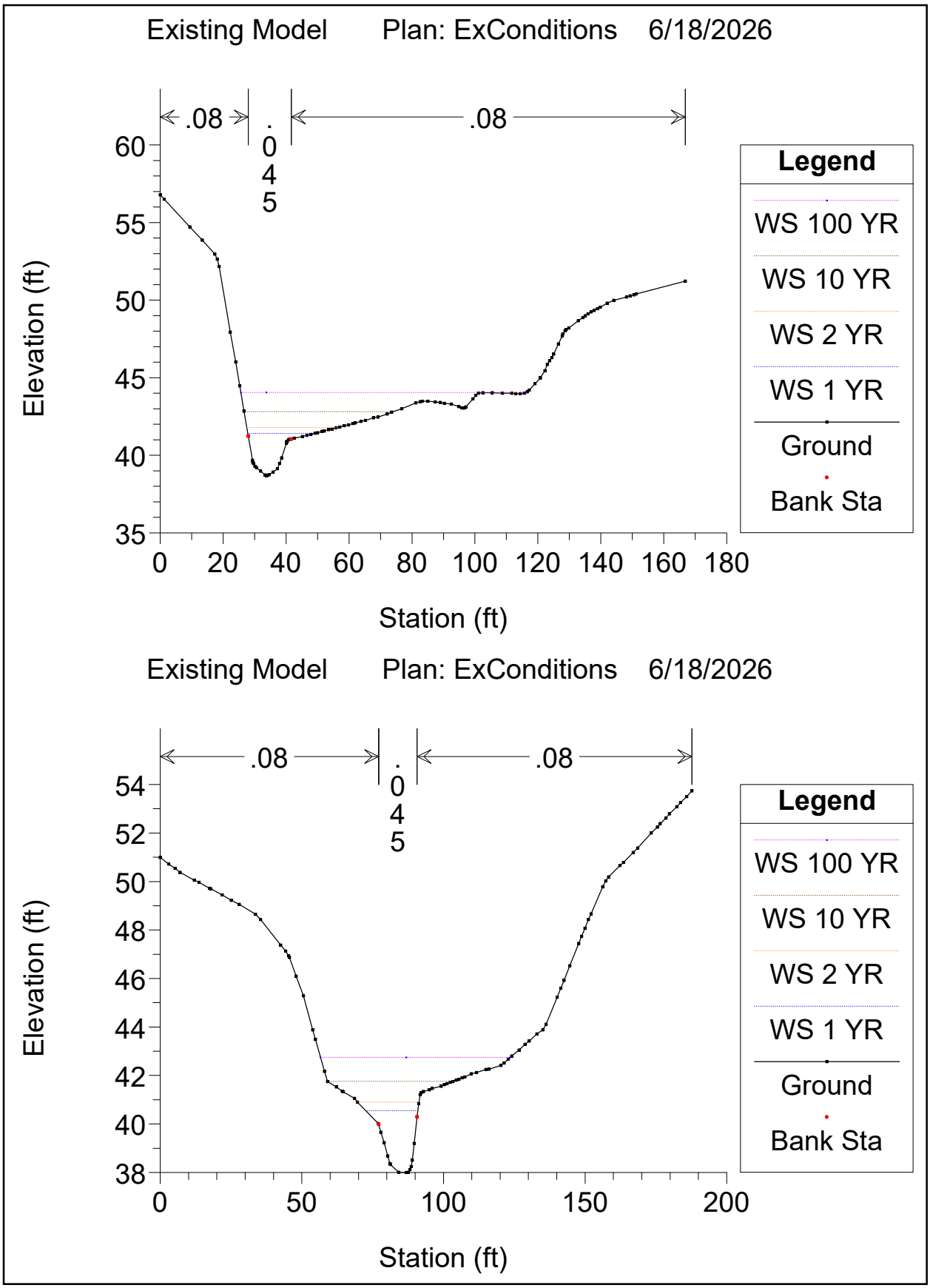
WATERWORKS EXISTING CONDITIONS CROSS SECTIONS



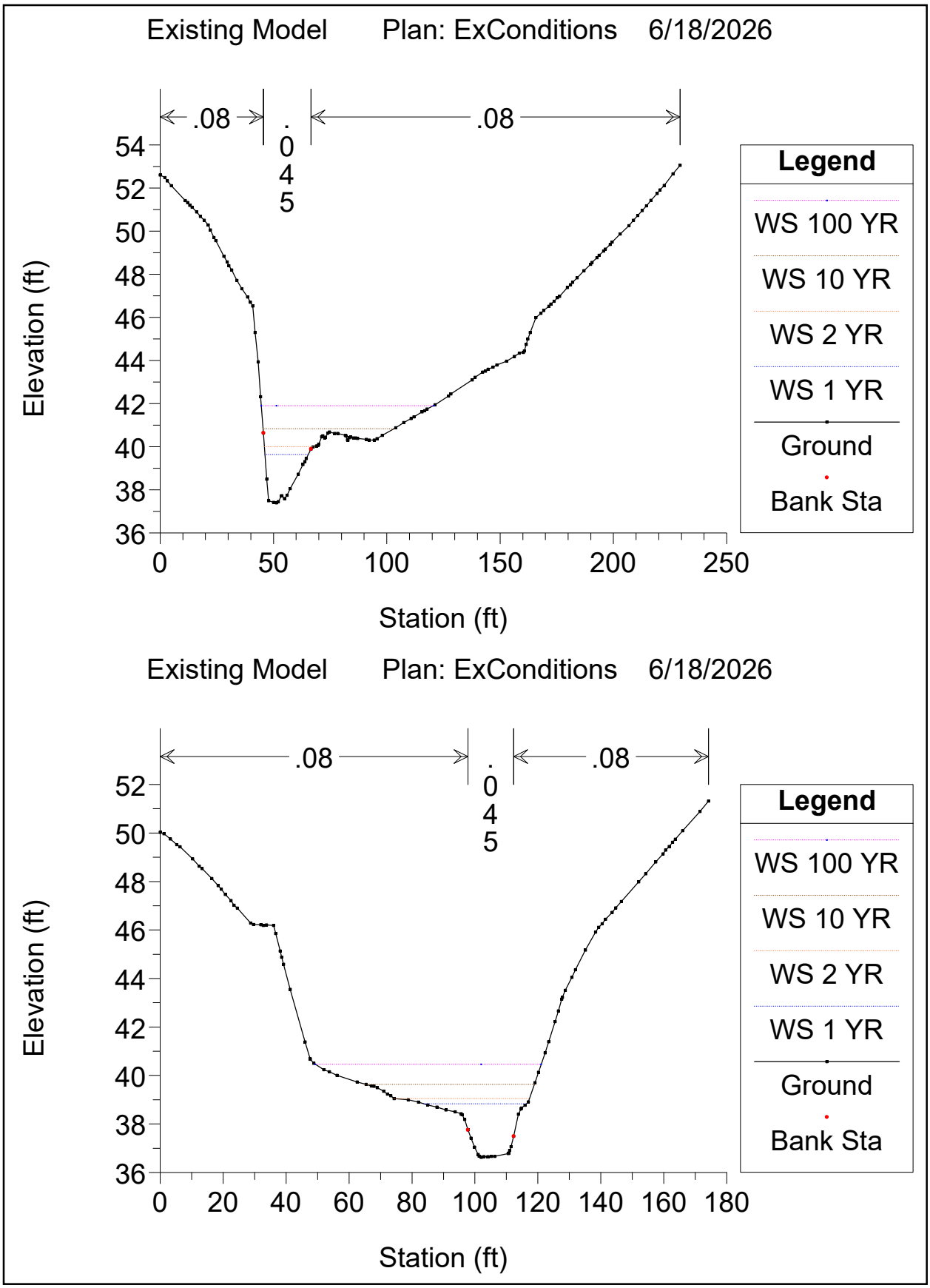
WATERWORKS EXISTING CONDITIONS CROSS SECTIONS



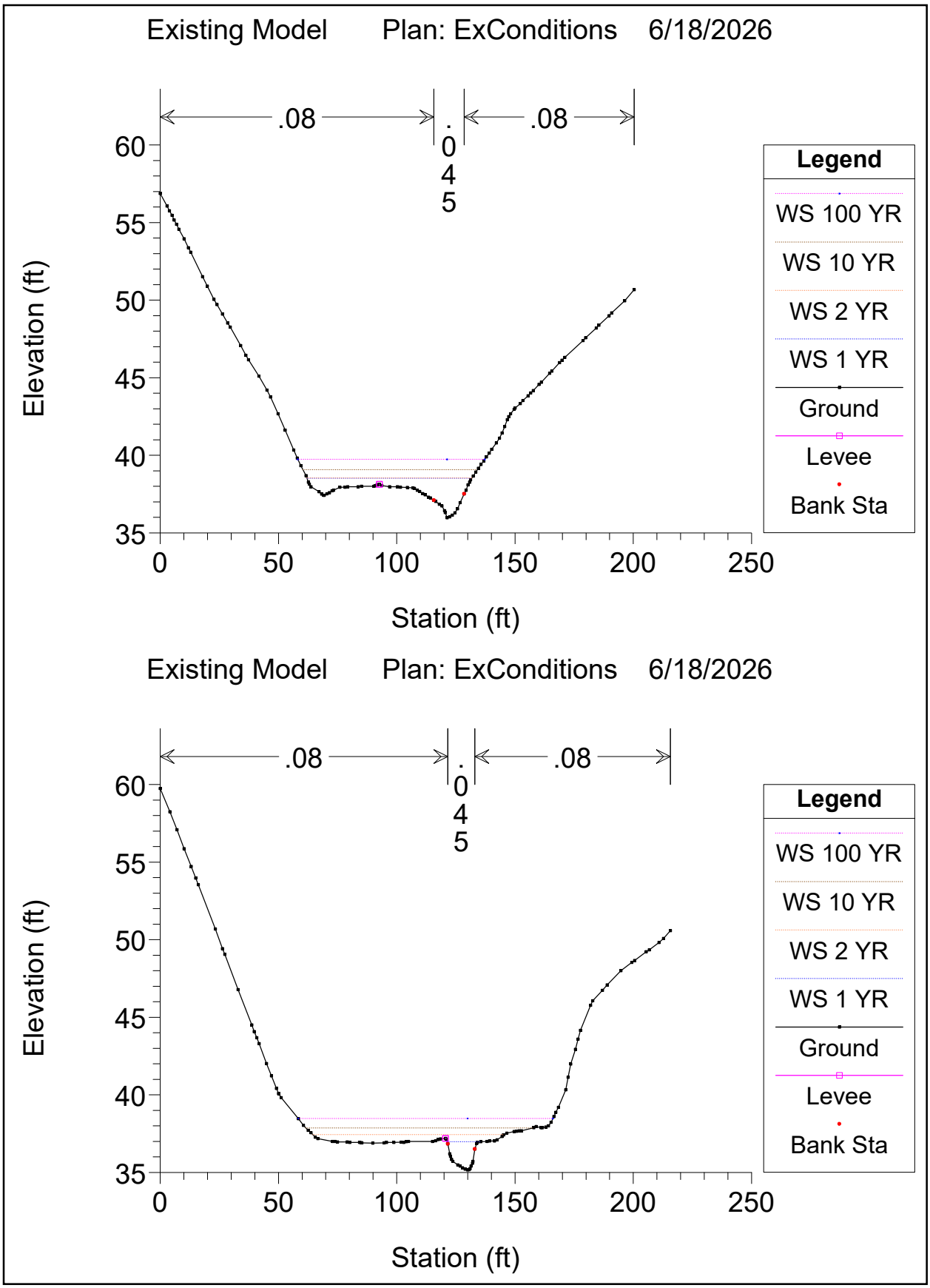
WATERWORKS EXISTING CONDITIONS CROSS SECTIONS



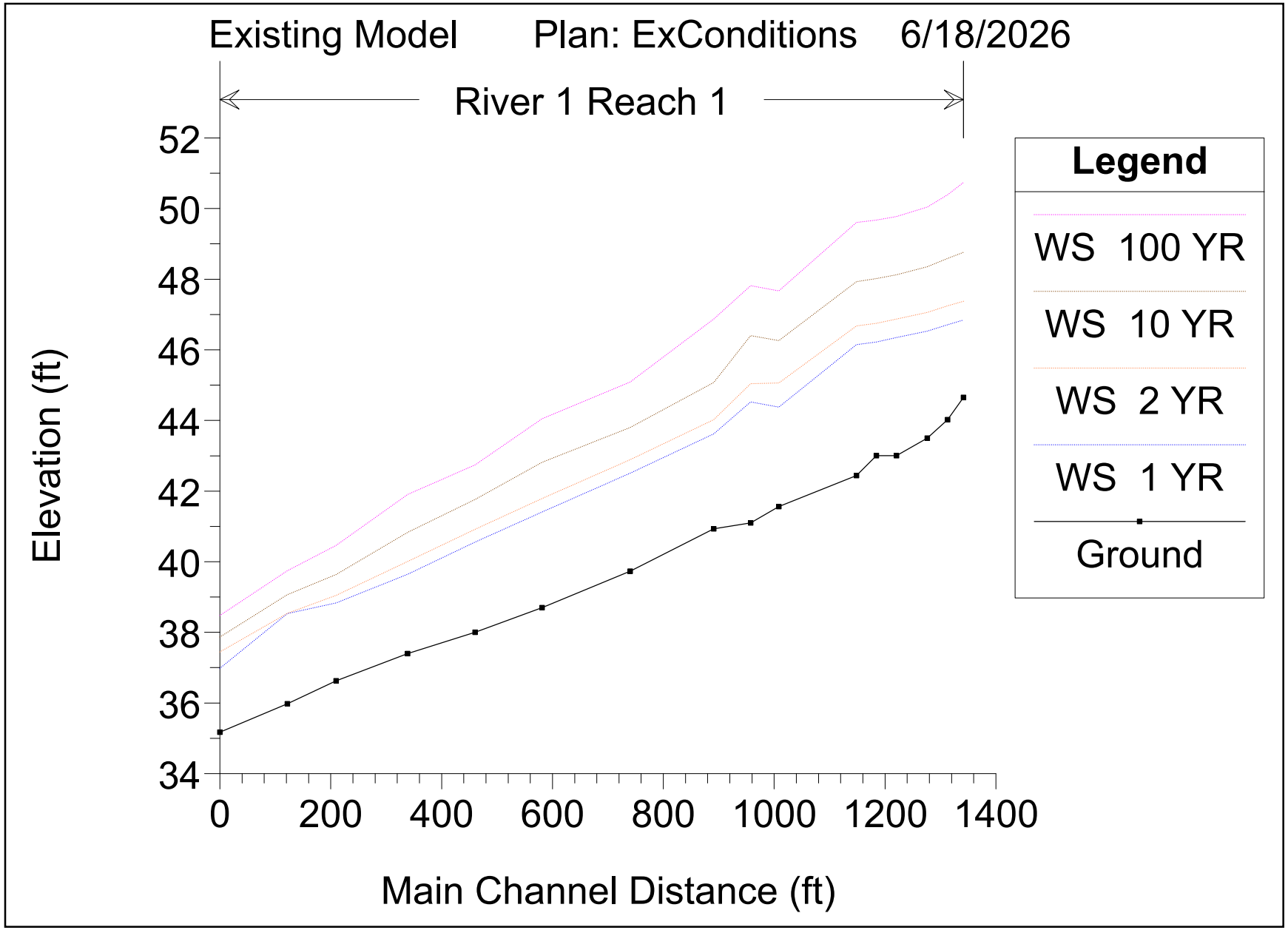
WATERWORKS EXISTING CONDITIONS CROSS SECTIONS



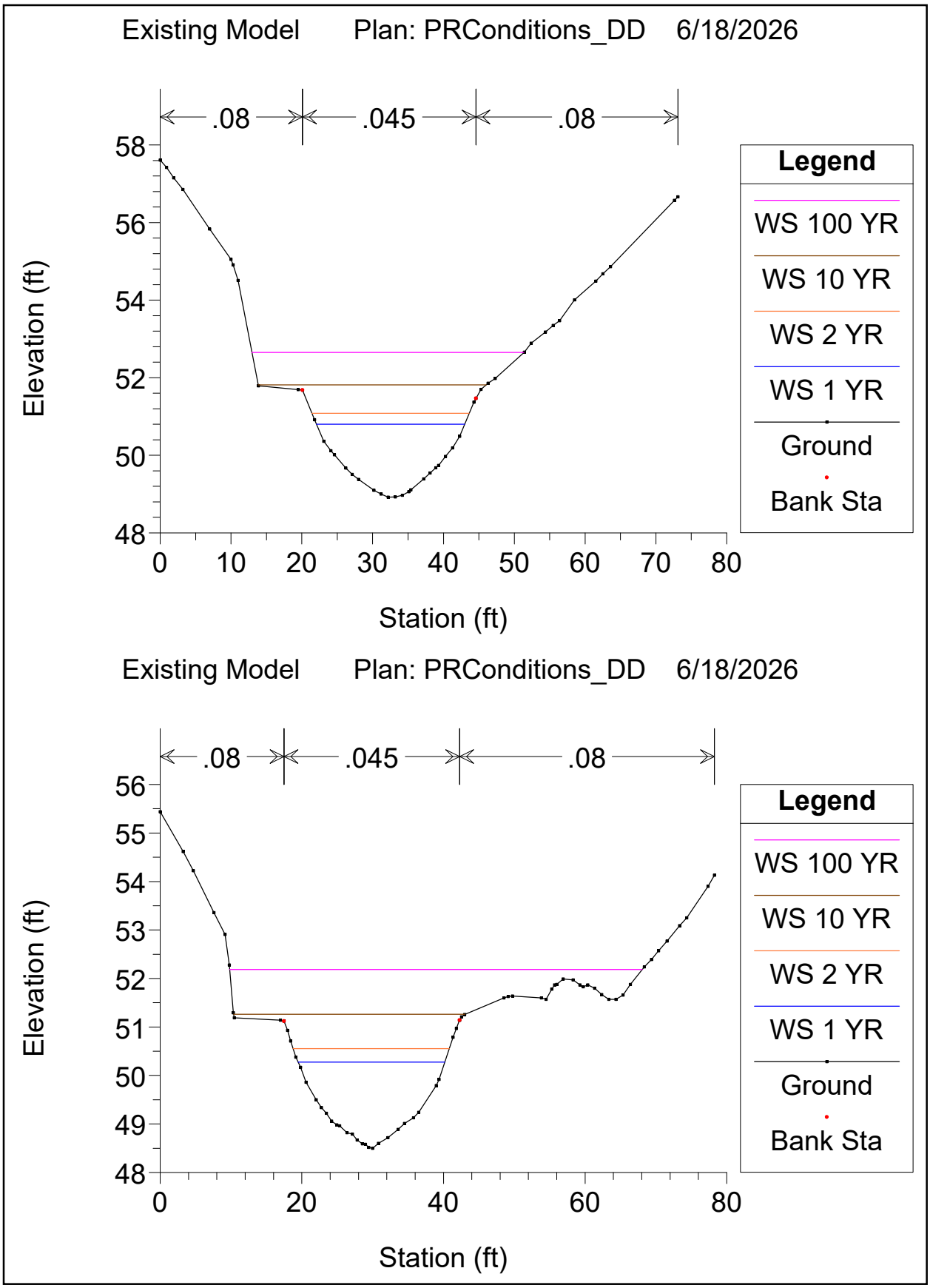
WATERWORKS EXISTING CONDITIONS CROSS SECTIONS



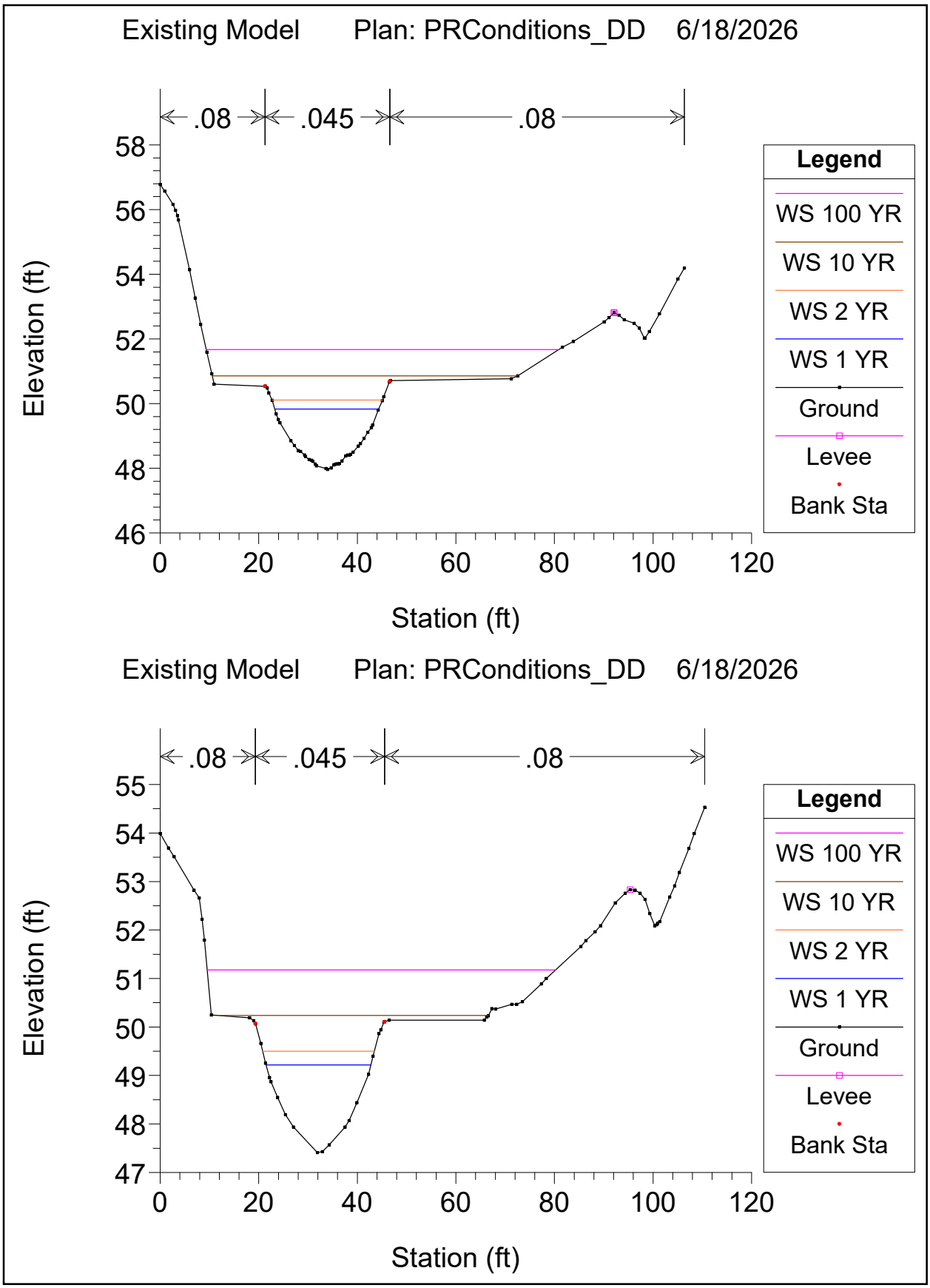
WATERWORKS EXISTING CONDITIONS PROFILE



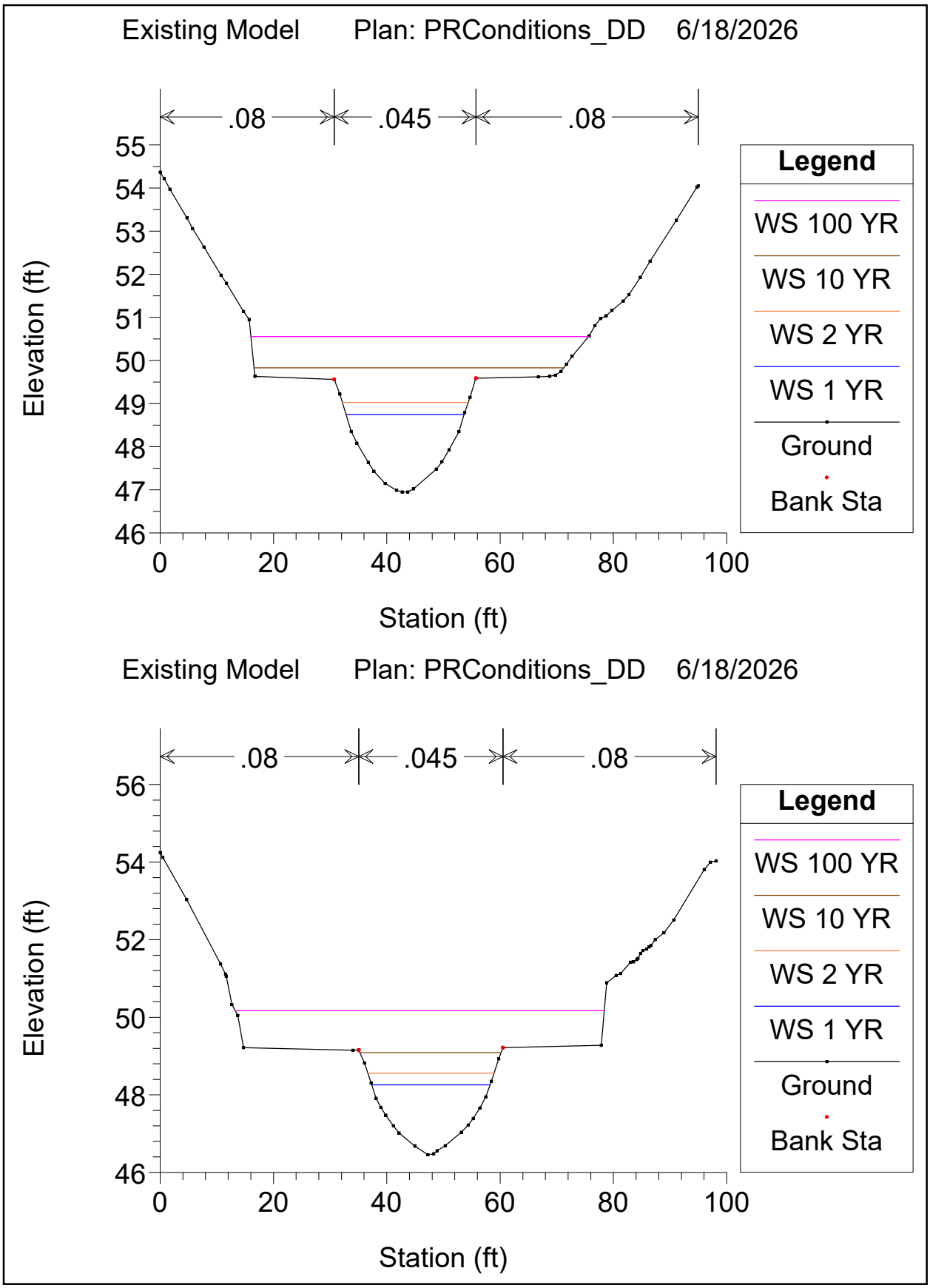
WATERWORKS PROPOSED CONDITIONS CROSS SECTIONS



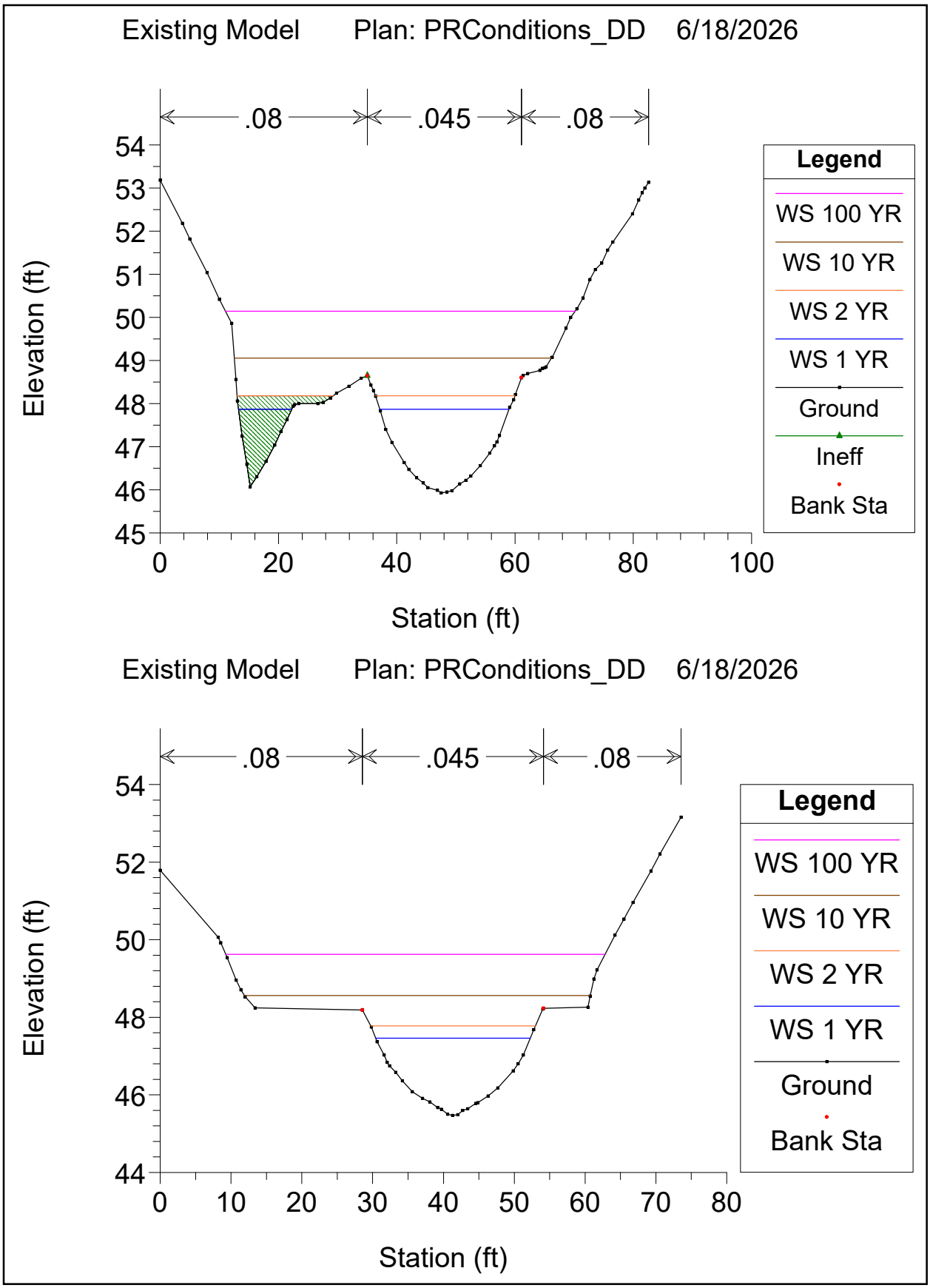
WATERWORKS PROPOSED CONDITIONS CROSS SECTIONS



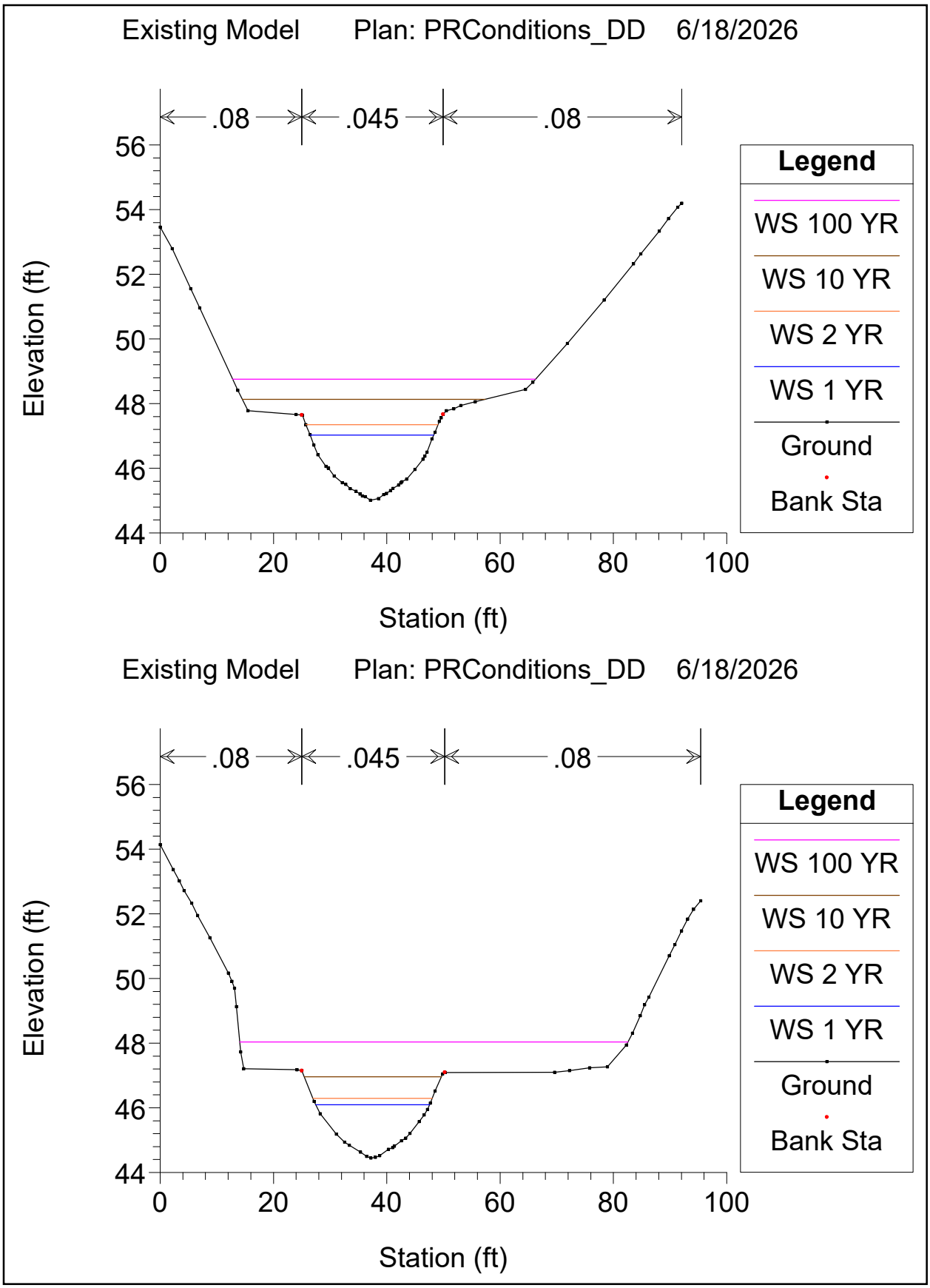
WATERWORKS PROPOSED CONDITIONS CROSS SECTIONS



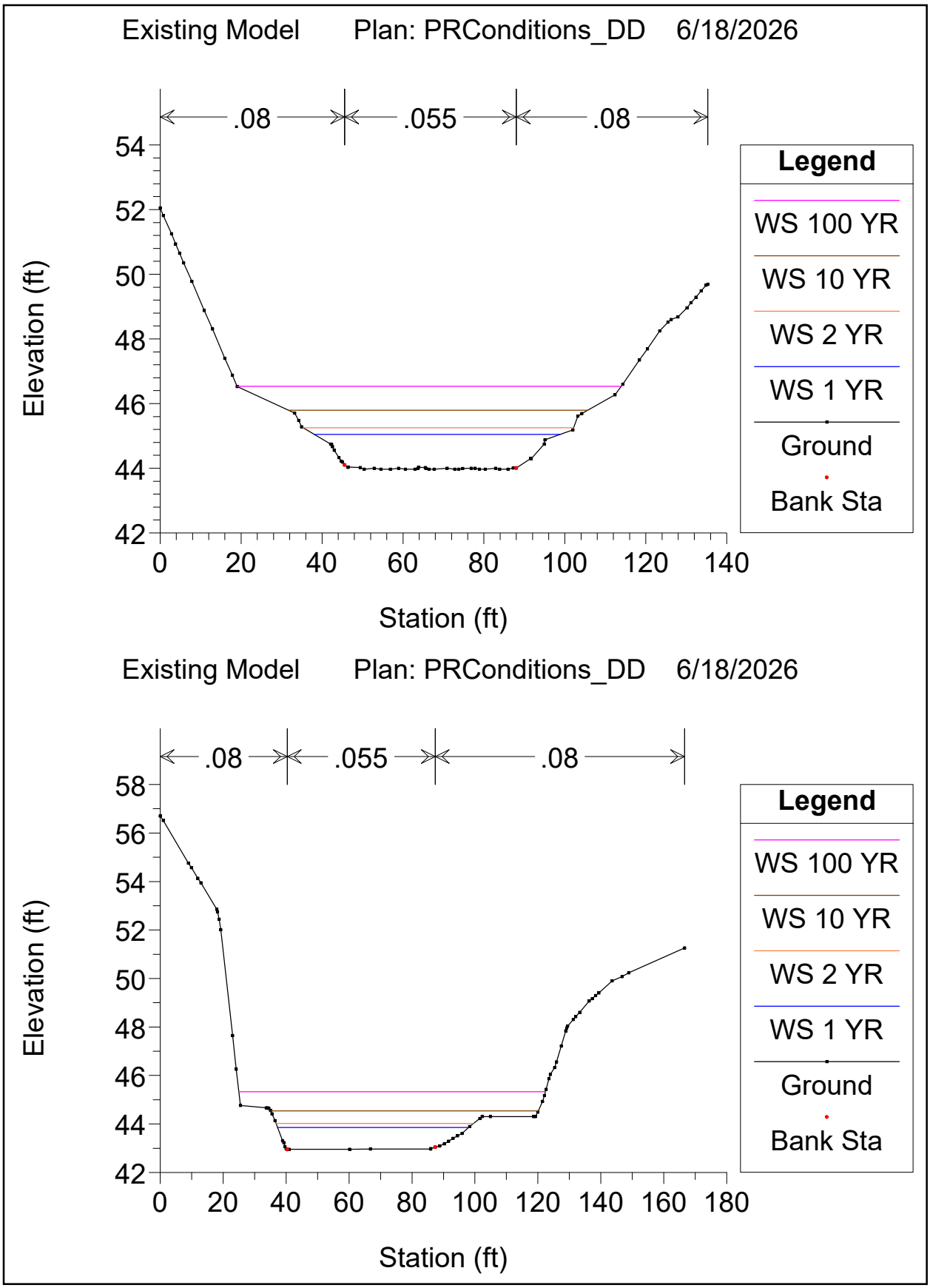
WATERWORKS PROPOSED CONDITIONS CROSS SECTIONS



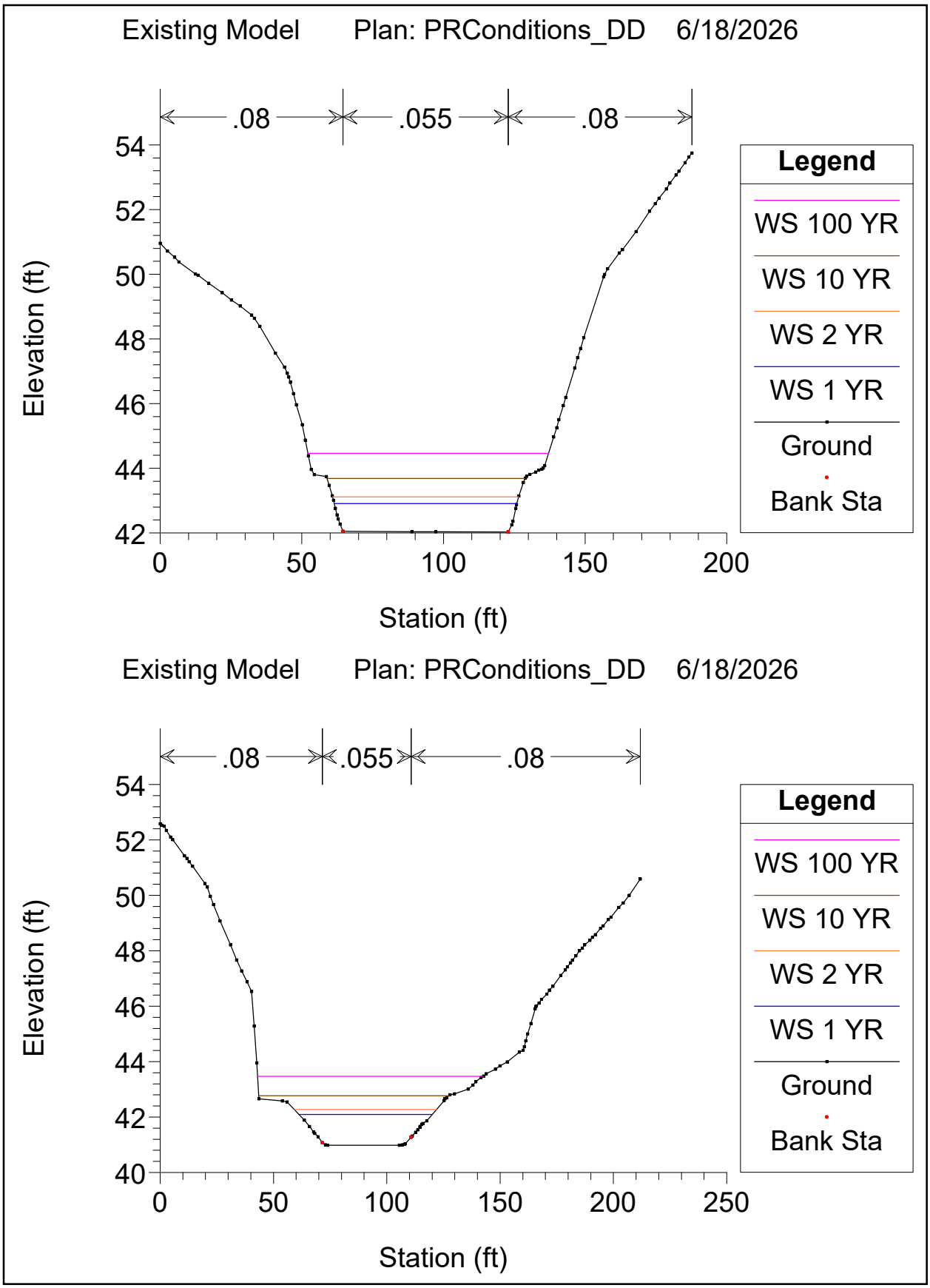
WATERWORKS PROPOSED CONDITIONS CROSS SECTIONS



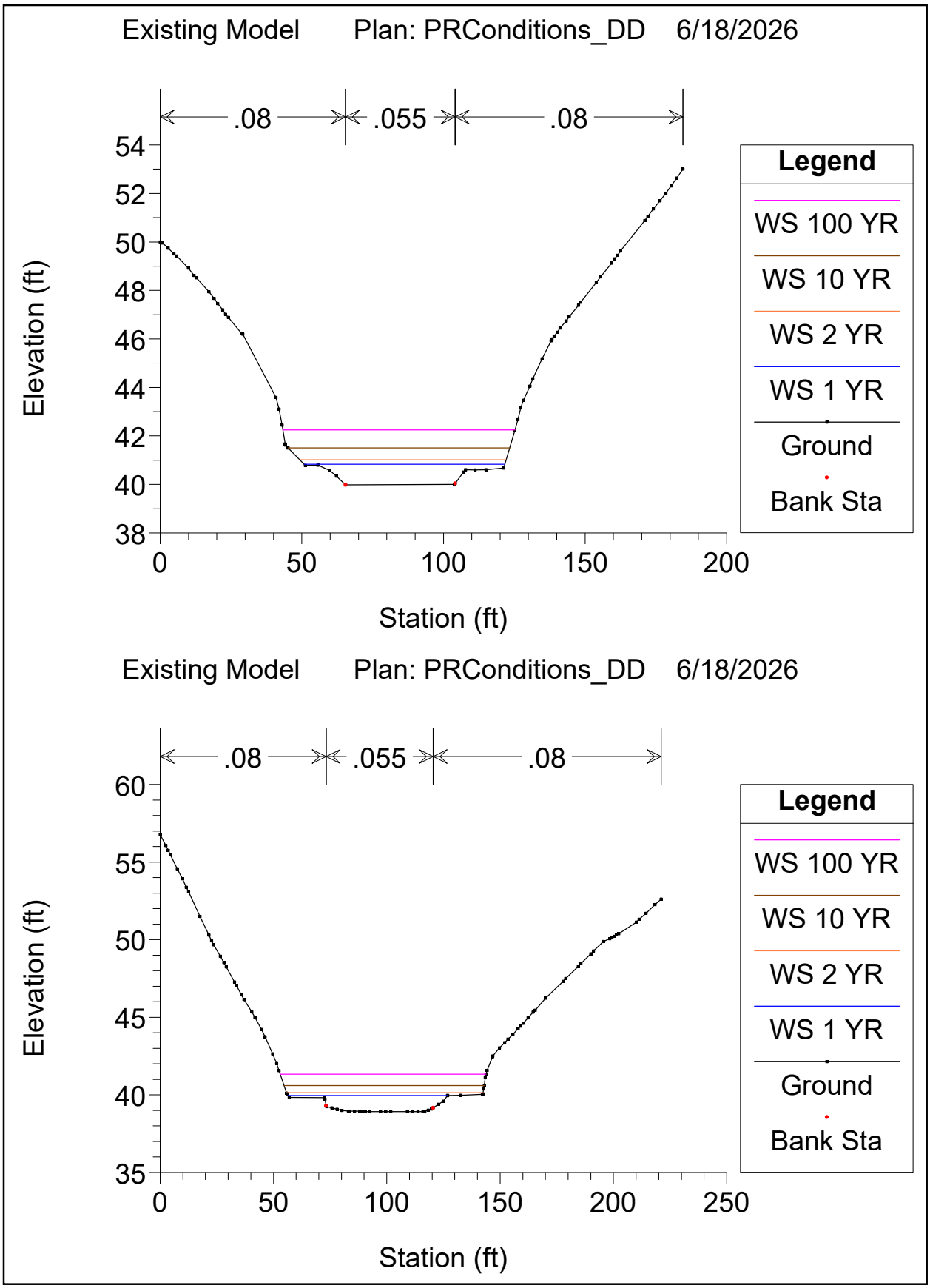
WATERWORKS PROPOSED CONDITIONS CROSS SECTIONS



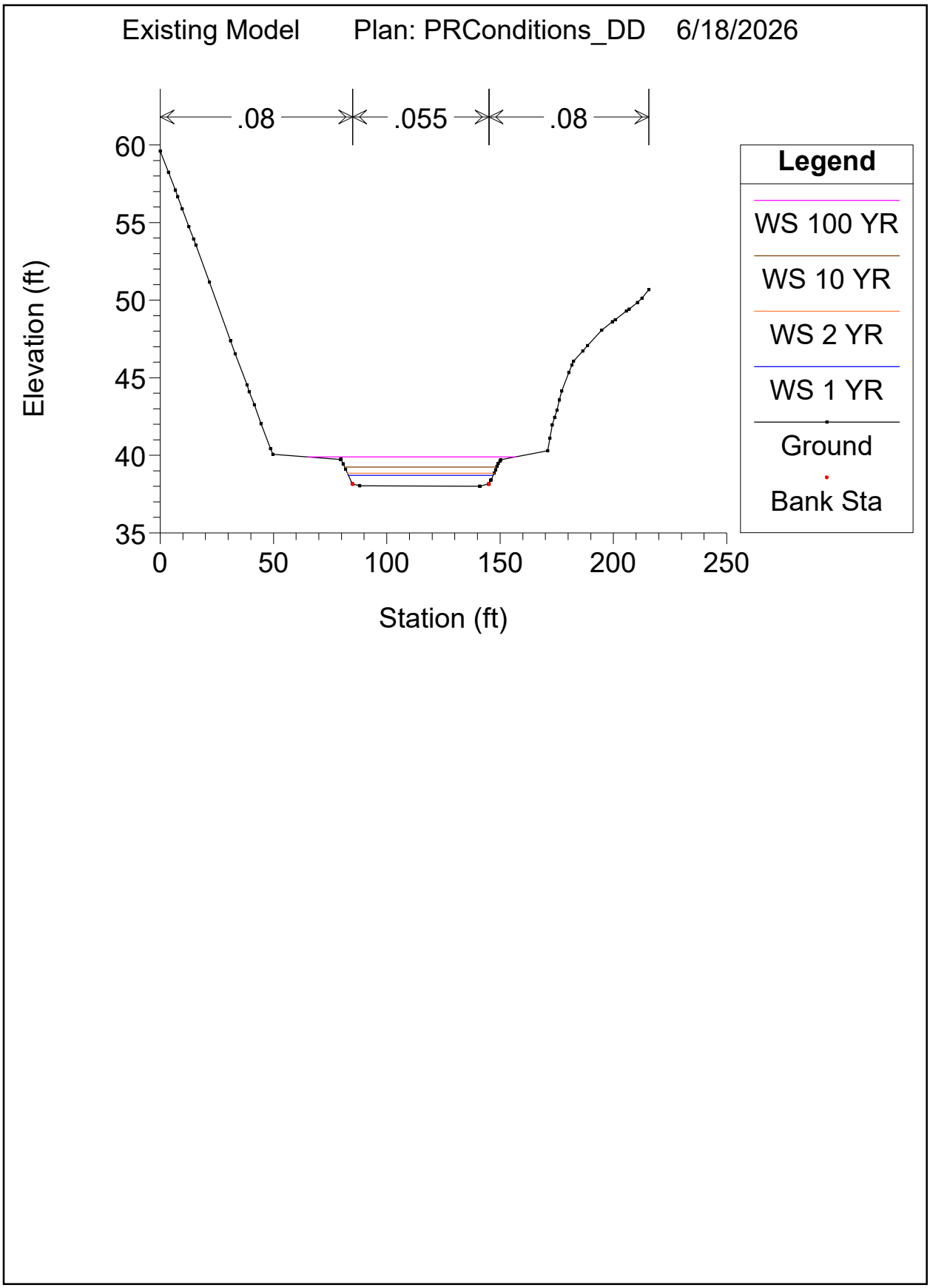
WATERWORKS PROPOSED CONDITIONS CROSS SECTIONS



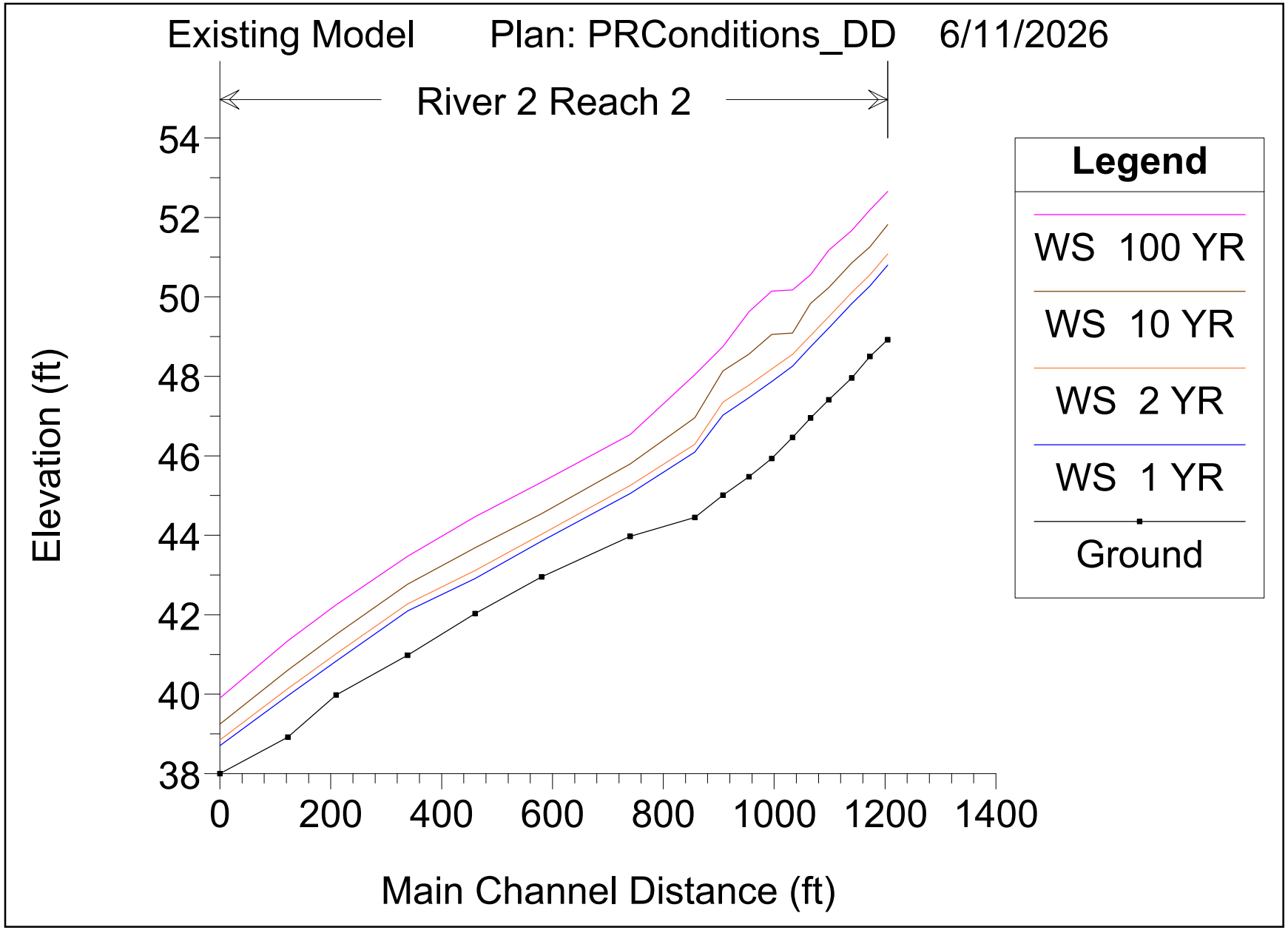
WATERWORKS PROPOSED CONDITIONS CROSS SECTIONS



WATERWORKS PROPOSED CONDITIONS CROSS SECTIONS



WATERWORKS PROPOSED CONDITIONS PROFILE



WATERWORKS EXISTING CONDITIONS OUTPUT (VELOCITY AND SHEAR STRESS)

HEC-RAS Plan: EX River: River 1 Reach: Reach 1

Reach	River Sta	Profile	W.S. Elev	Shear LOB	Shear Chan	Shear ROB	Shear Total	Vel Left	Vel Chnl	Vel Right	Vel Total
			(ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
Reach 1	1886	1 YR	46.84	0.14	0.73	0.10	0.66	0.72	3.90	0.59	3.83
Reach 1	1886	2 YR	47.37	0.18	0.76	0.14	0.65	0.88	4.15	0.77	4.00
Reach 1	1886	10 YR	48.76	0.28	0.95	0.24	0.73	1.24	5.01	1.13	4.57
Reach 1	1886	100 YR	50.74	0.45	1.38	0.40	0.95	1.73	6.49	1.60	5.50
Reach 1	1858	1 YR	46.71		0.58	0.13	0.52		3.58	0.76	3.49
Reach 1	1858	2 YR	47.25	0.02	0.68	0.17	0.59	0.25	4.00	0.91	3.86
Reach 1	1858	10 YR	48.59	0.13	1.03	0.29	0.79	0.73	5.27	1.27	4.90
Reach 1	1858	100 YR	50.39	0.32	1.79	0.53	1.22	1.31	7.38	1.84	6.50
Reach 1	1821	1 YR	46.53	0.14	0.61	0.15	0.48	0.79	3.77	0.83	3.51
Reach 1	1821	2 YR	47.06	0.19	0.74	0.19	0.55	0.99	4.27	0.98	3.88
Reach 1	1821	10 YR	48.35	0.37	1.18	0.33	0.80	1.50	5.74	1.37	4.87
Reach 1	1821	100 YR	50.04	0.75	2.13	0.60	1.32	2.28	8.13	1.97	6.40
Reach 1	1765	1 YR	46.35	0.11	0.52	0.16	0.40	0.70	3.54	0.91	3.23
Reach 1	1765	2 YR	46.87	0.15	0.65	0.21	0.47	0.87	4.08	1.08	3.61
Reach 1	1765	10 YR	48.13	0.30	1.11	0.39	0.74	1.32	5.62	1.57	4.66
Reach 1	1765	100 YR	49.78	0.59	2.02	0.33	0.68	1.98	7.96	1.35	5.12
Reach 1	1729	1 YR	46.22	0.05	0.55	0.18	0.45	0.40	3.55	0.93	3.34
Reach 1	1729	2 YR	46.75	0.10	0.65	0.23	0.50	0.65	3.98	1.11	3.63
Reach 1	1729	10 YR	48.01	0.24	1.01	0.39	0.69	1.15	5.27	1.57	4.42
Reach 1	1729	100 YR	49.67	0.40	1.75	0.49	0.82	1.54	7.32	1.77	5.15
Reach 1	1693	1 YR	46.14	0.19	0.41	0.08	0.31	1.07	3.13	0.58	2.68
Reach 1	1693	2 YR	46.68	0.25	0.50	0.11	0.37	1.25	3.58	0.74	2.96
Reach 1	1693	10 YR	47.93	0.37	0.86	0.24	0.55	1.57	4.93	1.17	3.74
Reach 1	1693	100 YR	49.60	0.61	1.50	0.28	0.72	2.12	6.85	1.27	4.43
Reach 1	1553	1 YR	44.38	0.34	3.15	1.11	2.17	1.05	8.20	2.30	7.31
Reach 1	1553	2 YR	45.06	0.59	2.92	1.13	1.53	1.60	8.25	2.46	6.26
Reach 1	1553	10 YR	46.26	1.32	3.55	1.48	1.91	2.80	9.61	3.02	6.00
Reach 1	1553	100 YR	47.67	2.32	5.12	2.25	2.83	4.02	12.10	3.93	6.76
Reach 1	1502	1 YR	44.52	0.09	0.47	0.10	0.30	0.60	3.33	0.66	2.95
Reach 1	1502	2 YR	45.04	0.12	0.55	0.15	0.34	0.77	3.72	0.89	3.06
Reach 1	1502	10 YR	46.40	0.20	0.76	0.28	0.43	1.08	4.62	1.33	3.26
Reach 1	1502	100 YR	47.81	0.36	1.35	0.57	0.73	1.49	6.43	2.04	4.05
Reach 1	1436	1 YR	43.62	0.30	1.94	0.53	1.33	1.04	6.45	1.53	5.71
Reach 1	1436	2 YR	44.02	0.40	2.33	0.73	1.50	1.27	7.28	1.89	6.08
Reach 1	1436	10 YR	45.07	0.67	3.34	1.28	1.96	1.79	9.24	2.75	6.79
Reach 1	1436	100 YR	46.87	0.73	3.21	0.99	1.26	2.04	9.70	2.50	4.87
Reach 1	1285	1 YR	42.50	0.14	0.73	0.14	0.57	0.74	4.02	0.74	3.81
Reach 1	1285	2 YR	42.89	0.21	0.93	0.22	0.68	0.96	4.66	1.00	4.24
Reach 1	1285	10 YR	43.80	0.36	1.59	0.34	0.80	1.34	6.41	1.30	5.00
Reach 1	1285	100 YR	45.09	0.43	1.56	0.56	0.70	1.60	6.69	1.91	3.51
Reach 1	1126	1 YR	41.41	0.03	0.84	0.09	0.59	0.24	4.18	0.54	3.99
Reach 1	1126	2 YR	41.79	0.09	0.99	0.18	0.58	0.52	4.67	0.85	4.07
Reach 1	1126	10 YR	42.82	0.21	1.21	0.38	0.63	0.97	5.51	1.44	3.83
Reach 1	1126	100 YR	44.05	0.40	1.76	0.52	0.72	1.46	7.00	1.76	3.83
Reach 1	1005	1 YR	40.55	0.11	0.74	0.04	0.58	0.63	3.96	0.31	3.81
Reach 1	1005	2 YR	40.92	0.20	0.93	0.10	0.65	0.91	4.56	0.57	4.18
Reach 1	1005	10 YR	41.76	0.41	1.54	0.16	0.70	1.44	6.20	0.76	4.76
Reach 1	1005	100 YR	42.74	1.03	2.47	0.54	1.10	2.57	8.21	1.67	5.08
Reach 1	883	1 YR	39.64		0.76		0.76		3.83		3.83
Reach 1	883	2 YR	40.00		0.87	0.02	0.81		4.20	0.22	4.20
Reach 1	883	10 YR	40.83	0.03	1.22	0.21	0.59	0.25	5.30	0.92	4.36
Reach 1	883	100 YR	41.90	0.18	1.59	0.56	0.85	0.84	6.43	1.81	4.31
Reach 1	754	1 YR	38.83	0.09	0.60	0.12	0.32	0.55	3.60	0.71	3.11
Reach 1	754	2 YR	39.05	0.13	0.85	0.21	0.39	0.70	4.39	0.95	3.49
Reach 1	754	10 YR	39.63	0.41	1.54	0.50	0.73	1.42	6.13	1.62	4.15
Reach 1	754	100 YR	40.46	0.87	2.59	0.99	1.24	2.26	8.30	2.45	4.85

WATERWORKS EXISTING CONDITIONS OUTPUT (VELOCITY AND SHEAR STRESS)

HEC-RAS Plan: EX River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	W.S. Elev	Shear LOB	Shear Chan	Shear ROB	Shear Total	Vel Left	Vel Chnl	Vel Right	Vel Total
			(ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
Reach 1	666	1 YR	38.53	0.15	0.42	0.10	0.20	0.86	3.02	0.66	1.71
Reach 1	666	2 YR	38.54	0.29	0.79	0.19	0.38	1.19	4.13	0.91	2.33
Reach 1	666	10 YR	39.07	0.58	1.17	0.33	0.66	1.84	5.22	1.26	2.87
Reach 1	666	100 YR	39.74	1.18	2.01	0.64	1.26	2.82	7.13	1.86	3.90
Reach 1	545	1 YR	36.98	0.12	2.33	0.21	1.94	0.51	6.68	0.75	6.57
Reach 1	545	2 YR	37.44	0.34	1.33	0.30	0.48	1.19	5.29	1.10	2.87
Reach 1	545	10 YR	37.87	0.76	1.96	0.47	0.84	1.99	6.64	1.44	3.28
Reach 1	545	100 YR	38.48	1.38	2.71	0.95	1.40	2.92	8.12	2.27	3.91

WATERWORKS PROPOSED CONDITIONS OUTPUT (VELOCITY AND SHEAR STRESS)

HEC-RAS Plan: PR_DD River: River 2 Reach: Reach 2

Reach	River Sta	Profile	W.S. Elev	Shear LOB	Shear Chan	Shear ROB	Shear Total	Vel Left	Vel Chnl	Vel Right	Vel Total
			(ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
Reach 2	1751	1 YR	50.80		0.95		0.95		4.20		4.20
Reach 2	1751	2 YR	51.08		1.13		1.13		4.69		4.69
Reach 2	1751	10 YR	51.82	0.07	1.62	0.12	1.26	0.40	5.94	0.58	5.86
Reach 2	1751	100 YR	52.65	0.84	2.83	0.56	2.06	2.08	8.32	1.58	7.52
Reach 2	1718	1 YR	50.27		1.16		1.16		4.57		4.57
Reach 2	1718	2 YR	50.55		1.33		1.33		5.03		5.03
Reach 2	1718	10 YR	51.26	0.10	1.87	0.05	1.45	0.51	6.30	0.32	6.21
Reach 2	1718	100 YR	52.19	0.92	2.70	0.51	1.50	2.22	8.10	1.51	6.63
Reach 2	1686	1 YR	49.83		0.95		0.95		4.20		4.20
Reach 2	1686	2 YR	50.11		1.13		1.13		4.69		4.69
Reach 2	1686	10 YR	50.85	0.23	1.55	0.09	0.72	0.90	5.79	0.49	5.25
Reach 2	1686	100 YR	51.67	0.83	2.24	0.67	1.26	2.14	7.39	1.85	5.42
Reach 2	1644	1 YR	49.22		1.08		1.08		4.42		4.42
Reach 2	1644	2 YR	49.50		1.24		1.24		4.87		4.87
Reach 2	1644	10 YR	50.24	0.03	1.68	0.09	0.86	0.24	5.97	0.47	5.73
Reach 2	1644	100 YR	51.18	0.69	2.11	0.65	1.20	1.91	7.17	1.84	5.35
Reach 2	1611	1 YR	48.75		1.00		1.00		4.30		4.30
Reach 2	1611	2 YR	49.03		1.18		1.18		4.79		4.79
Reach 2	1611	10 YR	49.83	0.18	1.48	0.16	0.78	0.78	5.69	0.72	5.12
Reach 2	1611	100 YR	50.55	0.86	2.53	0.76	1.54	2.15	7.82	1.98	6.08
Reach 2	1579	1 YR	48.26		1.08		1.08		4.44		4.44
Reach 2	1579	2 YR	48.56		1.22		1.22		4.85		4.85
Reach 2	1579	10 YR	49.09		2.20		2.20		6.76		6.76
Reach 2	1579	100 YR	50.17	0.78	2.25	0.74	1.34	2.05	7.39	1.98	5.54
Reach 2	1541	1 YR	47.87		0.75		0.75		3.78		3.78
Reach 2	1541	2 YR	48.18		0.88		0.88		4.17		4.17
Reach 2	1541	10 YR	49.06	0.45	0.77	0.10	0.57	1.64	4.16	0.60	3.24
Reach 2	1541	100 YR	50.14	0.73	1.10	0.33	0.83	2.27	5.32	1.35	3.96
Reach 2	1500	1 YR	47.46		0.77		0.77		3.82		3.82
Reach 2	1500	2 YR	47.78		0.89		0.89		4.21		4.21
Reach 2	1500	10 YR	48.56	0.19	1.22	0.18	0.74	0.86	5.21	0.81	4.68
Reach 2	1500	100 YR	49.63	0.67	1.64	0.58	1.12	2.00	6.46	1.81	5.12
Reach 2	1453	1 YR	47.02		0.73		0.73		3.73		3.73
Reach 2	1453	2 YR	47.35		0.85		0.85		4.11		4.11
Reach 2	1453	10 YR	48.14	0.22	1.19	0.10	0.77	0.94	5.18	0.57	4.78
Reach 2	1453	100 YR	48.75	0.83	2.54	0.54	1.55	2.11	7.88	1.58	6.52
Reach 2	1402	1 YR	46.09		1.52		1.52		5.17		5.17
Reach 2	1402	2 YR	46.29		1.94		1.94		5.97		5.97
Reach 2	1402	10 YR	46.96		2.61		2.61		7.30		7.30
Reach 2	1402	100 YR	48.04	0.77	2.51	0.83	1.45	1.99	7.76	2.08	5.75
Reach 2	1286	1 YR	45.05	0.15	0.41	0.19	0.34	0.76	2.22	0.91	2.01
Reach 2	1286	2 YR	45.25	0.18	0.51	0.23	0.40	0.87	2.54	1.01	2.24
Reach 2	1286	10 YR	45.79	0.34	0.77	0.39	0.60	1.31	3.31	1.44	2.81
Reach 2	1286	100 YR	46.54	0.49	1.29	0.64	0.88	1.64	4.53	1.95	3.57
Reach 2	1124	1 YR	43.85	0.28	0.51	0.27	0.46	1.10	2.40	1.07	2.22
Reach 2	1124	2 YR	44.03	0.34	0.63	0.34	0.56	1.24	2.74	1.24	2.51
Reach 2	1124	10 YR	44.54	0.47	0.92	0.32	0.66	1.54	3.54	1.21	3.01
Reach 2	1124	100 YR	45.33	0.47	1.21	0.65	0.89	1.60	4.34	1.98	3.48
Reach 2	1005	1 YR	42.91	0.20	0.38	0.22	0.36	0.92	2.05	0.97	1.98
Reach 2	1005	2 YR	43.11	0.23	0.44	0.24	0.41	1.03	2.29	1.06	2.21
Reach 2	1005	10 YR	43.68	0.30	0.61	0.30	0.56	1.25	2.91	1.23	2.75
Reach 2	1005	100 YR	44.46	0.42	0.98	0.39	0.80	1.54	3.93	1.45	3.54
Reach 2	881	1 YR	42.09	0.20	0.44	0.16	0.35	0.93	2.31	0.81	2.06
Reach 2	881	2 YR	42.27	0.26	0.57	0.22	0.45	1.08	2.69	0.99	2.35
Reach 2	881	10 YR	42.77	0.31	0.95	0.40	0.63	1.20	3.67	1.41	2.97
Reach 2	881	100 YR	43.47	0.74	1.46	0.57	0.97	2.10	4.81	1.76	3.64

WATERWORKS PROPOSED CONDITIONS OUTPUT (VELOCITY AND SHEAR STRESS)

HEC-RAS Plan: PR_DD River: River 2 Reach: Reach 2 (Continued)

Reach	River Sta	Profile	W.S. Elev	Shear LOB	Shear Chan	Shear ROB	Shear Total	Vel Left	Vel Chnl	Vel Right	Vel Total
			(ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)	(ft/s)	(ft/s)
Reach 2	756	1 YR	40.83	0.26	0.84	0.26	0.58	0.97	3.04	0.96	2.61
Reach 2	756	2 YR	41.01	0.37	0.91	0.39	0.66	1.23	3.27	1.27	2.73
Reach 2	756	10 YR	41.50	0.60	1.17	0.68	0.90	1.74	3.96	1.89	3.20
Reach 2	756	100 YR	42.25	1.00	1.60	1.06	1.30	2.49	4.96	2.59	3.94
Reach 2	668	1 YR	39.96	0.06	0.42	0.20	0.31	0.40	2.22	0.91	2.06
Reach 2	668	2 YR	40.14	0.14	0.52	0.13	0.34	0.71	2.53	0.68	2.21
Reach 2	668	10 YR	40.60	0.35	0.77	0.35	0.57	1.31	3.26	1.31	2.71
Reach 2	668	100 YR	41.34	0.65	1.14	0.68	0.91	2.00	4.22	2.05	3.44
Reach 2	546	1 YR	38.70	0.28	0.67	0.26	0.65	1.01	2.62	0.95	2.58
Reach 2	546	2 YR	38.85	0.35	0.81	0.33	0.78	1.17	2.98	1.12	2.92
Reach 2	546	10 YR	39.25	0.55	1.21	0.54	1.14	1.57	3.89	1.55	3.77
Reach 2	546	100 YR	39.90	0.31	1.86	0.45	1.34	1.07	5.18	1.38	4.81

WATERWORKS EXISTING CONDITIONS OUTPUT (STANDARD TABLE 1)

HEC-RAS Plan: EX River: River 1 Reach: Reach 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	1886	1 YR	107.00	44.65	46.84	46.19	47.08	0.006912	3.90	27.94	16.66	0.51
Reach 1	1886	2 YR	148.00	44.65	47.37	46.47	47.64	0.005554	4.15	37.04	17.73	0.48
Reach 1	1886	10 YR	291.00	44.65	48.76	47.29	49.14	0.004354	5.01	63.62	20.55	0.46
Reach 1	1886	100 YR	596.00	44.65	50.74	48.66	51.36	0.004129	6.49	108.29	24.69	0.48
Reach 1	1858	1 YR	107.00	44.02	46.71		46.91	0.004520	3.58	30.65	14.09	0.42
Reach 1	1858	2 YR	148.00	44.02	47.25		47.49	0.004351	4.00	38.35	14.78	0.42
Reach 1	1858	10 YR	291.00	44.02	48.59		49.01	0.004495	5.27	59.35	16.55	0.46
Reach 1	1858	100 YR	596.00	44.02	50.39		51.20	0.005465	7.38	91.72	19.44	0.53
Reach 1	1821	1 YR	107.00	43.50	46.53	45.42	46.75	0.004092	3.77	30.44	14.22	0.42
Reach 1	1821	2 YR	148.00	43.50	47.06	45.78	47.33	0.004106	4.27	38.19	15.32	0.43
Reach 1	1821	10 YR	291.00	43.50	48.35	46.80	48.83	0.004633	5.74	59.76	17.96	0.48
Reach 1	1821	100 YR	596.00	43.50	50.04	48.45	50.98	0.006027	8.13	93.07	21.52	0.58
Reach 1	1765	1 YR	107.00	43.00	46.35	45.05	46.54	0.003177	3.54	33.13	14.59	0.37
Reach 1	1765	2 YR	148.00	43.00	46.87	45.41	47.12	0.003352	4.08	41.01	15.73	0.40
Reach 1	1765	10 YR	291.00	43.00	48.13	46.44	48.59	0.004145	5.62	62.50	18.48	0.46
Reach 1	1765	100 YR	596.00	43.00	49.78	48.11	50.64	0.005516	7.96	116.39	53.26	0.56
Reach 1	1729	1 YR	107.00	43.00	46.22		46.41	0.003914	3.55	32.06	15.76	0.40
Reach 1	1729	2 YR	148.00	43.00	46.75		46.99	0.003798	3.98	40.82	17.53	0.41
Reach 1	1729	10 YR	291.00	43.00	48.01		48.42	0.004142	5.27	65.82	22.11	0.45
Reach 1	1729	100 YR	596.00	43.00	49.67		50.41	0.005137	7.32	115.82	42.34	0.53
Reach 1	1693	1 YR	107.00	42.44	46.14		46.29	0.002529	3.13	39.98	18.15	0.33
Reach 1	1693	2 YR	148.00	42.44	46.68		46.86	0.002629	3.58	50.02	19.64	0.34
Reach 1	1693	10 YR	291.00	42.44	47.93		48.26	0.003287	4.93	77.83	25.59	0.40
Reach 1	1693	100 YR	596.00	42.44	49.60		50.20	0.004218	6.85	134.53	45.89	0.48
Reach 1	1553	1 YR	107.00	41.56	44.38	44.38	45.39	0.027472	8.20	14.64	9.35	0.94
Reach 1	1553	2 YR	148.00	41.56	45.06	45.06	46.02	0.019807	8.25	23.64	16.66	0.84
Reach 1	1553	10 YR	291.00	41.56	46.26	46.26	47.36	0.017209	9.61	48.53	24.17	0.82
Reach 1	1553	100 YR	596.00	41.56	47.67	47.67	49.16	0.018621	12.10	88.22	32.43	0.90
Reach 1	1502	1 YR	107.00	41.10	44.52	43.18	44.69	0.003075	3.33	36.33	21.19	0.36
Reach 1	1502	2 YR	148.00	41.10	45.04	43.54	45.25	0.003038	3.72	48.42	24.99	0.36
Reach 1	1502	10 YR	291.00	41.10	46.40	44.62	46.69	0.002933	4.62	89.25	35.22	0.38
Reach 1	1502	100 YR	596.00	41.10	47.81	46.11	48.31	0.003977	6.43	147.05	46.79	0.46
Reach 1	1436	1 YR	107.00	40.93	43.62	43.39	44.25	0.016730	6.45	18.75	12.92	0.79
Reach 1	1436	2 YR	148.00	40.93	44.02	43.83	44.80	0.016872	7.28	24.35	15.02	0.81
Reach 1	1436	10 YR	291.00	40.93	45.07	44.98	46.22	0.017004	9.24	42.88	20.37	0.86
Reach 1	1436	100 YR	596.00	40.93	46.87	46.87	47.87	0.010851	9.70	122.37	61.66	0.74
Reach 1	1285	1 YR	107.00	39.73	42.50	41.69	42.75	0.005788	4.02	28.09	16.56	0.48
Reach 1	1285	2 YR	148.00	39.73	42.89	42.02	43.22	0.006215	4.66	34.88	18.62	0.52
Reach 1	1285	10 YR	291.00	39.73	43.80	43.00	44.40	0.007837	6.41	58.19	33.96	0.61
Reach 1	1285	100 YR	596.00	39.73	45.09	44.54	45.56	0.005587	6.69	169.71	81.18	0.54
Reach 1	1126	1 YR	107.00	38.70	41.41		41.68	0.007989	4.18	26.78	21.01	0.54
Reach 1	1126	2 YR	148.00	38.70	41.79		42.12	0.007783	4.67	36.32	28.87	0.55
Reach 1	1126	10 YR	291.00	38.70	42.82		43.22	0.006554	5.51	76.04	47.38	0.54
Reach 1	1126	100 YR	596.00	38.70	44.05		44.61	0.006908	7.00	155.69	90.44	0.58
Reach 1	1005	1 YR	107.00	38.00	40.55		40.80	0.006532	3.96	28.09	18.47	0.50
Reach 1	1005	2 YR	148.00	38.00	40.92		41.23	0.006923	4.56	35.39	21.90	0.53
Reach 1	1005	10 YR	291.00	38.00	41.76	41.06	42.31	0.008446	6.20	61.20	44.54	0.61
Reach 1	1005	100 YR	596.00	38.00	42.74	42.60	43.58	0.010365	8.21	117.23	66.90	0.71
Reach 1	883	1 YR	107.00	37.40	39.64		39.87	0.008910	3.83	27.92	19.17	0.56
Reach 1	883	2 YR	148.00	37.40	40.00		40.28	0.008705	4.20	35.27	22.11	0.57
Reach 1	883	10 YR	291.00	37.40	40.83	40.15	41.25	0.008533	5.30	66.72	57.70	0.59
Reach 1	883	100 YR	596.00	37.40	41.90		42.43	0.007785	6.43	138.35	76.04	0.60
Reach 1	754	1 YR	107.00	36.63	38.83		39.03	0.004929	3.60	34.43	32.65	0.45
Reach 1	754	2 YR	148.00	36.63	39.05		39.33	0.006368	4.39	42.36	42.95	0.52
Reach 1	754	10 YR	291.00	36.63	39.63	39.33	40.14	0.009056	6.13	70.15	53.65	0.65
Reach 1	754	100 YR	596.00	36.63	40.46	40.36	41.26	0.011749	8.30	122.82	71.76	0.77
Reach 1	666	1 YR	107.00	35.98	38.53	37.89	38.63	0.003632	3.02	62.75	69.68	0.38
Reach 1	666	2 YR	148.00	35.98	38.54	38.29	38.73	0.006734	4.13	63.57	69.76	0.52
Reach 1	666	10 YR	291.00	35.98	39.07	38.73	39.33	0.007793	5.22	101.54	73.76	0.59
Reach 1	666	100 YR	596.00	35.98	39.74	39.35	40.19	0.010549	7.13	152.95	79.07	0.71
Reach 1	545	1 YR	107.00	35.17	36.98	36.98	37.68	0.028465	6.68	16.29	14.07	0.99

WATERWORKS EXISTING CONDITIONS OUTPUT (STANDARD TABLE 1)

HEC-RAS Plan: EX River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	545	2 YR	148.00	35.17	37.44	37.44	37.78	0.012208	5.29	51.51	80.85	0.68
Reach 1	545	10 YR	291.00	35.17	37.87	37.87	38.30	0.014649	6.64	88.74	95.79	0.77
Reach 1	545	100 YR	596.00	35.17	38.48	38.43	39.01	0.016005	8.12	152.36	107.69	0.84

WATERWORKS PROPOSED CONDITIONS OUTPUT (STANDARD TABLE 1)

HEC-RAS Plan: PR_DD River: River 2 Reach: Reach 2

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 2	1751	1 YR	107.00	48.92	50.80	50.47	51.07	0.012818	4.20	25.46	20.92	0.67
Reach 2	1751	2 YR	148.00	48.92	51.08	50.73	51.42	0.013084	4.69	31.53	22.20	0.69
Reach 2	1751	10 YR	291.00	48.92	51.82	51.43	52.36	0.013385	5.94	49.66	32.19	0.74
Reach 2	1751	100 YR	596.00	48.92	52.65	52.53	53.70	0.016481	8.32	79.24	38.40	0.87
Reach 2	1718	1 YR	107.00	48.50	50.27		50.60	0.016713	4.57	23.40	20.70	0.76
Reach 2	1718	2 YR	148.00	48.50	50.55		50.95	0.016355	5.03	29.40	22.07	0.77
Reach 2	1718	10 YR	291.00	48.50	51.26	51.01	51.88	0.016575	6.30	46.84	32.64	0.81
Reach 2	1718	100 YR	596.00	48.50	52.19	52.19	53.15	0.015995	8.10	89.87	58.26	0.86
Reach 2	1686	1 YR	107.00	47.96	49.83	49.53	50.11	0.012873	4.20	25.50	21.06	0.67
Reach 2	1686	2 YR	148.00	47.96	50.11	49.77	50.45	0.013189	4.69	31.58	22.42	0.70
Reach 2	1686	10 YR	291.00	47.96	50.85	50.47	51.37	0.013014	5.79	55.46	61.88	0.73
Reach 2	1686	100 YR	596.00	47.96	51.67	51.57	52.42	0.013331	7.39	109.99	71.58	0.78
Reach 2	1644	1 YR	107.00	47.41	49.22	48.97	49.52	0.015452	4.42	24.20	21.26	0.73
Reach 2	1644	2 YR	148.00	47.41	49.50	49.22	49.87	0.015093	4.87	30.40	22.63	0.74
Reach 2	1644	10 YR	291.00	47.41	50.24	49.92	50.79	0.014896	5.97	50.81	54.47	0.77
Reach 2	1644	100 YR	596.00	47.41	51.18	51.02	51.89	0.012402	7.17	111.51	70.70	0.76
Reach 2	1611	1 YR	107.00	46.95	48.75		49.03	0.013721	4.30	24.88	20.81	0.69
Reach 2	1611	2 YR	148.00	46.95	49.03		49.38	0.013949	4.79	30.92	22.21	0.72
Reach 2	1611	10 YR	291.00	46.95	49.83	49.41	50.33	0.012150	5.69	56.88	54.68	0.71
Reach 2	1611	100 YR	596.00	46.95	50.55	50.51	51.41	0.015274	7.82	98.09	59.61	0.83
Reach 2	1579	1 YR	107.00	46.46	48.26		48.56	0.015321	4.44	24.08	20.86	0.73
Reach 2	1579	2 YR	148.00	46.46	48.56		48.92	0.014563	4.85	30.53	22.24	0.73
Reach 2	1579	10 YR	291.00	46.46	49.09	48.95	49.80	0.021009	6.76	43.03	24.89	0.91
Reach 2	1579	100 YR	596.00	46.46	50.17	50.05	50.92	0.013350	7.39	107.52	65.13	0.78
Reach 2	1541	1 YR	107.00	45.93	47.87	47.42	48.09	0.009512	3.78	28.33	30.85	0.58
Reach 2	1541	2 YR	148.00	45.93	48.18	47.68	48.45	0.009578	4.17	35.48	39.87	0.60
Reach 2	1541	10 YR	291.00	45.93	49.06	48.37	49.28	0.005710	4.16	89.69	53.62	0.49
Reach 2	1541	100 YR	596.00	45.93	50.14	49.11	50.50	0.005474	5.32	150.67	59.15	0.52
Reach 2	1500	1 YR	107.00	45.47	47.46		47.69	0.009888	3.82	28.01	21.84	0.59
Reach 2	1500	2 YR	148.00	45.47	47.78		48.06	0.009734	4.21	35.11	23.25	0.60
Reach 2	1500	10 YR	291.00	45.47	48.56		48.97	0.009429	5.21	62.12	48.82	0.63
Reach 2	1500	100 YR	596.00	45.47	49.63		50.21	0.008444	6.46	116.51	53.57	0.64
Reach 2	1453	1 YR	107.00	45.01	47.02		47.24	0.009155	3.73	28.65	21.79	0.57
Reach 2	1453	2 YR	148.00	45.01	47.35		47.61	0.009027	4.11	35.98	23.32	0.58
Reach 2	1453	10 YR	291.00	45.01	48.14	47.51	48.55	0.008837	5.18	60.87	42.89	0.61
Reach 2	1453	100 YR	596.00	45.01	48.75	48.66	49.66	0.014778	7.88	91.45	53.44	0.83
Reach 2	1402	1 YR	107.00	44.45	46.09	46.01	46.51	0.024054	5.17	20.69	20.07	0.90
Reach 2	1402	2 YR	148.00	44.45	46.29	46.26	46.84	0.026934	5.97	24.80	21.06	0.97
Reach 2	1402	10 YR	291.00	44.45	46.96	46.96	47.79	0.026054	7.30	39.86	24.19	1.00
Reach 2	1402	100 YR	596.00	44.45	48.04	48.04	48.87	0.015595	7.76	103.71	68.55	0.84
Reach 2	1286	1 YR	107.00	43.97	45.05		45.12	0.006266	2.22	53.16	60.82	0.38
Reach 2	1286	2 YR	148.00	43.97	45.25		45.35	0.006454	2.54	66.21	66.89	0.40
Reach 2	1286	10 YR	291.00	43.97	45.79	45.08	45.95	0.006853	3.31	103.64	73.88	0.43
Reach 2	1286	100 YR	596.00	43.97	46.54	45.68	46.81	0.008097	4.53	166.92	94.97	0.50
Reach 2	1124	1 YR	107.00	42.95	43.85		43.94	0.009244	2.40	48.19	60.64	0.45
Reach 2	1124	2 YR	148.00	42.95	44.03		44.14	0.009548	2.74	58.87	62.78	0.47
Reach 2	1124	10 YR	291.00	42.95	44.54		44.72	0.009380	3.54	96.63	85.08	0.50
Reach 2	1124	100 YR	596.00	42.95	45.33		45.58	0.008176	4.34	171.25	97.44	0.50
Reach 2	1005	1 YR	107.00	42.03	42.91		42.98	0.006898	2.05	53.92	64.47	0.39
Reach 2	1005	2 YR	148.00	42.03	43.11		43.19	0.006516	2.29	67.11	65.65	0.39
Reach 2	1005	10 YR	291.00	42.03	43.68		43.81	0.005975	2.91	105.65	70.00	0.40
Reach 2	1005	100 YR	596.00	42.03	44.46		44.69	0.006498	3.93	168.53	84.97	0.44
Reach 2	881	1 YR	107.00	40.98	42.09		42.17	0.006416	2.31	51.93	58.87	0.39
Reach 2	881	2 YR	148.00	40.98	42.27		42.38	0.007145	2.69	62.85	62.82	0.42
Reach 2	881	10 YR	291.00	40.98	42.77		42.95	0.008603	3.67	98.00	83.89	0.49
Reach 2	881	100 YR	596.00	40.98	43.47		43.77	0.009463	4.81	163.81	99.51	0.54
Reach 2	756	1 YR	107.00	39.98	40.83		40.96	0.016040	3.04	40.95	70.79	0.59
Reach 2	756	2 YR	148.00	39.98	41.01		41.16	0.014187	3.27	54.27	72.81	0.57
Reach 2	756	10 YR	291.00	39.98	41.50		41.71	0.012414	3.96	91.03	78.11	0.57
Reach 2	756	100 YR	596.00	39.98	42.25		42.56	0.011350	4.96	151.32	81.96	0.58
Reach 2	668	1 YR	107.00	38.92	39.96		40.03	0.006847	2.22	51.84	70.40	0.39

WATERWORKS PROPOSED CONDITIONS OUTPUT (STANDARD TABLE 1)

HEC-RAS Plan: PR_DD River: River 2 Reach: Reach 2 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 2	668	2 YR	148.00	38.92	40.14		40.24	0.007142	2.53	66.92	86.69	0.41
Reach 2	668	10 YR	291.00	38.92	40.60		40.75	0.007611	3.26	107.27	88.28	0.45
Reach 2	668	100 YR	596.00	38.92	41.34		41.57	0.007713	4.22	173.37	90.73	0.48
Reach 2	546	1 YR	107.00	38.00	38.70	38.49	38.81	0.016004	2.62	41.48	63.90	0.56
Reach 2	546	2 YR	148.00	38.00	38.85	38.60	38.98	0.016022	2.98	50.65	64.78	0.58
Reach 2	546	10 YR	291.00	38.00	39.25	38.92	39.48	0.016009	3.89	77.10	67.09	0.62
Reach 2	546	100 YR	596.00	38.00	39.90	39.46	40.31	0.016004	5.18	123.91	91.76	0.67

WATERWORKS EXISTING CONDITIONS OUTPUT (STANDARD TABLE 2)

HEC-RAS Plan: EX River: River 1 Reach: Reach 1

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Reach 1	1886	1 YR	47.08	46.84	0.24	0.16	0.01	0.28	106.59	0.13	16.66
Reach 1	1886	2 YR	47.64	47.37	0.27	0.14	0.01	0.92	146.55	0.53	17.73
Reach 1	1886	10 YR	49.14	48.76	0.38	0.13	0.00	5.13	282.26	3.60	20.55
Reach 1	1886	100 YR	51.36	50.74	0.62	0.14	0.02	20.98	559.17	15.86	24.69
Reach 1	1858	1 YR	46.91	46.71	0.20	0.16	0.00		106.29	0.71	14.09
Reach 1	1858	2 YR	47.49	47.25	0.25	0.16	0.00	0.01	146.48	1.51	14.78
Reach 1	1858	10 YR	49.01	48.59	0.42	0.17	0.01	0.65	284.82	5.53	16.55
Reach 1	1858	100 YR	51.20	50.39	0.81	0.21	0.01	5.31	572.00	18.69	19.44
Reach 1	1821	1 YR	46.75	46.53	0.22	0.20	0.01	1.00	104.90	1.10	14.22
Reach 1	1821	2 YR	47.33	47.06	0.28	0.20	0.01	2.43	143.45	2.12	15.32
Reach 1	1821	10 YR	48.83	48.35	0.48	0.24	0.01	10.53	273.54	6.93	17.96
Reach 1	1821	100 YR	50.98	50.04	0.94	0.32	0.02	37.40	537.95	20.65	21.52
Reach 1	1765	1 YR	46.54	46.35	0.19	0.13	0.00	0.83	103.74	2.42	14.59
Reach 1	1765	2 YR	47.12	46.87	0.25	0.13	0.00	1.81	141.64	4.54	15.73
Reach 1	1765	10 YR	48.59	48.13	0.46	0.15	0.02	6.99	269.45	14.56	18.48
Reach 1	1765	100 YR	50.64	49.78	0.86	0.19	0.04	23.29	519.49	53.22	53.26
Reach 1	1729	1 YR	46.41	46.22	0.19	0.11	0.02	0.08	104.70	2.22	15.76
Reach 1	1729	2 YR	46.99	46.75	0.24	0.11	0.02	0.56	142.90	4.54	17.53
Reach 1	1729	10 YR	48.42	48.01	0.40	0.13	0.02	5.17	269.97	15.86	22.11
Reach 1	1729	100 YR	50.41	49.67	0.74	0.17	0.04	31.35	521.83	42.82	42.34
Reach 1	1693	1 YR	46.29	46.14	0.14	0.81	0.09	8.23	98.21	0.56	18.15
Reach 1	1693	2 YR	46.86	46.68	0.18	0.76	0.08	13.78	132.82	1.40	19.64
Reach 1	1693	10 YR	48.26	47.93	0.33	0.82	0.08	34.03	250.66	6.31	25.59
Reach 1	1693	100 YR	50.20	49.60	0.59	0.95	0.09	99.08	473.17	23.75	45.89
Reach 1	1553	1 YR	45.39	44.38	1.01	0.35	0.25	0.44	102.64	3.92	9.35
Reach 1	1553	2 YR	46.02	45.06	0.96	0.32	0.23	6.63	133.10	8.27	16.66
Reach 1	1553	10 YR	47.36	46.26	1.10	0.30	0.25	51.34	216.51	23.15	24.17
Reach 1	1553	100 YR	49.16	47.67	1.48	0.37	0.30	174.61	363.33	58.06	32.43
Reach 1	1502	1 YR	44.69	44.52	0.17	0.40	0.05	0.48	103.60	2.92	21.19
Reach 1	1502	2 YR	45.25	45.04	0.20	0.39	0.06	1.25	138.12	8.62	24.99
Reach 1	1502	10 YR	46.69	46.40	0.28	0.38	0.09	5.41	243.82	41.77	35.22
Reach 1	1502	100 YR	48.31	47.81	0.49	0.38	0.05	17.77	443.63	134.60	46.79
Reach 1	1436	1 YR	44.25	43.62	0.62	1.38	0.11	0.40	102.90	3.70	12.92
Reach 1	1436	2 YR	44.80	44.02	0.77	1.45	0.13	0.88	138.28	8.85	15.02
Reach 1	1436	10 YR	46.22	45.07	1.15	1.66	0.17	3.42	249.11	38.47	20.37
Reach 1	1436	100 YR	47.87	46.87	1.00	1.12	0.16	11.28	394.33	190.39	61.66
Reach 1	1285	1 YR	42.75	42.50	0.25	1.07	0.00	0.45	105.64	0.91	16.56
Reach 1	1285	2 YR	43.22	42.89	0.33	1.10	0.00	1.14	144.11	2.74	18.62
Reach 1	1285	10 YR	44.40	43.80	0.59	1.12	0.06	5.79	269.86	15.36	33.96
Reach 1	1285	100 YR	45.56	45.09	0.47	0.94	0.01	22.99	386.81	186.20	81.18
Reach 1	1126	1 YR	41.68	41.41	0.27	0.87	0.01	0.00	106.28	0.72	21.01
Reach 1	1126	2 YR	42.12	41.79	0.33	0.89	0.00	0.07	143.22	4.71	28.87
Reach 1	1126	10 YR	43.22	42.82	0.40	0.89	0.01	1.05	246.49	43.46	47.38
Reach 1	1126	100 YR	44.61	44.05	0.57	1.01	0.03	4.94	431.46	159.60	90.44
Reach 1	1005	1 YR	40.80	40.55	0.24	0.92	0.00	0.79	106.20	0.01	18.47
Reach 1	1005	2 YR	41.23	40.92	0.32	0.94	0.01	3.15	144.73	0.12	21.90
Reach 1	1005	10 YR	42.31	41.76	0.55	1.02	0.04	20.19	267.82	2.99	44.54
Reach 1	1005	100 YR	43.58	42.74	0.84	1.05	0.09	84.86	464.82	46.33	66.90
Reach 1	883	1 YR	39.87	39.64	0.23	0.83	0.01		107.00		19.17
Reach 1	883	2 YR	40.28	40.00	0.27	0.95	0.00		147.99	0.01	22.11
Reach 1	883	10 YR	41.25	40.83	0.42	1.10	0.01	0.00	277.90	13.10	57.70
Reach 1	883	100 YR	42.43	41.90	0.53	1.15	0.03	0.48	482.08	113.44	76.04
Reach 1	754	1 YR	39.03	38.83	0.20	0.37	0.03	2.17	103.57	1.26	32.65
Reach 1	754	2 YR	39.33	39.05	0.28	0.57	0.03	5.42	139.91	2.66	42.95
Reach 1	754	10 YR	40.14	39.63	0.50	0.73	0.07	33.48	247.42	10.10	53.65

WATERWORKS EXISTING CONDITIONS OUTPUT (STANDARD TABLE 2)

HEC-RAS Plan: EX River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Reach 1	754	100 YR	41.26	40.46	0.80	0.97	0.11	131.04	434.19	30.78	71.76
Reach 1	666	1 YR	38.63	38.53	0.10	0.89	0.06	31.65	74.33	1.02	69.68
Reach 1	666	2 YR	38.73	38.54	0.19	0.94	0.01	44.32	102.24	1.44	69.76
Reach 1	666	10 YR	39.33	39.07	0.26	1.02	0.02	121.45	164.62	4.92	73.76
Reach 1	666	100 YR	40.19	39.74	0.44	1.17	0.01	293.39	286.38	16.22	79.07
Reach 1	545	1 YR	37.68	36.98	0.69			0.01	106.78	0.21	14.07
Reach 1	545	2 YR	37.78	37.44	0.33			30.32	112.32	5.37	80.85
Reach 1	545	10 YR	38.30	37.87	0.43			99.98	173.12	17.90	95.79
Reach 1	545	100 YR	39.01	38.48	0.53			256.16	268.20	71.64	107.69

WATERWORKS PROPOSED CONDITIONS OUTPUT (STANDARD TABLE 2)

HEC-RAS Plan: PR_DD River: River 2 Reach: Reach 2

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Reach 2	1751	1 YR	51.07	50.80	0.27	0.47	0.01		107.00		20.92
Reach 2	1751	2 YR	51.42	51.08	0.34	0.47	0.01		148.00		22.20
Reach 2	1751	10 YR	52.36	51.82	0.55	0.48	0.01	0.20	290.68	0.12	32.19
Reach 2	1751	100 YR	53.70	52.65	1.04	0.52	0.02	12.72	577.40	5.87	38.40
Reach 2	1718	1 YR	50.60	50.27	0.32	0.48	0.02		107.00		20.70
Reach 2	1718	2 YR	50.95	50.55	0.39	0.48	0.02		148.00		22.07
Reach 2	1718	10 YR	51.88	51.26	0.62	0.48	0.03	0.36	290.63	0.01	32.64
Reach 2	1718	100 YR	53.15	52.19	0.96	0.48	0.06	16.76	559.22	20.02	58.26
Reach 2	1686	1 YR	50.11	49.83	0.27	0.58	0.00		107.00		21.06
Reach 2	1686	2 YR	50.45	50.11	0.34	0.58	0.00		148.00		22.42
Reach 2	1686	10 YR	51.37	50.85	0.51	0.57	0.00	2.70	286.89	1.40	61.88
Reach 2	1686	100 YR	52.42	51.67	0.75	0.52	0.01	26.30	518.99	50.71	71.58
Reach 2	1644	1 YR	49.52	49.22	0.30	0.48	0.00		107.00		21.26
Reach 2	1644	2 YR	49.87	49.50	0.37	0.48	0.00		148.00		22.63
Reach 2	1644	10 YR	50.79	50.24	0.55	0.45	0.02	0.06	289.99	0.95	54.47
Reach 2	1644	100 YR	51.89	51.18	0.71	0.46	0.02	17.27	524.88	53.86	70.70
Reach 2	1611	1 YR	49.03	48.75	0.29	0.47	0.00		107.00		20.81
Reach 2	1611	2 YR	49.38	49.03	0.36	0.46	0.00		148.00		22.21
Reach 2	1611	10 YR	50.33	49.83	0.49	0.51	0.02	2.59	286.06	2.35	54.68
Reach 2	1611	100 YR	51.41	50.55	0.86	0.46	0.03	29.57	534.77	31.66	59.61
Reach 2	1579	1 YR	48.56	48.26	0.31	0.45	0.03		107.00		20.86
Reach 2	1579	2 YR	48.92	48.56	0.37	0.44	0.03		148.00		22.24
Reach 2	1579	10 YR	49.80	49.09	0.71	0.37	0.14		291.00		24.89
Reach 2	1579	100 YR	50.92	50.17	0.75	0.30	0.12	42.47	521.49	32.04	65.13
Reach 2	1541	1 YR	48.09	47.87	0.22	0.40	0.00		107.00		30.85
Reach 2	1541	2 YR	48.45	48.18	0.27	0.40	0.00		148.00		39.87
Reach 2	1541	10 YR	49.28	49.06	0.23	0.29	0.02	50.27	239.89	0.84	53.62
Reach 2	1541	100 YR	50.50	50.14	0.35	0.27	0.02	126.10	457.66	12.24	59.15
Reach 2	1500	1 YR	47.69	47.46	0.23	0.45	0.00		107.00		21.84
Reach 2	1500	2 YR	48.06	47.78	0.28	0.44	0.00		148.00		23.25
Reach 2	1500	10 YR	48.97	48.56	0.41	0.43	0.00	4.73	284.61	1.65	48.82
Reach 2	1500	100 YR	50.21	49.63	0.58	0.52	0.03	49.43	528.52	18.04	53.57
Reach 2	1453	1 YR	47.24	47.02	0.22	0.71	0.02		107.00		21.79
Reach 2	1453	2 YR	47.61	47.35	0.26	0.74	0.03		148.00		23.32
Reach 2	1453	10 YR	48.55	48.14	0.41	0.72	0.04	3.92	286.30	0.78	42.89
Reach 2	1453	100 YR	49.66	48.75	0.91	0.77	0.02	23.63	557.27	15.10	53.44
Reach 2	1402	1 YR	46.51	46.09	0.42	1.28	0.10		107.00		20.07
Reach 2	1402	2 YR	46.84	46.29	0.55	1.36	0.14		148.00		21.06
Reach 2	1402	10 YR	47.79	46.96	0.83	1.40	0.20		291.00		24.19
Reach 2	1402	100 YR	48.87	48.04	0.83	1.29	0.17	17.96	520.45	57.59	68.55
Reach 2	1286	1 YR	45.12	45.05	0.07	1.18	0.00	2.17	99.93	4.90	60.82
Reach 2	1286	2 YR	45.35	45.25	0.09	1.21	0.00	4.08	135.81	8.11	66.89
Reach 2	1286	10 YR	45.95	45.79	0.15	1.22	0.00	14.37	253.16	23.48	73.88
Reach 2	1286	100 YR	46.81	46.54	0.27	1.22	0.01	42.67	489.00	64.33	94.97
Reach 2	1124	1 YR	43.94	43.85	0.08	0.96	0.01	1.70	100.00	5.30	60.64
Reach 2	1124	2 YR	44.14	44.03	0.11	0.94	0.01	2.64	136.80	8.55	62.78
Reach 2	1124	10 YR	44.72	44.54	0.18	0.89	0.02	6.79	262.13	22.08	85.08
Reach 2	1124	100 YR	45.58	45.33	0.25	0.88	0.01	23.67	482.86	89.47	97.44
Reach 2	1005	1 YR	42.98	42.91	0.06	0.80	0.00	1.37	104.08	1.55	64.47
Reach 2	1005	2 YR	43.19	43.11	0.08	0.82	0.00	2.23	143.36	2.41	65.65
Reach 2	1005	10 YR	43.81	43.68	0.13	0.85	0.01	6.00	278.88	6.12	70.00
Reach 2	1005	100 YR	44.69	44.46	0.23	0.91	0.01	20.31	555.43	20.26	84.97
Reach 2	881	1 YR	42.17	42.09	0.08	1.21	0.01	4.75	99.21	3.03	58.87
Reach 2	881	2 YR	42.38	42.27	0.10	1.21	0.00	7.78	134.69	5.52	62.82
Reach 2	881	10 YR	42.95	42.77	0.19	1.24	0.00	19.57	254.00	17.43	83.89

WATERWORKS PROPOSED CONDITIONS OUTPUT (STANDARD TABLE 2)

HEC-RAS Plan: PR_DD River: River 2 Reach: Reach 2 (Continued)

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Reach 2	881	100 YR	43.77	43.47	0.29	1.21	0.00	76.27	466.16	53.57	99.51
Reach 2	756	1 YR	40.96	40.83	0.13	0.90	0.02	3.75	98.80	4.45	70.79
Reach 2	756	2 YR	41.16	41.01	0.15	0.91	0.02	8.28	129.64	10.08	72.81
Reach 2	756	10 YR	41.71	41.50	0.21	0.94	0.02	27.04	231.88	32.08	78.11
Reach 2	756	100 YR	42.56	42.25	0.31	0.96	0.02	79.16	433.83	83.01	81.96
Reach 2	668	1 YR	40.03	39.96	0.07	1.22	0.00	0.91	103.42	2.67	70.40
Reach 2	668	2 YR	40.24	40.14	0.09	1.24	0.00	3.82	139.85	4.32	86.69
Reach 2	668	10 YR	40.75	40.60	0.15	1.26	0.01	17.95	251.29	21.76	88.28
Reach 2	668	100 YR	41.57	41.34	0.23	1.25	0.02	56.01	471.56	68.43	90.73
Reach 2	546	1 YR	38.81	38.70	0.11			0.56	105.98	0.46	63.90
Reach 2	546	2 YR	38.98	38.85	0.14			1.00	146.13	0.87	64.78
Reach 2	546	10 YR	39.48	39.25	0.23			3.19	284.86	2.95	67.09
Reach 2	546	100 YR	40.31	39.90	0.41			6.60	581.94	7.46	91.76

Appendix E: Channel Sizing Worksheets

SPSC Sizing Spreadsheet
(Based on Anne Arundel County SPSC Guidelines, Revised 07/2022)
Reach 1 - SPSC

Designer must select/input
Calculated value/Designer shall not change
Default values provided. Advanced designer may change to customize to site specific design

Riffle Weir Sizing			
	Q_{100}	Q_{10}	Q_2
Design Flow (cfs)	369.0	200.0	16.0
Width (ft)	25.0	25.0	25.0
L, Length (ft)	15.0	15.0	15.0
H, Height (ft)	0.5	0.5	0.5
Design Depth of flow (ft)	2.60	2.05	0.73
D50 (in)	8	8	8
P_D, Parabolic Depth (ft)	2.75	2.75	2.75
Width Depth Ratio (W/P_D)	9.1	9.1	9.1
Manning's n Value	0.044	0.046	0.064
Slope (ft/ft)	3.33%	3.33%	3.33%
Rock Unit Weight (lbs/cf)	165.0	165.0	165.0
Top Width at Depth	24.3	21.6	12.9
Flow area (sf)	42.2	29.5	6.3
Hydraulic Radius	1.68	1.33	0.48
Froude	0.96	0.88	0.54
Isbash Maximum Velocity (ft/s)	10.08	10.08	10.08
Depth ("A") at TW/4 offset from centerline	2.06	2.06	2.06
Calculated Flow at Design Depth (cfs)	370.2	211.9	16.4
Calculated Velocity (ft/s)	8.78	7.18	2.62
Does the proposed section provide adequate conveyance?	YES	YES	YES
Is the proposed velocity less than the maximum allowable velocity?	YES	YES	YES

SPSC Sizing Spreadsheet
(Based on Anne Arundel County SPSC Guidelines, Revised 07/2022)
Reach 2 - Valley-Wide RSC

Designer must select/input
Calculated value/Designer shall not change
Default values provided. Advanced designer may change to customize to site specific design

Riffle Weir Sizing			
	Q_{100}	Q_{10}	Q_2
Design Flow (cfs)	588.0	286.0	147.0
Width (ft)	70.0	70.0	70.0
L, Length (ft)	15.0	15.0	15.0
H, Height (ft)	1.0	1.0	1.0
Design Depth of flow (ft)	1.65	1.30	0.95
D50 (in)	10	10	10
P_D, Parabolic Depth (ft)	1.65	1.65	1.65
Width Depth Ratio (W/P_D)	42.5	42.5	42.5
Manning's n Value	0.053	0.057	0.065
Slope (ft/ft)	6.67%	6.67%	6.67%
Rock Unit Weight (lbs/cf)	165.0	165.0	165.0
Top Width at Depth	70.1	62.2	53.2
Flow area (sf)	77.1	53.9	33.7
Hydraulic Radius	1.10	0.87	0.63
Froude	1.05	0.94	0.79
Isbash Maximum Velocity (ft/s)	8.08	11.27	11.27
Depth ("A") at TW/4 offset from centerline	1.24		1.24
Calculated Flow at Design Depth (cfs)	592.6	327.6	146.6
Calculated Velocity (ft/s)	7.69	6.08	4.36
Does the proposed section provide adequate conveyance?	YES	YES	NO
Is the proposed velocity less than the maximum allowable velocity?	YES	YES	YES

Width Depth Ratio note	W/D>10
Parabolic Depth note	PD<=2.0

Appendix F: Design Development Plans

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION
DESIGN DEVELOPMENT PLAN
ARUNDEL RIVERS FEDERATION
CITY OF ANNAPOLIS - SOUTH RIVER WATERSHED

2607 HOUSLEY RD
ANNAPOLIS, MD 21401

CONSULTANT'S CERTIFICATION

"THE DEVELOPER'S PLAN TO CONTROL SILT AND EROSION IS ADEQUATE TO CONTAIN THE SILT AND EROSION ON THE PROPERTY COVERED BY THE PLAN." I CERTIFY THAT THIS PLAN OF EROSION AND SEDIMENT CONTROL REPRESENTS A PRACTICAL AND WORKABLE PLAN BASED ON MY PERSONAL KNOWLEDGE OF THIS SITE, AND WAS PREPARED IN ACCORDANCE WITH THE REQUIREMENTS OF THE ANNE ARUNDEL SOIL CONSERVATION DISTRICT PLAN SUBMITTAL GUIDELINES AND THE CURRENT MARYLAND STANDARDS AND SPECIFICATIONS FOR SEDIMENT AND EROSION CONTROL. I HAVE REVIEWED THIS SEDIMENT AND EROSION CONTROL PLAN WITH THE OWNER/DEVELOPER.

MD. P.E. LICENSE # 30734

MD. LAND SURVEYOR LICENSE# _____

MD. LANDSCAPE ARCHITECT # _____

NAME DOUG STREAKER

FIRM NAME
BIOHABITATS, INC.

STREET ADRESS
2081 CLIPPER ROAD
BALTIMORE, MD 21211

SEAL

SIGNATURE

DATE

STANDARD RESPONSIBILITY NOTES

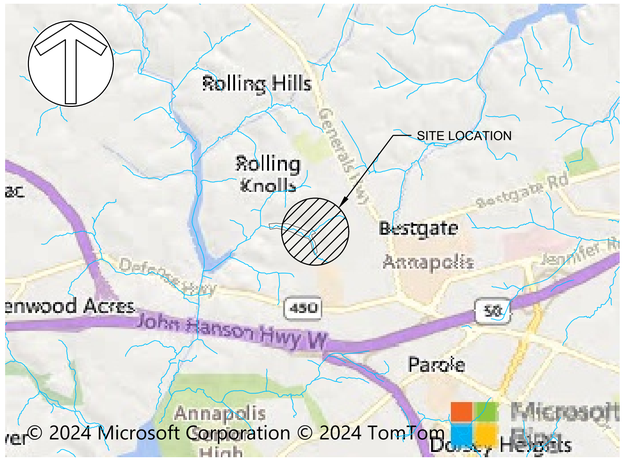
1. I (WE) CERTIFY THAT:
a. ALL DEVELOPMENT AND CONSTRUCTION WILL BE DONE IN ACCORDANCE WITH THIS SEDIMENT AND EROSION CONTROL PLAN, AND FURTHER, AUTHORIZE THE RIGHT OF ENTRY FOR PERIODIC ON-SITE EVALUATION BY THE ANNE ARUNDEL SOIL CONSERVATION DISTRICT(AASCD) BOARD OF SUPERVISORS OR THEIR AUTHORIZED AGENTS.
b. ANY RESPONSIBLE PERSONNEL INVOLVED IN THE CONSTRUCTION PROJECT WILL HAVE A CERTIFICATE OF ATTENDANCE FROM THE MARYLAND DEPARTMENT OF THE ENVIRONMENT'S APPROVED TRAINING PROGRAM FOR THE CONTROL OF SEDIMENT AND EROSION BEFORE BEGINNING THE PROJECT.
RESPONSIBLE PERSONNEL ON SITE: _____

c. IF APPLICABLE, THE APPROPRIATE ENCLOSURE WILL BE CONSTRUCTED AND MAINTAINED ON SEDIMENT BASIN(S) INCLUDED IN THIS PLAN. SUCH STRUCTURE(S) WILL BE IN COMPLIANCE WITH THE ANNE ARUNDEL COUNTY CODE.
2. THE DEVELOPER IS RESPONSIBLE FOR THE ACQUISITION OF ALL EASEMENTS, RIGHT, AND/OR RIGHTS-OF-WAY THAT MAY BE REQUIRED FOR THE SEDIMENT AND EROSION CONTROL PRACTICES, STORM WATER MANAGEMENT PRACTICES AND THE DISCHARGE OF STORM WATER ONTO OR ACROSS ADJACENT OR DOWNSTREAM PROPERTIES INCLUDED IN THE PLAN.
3. FOR INITIAL SOIL DISTURBANCE OR RE-DISTURBANCE, PERMANENT AND/OR TEMPORARY STABILIZATION PER THE AASCD VEGETATIVE ESTABLISHMENT SHALL BE COMPLETED WITHIN THREE CALENDAR DAYS FOR THE SURFACE OF ALL CONTROLS, DIKES, SWALES, DITCHES, PERIMETER SLOPES AND ALL SLOPES GREATER THAN 3 HORIZONTAL TO 1 VERTICAL (3:1); AND SEVEN DAYS FOR ALL OTHER DISTURBED OR GRADED AREAS ON THE PROJECT SITE.
4. THE GRADING AND SEDIMENT CONTROL APPROVAL ON THIS PLAN EXTENDS ONLY TO THOSE AREAS WITHIN THE LIMITS OF DISTURBANCE.
5. THE APPROVAL OF THIS PLAN FOR SEDIMENT AND EROSION CONTROL DOES NOT RELIEVE THE DEVELOPER/CONSULTANT FROM COMPLYING WITH FEDERAL, STATE OR COUNTY REQUIREMENTS PERTAINING TO ENVIRONMENTAL ISSUES.
6. THE DEVELOPER MUST REQUEST THAT THE SEDIMENT AND EROSION CONTROL INSPECTOR APPROVE WORK COMPLETED IN ACCORDANCE WITH THE APPROVED EROSION AND SEDIMENT CONTROL PLAN, THE GRADING OR BUILDING PERMIT, AND THE ORDINANCE.
7. ALL MATERIAL SHALL BE TAKEN TO A SITE WITH AN APPROVED SEDIMENT AND EROSION CONTROL PLAN.
8. FIRST PHASE INSPECTION AND APPROVAL OF THE SEDIMENT AND EROSION CONTROL INSPECTOR SHALL BE REQUIRED UPON COMPLETION OF THE INSTALLATION OF EROSION AND SEDIMENT CONTROLS PRIOR TO PROCEEDING WITH ANY OTHER EARTH DISTURBANCE OR GRADING. OTHER BUILDING OR GRADING INSPECTION APPROVALS MAY NOT BE AUTHORIZED UNTIL THE INITIAL APPROVAL BY THE SEDIMENT AND EROSION CONTROL INSPECTOR IS GIVEN.
a. INSPECTION AND PERMITS MAY ALSO REQUIRE THAT AN INSPECTION AND CERTIFICATION OF THE INSTALLATION OF SEDIMENT CONTROL ALSO BE PERFORMED BY A DESIGN PROFESSIONAL PRIOR TO CONSTRUCTION COMMENCING.
9. APPROVAL FROM THE INSPECTOR MUST BE REQUESTED ON FINAL STABILIZATION OF ALL SITES PRIOR TO REMOVAL OF SEDIMENT AND EROSION CONTROLS.
10. EXISTING TOPOGRAPHY MUST BE FIELD VERIFIED BY RESPONSIBLE PERSONNEL TO THE SATISFACTION OF THE SEDIMENT CONTROL INSPECTOR PRIOR TO COMMENCING WORK.

_____ _____
SIGNATURE OF DEVELOPER/OWNER DATE

PRINT: NAME: _____
TITLE: _____
AFFILIATION: _____
ADDRESS: _____
TELEPHONE NUMBER: _____
EMAIL ADDRESS: _____

VICINITY MAP



SCALE: 1" = 2000'

SITE ANALYSIS TABULATION	
	TOTAL
TOTAL AREA OF PROPERTY	400.8 AC - (CUMULATIVE AREA OF ALL PROPERTIES IMPACTED)
DISTURBED AREA	1.93 AC
IN STREAM AREA NOT TO BE STABILIZED	0 SY
AREA MECHANICALLY STABILIZED	0 AC
AREA VEGETATIVELY STABILIZED	1.58 AC
TOTAL CUT	449.13 CY
TOTAL FILL	2,441.46 CY
TOTAL SPOIL	0 CY
TOTAL IMPORTED FILL	1,992.33 CY

* ESTIMATED INFORMATION NOT INTENDED FOR BIDDING

NOTE:
CUT AND FILL ESTIMATED VOLUMES IN THE TABLE ARE CALCULATED BASED ON CAD 3D SURFACE ANALYSIS BETWEEN EXISTING GRADES SHOWN (TOPOGRAPHIC SURVEY PERFORMED IN 2017) AND PROPOSED FINISHED GRADES. THESE ESTIMATES ARE NOT INTENDED FOR BIDDING AND DO NOT ACCOUNT FOR EXPANSION OR COMPACTION OF SOIL MATERIALS OR OVER EXCAVATION REQUIRED TO MEET SUBGRADE.

OVER EXCAVATION SHALL BE INCIDENTAL TO STRUCTURE PLACEMENT.

SITE INFORMATION TABULATION

A. OWNER INFORMATION -SEE PROPERTY OWNERSHIP TABLE
B. ENGINEER INFORMATION - BIOHABITATS
C. TAX MAP/PARCEL- SEE PROPERTY OWNERSHIP TABLE
D. PLAT REFERENCE - SEE PROPERTY OWNERSHIP TABLE
E. PROPERTY AREA - SEE PROPERTY OWNERSHIP TABLE
F. DISTRICT - 02
G. ZONING - OPEN SPACE (OS)
H. STREAM USE DESIGNATION - CLASS I
I. SUBWATERSHED/WATERSHED - MD 8 DIGIT 02131003/SOUTH RIVER
J. CRITICAL AREA - NO

Property Owner	Tax Map	Parcel	Plat Reference	Property Area (ac)
CITY OF ANNAPOLIS MAYOR & ALDERMN	44	226	L.2410 F.360	395.4
KRG GATEWAY VILLAGE LLC	45	752	180 F.33	5.4
ANNE ARUNDEL COUNTY RIGHT OF WAY	N/A	N/A	N/A	N/A

Sheet List Table	
Sheet Number	Sheet Title
1	TITLE SHEET
2	GENERAL NOTES
3	SHEET LAYOUT KEY MAP
4	EXISTING CONDITIONS
5	EXISTING CONDITIONS
6	EXISTING FEATURES AND SITE RESOURCES NOTES
7	FOREST STAND DELINEATION NOTES
8	FOREST STAND DELINEATION NOTES
9	FOREST STAND DELINEATION PLAN
10	FOREST STAND DELINEATION PLAN
11	GRADING PLAN
12	GRADING PLAN
13	PROFILE
14	STRUCTURE TABLES
15	EROSION & SEDIMENT CONTROL PLAN
16	EROSION & SEDIMENT CONTROL PLAN
17	EROSION & SEDIMENT CONTROL DETAILS
18	EROSION & SEDIMENT CONTROL DETAILS
19	EROSION & SEDIMENT CONTROL DETAILS
20	EROSION AND SEDIMENT CONTROL NOTES
21	SEQUENCE OF CONSTRUCTION
22	TREE PROTECTION AND REMOVAL DETAILS AND NOTES
23	DETAILS
24	DETAILS
25	DETAILS
26	DETAILS
27	LANDSCAPE PLAN
28	LANDSCAPE PLAN
29	LANDSCAPE DETAILS
30	LANDSCAPE SCHEDULE

ANNE ARUNDEL SOIL CONSERVATION DISTRICT
SEDIMENT AND EROSION CONTROL APPROVAL

BEFORE YOU DIG CALL
1-800-257-7777 OR DIAL 811
MISS UTILITY
CALL BEFORE YOU DIG

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	AS SHOWN
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	1 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

TITLE SHEET

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\cv01aw.dwg

GENERAL NOTES

1. SITE CONDITIONS - THE CONTRACTOR SHALL CONTINUALLY REVIEW SITE CONDITIONS. CONDITIONS REQUIRING CONSTRUCTION DIFFERENT OF THAT SHOWN ON THE PLANS SHALL BE REPORTED TO THE OWNER/ENGINEER PRIOR TO PROCEEDING WITH THE AFFECTED CONSTRUCTION.
2. PROTECTION OF PROPERTY - THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF PUBLIC AND PRIVATE PROPERTY ADJACENT TO HIS WORK AND SHALL EXERCISE DUE CAUTION TO AVOID DAMAGE TO SUCH PROPERTY. THE CONTRACTOR SHALL REPLACE OR REPAIR TO THEIR ORIGINAL CONDITION, ALL IMPROVEMENTS WITHIN OR ADJACENT TO THE AREA OF WORK WHICH ARE NOT DESIGNATED FOR REMOVAL, AND WHICH ARE DAMAGED OR REMOVED AS A RESULT OF HIS OPERATIONS. CONTRACTOR SHALL PERFORM FULL WIDTH REPAIR OR REPLACE ANY DAMAGED ROADS, CURBS, FENCES, DRIVEWAY, AND SIDEWALKS IN KIND AT NO COST TO COUNTY.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL PROPERTY CORNER MARKERS. PROPERTY CORNER MARKERS DAMAGED BY CONSTRUCTION ACTIVITIES SHALL BE REESTABLISHED BY A PROFESSIONAL SURVEYOR LICENSED IN MARYLAND AT NO COST TO COUNTY.
4. SAFETY - NEITHER THE OWNER NOR THE ENGINEER/DESIGNATED SPECIALIST WILL BE RESPONSIBLE FOR ENSURING CONTRACTOR'S COMPLIANCE WITH SAFETY MEASURES OR REGULATIONS. THE CONTRACTOR SHALL DESIGN, CONSTRUCT, AND MAINTAIN ALL SAFETY DEVICES, AND SHALL BE SOLELY RESPONSIBLE FOR CONFORMING TO ALL LOCAL, STATE, FEDERAL, AND CONTRACTUAL SAFETY AND HEALTH STANDARDS, LAWS, AND REGULATIONS.
5. THE CONTRACTOR SHALL COMPLY TO THE FULLEST EXTENT WITH THE LATEST STANDARDS OF OSHA DIRECTIVES OR ANY OTHER AGENCY HAVING JURISDICTION FOR ALL ACTIVITIES ASSOCIATED WITH THIS PROJECT. THE CONTRACTOR IS RESPONSIBLE FOR COMPLYING WITH OSHA PERFORMANCE CRITERIA.
6. CONTRACTOR SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF PROJECT CONSTRUCTION, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY.
7. STANDARDS SPECIFICATIONS - ALL CONSTRUCTION WORK AND INSTALLATION SHALL CONFORM TO THE PROJECT SPECIFICATIONS PROVIDED WITH THE CONTRACT DOCUMENTS AND ANY STANDARD SPECIFICATIONS AS INDICATED ON THESE PLANS.
8. NO CONSTRUCTION ACTIVITIES INCLUDING THE INSTALLATION OF EROSION AND SEDIMENT CONTROL MEASURES SHALL BEGIN UNTIL ALL THE REQUIRED EASEMENTS, RIGHT-OF-WAYS AND PERMITS HAVE BEEN OBTAINED.
9. APPROVED PLANS - NO CONSTRUCTION SHALL BE STARTED WITHOUT APPROVED PLANS. ANY CONSTRUCTION DONE WITHOUT APPROVED PLANS AND PRIOR TO NOTIFICATION TO THE INSPECTOR WILL BE AT THE CONTRACTOR'S RISK, UNLESS SPECIFICALLY DIRECTED BY THE OWNER IN WRITING. THE OWNER RESERVES THE RIGHT TO REJECT CONSTRUCTION DONE WITHOUT APPROVED PLANS. THE CONTRACTOR SHALL HAVE COPIES OF THE APPROVED PLANS FOR THIS PROJECT ON THE SITE AT ALL TIMES AND SHALL BE FAMILIAR WITH ALL APPLICABLE STANDARDS AND SPECIFICATIONS.
10. THE CONTRACTOR SHALL MAINTAIN AN AS-BUILT REDLINE SET OF PLANS ON THE SITE AT ALL TIMES.
11. INSPECTIONS - THE CONTRACTOR IS RESPONSIBLE FOR ARRANGING THE REQUIRED INSPECTIONS. THE PRESENCE OR ABSENCE OF AN INSPECTOR WILL NOT RELIEVE THE CONTRACTOR OF FULL RESPONSIBILITY FOR THE PROPER PERFORMANCE OF WORK.
12. ELECTRONIC FILES MAY BE PROVIDED TO THE CONTRACTOR UPON REQUEST FOR THE SOLE PURPOSE OF PROVIDING CONSTRUCTION STAKING FOR GRADING ACTIVITIES. APPROVED PLANS SHALL TAKE PRECEDENCE OVER ELECTRONIC FILES.
13. WRITTEN DIMENSIONS ON THE PLANS AND DETAILS SHALL TAKE PRECEDENCE OVER SCALED DIMENSIONS.
14. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONTROL AND MAINTENANCE OF ALL DRAINAGE FLOWS DURING CONSTRUCTION.
15. IT SHALL BE UNDERSTOOD THAT FAILURE TO MENTION SPECIFICALLY ANY WORK WHICH WOULD NATURALLY BE REQUIRED TO COMPLETE THE PROJECT SHALL NOT RELIEVE THE CONTRACTOR OF HIS RESPONSIBILITY TO COMPLETE SUCH WORK AT NO COST TO COUNTY.
16. THE CONTRACTOR MUST STORE ALL EQUIPMENT, MATERIALS, AND/OR SUPPLIES WITHIN DESIGNATED AREAS OF THE LOD AND ALL CONSTRUCTION ACTIVITIES AND ACCESS MUST REMAIN WITHIN THE LOD AS SHOWN ON THE PLANS.
17. A DISTINCTION BETWEEN NEW AND EXISTING ITEMS HAS BEEN MADE ON THE DRAWINGS BY LINE WEIGHT. BLACK LINES REPRESENT NEW WORK UNDER THIS CONTRACT; GRAY LINES REPRESENT EXISTING FEATURES.
18. SHOULD THE CONTRACTOR DISCOVER ANY DISCREPANCIES BETWEEN THE PLANS AND FIELD CONDITIONS, THE ENGINEER AND/OR OWNER IS TO BE NOTIFIED IMMEDIATELY TO RESOLVE THE SITUATION. SHOULD THE CONTRACTOR MAKE FIELD CORRECTIONS OR ADJUSTMENTS WITHOUT NOTIFYING THE OWNER, THEN THE CONTRACTOR ASSUMES ALL RESPONSIBILITY FOR THOSE CHANGES.
19. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, PROCEDURES, SAFETY PRECAUTIONS, AND PROGRAMS UNLESS OTHERWISE NOTED ON THE PLANS.
20. UPON COMPLETION OF THE WORK, BUT PRIOR TO DE-MOBILIZATION, THE CONTRACTOR SHALL REMOVE ALL REMNANTS OF CONSTRUCTION MATERIALS FROM THE SITE. THE CONTRACTOR SHALL RESTORE ALL DISTURBED AREAS TO A CONDITION EQUAL OR BETTER THAN THE PRE-CONSTRUCTION CONDITIONS.
21. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS "STANDARD DETAILS AND SPECIFICATIONS" UNLESS OTHERWISE NOTED.
22. THE CONTRACTOR SHALL NOTIFY THE ANNE ARUNDEL COUNTY INSPECTIONS PERMITS CENTER (410-222-7780) TWO (2) DAYS PRIOR TO BEGINNING CONSTRUCTION.
23. MDE IN-STREAM CLOSURE PERIOD IS MARCH 1 TO JUNE 15.
24. USFWS TREE REMOVAL RECOMMENDED RESTRICTION PERIOD IS APRIL 1 TO NOVEMBER 14.
25. THE GRADING TOLERANCE IS +/- 0.2' VERTICAL AND +/- 0.5' HORIZONTAL. STRUCTURE ELEVATION/LOCATIONS AND GRADING MAY BE FIELD ADJUSTED AT THE DIRECTION OF THE PROJECT ENGINEER/DESIGNATED SPECIALIST.
26. EXCAVATION TO BE PERFORMED BY MECHANICAL MEANS ONLY. BLASTING AND HYDRAULIC DREDGING IS NOT PERMITTED.
27. IMPORTED FILL MATERIAL MUST BE FREE OF CONTAMINATION LEVELS OF ANY POLLUTANT THAT IS, OR MAY BE CONSIDERED TO REPRESENT, A POSSIBLE HEALTH HAZARD TO THE PUBLIC OR MAY BE DETRIMENTAL TO SURFACE OR GROUND WATER QUALITY, OR WHICH MAY CAUSE DAMAGE TO PROPERTY OR THE DRAINAGE SYSTEM. ALL FILL MATERIAL MUST BE FREE OF HAZARDOUS MATERIALS AND COMPLY WITH ALL APPLICABLE DISTRICT AND FEDERAL REGULATIONS.

EXISTING CONDITIONS NOTES

1. BEARNGS SHOWN ON THIS PLAT ARE REFERRED TO THE SYSTEM OF COORDINATES ESTABLISHED IN THE ANNE ARUNDEL COUNTY SURVEY CONTROL SYSTEM AS REFERENCED FROM THE FOLLOWING TRAVERSE/CONTROL & BENCHMARK STATIONS.
   2195: NORTH: 482598.721 EAST: 1440104.273 ELEV: 84.19
   2196: NORTH: 482965.211 EAST: 1441321.306 ELEV: 90.03
2. CURRENT OWNERSHIP: CITY OF ANNAPOLIS, LIBER 2410 FOLIO 360.
3. THE FIELD WORK FOR THIS SURVEY WAS COMPLETED ON FEBRUARY 19, 2025.
4. UTILITY INFORMATION SHOWN HEREON IS A RESULT OF FIELD LOCATIONS OF VISIBLE SURFACE STRUCTURES SUPPLEMENTED WITH AVAILABLE PLAN INFORMATION PROVIDED TO THIS FIRM AT THE TIME OF THE SURVEY.
5. THE SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A TITLE REPORT.
6. ELEVATIONS ARE REFERRED TO NAVD 88.
7. EXISTING CONDITIONS AND GRADES MAY HAVE CHANGED SINCE THE ORIGINAL SURVEY WAS COMPLETED. IT IS THE CONTRACTOR'S RESPONSIBILITY TO CONFIRM EXISTING CONDITIONS AND GRADES AND ADJUST QUANTITIES, EARTHWORK AND WORK EFFORTS AS NECESSARY AT NO ADDITIONAL COST TO THE PROJECT OWNER. THE CONTRACTOR SHALL REPORT ANY DISCREPANCIES TO THE OWNER AND ENGINEER/DESIGNATED SPECIALIST PRIOR TO THE BEGINNING OF CONSTRUCTION.
8. CONTOURS OUTSIDE OF SURVEY LIMITS ARE 2017 AA COUNTY LIDAR DISPLAYED AT 1' CONTOUR INTERVAL.
9. THE PROPERTY BOUNDARY OUTLINES SHOWN HEREON ARE BASED UPON DEEDS AND PLATS OF RECORD AND OVERLAID ONTO THE TOPOGRAPHIC SURVEY. THIS IS NOT TO BE CONSTRUED AS A BOUNDARY SURVEY.
10. WETLAND DELINEATION AND FOREST STAND DELINEATION WERE ORIGINALLY COMPLETED BY BIOHABITATS IN FALL 2024.

UTILITY NOTES

1. VISIBLE ABOVE GROUND UTILITIES HAVE BEEN PROVIDED VIA TOPOGRAPHIC SURVEY. SUBSURFACE UTILITY LOCATIONS AND ELEVATIONS ARE APPROXIMATE AND TAKEN FROM BEST AVAILABLE PLANS, RECORDS, AND/OR FIELD RECONNAISSANCE. OTHER UTILITIES MAY EXIST THAT ARE NOT SHOWN AND SHOULD BE VERIFIED IN THE FIELD BY THE CONTRACTOR. THE CONTRACTOR SHALL TAKE ALL NECESSARY MEASURES TO LOCATE AND PROTECT THE EXISTING UTILITIES AND MAINTAIN UNINTERRUPTED SERVICE. ANY DAMAGE INCURRED DUE TO THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED IMMEDIATELY AT THE CONTRACTOR'S EXPENSE.
2. THE CONTRACTOR SHALL NOTIFY MISS UTILITY AT 1-800-257-7777 A MINIMUM OF FORTY-EIGHT (48) HOURS BEFORE STARTING WORK. ALL EXISTING UTILITIES MUST BE MARKED IN THE FIELD PRIOR TO CONSTRUCTION.
3. THE CONTRACTOR SHALL CONFIRM EXISTING UTILITY LOCATION AND ELEVATION AT ALL LOCATION(S) WHERE THE PROPOSED WORK CROSSES THE EXISTING UTILITIES. THE ENGINEER IS TO BE NOTIFIED OF THIS INFORMATION IN ADVANCE OF CONSTRUCTION AND IF THERE ARE ANY CONFLICTS WITH THE PROPOSED WORK.
4. THE CONTRACTOR SHALL EXERCISE CARE WHEN DIGGING ADJACENT TO AND CROSSING THE UTILITIES TO ENSURE THAT THESE AND ALL UTILITIES ARE PROTECTED FROM DAMAGE DURING CONSTRUCTION. ANY DAMAGE TO THE UTILITIES IS THE CONTRACTOR'S RESPONSIBILITY.
5. ANY EXISTING UTILITIES NOT IMPACTED BY THE PROPOSED WORK ARE TO BE PROTECTED AND TO REMAIN IN SERVICE.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SPILLAGE OF RAW SEWAGE OR OTHER SUBSTANCES THAT WOULD BE CONSIDERED DANGEROUS TO THE ENVIRONMENT DURING ITS CONSTRUCTION OPERATIONS. THE CONTRACTOR SHALL FURNISH ALL NECESSARY EQUIPMENT (PLUGGING, PUMPING, CONTAINMENT EQUIPMENT, ETC.) TO PREVENT SPILLAGE OR AS REQUIRED TO SUCCESSFULLY TRANSPORT SEWAGE TO COMPLETE HIS WORK. ALL SEWAGE TRANSPORT SHALL BE BY A DISPOSAL CONTRACTOR LICENSED IN ALL JURISDICTIONS FOR WHICH THE SEWAGE WILL BE TRANSPORTED.
7. THE CONTRACTOR SHALL VERIFY, BY FIELD MEASUREMENT, THE OUTSIDE DIMENSIONS AND MATERIAL OF ALL PIPES, FITTINGS, AND STRUCTURES TO ASSURE PROPER CLEARANCE AND SPACING PRIOR TO FABRICATION OR INSTALLATION.
8. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO EXISTING UTILITIES THAT MAY OCCUR AS A RESULT OF THE CONSTRUCTION. DAMAGED UTILITIES ARE TO BE IMMEDIATELY REPORTED TO BOTH THE UTILITY OWNER AND PROJECT ENGINEER. ANY DAMAGE TO EXISTING STRUCTURES INCLUDING SEWER PIPES/MANHOLES, STORM DRAIN PIPES/STRUCTURES SHALL BE REPAIRED TO THE UTILITY OWNER'S SATISFACTION BY THE CONTRACTOR AT HIS/HER OWN EXPENSE.

DEMOLITION

1. CONTRACTOR SHALL COORDINATE WITH UTILITY COMPANIES FOR SHUTOFF, CAPPING AND CONTINUATION OF UTILITY SERVICES AS REQUIRED.
2. CONTRACTOR SHALL REMOVE AND TRANSPORT ALL DEBRIS, RUBBISH AND OTHER MATERIALS RESULTING FROM ALL DEMOLITION OPERATIONS TO A LEGAL DISPOSAL OFF SITE.
3. REMOVAL OF ASPHALT AND CONCRETE PAVEMENT SHALL INCLUDE THE REMOVAL OF ALL SURFACE, BASE AND SUB-BASE MATERIALS UNLESS OTHERWISE SPECIFIED.
4. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY AND DETERMINE THE EXACT LOCATION AND DEPTH OF ALL UTILITIES PRIOR TO COMMENCING WORK.
5. THE CONTRACTOR MUST HAND-DIG OR VACUUM EXCAVATE TEST PITS AT ALL UTILITY CROSSINGS TO DETERMINE THE EXACT LOCATION AND DEPTH OF ALL UTILITIES AS WELL IN DEMOLITION WORK AND PRIOR TO ORDERING PIPE MATERIALS AND STRUCTURE. UTILITIES FOUND DURING DEMOLITION OR CONSTRUCTION ACTIVITIES SHALL BE THE RESPONSIBILITY OF ANY CONTRACTOR ENGAGED IN EXCAVATION AT THIS SITE. THE OWNER AND PROJECT ENGINEER/DESIGNATED SPECIALIST SHALL BE NOTIFIED IMMEDIATELY OF ANY UTILITY FINDINGS WHICH DEVIATE FROM THE CONDITIONS SHOWN.
6. ALL EROSION & SEDIMENT CONTROL METHODS SHALL BE INSTALLED BEFORE THE START OF ANY EXCAVATION AND/OR DEMOLITION. IF ANY ONSITE INSPECTION REVEALS FURTHER EROSION CONTROL MEASURES ARE NECESSARY, THE SAME SHALL BE PROVIDED. REFER TO EROSION AND SEDIMENT CONTROL PLAN AND DETAILS.
7. SEE THE EROSION & SEDIMENT CONTROL PLAN SHEETS FOR ALL EXISTING TREES TO REMAIN AND BE PROTECTED. SEE DRAWING TP-01 FOR TREE PROTECTION AND REMOVAL NOTES AND DETAILS.
8. NOTE PROXIMITY OF ADJACENT STRUCTURES AND UTILITY LINES AND MAINTAIN CONTINUED SERVICE DURING CONSTRUCTION. COORDINATE WITH RESPECTIVE UTILITY COMPANIES AND ENGINEER SHOULD RELOCATION OF SERVICE BE REQUIRED.
9. REMOVAL OF ALL WALLS/RETAINING WALLS AND FENCES SHALL INCLUDE THE REMOVAL OF THEIR FOUNDATION UNLESS OTHERWISE INDICATED ON THESE DRAWINGS.
10. UNLESS OTHERWISE SHOWN ON THESE DRAWINGS, EXISTING PAVEMENT TO REMAIN. CONTRACTOR TO PROVIDE PRE-CONSTRUCTION VIDEO OF EXISTING PAVEMENT. EXISTING PAVEMENT, DISTURBED OR DAMAGED DURING CONSTRUCTION, SHALL BE REPLACED PER COUNTY STANDARDS AND SPECIFICATIONS AT NO ADDITIONAL COST.
11. WHERE PORTIONS OF EXISTING BITUMINOUS OR CONCRETE PAVING ARE TO BE REMOVED, THE EXISTING PAVEMENT SHALL BE SAW-CUT.

GENERAL EROSION AND SEDIMENT CONTROL NOTES

1. THE CONTRACTOR IS REQUIRED TO PROVIDE AND MAINTAIN EROSION AND SEDIMENT CONTROL MEASURES IN ACCORDANCE WITH "2011 MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL". REFER TO STANDARD DETAILS AND DETAILED SPECIFICATIONS OF EACH PRACTICE SPECIFIED HEREIN.
2. NOTIFY THE COUNTY INSPECTION AND PERMITS 3 DAYS PRIOR TO STARTING WORK ON THIS PROJECT.
3. THE CONTRACTOR SHALL VERIFY SITE CONDITIONS AND REPORT ANY DISCREPANCIES TO THE OWNER AND ENGINEER/DESIGNATED SPECIALIST PRIOR TO THE BEGINNING OF CONSTRUCTION.
4. ALL DISTURBED AREAS NOT STABILIZED DAILY SHALL DRAIN TO A SEDIMENT CONTROL DEVICE. NO DISTURBED AREAS TO BE ALLOWED TO DRAIN DIRECTLY OFF SITE.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ASSURING THAT THE SEDIMENT CONTROL MEASURES ARE FUNCTIONAL ON A DAY-TO-DAY BASIS.
6. DISTURBED AREAS AT STORM DRAIN OUTFALLS SHALL BE STABILIZED IMMEDIATELY AFTER COMPLETION.
7. ALL SEDIMENT CONTROL FACILITIES ARE TO REMAIN IN PLACE UNTIL AREA ABOVE FACILITIES ARE STABILIZED AND PERMISSION FOR REMOVAL HAS BEEN OBTAINED FROM THE DOEE SEDIMENT CONTROL INSPECTOR.
8. EXCESS EXCAVATION AND TRASH/DEBRIS WILL BE HAULED TO AN APPROVED DISPOSAL SITE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING APPROVALS FOR ALL OFF-SITE BORROW PITS AND DISPOSAL AREAS.
9. SEDIMENT CONTROL MEASURES MUST BE INSPECTED AND MAINTAINED REGULARLY TO ENSURE THAT THE INTENDED PURPOSES ARE ACCOMPLISHED.
10. THE CONTRACTOR IS REQUIRED TO COMPLY WITH INSPECTION AND REPORTING REQUIREMENTS AS DEFINED BY THE PROJECT'S MDE GENERAL PERMIT FOR STORMWATER.
11. AT THE END OF EACH WORKING DAY, ALL SEDIMENT CONTROL PRACTICES WILL BE INSPECTED AND LEFT IN OPERATIONAL CONDITION.
12. DUST CONTROL WILL BE PROVIDED FOR ALL DISTURBED AREAS. REFER TO "2011 MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL", PG. H.22, FOR ACCEPTABLE METHODS AND SPECIFICATIONS FOR DUST CONTROL.
13. PUMPING SEDIMENT-LADEN WATER INTO WATERS OF THE STATE IS STRICTLY PROHIBITED.
14. THE CONTRACTOR SHALL PROTECT ALL POINTS OF CONSTRUCTION INGRESS AND EGRESS TO PREVENT THE DEPOSITION OF MATERIALS ON PUBLIC ROAD AND PRIVATE PROPERTY. ALL MATERIAL DEPOSITED ON PUBLIC ROADS SHALL BE MECHANICALLY REMOVED IMMEDIATELY. FLUSHING OF THE ROAD SURFACE IS PROHIBITED.
15. ANY CHANGE TO THE LIMIT OF DISTURBANCE ON THE PLAN REQUIRES RESUBMISSION TO ANNE ARUNDEL COUNTY INSPECTIONS AND PERMITS - GRADING AND SEDIMENT CONTROL FOR APPROVAL.
16. THE CONTRACTOR MUST STORE ALL EQUIPMENT WITHIN THE LOD AND ALL CONSTRUCTION ACTIVITIES AND ACCESS MUST REMAIN WITHIN THE LOD AS SHOW ON THE PLANS.

LEGEND

EXISTING		PROPOSED	
	MAJOR CONTOUR	425	MAJOR CONTOUR
	MINOR CONTOUR	424	MINOR CONTOUR
	PROPERTY LINE		BASELINE
SS SS	SANITARY SEWER	LOD	LIMIT OF DISTURBANCE
SD	STORM DRAIN	100 YR	100 YEAR FLOODPLAIN
W W	WATER SUPPLY	RSF	REINFORCED SILT FENCE
E E	ELECTRIC	BFD BFD	BASE FLOW DIVERSION PIPE
G G	GAS		SPSC RIFFLE
C C	COMMUNICATIONS		VALLEY WIDE RIFFLE
CA CA	CRITICAL AREA BOUNDARY		PLUNGE POOL
CAB CAB	CRITICAL AREA BUFFER		POOL LIMITS
	SOIL TYPE BOUNDARY		POST AND WATTLE STRUCTURE
100YR	100 YEAR FLOODPLAIN (HEC-RAS)		IN-CHANNEL HAUL ROAD (ICHR)
FEMA 100	100 YEAR FLOODPLAIN (FEMA)		STAGING AND STOCKPILING AREA
	STREAM CENTERLINE		CONSTRUCTION ACCESS ROAD
WL WL	WETLAND LIMIT	SCE	STONE CONSTRUCTION ENTRANCE
WB	WETLAND BUFFER		TREE PLANKING
WUS	WATER OF THE US		TREE REMOVAL
	LIMIT OF SURVEY		
	TREELINE		
	TREE		
	TRAVERSE POINT		

FOREST STAND DELINEATION

WB	WETLAND BUFFER
SB SB	STREAM BUFFER
	SOIL BOUNDARY
	STUDY BOUNDARY
FSD	FOREST STAND BOUNDARY
WL WL WL WL	WETLANDS
CRZ CRZ CRZ	SPECIMEN TREE
	FOREST SURVEY POINT
	SLOPES > 25°
	SLOPES 15° - 25°

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY	APPROVED / DATE	APPROVED / DATE
		CHIEF ENGINEER	PROJECT MANAGER
		APPROVED / DATE	APPROVED / DATE
		ASSISTANT CHIEF ENGINEER	CHIEF, RIGHT-OF-WAY

SCALE:	NA
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	2 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

GENERAL NOTES



HORIZONTAL SCALE

0 100 200

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers FEDERATION
ADVANCED IMPERVIOUS CURBS

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED	
DATE	BY

APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	1"=100'
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	3 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

SHEET LAYOUT KEY MAP

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\si01aw.dwg

MATCHLINE - SHEET 5

REGATTA BAY II
LTD PARTNERSHIP
L.13917 F.251

CITY OF ANNAPOLIS
MAYOR & ALDERMN
L.2410 F.360

KRG GATEWAY
VILLAGE LLC
NO DEED
REFFERENCE
PLAT 180 F.33

CENTERLINE OF STREAM
&
THALWEG

EX RIPRAP TO BE SALVAGED AND STOCKPILED FOR REUSE

RIPRAP

CONCRETE HEADWALL

INV 8" HDPE=52.91
INV 56" RCP=48.39
INV 8" HDPE=52.94

STORM DRAIN INLET
TOP ELEV=67.80
INV(SE)21" RCP=63.30

STORM DRAIN MANHOLE
TOP ELEV=67.64
INV(NW)21" RCP=62.94
INV(NE)21" RCP=61.74
INV(SW)21" RCP=63.54

STORM DRAIN INLET
TOP ELEV=67.97
INV(NW) 21" RCP=64.22

CONCRETE RISER (SEE DIAGRAM)
TOP ELEV=67.85
INV 56" RCP=49.00
INV 12" RCP=55.95

POND

CONCRETE CURB
CONCRETE WALK

CONNECT TO EXIST. 21" RCP

SD 21" RCP

SD

HAND RAIL

HAND BOX

HOUSLEY ROAD
(80' PUBLIC R/W)

TR 101
TR 100
TR 2
TR 3

EXISTING FEATURES NOTES:

1. ONLY SURVEYED TREES GREATER THAN 10" DBH WITHIN STUDY AREA ARE SHOWN ON THE PLANS. SEE SHEET 6 FOR TREE TABLE.
2. SEE SHEET 22 FOR TREE PROTECTION AND REMOVAL NOTES AND DETAILS.
3. WITHIN THE LOD, CONTRACTOR SHALL CLEAN UP AND PROPERLY DISPOSE OF MISCELLANEOUS DEBRIS.
4. SEE SHEET 6 FOR EXISTING TREE INFORMATION AND NOTES.

HORIZONTAL SCALE
0 20 40

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED DATE		APPROVED DATE	
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED DATE		APPROVED DATE	
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	1" = 20'
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	4 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK
STREAM RESTORATION

EXISTING CONDITIONS



EXISTING FEATURES NOTES:

1. ONLY SURVEYED TREES GREATER THAN 10" DBH WITHIN STUDY AREA ARE SHOWN ON THE PLANS. SEE SHEET 6 FOR TREE TABLE.
2. SEE SHEET 22 FOR TREE PROTECTION AND REMOVAL NOTES AND DETAILS.
3. WITHIN THE LOD, CONTRACTOR SHALL CLEAN UP AND PROPERLY DISPOSE OF MISCELLANEOUS DEBRIS.
4. SEE SHEET 6 FOR EXISTING TREE INFORMATION AND NOTES.

HORIZONTAL SCALE

0 20 40

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED DATE		APPROVED DATE	
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED DATE		APPROVED DATE	
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	1" = 20'
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	5 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK
STREAM RESTORATION

EXISTING CONDITIONS

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\ec01aw.dwg

Tree ID	Species	Scientific Name	DBH	Condition	Notes	Status (TBR or TBP)
2735	American beech	*Fagus grandifolia*	26.9	Excellent		
2736	Tulip poplar	*Liriodendron tulipifera*	29.1	Good		
2737	Chestnut oak	*Quercus montana*	27.0	Fair		TBR
2738	American beech	*Fagus grandifolia*	21.0	Good	English ivy @base	TBP
2739	Tulip poplar	*Liriodendron tulipifera*	27.3	Fair		
2740	American beech	*Fagus grandifolia*	13.0	Good		TBP
2741	White oak	*Quercus alba*	16.4	Fair	Stream bank undercut	TBR
2742	Tulip poplar	*Liriodendron tulipifera*	18.7	Good		TBP
2743	White oak	*Quercus alba*	25.4	Fair		
2744	American beech	*Fagus grandifolia*	29.9	Fair	Hollow	
2745	Chestnut oak	*Quercus montana*	27.9	Dead	Hazard?	
2746	American beech	*Fagus grandifolia*	13.0	Good		TBR
2747	American beech	*Fagus grandifolia*	24.7	Poor	Trunk decay	TBR
2748	White oak	*Quercus alba*	25.5	Good		
2749	Tulip poplar	*Liriodendron tulipifera*	12.6	Good		
2750	Tulip poplar	*Liriodendron tulipifera*	13.9	Good	Lean	TBR
2751	American beech	*Fagus grandifolia*	30.4	Fair	Upper trunk decay	TBR
2752	Tulip Poplar	*Liriodendron tulipifera*	19.8	Good		TBP
2753	American beech	*Fagus grandifolia*	27.2	Good		
2754	Red maple	*Acer rubrum*	16.0	Poor	Hollow	TBR
2755	Red maple	*Acer rubrum*	23.5	Fair		TBP
2756	American beech	*Fagus grandifolia*	24.4	Good		
2757	Tulip poplar	*Liriodendron tulipifera*	27.9	Fair		
2758	Tulip poplar	*Liriodendron tulipifera*	16.6	Good		
2759	Chestnut oak	*Quercus montana*	14.0	Good		
2760	White oak	*Quercus alba*	18.5	Good		
2761	White oak	*Quercus alba*	19.8	Excellent		
2762	American beech	*Fagus grandifolia*	27.8	Fair	Hollow	
2763	Chestnut oak	*Quercus montana*	21.2	Fair		
2764	American beech	*Fagus grandifolia*	12.6	Fair		
2765	American beech	*Fagus grandifolia*	16.3	Excellent		
2766	Chestnut oak	*Quercus montana*	32.3	Dead	Hazard?	TBR
2767	Tulip poplar	*Liriodendron tulipifera*	45.0	Poor	Hollow	
2768	American beech	*Fagus grandifolia*	19.0	Excellent		
2769	White oak	*Quercus alba*	42.8	Fair		
2770	American beech	*Fagus grandifolia*	30.9	Fair		TBP
2771	Tulip poplar	*Liriodendron tulipifera*	20.7	Fair	Hollow	TBP
2772	Tulip poplar	*Liriodendron tulipifera*	20.1	Good		TBP
2773	Tulip poplar	*Liriodendron tulipifera*	27.7	Good		TBP
2774	Tulip poplar	*Liriodendron tulipifera*	24.7	Good		TBP
2775	Red maple	*Acer rubrum*	12.0	Poor		TBP
2776	American beech	*Fagus grandifolia*	14.8	Fair	Hollow	TBP
2777	White oak	*Quercus alba*	28.4	Dead	Hazard?	TBP
2778	Red maple	*Acer rubrum*	17.9	Good		TBP
2779	Tulip poplar	*Liriodendron tulipifera*	25.7	Fair		TBP
2780	Tulip poplar	*Liriodendron tulipifera*	16.0	Poor	Hollow	TBR
2781	Black gum	*Nyssa sylvatica*	14.4	Fair	Stream bank erosion	TBR
2782	American beech	*Fagus grandifolia*	16.8	Excellent		TBR
2783	Tulip poplar	*Liriodendron tulipifera*	34.7	Good		
2784	American beech	*Fagus grandifolia*	12.7	Excellent		
2785	Red maple	*Acer rubrum*	15.0	Fair		TBP
2786	Tulip poplar	*Liriodendron tulipifera*	27.4	Good		TBP
2787	Red maple	*Acer rubrum*	15.8	Fair	Hollow	TBP
2788	Black gum	*Nyssa sylvatica*	13.5	Good		TBP
2789	American beech	*Fagus grandifolia*	17.2	Good		TBP
2790	American beech	*Fagus grandifolia*	12.5	Good		TBP
2791	American beech	*Fagus grandifolia*	23.6	Good		
2792	Tulip poplar	*Liriodendron tulipifera*	23.7	Fair	Hollow	TBP
2793	Black gum	*Nyssa sylvatica*	12.5	Good		
2794	Tulip poplar	*Liriodendron tulipifera*	24.0	Fair	Hollow	TBP
2795	White oak	*Quercus alba*	29.2	Excellent		
2796	American beech	*Fagus grandifolia*	26.2	Excellent		
2797	Red maple	*Acer rubrum*	14.6	Good		TBP
2798	Red maple	*Acer rubrum*	16.4	Good		
2799	American beech	*Fagus grandifolia*	23.6	Good		
2800	American beech	*Fagus grandifolia*	22.6	Good		
2801	Black gum	*Nyssa sylvatica*	12.3	Fair		
2802	American beech	*Fagus grandifolia*	13.5	Good		
2803	Hickory	*Carya sp.*	22.3	Good		
2804	American beech	*Fagus grandifolia*	13.8	Good		
2805	Tulip poplar	*Liriodendron tulipifera*	25.0	Fair	Hollow	TBP
2806	Unknown	*NA*	32.8	Dead	Hazard?	TBR
2807	Unknown	*NA*	15.0	Dead		TBP
2808	Tulip poplar	*Liriodendron tulipifera*	27.3	Poor		TBP
2809	American beech	*Fagus grandifolia*	34.5	Poor		TBR
2810	Tulip poplar	*Liriodendron tulipifera*	17.0	Good		TBP
2811	Tulip poplar	*Liriodendron tulipifera*	22.5	Poor	Tipped	TBR
2812	American beech	*Fagus grandifolia*	12.6	Good		TBR
2813	Red maple	*Acer rubrum*	13.4	Good		TBR
2814	American beech	*Fagus grandifolia*	22.0	Excellent		
2815	Tulip poplar	*Liriodendron tulipifera*	16.7	Good		
2816	American beech	*Fagus grandifolia*	14.5	Good		
2817	American beech	*Fagus grandifolia*	15.0	Fair	Stream bank erosion	TBP
2818	American beech	*Fagus grandifolia*	13.6	Excellent		TBP
2819	American beech	*Fagus grandifolia*	17.3	Excellent		
2820	White oak	*Quercus alba*	26.1	Fair		TBP
2821	Chestnut oak	*Quercus montana*	38.3	Poor		
2822	American beech	*Fagus grandifolia*	15.5	Good	Stream bank undercut	TBP
2823	American beech	*Fagus grandifolia*	13.5	Fair	Hollow	
2824	American beech	*Fagus grandifolia*	12.5	Good		
2825	Chestnut oak	*Quercus montana*	24.1	Fair		
2826	American beech	*Fagus grandifolia*	17.2	Good		
2827	American beech	*Fagus grandifolia*	16.5	Good		
2828	Chestnut oak	*Quercus montana*	39.4	Good		
2829	Tulip poplar	*Liriodendron tulipifera*	27.6	Fair	Hollow, stream bank erosion	TBP
2830	Black gum	*Nyssa sylvatica*	28.5	Good		TBP
2831	American beech	*Fagus grandifolia*	12.7	Good		TBP
2832	American beech	*Fagus grandifolia*	13.8	Good		TBP
2833	Chestnut oak	*Quercus montana*	14.4	Good		
2834	Tulip poplar	*Liriodendron tulipifera*	24.5	Good		TBP
2835	American beech	*Fagus grandifolia*	15.2	Good		
2836	American beech	*Fagus grandifolia*	16.0	Fair	Hollow	TBR
2837	Red oak	*Quercus rubra*	21.9	Dead	Hazard?	TBR
2838	Tulip poplar	*Liriodendron tulipifera*	27.2	Good	Stream bank undercut	TBR
2839	Chestnut oak	*Quercus montana*	17.0	Poor		TBP
2840	Hickory	*Carya sp.*	15.0	Good		
2841	Hickory	*Carya sp.*	15.7	Good	Stream bank erosion	TBP
2842	Chestnut oak	*Quercus montana*	17.8	Fair		TBP
2843	American beech	*Fagus grandifolia*	12.0	Good		
2844	Tulip poplar	*Liriodendron tulipifera*	26.5	Good		
2845	American beech	*Fagus grandifolia*	21.4	Good		
2846	Tulip poplar	*Liriodendron tulipifera*	35.8	Good	Stream bank erosion	TBP
2847	White oak	*Quercus alba*	26.5	Excellent		TBP
2848	American beech	*Fagus grandifolia*	13.9	Excellent		TBP
2849	Southern red oak	*Quercus falcata*	17.2	Good		
2850	American beech	*Fagus grandifolia*	12.8	Good		

NOTE:
1. STATUS INDICATES TREES WITHIN OR ADJACENT TO LOD THAT WILL BE REMOVED (TBR) OR PROTECTED (TBP) DURING CONSTRUCTION. ALL OTHER TREES ARE OUTSIDE OF THE LOD AND WILL NOT BE IMPACTED.

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	NA
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	6 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

EXISTING FEATURES AND SITE RESOURCES NOTES

ANNAPOLIS WATERWORKS FSD NARRATIVE

THE ANNAPOLIS WATERWORKS STREAM RESTORATION SITE CONTAINS ONE DISTINCT FOREST STAND. BASED ON DATA COLLECTED ON SITE ON SEPTEMBER 12, 2024, THE FOREST COMMUNITY HAS BEEN CLASSIFIED ACCORDING TO US NATIONAL VEGETATION INVENTORY TYPE AS A MID-ATLANTIC MESIC MIXED HARDWOOD FOREST. THE STREAM IS IN A SMALL VALLEY WITH MODERATELY STEEP WALLS, WITH THE TOPOGRAPHY BECOMING LESS STEEP AND THE FLOODPLAIN WIDENING AS THE WATERWAY MOVES DOWNSTREAM THROUGH THE PROJECT AREA. THERE IS A PALUSTRINE WETLAND IN THE DOWNSTREAM PORTION OF THE STREAM CORRIDOR, ACCORDING TO MARYLAND'S MERLIN DATABASE.

OUTSIDE THE IMMEDIATE STREAM CHANNEL, THE ENTIRE PROJECT SITE IS FORESTED. THE STREAM, BROAD CREEK, ORIGINATES FROM THE OUTFALL OF A STORMWATER DETENTION POND AND GENERALLY FLOWS FROM SOUTHEAST TO NORTHWEST. THERE IS A ROAD AND HEAVY COMMERCIAL DEVELOPMENT WITH HIGH PROPORTIONS OF IMPERVIOUS SURFACES TO THE SOUTHEAST. FORESTED AREAS SURROUND THE PROJECT SITE BEYOND THE OUTFALL, WITH A RESIDENTIAL NEIGHBORHOOD TO THE NORTH, BEYOND A FOREST BUFFER.

THE FOREST STAND AND ITS STRUCTURE ARE OF HIGH QUALITY, WITH CANOPY COVERAGE RANGING FROM 80%-100% THROUGHOUT THE SITE. THERE IS VERY LITTLE ENCROACHMENT OF NON-NATIVE INVASIVE (NNI) PLANT SPECIES, WITH MANY PLANT SPECIES IN ALL STRATA BEING NATIVE TO THE REGION. HOWEVER, DEER HERBIVORY IS VERY HIGH, WHICH IS HAMPERING REGENERATION OF TREE SEEDLINGS AND SLOWING RECRUITMENT EFFORTS OF TREE SPECIES TO HIGHER STRATA. THE SITE AND ITS SURROUNDING FOREST ARE CURRENTLY DESIGNATED ON MARYLAND'S MERLIN DATABASE AS FOREST AND WERE HISTORICALLY CLASSIFIED AS FOREST AS WELL.

THE MIXED HARDWOOD STAND THAT IS WITHIN THE PROJECT AREA PROPOSED LIMITS OF DISTURBANCE (LOD) IS APPROXIMATELY 6.4 ACRES AND IS SURROUNDED BY ADDITIONAL FOREST ON ALL SIDES EXCEPT FOR THE EXTREME SOUTHEAST EDGE, WHICH IS BORDERED BY A ROAD. THE FOREST IN THE PROJECT AREA IS CHARACTERIZED BY A TREE CANOPY DOMINATED BY MATURE BEECH (*FAGUS GRANDIFOLIA*) AND TULIP POPLAR (*LIRIODENDRON TULIPIFERA*) TREES, SEVERAL OF WHICH ARE OF SPECIMEN SIZE. OTHER TREE SPECIES IN THE PROJECT AREA WERE DOCUMENTED AND ARE RED MAPLE (*ACER RUBRUM*), HICKORIES (*CARYA* SPP., LIKELY *CARYA TOMENTOSA*), BLACK GUM (*NYSSA SYLVATICA*), WHITE OAK (*QUERCUS ALBA*), SOUTHERN RED OAK (*QUERCUS FALCATA*), RED OAK (*QUERCUS RUBRA*), AND CHESTNUT OAK (*QUERCUS MONTANA*). ALL THE AFOREMENTIONED SPECIES WERE PRESENT IN THE PROJECT AREA WITH AT LEAST ONE INDIVIDUAL OF 12" DIAMETER AT BREAST HEIGHT (DBH) OR GREATER. OF THE TREES 12" DBH OR GREATER, TEN WERE OF SPECIMEN SIZE. FOUR WERE BEECH, THREE WERE TULIP POPLAR, THREE WERE CHESTNUT OAK, AND ONE WAS A WHITE OAK. ONE WAS IN EXCELLENT CONDITION, THREE WERE GOOD, THREE WERE FAIR, AND THREE WERE IN POOR CONDITION. TWO LARGE TREES WERE DEAD AND STILL STANDING AS OF THE DATE OF DATA COLLECTION.

UNDERSTORY TREE SPECIES IN POLE, SAPLING, AND SEEDLING SIZES OBSERVED AND DOCUMENTED VIA FOREST STAND PLOTS ALSO INCLUDED AMERICAN HOLLY (*ILEX OPACA),* MOCKERNUT HICKORY (*CARYA TOMENTOSA*), IRONWOOD (*CARPINUS CAROLINIANA*), BLACK CHERRY (*PRUNUS SEROTINA*), AND WILLOW OAK (*QUERCUS PHELLOS*). THERE WERE 14 DISTINCT NATIVE TREE SPECIES ACROSS ALL STRATA DOCUMENTED AT THE SITE, WITH AN AVERAGE OF APPROXIMATELY 280 LIVE STEMS PER ACRE. LIVE STEMS 2 INCHES DBH AND GREATER AVERAGED 190 PER ACRE.

WHILE NNI SPECIES WERE RARE, THERE WERE SOME DOCUMENTED AT THE SITE IN SMALL NUMBERS. THE OBSERVED AND DOCUMENTED SPECIES WERE JAPANESE BARBERRY (*BERBERIS THUNGERGII*), JAPANESE HONEYSUCKLE (*LONICERA JAPONICA*), ENGLISH IVY (*HEDERA HELIX*), JAPANESE STILTGRASS (*MICROSTEGIUM VIMINEUM*), MILE-A-MINUTE (*PERSICARIA PERFOLIATA*), AND JAPANESE KNOTWEED (*REYNOUTRIA JAPONICA*). DESPITE THE OCCURRENCES OF THESE NNI SPECIES, THE VAST MAJORITY OF PLANT SPECIES IN THE LOWER STRATA WERE NATIVE. NONE OF THE PLANT SPECIES DOCUMENTED WERE CONSIDERED RARE, THREATENED OR ENDANGERED AS OF THE DATE OF DATA COLLECTION.

THE RETENTION POTENTIAL OF THE PROJECT AREA FOREST STAND IS HIGH, GIVEN ITS HIGH QUALITY, DIVERSITY OF NATIVE PLANT SPECIES, AND SURROUNDING FORESTED BUFFER. ALTHOUGH THE PROPOSED STREAM RESTORATION COULD INVOLVE CLEARING OF FOREST, THESE ARE TEMPORARY IMPACTS WITH NO PERMANENT CHANGE IN LAND USE OR COVER TYPE. REFORESTATION IS PROPOSED FOR ALL AREAS OF TREE REMOVAL WITHIN THE LOD. CONSIDERATION SHOULD BE GIVEN TO MONITORING AND EARLY TREATMENT OF NNI SPECIES, AS WELL AS POTENTIAL PROTECTION OF TREE SEEDLINGS FROM DEER BROWSE.

Property: Annapolis Waterworks Park **Prepared By: B. Salladin**
Stand #: 1 **Plot #:** C **Plot Size:** 1/10 AC **Date: 09/13/2024**
Basal Area (sf/ac): 185

Size Class of Trees >20' in height within sample plot

Tree Species	# of Trees 2-5.9" dbh			# of Trees 6-11.9" dbh			# of Trees 12-19.9" dbh			# of Trees 20-29.9" dbh			# of Trees >30" dbh			TOTAL
Crown Position	Dom	CoD	Other	Dom	CoD	Other	Dom	CoD	Other	Dom	CoD	Other	Dom	CoD	Other	
American beech			7					1								8
American holly			1													1
Ironwood			1			2										3
Mockernut Hickory			1													1
Tulip poplar								1			1			1		3
Red maple						1		2								3
																0
																0
																0
																0
																0
																0
																0
																0
Total Number of Trees per Size Class	10			3			4			1			1			19
Number & Size of Standing Dead Trees	0			0			0			0			0			0

Common Understory Species 3'-20':	% of Canopy Closure					TOTAL
American beech	Y	Y	Y	N	Y	80
Barberry	% Understory Cover 3-20'					
Ironwood	Y	N	N	N	N	20
Hickory	% of Herbaceous Cover 0'-3'					
Common Herbaceous Species 0'-3':	Y	Y	Y	Y	W	80
Christmas fern	% Downed Woody Debris					
Greenbriar	Y	Y	Y	N	N	60
Eastern wahoo	% Invasive Cover by Layer					
Netted chain fern	C		U		H	
Sedge	0		0		5	

Percent of Invasive Cover per Plot (All Layers): 8

Plot Successional Stage: Mature Forest

Total Trees per Acre: 190

Property: Annapolis Waterworks Park **Prepared By: B. Salladin**
Stand #: 1 **Plot #:** A **Plot Size:** 1/10 AC **Date: 09/13/2024**
Basal Area (sf/ac): 280

Size Class of Trees >20' in height within sample plot

Tree Species	# of Trees 2-5.9" dbh			# of Trees 6-11.9" dbh			# of Trees 12-19.9" dbh			# of Trees 20-29.9" dbh			# of Trees >30" dbh			TOTAL
Crown Position	Dom	CoD	Other	Dom	CoD	Other	Dom	CoD	Other	Dom	CoD	Other	Dom	CoD	Other	
American beech			7		2			3			1					13
American holly			2													2
Black gum		1														1
Chestnut oak								1								1
Hickory		1			1											2
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
Total Number of Trees per Size Class	11			3			4			1			0			19
Number & Size of Standing Dead Trees				1												1

Common Understory Species 3'-20':	% of Canopy Closure					TOTAL
American beech	Y	Y	Y	Y	Y	100
American holly	% Understory Cover 3-20'					
Black gum	N	N	N	Y	N	20
	% of Herbaceous Cover 0'-3'					
Common Herbaceous Species 0'-3':	N	Y	N	N	N	20
Christmas fern	% Downed Woody Debris					
Greenbriar	Y	N	N	N	N	20
Wintergreen	% Invasive Cover by Layer					
Partridgeberry	C		U		H	
American beech seedlings	0		0		0	

Percent of Invasive Cover per Plot (All Layers): 0

Plot Successional Stage: Mature Forest

Total Trees per Acre: 190

Property: Annapolis Waterworks Park **Prepared By: B. Salladin**
Stand #: 1 **Plot #:** B **Plot Size:** 1/10 AC **Date: 09/13/2024**
Basal Area (sf/ac): 196

Size Class of Trees >20' in height within sample plot

Tree Species	# of Trees 2-5.9" dbh			# of Trees 6-11.9" dbh			# of Trees 12-19.9" dbh			# of Trees 20-29.9" dbh			# of Trees >30" dbh			TOTAL
Crown Position	Dom	CoD	Other	Dom	CoD	Other	Dom	CoD	Other	Dom	CoD	Other	Dom	CoD	Other	
American beech			9		2			3								14
American holly			2													2
Black gum					1											1
Chestnut oak								1								1
White oak					1											1
Tulip poplar								1								1
																0
																0
																0
																0
																0
																0
																0
																0
																0
Total Number of Trees per Size Class	11			4			0			5			0			20
Number & Size of Standing Dead Trees	1			1			1			1						4

Common Understory Species 3'-20':	% of Canopy Closure					TOTAL
American beech	Y	Y	Y	N	Y	80
Hickory	% Understory Cover 3-20'					
Mtn Laurel	Y	N	N	N	N	20
	% of Herbaceous Cover 0'-3'					
Common Herbaceous Species 0'-3':	C	N	E	S	W	0
Christmas fern	% Downed Woody Debris					
Greenbriar	Y	N	N	N	N	20
Eastern wahoo	% Invasive Cover by Layer					
	C		U		H	
	0		0		5	

Percent of Invasive Cover per Plot (All Layers): 2

Plot Successional Stage: Mature Forest

Total Trees per Acre: 200

ANNAPOLIS WATERWORKS WETLAND DELINEATION SUMMARY STATEMENT

THREE NONTIDAL WETLANDS (WETLAND 3, 4 AND 5) WERE DELINEATED WITHIN THE LIMITS OF DELINEATION (SEE TABLE 1). WETLANDS 3 AND 4 (W3 AND W4) ARE CLASSIFIED AS PALUSTRINE FORESTED (PFO) AND ARE LOCATED ALONG FLOODPLAIN BENCHES BEGINNING AT THE CONFLUENCE OF BROAD CREEK AND THE MAIN TRIBUTARY. ITS WETLAND HYDROLOGY IS SUPPORTED BY GROUNDWATER, SURFACE RUNOFF FROM THE ADJACENT UPLAND HILLSLOPES, AND OVERBANK FLOWS FROM THE TRIBUTARY. WETLAND 5 (W5) IS CLASSIFIED AS PALUSTRINE FORESTED (PFO) AND PALUSTRINE EMERGENT, IT BEGINS AT THE CONFLUENCE OF THE MAIN TRIBUTARY AND XXX AND CONTINUES TO THE WEST BEYOND THE LIMITS OF DELINEATION. ITS WETLAND HYDROLOGY IS SUPPORTED BY GROUNDWATER, SURFACE RUNOFF FROM THE ADJACENT UPLAND HILLSLOPES, AND OVERBANK FLOWS FROM THE MAIN TRIBUTARY. BASED ON BIOHABITATS BEST PROFESSIONAL JUDGEMENT, IT IS ANTICIPATED THE DELINEATED WETLANDS ARE JURISDICTIONAL UNDER THE CLEAN WATER ACT AND WILL BE REGULATED BY THE US ARMY CORPS OF ENGINEERS (USACE) AND MARYLAND DEPARTMENT OF THE ENVIRONMENT (MDE).

Table 1 Nontidal Wetland Summary

Wetland Name	Area Within Survey Limits: Square Feet	Area Within Survey Limits: Acres	Classification (Cowardin et. al., 1979)
Wetland 3	2,702	0.06	PFO
Wetland 4	269	0.006	PFO
Wetland 5	41,588	0.95	PFO/PEM

Annapolis Waterworks Park Project Specimen Trees

Tree ID	Species	Scientific Name	DBH	Condition
2735	American beech	*Fagus grandifolia*	26.9	Excellent
2751	American beech	*Fagus grandifolia*	30.4	Fair
2766	Chestnut oak	*Quercus montana*	32.3	Dead
2767	Tulip poplar	*Liriodendron tulipifera*	45.0	Poor
2769	White oak	*Quercus alba*	42.8	Fair
2770	American beech	*Fagus grandifolia*	30.9	Fair
2783	Tulip poplar	*Liriodendron tulipifera*	34.7	Good
2806	Unknown	*NA*	32.8	Dead
2809	American beech	*Fagus grandifolia*	34.5	Poor
2821	Chestnut oak	*Quercus montana*	38.3	Poor
2828	Chestnut oak	*Quercus montana*	39.4	Good
2846	Tulip poplar	*Liriodendron tulipifera*	35.8	Good

SOILS TABLE

Map Unit Symbol	Soil Series	Hydric Soil Rating	Erodibility Factor
AsF	Annapolis fine sandy loam, 25 to 40 percent slopes	No	0.24
Uz	Urban land	No	N/A
WBA	Widewater and Issue soils, 0 to 2 percent slopes, frequently flooded	Yes	0.37

MD DNR QUALIFIED PROFESSIONAL
SAF CERTIFIED FORESTER
ISA CERTIFIED ARBORIST

Signed: Date: 05/04/2026

Bryon W. Salladin
2081 Clipper Park Road, Baltimore, MD 21211
410-554-0156 ext. 1030
bsalladin@biohabitats.com

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation
ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED DATE — CHIEF ENGINEER
APPROVED DATE — PROJECT MANAGER
APPROVED DATE — ASSISTANT CHIEF ENGINEER
APPROVED DATE — CHIEF, RIGHT-OF-WAY

SCALE:	NA
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	7 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

FOREST STAND DELINEATION NOTES

FWS TRILOGY LETTER

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Ecological Services Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401-7307
Phone: (410) 573-4599 Fax: (410) 266-9127

In Reply Refer To: 03/05/2026 15:19:10 UTC
Project code: 2024-0135287
Project Name: Annapolis Waterworks Park

Federal Nexus: no
Federal Action Agency (if applicable):

Subject: Technical assistance for 'Annapolis Waterworks Park'

Dear Kayla Brown:

This letter records your determination using the Information for Planning and Consultation (IPaC) system provided to the U.S. Fish and Wildlife Service (Service) on March 05, 2026, for 'Annapolis Waterworks Park' (here forward, Project). This project has been assigned Project Code 2024-0135287 and all future correspondence should clearly reference this number. **Please carefully review this letter. Your Endangered Species Act (Act) requirements may not bbe complete.**

Ensuring Accurate Determinations When Using IPaC

The Service developed the IPaC system and associated species' determination keys in accordance with the Endangered Species Act of 1973 (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and based on a standing analysis. All information submitted by the Project proponent into IPaC must accurately represent the full scope and details of the Project.

Failure to accurately represent or implement the Project as detailed in IPaC or the Northern Long-eared Bat and Tricolored Bat Range-wide Determination Key (Dkey), invalidates this letter. ***Answers to certain questions in the DKey commit the project proponent to implementation of conservation measures that must be followed for the ESA determination to remain valid. Note that conservation measures for northern long-eared bat and tricolored bat may differ. If both bat species are present in the action area and the key suggests more conservative measures for one of the species for your project, the Project may need to apply the most conservative measures in order to avoid adverse effects. If unsure which conservation measures should be applied, please contact the appropriate Ecological Services Field Office***

Determination for the Northern Long-Eared Bat and Tricolored Bat

Based upon your IPaC submission and a standing analysis completed by the Service, your project has reached the following effect determination(s):

Species	Listing Status	Determination
Tricolored Bat (*Perimyotis subflavus*)	Proposed Endangered	NLAA

Federal agencies must consult with U.S. Fish and Wildlife Service under section 7(a)(2) of the Endangered Species Act (ESA) when an action *may affect* a listed species. Tricolored bat is proposed for listing as endangered under the ESA, but not yet listed. For actions that may affect a proposed species, agencies cannot consult, but they can *confer* under the authority of section 7(a)(4) of the ESA. Such conferences can follow the procedures for a consultation and be adopted as such if and when the proposed species is listed. Should the tricolored bat be listed, agencies must review projects that are not yet complete, or projects with ongoing effects within the tricolored bat range that previously received a NE or NLAA determination from the key to confirm that the determination is still accurate.

You have indicated that you must remove a hazard tree in order to prevent imminent loss of human life. Be advised that the Act's implementing regulations (50 CFR part 17) include a take exemption pursuant to the defense of human life (for endangered species, see 50 CFR 17.21(c)(2)): ''any person may take endangered [or threatened] wildlife in defense of his own life or the lives of others.''). The regulations at 50 CFR 17.21(c)(4) require that any person taking, including killing, listed wildlife in defense of human life under this exception must notify our headquarters Office of Law Enforcement, at the address provided at 50 CFR 2.1(b), in writing, within 5 days. In addition, section 11 of the Act enumerates the penalties and enforcement of the Act. In regard to civil penalties, section 11(a)(3) of the Act states, ''Notwithstanding any other provision of this [Act], no civil penalty shall be imposed if it can be shown by a preponderance of the evidence that the defendant committed an act based on a good faith belief that he was acting to protect himself or herself, a member of his or her family, or any other individual from bodily harm, from any endangered or threatened species'' (16 U.S.C. 1540(a)(3)). Section 11(b)(3) of the Act contains similar language in regard to criminal violations (see 16 U.S.C. 1540(b)(3)). If you think incidental take of listed bats was reasonably certain to have occurred as a result of your hazard tree removal, we advise you to contact the Office of Law Enforcement as outlined above. In the future, we recommend planning ahead so that tree removal of potentially hazardous trees does not become an emergency. If you determine an emergency exists, however, and human life is in imminent danger, do not delay action. Also do not delay action if removal of the hazard tree is part of a federal response to a situation involving an act of God, disaster, casualty, national defense or security emergency, etc. - coordinate with the local USFWS field office as soon as practicable after the emergency is under control.

Other Species and Critical Habitat that May be Present in the Action Area

The IPaC-assisted determination key for the northern long-eared bat and tricolored bat does not apply to the following ESA-protected species and/or critical habitat that also may occur in your Action area:

- Monarch Butterfly *Danaus plexippus* Proposed Threatened

MHT TRILOGY LETTER

Date: October 11, 2024

To: Kayla Brown
Biohabitats Inc

Project Name: Annapolis Waterworks Park Stream Restoration
County: Anne Arundel County
Agency: Corps of Engineers
Second Agency: -- Not noted --
MHT Log #: 202404233

MHT Response: Thank you for providing the Maryland Historical Trust the opportunity to comment on the above-referenced undertaking using the MHT e106 system. The Maryland Historical Trust has reviewed the submitted project for its effects on historic and archeological resources, pursuant to Section 106 of the National Historic Preservation Act of 1966 and/or the Maryland Historical Trust Act of 1985. We offer the following comments and/or concurrence with the agency's findings:

No historic properties will be affected by the proposed undertaking. Additional consultation with our office may be required if there are any significant changes in project scope or location.

Thank you for your cooperation in this review process. Since the MHT response is now complete, this response will appear in the Completed section of your project dashboard. No hard copy of this response or attachments will be sent. If you have questions, please contact the following MHT project reviewers:

Dixie Henry dixie.henry@maryland.gov

Maryland Historical Trust
Project Review and Compliance
100 Community Place
Crownsville, MD 21032
mht.section106@maryland.gov

MHT.Maryland.gov
Planning.Maryland.gov

DNR TRILOGY LETTER

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Wes Moore, Governor
Aruna Miller, Lt. Governor
Josh Kurtz, Secretary
David Goshorn, Deputy Secretary

June 10, 2026

Ms. Kayla Brown
Biohabitats, Inc.
The Stables Building
2081 Clipper Park Road
Baltimore, MD 21211

RE: Environmental Review for Annapolis Waterworks Stream Restoration, Annapolis Waterworks Trail - Housley Road Trailhead, Anne Arundel County, Maryland.

Dear Ms. Brown:

The Wildlife and Heritage Service has determined that there is a wetland on site designated as a Nontidal Wetland of Special State Concern that is associated with the South Basin of Broad Creek. Nontidal Wetlands of Special State Concern are regulated, along with their 100-foot upland buffer, as such by Maryland Department of the Environment. Your project may need review by MDE for any necessary permits related to this wetland.

Part of the reason that this Nontidal Wetland of Special State Concern is designated here is due to the presence of a state-listed endangered orchid documented on the Annapolis Waterworks Park property. This species only occurs at four other known locations in the state and is vulnerable to collection. This orchid may be difficult to survey, as it does not produce above-ground growth every year. A habitat assessment may be warranted, so that potential habitat for this species can be removed from the limits-of-disturbance. It is thought that this rare plant species relies on a soil fungus in order to absorb water and nutrients and that the fungus only grows in well developed, undisturbed, loamy soils. Due to the rare plant's association with soil fungi, any disturbance that dries or compacts the soil may eliminate this occurrence. For further technical assistance regarding conservation measures for the endangered orchid on this site, please contact Katharine McCarthy of the Wildlife and Heritage Service at Katharine.mccarthy@maryland.gov or at 410-260-8569.

Also, invasive species pose a threat to this occurrence of the endangered orchid. The upland slopes and trails around the impoundment are bordered by non-native species such as Japanese honeysuckle (*Lonicera japonica*) and English ivy (*Hedera helix*). We would encourage the applicant to take appropriate measures to prevent the introduction or further spread of invasive species into the rare species habitat.

In addition, our remote analysis suggests that the forested area on this property contains Forest Interior Dwelling Species (FIDS) habitat, especially for birds. Populations of many bird species which depend on this type of forested habitat are declining in Maryland and throughout the Eastern United States. The declines in FIDS populations have been attributed in part to the loss and fragmentation of forests due largely to urbanization, agriculture, and some forest management practices. The key to maintaining suitable breeding habitat for FIDS, and halting or reversing their declines, is the protection of extensive, unbroken forested areas throughout the region. The conservation of FIDS habitat throughout Maryland is strongly encouraged by the Wildlife and Heritage Service.

If the project changes in the future such that the limits of proposed disturbance or overall site boundaries are modified, please provide us with revised project maps and we will provide you with an updated evaluation. Thank you for allowing us the opportunity to review this project. If you should have any further questions regarding this information, please contact me at lori.byrne@maryland.gov or at (410) 260-8573.

Sincerely,

Lori A. Byrne,
Environmental Review Coordinator
Wildlife and Heritage Service
MD Dept. of Natural Resources

ER# 2026.0794.aa
Cc: K. McCarthy, DNR

MD DNR QUALIFIED PROFESSIONAL
SAF CERTIFIED FORESTER
ISA CERTIFIED ARBORIST

Signed: Date: 05/04/2026

Bryon W. Salladin
2081 Clipper Park Road, Baltimore, MD 21211
410-554-0156 ext. 1030
bsalladin@biohabitats.com

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY	APPROVED / DATE	APPROVED / DATE
		CHIEF ENGINEER	PROJECT MANAGER
		APPROVED / DATE	APPROVED / DATE
		ASSISTANT CHIEF ENGINEER	CHIEF, RIGHT-OF-WAY

SCALE:	NA
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	8 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

FOREST STAND DELINEATION NOTES

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\cv01aw.dwg

MATCHLINE - SHEET 10

REGATTA BAY II
LTD PARTNERSHIP
L.13917 F.251

CITY OF ANNAPOLIS
MAYOR & ALDERMN
L.2410 F.360

KRG GATEWAY
VILLAGE LLC
NO DEED
REFFERENCE
PLAT 180 F.33

EXTENTS OF RESIDENTIAL PARKING LOT
DUMPSTERS
RESIDENTIAL PARKING LOT
RESIDENTIAL APARTMENT BUILDING
EXTENTS OF RESIDENTIAL PARKING LOT
SIDEWALK
EXISTING TRAIL
CENTERLINE OF STREAM & THALWEG
FLOW
RIPRAP
CONCRETE HEADWALL
INV 8" HDPE=52.91
INV 56" RCP=48.39
INV 8" HDPE=52.94
#2751
#2846
#2735
FSD-1B
TR 101
TR 100
TR 3
TR 2
AsF
WBA
WB
WBA
AsF
ASF
UZ
GRASS
GRASS
CONCRETE CURB
CONCRETE WALK
STORM DRAIN INLET
TOP ELEV=67.80
INV(SE)21" RCP=63.30
STORM DRAIN MANHOLE
TOP ELEV=67.64
INV(NW)21" RCP=62.94
INV(NE)21" RCP=61.74
INV(SW)21" RCP=63.54
CONCRETE RISER (SEE DIAGRAM)
TOP ELEV=67.85
INV 56" RCP=49.00
INV 12" RCP=55.95
POND
STORM DRAIN INLET
TOP ELEV=67.97
INV(NW) 21" RCP=64.22
HAND RAIL
HOUSLEY ROAD
(60' PUBLIC R/W)
S 38°21'21" W 317.02'
HAND BOX
SD 21" RCP
SD
SIDE FLOW CONC.

NOTES:
1. FOREST STAND DELINEATION PLAN BASED ON DATA COLLECTED ON SITE ON SEPTEMBER 12, 2024.

MD DNR QUALIFIED PROFESSIONAL
SAF CERTIFIED FORESTER
ISA CERTIFIED ARBORIST

Signed: _____ Date: 05/04/2026

Bryon W. Salladin
2081 Clipper Park Road, Baltimore, MD 21211
410-554-0156 ext. 1030
bsalladin@biohabitats.com

HORIZONTAL SCALE
0 20 40

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation
ARUNDELRIVERS.ORG

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

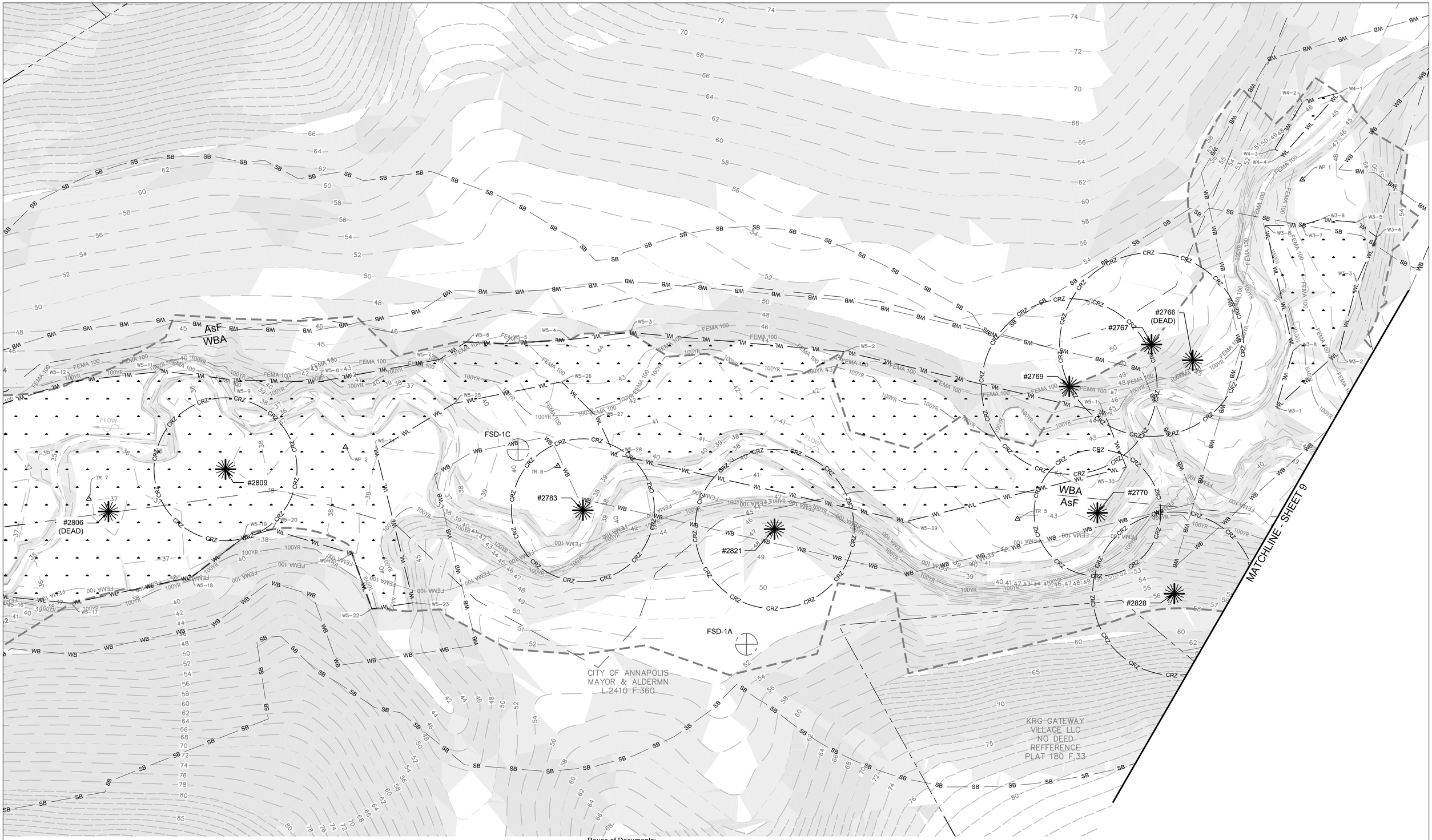
APPROVED DATE	APPROVED DATE
CHIEF ENGINEER	PROJECT MANAGER
APPROVED DATE	APPROVED DATE
ASSISTANT CHIEF ENGINEER	CHIEF, RIGHT-OF-WAY

SCALE:	1" = 20'
DRAWN BY	KB
CHECKED BY	DSJC
SHEET NO.	9 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

FOREST STAND DELINEATION PLAN

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\fsd01aw.dwg



NOTES:
1. FOREST STAND DELINEATION PLAN BASED ON DATA COLLECTED ON SITE ON SEPTEMBER 12, 2024.

MD DNR QUALIFIED PROFESSIONAL
SAF CERTIFIED FORESTER
ISA CERTIFIED ARBORIST

Signed: Bryon W. Salladin Date: 05/04/2026

Bryon W. Salladin
2081 Clipper Park Road, Baltimore, MD 21211
410-554-0156 ext. 1030
bsalladin@biohabitats.com

HORIZONTAL SCALE
0 20 40

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation
ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

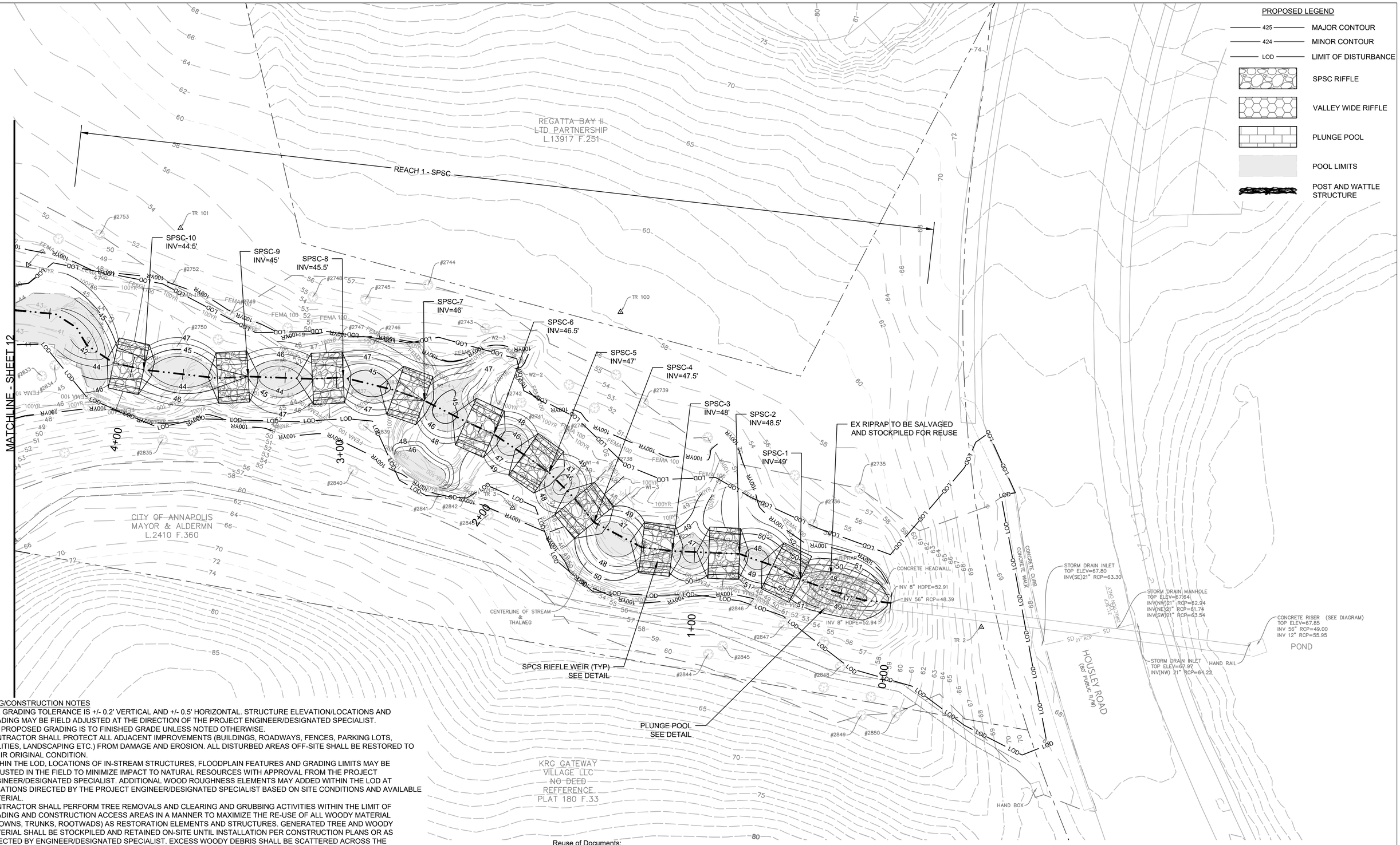
REVISED DATE	BY

APPROVED DATE		APPROVED DATE	
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED DATE		APPROVED DATE	
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	1" = 20'
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	10 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

FOREST STAND DELINEATION PLAN



GRADING/CONSTRUCTION NOTES

1. THE GRADING TOLERANCE IS +/- 0.2' VERTICAL AND +/- 0.5' HORIZONTAL. STRUCTURE ELEVATION/LOCATIONS AND GRADING MAY BE FIELD ADJUSTED AT THE DIRECTION OF THE PROJECT ENGINEER/DESIGNATED SPECIALIST.
2. ALL PROPOSED GRADING IS TO FINISHED GRADE UNLESS NOTED OTHERWISE.
3. CONTRACTOR SHALL PROTECT ALL ADJACENT IMPROVEMENTS (BUILDINGS, ROADWAYS, FENCES, PARKING LOTS, UTILITIES, LANDSCAPING ETC.) FROM DAMAGE AND EROSION. ALL DISTURBED AREAS OFF-SITE SHALL BE RESTORED TO THEIR ORIGINAL CONDITION.
4. WITHIN THE LOD, LOCATIONS OF IN-STREAM STRUCTURES, FLOODPLAIN FEATURES AND GRADING LIMITS MAY BE ADJUSTED IN THE FIELD TO MINIMIZE IMPACT TO NATURAL RESOURCES WITH APPROVAL FROM THE PROJECT ENGINEER/DESIGNATED SPECIALIST. ADDITIONAL WOOD ROUGHNESS ELEMENTS MAY ADDED WITHIN THE LOD AT LOCATIONS DIRECTED BY THE PROJECT ENGINEER/DESIGNATED SPECIALIST BASED ON SITE CONDITIONS AND AVAILABLE MATERIAL.
5. CONTRACTOR SHALL PERFORM TREE REMOVALS AND CLEARING AND GRUBBING ACTIVITIES WITHIN THE LIMIT OF GRADING AND CONSTRUCTION ACCESS AREAS IN A MANNER TO MAXIMIZE THE RE-USE OF ALL WOODY MATERIAL (CROWNS, TRUNKS, ROOTWADS) AS RESTORATION ELEMENTS AND STRUCTURES. GENERATED TREE AND WOODY MATERIAL SHALL BE STOCKPILED AND RETAINED ON-SITE UNTIL INSTALLATION PER CONSTRUCTION PLANS OR AS DIRECTED BY ENGINEER/DESIGNATED SPECIALIST. EXCESS WOODY DEBRIS SHALL BE SCATTERED ACROSS THE FLOODPLAIN, PRIMARILY FOCUSED ALONG CONCENTRATED FLOW PATHS TO INTERUPT DIRECT DOWN VALLEY DIRECTION OF OVERBANK FLOWS.
6. ALL TREE REMOVALS SHALL BE DONE IN A MANNER TO MINIMIZE NEGATIVE IMPACTS TO RESIDUAL STANDING TREES, SHRUBS AND WETLANDS.
7. THE GRADING PLAN DOES NOT SHOW ALL ELEMENTS OF EACH STRUCTURE. SEE CONSTRUCTION DETAILS AND NOTES FOR INSTALLATION AND DETAIL OF EACH STRUCTURE.
8. SEE EROSION AND SEDIMENT CONTROL SHEETS FOR CONSTRUCTION ACCESS AND SEDIMENT CONTROL MEASURES.
9. IF NEEDED, IMPORTED ROOTWADS AND WOOD MATERIAL SHALL BE AS FRESHLY HARVESTED TO MAXIMUM EXTENT POSSIBLE, MAXIMUM HARVEST OF FOUR MONTHS PRIOR, WITH MINIMAL DECAY, AND MEET THE SPECIFICATION PROVIDED IN THE CONSTRUCTION DETAILS.
10. SEE DRAWING 22 FOR TREE PROTECTION AND REMOVAL NOTES AND DETAILS.

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED DATE		APPROVED DATE	
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED DATE		APPROVED DATE	
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	1" = 20'
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	11 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

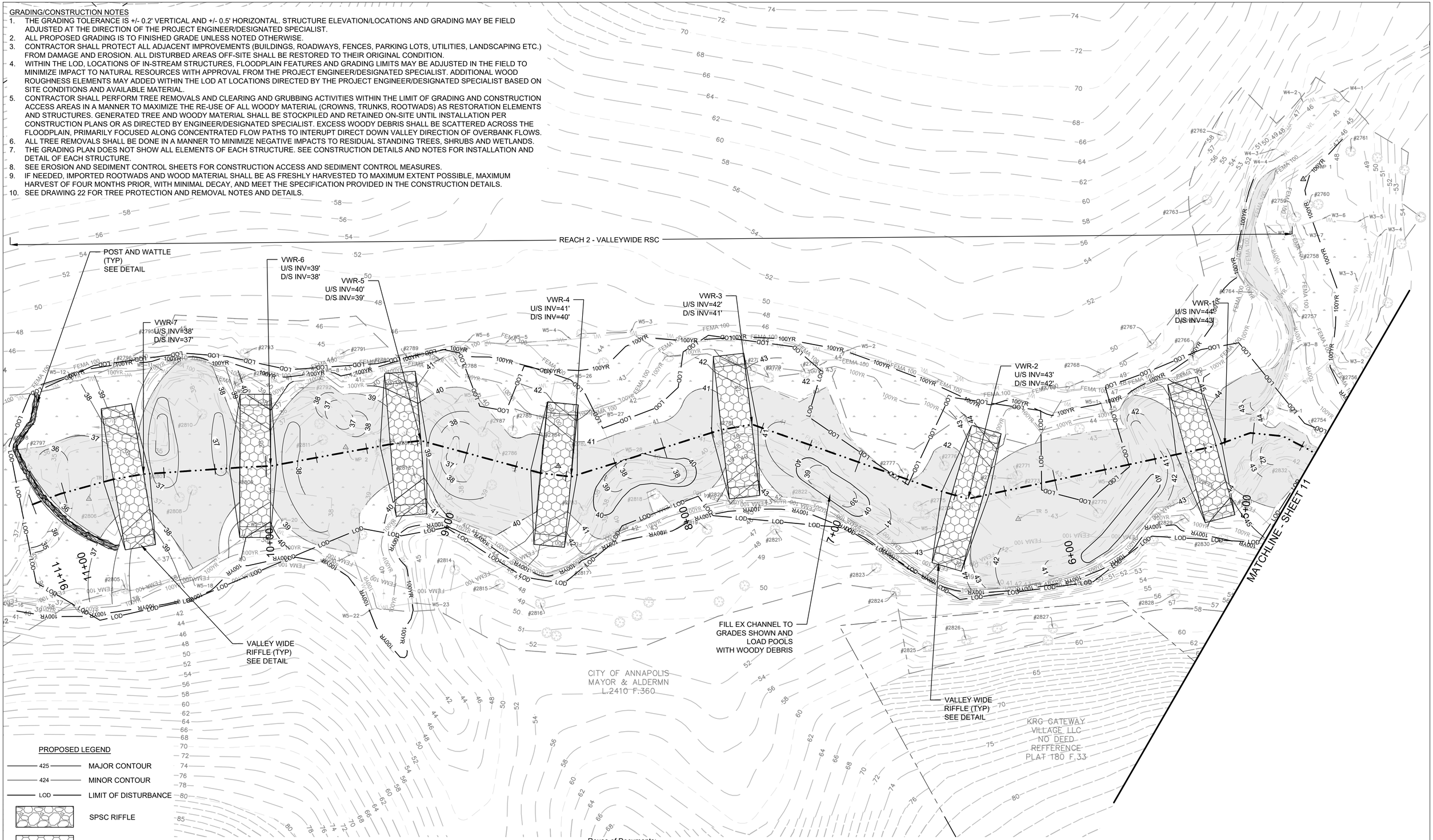
ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

GRADING PLAN

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\pc01aw.dwg

GRADING/CONSTRUCTION NOTES

1. THE GRADING TOLERANCE IS +/- 0.2' VERTICAL AND +/- 0.5' HORIZONTAL. STRUCTURE ELEVATION/LOCATIONS AND GRADING MAY BE FIELD ADJUSTED AT THE DIRECTION OF THE PROJECT ENGINEER/DESIGNATED SPECIALIST.
2. ALL PROPOSED GRADING IS TO FINISHED GRADE UNLESS NOTED OTHERWISE.
3. CONTRACTOR SHALL PROTECT ALL ADJACENT IMPROVEMENTS (BUILDINGS, ROADWAYS, FENCES, PARKING LOTS, UTILITIES, LANDSCAPING ETC.) FROM DAMAGE AND EROSION. ALL DISTURBED AREAS OFF-SITE SHALL BE RESTORED TO THEIR ORIGINAL CONDITION.
4. WITHIN THE LOD, LOCATIONS OF IN-STREAM STRUCTURES, FLOODPLAIN FEATURES AND GRADING LIMITS MAY BE ADJUSTED IN THE FIELD TO MINIMIZE IMPACT TO NATURAL RESOURCES WITH APPROVAL FROM THE PROJECT ENGINEER/DESIGNATED SPECIALIST. ADDITIONAL WOOD ROUGHNESS ELEMENTS MAY ADDED WITHIN THE LOD AT LOCATIONS DIRECTED BY THE PROJECT ENGINEER/DESIGNATED SPECIALIST BASED ON SITE CONDITIONS AND AVAILABLE MATERIAL.
5. CONTRACTOR SHALL PERFORM TREE REMOVALS AND CLEARING AND GRUBBING ACTIVITIES WITHIN THE LIMIT OF GRADING AND CONSTRUCTION ACCESS AREAS IN A MANNER TO MAXIMIZE THE RE-USE OF ALL WOODY MATERIAL (CROWNS, TRUNKS, ROOTWADS) AS RESTORATION ELEMENTS AND STRUCTURES. GENERATED TREE AND WOODY MATERIAL SHALL BE STOCKPILED AND RETAINED ON-SITE UNTIL INSTALLATION PER CONSTRUCTION PLANS OR AS DIRECTED BY ENGINEER/DESIGNATED SPECIALIST. EXCESS WOODY DEBRIS SHALL BE SCATTERED ACROSS THE FLOODPLAIN, PRIMARILY FOCUSED ALONG CONCENTRATED FLOW PATHS TO INTERUPT DIRECT DOWN VALLEY DIRECTION OF OVERBANK FLOWS.
6. ALL TREE REMOVALS SHALL BE DONE IN A MANNER TO MINIMIZE NEGATIVE IMPACTS TO RESIDUAL STANDING TREES, SHRUBS AND WETLANDS.
7. THE GRADING PLAN DOES NOT SHOW ALL ELEMENTS OF EACH STRUCTURE. SEE CONSTRUCTION DETAILS AND NOTES FOR INSTALLATION AND DETAIL OF EACH STRUCTURE.
8. SEE EROSION AND SEDIMENT CONTROL SHEETS FOR CONSTRUCTION ACCESS AND SEDIMENT CONTROL MEASURES.
9. IF NEEDED, IMPORTED ROOTWADS AND WOOD MATERIAL SHALL BE AS FRESHLY HARVESTED TO MAXIMUM EXTENT POSSIBLE, MAXIMUM HARVEST OF FOUR MONTHS PRIOR, WITH MINIMAL DECAY, AND MEET THE SPECIFICATION PROVIDED IN THE CONSTRUCTION DETAILS.
10. SEE DRAWING 22 FOR TREE PROTECTION AND REMOVAL NOTES AND DETAILS.



PROPOSED LEGEND

- 425 — MAJOR CONTOUR
- 424 — MINOR CONTOUR
- LOD — LIMIT OF DISTURBANCE
- SPSC RIFFLE
- VALLEY WIDE RIFFLE
- PLUNGE POOL
- POOL LIMITS
- POST AND WATTLE STRUCTURE

HORIZONTAL SCALE
0 20 40

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation
ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

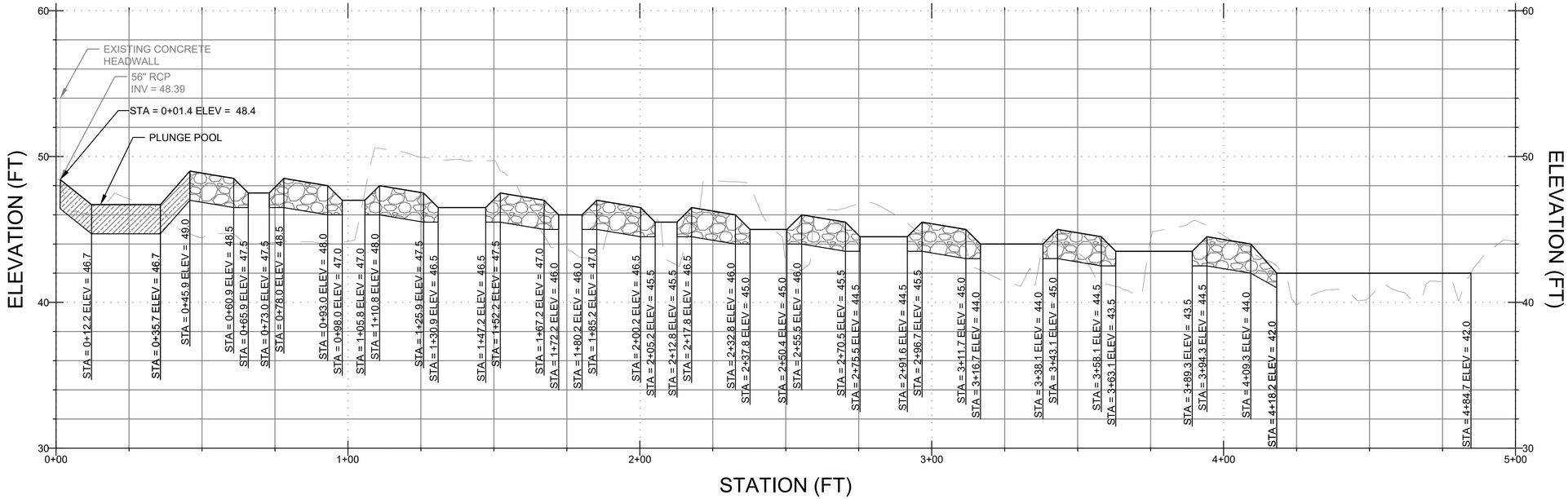
REVISED DATE	BY

APPROVED DATE	APPROVED DATE	SCALE:	1" = 20'
		DRAWN BY	KB
CHIEF ENGINEER	PROJECT MANAGER	CHECKED BY	DS/JC
APPROVED DATE	APPROVED DATE	SHEET NO.	12 OF 31
		PROJECT NO.	24015.01
ASSISTANT CHIEF ENGINEER	CHIEF, RIGHT-OF-WAY	PROPOSAL NO.	

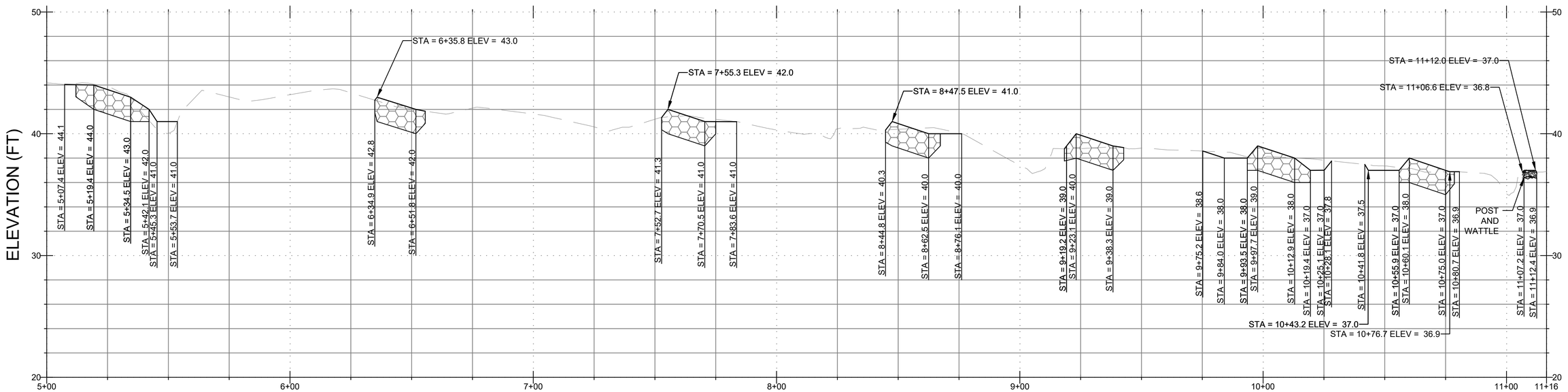
ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

GRADING PLAN

PROFILE VIEW OF REACH 1 - SPSC



PROFILE VIEW OF REACH 2 - VALLEY-WDE RSC



PROFILE LEGEND

- EXISTING GROUND
- PROPOSED GROUND
- RIFFLE
- VALLEY-WIDE RIFFLE
- PLUNGE POOL
- POST AND WATTLE STRUCTURE

VERTICAL SCALE 0 4 8

HORIZONTAL SCALE 0 20 40

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation
ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	AS SHOWN
DRAWN BY	TB
CHECKED BY	DS/JC
SHEET NO.	13 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

PROFILE

STRUCTURE TABLES								
RIFFLES								
REACH 1-SPSC								
DESIGN						AS-BUILT		
ID	Station	Node	Easting	Northing	Elevation	Easting	Northing	Elevation
SPSC-1		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
SPSC-2		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
SPSC-3		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
SPSC-4		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
SPSC-5		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
SPSC-6		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
SPSC-7		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
SPSC-8		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
SPSC-9		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
SPSC-10		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						

NOTE: STRUCTURE TABLES WILL BE PROVIDED ON 90% DESIGN PLANS

STRUCTURE TABLES								
RIFFLES								
REACH 2-VALLEY-WIDE RSC								
DESIGN						AS-BUILT		
ID	Station	Node	Easting	Northing	Elevation	Easting	Northing	Elevation
VWR-1		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
VWR-2		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
VWR-3		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
VWR-4		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
VWR-5		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
VWR-6		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						
VWR-7		USL						
		USR						
		A						
		B						
		C						
		D						
		E						
		DSL						
		DSR						

STRUCTURE TABLE INFORMATION WILL BE PROVIDED AT 95% SUBMITTAL

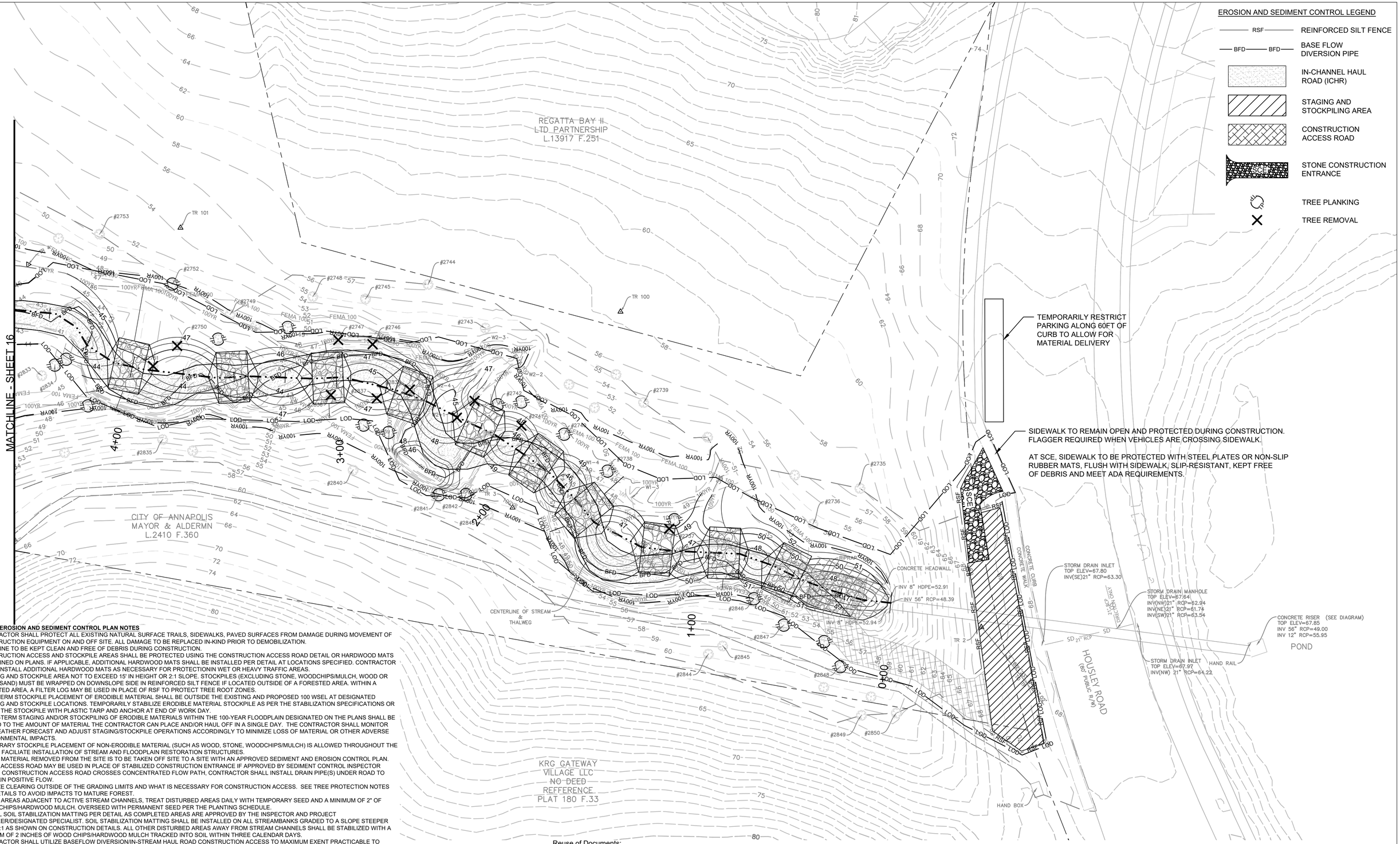
Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers FEDERATION ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED		APPROVED DATE	APPROVED DATE	SCALE: NA	ANNAPOLIS WATERWORKS PARK STREAM RESTORATION
DATE	BY			DRAWN BY TB	
		CHIEF ENGINEER	PROJECT MANAGER	CHECKED BY DS/JC	
		APPROVED DATE	APPROVED DATE	SHEET NO. 14 OF 31	STRUCTURE TABLES
				PROJECT NO. 24015.01	
		ASSISTANT CHIEF ENGINEER	CHIEF, RIGHT-OF-WAY	PROPOSAL NO.	



ACCESS / EROSION AND SEDIMENT CONTROL PLAN NOTES

1. CONTRACTOR SHALL PROTECT ALL EXISTING NATURAL SURFACE TRAILS, SIDEWALKS, PAVED SURFACES FROM DAMAGE DURING MOVEMENT OF CONSTRUCTION EQUIPMENT ON AND OFF SITE. ALL DAMAGE TO BE REPLACED IN-KIND PRIOR TO DEMOBILIZATION.
2. CURB LINE TO BE KEPT CLEAN AND FREE OF DEBRIS DURING CONSTRUCTION.
3. CONSTRUCTION ACCESS AND STOCKPILE AREAS SHALL BE PROTECTED USING THE CONSTRUCTION ACCESS ROAD DETAIL OR HARDWOOD MATS AS DEFINED ON PLANS. IF APPLICABLE, ADDITIONAL HARDWOOD MATS SHALL BE INSTALLED PER DETAIL AT LOCATIONS SPECIFIED. CONTRACTOR SHALL INSTALL ADDITIONAL HARDWOOD MATS AS NECESSARY FOR PROTECTIONIN WET OR HEAVY TRAFFIC AREAS.
4. STAGING AND STOCKPILE AREA NOT TO EXCEED 15' IN HEIGHT OR 2:1 SLOPE. STOCKPILES (EXCLUDING STONE, WOODCHIPS/MULCH, WOOD OR CLEAN SAND) MUST BE WRAPPED ON DOWNSLOPE SIDE IN REINFORCED SILT FENCE IF LOCATED OUTSIDE OF A FORESTED AREA. WITHIN A FORESTED AREA, A FILTER LOG MAY BE USED IN PLACE OF RSF TO PROTECT TREE ROOT ZONES.
5. LONG-TERM STOCKPILE PLACEMENT OF ERODIBLE MATERIAL SHALL BE OUTSIDE THE EXISTING AND PROPOSED 100 WSEL AT DESIGNATED STAGING AND STOCKPILE LOCATIONS. TEMPORARILY STABILIZE ERODIBLE MATERIAL STOCKPILE AS PER THE STABILIZATION SPECIFICATIONS OR COVER THE STOCKPILE WITH PLASTIC TARP AND ANCHOR AT END OF WORK DAY.
6. SHORT-TERM STAGING AND/OR STOCKPILING OF ERODIBLE MATERIALS WITHIN THE 100-YEAR FLOODPLAIN DESIGNATED ON THE PLANS SHALL BE LIMITED TO THE AMOUNT OF MATERIAL THE CONTRACTOR CAN PLACE AND/OR HAUL OFF IN A SINGLE DAY. THE CONTRACTOR SHALL MONITOR THE WEATHER FORECAST AND ADJUST STAGING/STOCKPILE OPERATIONS ACCORDINGLY TO MINIMIZE LOSS OF MATERIAL OR OTHER ADVERSE ENVIRONMENTAL IMPACTS.
7. TEMPORARY STOCKPILE PLACEMENT OF NON-ERODIBLE MATERIAL (SUCH AS WOOD, STONE, WOODCHIPS/MULCH) IS ALLOWED THROUGHOUT THE LOD TO FACILIATE INSTALLATION OF STREAM AND FLOODPLAIN RESTORATION STRUCTURES.
8. WASTE MATERIAL REMOVED FROM THE SITE IS TO BE TAKEN OFF SITE TO A SITE WITH AN APPROVED SEDIMENT AND EROSION CONTROL PLAN.
9. MULCH ACCESS ROAD MAY BE USED IN PLACE OF STABILIZED CONSTRUCTION ENTRANCE IF APPROVED BY SEDIMENT CONTROL INSPECTOR
10. WHERE CONSTRUCTION ACCESS ROAD CROSSES CONCENTRATED FLOW PATH, CONTRACTOR SHALL INSTALL DRAIN PIPE(S) UNDER ROAD TO MAINTAIN POSITIVE FLOW.
11. MINIMIZE CLEARING OUTSIDE OF THE GRADING LIMITS AND WHAT IS NECESSARY FOR CONSTRUCTION ACCESS. SEE TREE PROTECTION NOTES AND DETAILS TO AVOID IMPACTS TO MATURE FOREST.
12. WITHIN AREAS ADJACENT TO ACTIVE STREAM CHANNELS, TREAT DISTURBED AREAS DAILY WITH TEMPORARY SEED AND A MINIMUM OF 2" OF WOOD CHIPS/HARDWOOD MULCH. OVERSEED WITH PERMANENT SEED PER THE PLANTING SCHEDULE.
13. INSTALL SOIL STABILIZATION MATTING PER DETAIL AS COMPLETED AREAS ARE APPROVED BY THE INSPECTOR AND PROJECT ENGINEER/DESIGNATED SPECIALIST. SOIL STABILIZATION MATTING SHALL BE INSTALLED ON ALL STREAMBANKS GRADED TO A SLOPE STEEPER THAN 3:1 AS SHOWN ON CONSTRUCTION DETAILS. ALL OTHER DISTURBED AREAS AWAY FROM STREAM CHANNELS SHALL BE STABILIZED WITH A MINIMUM OF 2 INCHES OF WOOD CHIPS/HARDWOOD MULCH TRACKED INTO SOIL WITHIN THREE CALENDAR DAYS.
14. CONTRACTOR SHALL UTILIZE BASEFLOW DIVERSION/IN-STREAM HAUL ROAD CONSTRUCTION ACCESS TO MAXIMUM EXENT PRACTICABLE TO MINIMIZE DISTURBANCE TO FLOODPLAIN RESOURCES.
15. AS SITE CONDITIONS DICTATE; THE CONTRACTOR SHALL INSTALL A STREAM DIVERSION (PUMP AROUND PRACTICE AND/OR CLEAR WATER DIVERSION) TO MAINTAIN A DRY ACTIVE WORK AREA(S). EACH WORK AREA LENGTH SHALL NOT EXCEED WHAT CAN BE COMPLETED IN ONE DAY. STREAM DIVERSION LOCATIONS SHOWN ARE REPRESENTATIVE AND MAY BE ADJUSTED IN THE FIELD TO ACHIEVE DRY WORK AREA(S).
16. WHEN STREAM DIVERSION PRACTICES ARE UTILIZED, THE EXACT LOCATION OF THE PUMPS, HOSES, SEDIMENT DIKES, AND FILTER BAGS MAY BE MODIFIED IN THE FIELD BASED ON EXISTING CONDITIONS. ANY ADJUSTMENTS MUST BE APPROVED BY THE ENGINEER/DESIGNATED SPECIALIST AND SEDIMENT CONTROL INSPECTOR.
17. ENTIRE SITE SHALL BE TEMPORARILY STABILIZED IN ACCORDANCE WITH THE 2019 STREAM RESTORATION STABILZATION NOTES PRIOR TO REMOVING SEDIMENT CONTROLS.
18. UPON COMPLETION OF WORK, ALL WOODCHIPS OR HARDWOOD MULCH USED FOR TEMPORARY STABILIZATION OR CONSTRUCTION ACCESS SHALL BE SPREAD TO A 2" TO 4" THICKNESS WITHIN DISTURBED SOIL SURFACES AND INCORPORATED INTO THE TOP LAYER OF SOIL PRIOR TO PLANTING.
19. WOODCHIPS OR HARDWOOD MULCH USED FOR STABILIZATION SHALL BE DERIVED FROM FRESH OR AGED HARDWOOD INCLUDING BARK, WOOD FRAGMENTS AND GRINDINGS. WOODCHIPS AND HARDWOOD MULCH SHALL BE FREE OF LEAVES, VINES INCLUDING POISON IVY, TRASH AND FOREIGN MATTER, AND MAY INCLUDE CHUNKS UP TO 3 INCHES IN ANY DIMENSION.

HORIZONTAL SCALE
0 20 40

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	1" = 20'
DRAWN BY	TB
CHECKED BY	DS/JC
SHEET NO.	15 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK
STREAM RESTORATION

EROSION & SEDIMENT CONTROL PLAN

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\esc-01.dwg

EROSION AND SEDIMENT CONTROL LEGEND

- RSF — REINFORCED SILT FENCE
- BFD — BFD — BASE FLOW DIVERSION PIPE
- IN-CHANNEL HAUL ROAD (ICHR)
- STAGING AND STOCKPILING AREA
- CONSTRUCTION ACCESS ROAD
- SCE — STONE CONSTRUCTION ENTRANCE
- TP — TREE PLANKING
- TREE REMOVAL

ACCESS / EROSION AND SEDIMENT CONTROL PLAN NOTES

1. CONTRACTOR SHALL PROTECT ALL EXISTING NATURAL SURFACE TRAILS, SIDEWALKS, PAVED SURFACES FROM DAMAGE DURING MOVEMENT OF CONSTRUCTION EQUIPMENT ON AND OFF SITE. ALL DAMAGE TO BE REPLACED IN-KIND PRIOR TO DEMOBILIZATION.
2. CURB LINE TO BE KEPT CLEAN AND FREE OF DEBRIS DURING CONSTRUCTION.
3. CONSTRUCTION ACCESS AND STOCKPILE AREAS SHALL BE PROTECTED USING THE CONSTRUCTION ACCESS ROAD DETAIL OR HARDWOOD MATS AS DEFINED ON PLANS. IF APPLICABLE, ADDITIONAL HARDWOOD MATS SHALL BE INSTALLED PER DETAIL AT LOCATIONS SPECIFIED. CONTRACTOR SHALL INSTALL ADDITIONAL HARDWOOD MATS AS NECESSARY FOR PROTECTIONIN WET OR HEAVY TRAFFIC AREAS.
4. STAGING AND STOCKPILE AREA NOT TO EXCEED 15' IN HEIGHT OR 2:1 SLOPE. STOCKPILES (EXCLUDING STONE, WOODCHIPS/MULCH, WOOD OR CLEAN SAND) MUST BE WRAPPED ON DOWNSLOPE SIDE IN REINFORCED SILT FENCE IF LOCATED OUTSIDE OF A FORESTED AREA. WITHIN A FORESTED AREA, A FILTER LOG MAY BE USED IN PLACE OF RSF TO PROTECT TREE ROOT ZONES.
5. LONG-TERM STOCKPILE PLACEMENT OF ERODIBLE MATERIAL SHALL BE OUTSIDE THE EXISTING AND PROPOSED 100 WSEL AT DESIGNATED STAGING AND STOCKPILE LOCATIONS. TEMPORARILY STABILIZE ERODIBLE MATERIAL STOCKPILE AS PER THE STABILIZATION SPECIFICATIONS OR COVER THE STOCKPILE WITH PLASTIC TARP AND ANCHOR AT END OF WORK DAY.
6. SHORT-TERM STAGING AND/OR STOCKPILING OF ERODIBLE MATERIALS WITHIN THE 100-YEAR FLOODPLAIN DESIGNATED ON THE PLANS SHALL BE LIMITED TO THE AMOUNT OF MATERIAL THE CONTRACTOR CAN PLACE AND/OR HAUL OFF IN A SINGLE DAY. THE CONTRACTOR SHALL MONITOR THE WEATHER FORECAST AND ADJUST STAGING/STOCKPILE OPERATIONS ACCORDINGLY TO MINIMIZE LOSS OF MATERIAL OR OTHER ADVERSE ENVIRONMENTAL IMPACTS.
7. TEMPORARY STOCKPILE PLACEMENT OF NON-ERODIBLE MATERIAL (SUCH AS WOOD, STONE, WOODCHIPS/MULCH) IS ALLOWED THROUGHOUT THE LOD TO FACILIATE INSTALLATION OF STREAM AND FLOODPLAIN RESTORATION STRUCTURES.
8. WASTE MATERIAL REMOVED FROM THE SITE IS TO BE TAKEN OFF SITE TO A SITE WITH AN APPROVED SEDIMENT AND EROSION CONTROL PLAN.
9. MULCH ACCESS ROAD MAY BE USED IN PLACE OF STABILIZED CONSTRUCTION ENTRANCE IF APPROVED BY SEDIMENT CONTROL INSPECTOR
10. WHERE CONSTRUCTION ACCESS ROAD CROSSES CONCENTRATED FLOW PATH, CONTRACTOR SHALL INSTALL DRAIN PIPE(S) UNDER ROAD TO MAINTAIN POSITIVE FLOW.
11. MINIMIZE CLEARING OUTSIDE OF THE GRADING LIMITS AND WHAT IS NECESSARY FOR CONSTRUCTION ACCESS. SEE TREE PROTECTION NOTES AND DETAILS TO AVOID IMPACTS TO MATURE FOREST.
12. WITHIN AREAS ADJACENT TO ACTIVE STREAM CHANNELS, TREAT DISTURBED AREAS DAILY WITH TEMPORARY SEED AND A MINIMUM OF 2" OF WOOD CHIPS/HARDWOOD MULCH. OVERSEED WITH PERMANENT SEED PER THE PLANTING SCHEDULE.
13. INSTALL SOIL STABILIZATION MATTING PER DETAIL AS COMPLETED AREAS ARE APPROVED BY THE INSPECTOR AND PROJECT ENGINEER/DESIGNATED SPECIALIST. SOIL STABILIZATION MATTING SHALL BE INSTALLED ON ALL STREAMBANKS GRADED TO A SLOPE STEEPER THAN 3:1 AS SHOWN ON CONSTRUCTION DETAILS. ALL OTHER DISTURBED AREAS AWAY FROM STREAM CHANNELS SHALL BE STABILIZED WITH A MINIMUM OF 2 INCHES OF WOOD CHIPS/HARDWOOD MULCH TRACKED INTO SOIL WITHIN THREE CALENDAR DAYS.
14. CONTRACTOR SHALL UTILIZE BASEFLOW DIVERSION/IN-STREAM HAUL ROAD CONSTRUCTION ACCESS TO MAXIMUM EXENT PRACTICABLE TO MINIMIZE DISTURBANCE TO FLOODPLAIN RESOURCES.
15. AS SITE CONDITIONS DICTATE; THE CONTRACTOR SHALL INSTALL A STREAM DIVERSION (PUMP AROUND PRACTICE AND/OR CLEAR WATER DIVERSION) TO MAINTAIN A DRY ACTIVE WORK AREA(S). EACH WORK AREA LENGTH SHALL NOT EXCEED WHAT CAN BE COMPLETED IN ONE DAY. STREAM DIVERSION LOCATIONS SHOWN ARE REPRESENTATIVE AND MAY BE ADJUSTED IN THE FIELD TO ACHIEVE DRY WORK AREA(S).
16. WHEN STREAM DIVERSION PRACTICES ARE UTILIZED, THE EXACT LOCATION OF THE PUMPS, HOSES, SEDIMENT DIKES, AND FILTER BAGS MAY BE MODIFIED IN THE FIELD BASED ON EXISTING CONDITIONS. ANY ADJUSTMENTS MUST BE APPROVED BY THE ENGINEER/DESIGNATED SPECIALIST AND SEDIMENT CONTROL INSPECTOR.
17. ENTIRE SITE SHALL BE TEMPORARILY STABILIZED IN ACCORDANCE WITH THE 2019 STREAM RESTORATION STABILZATION NOTES PRIOR TO REMOVING SEDIMENT CONTROLS.
18. UPON COMPLETION OF WORK, ALL WOODCHIPS OR HARDWOOD MULCH USED FOR TEMPORARY STABILIZATION OR CONSTRUCTION ACCESS SHALL BE SPREAD TO A 2" TO 4" THICKNESS WITHIN DISTURBED SOIL SURFACES AND INCORPORATED INTO THE TOP LAYER OF SOIL PRIOR TO PLANTING.
19. WOODCHIPS OR HARDWOOD MULCH USED FOR STABILIZATION SHALL BE DERIVED FROM FRESH OR AGED HARDWOOD INCLUDING BARK, WOOD FRAGMENTS AND GRINDINGS. WOODCHIPS AND HARDWOOD MULCH SHALL BE FREE OF LEAVES, VINES INCLUDING POISON IVY, TRASH AND FOREIGN MATTER, AND MAY INCLUDE CHUNKS UP TO 3 INCHES IN ANY DIMENSION.

CITY OF ANNAPOLIS
MAYOR & ALDERMN
L.2410 F.360

KRG GATEWAY
VILLAGE LLC
NO DEED
REFFERENCE
PLAT 180 F.33

MATCHLINE - SHEET 15

HORIZONTAL SCALE
0 20 40

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation
ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

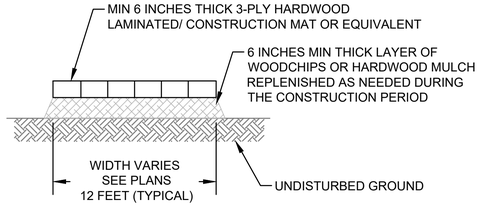
REVISED DATE	BY

APPROVED DATE		APPROVED DATE	
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED DATE		APPROVED DATE	
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	1" = 20'
DRAWN BY	TB
CHECKED BY	DS/JC
SHEET NO.	16 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

EROSION & SEDIMENT CONTROL PLAN

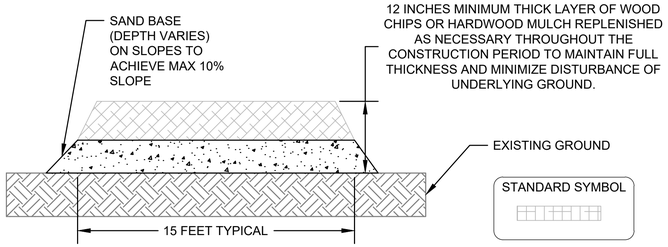


NOTES:

1. HARDWOOD MATS ARE NEEDED ALONG THE STREAM VALLEY BOTTOM WITHIN WETLANDS AND WHERE SATURATED SOIL CONDITIONS PERSIST. CONTRACTOR SHALL INSTALL HARDWOOD MATS AS NEEDED FOR ADDITIONAL PROTECTION IN WET OR HEAVY TRAFFIC AREAS.
2. ON SLOPES, IF ACCESS ROAD REMAINS GREATER THAN 10%, CONTRACTOR SHALL UTILIZE HARDWOOD MATS ON THE SECTIONS OF ROAD THAT ARE GREATER THAN 10%.
3. ACCESS ROUTES TO BE VERIFIED BY THE ENGINEER AT THE EROSION AND SEDIMENT CONTROL MEETING. REVISIONS TO THE ALIGNMENT THAT MINIMIZE TREE DISTURBANCE ARE ENCOURAGED AND REQUIRE REVIEW AND APPROVAL BY THE ENGINEER.
4. THE CONTRACTOR SHALL ENSURE THAT EQUIPMENT IS KEPT ON MATS AT ALL TIMES WHERE MATS ARE PRESENT.
5. THE CONTRACTOR SHALL MAINTAIN ACCESS ROADS THROUGHOUT THE CONSTRUCTION PERIOD. UPON COMPLETION OF PROJECT, WOODCHIPS SHALL BE SPREAD TO A MAXIMUM DEPTH OF 2 INCHES.
6. SCARIFICATION OF COMPACTED WOODCHIPS OR HARDWOOD MULCH TO OCCUR UPON REMOVAL OF THE ACCESS ROAD, AT DIRECTION OF THE ENGINEER.

HARDWOOD MAT CROSS SECTION

NOT TO SCALE



NOTES:

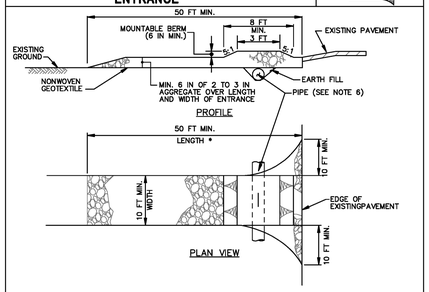
1. ACCESS ROUTES TO BE VERIFIED BY ENGINEER AT EROSION AND SEDIMENT CONTROL MEETING. REVISIONS TO THE ALIGNMENT THAT MINIMIZE TREE DISTURBANCE ARE ENCOURAGED AND REQUIRE REVIEW AND APPROVAL BY THE ENGINEER.
2. CONTRACTOR SHALL MAINTAIN CONSTRUCTION ACCESS THROUGHOUT CONSTRUCTION PERIOD, REPLENISHING MULCH AS NECESSARY.
3. UPON COMPLETION OF PROJECT, ACCESS PATHS SHALL BE RESTORED TO FINISHED GRADE BY UNCOMPACTED WOOD CHIPS/HARDWOOD MULCH AND INCORPORATED INTO GRADE, AND PLACEMENT OF SCATTERED WOODY DEBRIS TO ROUGHEN PATH. IF ACCESS PATH GETS DEPRESSED BELOW GRADE, BORROW MAY BE REQUIRED AT DIRECTION OF ENGINEER/DESIGNATED SPECIALIST TO RE-ESTABLISH GRADES THAT MATCH FLOODPLAIN.
4. STAGING AND STOCKPILING AREAS TO BE PROTECTED USING SAME PROTECTION AND REPLENISHMENT REQUIREMENTS.
5. ON SLOPED SURFACES, GRADES ALONG MULCH ACCESS ROAD SHALL BE ADJUSTED THROUGH A COMBINATION OF EXCAVATION WITHIN UPSLOPE AREA AND FILL AT TOE OF SLOPE WITH SAND TO ACHIEVE RUNNING SLOPE OF 10%.
6. IF ACCESS ROAD REMAINS GREATER THAN 10%, CONTRACTOR SHALL UTILIZE HARDWOOD MATS ON THE SECTIONS OF ROAD THAT ARE GREATER THAN 10%.

CONSTRUCTION ACCESS ROAD SECTION

NOT TO SCALE

DETAIL B-1 STABILIZED CONSTRUCTION ENTRANCE

STANDARD SYMBOL: SCE



CONSTRUCTION SPECIFICATIONS

1. PLACE STABILIZED CONSTRUCTION ENTRANCE IN ACCORDANCE WITH THE APPROVED PLAN. VEHICLES MUST TRAVEL OVER THE ENTIRE LENGTH OF THE SCE. USE MINIMUM LENGTH OF 50 FEET (*30 FEET FOR SINGLE RESIDENCE LOT). USE MINIMUM WIDTH OF 10 FEET. FLARE SCE 10 FEET MINIMUM AT THE EXISTING ROAD TO PROVIDE A TURNING RADIUS.
2. PIPE ALL SURFACE WATER FLOWING TO OR DIVERTED TOWARD THE SCE UNDER THE ENTRANCE, MAINTAINING POSITIVE DRAINAGE. PROTECT PIPE INSTALLED THROUGH THE SCE WITH A MOUNTABLE BERM WITH 5:1 SLOPES AND A MINIMUM OF 12 INCHES OF STONE OVER THE PIPE. PROVIDE PIPE AS SPECIFIED ON APPROVED PLAN. WHEN THE SCE IS LOCATED AT A HIGH SPOT AND HAS NO DRAINAGE TO CONVEY, A PIPE IS NOT NECESSARY. A MOUNTABLE BERM IS REQUIRED WHEN SCE IS NOT LOCATED AT A HIGH SPOT.
3. PREPARE SUBGRADE AND PLACE NONWOVEN GEOTEXTILE, AS SPECIFIED IN SECTION H-1 MATERIALS.
4. PLACE CRUSHED AGGREGATE (2 TO 3 INCHES IN SIZE) OR EQUIVALENT RECYCLED CONCRETE (WITHOUT REBAR) AT LEAST 6 INCHES DEEP OVER THE LENGTH AND WIDTH OF THE SCE.
5. MAINTAIN ENTRANCE IN A CONDITION THAT MINIMIZES TRACKING OF SEDIMENT. ADD STONE OR MAKE OTHER REPAIRS AS CONDITIONS DEMAND TO MAINTAIN CLEAN SURFACE, MOUNTABLE BERM, AND SPECIFIED DIMENSIONS. IMMEDIATELY REMOVE STONE AND/OR SEDIMENT SPILLED, DROPPED, OR TRACKED ONTO ADJACENT ROADWAY BY VACUUMING, SCRAPING, AND/OR SWEEPING. WASHING ROADWAY TO REMOVE MUD TRACKED ONTO PAVEMENT IS NOT ACCEPTABLE UNLESS WASH WATER IS DIRECTED TO AN APPROVED SEDIMENT CONTROL PRACTICE.

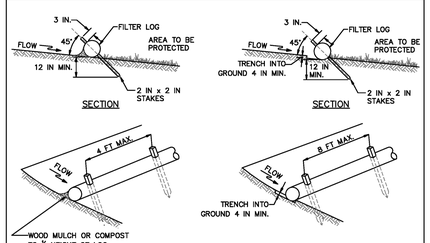
MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE	2011	MARYLAND DEPARTMENT OF ENVIRONMENT WATER MANAGEMENT ADMINISTRATION

DETAIL E-6 FILTER LOG

STANDARD SYMBOL: FL-18

DESIGNATION FL-18 REFERS TO 18 INCH DIAMETER FILTER LOG



1 OF 2

MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE	2011	MARYLAND DEPARTMENT OF ENVIRONMENT WATER MANAGEMENT ADMINISTRATION

DETAIL E-6 FILTER LOG

STANDARD SYMBOL: FL-18

DESIGNATION FL-18 REFERS TO 18 INCH DIAMETER FILTER LOG

CONSTRUCTION SPECIFICATIONS

1. PRIOR TO INSTALLATION, CLEAR ALL OBSTRUCTIONS INCLUDING ROCKS, CLODS, AND DEBRIS GREATER THAN ONE INCH THAT MAY INTERFERE WITH PROPER FUNCTION OF FILTER LOG.
2. FILL LOG NETTING UNIFORMLY WITH COMPOST (IN ACCORDANCE WITH SECTION H-1 MATERIALS), OR OTHER APPROVED BIODEGRADABLE MATERIAL TO DESIRED LENGTH SUCH THAT LOGS DO NOT DEFORM.
3. INSTALL FILTER LOGS PERPENDICULAR TO THE FLOW DIRECTION AND PARALLEL TO THE SLOPE WITH THE BEGINNING AND END OF THE INSTALLATION POINTING SLIGHTLY UP THE SLOPE CREATING A "J" SHAPE AT EACH END TO PREVENT BYPASS.
4. FOR UNTRENCHED INSTALLATION BLOW OR HAND PLACE MULCH OR COMPOST ON UPHILL SIDE OF THE SLOPE ALONG LOG.
5. STAKE FILTER LOG EVERY 4 FEET OR CLOSER ALONG ENTIRE LENGTH OF LOG OR TRENCH LOG INTO GROUND A MINIMUM OF 4 INCHES AND STAKE LOG EVERY 8 FEET OR CLOSER.
6. USE STAKES WITH A MINIMUM NOMINAL CROSS SECTION OF 2X2 INCH AND OF SUFFICIENT LENGTH TO ATTAIN A MINIMUM OF 12 INCHES INTO THE GROUND AND 3 INCHES PROTRUDING ABOVE LOG.
7. WHEN MORE THAN ONE LOG IS NEEDED, OVERLAP ENDS 12 INCHES MINIMUM AND STAKE.
8. REMOVE SEDIMENT WHEN IT HAS ACCUMULATED TO A DEPTH OF ½ THE EXPOSED HEIGHT OF LOG AND REPLACE MULCH. REPLACE FILTER LOG IF TORN. REINSTALL FILTER LOG IF UNDERMINING OR DISLODGING OCCURS. REPLACE CLOGGED FILTER LOGS. FOR PERMANENT APPLICATIONS, ESTABLISH AND CONTINUOUSLY MEET REQUIREMENTS FOR ADEQUATE VEGETATIVE ESTABLISHMENT IN ACCORDANCE WITH SECTION B-4 VEGETATIVE STABILIZATION.

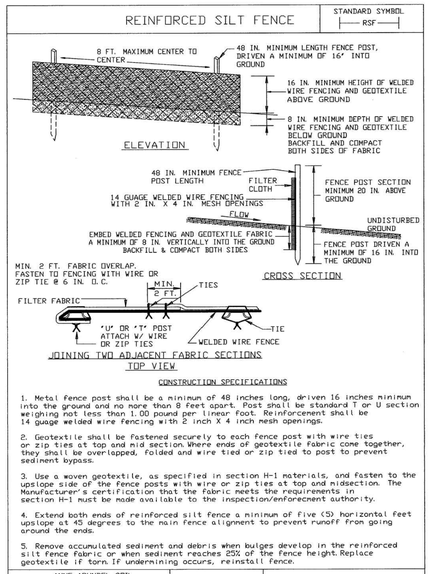
2 OF 2

MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE	2011	MARYLAND DEPARTMENT OF ENVIRONMENT WATER MANAGEMENT ADMINISTRATION

REINFORCED SILT FENCE

STANDARD SYMBOL: RSF



CONSTRUCTION SPECIFICATIONS

1. Metal fence post shall be a minimum of 48 inches long, driven 16 inches minimum into the ground and no more than 8 feet apart. Post shall be standard T or U section weighing not less than 1.00 pound per linear foot. Reinforcement shall be 14 guage welded wire fencing with 2 inch X 4 inch mesh openings.
2. Geotextile shall be fastened securely to each fence post with wire ties or zip ties at top and mid section. Where ends of geotextile fabric come together, they shall be overlapped, folded and wire tied or zip tied to post to prevent sediment bypass.
3. Use a woven geotextile, as specified in section H-1 materials, and fasten to the upslope side of the fence posts with wire or zip ties at top and midsection. The Manufacturer's certification that the fabric meets the requirements in section H-1 must be made available to the inspection/enforcement authority.
4. Extend both ends of reinforced silt fence a minimum of five (5) horizontal feet upslope at 45 degrees to the main fence alignment to prevent runoff from going around the ends.
5. Renove accumulated sediment and debris when bulges develop in the reinforced silt fence fabric or when sediment reaches 25% of the fence height. Replace geotextile if torn. If undermining occurs, reinstall fence.

ANNE ARUNDEL SOIL CONSERVATION DISTRICT	2015	

REINFORCED SILT FENCE

Design Criteria

Reinforced Silt Fence Desisgn Constraints

Average Slope Steepness	Maximum Slope Length	Maximum Silt Fence Length
Flatter than 50:1 (<2%)	300 feet*	Unlimited
50:1 to 10:1 (2-10%)	125 feet	1,000 feet
10:1 to 5:1 (10-20%)	100 feet	750 feet
5:1 (>20%)	40 feet	250 feet

*Maximum slope length is unlimited on the Hydrolic Soil Group (HSG) "A" soils

1. The use of Reinforced Silt Fence must conform to the design constraints listed above.
2. The area downgrade of the Reinforced Silt Fence must be undisturbed ground.
3. Reinforced Silt Fence must be placed along the contour.
4. Reinforced Silt Fence should be used with caution in areas where rocky soils may prevent trenching.
5. Extend both ends of reinforced silt fence a minimum of five (5) horizontal feet upslope and 45 degrees to the main fence alignment to prevent runoff fron going around the edges

ANNE ARUNDEL SOIL CONSERVATION DISTRICT	2015	

STEP POOL STORM CONVEYANCE STABILIZATION NOTES:

1. TEMPORARY STABILIZATION NOTE:
1.1. TEMPORARY STABILIZATION FOR ANY AREA OF EARTH DISTURBED AROUND THE POOLS AND RIFFLE ZONES OF A SPSC (E.G., STEP POOL STORM CONVEYANCE SYSTEM) SHALL BE CONSIDERED ACHIEVED WHEN UNIFORMLY COVERING THE AREA WITH 2 TO 4 INCHES OF WOOD CHIPS. ANNUAL RYE MAY BE UTILIZED FOR THE TEMPORARY SEEDING APPLICATION PERIOD FOUND UNDER THE ANNE ARUNDEL SOIL CONSERVATION DISTRICT'S (AASCD) VEGETATIVE ESTABLISHMENT SPECIFICATION OR 2011 STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL.
2. PERMANENT STABILIZATION NOTE:
2.1. PERMANENT STABILIZATION FOR AN AREA OF EARTH DISTURBANCE OF A SPSC SHALL BE CONSIDERED ACHIEVED WHEN THE BANKS AND FLOODPLAIN ARE COVERED WITH FULLY BIODEGRADABLE STABILIZATION MATTING INSTALLED PER MANUFACTURER'S INSTRUCTIONS AND A (NATIVE PLANTS) PLANTING PLAN HAS BEEN IMPLEMENTED.

MAINTENANCE NOTE:

CONTRACTOR SHALL INSPECT AND MAINTAIN ALL SEDIMENT CONTROL MEASURES AND DEVICES AFTER EVERY STORM EVENT. MAINTENANCE SHALL INCLUDE, BUT NOT BE LIMITED TO THE REMOVAL OF ALL ACCUMULATED SEDIMENT. GEOTEXTILE FABRIC SHALL BE REPLACED AS NEEDED TO ENSURE PROPER FUNCTION.

TEMPORARY STOCKPILES NOTES:

TEMPORARY STOCKPILES SHALL BE:

1.) LOCATED WITHIN THE LIMIT OF DISTURBANCE (LOD).

2.) DRAIN TO A FUNCTIONING SEDIMENT CONTROL DEVICE.

3.) POSITIONED TO NOT IMPEDE UPON, OR IMPAIR THE FUNCTION OF SAID DEVICE.

4.) POSITIONED TO NOT ALTER DRAINAGE DIVIDES.

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers FEDERATION
ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED DATE	APPROVED DATE
CHIEF ENGINEER	PROJECT MANAGER
APPROVED DATE	APPROVED DATE
ASSISTANT CHIEF ENGINEER	CHIEF, RIGHT-OF-WAY

SCALE:	NTS
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	17 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

EROSION & SEDIMENT CONTROL DETAILS

MGWC 1.2: PUMP-AROUND PRACTICE

DESCRIPTION THE WORK SHALL CONSIST OF INSTALLING A TEMPORARY PUMP AROUND AND SUPPORTING MEASURES TO DIVERT FLOW AROUND INSTREAM CONSTRUCTION SITES.

IMPLEMENTATION SEQUENCE SEDIMENT CONTROL MEASURES, PUMP-AROUND PRACTICES, AND ASSOCIATED CHANNEL AND BANK CONSTRUCTION SHALL BE COMPLETED IN THE FOLLOWING SEQUENCE (REFER TO DETAIL 1.2):

1. CONSTRUCTION ACTIVITIES INCLUDING THE INSTALLATION OF EROSION AND SEDIMENT CONTROL MEASURES SHALL NOT BEGIN UNTIL ALL NECESSARY EASEMENTS AND/OR RIGHT-OF-WAYS HAVE BEEN ACQUIRED. ALL EXISTING UTILITIES SHALL BE MARKED IN THE FIELD PRIOR TO CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO EXISTING UTILITIES THAT MAY RESULT FROM CONSTRUCTION AND SHALL REPAIR THE DAMAGE AT HIS/HER OWN EXPENSE TO THE COUNTY'S OR UTILITY COMPANY'S SATISFACTION.

2. THE CONTRACTOR SHALL NOTIFY THE MARYLAND DEPARTMENT OF THE ENVIRONMENT OR WMA SEDIMENT CONTROL INSPECTOR AT LEAST 5 DAYS BEFORE BEGINNING CONSTRUCTION. ADDITIONALLY, THE CONTRACTOR SHALL INFORM THE LOCAL ENVIRONMENTAL PROTECTION AND RESOURCE MANAGEMENT INSPECTION AND ENFORCEMENT DIVISION AND THE PROVIDER OF LOCAL UTILITIES A MINIMUM OF 48 HOURS BEFORE STARTING CONSTRUCTION.

3. THE CONTRACTOR SHALL CONDUCT A PRE-CONSTRUCTION MEETING ON SITE WITH THE WMA SEDIMENT CONTROL INSPECTOR, THE COUNTY PROJECT MANAGER, AND THE ENGINEER TO REVIEW LIMITS OF DISTURBANCE, EROSION AND SEDIMENT CONTROL REQUIREMENTS, AND THE SEQUENCE OF CONSTRUCTION. THE CONTRACTOR SHALL STAKE OUT ALL LIMITS OF DISTURBANCE PRIOR TO THE PRE-CONSTRUCTION MEETING SO THEY MAY BE REVIEWED. THE PARTICIPANTS WILL ALSO DESIGNATE THE CONTRACTOR'S STAGING AREAS AND FLAG ALL TREES WITHIN THE LIMIT OF DISTURBANCE WHICH WILL BE REMOVED FOR CONSTRUCTION ACCESS. TREES SHALL NOT BE REMOVED WITHIN THE LIMIT OF DISTURBANCE WITHOUT APPROVAL FROM THE WMA OR LOCAL AUTHORITY.

4. CONSTRUCTION SHALL NOT BEGIN UNTIL ALL SEDIMENT AND EROSION CONTROL MEASURES HAVE BEEN INSTALLED AND APPROVED BY THE ENGINEER AND THE SEDIMENT CONTROL INSPECTOR. THE CONTRACTOR SHALL STAY WITHIN THE LIMITS OF THE DISTURBANCE AS SHOWN ON THE PLANS AND MINIMIZE DISTURBANCE WITHIN THE WORK AREA WHENEVER POSSIBLE.

5. UPON INSTALLATION OF ALL SEDIMENT CONTROL MEASURES AND APPROVAL BY THE SEDIMENT CONTROL INSPECTOR AND THE LOCAL ENVIRONMENTAL PROTECTION AND RESOURCE MANAGEMENT INSPECTION AND ENFORCEMENT DIVISION, THE CONTRACTOR SHALL BEGIN WORK AT THE UPSTREAM SECTION AND PROCEED DOWNSTREAM BEGINNING WITH THE ESTABLISHMENT OF STABILIZED CONSTRUCTION ENTRANCES. IN SOME CASES, WORK MAY BEGIN DOWNSTREAM IF APPROPRIATE. THE SEQUENCE OF CONSTRUCTION MUST BE FOLLOWED UNLESS THE CONTRACTOR GETS WRITTEN APPROVAL FOR DEVIATIONS FROM THE WMA OR LOCAL AUTHORITY. THE CONTRACTOR SHALL ONLY BEGIN WORK IN AN AREA WHICH CAN BE COMPLETED BY THE END OF THE DAY INCLUDING GRADING ADJACENT TO THE CHANNEL. AT THE END OF EACH WORK DAY, THE WORK AREA MUST BE STABILIZED AND THE PUMP AROUND REMOVED FROM THE CHANNEL. WORK SHALL NOT BE CONDUCTED IN THE CHANNEL DURING RAIN EVENTS.

6. SANDBAG DIKES SHALL BE SITUATED AT THE UPSTREAM AND DOWNSTREAM ENDS OF THE WORK AREA AS SHOWN ON THE PLANS, AND STREAM FLOW SHALL BE PUMPED AROUND THE WORK AREA. THE PUMP SHALL DISCHARGE ONTO A STABLE VELOCITY DISSIPATER MADE OF RIPRAP OR SANDBAGS. TEMPORARY MEASURE FOR DEWATERING INCHANNEL CONSTRUCTION SITES.

7. WATER FROM THE WORK AREA SHALL BE PUMPED TO A SEDIMENT FILTERING MEASURE SUCH AS A DEWATERING BASIN, SEDIMENT BAG, OR OTHER APPROVED SOURCE. THE MEASURE SHALL BE LOCATED SUCH THAT THE WATER DRAINS BACK INTO THE CHANNEL BELOW THE DOWNSTREAM SANDBAG DIKE.

8. TRAVERSING A CHANNEL REACH WITH EQUIPMENT WITHIN THE WORK AREA WHERE NO WORK IS PROPOSED SHALL BE AVOIDED. IF EQUIPMENT HAS TO TRAVERSE SUCH A REACH FOR ACCESS TO ANOTHER AREA, THEN TIMBER MATS OR SIMILAR MEASURES SHALL BE USED TO MINIMIZE DISTURBANCE TO THE CHANNEL. TEMPORARY STREAM CROSSINGS SHALL BE USED ONLY WHEN NECESSARY AND SHALL BE USED ONLY WHERE NOTED ON THE PLANS OR SPECIFIED. (SEE SECTION 4, STREAM CROSSINGS, MARYLAND GUIDELINES TO WATERWAY CONSTRUCTION).

9. ALL STREAM RESTORATION MEASURES SHALL BE INSTALLED AS INDICATED BY THE PLANS AND ALL BANKS GRADED IN ACCORDANCE WITH THE GRADING PLANS AND TYPICAL CROSS-SECTIONS. ALL GRADING MUST BE STABILIZED AT THE END OF EACH DAY WITH SEED AND MULCH OR SEED AND MATTING AS SPECIFIED ON THE PLANS.

10. AFTER AN AREA IS COMPLETED AND STABILIZED, THE CLEAN WATER DIKE SHALL BE REMOVED. AFTER THE FIRST SEDIMENT FLUSH, A NEW CLEAN WATER DIKE SHALL BE ESTABLISHED UPSTREAM FROM THE OLD SEDIMENT DIKE. FINALLY, UPON ESTABLISHMENT OF A NEW SEDIMENT DIKE BELOW THE OLD ONE, THE OLD SEDIMENT DIKE SHALL BE REMOVED.

11. A PUMP AROUND MUST BE INSTALLED ON ANY TRIBUTARY OR STORM DRAIN OUTFALL WHICH CONTRIBUTES BASEFLOW TO THE WORK AREA. THIS SHALL BE ACCOMPLISHED BY LOCATING A SANDBAG DIKE AT THE DOWNSTREAM END OF THE TRIBUTARY OR STORM DRAIN OUTFALL AND PUMPING THE STREAM FLOW AROUND THE WORK AREA. THIS WATER SHALL DISCHARGE ONTO THE SAME VELOCITY DISSIPATER USED FOR THE MAIN STEM PUMP AROUND.

12. IF A TRIBUTARY IS TO BE RESTORED, CONSTRUCTION SHALL TAKE PLACE ON THE TRIBUTARY BEFORE WORK ON THE MAIN STEM REACHES THE TRIBUTARY CONFLUENCE. CONSTRUCTION IN THE TRIBUTARY, INCLUDING PUMP AROUND PRACTICES, SHALL FOLLOW THE SAME SEQUENCE AS FOR THE MAIN STEM OF THE RIVER OR STREAM. WHEN CONSTRUCTION ON THE TRIBUTARY IS COMPLETED, WORK ON THE MAIN STEM SHALL RESUME. WATER FROM THE TRIBUTARY SHALL CONTINUE TO BE PUMPED AROUND THE WORK AREA IN THE MAIN STEM.

13. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING ACCESS TO AND MAINTAINING ALL EROSION AND SEDIMENT CONTROL DEVICES UNTIL THE SEDIMENT CONTROL INSPECTOR APPROVES THEIR REMOVAL.

14. AFTER CONSTRUCTION, ALL DISTURBED AREAS SHALL BE REGRADED AND REVEGETATED AS PER THE PLANTING PLAN.

15. IF, IN THE JUDGMENT OF THE ENGINEER, INADEQUATE ENERGY DISSIPATION OR CHANNEL BED EROSION IS OCCURRING, THE CONTRACTOR SHALL BE REQUIRED TO INCREASE THE MATERIAL OR PLACEMENT SIZE OF THE OUTFALL PROTECTION AT THE DIRECTION OF THE ENGINEER.

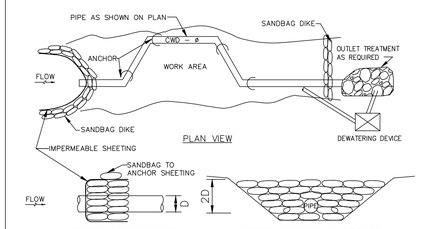
16. THE CONDITION OF THE OUTLET PROTECTION SANDBAGS IS TO BE CHECKED TWICE PER DAY (START OF WORK DAY AND MID-DAY) TO ENSURE THAT SAND IS NOT ESCAPING BAGS. DAMAGED OR LEAKING BAGS ARE TO BE REMOVED AND REPLACED.

17. OUTFALL PROTECTION MATERIALS AND GEOTEXTILE SHALL BE REMOVED FROM THE CHANNEL AT THE COMPLETION OF EACH CONSTRUCTION STAGE.

DETAIL C-6 CLEAR WATER DIVERSION PIPE

STANDARD SYMBOL: CWD – 6

DESIGNATION CWD–6 REFERS TO 6 INCH CLEAR WATER DIVERSION.



PROFILE OF SANDBAGS — SECTION THROUGH SANDBAGS

CONSTRUCTION SPECIFICATIONS

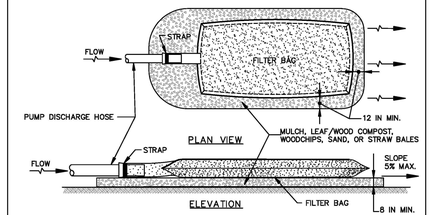
1. FLEXIBLE PIPE IS PREFERRED. HOWEVER, CORRUGATED METAL PIPE OR EQUIVALENT PVC PIPE CAN BE USED. MAKE ALL JOINTS WATERTIGHT.
2. FOR SANDBAGS USE MATERIALS THAT ARE RESISTANT TO ULTRA–VIOLENT RADIATION, TEARING, AND PUNCTURE AND WOVEN TIGHTLY ENOUGH TO PREVENT LEAKAGE OF FILL MATERIAL.
3. USE 10 MIL OR THICKER, UV RESISTANT, IMPERMEABLE SHEETING OR OTHER APPROVED MATERIAL THAT IS IMPERMEABLE AND RESISTANT TO PUNTURING AND TEARING.
4. PLACE IMPERMEABLE SHEETING SUCH THAT UPGRADE PORTION OVERLAPS DOWNGRADE PORTION BY A MINIMUM OF 18 INCHES.
5. SET HEIGHT OF SANDBAG DIKE AT TWCE THE PIPE DIAMETER. MAINTAIN HEIGHT ALONG LENGTH OF SANDBAG DIKE. PLACE DOUBLE ROW OF SANDBAGS.
6. AT A MINIMUM, SECURELY ANCHOR DIVERSION PIPE AT EACH DOWNGRADE JOINT.
7. SET OUTLET END OF DIVERSION PIPE LOWER THAN INLET END.
8. PROVIDE OUTLET PROTECTION AS REQUIRED ON APPROVED PLAN.
9. DEWATER WORK AREA USING AN APPROVED EROSION AND SEDIMENT CONTROL PRACTICE AS SPECIFIED ON APPROVED PLAN.
10. KEEP POINT OF DISCHARGE FREE OF EROSION. MAINTAIN WATER TIGHT CONNECTIONS AND POSITIVE DRAINAGE. REPLACE SANDBAGS AND IMPERMEABLE SHEETING IF TORN.

MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE	2011	MARYLAND DEPARTMENT OF ENVIRONMENT WATER MANAGEMENT ADMINISTRATION

DETAIL F-4 FILTER BAG

STANDARD SYMBOL: ☒FB



CONSTRUCTION SPECIFICATIONS

1. TIGHTLY SEAL SLEEVE AROUND THE PUMP DISCHARGE HOSE WITH A STRAP OR SIMILAR DEVICE.
2. PLACE FILTER BAG ON SUITABLE BASE (E.G., MULCH, LEAF/WOOD COMPOST, WOODCHIPS, SAND, OR STRAW BALES) LOCATED ON A LEVEL OR 5% MAXIMUM SLOPING SURFACE. DISCHARGE TO A STABILIZED AREA. EXTEND BASE A MINIMUM OF 12 INCHES FROM EDGES OF BAG.
3. CONTROL PUMPING RATE TO PREVENT EXCESSIVE PRESSURE WITHIN THE FILTER BAG IN ACCORDANCE WITH THE MANUFACTURERR RECOMMENDATIONS. AS THE BAG FILLS WITH SEDIMENT, REDUCE PUMPING RATE.
4. REMOVE AND PROPERLY DISPOSE OF FILTER BAG UPON COMPLETION OF PUMPING OPERATIONS OR AFTER BAG HAS REACHED CAPACITY, WHICHEVER OCCURS FIRST. SPREAD THE DEWATERED SEDIMENT FROM THE BAG IN AN APPROVED UPLAND AREA AND STABILIZE WITH SEED AND MULCH BY THE END OF THE WORK DAY. RESTORE THE SURFACE AREA BENEATH THE BAG TO ORIGINAL CONDITION UPON REMOVAL OF THE DEVICE.
5. USE NONWOVEN GEOTEXTILE WITH DOUBLE STITCHED SEAMS USING HIGH STRENGTH THREAD. SIZE SLEEVE TO ACCOMMODATE A MAXIMUM 4 INCH DIAMETER PUMP DISCHARGE HOSE. THE BAG MUST BE MANUFACTURED FROM A NONWOVEN GEOTEXTILE THAT MEETS OR EXCEEDS MINIMUM AVERAGE ROLL VALUES (MARV) FOR THE FOLLOWING:

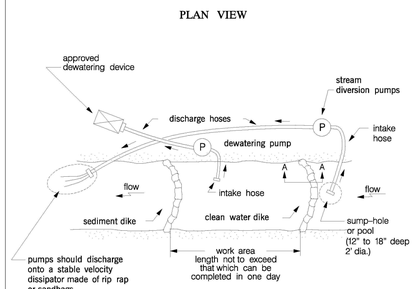
GRAB TENSILE	250 LB	ASTM D–4632
PUNCTURE	150 LB	ASTM D–4833
FLOW RATE	70 GAL/MIN/FT²	ASTM D–4491
PERMITTIVITY (SEC^{-1})	1.2 SEC^{-1}	ASTM D–4491
UV RESISTANCE	70% STRENGTH @ 500 HOURS	ASTM D–4355
APPARENT OPENING SIZE (AOS)	0.15–0.18 MM	ASTM D–4751
SEAM STRENGTH	90%	ASTM D–4632

6. REPLACE FILTER BAG IF BAG CLOGS OR HAS RIPS, TEARS, OR PUNCTURES. DURING OPERATION KEEP CONNECTION BETWEEN PUMP HOSE AND FILTER BAG WATER TIGHT. REPLACE BEDDING IF IT BECOMES DISPLACED.

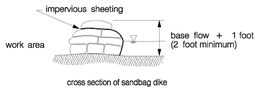
MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE	2011	MARYLAND DEPARTMENT OF ENVIRONMENT WATER MANAGEMENT ADMINISTRATION

Maryland's Guidelines To Waterway Construction
DETAIL 1.2: PUMP–AROUND PRACTICE

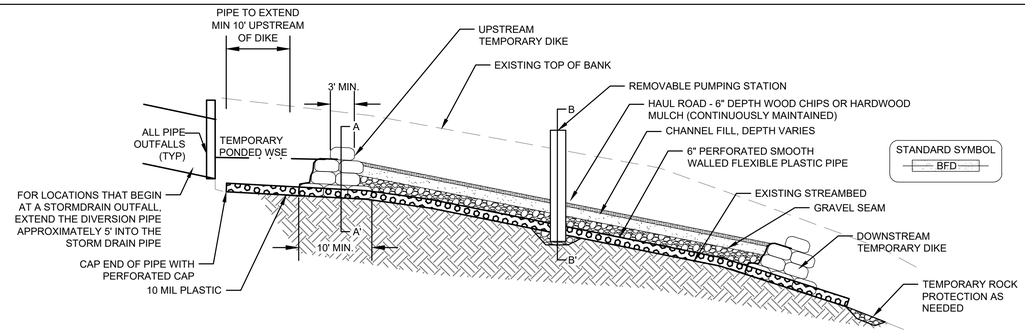


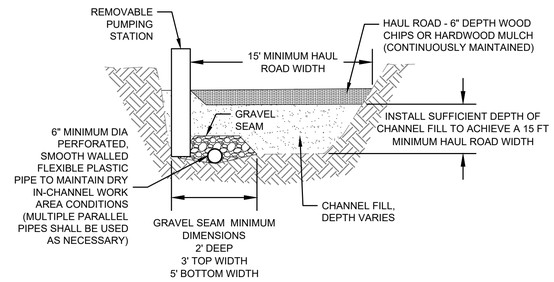
SECTION A–A



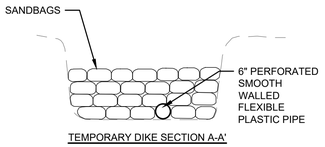
cross section of sandbag dike

TEMPORARY INSTREAM CONSTRUCTION MEASURES	*REVISED NOVEMBER 2000 PAGE 1.2 – 3*	MARYLAND DEPARTMENT OF THE ENVIRONMENT WATER MANAGEMENT ADMINISTRATION





REMOVABLE PUMPING STATION SECTION B-B'



TEMPORARY DIKE SECTION A-A'

IN-CHANNEL HAUL ROAD/BASE FLOW DIVERSION EXECUATION:

1. INSTALL PERFORATED FLEXIBLE DIVERSION PIPE(S) ALONG THE EXISTING CHANNEL THALWEG FROM THE UPSTREAM END OF THE WORK AREA TO THE DOWNSTREAM LIMIT, ENSURING THAT DIVERSION PIPE DISCHARGES TO A STABLE SURFACE.
2. FOR LOCATIONS THAT BEGIN AT A STORM DRAIN OUTFALL, INSERT THE DIVERSION PIPE APPROXIMATELY 5' INTO THE STORM DRAIN PIPE WHEN POSSIBLE. IF OUTFALL HAS SEVERELY ERODED THE RECEIVING STREAMBED AND PIPE IS NO LONGER AT A SIMILAR ELEVATION AS THE STREAMBED, START UNDERDRAIN PIPE AT THE END OF THE STORM DRAIN PIPE.
3. FOR LOCATIONS THAT BEGIN WITHOUT A STORM DRAIN OUTFALL, EXTEND DIVERSION PIPE A MINIMUM OF 10 FT UPSTREAM OF DIKE LOCATION.
4. CAP THE UPSTREAM END OF THE PIPE WITH A PERFORATED END CAP.
5. SECURE ENTIRE LENGTH OF DIVERSION PIPE EVERY 15 FT WITH SANDBAGS, STAKES AND WIRE TIES TO KEEP PIPE IN PLACE AS FILL IS INSTALLED ABOVE IT. FOR THE LENGTH OF PIPE INSERTED INTO A STORM DRAIN PIPE, SECURE WITH SANDBAGS ALONG ENTIRE LENGTH OF INSERTED PIPE.
6. INSTALL UPSTREAM AND DOWNSTREAM DIKES USING SANDBAGS WITH DIVERSION PIPE EXTENDING PAST EACH. BEGIN INSTALLING GRAVEL SEAM, FILLING OVERTOP THE DIVERSION PIPE. KEEP DIVERSION PIPE ABOVE UPSTREAM DIKE EXPOSED TO ALLOW PONDED WATER TO CONTINUOUSLY DRAIN.
7. APPROXIMATELY EVERY 400 FT OF CHANNEL, INSTALL A 24" PERFORATED HDPE PIPE VERTICALLY FROM THE BOTTOM OF THE GRAVEL SEAM TO A MIN OF 24" ABOVE FLOODPLAIN GRADE ALONG THE BANK TO FUNCTION AS A REMOVABLE PUMPING STATION. REMOVABLE PUMPING STATION SHALL BE USED AS SUMP PIT FOR DEWATERING PURPOSES AS NEEDED.
8. INSTALL CHANNEL FILL ABOVE GRAVEL SEAM TO APPROXIMATE ELEVATION OF PROPOSED POOL, AT MINIMUM HEIGHT TO ACHIEVE A WORKING HAUL ROAD WIDTH OF 15 FT.
9. INSTALL AND MAINTAIN 6 INCHES OF WOODCHIPS OR HARDWOOD MULCH AS SURFACE OF HAUL ROAD.
10. CONTRACTOR SHALL ACTIVELY MAINTAIN DIVERSION PIPE AND IN-CHANNEL HAUL ROAD WIDTH AND DEPTH DURING THE DURATION OF ITS USE.
11. A STREAM PUMP AROUND SHALL BE USED IN TANDEM WITH DIVERSION PIPE WHEN NECESSARY TO MAINTAIN A DRY WORK AREA.
12. AS CONSTRUCTION OF IN-STREAM WORK PROGRESSES UPSTREAM, THE DOWNSTREAM TEMPORARY DIKE SHALL BE RELOCATED TO THE DOWNSTREAM LIMIT OF WORK EACH DAY. COMPLETED IN-STREAM GRADE CONTROL STRUCTURES (RIFFLES, CASCADES, ETC) MAY BE USED IN LIEU OF THE DOWNSTREAM TEMPORARY DIKE.
13. SECTION OF DIVERSION PIPE SHALL BE REMOVED DURING INSTALLATION OF STREAM STRUCTURES AND GRADING OF POOLS TO RESTORE FLOW TO SURFACE.
14. AS STREAM WORK IS COMPLETED AND DIVERSION PIPE REMOVED, GRAVEL SEAM SHALL BE CHOKED UP WITH SEDIMENT APPROXIMATELY EVERY 100 FT. EACH GRAVEL SEAM INTERRUPTION SHALL BE 1' LONG SECTION OF CHOKED SEAM, FOR THE FULL WIDTH AND DEPTH.
15. WOODCHIPS FROM HAUL ROAD SHALL BE INCORPORATED INTO CHANNEL FILL AS WORK IS COMPLETED.

IN-CHANNEL HAUL ROAD/BASE FLOW DIVERSION MATERIALS:

1. PERFORATED PIPE SHALL BE SMOOTHED WALLED FLEXIBLE PLASTIC PIPE (HDPE) SIZED TO MAINTAIN DRY CONDITIONS, 6" DIA MINIMUM. MULTIPLE ROWS ALLOWABLE
2. GRAVEL SEAM SHALL BE COMPOSED OF EITHER WASHED PEA GRAVEL (3/8 INCH DIAMETER, ROUNDED PARTICLES) OR WASHED #57 CRUSHED STONE (1/2 TO 1" DIAMETER).
3. WOOD STAKES SHALL BE 2" X 2" HARDWOOD STAKES, 1 FOOT LONG.
4. CHANNEL FILL MATERIAL SHALL BE COMPOSED OF 80% IMPORTED OR ON-SITE SALVAGED MATERIAL MIXED WITH 20% HARDWOOD MULCH BY VOLUME. IMPORTED MATERIAL SHALL CONSIST OF SAND, LOAMY SAND, SANDY LOAM AND LOAM TEXTURES, AS DEFINED BY USDA. MATERIAL GRADATION SHALL BE UP TO 20% CLAY (<0.002 MM) UP TO 50% SILT (0.002 MM TO 0.05 MM), 30% TO 100% SAND (0.05 MM TO 2.0 MM), AND UP TO 5% GRAVEL (2.0MM TO 2.0 IN). SALVAGED MATERIAL SHALL ONLY BE GENERATED FROM APPROVED ON-SITE GRADING ACTIVITIES AND MEET THE SPECIFICATIONS FOR IMPORTED MATERIAL. HARDWOOD MULCH SHALL CONSIST OF NATURAL UNCOMPOSTED WOOD AND BARK FROM HARDWOOD TREES THAT HAVE BEEN MILLED TO A MINIMUM PARTICLE SIZE OF 1 X 1/2 X 1/4 INCH AND MAXIMUM PARTICLE SIZE OF 4 X 4 X 2 INCH WITH LESS THAN 20% SAWDUST.
5. HAUL ROAD - 6 INCHES MINIMUM THICK LAYER OF WOOD CHIPS OR HARDWOOD MULCH REPLENISHED AS NECESSARY THROUGHOUT THE CONSTRUCTION PERIOD TO MAINTAIN FULL THICKNESS.

IN CHANNEL HAUL ROAD/ BASE FLOW DIVERSION

NOT TO SCALE

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

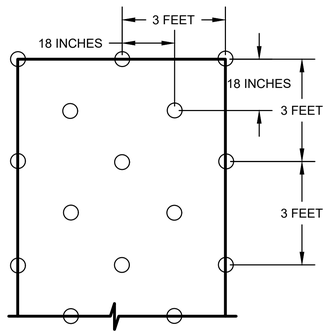
SCALE:	AS SHOWN
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	18 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK
STREAM RESTORATION

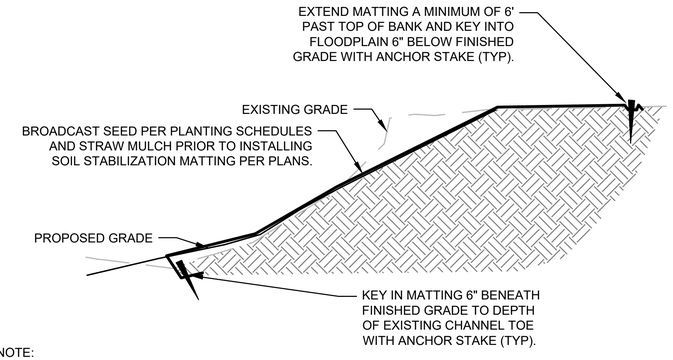
EROSION & SEDIMENT CONTROL DETAILS

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\dt01aw.dwg

NOTES:
1. ANCHOR PATTERN 2 ANCHORS/SQUARE YARD
2. WOODEN STAKES (AT LEAST 12 INCHES LONG) SHALL BE USED TO ANCHOR COIR MATTING TO THE GROUND SURFACE.
3. KEY COIR MATTING INTO TOE OF SLOPE. SECURE WITH 2 INCHES X 2 INCHES X 12 INCHES HARDWOOD STAKES. CONTRACTOR SHALL CUT NOTCH INTO SIDE OF STAKE 1 INCH FROM TOP.
4. USE 2 INCHES X 2 INCHES X 12 INCHES HARDWOOD STAKES TO SECURE ALL OTHER AREAS OF COIR MATTING, USING NOTCHES AS IN #3
5. ALL MATTING SHALL OVERLAP IN A DOWN VALLEY OR DOWNSTREAM DIRECTION, WITH A MINIMUM OVERLAP OF 6 INCHES.
6. ALL MATTING SHALL BE COIR MAT 700 OR EQUIVALENT



PLAN

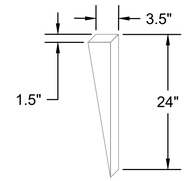


NOTE:
1. ALL MATTING SHALL BE COIR MAT 700 SERIES (700 GRAMS/SQUARE METER) OR EQUIVALENT UNLESS APPROVED BY ENGINEER.
2. WITHIN SPSC REACHES, COIR MATTING SHALL BE INSTALLED ON THE FINISHED GRADE OF ALL GRADED/DISTURBED STREAMBANKS ABOVE POOL ELEVATION THAT ARE 3:1 OR STEEPER, OR AT DIRECTION OF THE COUNTY.
3. WITHIN RSC REACHES (VALLEY-WIDE RIFFLES AND CASCADES), COIR MATTING SHALL BE INSTALLED ON THE FINISHED GRADE OF ALL GRADED/DISTURBED VALLEY WALL TIES IN AND ALL SURFACES THAT ARE 3:1 OR STEEPER, OR AT DIRECTION OF THE COUNTY.

CROSS SECTION

SOIL STABILIZATION MATTING

NOT TO SCALE



NOTE: ANCHOR STAKES SHALL BE TAPERED TWO FOOT LONG WOODEN STAKES CONSISTING OF STANDARD 2" X 4" WOODEN BOARDS CUT DIAGONALLY.

ANCHOR STAKE DETAIL

NOT TO SCALE

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers FEDERATION
ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	NTS
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	19 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

EROSION & SEDIMENT CONTROL DETAILS

2019 STREAM RESTORATION STABILIZATION NOTES:

TEMPORARY STABILIZATION

CONDITIONS WHERE PRACTICE APPLIES: EXPOSED SOIL WHERE GROUND COVER IS NEEDED FOR A PERIOD OF 6 MONTHS OR LESS. FOR LONGER DURATION OF TIME, PERMANENT STABILIZATION PRACTICES ARE REQUIRED.

1. TEMPORARY STABILIZATION FOR ANY DISTURBED AREAS ON THE FLOODPLAIN AND TERRACES ADJACENT TO THE RESTORED STREAM CHANNEL SHALL BE CONSIDERED ACHIEVED USING ONE OF THE FOLLOWING MEASURES:
   a. THE DISTURBED AREA IS UNIFORMLY COVERED WITH 2 TO 4 INCHES OF WOOD CHIPS
   b. THE DISTURBED AREA HAS BEEN SEEDED WITH ANNUAL RYE GRASS FOLLOWING THE TEMPORARY SEEDING APPLICATION PERIODS FOUND UNDER THE ANNE ARUNDEL SOIL CONSERVATION DISTRICT (AASCD) VEGETATIVE ESTABLISHMENT SPECIFICATION OR 2011 STANDARDS AND SPECIFICATIONS FOR SOIL SOIL EROSION AND SEDIMENT CONTROL. NO SOIL TEST, LIME, OR FERTILIZER WILL BE REQUIRED.

PERMANENT STABILIZATION

CONDITIONS WHERE PRACTICE APPLIES: EXPOSED SOILS WHERE GROUND COVER IS NEEDED FOR 6 MONTHS OR MORE.

1. PERMANENT STABILIZATION FOR CONSTRUCTED STREAM BANKS GREATER THAN 6 INCHES SHALL BE CONSIDERED ACHIEVED WHEN ALL STREAM BANKS ARE SEEDED (NATIVE SEED MIX) AND LINED WITH A FULLY BIODEGRADABLE STABILIZATION MATTING WITH APPROPRIATE STRENGTH PROPERTIES DEPENDENT ON LOCAL SHEAR STRESS CONDITIONS
2. PERMANENT STABILIZATION FOR DISTURBED FLOODPLAIN AND TERRACES ADJACENT TO THE RESTORED STREAM CHANNEL SHALL BE CONSIDERED ACHIEVED USING ONE OF THE FOLLOWING MEASURES:
   a. THE DISTURBED AREA IS COVERED WITH 2 TO 4 INCHES OF COMPOST (APPLIED OVER ANY WOOD CHIPS USED FOR TEMPORARY STABILIZATION) AND THE NATIVE PLANTING PLAN (INCLUDING PERMANENT SEEDING) HAS BEEN IMPLEMENTED.
   b. THE DISTURBED AREA IS COVERED WITH 2 TO 4 INCHES OF WOOD CHIPS TRACKED INTO SOIL AND THE NATIVE PLANTING PLAN (INCLUDING PERMANENT SEEDING) HAS BEEN IMPLEMENTED.
   c. THE DISTURBED AREA IS COVERED WITH 2 TO 4 INCHES OF TOPSOIL (FURNISHED OR SALVAGED) AND FULLY BIODEGRADABLE STABILIZATION MATTING INSTALLED PER MANUFACTURER'S INSTRUCTIONS AND A NATIVE PLANTING PLAN (INCLUDING PERMANENT SEEDING) HAS BEEN IMPLEMENTED, REGARDLESS OF SOIL TREATMENT,
   d. THE DISTURBED AREAS SHALL RECEIVE HYDROSEEDING OR FLEXIBLE GROWTH MEDIUM (FGM) AFTER THE ESTABLISHMENT OF FINAL GRADES AND MICROTOPOGRAPHY (IF APPLICABLE) IN ACCORDANCE WITH THE PROJECT CONSTRUCTION DETAILS OR LANDSCAPING PLANS.
   e. THE DISTURBED AREA HAS ADEQUATE VEGETATIVE ESTABLISHMENT WITH 95% GROUNDCOVER.

TOPSOILING

1. TOPSOIL IS PLACED OVER PREPARED SUBSOIL PRIOR TO ESTABLISHMENT OF PERMANENT VEGETATION. THE PURPOSE IS TO PROVIDE A SUITABLE SOIL MEDIUM FOR VEGETATIVE GROWTH. SOILS OF CONCERN HAVE LOW MOISTURE CONTENT, LOW NUTRIENT LEVELS, LOW PH, MATERIALS TOXIC TO PLANTS, AND/OR UNACCEPTABLE SOIL GRADATION.
2. TOPSOIL SALVAGED FROM AN EXISTING SITE MAY BE USED PROVIDED IT MEETS THE STANDARDS AS SET FORTH IN THESE SPECIFICATIONS. TYPICALLY, THE DEPTH OF TOPSOIL TO BE SALVAGED FOR A GIVEN SOIL TYPE CAN BE FOUND IN THE REPRESENTATIVE SOIL PROFILE SECTION IN THE SOIL SURVEY PUBLISHED BY USDA-NRCS.
3. TOPSOILING IS LIMITED TO AREAS HAVING 2:1 OR FLATTER SLOPES WHERE:
   a. THE TEXTURE OF THE EXPOSED SUBSOIL/PARENT MATERIAL IS NOT ADEQUATE TO PRODUCE VEGETATIVE GROWTH.
   b. THE SOIL MATERIAL IS SO SHALLOW THAT THE ROOTING ZONE IS NOT DEEP ENOUGH TO SUPPORT PLANTS OR FURNISH CONTINUING SUPPLIES OF MOISTURE AND PLANT NUTRIENTS.
   c. THE ORIGINAL SOIL TO BE VEGETATED CONTAINS MATERIAL TOXIC TO PLANT GROWTH.
   d. THE SOIL IS SO ACIDIC THAT TREATMENT WITH LIMESTONE IS NOT FEASIBLE.
4. AREAS HAVING SLOPES STEEPER THAN 2:1 REQUIRE SPECIAL CONSIDERATION AND DESIGN.
5. TOPSOIL SPECIFICATIONS: SOIL TO BE USED AS TOPSOIL MUST MEET THE FOLLOWING CRITERIA:
   a. TOPSOIL MUST BE A LOAM, SANDY LOAM, CLAY LOAM, SILT LOAM, SANDY CLAY LOAM, OR LOAMY SAND. OTHER SOILS MAY BE USED IF RECOMMENDED BY AN AGRONOMIST OR SOIL SCIENTIST AND APPROVED BY THE APPROPRIATE APPROVAL AUTHORITY. TOPSOIL MUST NOT BE A MIXTURE OF CONTRASTING TEXTURED SUBSOILS AND MUST CONTAIN LESS THAN 5 PERCENT BY VOLUME OF CINDERS, STONES, SLAG, COARSE FRAGMENTS, GRAVEL, STICKS, ROOTS, TRASH, OR OTHER MATERIALS LARGER THAN 1 INCHES IN DIAMETER.
   b. TOPSOIL MUST BE FREE OF NOXIOUS PLANTS OR PLANT PARTS SUCH AS BERMUDA GRASS, QUACK GRASS, JOHNSON GRASS, NUT SEDGE, POISON IVY, THISTLE, OR OTHERS AS SPECIFIED.
   c. TOPSOIL SUBSTITUTES OR AMENDMENTS, AS RECOMMENDED BY A QUALIFIED AGRONOMIST OR SOIL SCIENTIST AND APPROVED BY THE APPROPRIATE APPROVAL AUTHORITY, MAY BE USED IN LIEU OF NATURAL TOPSOIL.
6. TOPSOIL APPLICATION
   a. EROSION AND SEDIMENT CONTROL PRACTICES MUST BE MAINTAINED WHEN APPLYING TOPSOIL.
   b. UNIFORMLY DISTRIBUTE TOPSOIL IN A 5 TO 8 INCH LAYER AND LIGHTLY COMPACT TO A MINIMUM THICKNESS OF 4 INCHES. SPREADING IS TO BE PERFORMED IN SUCH A MANNER THAT SODDING OR SEEDING CAN PROCEED WITH A MINIMUM OF ADDITIONAL SOIL PREPARATION AND TILLAGE. ANY IRREGULARITIES IN THE SURFACE RESULTING FROM TOPSOILING OR OTHER OPERATIONS MUST BE CORRECTED IN ORDER TO PREVENT THE FORMATION OF DEPRESSIONS OR WATER POCKETS.
   c. TOPSOIL MUST NOT BE PLACED IF THE TOPSOIL OR SUBSOIL IS IN A FROZEN OR MUDDY CONDITION WHEN THE SUBSOIL IS EXCESSIVELY WET OR IN A CONDITION THAT MAY OTHERWISE BE DETRIMENTAL TO PROPER GRADING AND SEEDBED PREPARATION.

SOIL AMENDMENTS (FERTILIZER AND LIME SPECIFICATIONS)

1. SOIL TESTS MUST BE PERFORMED TO DETERMINE THE EXACT RATIOS AND APPLICATION RATES FOR BOTH LIME AND FERTILIZER ON SITES HAVING DISTURBED AREAS OF 5 ACRES OR MORE. SOIL ANALYSIS MAY BE PERFORMED BY A RECOGNIZED PRIVATE OR COMMERCIAL LABORATORY. SOIL SAMPLES TAKEN FOR ENGINEERING PURPOSES MAY ALSO BE USED FOR CHEMICAL ANALYSES.
2. FERTILIZERS MUST BE UNIFORM IN COMPOSITION, FREE FLOWING AND SUITABLE FOR ACCURATE APPLICATION BY APPROPRIATE EQUIPMENT. MANURE MAY BE SUBSTITUTED FOR FERTILIZER WITH PRIOR APPROVAL FROM THE APPROPRIATE APPROVAL AUTHORITY. FERTILIZERS MUST ALL BE DELIVERED TO THE SITE FULLY LABELED ACCORDING TO THE APPLICABLE LAWS AND MUST BEAR THE NAME, TRADE NAME OR TRADEMARK AND WARRANTY OF THE PRODUCER.
3. LIME MATERIALS MUST BE GROUND LIMESTONE (HYDRATED OR BURNT LIME MAY BE SUBSTITUTED EXCEPT WHEN HYDROSEEDING) WHICH CONTAINS AT LEAST 50 PERCENT TOTAL OXIDES (CALCIUM OXIDE PLUS MAGNESIUM OXIDE). LIMESTONE MUST BE GROUND TO SUCH FINENESS THAT AT LEAST 50 PERCENT WILL PASS THROUGH A #100 MESH SIEVE AND 98 TO 100 PERCENT WILL PASS THROUGH A #20 MESH SIEVE.
4. LIME AND FERTILIZER ARE TO BE EVENLY DISTRIBUTED AND INCORPORATED INTO THE TOP 3 TO 5 INCHES OF SOIL BY DISKING OR OTHER SUITABLE MEANS.
5. WHERE THE SUBSOIL IS EITHER HIGHLY ACIDIC OR COMPOSED OF HEAVY CLAYS, SPREAD GROUND LIMESTONE AT THE RATE OF 4 TO 8 TONS/ACRE(200-400 POUNDS PER 1,000 SQUARE FEET) PRIOR TO THE PLACEMENT OF TOPSOIL.

SEEDING AND MULCHING

A. SEEDING

1. SPECIFICATIONS
   a. ALL SEED MUST MEET THE REQUIREMENTS OF THE MARYLAND STATE SEED LAW. ALL SEED MUST BE SUBJECT TO RE-TESTING BY A RECOGNIZED SEED LABORATORY. ALL SEED USED MUST HAVE BEEN TESTED WITHIN THE 6 MONTHS IMMEDIATELY PRECEDING THE DATE OF SOWING ON ANY PROJECT. REFER TO TABLE B.4 REGARDING THE QUALITY OF SEED. SEED TAGS MUST BE AVAILABLE UPON REQUEST TO THE INSPECTOR TO VERIFY TYPE AND RATE OF SEED USED.
   b. MULCH ALONE MAY BE APPLIED BETWEEN THE FALL AND SPRING SEEDING DATES ONLY IF THE GROUND IS FROZEN. THE APPROPRIATE SEEDING MIXTURE MUST BE APPLIED WHEN THE GROUND THAWS.
   c. INOCULANTS: THE INOCULANT FOR TREATING LEGUME SEED IN THE SEED MIXTURES MUST BE A PURE CULTURE OF NITROGEN FIXING BACTERIA PREPARED SPECIFICALLY FOR THE SPECIES. INOCULANTS MUST NOT BE USED LATER THAN THE DATE INDICATED ON THE CONTAINER. ADD FRESH INOCULANTS AS DIRECTED ON THE PACKAGE. USE FOUR TIMES THE RECOMMENDED RATE WHEN HYDROSEEDING. NOTE: IT IS VERY IMPORTANT TO KEEP INOCULANT AS COOL AS POSSIBLE UNTIL USED. TEMPERATURES ABOVE 75 TO 80 DEGREES FAHRENHEIT CAN WEAKEN BACTERIA AND MAKE THE INOCULANT LESS EFFECTIVE.
   d. SOD OR SEED MUST NOT BE PLACED ON SOIL WHICH HAS BEEN TREATED WITH SOIL STERILANTS OR CHEMICALS USED FOR WEED CONTROL UNTIL SUFFICIENT TIME HAS ELAPSED (14 DAYS MIN.) TO PERMIT DISSIPATION OF PHYTO-TOXIC MATERIALS.
2. APPLICATION
   a. DRY SEEDING: THIS INCLUDES USE OF CONVENTIONAL DROP OR BROADCAST SPREADERS.
   i. INCORPORATE SEED INTO THE SUBSOIL AT THE RATES PRESCRIBED ON TEMPORARY SEEDING TABLE B.1, PERMANENT SEEDING TABLE B.3, OR SITE-SPECIFIC SEEDING SUMMARIES.
   ii. APPLY SEED IN TWO DIRECTIONS, PERPENDICULAR TO EACH OTHER. APPLY HALF THE SEEDING RATE IN EACH DIRECTION. ROLL THE SEEDED AREA WITH A WEIGHTED ROLLER TO PROVIDE GOOD SEED TO SOIL CONTACT.
   b. DRILL OR CULTIPACKER SEEDING: MECHANIZED SEEDERS THAT APPLY AND COVER SEED WITH SOIL.
   i. CULTIPACKING SEEDERS ARE REQUIRED TO BURY THE SEED IN SUCH A FASHION AS TO PROVIDE AT LEAST 1/4 INCH OF SOIL COVERING. SEEDBED MUST BE FIRM AFTER PLANTING.
   ii. APPLY SEED IN TWO DIRECTIONS, PERPENDICULAR TO EACH OTHER. APPLY HALF THE SEEDING RATE IN EACH DIRECTION.
   c. HYDROSEEDING: APPLY SEED UNIFORMLY WITH HYDROSEEDER (SLURRY INCLUDES SEED AND FERTILIZER).
   i. IF FERTILIZER IS BEING APPLIED AT THE TIME OF SEEDING, THE APPLICATION RATES SHOULD NOT EXCEED THE FOLLOWING: NITROGEN, 100 POUNDS PER ACRE TOTAL OF SOLUBLE NITROGEN; P2O5 (PHOSPHOROUS), 200 POUNDS PER ACRE; K2O (POTASSIUM), 200 POUNDS PER ACRE.
   ii. LIME: USE ONLY GROUND AGRICULTURAL LIMESTONE (UP TO 3 TONS PER ACRE MAY BE APPLIED BY HYDROSEEDING). NORMALLY, NOT MORE THAN 2 TONS ARE APPLIED BY HYDROSEEDING AT ANY ONE TIME. DO NOT USE BURNT OR HYDRATED LIME WHEN HYDROSEEDING.
   iii. MIX SEED AND FERTILIZER ON SITE AND SEED IMMEDIATELY AND WITHOUT INTERRUPTION.
   iv. WHEN HYDROSEEDING DO NOT INCORPORATE SEED INTO THE SOIL.

MULCHING

1. MULCH MATERIALS (IN ORDER OF PREFERENCE)
   a. STRAW CONSISTING OF THOROUGHLY THRESHED WHEAT, RYE, OAT, OR BARLEY AND REASONABLY BRIGHT IN COLOR. STRAW IS TO BE FREE OF NOXIOUS WEED SEEDS AS SPECIFIED IN THE MARYLAND SEED LAW AND NOT MUSTY, MOLDY, CAKED, DECAYED, OR EXCESSIVELY DUSTY. NOTE: ONLY STERILE STRAW MULCH SHOULD BE USED IN AREAS WHERE ONE SPECIES OF GRASS IS DESIRED.
   b. WOOD CELLULOSE FIBER MULCH (WCFM) CONSISTING OF SPECIALLY PREPARED WOOD CELLULOSE PROCESSED INTO A UNIFORM FIBROUS PHYSICAL STATE.
   i. WCFM IS TO BE DYED GREEN OR CONTAIN A GREEN DYE IN THE PACKAGE THAT WILL PROVIDE AN APPROPRIATE COLOR TO FACILITATE VISUAL INSPECTION OF THE UNIFORMLY SPREAD SLURRY.
   ii. WCFM, INCLUDING DYE, MUST CONTAIN NO GERMINATION OR GROWTH INHIBITING FACTORS.
   iii. WCFM MATERIALS ARE TO BE MANUFACTURED AND PROCESSED IN SUCH A MANNER THAT THE WOOD CELLULOSE FIBER MULCH WILL REMAIN IN UNIFORM SUSPENSION IN WATER UNDER AGITATION AND WILL BLEND WITH SEED, FERTILIZER AND OTHER ADDITIVES TO FORM A HOMOGENEOUS SLURRY. THE MULCH MATERIAL MUST FORM A BLOTTER-LIKE GROUND COVER, ON APPLICATION, HAVING MOISTURE ABSORPTION AND PERCOLATION PROPERTIES AND MUST COVER AND HOLD GRASS SEED IN CONTACT WITH THE SOIL WITHOUT INHIBITING THE GROWTH OF THE GRASS SEEDLINGS.
   iv. WCFM MATERIAL MUST NOT CONTAIN ELEMENTS OR COMPOUNDS AT CONCENTRATION LEVELS THAT WILL BE PHYTO-TOXIC.
   v. WCFM MUST CONFORM TO THE FOLLOWING PHYSICAL REQUIREMENTS: FIBER LENGTH OF APPROXIMATELY 10 MILLIMETERS, DIAMETER APPROXIMATELY 1 MILLIMETER, PH RANGE OF 4.0 TO 8.5, ASH CONTENT OF 1.6 PERCENT MAXIMUM AND WATER HOLDING CAPACITY OF 90 PERCENT MINIMUM.
2. APPLICATION:
   a. APPLY MULCH TO ALL SEEDED AREAS IMMEDIATELY AFTER SEEDING.
   b. WHEN STRAW MULCH IS USED, SPREAD IT OVER ALL SEEDED AREAS AT THE RATE OF 2 TONS PER ACRE TO A UNIFORM LOOSE DEPTH OF 1 TO 2 INCHES. APPLY MULCH TO ACHIEVE A UNIFORM DISTRIBUTION AND DEPTH SO THAT THE SOIL SURFACE IS NOT EXPOSED. WHEN USING A MULCH ANCHORING TOOL, INCREASE THE APPLICATION RATE TO 2.5 TONS PER ACRE.
   c. WOOD CELLULOSE FIBER USED AS MULCH MUST BE APPLIED AT A NET DRY WEIGHT OF 1500 POUNDS PER ACRE. MIX THE WOOD CELLULOSE FIBER WITH WATER TO ATTAIN A MIXTURE WITH A MAXIMUM OF 50 POUNDS OF WOOD CELLULOSE FIBER PER 100 GALLONS OF WATER.
3. ANCHORING:
   a. PERFORM MULCH ANCHORING IMMEDIATELY FOLLOWING APPLICATION TO MINIMIZE LOSS BY WIND OR WATER. THIS MAY BE DONE BY ONE OF THE FOLLOWING METHODS (LISTED BY REFERENCE), DEPENDING UPON THE SIZE OF THE AREA AND EROSION HAZARD:
   i. MULCH ANCHORING TOOL IS A TRACTOR DRAWN IMPLEMENT DESIGNED TO PUNCH AND ANCHOR MULCH INTO THE SOIL SURFACE A MINIMUM OF 2 INCHES. THIS PRACTICE IS MOST EFFECTIVE ON LARGE AREAS, BUT IS LIMITED TO FLATTER SLOPES WHERE EQUIPMENT CAN OPERATE SAFELY. IF USED ON SLOPING LAND, THIS PRACTICE SHOULD BE USED ON THE CONTOUR IF POSSIBLE.
   ii. WOOD CELLULOSE FIBER MAY BE USED FOR ANCHORING STRAW. APPLY THE FIBER BINDER AT A NET DRY WEIGHT OF 750 POUNDS PER ACRE. MIX THE WOOD CELLULOSE FIBER WITH WATER AT A MAXIMUM OF 50 POUNDS OF WOOD CELLULOSE FIBER PER 100 GALLONS OF WATER.
   iii. SYNTHETIC BINDERS SUCH AS ACRYLIC DLR (AGRO-TACK), DCA_70, PETROSET, TERRA TAX II, TERRA TACK AR OR OTHER APPROVED EQUAL MAY BE USED WITH WRITTEN APPROVAL FROM DESIGN PROJECT MANAGER. FOLLOW APPLICATION RATES AS SPECIFIED BY THE MANUFACTURER. APPLICATION OF LIQUID BINDERS NEEDS TO BE HEAVIER AT THE EDGES WHERE WIND CATCHES MULCH, SUCH AS IN VALLEYS AND ON CRESTS OF BANKS. USE OF ASPHALT BINDERS IS STRICTLY PROHIBITED.

STEP POOL STORM CONVEYANCE STABILIZATION NOTES:

1. TEMPORARY STABILIZATION NOTE:
   1.1. TEMPORARY STABILIZATION FOR ANY AREA OF EARTH DISTURBED AROUND THE POOLS AND RIFFLE ZONES OF A SPSC (E.G., STEP POOL STORM CONVEYANCE SYSTEM) SHALL BE CONSIDERED ACHIEVED WHEN UNIFORMLY COVERING THE AREA WITH 2 TO 4 INCHES OF WOOD CHIPS. ANNUAL RYE MAY BE UTILIZED FOR THE TEMPORARY SEEDING APPLICATION PERIOD FOUND UNDER THE ANNE ARUNDEL SOIL CONSERVATION DISTRICT'S (AASCD) VEGETATIVE ESTABLISHMENT SPECIFICATION OR 2011 STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL.
2. PERMANENT STABILIZATION NOTE:
   2.1. PERMANENT STABILIZATION FOR AN AREA OF EARTH DISTURBANCE OF A SPSC SHALL BE CONSIDERED ACHIEVED WHEN THE BANKS AND FLOODPLAIN ARE COVERED WITH FULLY BIODEGRADABLE STABILIZATION MATTING INSTALLED PER MANUFACTURER'S INSTRUCTIONS AND A (NATIVE PLANTS) PLANTING PLAN HAS BEEN IMPLEMENTED.

VEGETATIVE ESTABLISHMENT NOTES

FOLLOWING INITIAL SOIL DISTURBANCES OR REDISTURBANCE, PERMANENT OR TEMPORARY STABILIZATION SHALL BE COMPLETED WITHIN THREE CALENDAR DAYS FOR THE SURFACE OF ALL PERIMETER CONTROLS, DIKES, SWALES, DITCHES, PERIMETER SLOPES, AND ALL SLOPES GREATER THAN 3 HORIZONTAL TO 1 VERTICAL (3:1) AND SEVEN DAYS FOR ALL OTHER DISTURBED OR GRADED AREAS ON THE PROJECT SITE.

1. PERMANENT SEEDING:

1.A. SOIL TESTS: LIME AND FERTILIZER WILL BE APPLIED PER SOIL TESTS RESULTS FOR SITES GREATER THAN 5 ACRES. SOIL TESTS WILL BE DONE AT COMPLETION OF INITIAL ROUGH GRADING OR AS RECOMMENDED BY THE SEDIMENT CONTROL INSPECTOR. RATES AND ANALYSES WILL BE PROVIDED TO THE GRADING INSPECTOR AS WELL AS THE CONTRACTOR. OCCURANCE OF ACID SULFATE SOILS (GRAYING BLACK COLOR) WILL REQUIRE COVERING WITH A MINIMUM OF 12 INCHES OF CLEAN SOIL WITH 6 INCHES MINIMUM CAPPING OF TOP SOIL. NO STOCKPILING OF MATERIALS ALLOWED. IF NEEDED, SOIL TESTS SHOULD BE DONE BEFORE AND AFTER A 6-WEEK INCUBATION PERIOD TO ALLOW OXIDATION OF SULFATES.

THE MINIMUM SOIL CONDITIONS REQUIRED FOR PERMANENT VEGETATIVE ESTABLISHMENT ARE:

a. SOIL PH SHALL BE BETWEEN 6.0 AND 7.0

b. SOLUBLE SALTS SHALL BE LESS THAN 500 PARTS PER MILLION (PPM).

c. THE SOIL SHALL CONTAIN LESS THAN 40% CLAY BUT ENOUGH FINE GRAINED MATERIAL (>30% SILT PLUS CLAY) TO PROVIDE THE CAPACITY TO HOLD A MODERATE AMOUNT OF MOISTURE. AN EXCEPTION IS IF LOVEGRASS OR SERECIA LESPEDEZA IS TO BE PLANTED, THEN A SANDY SOIL (<30% SILT PLUS CLAY) WOULD BE ACCPETABLE.

d. SOIL SHALL CONTAIN 1.5% MINIMUM ORGANIC MATTER BY WEIGHT.

e. SOIL MUST CONTAIN SUFFICIENT PORE SPACE TO PERMIT ADEQUATE ROOT PENETRATION.

f. IF THESE CONDITIONS CANNOT BE MET BY SOILS ON SITE, ADDING TOPSOIL IS REQUIRED IN ACCORDANCE WITH THE STANDARD AND SPECIFICATION FOR SOIL PREPARATION, TOPSOILING AND SOIL AMENDMENTS FROM THE 2011 MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL OR AMENDMENTS MADE AS RECOMMENDED BY A CERTIFIED AGRONOMIST.

1.B. SEEDBED PREPARATION: AREA TO BE SEEDED SHALL BE LOOSE AND FRIABLE TO A DEPTH OF AT LEAST 3-5 INCHES. THE TOP LAYER SHALL BE LOOSENED BY RAKING, DISKING OR OTHER ACCEPTABLE MEANS BEFORE SEEDING OCCURS. FOR SITES LESS THAN 5 ACRES, APPLY 100 POUNDS DOLOMITIC LIMESTONE AND 21 POUNDS OF 10-10-10 FERTILIZER PER 1,000 SQUARE FEET. HARROW OR DISK LIME AND FERTILIZER INTO THE SOIL TO A DEPTH OF AT LEAST 3-5 INCHES OF SLOPES FLATTER THAN 3:1.

1.C. SEEDING: APPLY 5.6 POUNDS PER 1,000 SQUARE FEET OF TALL FESCUE BETWEEN FEBRUARY 1 AND APRIL 30 OR BETWEEN AUGUST 15 AND OCTOBER 31. APPLY SEED UNIFORMLY ON A MOIST FIRM SEEDBED WITH A CYCLONE SEEDER, CULTIPACKER SEEDER OR HYDROSEEDER (SLURRY INCLUDES SEEDS AND FERTILIZER, RECOMMENDED ON STEEP SLOPES ONLY). MAXIMUM SEED DEPTH SHOULD BE ½ INCH IN CLAYEY SOILS AND 1 ½ INCH IN SANDY SOILS WHEN USING OTHER THAN THE HYDROSEEDER METHOD. IRRIGATE WHERE NECESSARY TO SUPPORT ADEQUATE GROWTH UNTIL VEGETATION IS FIRMLY ESTABLISHED. IF OTHER SEED MIXES ARE TO BE USED, SELECT FROM TABLE B3 AND B5 OF THE 2011 MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL.

1.D. MULCHING: MULCH SHALL BE APPLIED TO ALL SEEDED AREAS IMMEDIATELY AFTER SEEDING. DURING THE TIME PERIODS WHEN SEEDING IS NOT PERMITTED, MULCH SHALL BE APPLIED IMMEDIATELY AFTER GRADING. MULCH SHALL BE UNROTTED, UNCHOPPED, SMALL GRAIN STRAW APPLIED AT A RATE OF 2 TONS PER ACRE OR 90 POUNDS PER 1,000 SQUARE FEET (2 BALES). APPLY MULCH TO ACHIEVE A UNIFORM DISTRIBUTION AND DEPTH SO THAT THE SOIL SURFACE IS NOT EXPOSED. IF A MULCH-ANCHORING TOOL IS USED, APPLY 2.5 TONS PER ACRE. MULCH MATERIALS SHALL BE RELATIVELY FREE OF ALL KINDS OF WEEDS AND SHALL BE COMPLETELY FREE OF PROHIBITED NOXIOUS WEEDS. SPREAD MULCH UNIFORMLY, MECHANICALLY OR BY HAND, TO A DEPTH OF 1-2 INCHES.

1.E. SECURING STRAW MULCH: STRAW MULCH SHALL BE SECURED IMMEDIATELY FOLLOWING MULCH APPLICATION TO MINIMIZE MOVEMENT BY WIND OR WATER. THE FOLLOWING METHODS ARE PERMITTED:

i. USING A MULCH-ANCHORING TOOL WHICH IS DESIGNED TO PUNCH AND ANCHOR MULCH INTO THE SOIL SURFACE TO A MINIMUM DEPTH OF 2 INCHES. THIS IS THE MOST EFFECTIVE METHOD FOR SECURING MULCH, HOWEVER, IT IS LIMITED TO RELATIVELY FLAT AREAS WHERE EQUIPMENT CAN OPERATE SAFELY.

ii. WOOD CELLULOSE FIBER MAY BE USED FOR ANCHORING STRAW. APPLY THE FIBER BINDER AT A NET DRY WEIGHT OF 750 POUNDS PER ACRE. IF MIXED WITH WATER, USE 50 POUNDS OF WOOD CELLULOSE FIBER PER 100 GALLONS OF WATER.

iii. LIQUID BINDERS MAY BE USED. APPLY AT HIGHER RATES AT THE EDGE WHERE WIND CATCHES MULCH, SUCH AS IN VALLEYS AND ON CRESTS OF SLOPES. THE REMAINDER OF THE AREA SHOULD APPEAR UNIFORM AFTER BINDER APPLICATION. BINDERS LISTED IN THE 2011 MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL OR APPROVED EQUAL SHALL BE APPLIED AT RATES RECOMMENDED BY THE MANUFACTURERS.

iv. LIGHTWEIGHT PLASTIC NETTING MAY BE USED TO SECURE MULCH. THE NETTING WILL BE STAPLED TO THE GROUND ACCORDING TO MANUFACTURER'S RECOMMENDATION.

2. TEMPORARY SEEDING:

LIME: 100 POUNDS OF DOLOMITIC LIMESTONE PER 1,000 SQUARE FEET.
FERTILIZER: 15 POUNDS OF 10-10-10 PER 1,000 SQUARE FEET.
SEED: PERENNIAL RYE - 0.92 POUNDS PER 1,000 SQUARE FEET (FEBRUARY 1 THROUGH APRIL 30 OR AUGUST 15 THROUGH OCTOBER 31).
MILLET - 0.92 POUNDS PER 1,000 SQUARE FEET (MAY 1 THROUGH APRIL 15).
MULCH: SAME AS 1 D AND E ABOVE.

3. NO FILLS MAY BE PLACED ON FROZEN GROUND. ALL FILL IS TO BE PLACED IN APPROXIMATELY HORIZONTAL LAYERS, EACH LAYER HAVING A LOOSE THICKNESS OF NOT MORE THAN 8 INCHES. ALL COMPACTION REQUIREMENTS ARE IN ACCORDANCE TO ANNE ARUNDEL COUNTY STANDARD SPECIFICATIONS FOR CONSTRUCTION AS WELL AS THE AA COUNTY DESIGN MANUAL AND STANDARD DETAILS. FILLS FOR POND EMBANKMENTS SHALL BE COMPACTED AS PER MD-378 CONSTRUCTION SPECIFICATIONS. ALL OTHER FILLS SHALL BE COMPACTED SUFFICIENTLY SO AS TO BE STABLE AND PREVENT EROSION AND SLIPPAGE.

4. PERMANENT SOD: INSTALLATION OF SOD SHOULD FOLLOW PERMANENT SEEDING DATES. SEEDBED PREPARATION FOR SOD SHALL BE AS NOTED IN SECTION (B) ABOVE. PERMANENT SOD IS TO BE TALL FESCUE, STATE APPROVED SOD; LIME AND FERTILIZER PER PERMANENT SEEDING SPECIFICATIONS AND LIGHTLY IRRIGATE SOIL PRIOR TO LAYING SOD. SOD IS TO BE LAID ON THE CONTOUR WITH ALL ENDS TIGHTLY ABUTTING. JOINTS ARE TO BE STAGGERED BETWEEN ROWS. WATER AND ROLL OR TAMP SOD TO INSURE POSITIVE ROOT CONTACT WITH THE SOIL. ALL SLOPES STEEPER THAN 3:1, AS SHOWN, ARE TO BE PERMANENTLY SODDED OR PROTECTED WITH AN APPROVED EROSION CONTROL NETTING. ADDITIONAL WATERING FOR ESTABLISHMENT MAY BE REQUIRED. SOD IS NOT TO BE INSTALLED ON FROZEN GROUND. SOD SHALL NOT BE TRANSPLANTED WHEN MOISTURE CONTENT (DRY OR WET) AND/OR EXTREME TEMPERATURE MAY ADVERSELY AFFECT ITS SURVIVAL. IN THE ABSENCE OF ADEQUATE RAINFALL, IRRIGATION SHOULD BE PERFORMED TO ENSURE ESTABLISHMENT OF SOD.

5. MINING OPERATIONS: SEDIMENT CONTROL PLANS FOR MINING OPERATIONS MUST INCLUDE THE FOLLOWING SEEDING DATES AND MIXTURES: FOR SEEDING DATES OF FEBRUARY 1 THROUGH APRIL 30 AND AUGUST 15 THROUGH OCTOBER 31, USE SEED MIXTURE OF TALL FESCUE AT THE RATE OF 2 POUNDS PER 1,000 SQUARE FEET AND SERICEA LESPEDEZA AT THE MINIMUM RATE OF 0.5 POUNDS FOR 1,000 SQUARE FEET.

6. TOPSOIL SHALL BE APPLIED AS PER THE STANDARD AND SPECIFICATIONS FOR SOIL PREPARATION, TOPSOILING, AND SOIL AMENDMENTS FROM THE 2011 MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL.

7. USE OF THESE VEGETATIVE ESTABLISHMENT SPECIFICATIONS DOES NOT PRECLUDE THE PERMITTEE OR CONTRACTOR FROM MEETING ALL THE REQUIREMENTS SET FORTH IN THE 2011 MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL.

BEST MANAGEMENT PRACTICES FOR WORKING IN NONTIDAL WETLANDS, WETLAND BUFFERS, WATERWAYS, AND 100-YEAR FLOODPLAINS

1. NO EXCESS FILL, CONSTRUCTION MATERIAL, OR DEBRIS SHALL BE STOCKPILED OR STORED IN NONTIDAL WETLANDS, NONTIDAL WETLAND BUFFERS, WATERWAYS, OR THE 100-YEAR FLOODPLAIN.
2. PLACE MATERIALS IN A LOCATION AND MANNER WHICH DOES NOT ADVERSELY IMPACT SURFACE OR SUBSURFACE WATER FLOW INTO OR OUT OF NONTIDAL WETLANDS, NONTIDAL WETLAND BUFFERS, WATERWAYS, OR THE 100-YEAR FLOODPLAIN.
3. DO NOT USE THE EXCAVATED MATERIAL AS BACKFILL IF IT CONTAINS WASTE METAL PRODUCTS, UNSIGHTLY DEBRIS, TOXIC MATERIAL, OR ANY OTHER DELETERIOUS SUBSTANCE. IF ADDITIONAL BACKFILL IS REQUIRED, USE CLEAN MATERIAL FREE OF WASTE METAL PRODUCTS, UNSIGHTLY DEBRIS, TOXIC MATERIAL, OR ANY OTHER DELETERIOUS SUBSTANCE.
4. PLACE HEAVY EQUIPMENT ON MATS OR SUITABLY OPERATE THE EQUIPMENT TO PREVENT DAMAGE TO NONTIDAL WETLANDS, NONTIDAL WETLAND BUFFERS, WATERWAYS, OR THE 100-YEAR FLOODPLAIN.
5. REPAIR AND MAINTAIN ANY SERVICEABLE STRUCTURE OR FILL SO THERE IS NO PERMANENT LOSS OF NONTIDAL WETLANDS, NONTIDAL WETLAND BUFFERS, OR WATERWAYS, OR PERMANENT MODIFICATION OF THE 100-YEAR FLOODPLAIN IN EXCESS OF THAT LOST UNDER THE ORIGINALLY AUTHORIZED STRUCTURE OR FILL.
6. RECTIFY ANY NONTIDAL WETLANDS, WETLAND BUFFERS, WATERWAYS, OR 100-YEAR FLOODPLAIN TEMPORARILY IMPACTED BY ANY CONSTRUCTION.
7. ALL STABILIZATION IN THE NONTIDAL WETLAND AND NONTIDAL WETLAND BUFFER SHALL CONSIST OF THE FOLLOWING SPECIES: ANNUAL RYEGRASS (*LOLIUM MULTIFLORUM*), MILLET (*SETARIA ITALICA*), BARLEY (*HORDEUM* SP.), OATS (*UNIOLA* SP.), AND/OR RYE (*SECALE CEREALE*). THESE SPECIES WILL ALLOW FOR THE STABILIZATION OF THE SITE WHILE ALSO ALLOWING FOR THE VOLUNTARY REVEGETATION OF NATURAL WETLAND SPECIES. OTHER NON-PERSISTENT VEGETATION MAY BE ACCEPTABLE, BUT MUST BE APPROVED BY THE NONTIDAL W

SEQUENCE OF CONSTRUCTION

GENERAL NOTES:

1. CONSTRUCTION ACTIVITIES INCLUDING THE INSTALLATION OF EROSION AND SEDIMENT CONTROL MEASURES SHALL NOT BEGIN UNTIL ALL REQUIRED EASEMENTS AND RIGHT-OF-WAYS HAVE BEEN OBTAINED. CONSTRUCTION SHALL NOT BEGIN ON A REACH UNTIL ALL SEDIMENT AND EROSION CONTROL MEASURES FOR THAT SECTION HAVE BEEN INSTALLED AND APPROVED BY THE PROJECT ENGINEER/DESIGNATED SPECIALIST AND THE SEDIMENT CONTROL INSPECTOR.

2. SPECIFIC TREES TO BE HARVESTED FOR STREAM RESTORATION ELEMENTS AND TREE PROTECTION MEASURES FOR TREES TO REMAIN SHALL BE DETERMINED AND MARKED IN THE FIELD BY THE DESIGNATED SPECIALIST PER NOTES AND DETAILS ON TP-01. ALL TREE HARVESTING SHALL BE DONE IN A MANNER TO MAXIMIZE THEIR USAGE IN THE PROPOSED RESTORATION STRUCTURES (IE MAINTAIN SPECIFIED TRUNK LENGTHS, ROOT WADS, ETC) AND TO MINIMIZE NEGATIVE IMPACTS TO RESIDUAL STANDING TREES, SHRUBS AND WETLANDS. TREE FELLING TO BE DONE IN ACCORDANCE WITH OSHA LOGGING STANDARD, 29 CFR 1910.266.

3. THE LIMIT OF DISTURBANCE (LOD) SHOWN ON THE PLANS ENCOMPASSES ALL ACTIVITIES RELATED TO THE STREAM CHANNEL IMPROVEMENTS, CONSTRUCTION ACCESS AND PLANTING ZONES. ALL HEAVY EQUIPMENT AND VEHICLE ACCESS SHALL GENERALLY FOLLOW THE PRIMARY CONSTRUCTION ACCESS PATH AND GRADING AREA AS SHOWN ALONG THE CHANNELS, BUT MAY BE ADJUSTED IN THE FIELD TO MINIMIZE IMPACT TO NATURAL RESOURCES WITH APPROVAL FROM THE PROJECT ENGINEER/DESIGNATED SPECIALIST.

4. WITHIN THE LOD, LOCATIONS OF STREAM AND FLOODPLAIN STRUCTURES AND GRADING MAY BE ADJUSTED IN THE FIELD TO MINIMIZE IMPACT TO NATURAL RESOURCES AND MAXIMIZE FUNCTION WITH APPROVAL FROM THE PROJECT ENGINEER/DESIGNATED SPECIALIST. ADDITIONAL WOOD ELEMENTS MAY BE ADDED WITHIN THE LOD AT LOCATIONS DIRECTED BY THE PROJECT ENGINEER/DESIGNATED SPECIALIST BASED ON SITE CONDITIONS AND AVAILABLE MATERIAL.

5. WHEN STREAM DIVERSION PRACTICES ARE UTILIZED, THE EXACT LOCATION OF THE PUMPS, HOSES, SEDIMENT DIKES, AND FILTER BAGS MAY BE MODIFIED IN THE FIELD BASED ON EXISTING CONDITIONS. ANY ADJUSTMENTS MUST BE APPROVED BY THE CONSTRUCTION MANAGER AND SEDIMENT CONTROL INSPECTOR.

6. FOR ALL ASPECTS OF STREAM WORK AND THROUGHOUT THE TIMEFRAME OF CONSTRUCTION OF THE STREAM IMPROVEMENTS, THE FOLLOWING APPLIES:

   6.1 THE CONTRACTOR SHALL BE RESPONSIBLE FOR ASSURING THAT THE SEDIMENT CONTROL MEASURES ARE FUNCTIONAL ON A DAY TO DAY BASIS. ALL DRAINAGE WITHIN THE IMMEDIATE WORK AREA MUST DRAIN TO AN MDE APPROVED E&S DEVICE.

   6.2 NO INSTREAM WORK IS ALLOWED WITHIN PERENNIAL AND INTERMITTENT REACHES FROM MARCH 1ST TO JUNE 15TH OF ANY YEAR TO MINIMIZE IMPACT TO AQUATIC SPECIES.

7. FOLLOWING INITIAL SOIL DISTURBANCE OR RE-DISTURBANCE, TEMPORARY STABILIZATION SHALL BE COMPLETED AT THE END OF EVERY WORKING DAY AND ROUTINELY MONITORED BY CONTRACTOR UNTIL PROPOSED CONSTRUCTION IS COMPLETED.

8. WOODCHIPS OR HARDWOOD MULCH MAY BE USED FOR STABILIZATION WITHIN A FORESTED AREA; AND SHALL BE DERIVED FROM FRESH OR AGED HARDWOOD INCLUDING BARK, WOOD FRAGMENTS AND GRINDINGS. WOODCHIPS AND HARDWOOD MULCH SHALL BE FREE OF LEAVES, VINES INCLUDING POISON IVY, TRASH AND FOREIGN MATTER, AND MAY INCLUDE CHUNKS UP TO 3 INCHES IN ANY DIMENSION. WITHIN THE TURFGRASS AREAS, STRAW MULCH SHALL BE USED FOR TEMPORARY STABILIZATION.

9. THE DIVERSION HOSE SHALL BE DISCHARGED IN A NON-EROSIVE MANNER AS SHOWN ON THE EROSION AND SEDIMENT CONTROL DETAIL SHEET (MARYLAND'S GUIDELINES TO WATERWAY CONSTRUCTION DETAIL 1.2). THE CONTRACTOR SHALL SIZE PUMPING OPERATIONS ADEQUATELY TO DIVERT STREAM BASE FLOW. AT THE END OF EACH WORKING DAY, THE CONTRACTOR SHALL STABILIZE ALL DISTURBED AREAS THAT DO NOT DRAIN TO AN MDE APPROVED SEDIMENT CONTROL MEASURE. SET AND RE-SET PUMP AROUND PRACTICE AND ASSOCIATED CONTROLS AS NEEDED TO PERFORM GRADING OPERATIONS ON A DAILY BASIS.

10. CONSTRUCTION SHALL BE DONE IN ACCORDANCE WITH THE SEQUENCE OF CONSTRUCTION, CONSTRUCTION PLANS AND EROSION AND SEDIMENT CONTROL DETAILS AND NOTES. DO NOT CLEAR AND GRUB THE ENTIRE PROJECT AREA. CLEAR AND GRUB ONLY AS DIRECTED BY THE PROJECT ENGINEER/DESIGNATED SPECIALIST AND ONLY WHERE CONSTRUCTION ACCESS IS NEEDED, OR GRADING IS TAKING PLACE AND CAN BE STABILIZED IN ONE WORKING DAY (IN 250 FT INCREMENTS MAXIMUM). MULTIPLE REACHES MAY BE UNDER CONSTRUCTION CONCURRENTLY, OR IN A DIFFERENT REACH ORDER OR DIRECTION OF WORK THAN LISTED IN THE SEQUENCE WITH WRITTEN APPROVAL FROM THE COUNTY PROJECT MANAGER AND PROJECT ENGINEER/DESIGNATED SPECIALIST, AS LONG AS THE REACH SEDIMENT CONTROL MEASURES ARE APPROVED. SIDE CHANNELS MAY BE CONSTRUCTED SIMULTANEOUSLY WITH MAIN CHANNEL WORK.

PRE-CONSTRUCTION NOTIFICATIONS

1. THE CONTRACTOR SHALL NOTIFY THE ANNE ARUNDEL COUNTY DEPARTMENT OF INSPECTIONS AND PERMITS (410-222-7780) AT LEAST 48 HOURS BEFORE COMMENCING WORK. WORK MAY NOT COMMENCE UNTIL THE PERMITTEE OR THE RESPONSIBLE PERSONNEL HAVE MET ON SITE WITH THE SEDIMENT AND EROSION CONTROL INSPECTOR TO REVIEW THE APPROVED PLANS.

2. THE CONTRACTOR SHALL NOTIFY MDE COMPLIANCE INSPECTOR AT 410-537-3510 AT LEAST 24 HOURS BEFORE COMMENCING WORK.

3. THE CONTRACTOR SHALL CALL MISS UTILITY AT 1-800-277-7777 A MINIMUM OF FORTY-EIGHT (48) HOURS BEFORE STARTING CONSTRUCTION. ALL EXISTING UTILITIES MUST BE MARKED IN THE FIELD PRIOR TO CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO EXISTING UTILITIES THAT MAY OCCUR AS A RESULT OF THE CONSTRUCTION. DAMAGED UTILITIES ARE TO BE IMMEDIATELY REPORTED TO BOTH THE UTILITY OWNER AND PROJECT ENGINEER/DESIGNATED SPECIALIST. ANY DAMAGE TO EXISTING STRUCTURES INCLUDING SEWER PIPES/MANHOLES, STORM DRAIN PIPES/STRUCTURES SHALL BE REPAIRED TO THE UTILITY OWNER'S SATISFACTION AT THE CONTRACTOR'S EXPENSE.

PRE-CONSTRUCTION SITE SETUP AND EROSION AND SEDIMENT CONTROL REACH (RELATES TO EACH CONSTRUCTION IMPLEMENTATION REACH)

1. THE CONTRACTOR SHALL STAKE OUT THE NECESSARY LOD OF REACH. (5 DAYS)

2. THE CONTRACTOR SHALL CONDUCT A PRE-CONSTRUCTION MEETING ONSITE WITH SEDIMENT CONTROL INSPECTOR AND THE PROJECT ENGINEER/DESIGNATED SPECIALIST TO REVIEW THE CONSTRUCTION ACCESS, EROSION AND SEDIMENT CONTROL REQUIREMENTS, AND THE SEQUENCE OF CONSTRUCTION. THE PARTICIPANTS WILL ALSO VERIFY THE LOCATION OF THE TEMPORARY STOCKPILE AREA AND ANY NECESSARY STAGING AREA, AND FLAG ANY TREES WITHIN THE LIMITS OF DISTURBANCE WHICH WILL BE PROTECTED USING TREE PLANKING OR TREE PROTECTION FENCE, SEE DETAILS ON TP-01. STAKING WILL BE COMPLETED PRIOR TO THE PRE-CONSTRUCTION MEETING WITH THE INSPECTOR AND PROJECT ENGINEER/DESIGNATED SPECIALIST. (2 DAYS)

3. CONSTRUCTION ACCESS LOCATIONS SHALL BE ESTABLISHED AS SHOWN ON THE PLANS, INCLUDING THE INSTALLATION OF A STABILIZED CONSTRUCTION ENTRANCES AND ASSOCIATED STAGING AND STOCKPILE AREAS. INSTALL TEMPORARY ACCESS BRIDGES AND CONSTRUCTION ACCESS ROAD AS SHOWN (SEE EROSION AND SEDIMENT PLAN AND CONSTRUCTION ACCESS ROAD DETAIL ON ES SHEETS). CONTRACTOR SHALL REPLENISH MULCH ALONG ACCESS ROAD AS NECESSARY THROUGHOUT CONSTRUCTION TO MAINTAIN FULL THICKNESS AND MINIMIZE DISTURBANCE OF UNDERLYING GROUND. CONTRACTOR SHALL INSTALL HARDWOOD MATS AS NECESSARY FOR ADDITIONAL PROTECTION IN WET OR HEAVY TRAFFIC AREAS TO PROTECT UNDERLYING GROUND. RETAIN HARVESTED LOGS, ROOT WADS, SLASH AND OTHER WOODY DEBRIS SUITABLE FOR USE AS INSTREAM STRUCTURES AND WOODY DEBRIS PLACEMENT ON-SITE; DO NOT CHIP MATERIALS THAT MEET THE REQUIREMENTS OF ANY STRUCTURE OR TREATMENT. (5 DAYS)

4. THE CONTRACTOR SHALL CLEAR MINIMUM AREA NECESSARY TO INSTALL SEDIMENT CONTROLS AND THE STAGING/LAYDOWN AREAS. MECHANICAL STABILIZATION WILL BE REQUIRED ON THE STAGING/LAYDOWN AREAS AND HEAVY USE AREAS, INCLUDING TRAVEL LANES. (2 DAYS)

5. THE CONTRACTOR SHALL INSTALL THE TREE PROTECTION MEASURES (ORANGE FENCE AND PLANKING) AS AGREED UPON WITH THE DESIGNATED SPECIALIST PER THE NOTES AND DETAILS ON TP-01. (1 DAY)

6. INSTALL PERIMETER CONTROLS AROUND STAGING AND STOCKPILE AREAS. STOCKPILE PLACEMENT OF ERODIBLE MATERIAL SHALL BE OUTSIDE THE EXISTING AND PROPOSED 100 WSEL AND SURROUNDED ALONG THE PERIMETER WITH REINFORCED SILT FENCE (RSF) IF LOCATED OUTSIDE OF A FORESTED AREA. WITHIN A FORESTED AREA, A FILTER LOG MAY BE USED AROUND STOCKPILE AREAS IN PLACE OF RSF TO PROTECT TREE ROOT ZONES.STAGING AND STOCKPILE AREA NOT TO EXCEED 15' IN HEIGHT OR 2:1 SLOPE. BORROW MATERIAL TO BE TAKEN OFF SITE TO A SITE WITH AN APPROVED SEDIMENT AND EROSION CONTROL PLAN. TEMPORARILY STABILIZE STOCKPILE AS PER THE STABILIZATION SPEC OR COVER THE STOCKPILE WITH PLASTIC TARP AND ANCHOR AT THE END OF EACH WORKDAY. STAGING AND STOCKPILING AREAS TO BE PROTECTED USING SAME PROTECTION AND REPLENISHMENT REQUIREMENTS AS MULCH ACCESS ROAD. (1 DAY)

7. THE SEDIMENT AND EROSION CONTROL INSPECTOR WILL BE NOTIFIED UPON COMPLETION OF THE SEDIMENT CONTROL INSTALLATION. UPON COMPLETION OF CONTROL INSTALLATION AND WITH APPROVAL OF THE SEDIMENT AND EROSION CONTROL INSPECTOR, THE CONTRACTOR MAY BEGIN GRADING OPERATIONS (1 DAY).

CONSTRUCTION IMPLEMENTATION REACH 2 - STA 11+00 TO 4+75

1. WITH APPROVAL FROM EROSION AND SEDIMENT CONTROL INSPECTOR, BEGIN IMPLEMENTATION OF THIS REACH.

2. PERFORM THE CLEARING AND GRUBBING AND DEMOLITION OPERATIONS NECESSARY THIS REACH OF STREAM CONSTRUCTION. CARE MUST BE TAKEN TO MINIMIZE SITE DISTURBANCE AND UNNECESSARY CLEARING AND GRUBBING. RETAIN HARVESTED LOGS, ROOT WADS, SLASH AND OTHER WOODY DEBRIS SUITABLE FOR USE AS INSTREAM STRUCTURES AND WOODY DEBRIS PLACEMENT ON-SITE. (5 DAYS)

3. THE CONTRACTOR SHALL STAKE OUT PROPOSED BASELINE STATIONING AS SHOWN ON THE GEOMETRY PLAN AND STRUCTURES AS SHOWN ON THE GRADING PLAN. (5 DAYS)

4. AS SITE CONDITIONS DICTATE; THE CONTRACTOR SHALL INSTALL A STREAM DIVERSION (PUMP AROUND PRACTICE OR CLEAR WATER DIVERSION) TO MAINTAIN A DRY ACTIVE WORK AREA(S) AND PERFORM PROPOSED GRADING AND STREAM AND FLOODPLAIN STRUCTURE INSTALLATION PER GRADING PLAN AND CONSTRUCTION DETAILS. INSTALLATION SHALL GENERALLY BEGIN AT THE DOWNSTREAM END OF REACH AND WORK IN AN UPSTREAM DIRECTION. COINCIDENTALLY INSTALL PROPOSED IMPROVEMENTS ON ALL SIDE CHANNELS AND STORM DRAIN OUTFALLS AS MAIN STEM WORK PROCEEDS. EACH WORK AREA LENGTH SHALL NOT EXCEED WHAT CAN BE COMPLETED IN ONE DAY. PUMP-AROUND PRACTICE SHALL FOLLOW MARYLAND'S GUIDELINES TO WATERWAY CONSTRUCTION DETAIL 1.2, WHICH INCLUDES INSTALLATION OF SANDBAG DIKES STREAM DIVERSION PUMPS AND HOSES, AND APPROVED DEWATERING DEVICE. CLEAR WATER DIVERSION PRACTICE SHALL FOLLOW MDE DETAIL C-6, WHICH INCLUDES INSTALLATION OF SANDBAG DIKES, DIVERSION PIPES AND APPROVED DEWATERING DEVICE. (30 DAYS)

5. TREAT DISTURBED FLOODPLAIN AREAS DAILY WITH TEMPORARY SEED AND A MINIMUM OF 2 INCHES OF WOODCHIPS OR HARDWOOD MULCH STABILIZATION. AS COMPLETED AREAS ARE APPROVED BY THE INSPECTOR AND PROJECT ENGINEER/DESIGNATED SPECIALIST, PERMANENTLY STABILIZE WITH PERMANENT SEED PER THE PLANTING SCHEDULE AND WOODCHIPS/HARDWOOD MULCH. INSTALL SOIL STABILIZATION MATTING PER DETAILS. SOIL STABILIZATION MATTING SHALL BE INSTALLED ON ALL GRADED STREAMBANKS AS SPECIFIED ON CONSTRUCTION DETAILS (DISTURBED SLOPES THAT ARE 3:1 OR STEEPER). ALL OTHER DISTURBED AREAS SHALL BE STABILIZED WITH A MINIMUM OF 2 INCHES OF WOOD CHIPS/HARDWOOD MULCH TRACKED INTO SOIL ALONG WITH THE PERMANENT SEED WITHIN THREE CALENDAR DAYS. LENGTH OF EACH ACTIVE WORK AREA SHALL NOT EXCEED WHAT CAN BE COMPLETED IN ONE DAY. INSTALLATION SHALL GENERALLY BEGIN AT THE DOWNSTREAM END OF REACH AND WORK IN AN UPSTREAM DIRECTION. INSTALL PROPOSED IMPROVEMENTS ON ALL SIDE CHANNELS AND STORM DRAIN OUTFALLS AS MAIN STEM WORK PROCEEDS. (30 DAYS CONCURRENT WITH #4 ABOVE)

6. PRIOR TO COMPLETING THE PHASE, THE CONTRACTOR AND OWNER SHALL REVIEW THE ALIGNMENT OF A POST-RESTORATION ADAPTIVE MANAGEMENT PATH (SEE MULCH PATH DETAIL) THAT FOLLOWS THE FULL LENGTH OF RESTORATION GENERALLY ALONG THE TOE OF THE SLOPE AND REFINE IT BASED ON POST-RESTORATION CONDITIONS. ONCE AGREED UPON, CONTRACTOR SHALL INSTALL A 6' WIDE PATH THAT INCLUDES 6" OF SAND WITH A 6" SURFACE LAYER OF WOODCHIPS ALONG APPROVED ALIGNMENT WITHIN THE LOD.

7. INSTALL ALL HERBACEOUS AND WOODY PLANT MATERIAL (PLUGS, LIVE STAKE, BARE ROOT, CONTAINER, SHRUBS TREES) WITH APPROVAL OF ENGINEER/DESIGNATED SPECIALIST, PER THE LANDSCAPE PLAN AND DETAILS. THE CONTRACTOR MAY CHOOSE TO INSTALL PLANT MATERIAL AFTER ALL REACHES OF CONSTRUCTION ARE COMPLETE. IF THE CONTRACTOR CHOOSES THIS OPTION, THEN THE CONTRACTOR MUST NOTIFY THE COUNTY AND OBTAIN PERMISSION TO INSTALL PLANT MATERIAL AFTER ALL CONSTRUCTION REACHES ARE COMPLETE. (10 DAYS)

8. UPON PERMANENT STABILIZATION OF THE WORK AREA, AND WITH APPROVAL FROM THE INSPECTOR AND ENGINEER/DESIGNATED SPECIALIST, THE CONTRACTOR MAY REMOVE E&SC DEVICES AND PROCEED TO NEXT REACH. ANY AREAS DISTURBED BY REMOVING THE E&SC DEVICES SHALL BE STABILIZED IMMEDIATELY AND RESTORED TO PRECONSTRUCTION CONDITIONS. (5 DAYS)

CONSTRUCTION IMPLEMENTATION REACH 1 - STA 4+75 TO 0+00

1. WITH APPROVAL FROM EROSION AND SEDIMENT CONTROL INSPECTOR, BEGIN IMPLEMENTATION OF THIS REACH.

2. PERFORM THE CLEARING AND GRUBBING AND DEMOLITION OPERATIONS NECESSARY THIS REACH OF STREAM CONSTRUCTION. CARE MUST BE TAKEN TO MINIMIZE SITE DISTURBANCE AND UNNECESSARY CLEARING AND GRUBBING. RETAIN HARVESTED LOGS, ROOT WADS, SLASH AND OTHER WOODY DEBRIS SUITABLE FOR USE AS INSTREAM STRUCTURES AND WOODY DEBRIS PLACEMENT ON-SITE. (5 DAYS)

3. THE CONTRACTOR SHALL STAKE OUT PROPOSED BASELINE STATIONING AS SHOWN ON THE GEOMETRY PLAN AND STRUCTURES AS SHOWN ON THE GRADING PLAN. (5 DAYS)

4. AS SITE CONDITIONS DICTATE; THE CONTRACTOR SHALL INSTALL A STREAM DIVERSION (PUMP AROUND PRACTICE OR CLEAR WATER DIVERSION) TO MAINTAIN A DRY ACTIVE WORK AREA(S) AND PERFORM PROPOSED GRADING AND STREAM AND FLOODPLAIN STRUCTURE INSTALLATION PER GRADING PLAN AND CONSTRUCTION DETAILS. INSTALLATION SHALL GENERALLY BEGIN AT THE DOWNSTREAM END OF REACH AND WORK IN AN UPSTREAM DIRECTION. COINCIDENTALLY INSTALL PROPOSED IMPROVEMENTS ON ALL SIDE CHANNELS AND STORM DRAIN OUTFALLS AS MAIN STEM WORK PROCEEDS. EACH WORK AREA LENGTH SHALL NOT EXCEED WHAT CAN BE COMPLETED IN ONE DAY. PUMP-AROUND PRACTICE SHALL FOLLOW MARYLAND'S GUIDELINES TO WATERWAY CONSTRUCTION DETAIL 1.2, WHICH INCLUDES INSTALLATION OF SANDBAG DIKES STREAM DIVERSION PUMPS AND HOSES, AND APPROVED DEWATERING DEVICE. CLEAR WATER DIVERSION PRACTICE SHALL FOLLOW MDE DETAIL C-6, WHICH INCLUDES INSTALLATION OF SANDBAG DIKES, DIVERSION PIPES AND APPROVED DEWATERING DEVICE. (30 DAYS)

5. TREAT DISTURBED FLOODPLAIN AREAS DAILY WITH TEMPORARY SEED AND A MINIMUM OF 2 INCHES OF WOODCHIPS OR HARDWOOD MULCH STABILIZATION. AS COMPLETED AREAS ARE APPROVED BY THE INSPECTOR AND PROJECT ENGINEER/DESIGNATED SPECIALIST, PERMANENTLY STABILIZE WITH PERMANENT SEED PER THE PLANTING SCHEDULE AND WOODCHIPS/HARDWOOD MULCH. INSTALL SOIL STABILIZATION MATTING PER DETAILS. SOIL STABILIZATION MATTING SHALL BE INSTALLED ON ALL GRADED STREAMBANKS AS SPECIFIED ON CONSTRUCTION DETAILS (DISTURBED SLOPES THAT ARE 3:1 OR STEEPER). ALL OTHER DISTURBED AREAS SHALL BE STABILIZED WITH A MINIMUM OF 2 INCHES OF WOOD CHIPS/HARDWOOD MULCH TRACKED INTO SOIL ALONG WITH THE PERMANENT SEED WITHIN THREE CALENDAR DAYS. LENGTH OF EACH ACTIVE WORK AREA SHALL NOT EXCEED WHAT CAN BE COMPLETED IN ONE DAY. INSTALLATION SHALL GENERALLY BEGIN AT THE DOWNSTREAM END OF REACH AND WORK IN AN UPSTREAM DIRECTION. INSTALL PROPOSED IMPROVEMENTS ON ALL SIDE CHANNELS AND STORM DRAIN OUTFALLS AS MAIN STEM WORK PROCEEDS. (30 DAYS CONCURRENT WITH #4 ABOVE)

6. PRIOR TO COMPLETING THE PHASE, THE CONTRACTOR AND OWNER SHALL REVIEW THE ALIGNMENT OF A POST-RESTORATION ADAPTIVE MANAGEMENT PATH (SEE MULCH PATH DETAIL) THAT FOLLOWS THE FULL LENGTH OF RESTORATION GENERALLY ALONG THE TOE OF THE SLOPE AND REFINE IT BASED ON POST-RESTORATION CONDITIONS. ONCE AGREED UPON, CONTRACTOR SHALL INSTALL A 6' WIDE PATH THAT INCLUDES 6" OF SAND WITH A 6" SURFACE LAYER OF WOODCHIPS ALONG APPROVED ALIGNMENT WITHIN THE LOD.

7. INSTALL ALL HERBACEOUS AND WOODY PLANT MATERIAL (PLUGS, LIVE STAKE, BARE ROOT, CONTAINER, SHRUBS TREES) WITH APPROVAL OF ENGINEER/DESIGNATED SPECIALIST, PER THE LANDSCAPE PLAN AND DETAILS. THE CONTRACTOR MAY CHOOSE TO INSTALL PLANT MATERIAL AFTER ALL REACHES OF CONSTRUCTION ARE COMPLETE. IF THE CONTRACTOR CHOOSES THIS OPTION, THEN THE CONTRACTOR MUST NOTIFY THE COUNTY AND OBTAIN PERMISSION TO INSTALL PLANT MATERIAL AFTER ALL CONSTRUCTION REACHES ARE COMPLETE. (10 DAYS)

8. UPON PERMANENT STABILIZATION OF THE WORK AREA, AND WITH APPROVAL FROM THE INSPECTOR AND ENGINEER/DESIGNATED SPECIALIST, THE CONTRACTOR MAY REMOVE E&SC DEVICES AND PROCEED TO NEXT REACH. ANY AREAS DISTURBED BY REMOVING THE E&SC DEVICES SHALL BE STABILIZED IMMEDIATELY AND RESTORED TO PRECONSTRUCTION CONDITIONS. (5 DAYS)

LANDSCAPING

1. COMPLETE INSTALLATION OF ALL REMAINING TREE, SHRUB AND HERBACEOUS MATERIAL NOT INSTALLED PREVIOUSLY UNDER COMPLETED REACHES PER THE PLANTING PLAN AND DETAILS. (20 DAYS)

PROJECT COMPLETION

1. COMPLETE IN-KIND RESTORATION OF ANY DAMAGE TO EXISTING INFRASTRUCTURE EITHER ON-SITE OR OFF-SITE. THIS INCLUDES BUT IS NOT LIMITED TO: SIDEWALK, CURB AND GUTTER, PAVEMENT, TRAFFIC CALMING DEVICES, UTILITY APPURTENANCES, TREES, SIGNS, ETC.

2. COMPLETE FINAL PERMANENT VEGETATIVE STABILIZATION OF SITE PER THE LANDSCAPE PLAN.

3. CONDUCT A PUNCH LIST WALK-THROUGH WITH THE COUNTY PROJECT MANAGER, THE DESIGN PROJECT MANAGER, AND THE COUNTY SEDIMENT CONTROL INSPECTOR AND CORRECT ANY OUTSTANDING ITEMS.WITH WRITTEN APPROVAL FROM THE COUNTY SEDIMENT CONTROL INSPECTOR AND APPROVAL FROM COUNTY PROJECT MANAGER, REMOVE ANY REMAINING SEDIMENT CONTROL DEVICES AND IMMEDIATELY STABILIZE ANY DISTURBED AREAS.

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation
ARUNDELRIVERS.ORG

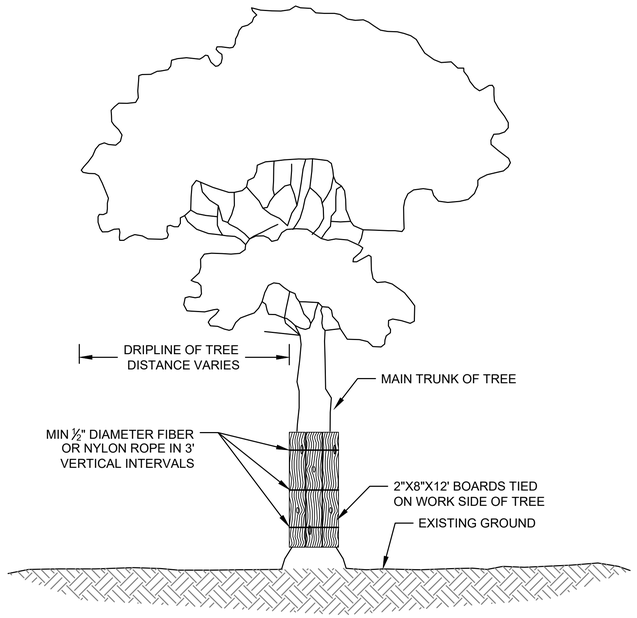
ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	REVISED BY

APPROVED DATE	APPROVED DATE	SCALE:	NA
CHIEF ENGINEER	PROJECT MANAGER	DRAWN BY	KB
APPROVED DATE	APPROVED DATE	CHECKED BY	DS/JC
ASSISTANT CHIEF ENGINEER	CHIEF, RIGHT-OF-WAY	SHEET NO.	21 OF 31
		PROJECT NO.	24015.01
		PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

SEQUENCE OF CONSTRUCTION



NOTES:

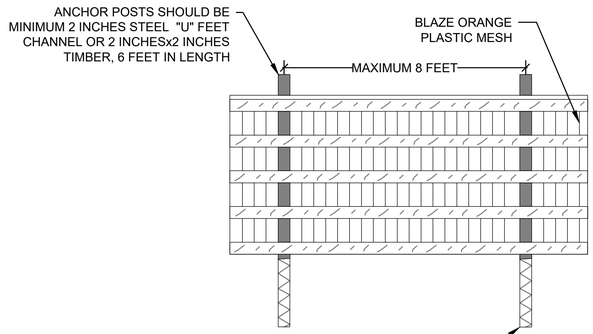
1. PROTECTION MEASURES WILL BE SET AS PART OF THE REVIEW PROCESS.
2. TIE SUFFICIENT 2"X8"X12' BOARDS AROUND MAIN TRUNK OF TREE WITH ½" DIAMETER ROPE (FIBER OR NYLON) TO PROTECT ALL AREAS EXPOSED TO CONSTRUCTION.
3. INSTALL WIRE EYE BOLTS WITH MINIMUM INNER DIAMETER OF ⅝" AND MINIMUM LENGTH OF 4" FIRMLY IN EACH PLANK WHERE FIBER OR NYLON ROPES CROSS OVER PLANKS.
4. WHERE SIGNIFICANT TREE BRANCHES EXIST WHICH PREVENT PLANK INSTALLATION, PLANKING SHALL EXTEND TO THE ELEVATION OF THE LOWEST BRANCH.

TREE PLANKING

NOT TO SCALE

GENERAL TREE PROTECTION AND REMOVAL NOTES

1. WITHIN PHASE B, PLANS SHOW SURVEYED TREES 24" AND GREATER DBH WITHIN THE STUDY AREA. IN SELECT AREAS, LOCATIONS OF ADDITIONAL TREES BETWEEN 12" AND 23" DBH ARE SHOWN, BUT THE PLANS DO NOT SHOW ALL 12" TO 23" DBH TREES WITHIN THE STUDY AREA. NO TREES LESS THAN 12" DBH ARE SHOWN.
2. WITHIN PHASE C, PLANS SHOW SURVEYED TREES 12" AND GREATER DBH WITHIN THE STUDY AREA. NO TREES LESS THAN 12" DBH ARE SHOWN.
3. SEE SHEET EF-XX FOR TREE (>/=30" DBH) TABLE.
4. THE PLANS IDENTIFY THE ANTICIPATED TREE SAVES AND REMOVALS ON ALL TREES GREATER THAN 24" DBH. ALL SMALLER TREES WITHIN THE LOD WILL BE EVALUATED FOR PROTECTION OR REMOVAL, AND ARE NOT EXPLICITLY SHOWN ON THE PLANS.
5. AT THE BEGINNING OF EACH PHASE OF WORK, THE CONTRACTOR SHALL IDENTIFY IN THE FIELD ALL POTENTIAL TREE REMOVALS OF TREES DIRECTLY WITHIN THE LIMITS OF GRADING AND/OR CONSTRUCTION ACCESS USING A NON-PERMANENT METHOD (FLAGGING OR WASHABLE PAINT). ALL OTHER TREES WITHIN THE LOD NOT MARKED IN THE FIELD FOR REMOVAL SHALL BE CONSIDERED TREE SAVES. INTENT IS FOR CONTRACTOR TO MAXIMIZE THE NUMBER OF TREE SAVES.
6. THE CONTRACTOR'S TREE REMOVALS AND SAVES SHALL BE REVIEWED WITH ARUNDEL RIVERS FEDERATION, CITY OF ANNAPOLIS TO OBTAIN CONCURRENCE BASED ON TREE HEALTH, CONDITION, SPECIES, OBSTRUCTION TO CONSTRUCTION ACCESS, CONFLICTS WITH GRADING AND NEED FOR SELECTIVE HARVESTING. FIELD ADJUSTMENTS TO CONSTRUCTION ACCESS AND WORK LIMITS MAY BE MADE AT THIS TIME WITH AGREEMENT BY ALL PARTIES AND REMOVAL MARKINGS ADJUSTED ACCORDINGLY. AT THIS TIME, TREE PROTECTION MEASURES (PLANKING AND FENCING) FOR TREES TO REMAIN SHALL BE DEFINED. GROUP OF TREES MAY BE GROUPED AS ONE PROTECTION AREA.
7. CONTRACTOR SHALL INSTALL AGREED UPON TREE PROTECTION MEASURES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL TREES, SHRUBS AND VEGETATION AS AGREED TO REMAIN. WHEN POSSIBLE, TREES SHALL BE PROTECTED AT THE DRIP LINE AND NO VEHICLE, MATERIAL OR EQUIPMENT SHALL BE STORED WITHIN THIS AREA UNLESS OTHERWISE NOTED.
8. ANY LIMB OR ROOT PRUNING NECESSARY TO PROTECTED TREES THAT MAY BE DAMAGED BY CONSTRUCTION ACCESS OR GRADING WILL BE DONE BY A LICENSED ARBORIST.
9. ALL TREE REMOVALS SHALL BE DONE IN A MANNER TO MAXIMIZE THEIR USAGE IN THE STRUCTURES (IE MAINTAIN SPECIFIED TRUNK LENGTHS, ROOT WADS, ETC) AND TO MINIMIZE NEGATIVE IMPACTS TO RESIDUAL STANDING TREES, SHRUBS AND WETLANDS. TREE FELLING TO BE DONE IN ACCORDANCE WITH OSHA LOGGING STANDARD, 29 CFR 1910.266.
10. TREE PROTECTION MEASURES SHALL BE MAINTAINED THROUGHOUT THE DURATION OF CONSTRUCTION.
11. FOLLOWING CONSTRUCTION AND WITH THE APPROVAL OF THE COUNTY, ALL TREE PROTECTION MEASURES, FLAGGING AND METAL TREE TAGS SHALL BE REMOVED BY THE CONTRACTOR.
12. GENERATED TREE AND WOODY MATERIAL SHALL BE STOCKPILED AND RETAINED ON-SITE UNTIL INSTALLATION PER CONSTRUCTION PLANS OR AS DIRECTED BY COUNTY REPRESENTATIVE/PROJECT ENGINEER/DESIGNATED SPECIALIST.



NOTES:

1. PROTECTION AREA WILL BE SET AS PART OF THE REVIEW PROCESS.
2. BOUNDARIES OF PROTECTION AREA SHOULD BE STAKED AND FLAGGED PRIOR TO INSTALLING DEVICES.
3. DEVICE SHOULD BE MAINTAINED THROUGHOUT CONSTRUCTION.

BLAZE ORANGE FENCE (TREE PROTECTION FENCE)

NOT TO SCALE

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers FEDERATION
ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

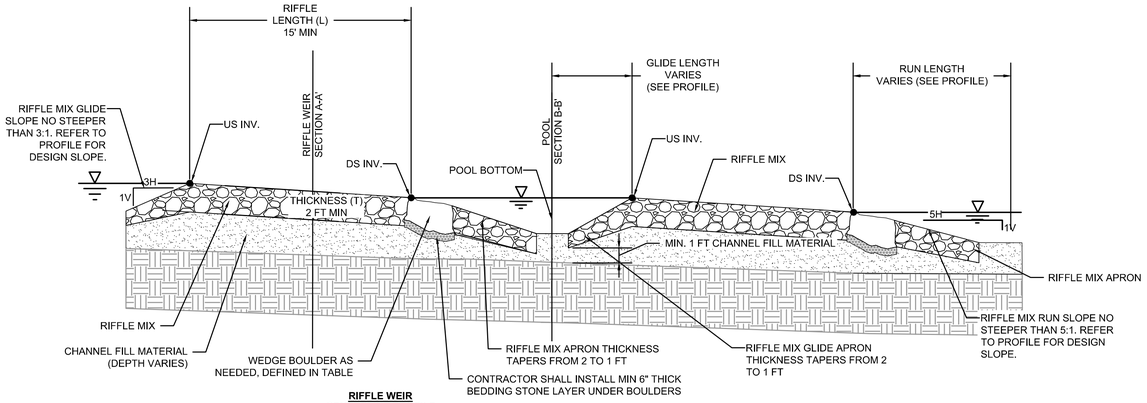
REVISED DATE	REVISED BY

APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

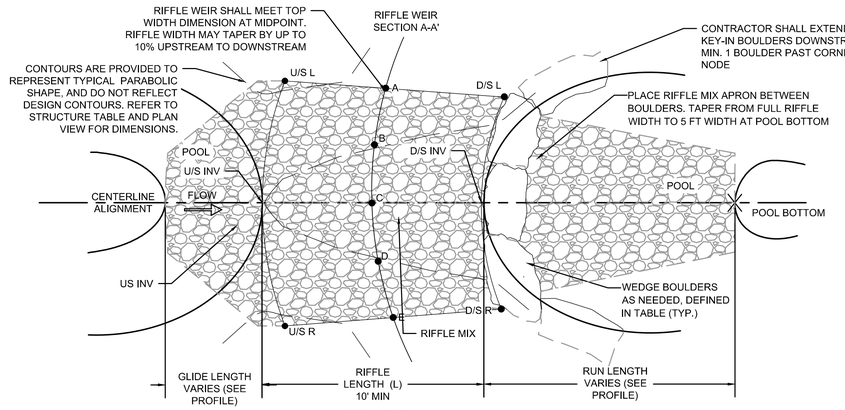
SCALE:	NTS
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	22 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

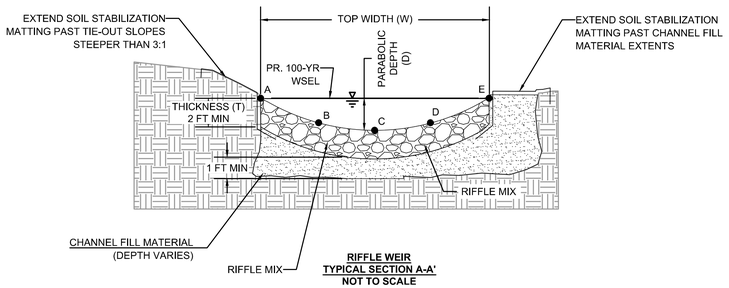
TREE PROTECTION AND REMOVAL DETAILS AND NOTES



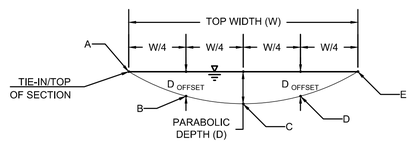
RIFFLE WEIR
CENTERLINE PROFILE
NOT TO SCALE



RIFFLE WEIR
PLAN VIEW
NOT TO SCALE



RIFFLE WEIR
TYPICAL SECTION A-A'
NOT TO SCALE



D_{OFFSET} = DEPTH OF PARABOLIC SECTION AT W/4 OFFSET.

PARABOLIC SECTION DIMENSIONS
NOT TO SCALE

RIFFLE WEIR DIMENSION TABLE								
REACH ID	US STA.	DA STA.	L (FT)	W (FT)	H (FT)*	D (FT)	D_{OFFSET} (FT)	D50 (IN)
REACH 1 SPSC	0+00	4+50	15	25	0.5	2.75	1.88	7

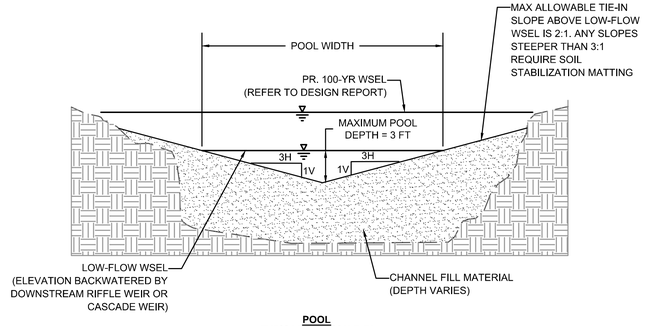
*RIFFLE WEIR HEIGHT (H) IS EQUAL TO THE UPSTREAM INVERT MINUS THE DOWNSTREAM INVERT

RIFFLE WEIR NOTES:

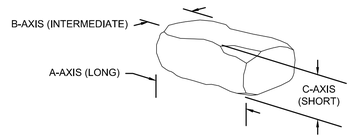
1. COUNTY REPRESENTATIVE WILL BE ON-SITE TO GUIDE RIFFLE INSTALLATION IN THE FIELD.
2. THE CROSS SECTION SHALL BE CONSTRUCTED IN A PARABOLIC SHAPE BETWEEN GIVEN NODES.
3. NATURAL CHANNEL MATERIAL MAY BE HARVESTED ON-SITE PRIOR TO INSTALLATION OF RIFFLE WEIR IF IT MEETS THE SPECIFICATIONS FOR USE AS WASH-IN OR RIFFLE MIX.
4. THE NUMBER OF BOULDERS VARIES DEPENDING ON TYPICAL SECTION WIDTH AND BOULDER DIMENSIONS.
5. THE BOULDERS SHALL BE TILTED DOWNSTREAM AS SHOWN ON THE DETAIL AND NOT STACKED.
6. TIE-OUT BOULDER SHALL EXTEND PAST THE DOWNSTREAM CORNER NODES A MIN. OF ONE BOULDER LENGTH (B-AXIS) INTO EXISTING BANK. WHERE THIS CONFLICTS WITH EXISTING TREE ROOTS OR BEDROCK, TIE-OUT BOULDER MAY BE ELIMINATED OR ADJUSTED AT DIRECTION OF ENGINEER.
7. RIFFLE MIX SHALL BE COMPOSED PRIMARILY OF A BASE COARSE MIX OF ANGULAR MATERIAL, WHICH SHALL MAKE UP APPROXIMATELY 70% OF THE TOTAL RIFFLE MIX VOLUME. TO MEET THE GRADATION OF A 7" D50, THIS BASE COARSE MIX CAN BE ACHIEVED USING THE FOLLOWING COMPOSITION:
   - -20% NO 57 STONE
   - -20% #2 STONE
   - -40% CLASS I RIP RIP
   - -20% CLASS II RIP RIP
8. THE WEARING SURFACE OF EACH RIFFLE SHALL BE AUGMENTED WITH SILICA COBBLE AND RANDOM BOULDERS PIECES MIXED INTO THE TOP LAYER OF THE BASE COARSE. THIS SHALL MAKE UP APPROXIMATELY 30% OF THE TOTAL RIFFLE MIX VOLUME. THIS AUGMENTED WEARING SURFACE MATERIAL SHALL BE COMPOSED OF THE FOLLOWING:
   - -70% 7" D50 SILICA COBBLE (SEE GRADATION ABOVE) RANGING FROM ROUNDED TO SUB-ANGULAR SHAPE.
   - -30% SUB-ANGULAR RANDOM BOULDERS (AVERAGE OF 18" D50)
9. ALL RIFFLE MIX SHALL BE WASHED-IN WITH SAND AND GRAVEL IN LIFTS SO IT IS INCORPORATED WITHIN THE FULL DEPTH TO CHOKE VOIDS PRIOR TO FINAL STABILIZATION. THE SAND AND GRAVEL ARE AN INCIDENTAL SUPPLEMENT TO THE RIFFLE MIX.
10. THE FINAL WEARING SURFACE SHALL BE A TIGHT STONE MATRIX OF ALL MATERIALS, WORKED TOGETHER WITH NO LOOSE MATERIAL.
11. TRIM ALL GEOTEXTILE AT OR BELOW FINISHED GRADE, IF USED.
12. ONCE RIFFLE WEIR IS CONSTRUCTED, STABILIZE ALL DISTURBED LOCATIONS AS SPECIFIED.
13. CONTOURS ARE PROVIDED TO REPRESENT TYPICAL PARABOLIC SHAPE, AND DO NOT REFLECT DESIGN CONTOURS. REFER TO STRUCTURE TABLE AND PLAN VIEW FOR DIMENSIONS.
14. SEE STRUCTURE TABLES ON SHEET ST-01 FOR NODE LOCATION INFORMATION.
15. SEE PROFILE FOR UPSTREAM AND DOWNSTREAM INVERT ELEVATION (U/S-INV AND D/S-INV).

RIFFLE MIX GRADATION TABLE			
D50 MEDIAN STONE SIZE (INCHES)	% OF MATERIAL SMALLER THAN TYPICAL STONE	TYPICAL STONE EQUIVALENT DIAMETER (INCHES)	TYPICAL STONE WEIGHT (POUNDS)*
6	70 - 100	12	85
	50 - 70	9	35
	35 - 50	6	10
	2 - 10	2	0.4
9	70 - 100	15	160
	50 - 70	12	85
	35 - 50	9	35
	2 - 10	3	1.3
12	70 - 100	21	440
	50 - 70	18	275
	35 - 50	12	85
	2 - 10	4	3
18	100	30	1280
	50 - 70	24	650
	35 - 50	18	275
	2 - 10	6	10
24	100	42	3500
	50 - 70	33	1700
	35 - 50	24	650
	2 - 10	9	35

*ASSUMED UNIT WEIGHT OF 165 $\frac{LBS}{FT^3}$



POOL
TYPICAL SECTION B-B'
NOT TO SCALE



BOULDER AXIS
NOT TO SCALE

BOULDER DIMENSIONS (IN)				
	A-AXIS	B-AXIS	C-AXIS	UNIT WEIGHT, LBS/FT³*
WEDGE BOULDERS	24-36"	24-36"	12-24"	145

CONTRACTOR SHALL USE SANDSTONE BOULDERS. IF CONTRACTOR CAN DEMONSTRATE THAT SOURCE SUPPLY IS LIMITED, GRANITE IS (165 LBS/FT^3) MAY BE AN ACCEPTABLE SUBSTITUTE WITH PRIOR APPROVAL

NOTES:

1. THE MEDIAN A-AXIS DIMENSION AVERAGED ACROSS THE FULL STRUCTURE SHALL EQUAL A MINIMUM OF 30".
2. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO SELECT MATERIAL THAT IS APPROPRIATELY SIZED TO ALLOW FOR ECONOMICAL CONSTRUCTION OF RIFFLE WEIR STRUCTURES MEETING THE DESIGN DIMENSIONS DESCRIBED IN THIS PLAN.

STANDARD SPSC STABILIZATION NOTES (AASCD)

PERMANENT STABILIZATION NOTES (INCLUDE ONE OF THE FOLLOWING):
PERMANENT STABILIZATION FOR AN AREA OF EARTH DISTURBANCE OF A SPSC SHALL BE CONSIDERED ACHIEVED WHEN THE AREA IS COVERED WITH 2 TO 4 INCHES OF COMPOST (APPLIED OVER WOODCHIPS TRACKED INTO SOIL AND A (NATIVE PLANTS) PLANTING PLAN HAS BEEN IMPLEMENTED, REGARDLESS OF SOIL TREATMENT.

PERMANENT STABILIZATION FOR AN AREA OF EARTH DISTURBANCE OF A SPSC SHALL BE CONSIDERED ACHIEVED WHEN THE BANKS AND FLOODPLAIN ARE COVERED WITH FULLY BIODEGRADABLE STABILIZATION MATTING INSTALLED PER MANUFACTURER'S INSTRUCTIONS AND A (NATIVE PLANTS) PLANTING PLAN HAS BEEN IMPLEMENTED.

ALL DISTURBED AREAS SHALL RECEIVE HYDROSEEDING OR FLEXIBLE GROWTH MEDIUM (FGM) AFTER THE ESTABLISHMENT OF FINAL GRADES AND MICROTOPOGRAPHY (IF APPLICABLE) IN ACCORDANCE WITH THE PROJECT LANDSCAPING PLANS.

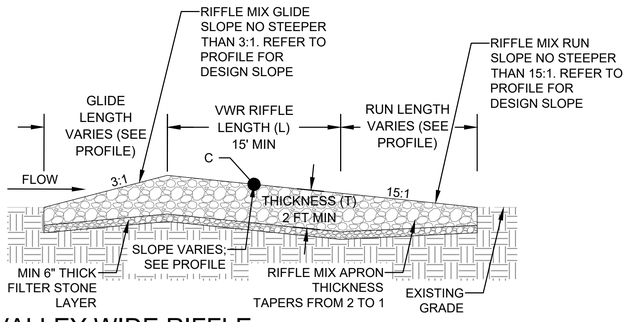
Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation
ARUNDELRIVERS.ORG

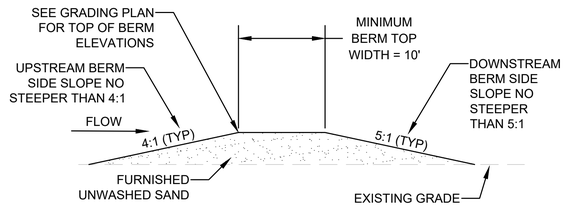
ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY	APPROVED DATE	APPROVED DATE	SCALE: NTS	ANNAPOLIS WATERWORKS PARK STREAM RESTORATION
				DRAWN BY KB	
		CHIEF ENGINEER	PROJECT MANAGER	CHECKED BY DSJC	
		APPROVED DATE	APPROVED DATE	SHEET NO. 23 OF 31	DETAILS
				PROJECT NO. 24015.01	
		ASSISTANT CHIEF ENGINEER	CHIEF, RIGHT-OF-WAY	PROPOSAL NO.	



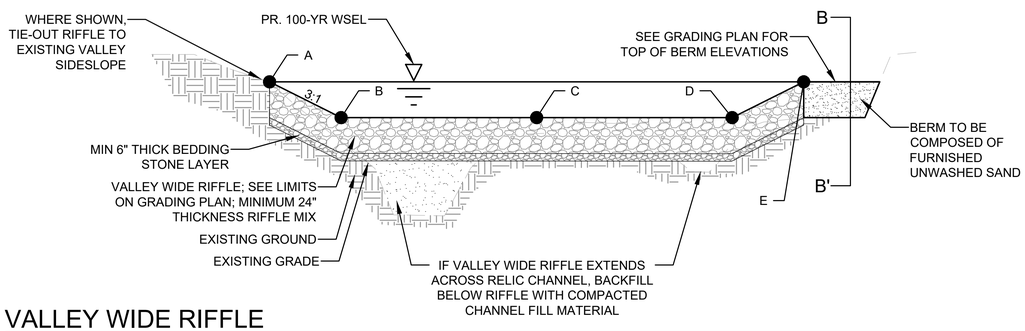
VALLEY WIDE RIFFLE
PROFILE VIEW (A-A')

NOT TO SCALE



VALLEY WIDE RIFFLE
PROFILE VIEW (B - B')

NOT TO SCALE

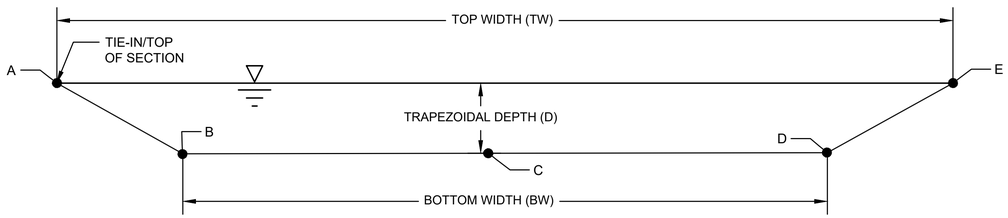


VALLEY WIDE RIFFLE
SECTION VIEW (A - A')

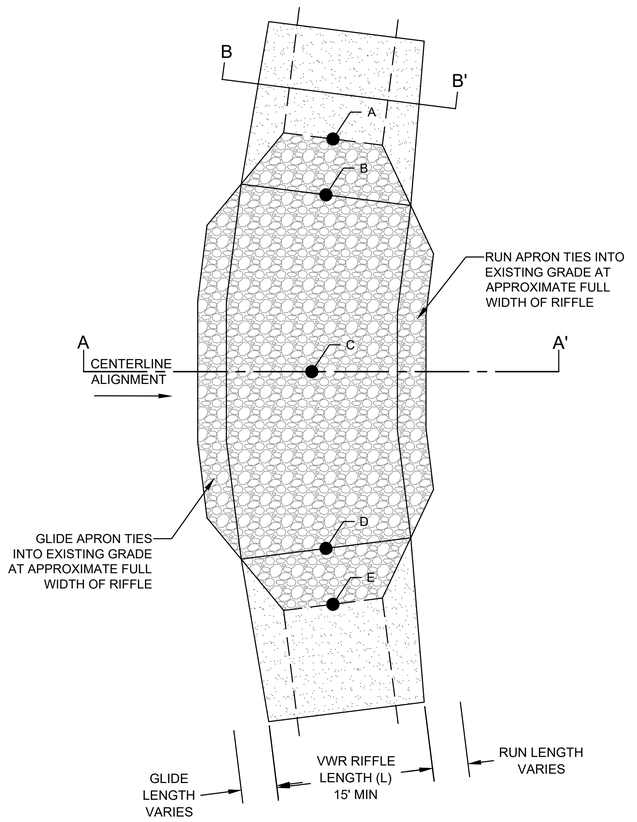
NOT TO SCALE

VALLEY WIDE RIFFLE NOTES:

1. NATURAL CHANNEL MATERIAL MAY BE HARVESTED ON-SITE FROM EXISTING CHANNEL PRIOR TO INSTALLATION OF RIFFLE WEIR IF IT MEETS THE SPECIFICATIONS FOR USE AS WASH-IN OR RIFFLE MIX.
2. PRIOR TO INSTALLING VALLEY WIDE RIFFLE, EXISTING CHANNEL SHALL BE FILLED, WITH MATERIAL TRACKED INTO CHANNEL TO ACHIEVE A WELL COMPACTED SURFACE.
3. VALLEY WIDE RIFFLE TO BE PLACED PERPENDICULAR TO THE VALLEY AS SHOWN ON THE PLAN.
4. THE CROSS SECTION SHALL BE CONSTRUCTED IN A TRAPEZOIDAL SHAPE BETWEEN GIVEN NODES.
5. TO MEET THE RIFFLE MIX GRADATION OF A 6" D50, THIS CAN BE ACHIEVED USING THE FOLLOWING COMPOSITION:
   - -20% NO 57 STONE
   - -30% #2 STONE
   - -50% CLASS I RIP RIP
6. ALL RIFFLE MIX SHALL BE WASHED-IN WITH SAND AND GRAVEL IN LIFTS SO IT IS INCORPORATED WITHIN THE FULL DEPTH TO CHOKE VOIDS PRIOR TO FINAL STABILIZATION. THE SAND AND GRAVEL ARE AN INCIDENTAL SUPPLEMENT TO THE RIFFLE MIX.
7. CONTRACTOR SHALL TRACK OVER STRUCTURE SEVERAL TIMES WITH THE EXCAVATOR TO COMPRESS THE VALLEY WIDE RIFFLE MATERIAL IN PLACE IN ONE FOOT LIFTS, ENSURING IT FORMS A COMPACTED, CONSOLIDATED VALLEY WIDE RIFFLE FOR THE FULL DEPTH.
8. THE FINAL WEARING SURFACE SHALL BE A TIGHT STONE MATRIX OF ALL MATERIALS, WORKED TOGETHER WITH NO LOOSE MATERIAL.
9. ONCE RIFFLE WEIR IS CONSTRUCTED, STABILIZE ALL DISTURBED LOCATIONS AS SPECIFIED.
10. SEE STRUCTURE TABLES ON SHEET 14 FOR NODE LOCATION INFORMATION.
11. SEE PROFILE FOR UPSTREAM AND DOWNSTREAM INVERT ELEVATIONS (U/S-INV AND D/S-INV)



TRAPEZOIDAL SECTION DIMENSIONS
NOT TO SCALE



VALLEY WIDE RIFFLE
PLAN VIEW

NOT TO SCALE

VALLEY WIDE RIFFLE MIX MATERIAL GRADATION TABLE			
D50 MEDIAN STONE SIZE (INCHES)	% OF MATERIAL SMALLER THAN TYPICAL STONE	TYPICAL STONE EQUIVALENT DIAMETER (INCHES)	TYPICAL STONE WEIGHT (POUNDS)*
6	70 - 100	12	85
	50 - 70	9	35
	35 - 50	6	10
	2 - 10	2	0.4
9	70 - 100	15	160
	50 - 70	12	85
	35 - 50	9	35
	2 - 10	3	1.3
12	70 - 100	21	440
	50 - 70	18	275
	35 - 50	12	85
	2 - 10	4	3
18	100	30	1280
	50 - 70	24	650
	35 - 50	18	275
	2 - 10	6	10
24	100	42	3500
	50 - 70	33	1700
	35 - 50	24	650
	2 - 10	9	35

*ASSUMED UNIT WEIGHT OF 165 $\frac{LBS}{FT}$

VALLEY WIDE WEIR DIMENSION TABLE								
REACH ID	US STA.	DA STA.	L (FT)	TW (FT)	BW (FT)	H (FT)	D (FT)	RIFFLE MIX D50 (IN)
REACH 2 RSC	4+50	11+00	15	70	35	1.00	1.60	9

*RIFFLE WEIR HEIGHT (H) IS EQUAL TO THE UPSTREAM INVERT MINUS THE DOWNSTREAM INVERT

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY	APPROVED / DATE	APPROVED / DATE
		CHIEF ENGINEER	PROJECT MANAGER
		APPROVED / DATE	APPROVED / DATE
		ASSISTANT CHIEF ENGINEER	CHIEF, RIGHT-OF-WAY

SCALE:	NTS
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	21 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

DETAILS

STREAM VALLEY BOTTOM WOOD ROUGHNESS NOTES:

SEQUENCE

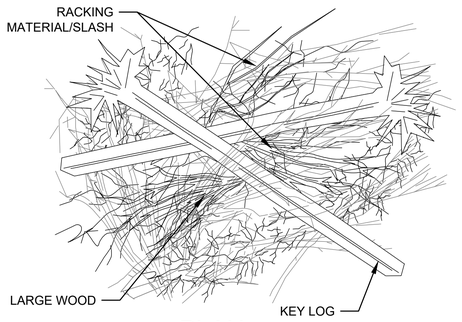
1. AFTER TREE SAVE AND REMOVAL DETERMINATIONS HAVE BEEN APPROVED BY THE COUNTY, CONTRACTOR SHALL BEGIN TREE REMOVAL OPERATION. HARVEST AND RETAIN WOODY MATERIAL ON-SITE THAT COMPLIES WITH THE MATERIAL SPECIFICATIONS, LEAVING AS MUCH OF THE BRANCHING AND ROOT FAN INTACT AS POSSIBLE. MATERIALS SHALL BE HANDLED AND STORED ON-SITE IN A MANNER SO AS TO MINIMIZE DAMAGE TO BRANCHING AND ROOT FANS. TREES IDENTIFIED FOR REMOVAL WITHIN GRADING LIMITS SHALL BE REMOVED BY PUSHING OVER, WITH THE ROOTBALL INTACT TO MAXIMUM EXTENT PRACTICABLE.
2. AS EXISTING STREAM CHANNEL IS BEING FILLED, CONTRACTOR SHALL INCORPORATE WOOD ROUGHNESS ELEMENTS AND SLASH INTO THE CHANNEL FILL AT THE DIRECTION OF ANNE ARUNDEL COUNTY.
3. ONCE GRADING IS COMPLETE, CONTRACTOR SHALL COORDINATE WITH ANNE ARUNDEL COUNTY TO ESTABLISH LIMITS OF WOOD ROUGHNESS TREATMENT WITHIN THE STREAM VALLEY BOTTOM. INSTALL WOOD ROUGHNESS ELEMENTS AND SLASH THROUGHOUT THE SET LIMITS, AT THE DIRECTION OF ANNE ARUNDEL COUNTY, INCORPORATING INTO THE FINISHED GRADE (APPROXIMATELY 40% INCORPORATED INTO GRADE). CONTRACTOR SHALL INSTALL OVERLAPPING KEY LOGS AND LARGE WOOD ELEMENTS OVERTOP RACKING AND SLASH MATERIAL TO PIN IN PLACE. THE APPROXIMATE DENSITY OF WOOD ROUGHNESS SHALL BE 4 CROSSING KEY LOG MEMBERS, 6 LARGE WOOD MEMBERS AND 8 RACKING MEMBERS FOR EVERY 2,000 SF OF ROUGHENED FLOODPLAIN.
4. FINAL SURFACE OF STREAM VALLEY BOTTOM SHALL BE A ROUGH, DENSE MATRIX OF WOOD WITHIN THE LIMITS DEFINED IN THE FIELD, WITH HUMMOCK AND HOLLOW MICROTOPOGRAPHY THAT VARIES WITHIN +/- 1 FT OF THE EXISTING/PROPOSED GRADE. CONFIGURATION OF WOOD ROUGHNESS ELEMENTS SHALL APPEAR NATURAL AND VARY ACROSS THE LIMITS. ALL EXPOSED LOG ENDS SHALL HAVE BROKEN OR ROUGHENED END, RATHER THAN SAW CUT END WHEN POSSIBLE.
5. FOLLOWING PLACEMENT OF WOOD ROUGHNESS ELEMENTS, CONTRACTOR SHALL SPREAD 2" OF WOODCHIPS TO STABILIZE ALL EXPOSED SURFACES.
6. THIS DETAIL DEPICTS THE TYPICAL PREFERRED COMPOSITION AND CONFIGURATION OF WOOD ROUGHNESS. ALTERATION OF THIS COMPOSITION/CONFIGURATION DUE TO ISSUES OBTAINING NECESSARY MATERIALS OR OTHER REASON IS ACCEPTABLE ONLY WITH PRIOR APPROVAL FROM ANNE ARUNDEL COUNTY.

WOOD ROUGHNESS MATERIALS

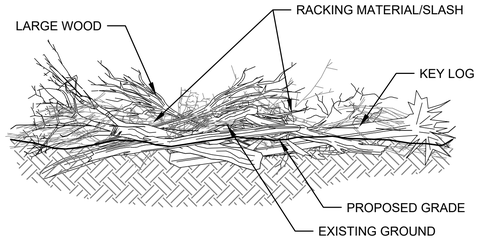
1. KEY LOGS - WOOD PIECES GREATER THAN 18" DBH WITH ATTACHED ROOTWADS AND OVER 35 FEET LONG.
2. LARGE WOOD - WOOD PIECES WITH 12-18" DBH WITH AND WITHOUT ATTACHED ROOTWAD AND OVER 25 FEET LONG.
3. RACKING MATERIAL - WOOD PIECES WITH 8-12" DBH WITH AND WITHOUT ROOTWADS, AND OVER 15 FEET LONG.
4. SLASH - WOODY VEGETATION SMALLER THAN DIMENSIONS ABOVE AT A THICKNESS OF 1 FT ON AVERAGE.
5. THE SOURCE OF WOODY MATERIAL SHALL BE GENERATED FROM ON-SITE. MATERIAL SHALL HAVE A CONSIDERABLE NUMBER OF BRANCHES THAT REMAIN EXPOSED AND IN CONTACT WITH THE STREAM FLOW AFTER INSTALLATION.

QUANTITIES

1. REACH 2: BETWEEN VALLEY WIDE RIFFLES, INSTALL APPROXIMATELY 56 PIECES OF KEY LOGS, 84 PIECES OF LARGE WOOD, 112 PIECES OF RACKING MATERIAL AND 1,050 CY OF SLASH MATERIAL.
2. IF TREE REMOVAL ON ONE REACH GENERATES MORE WOOD THAN REQUIRED WITHIN THAT REACH, EXCESS WOOD SHALL BE STOCKPILED AND TRANSPORTED FOR USE AS NEEDED WITHIN ANOTHER REACH OR PHASE.



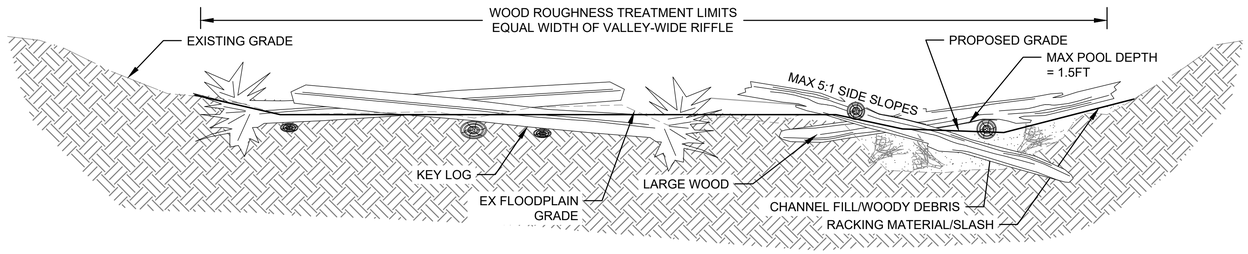
PLAN



SECTION

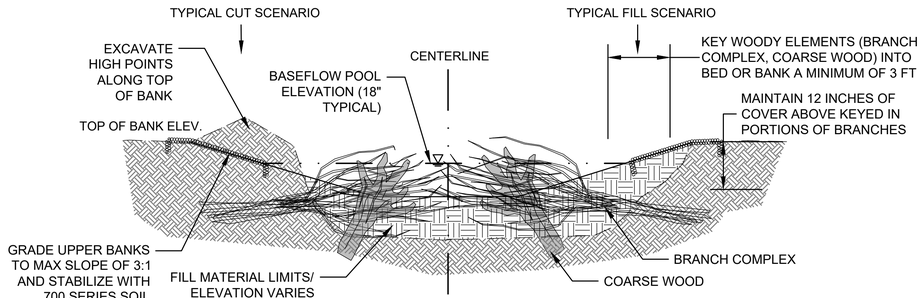
STREAM VALLEY BOTTOM WOOD ROUGHNESS
PLAN (TYPICAL)

NOT TO SCALE

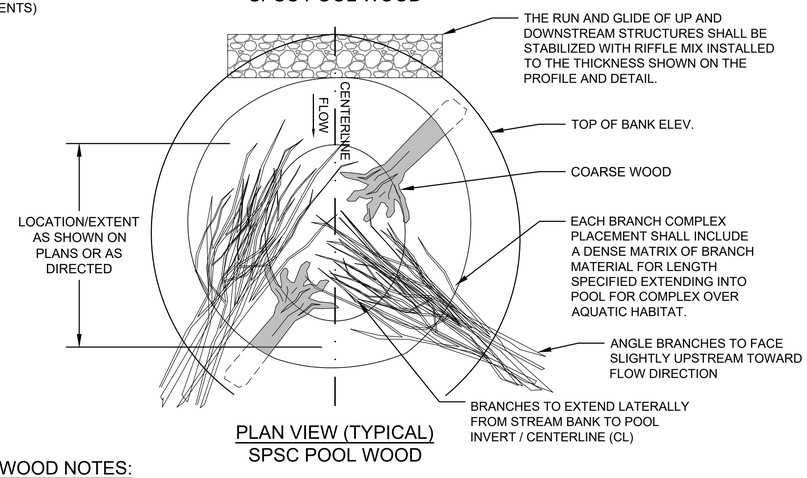


STREAM VALLEY BOTTOM WOOD ROUGHNESS
SECTION (TYPICAL)

NOT TO SCALE



SECTION VIEW (TYPICAL)
SPSC POOL WOOD



PLAN VIEW (TYPICAL)
SPSC POOL WOOD

SPSC POOL WOOD NOTES:

1. AFTER TREE SAVE AND REMOVAL DETERMINATIONS HAVE BEEN APPROVED BY ANNE ARUNDEL COUNTY, CONTRACTOR SHALL BEGIN TREE REMOVAL OPERATION. HARVEST AND RETAIN WOODY MATERIAL ON-SITE THAT COMPLIES WITH THE MATERIAL SPECIFICATIONS, LEAVING AS MUCH OF THE BRANCHING AND ROOT FAN INTACT AS POSSIBLE. MATERIALS SHALL BE HANDLED AND STORED ON-SITE IN A MANNER SO AS TO MINIMIZE DAMAGE TO BRANCHING AND ROOT FANS.
2. INSTALL SPSC POOL WOOD WITHIN EACH SPSC POOL, OR AS DIRECTED BY ANNE ARUNDEL COUNTY. EACH POOL TREATMENT SHALL INCLUDE A MINIMUM OF TWO BRANCH COMPLEXES AND TWO COARSE WOOD ELEMENTS, UNLESS OTHERWISE DIRECTED BY ANNE ARUNDEL COUNTY.
3. COARSE WOOD ELEMENT SHALL CONSIST OF TRUNKS OR LARGE LIMBS BETWEEN 12 TO 18 INCH DBH AND MINIMUM OF 5 FEET LONG. KEY COARSE WOOD A MINIMUM OF 3 FEET INTO BED OR TOE OF BANK. BASE OF ROOT FLARE/BRANCHES SHALL BE PLACED TIGHT TO FINISHED GRADE OF POOL. ROOT BALL/BRANCHES SHALL BE MOSTLY SUBMERGED DURING BASE FLOW.
4. BRANCH COMPLEXES SHALL CONSIST OF A DENSE MIX OF PARTIALLY BURIED BRANCHES ALONG POOL BOTTOM AS DIRECTED BY THE COUNTY. BRANCH MATERIAL SHALL RANGE FROM APPROXIMATELY 2 TO 12 INCHES DBH MATERIAL BUNDLED TOGETHER INTO A 24 INCH DIAMETER BUNDLE. EACH BUNDLE SHALL BE A MINIMUM OF 5 FEET LONG, AND SHALL BE KEYED HORIZONTALLY INTO THE STREAM BANK A MINIMUM OF 3 FEET. BRANCHES SHALL EXTEND HORIZONTALLY TO THE POOL INVERT (APPROXIMATE CENTERLINE OF CHANNEL). PROVIDE AT LEAST 12 INCHES OF FIRMLY TAMPED COVER ABOVE BRANCH MATERIAL AT ENDS KEYED INTO BANK. VERTICALLY, BRANCH COMPLEXES SHALL BE INSTALLED APPROXIMATELY 1' BELOW POOL BED AND PROTRUDE ABOVE POOL BED A MAXIMUM OF 1 FOOT. PROTRUSION HEIGHTS SHALL VARY.
5. PLACEMENT OF POOL WOODY TREATMENT MATERIAL SHALL APPEAR NATURAL AND VARY BETWEEN POOLS. ALL EXPOSED LOG ENDS SHALL HAVE BROKEN OR ROUGHENED END, RATHER THAN SAW CUT END WHEN POSSIBLE.
6. MATERIAL USED AS COARSE WOOD AND BRANCH COMPLEXES SHALL HAVE A CONSIDERABLE NUMBER OF BRANCHES THAT REMAIN IN CONTACT WITH THE STREAM FLOW AFTER INSTALLATION TO TRAP LEAVES AND DETRITUS.
7. BACKFILL AROUND WOODY ELEMENTS WITH CHANNEL FILL MATERIAL AS NEEDED TO MEET POOL GRADES SHOWN ON PROFILE.
8. ONCE A POOL BRANCH TREATMENT IS CONSTRUCTED, IMMEDIATELY STABILIZE ALL DISTURBED TIE-IN LOCATIONS AS SPECIFIED.
9. THIS DETAIL DEPICTS THE TYPICAL PREFERRED COMPOSITION AND CONFIGURATION OF POOL WOOD ELEMENTS. ALTERATION OF THIS COMPOSITION/CONFIGURATION DUE TO ISSUES OBTAINING NECESSARY MATERIALS OR OTHER REASON IS ACCEPTABLE ONLY WITH PRIOR APPROVAL FROM THE COUNTY.

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers FEDERATION ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

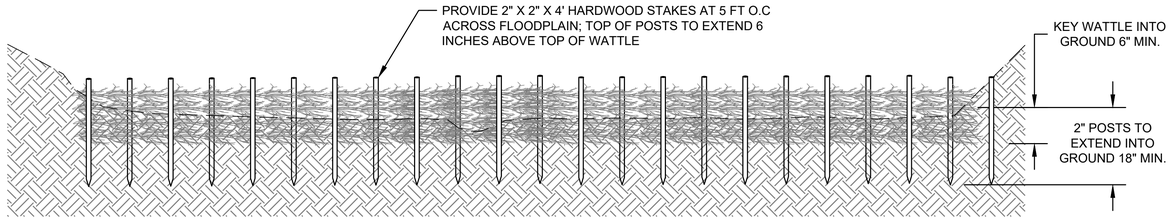
APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	NTS
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	25 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

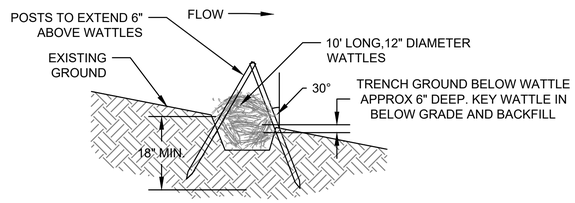
ANNAPOLIS WATERWORKS PARK
STREAM RESTORATION

DETAILS

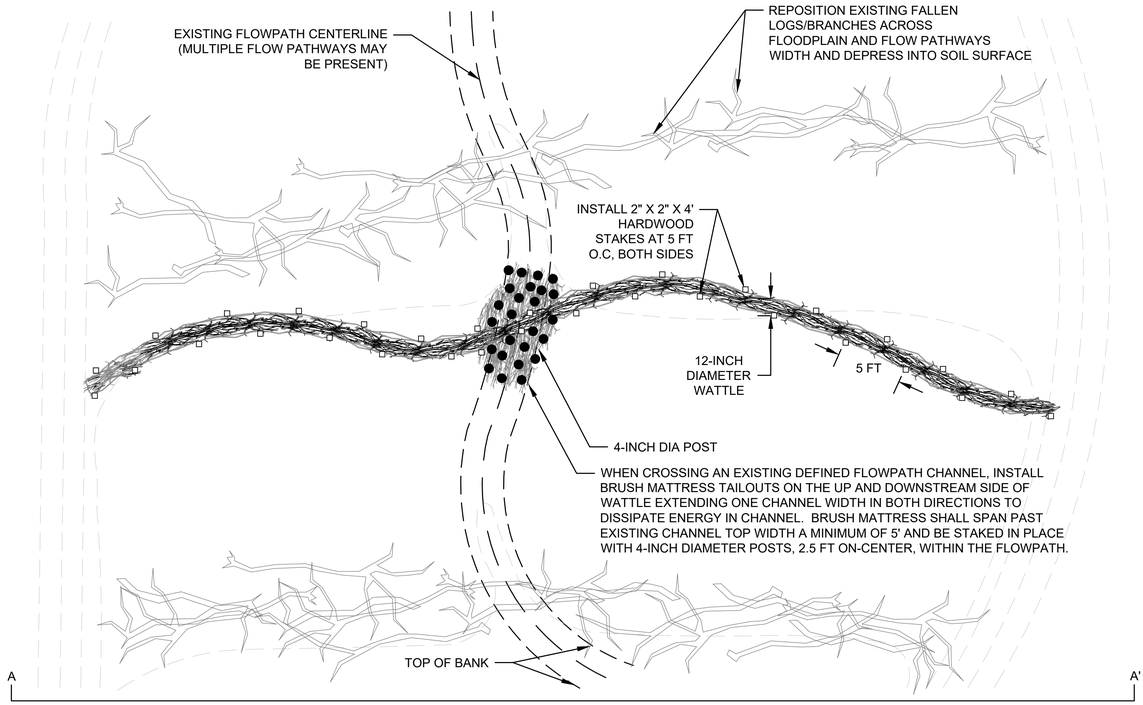
6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\dt01aw.dwg



SECTION A-A"



PROFILE



PLAN

POST AND WATTLE

NOT TO SCALE

POST AND WATTLE EXECUTION:

1. INSTALL POST AND WATTLE STRUCTURES AT LOCATIONS AND ELEVATIONS SHOWN ON PLAN AND PROFILE, OR AS DIRECTED BY ENGINEER/DESIGNATED SPECIALIST.
2. HARVEST WOODY MATERIAL ON-SITE THAT COMPLIES WITH THE MATERIAL SPECIFICATIONS. HARVEST MATERIAL AS PART OF THE CLEARING, TREE SALVAGING, AND HABITAT MATERIAL SALVAGING AND STOCKPILING OPERATIONS ONSITE, LEAVING AS MUCH OF THE BRANCHING AND ROOT FAN INTACT AS POSSIBLE. MATERIALS SHALL BE HANDLED AND STORED IN A MANNER SO AS TO MINIMIZE DAMAGE TO BRANCHING AND ROOT FANS.
3. HAND EXCAVATE A SHALLOW 5" DEPTH TRENCH ACROSS THE FLOODPLAIN AT LOCATIONS SHOWN. LAY WATTLES WITHIN TRENCH AND BACKFILL WITH EXCAVATED MATERIAL.
4. INSTALL WOODEN STAKES AT 5 FT ON-CENTER, BOTH SIDES, ALTERNATING STAKE LOCATIONS.
5. WHEN CROSSING AN EXISTING DEFINED FLOWPATH CHANNEL, INSTALL BRUSH MATTRESS TAILOUTS ON THE UP AND DOWNSTREAM SIDE OF WATTLE EXTENDING ONE CHANNEL WIDTH IN BOTH DIRECTIONS TO DISSIPATE ENERGY IN CHANNEL. BRUSH MATTRESS SHALL SPAN PAST EXISTING CHANNEL TOP WIDTH A MINIMUM OF 5' AND BE STAKED IN PLACE WITH 4-INCH DIAMETER POSTS, 2.5 FT ON-CENTER, WITHIN THE FLOWPATH.
6. BETWEEN WATTLES, CONTRACTOR SHALL REPOSITION EXISTING FALLEN LOGS/BRANCHES ACROSS FLOODPLAIN AND FLOW PATHWAYS WIDTH AND DEPRESS INTO SOIL SURFACE AS FEASIBLE.
7. ONCE CONSTRUCTED, IMMEDIATELY STABILIZE ALL DISTURBED TIE-IN LOCATIONS AS SPECIFIED.
8. WHERE POSSIBLE, ALL MATERIAL SHALL BE DRIVEN OR PUSHED INTO STREAM BED AND BANKS TO DEPTHS SPECIFIED WITH MINIMAL EXCAVATION. SHARPEN ENDS OF LOG WITH A CHAINSAW AND DRIVE SHARPENED INTO GROUND AS DIRECTED BY THE ENGINEER/DESIGNATED SPECIALIST.

POST AND WATTLE MATERIALS:

1. WATTLES SHALL CONSIST OF GREEN BRANCH CUTTINGS/BRUSH COMPOSED OF 1 TO 2 INCH DIAMETER MATERIALS, 5 TO 10 FEET LONG, WOVEN, COMPRESSED, AND BUNDLED TOGETHER TO FORM A MINIMUM OF 10 FT OF WATTLE. MATERIAL SHALL BE COMPRESSED USING A RATCHET STRAP OF SIMILAR METHOD AND TIED WITH A NATURAL FIBER ROPE.
2. BRUSH MATTRESS SHALL BE 50% BRUSH MIXED WITH 50% SALVAGED OR IMPORTED BED MATERIAL WITH A D50 OF 2". THE BRUSH COMPONENT SHALL BE COMPOSED OF AN EVEN MIX OF SMALL LIMBS AND ROOTWAD BETWEEN 4 TO 8 INCHES IN DIAMETER AND 3 TO 6 FOOT LONG, MIXED EVENLY WITH SMALLER DIAMETER AND LENGTH BRUSH.
3. WOOD STAKES SHALL BE 2" X 2" HARDWOOD STAKES, 4 FEET LONG.
4. WOOD POSTS SHALL BE MIN OF 4" DIAMETER SALVAGED OR FURNISHED WOOD POSTS, 4 FEET LONG.
5. ALL WOODY MATERIAL SHALL BE OBTAINED ONSITE TO MAXIMUM EXTENT POSSIBLE. ROT-RESISTANT SPECIES ARE PREFERRED FOR USE IF AVAILABLE. BUT ANY WOOD FREE OF DEFECTS, MAJOR DAMAGE AND DECAY CAN BE USED AS AVAILABLE.

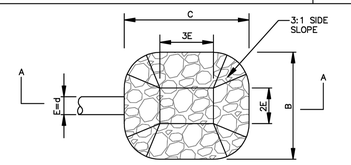
SUBMITTAL REQUIREMENTS:

1. WATTLES: SUBMITTAL APPROVAL REQUIRED IF IMPORTED
2. BRUSH MATTRESS: NA
3. WOOD STAKES: SUBMITTAL APPROVAL REQUIRED IF IMPORTED
4. WOOD POSTS: SUBMITTAL APPROVAL REQUIRED IF IMPORTED

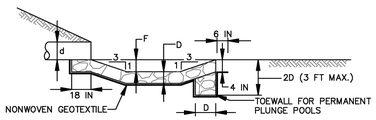
INSPECTION REQUIREMENTS:

1. CONTRACTOR SHALL PERFORM INITIAL QC ON ALL MATERIALS.
2. ENGINEER/DESIGNATED SPECIALIST TO VISUALLY INSPECT AND PROVIDE FINAL ACCEPTANCE OF EACH STRUCTURE BASED ON SITE INSPECTOR OR CONTRACTOR PROVIDED DOCUMENTATION (PHOTOS, ELEVATIONS).

DETAIL D-4-2 PLUNGE POOL — STANDARD SYMBOL: PP



PLAN VIEW



SECTION A–A

CONSTRUCTION SPECIFICATIONS

1. USE SPECIFIED CLASS OF RIPRAP.
2. USE NONWOVEN GEOTEXTILE AS SPECIFIED IN SECTION H–1 MATERIALS, AND PROTECT FROM PUNCHING, CUTTING, OR TEARING. REPAIR ANY DAMAGE OTHER THAN AN OCCASIONAL SMALL HOLE BY PLACING ANOTHER PIECE OF GEOTEXTILE OVER THE DAMAGED PART OR BY COMPLETELY REPLACING THE GEOTEXTILE. PROVIDE A MINIMUM OF ONE FOOT OVERLAP FOR ALL REPAIRS AND FOR JOINING TWO PIECES OF GEOTEXTILE.
3. PREPARE THE SUBGRADE FOR THE PLUNGE POOL TO THE REQUIRED LINES AND GRADES. COMPACT ANY FILL REQUIRED IN THE SUBGRADE TO A DENSITY OF APPROXIMATELY THAT OF THE SURROUNDING UNDISTURBED MATERIAL.
4. EMBED THE GEOTEXTILE A MINIMUM OF 4 INCHES AND EXTEND THE GEOTEXTILE A MINIMUM OF 6 INCHES BEYOND THE EDGE OF THE SCOUR HOLE.
5. STONE FOR THE PLUNGE POOL MAY BE PLACED BY EQUIPMENT, CONSTRUCT TO THE FULL COURSE THICKNESS IN ONE OPERATION AND IN SUCH A MANNER AS TO AVOID DISPLACEMENT OF UNDERLYING MATERIALS. DELIVER AND PLACE THE STONE FOR THE PLUNGE POOL IN A MANNER THAT WILL ENSURE THAT IT IS REASONABLY HOMOGENEOUS WITH THE SMALLER STONES AND SPALLS FILLING THE VOIDS BETWEEN THE LARGER STONES. PLACE STONE FOR THE PLUNGE POOL IN A MANNER TO PREVENT DAMAGE TO THE GEOTEXTILE. HAND PLACE TO THE EXTENT NECESSARY.
6. AT THE PLUNGE POOL OUTLET, PLACE THE STONE SO THAT IT MEETS THE EXISTING GRADE.
7. MAINTAIN LINE, GRADE, AND CROSS SECTION. KEEP OUTLET FREE OF EROSION. REMOVE ACCUMULATED SEDIMENT AND DEBRIS. AFTER HIGH FLOWS INSPECT FOR SCOUR AND DISLODGED RIPRAP. MAKE NECESSARY REPAIRS IMMEDIATELY.

MARYLAND STANDARDS AND SPECIFICATIONS FOR SOIL EROSION AND SEDIMENT CONTROL

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE	2011	MARYLAND DEPARTMENT OF ENVIRONMENT WATER MANAGEMENT ADMINISTRATION

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

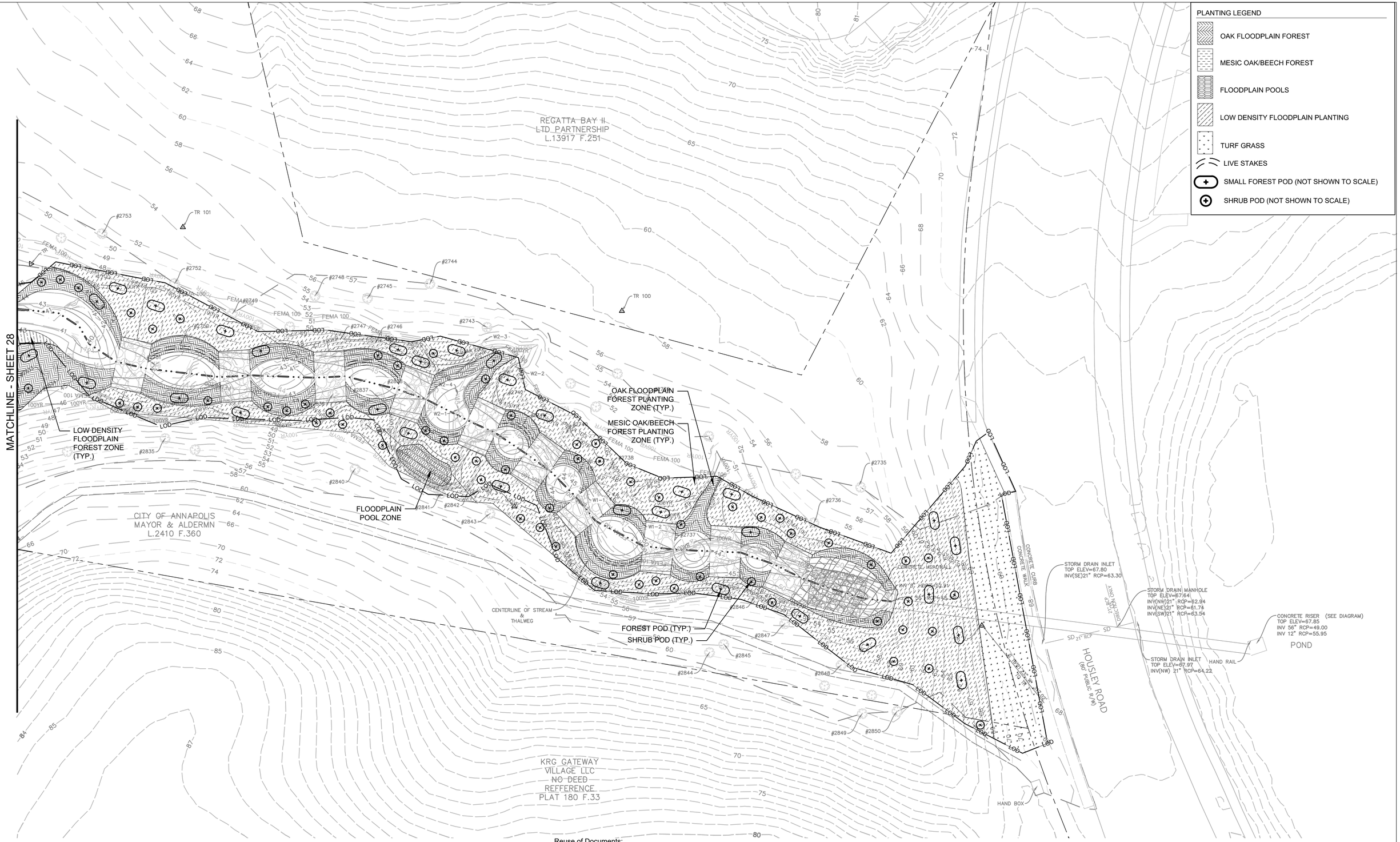
APPROVED DATE		APPROVED DATE	
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED DATE		APPROVED DATE	
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	NTS
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	26 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

DETAILS

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\dt01aw.dwg



Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED	
DATE	BY

APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	1" = 20'
DRAWN BY	TB
CHECKED BY	DS/JC
SHEET NO.	27 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

LANDSCAPE PLAN

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\pl01aw.dwg

PLANTING LEGEND

- OAK FLOODPLAIN FOREST
- MESIC OAK/BEECH FOREST
- FLOODPLAIN POOLS
- LOW DENSITY FLOODPLAIN PLANTING
- TURF GRASS
- LIVE STAKES
- SMALL FOREST POD (NOT SHOWN TO SCALE)
- SHRUB POD (NOT SHOWN TO SCALE)

LOW DENSITY FLOODPLAIN FOREST ZONE (TYP.)

OAK FLOODPLAIN FOREST PLANTING ZONE (TYP.)

MESIC OAK/BEECH FOREST PLANTING ZONE (TYP.)

FOREST POD (TYP.)

SHRUB POD (TYP.)

MATCHLINE - SHEET 27

CITY OF ANNAPOLIS
MAYOR & ALDERMN
L.2410 F.360

KRG GATEWAY
VILLAGE LLC
NO DEED
REFFERENCE
PLAT 180 F.33

HORIZONTAL SCALE
0 20 40

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

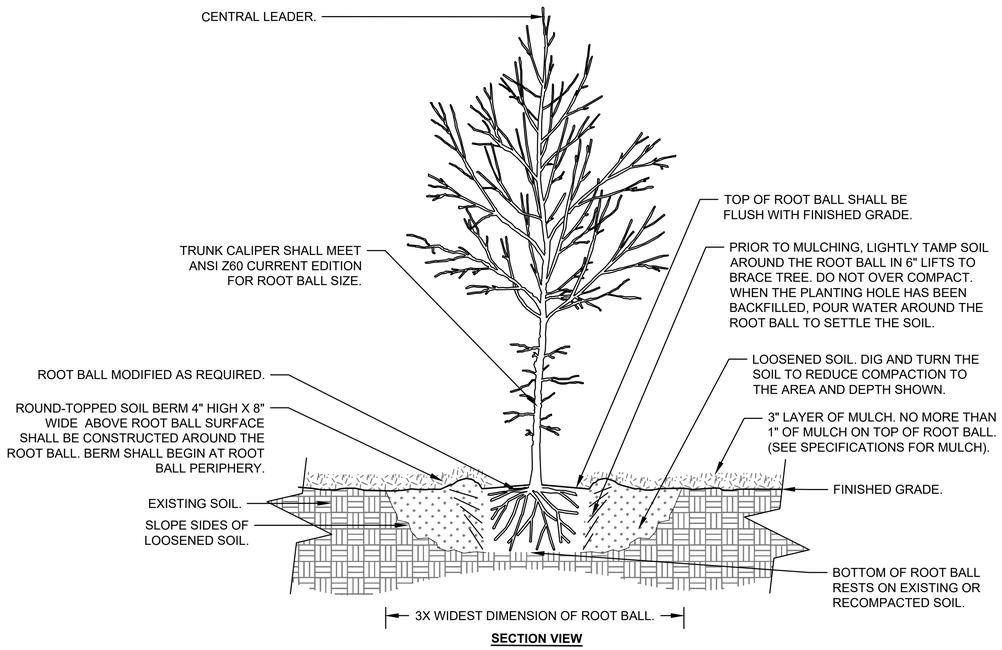
APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	1" = 20'
DRAWN BY	TB
CHECKED BY	DS/JC
SHEET NO.	28 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

LANDSCAPE PLAN

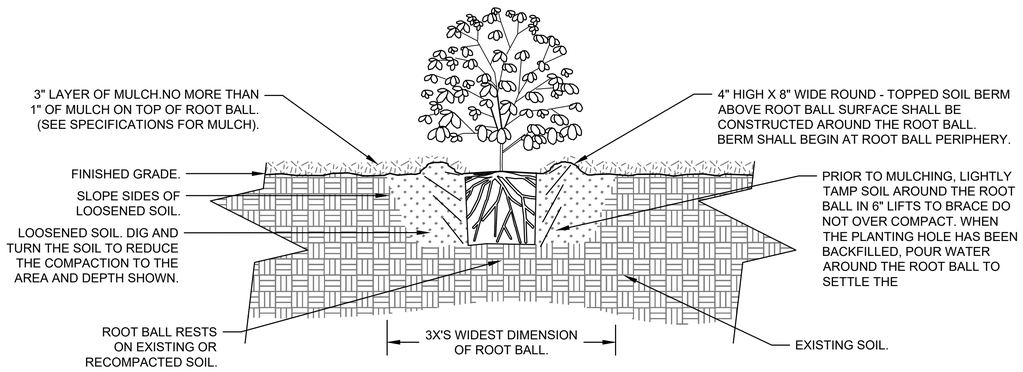
6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\pl01aw.dwg



SECTION VIEW

STANDALONE TREE PLANTING

NOT TO SCALE

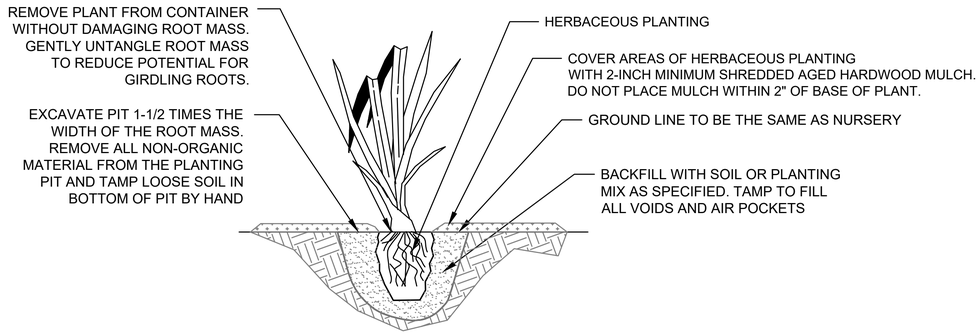


NOTE: SHRUBS MAY BE FENCED INDIVIDUALLY OR IN GROUPS, FOLLOWING FIELD PLACEMENT.

SECTION VIEW

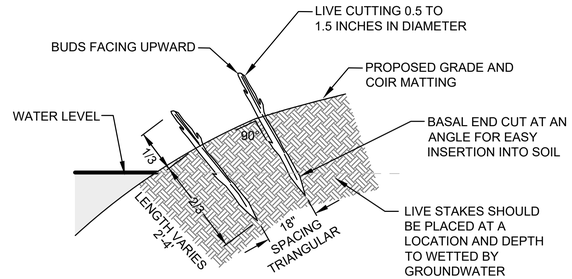
STANDALONE SHRUB PLANTING

NOT TO SCALE



HERBACEOUS PLANTING

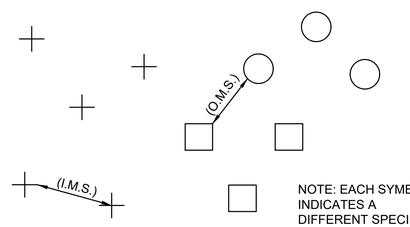
NOT TO SCALE



NOTE: DO NOT PLANT LIVE STAKE MATERIAL MORE THAN 1FT ABOVE CHANNEL BASEFLOW ELEVATION

LIVE STAKE INSTALLATION CROSS SECTION- TYPICAL

NOT TO SCALE



NOTE: EACH SYMBOL INDICATES A DIFFERENT SPECIES

1. PLANTS ARE ARRANGED IN CLUSTERS CONSISTING OF THE SAME SPECIES.
2. SPACING BETWEEN EACH CLUSTER IS DETERMINED BY THE OVERALL MINIMUM SPACING (O.M.S.) DISTANCE.
3. SPACING BETWEEN EACH SPECIES WITHIN EACH CLUSTER IS DETERMINED BY THE INDIVIDUAL MINIMUM SPACING (I.M.S.) DISTANCE.
4. CLUSTERS SHALL CONSIST OF ODD NUMBERS WITH NO LESS THAN 3 AND NO MORE THAN 7 INDIVIDUALS OF ONE SPECIES.

PLANT SPACING - CLUSTER PLAN VIEW

NOT TO SCALE

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation
ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

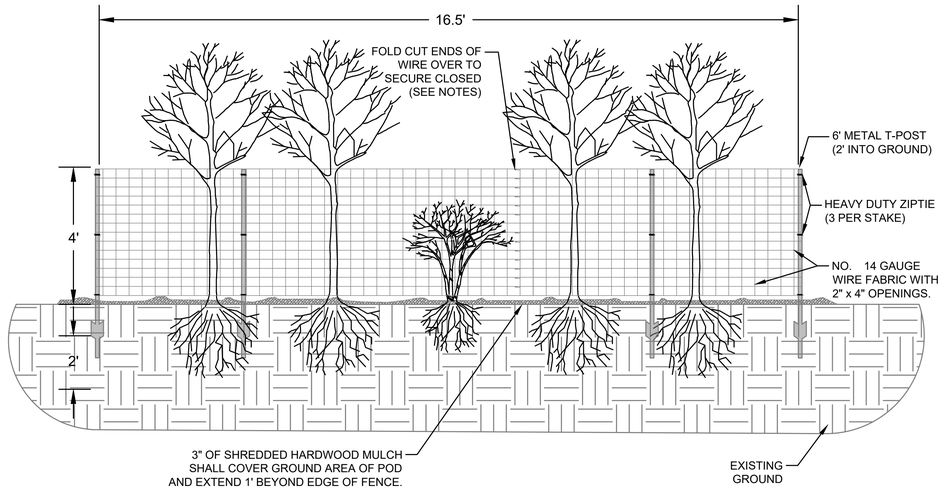
REVISED DATE	BY

APPROVED DATE		APPROVED DATE	
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED DATE		APPROVED DATE	
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	NTS
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	29 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

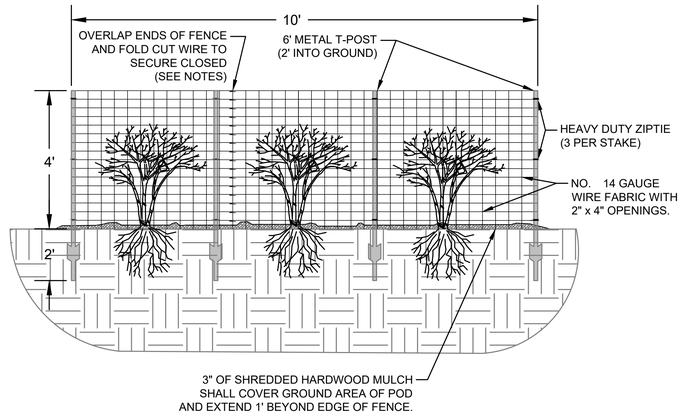
ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

LANDSCAPE DETAILS



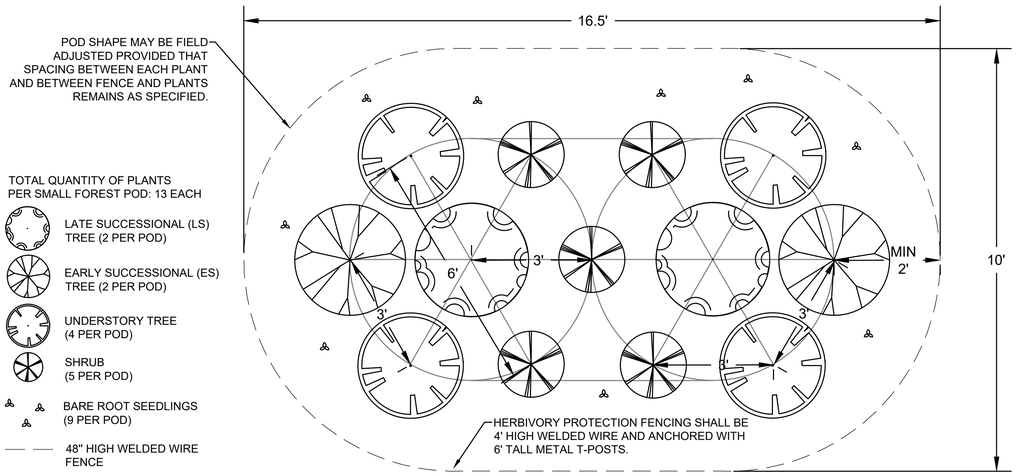
SMALL FOREST POD PLANTING - TYPICAL - SECTION VIEW

NOT TO SCALE



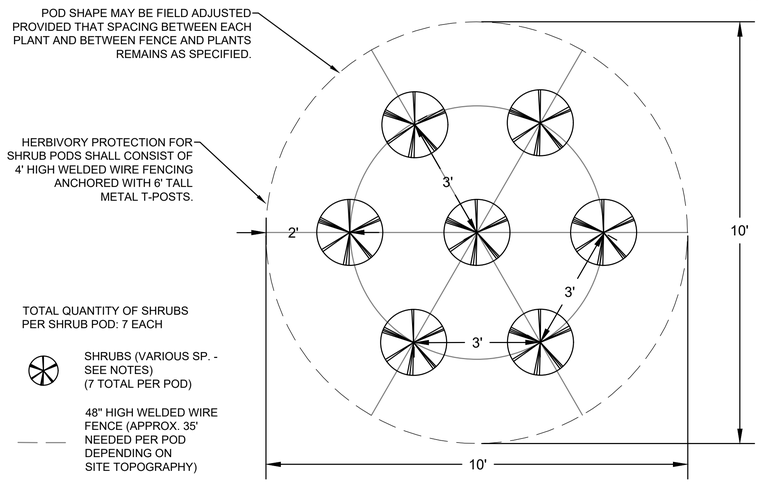
SHRUB POD PLANTING - TYPICAL - SECTION VIEW

NOT TO SCALE



SMALL FOREST POD PLANTING - TYPICAL - PLAN VIEW

NOT TO SCALE



SHRUB POD PLANTING - TYPICAL - AERIAL VIEW

NOT TO SCALE

POD PLANTING NOTES:

1. HERBIVORY PROTECTION FENCING
   - 1.1. HERBIVORY PROTECTION FENCING SHALL CONSIST OF 48-IN. HEIGHT NO. 14 GAUGE GALVANIZED STEEL WELDED WIRE MESH FABRIC WITH 2-IN. BY 4-IN. OPENINGS.
   - 1.2. FENCE STAKES SHALL BE 6' TALL METAL T-POSTS, HAMMERED 2' INTO GROUND. PROVIDE STAKES PER THE DETAIL AND/OR AS NEEDED TO MAINTAIN HERBIVORY PROTECTION FENCING IN A FIRM UPRIGHT POSITION.
   - 1.3. FENCE SHALL BE SECURED TO T-POSTS WITH THREE (3) HEAVY DUTY ZIPTIES PER POST.
   - 1.4. ENDS OF FENCE SHOULD OVERLAP BY APPROX 2'. FENCE SHALL BE SECURED CLOSED BY BENDING WELDED WIRE ONTO ITSELF TO ALLOW MAINTENANCE RE-ENTRY WITHOUT THE NEED TO CUT AND RETIE PLASTIC ZIPTIES.
   - 1.5. T-POSTS SHALL BE USED AS NEEDED TO ANCHOR EACH POD ENCLOSURE IN A FIRM UPRIGHT POSITION. POST SPACING SHALL NOT EXCEED 8'. PROVIDE ADDITIONAL POSTS AS NEEDED BASED ON FIELD CONDITIONS.
   - 1.6. A WILDLIFE PASSAGE GAP OF APPROXIMATELY 3" SHALL BE LEFT BETWEEN THE GROUND SURFACE AND THE BOTTOM OF THE FENCE.
   - 1.7. FENCING MAY BE FIELD ADJUSTED TO ACCOMMODATE FOR ON-GROUND OBSTACLES SUCH AS EXISTING TREES, STUMPS, LARGE ROCKS, AND LARGE WOODY DEBRIS, AS LONG AS THE FOLLOWING CONDITIONS ARE MET:
     - 1.7.1. ON CENTER SPACING BETWEEN PLANTS AND SPACING BETWEEN PLANTS AND FENCE SHALL REMAIN AS SPECIFIED IN THIS DETAIL.
     - 1.7.2. WILDLIFE PASSAGE GAP BETWEEN BOTTOM OF FENCE AND GROUND SHALL NOT EXCEED 5" IN ANY LOCATION.
     - 1.7.3. FENCING SHALL BE SECURELY CLOSED WITH NO LATERAL GAPS.
2. PLANTING
   - 2.1. PRIOR TO PLANTING, THE POD AREA SHALL BE CLEARED OF DEBRIS TO FACILITATE INSTALLATION.
   - 2.2. ALL PLANTS EXCEPT BARE ROOTS SHALL BE PLANTED AT A 3' O.C. SPACING FROM ONE ANOTHER WITHIN PODS.
   - 2.3. BARE ROOT SEEDLINGS SHALL BE PLANTED AT A RANDOM SPACING THROUGHOUT POD.
   - 2.4. A DISTANCE OF 2' O.C. SHALL BE MAINTAINED BETWEEN FENCE AND CONTAINER PLANTS WITHIN PODS.
   - 2.5. WITHIN PODS, TREE SPECIES SHALL BE MIXED TO THE MAXIMUM EXTENT POSSIBLE.
   - 2.6. WITHIN EACH POD, NO MORE THAN 3 DISTINCT SHRUB SPECIES SHALL BE PLANTED. WHERE POSSIBLE, GROUP LIKE SHRUB SPECIES NEXT TO ONE ANOTHER.
   - 2.7. IN PLANTING ZONES WHERE MULTIPLE PODS ARE SPECIFIED, SPECIES SHALL BE DISTRIBUTED EVENLY TO THE MAXIMUM EXTENT POSSIBLE ACROSS ALL PODS WITHIN THAT PLANTING ZONE.
   - 2.8. A LAYER OF 3" SHREDDED HARDWOOD MULCH SHALL COVER GROUND AREA OF POD AND EXTEND 1' BEYOND ITS EDGES.

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers FEDERATION

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY

APPROVED	DATE	APPROVED	DATE
CHIEF ENGINEER		PROJECT MANAGER	
APPROVED	DATE	APPROVED	DATE
ASSISTANT CHIEF ENGINEER		CHIEF, RIGHT-OF-WAY	

SCALE:	NTS
DRAWN BY	KB
CHECKED BY	DS/JC
SHEET NO.	30 OF 31
PROJECT NO.	24015.01
PROPOSAL NO.	

ANNAPOLIS WATERWORKS PARK STREAM RESTORATION

LANDSCAPE DETAILS

PLANT COMPOSITION SCHEDULE - ANNAPOLIS WATERWORKS PARK

AREA (sq ft) 23445
ZONE: Oak Floodplain Forest
AREA (acres) 0.54
FOREST PODS
FOREST PODS = 36

Quantity	Key	Scientific Name	Size	Spacing Type	Frequency (%)	Overall Minimum Spacing (ft)	Individual Species Spacing (ft)	Notes
		Trees				see detail		
		Overstory - ES						
43		*Quercus phellos*	#7	FOREST POD	15%		3	
29		*Quercus palustris*	#7	FOREST POD	10%		3	
		Overstory - LS						
14		*Quercus lyrata*	#7	FOREST POD	5%		3	
14		*Quercus pagoda*	#7	FOREST POD	5%		3	
44		*Quercus michauxii*	#7	FOREST POD	15%		3	
		Understory						
28		*Betula nigra*	#7	FOREST POD	10%		3	
29		*Carpinus caroliniana*	#7	FOREST POD	10%		3	
29		*Ilex opaca*	#7	FOREST POD	10%		3	
29		*Nyssa sylvatica*	#7	FOREST POD	10%		3	
29		*Magnolia virginiana*	#7	FOREST POD	10%		3	
288					**100%**			
		Bare Root Trees				see detail	see detail	
324		*Carya cordiformis*		FOREST POD	100%			
324					**100%**			
		Shrubs				see detail		
36		*Calycanthus floridus*	#3	FOREST POD	20%		3	
36		*Ilex verticillata*	#3	FOREST POD	20%		3	
18		*Itea virginica*	#3	FOREST POD	10%		3	
36		*Lindera benzoin*	#3	FOREST POD	20%		3	
27		*Viburnum dentatum*	#3	FOREST POD	15%		3	
27		*Viburnum nudum*	#3	FOREST POD	15%		3	
180					**100%**			

SHRUB PODS
SHRUB PODS = 69

Quantity	Key	Scientific Name	Size	Spacing Type	Frequency (%)	Overall Minimum Spacing (ft)	Individual Species Spacing (ft)	Notes
		Shrubs				see detail		
97		*Calycanthus floridus*	#3	SHRUB POD	20%		3	
97		*Ilex verticillata*	#3	SHRUB POD	20%		3	
48		*Itea virginica*	#3	SHRUB POD	10%		3	
97		*Lindera benzoin*	#3	SHRUB POD	20%		3	
72		*Viburnum dentatum*	#3	SHRUB POD	15%		3	
72		*Viburnum nudum*	#3	SHRUB POD	15%		3	
483					**100%**			

NOTES:
ES = early successional LS = late successional
See Forest and Shrub Pod Planting Details for guidance on plant layout and spacing. Pod locations shown on plan.
Planting Composition Schedule supersedes Plant Summary Schedule.

SEED MIX SCHEDULE

Area (ac): 0.54
ZONE: Oak Floodplain Forest seed mix
Seeding Rate (lbs/ac): 35

Quantity (lbs P.L.S.)	Scientific Name	Common Name	Unit	% Mix	Notes
0.28	*Asclepias incarnata*	*swamp milkweed*	LB of P.L.S. 76%	1.5%	
0.28	*Aster umbellatus*	*flat-topped white aster*	LB of P.L.S. 76%	1.5%	
0.28	*Boehmeria cylindrica*	*false nettle*	LB of P.L.S. 76%	1.5%	
1.13	*Cinna arundinacea*	*stout woodreed*	LB of P.L.S. 76%	6.0%	
0.19	*Carex intumescens*	*star sedge*	LB of P.L.S. 76%	1.0%	
0.94	*Carex lupulina, MD ecotype*	*hop sedge, MD ecotype*	LB of P.L.S. 76%	5.0%	
0.57	*Carex tribuloides*	*blunt broom sedge*	LB of P.L.S. 76%	3.0%	
1.88	*Dichanthelium clandestinum*	*deertongue grass*	LB of P.L.S. 76%	10.0%	
3.77	*Elymus virginicus*	*virginia wildrye*	LB of P.L.S. 76%	20.0%	
2.07	*Glyceria striata*	*fowl manna grass*	LB of P.L.S. 76%	11.0%	
0.57	*Iris versicolor*	*blue flag iris*	LB of P.L.S. 76%	3.0%	
0.57	*Leersia virginica*	*whitegrass*	LB of P.L.S. 76%	3.0%	
0.04	*Lobelia siphilitica*	*great blue lobelia*	LB of P.L.S. 76%	0.2%	
0.57	*Lycopus virginicus*	*Virginia bugleweed*	LB of P.L.S. 76%	3.0%	
0.19	*Onoclea sensibilis*	*sensitive fern*	LB of P.L.S. 76%	1.0%	
4.14	*Pancum rigidulum*	*redtop panicgrass*	LB of P.L.S. 76%	22.0%	
0.38	*Rudbeckia hirta*	*black eyed susan*	LB of P.L.S. 76%	2.0%	
0.38	*Solidago patula*	*roughleaf goldenrod*	LB of P.L.S. 76%	2.0%	
0.38	*Symphyotrichum lateriflorum*	*calico aster*	LB of P.L.S. 76%	2.0%	
0.24	*Vernonia noveboracensis*	*new york ironweed*	LB of P.L.S. 76%	1.3%	
18.84				**100.0%**	

NOTES
APPLY SEED WITH COVER CROP. If planting Sept 1 - Apr 30, use oats (Avena sativa) at 20-32 lb/ac OR Grain rye (Secale cereale) at 30 lb/ac. If seeding May 1-Aug 31, use millet (Urochloa racemosa) at 6-8 lb/ac. See info from seed supplier.
Scientific name prevails.

PLANT COMPOSITION SCHEDULE - ANNAPOLIS WATERWORKS PARK

AREA (sq ft) 17783
ZONE: Mesic Oak/ Beech Forest
AREA (acres) 0.41
FOREST PODS
FOREST PODS = 26

Quantity	Key	Scientific Name	Size	Spacing Type	Frequency (%)	Overall Minimum Spacing (ft)	Individual Species Spacing (ft)	Notes
		Trees				see detail		
		Overstory - ES						
31		*Quercus nigra*	#7	FOREST POD	15%		3	
21		*Pinus strobus*	#7	FOREST POD	10%		3	
		Overstory - LS						
10		*Fagus grandifolia*	#3	FOREST POD	5%		3	
10		*Quercus rubra*	#7	FOREST POD	5%		3	
32		*Quercus alba*	#7	FOREST POD	15%		3	
		Understory Trees						
31		*Betula nigra*	#7	FOREST POD	15%		3	
31		*Ilex opaca*	#7	FOREST POD	15%		3	
21		*Nyssa sylvatica*	#7	FOREST POD	10%		3	
21		*Symplocos tinctoria*	#7	FOREST POD	10%		3	
208					**100%**			
		Bare Root Trees				see detail	see detail	
117		*Carya glabra*	BARE ROOT	FOREST POD	50%			
117		*Sassafras albidum*	BARE ROOT	FOREST POD	50%			
234					**100%**			
		Shrubs				see detail		
20		Gaylussacia baccata	#3	FOREST POD	15%		3	
20		Euonymus americanus	#3	FOREST POD	15%		3	
24		Vaccinium angustifolium	#3	FOREST POD	20%		3	
33		Viburnum acerifolium	#3	FOREST POD	25%		3	
33		Viburnum dentatum	#3	FOREST POD	25%		3	
130					**100%**			

SHRUB PODS
SHRUB PODS = 50

Quantity	Key	Scientific Name	Size	Spacing Type	Frequency (%)	Overall Minimum Spacing (ft)	Individual Species Spacing (ft)	Notes
		Shrubs				see detail		
53		Gaylussacia baccata	#3	SHRUB POD	15%		3	
53		Euonymus americanus	#3	SHRUB POD	15%		3	
70		Vaccinium angustifolium	#3	SHRUB POD	20%		3	
87		Viburnum acerifolium	#3	SHRUB POD	25%		3	
87		Viburnum dentatum	#3	SHRUB POD	25%		3	
350					**100%**			

NOTES:
ES = early successional LS = late successional
See Forest and Shrub Pod Planting Details for guidance on plant layout and spacing. Pod locations shown on plan.
Planting Composition Schedule supersedes Plant Summary Schedule.

SEED MIX SCHEDULE

Area (ac): 0.41
ZONE: Mesic Oak/ Beech Forest seed mix
35

Quantity (lbs P.L.S.)	Scientific Name	Common Name	Unit	% Mix	Notes
0.11	*Aquilegia canadensis*	*eastern columbine*	LB of P.L.S. 76%	0.8%	
0.21	*Asclepias tuberosa*	*butterfly milkweed*	LB of P.L.S. 76%	1.5%	
0.19	*Aster pilosus*	*heath aster*	LB of P.L.S. 76%	1.4%	
0.07	*Chamaecrista fasciculata*	*partridge pea*	LB of P.L.S. 76%	0.5%	
2.35	*Elymus virginicus*	*virginia wildrye*	LB of P.L.S. 76%	17.0%	
0.14	*Geum laciniatum*	*rough avens*	LB of P.L.S. 76%	1.0%	
0.35	*Lespedeza virginica*	*slender lespedeza*	LB of P.L.S. 76%	2.5%	
0.28	*Liatris pycnostachya*	*prairie blazing star*	LB of P.L.S. 76%	2.0%	
0.17	*Pycnanthemum incanum*	*hoary mountain mint*	LB of P.L.S. 76%	1.2%	
0.55	*Rudbeckia hirta*	*black eyed susan*	LB of P.L.S. 76%	4.0%	
8.83	*Schizachyrium scoparium*	*little bluestem*	LB of P.L.S. 76%	64.0%	
0.41	*Senna hebecarpa*	*maryland senna*	LB of P.L.S. 76%	3.0%	
0.07	*Sisyrinchium angustifolium*	*narrow leaf blue eyed grass*	LB of P.L.S. 76%	0.5%	
0.03	*Solidago bicolor*	*white goldenrod*	LB of P.L.S. 76%	0.2%	
0.06	*Solidago juncea*	*early goldenrod*	LB of P.L.S. 76%	0.4%	
13.80				**100.0%**	

NOTES
APPLY SEED WITH COVER CROP. If planting Sept 1 - Apr 30, use oats (Avena sativa) at 20-32 lb/ac OR Grain rye (Secale cereale) at 30 lb/ac. If seeding May 1-Aug 31, use millet (Urochloa racemosa) at 6-8 lb/ac. See info from seed supplier.
Scientific name prevails.

PLANT COMPOSITION SCHEDULE - ANNAPOLIS WATERWORKS PAR

AREA (sq ft) 317
ZONE: Floodplain Pools
AREA (acres) 0.01

Quantity	Scientific Name	Size	Spacing Type	Frequency (%)	Overall Minimum Spacing (ft)	Individual Species Spacing (ft)	Notes
	Perennials				**2**		
16	*Carex tribuloides*	SP4	CLUSTER	20%		1	
16	*Cinna arundinacea*	SP4	CLUSTER	20%		1	
16	*Glyceria striata*	SP4	CLUSTER	20%		1	
16	*Saururus cernuus*	SP4	CLUSTER	20%		1	
16	*Onoclea sensibilis*	SP4	CLUSTER	20%		1	
79				**100%**			

NOTES:
See Plant Cluster Spacing detail.
Planting Composition Schedule supersedes Plant Summary Schedule.

PLANT COMPOSITION SCHEDULE - ANNAPOLIS WATERWORKS PARK

AREA (sq ft) 23866
ZONE: Low Density Floodplain Plantings
AREA (acres) 0.55
SHRUB PODS
SHRUB PODS = 43

Quantity	Key	Scientific Name	Size	Spacing Type	Frequency (%)	Overall Minimum Spacing (ft)	Individual Species Spacing (ft)	Notes
		Shrubs				see detail		
60		*Calycanthus floridus*	#3	SHRUB POD	20%		3	
60		*Ilex verticillata*	#3	SHRUB POD	20%		3	
60		*Lindera benzoin*	#3	SHRUB POD	20%		3	
31		*Vaccinium angustifolium*	#3	SHRUB POD	10%		3	
45		*Viburnum dentatum*	#3	SHRUB POD	15%		3	
45		*Viburnum nudum*	#3	SHRUB POD	15%		3	
301					**100%**			

NOTES:
ES = early successional LS = late successional
See Shrub Pod Planting Details for guidance on plant layout and spacing. Pod locations shown on plan.
Planting Composition Schedule supersedes Plant Summary Schedule.

SOIL BIOENGINEERING COMPOSITION SCHEDULE

Linear Feet (LF) 266

QTY	Scientific Name	Spacing Type	Frequency (%)	(Spacing (ft)	Notes
	Live Stakes			**2**	
47	*Alnus serrulata*		35%		
33	*Cornus sericea*		25%		
53	*Salix interior*		40%		
133			**100%**		

NOTES:
See Live Stake Planting Detail for guidance on plant layout and spacing. Live stake locations shown on plan.
Planting Composition Schedule supersedes Plant Summary Schedule.

SEED MIX SCHEDULE

Area (ac): 0.07
ZONE: Turfgrass
Seeding Rate (lbs/ac): 150

Quantity (lbs P.L.S.)	Scientific Name	Common Name	Unit	% Mix	Notes
25.07	*Festuca arundinacea*	*Tall fescue*	LB of P.L.S. 76%	30.0%	
25.07	*Lolium perenne*	*Perennial ryegrass*	LB of P.L.S. 76%	30.0%	
25.07	*Poa pratensis*	*Kentucky bluegrass*	LB of P.L.S. 76%	30.0%	
8.36	*Lolium multiflorum*	*Annual ryegrass*	LB of P.L.S. 76%	10.0%	
83.56				**100.0%**	

NOTES
APPLY SEED WITH COVER CROP. If planting Sept 1 - Apr 30, use oats (Avena sativa) at 20-32 lb/ac OR Grain rye (Secale cereale) at 30 lb/ac. If seeding May 1-Aug 31, use millet (Urochloa racemosa) at 6-8 lb/ac. See info from seed supplier.
Scientific name prevails.

Reuse of Documents:
This document, and the ideas and designs incorporated herein, as an instrument of Professional Service, is the property of Biohabitats, Inc. and is not to be used in whole or in part, for any other project without the written authorization of Biohabitats, Inc.

Biohabitats
The Stables Building 2081 Clipper Park Road
Baltimore, MD 21211 / ph: 410.554.0156
fx: 410.554.0168 / www.biohabitats.com
Restore the Earth & Inspire Ecological Stewardship

Arundel Rivers Federation
ARUNDELRIVERS.ORG

ANNE ARUNDEL COUNTY
CITY OF ANNAPOLIS

REVISED DATE	BY	APPROVED / DATE	APPROVED / DATE	SCALE: NA	ANNAPOLIS WATERWORKS PARK STREAM RESTORATION
		CHIEF ENGINEER	PROJECT MANAGER	DRAWN BY KB	
		APPROVED / DATE	APPROVED / DATE	CHECKED BY DS/JC	LANDSCAPE SCHEDULE
		ASSISTANT CHIEF ENGINEER	CHIEF, RIGHT-OF-WAY	SHEET NO. 31 OF 31	
				PROJECT NO. 24015.01	
				PROPOSAL NO.	

6/25/2026 m:\CADD\Projects\24015.01 annapolis waterworks park stream restoration\CAD\Plans\dl01aw.dwg



1% FOR THE PLANET

Certified B Corporation

Just.

Restore the Earth and Inspire Ecological Stewardship