ANNE ARUNDEL COUNTY
MARYLAND

Prepared For:

Anne Arundel County
Department of Public Works

HISTORIC LONDON TOWN & GARDEN SITE IMPROVEMENTS 60% DESIGN REPORT

Project No. P468700
Contract No. P468717

September 2024

Prepared by:

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1. BACKGROUND

Historic London Town and Gardens is a twenty-three-acre park featuring history, archaeology, and horticulture on the South River in Edgewater, Maryland. The park is owned by Anne Arundel County Department of Recreation and Parks (DRP) and managed by the London Town Foundation. The property has approximately 2,300 linear feet (LF) of shoreline on the South River and Almshouse Creek. The shoreline is currently protected with a combination of stone structures and timber bulkheads. Multiple pier structures in various conditions are also present along the shoreline. Additionally, stormwater runoff is also impacting various areas of the Park. Anne Arundel County has identified areas along the shoreline and within the Park where additional protection measures and/or improvements are needed, shown in Figure 1.

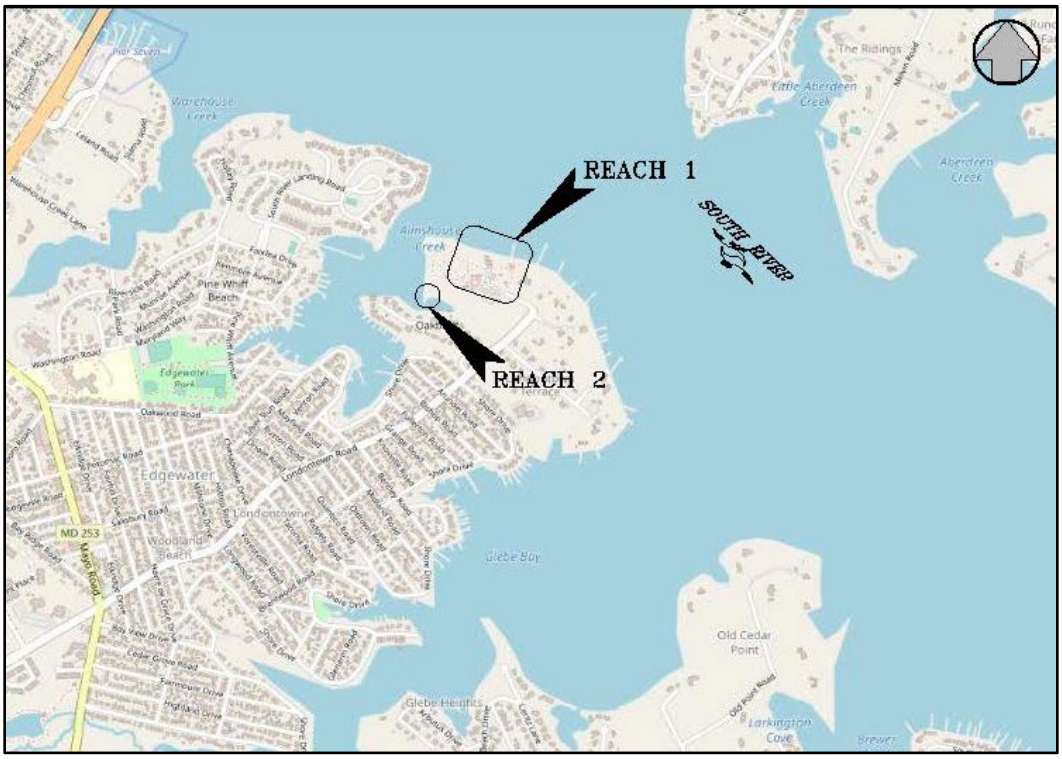

Figure 1 – Vicinity Map

In January 2023, BayLand completed an assessment of park features including the parking lot, shoreline protection, and main pier. Based on the assessment, the following project goals were developed for the London Town and Garden Site Improvements Projects:

- Reconstruct the main pier to allow for ADA access and for docking of ships such as and including the Pride of Baltimore;
- Convert the hardened shoreline along South River currently protected by a dilapidated bulkhead into a living shoreline;
- Provide shoreline protection through living shoreline techniques along 200 feet of natural shoreline along Almshouse Cove;

- Regrade the parking area and curb and gutter to re-direct drainage into previously constructed micro-bioretention facilities;
- Construct an RSC to reduce runoff velocities, provide flow attenuation and storage, and provide nutrient uptake of sediment and pollutants and improve groundwater recharge;
- Provide an ADA accessible path from the parking area to the main pier.

2. EXISTING CONDITIONS

The following paragraphs describe the existing conditions determined through desktop analysis or field investigations within the project area.

2.1. Topographic and Land Use Data

Topographic and land use data were compiled from a combination of published and field collected data. BayLand conducted a topographic and hydrographic survey of the site in March 2023. An existing conditions map for the project was compiled utilizing the survey data, Anne Arundel County Light Detection and Ranging (LiDAR) topography, and County Geographic Information System (GIS) data. Field investigations also mapped the location of utilities marked from an one-call utility request, trees, walking paths and other Park features. The compiled 'existing conditions' basemaps are provided in the attached drawings as Sheets 3 through 6.

2.2. Existing Shoreline

The project site is located at the entrance to Almshouse Creek from South River (38.941N, -76.540W). Reach 1 has a maximum fetch (distance of open water over which wind-generated waves can travel) of approximately 1.5 miles from the North (N) and Reach 2 has a fetch of approximately 0.2 miles from the Northwest (NW).

Currently, the shoreline along Reach 1 consists of a 663 linear foot (LF) timber bulkhead. Based on the site survey performed by BayLand, the elevation of the top of the existing bulkhead ranges from +4.1 to +5.3 feet above the North American Vertical Datum 1988 (NAVD88). The bulkhead along Reach 1 exhibits deteriorating structural members and shows that repairs have taken place to extend the useful life of the structure.

The shoreline along Reach 2 is an eroding natural shoreline with fallen trees and a fallen fence as well as undercutting of the banks. The fetch is less than a quarter mile, implying that erosion is caused by either boat wakes or frequent wave and flow conditions and likely not a result of large storm events.

Photo 1 – Added piles along Reach 1 during repair

Photo 2 – Deteriorating bulkhead members

Photo 3 –Eroding Shoreline along Reach 2 on Almshouse Cove

Photo 4 – Undercutting and fallen fence and trees on Almshouse Cove

2.3. Existing Main Pier

The existing pier at London Town provides access to the site for motorized and sailing vessels and is also utilized for events. It is a timber pier 172 feet in length with three finger piers on the west side. The pier was constructed more than 50 years ago at an elevation of +3.7' NAVD88 (+4.4 feet above MLW). Signs of deterioration along the pier include necking of the pilings at the water line, pitting of the tops of pilings due to the lack of pile caps, missing decking boards, and cracking of split caps and stringers.

2.4. Existing Parking Area

The existing gravel parking area is a result of the parking lot expansion that occurred in 2020. The parking area was intended to flow south into the micro-bioretention facilities, however, the 2023 assessment performed indicates that up to one-half of the parking area does not direct flow into these facilities. Instead, the parking lot grades channel the flow to the east and west down the parking lot entrances creating drainage and erosion issues in the open space area between the garden expansion and Educational Pavilion.

Photo 5 – London Town's existing 150 LF pier

Photo 6 – Piling necking at the waterline

Photo 7 – Pile Pitting

Photo 8 – Missing Decking Boards

Photo 9 – London Town's existing gravel parking lot

Photo 10 – Existing micro-bioretention facility located southeast of the parking lot

Photo 11 – Existing micro-bioretention located south of the parking lot

2.5. Upland Drainage Issues

The open space area between the garden expansion and Educational Pavilion experiences drainage issues from the gravel parking lot runoff. The area experiences frequent ponding and the ground is continuously saturated. The area has multiple depressions and lacks positive drainage, while also experiencing increased runoff from the parking lot expansion area as previously discussed.

Next, the open space between the access path to the William Brown House and the Shoreline is characterized by steep terrain allowing stormwater runoff to channelize and discharge into tidal waters at high velocities. This runoff has created a head cut just upstream of the existing shoreline and the head cut is actively moving upland, threatening existing sewer infrastructure and the historic lands.

Photo 12 – Developing head cut at the shoreline

Photo 13 – Depressions in open space area

Photo 14 – Steep terrain of open space area

2.6. Water Levels

Tidal datums are estimated from NOAA's Vertical Datum Transformation (VDatum)[1] at site location 38.941N, -76.540W and are presented in Table 1. These datums were used to develop the design of the living shoreline vegetated area.

Table 1 – Tidal Datums per NOAA VDatum Transformation

Datum	Water Elevation (ft. NAVD88)
MHHW	+0.5
MHW	+0.3
NAVD88	**+0.0**
MSL	-0.2
MLW	-0.7
MLLW	-1.0

3. PROPOSED DESIGN

To meet the project goals described in Section 1, the following design features are proposed as shown on Sheets 7 – 13 of the design drawings.

3.1 Proposed Living Shoreline

3.1.1 Reach 1

Shoreline protection along Reach 1 will be attained through installation of a living shoreline. Headland stone breakwaters will first be constructed parallel to and approximately 50 feet channelward of the existing bulkhead. These breakwaters attenuate wave energy approaching the shoreline to protect both the newly created marsh and the bulkhead and upland area. The newly created marsh area stretches approximately 50 feet from the existing shoreline to the breakwater and will act as a

[1] https://vdatum.noaa.gov/

further buffer to wave energy as well as provide environmental uplift to the area through marsh creation. The bulkhead is proposed to remain in place so as not to disturb the landward vegetation.

Figure 2 provides a cross-sectional view of the proposed living shoreline along Reach 1.

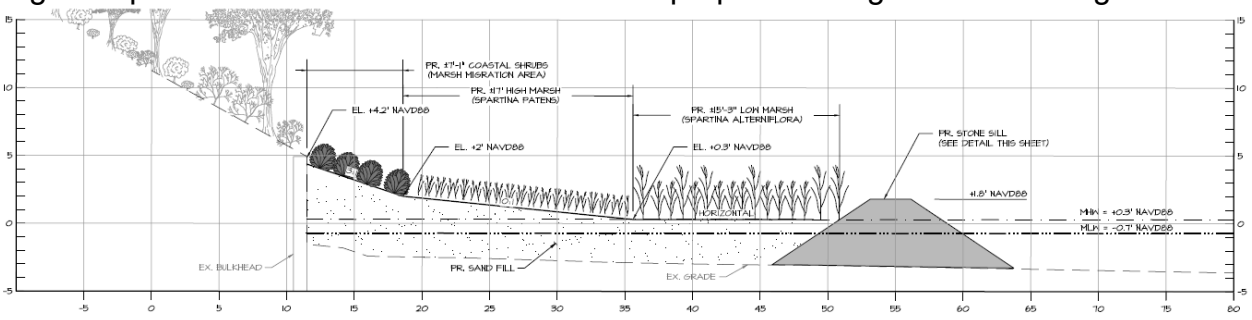

Figure 2 – Proposed Living Shoreline along Reach 1

Reach 1 also contains a small peninsula west of the existing pier. To adequately protect this peninsula, stone toe protection is proposed along this area. After placement, it will be covered with a 50/50 sand and pea gravel mix and planted with coastal shrubs and high marsh plantings at the same elevations as the rest of Reach 1, as shown in Figure 3.

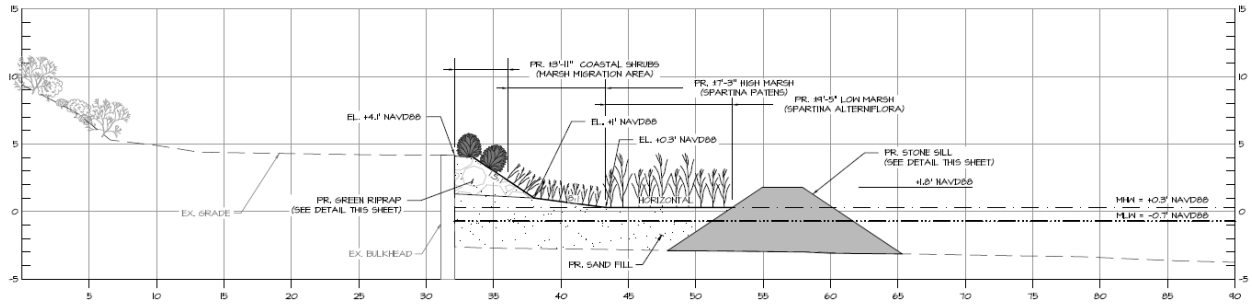

Figure 3 – Proposed Green Riprap Protection for Existing Peninsula

3.1.2 Reach 2

As Reach 2 has a significantly smaller fetch, the proposed design here involves a low-profile sill with sand placement and high and low marsh plantings. The stone sill will be constructed to a crest height of +0.3' NAVD88 (MHW), allowing it to be submerged daily. High marsh and low marsh plantings are proposed to provide tidal marsh habitat to the area, as shown in Figure 4.

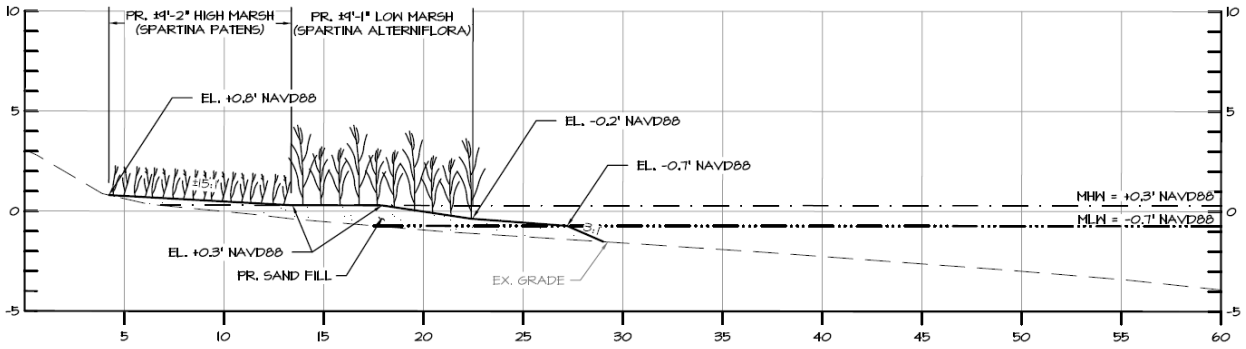

Figure 4 – Proposed Living Shoreline along Reach 2

3.2 Proposed ADA Accessible Boardwalk

An ADA Accessible boardwalk will guide visitors from the parking lot to the new pier. The ten-foot-wide boardwalk will begin at the edge of the gravel parking lot at the Rental Pavilion (elevation +31.6 feet NAVD88). From there, the boardwalk will traverse the steep terrain and drop to approximately 12.5 feet NAVD88 utilizing a series of ramps and gently sloped sections. Approximately 135 feet from the beginning of the boardwalk, the path will include stairs with a bypass made up of 3 ADA compliant ramps, as shown in Figure 5.

Handrails will be provided along the entirety of the boardwalk and ADA bypass. The boardwalk will be 10 feet wide, except for the ADA bypass which will be reduced to 6 feet.

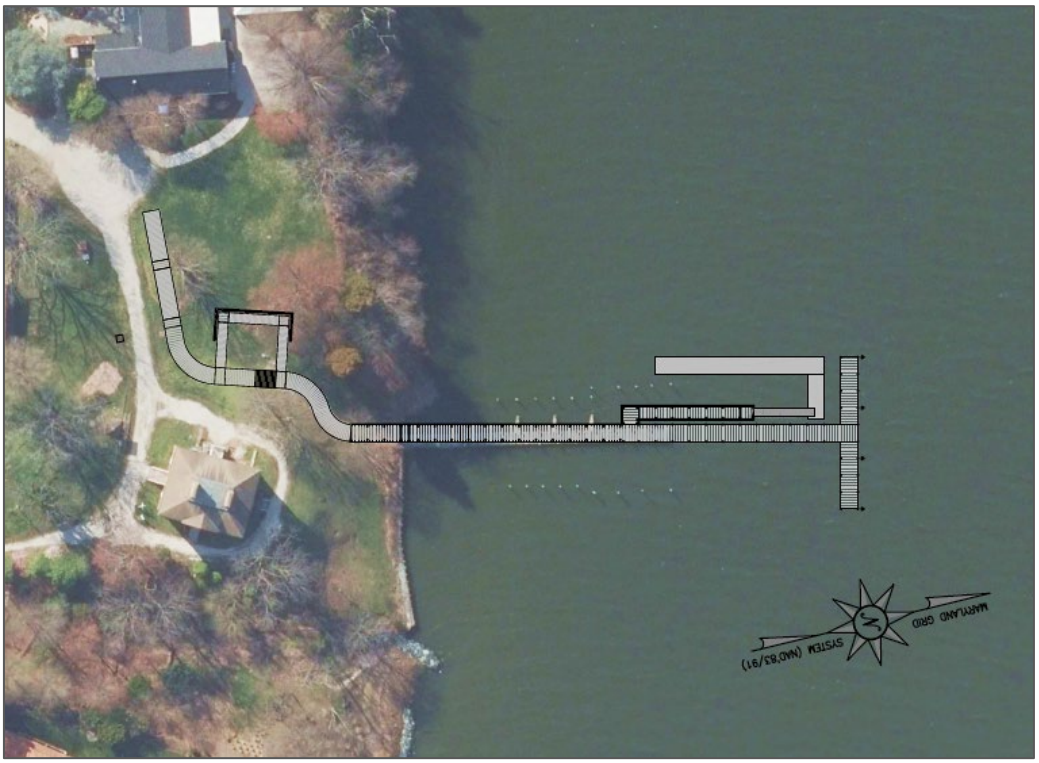

Figure 5 – ADA-Compliant Boardwalk and Main Pier

3.3 Proposed Main Pier Replacement

The proposed pier replacement will begin at the end of the ADA Accessible boardwalk at approximately elevation +12.5 feet NAVD88. The main pier will be 10-foot wide fixed timber structure. At the end of the main pier, two 10-foot wide piers will extend 40 LF on either side, perpendicular to the main pier. This stretch of pier will provide docking for tall ships such as the Pride of Baltimore as water depths are approximately 12 feet to 13 feet deep and the fixed pier is at elevation +6.7 feet NAVD88 (+7 feet MLW).

A fixed timber platform will offshoot from the main pier, leading to an eight-foot-wide by 60 LF ADA Accessible fixed ramp. A five-foot-wide by 22 LF ADA Accessible aluminum gangway will continue running parallel to the main pier, connecting the fixed pier to a floating platform that will be used for ADA compliant loading and unloading onto visiting vessels. The floating pier will be ten-foot by 100-feet and run parallel to the main pier towards the shoreline, providing docking for other vessels. A twenty-foot wide gap has been designed between the 100 LF floating pier and the 60 LF fixed pier to allow for additional docking of dinghies, kayaks, and other small vessels.

3.4 Proposed Drainage Improvements

The following recommendations are presented to improve the drainage within the Project Limits.

3.2.1 Proposed Parking Lot Re-grading

The existing gravel parking lot will be re-graded to direct flow away from the entrances and toward the existing micro-bioretention facilities. The existing curb and gutter and sidewalk will also be replaced to facilitate drainage towards the micro-bioretention facilities. The existing micro-bioretention facilities are sized to handle the increased flow from the parking lot re-grading.

3.1.3 Open Space Improvements

The open space between the planned garden expansion and Educational Pavilion will be regraded to fill the depressions across the entire area as necessary to provide positive drainage and ensure runoff can sheet flow through the area. Surface grading and fill will protect potential historical artifacts while allowing for continued use of area for events and demonstrations. A micro-bioretention is also proposed at the downstream limit of the open space area to capture, treat and slow runoff before discharging to the steep terrain of the downstream open space. The facility will be created with minimal to zero excavation by raising the access path to the William Brown House. The SWM BMP will also not adversely impact future 2027 plans for London Town or any existing, adjacent improvements.

Micro-bioretention is a practice utilized to capture and treat runoff from impervious cover on the site by passing runoff through a filter bed mixture of sand, soil, and organic matter. The proposed 474 square feet micro-bioretention area will treat runoff from a 1.08 acre drainage area, with a proposed 24” depth filter layer and 12” ponding depth. The micro-bioretention will have a 4” PVC underdrain and standard type ‘D’ inlet with a 12” HDPE outfall pipe. ESDv is calculated by determining the available storage in the filter bed plus available ponding storage.

The Micro-bioretention Summary in Table 3 below identifies the ESDv provided by the micro-bioretention area. Complete computations are located in Appendix B.

Table 3 – Micro-Bioretention ESDv Provided Summary				
	Elevation (ft)	Area (ft^2)	Storage (ft^3)	ESD_v (ft^3)
Pond	26.00	474	--	--
	27.00	862	668.1	668.1
	Area (ft^2)	Media Depth (ft)	Media Porosity (%)	ESD_v (ft^3)
Filter Bed	474	2.0	30	284.5
			Total ESD_v	952.5
			Required ESDv	911

A Step Pool Stormwater Conveyance (SPSC) system is also proposed in the open space area between the access path and tidal waters to further reduce velocities from stormwater runoff over the steep terrain. The SPSC systems will be designed per the May 2022 Design Guidelines for Step Pool Stormwater Conveyance (SPSC) developed by AA County. An SPSC system is a series of open-channel conveyance structures that convey, through attenuation ponds and cobble riffle weirs, surface storm flow to the outfall into the living shoreline. These systems safely convey, attenuate, and treat the quality of storm flow. SPSC systems utilize a series of constructed shallow aquatic pools, riffle grade control and native vegetation. For steeper slopes, boulder cascades are used to traverse grade.

The proposed SPSC design begins at a proposed 12” HDPE outfall and consists of a series of 8 cascade-pool segments and will outfall into the living shoreline. The SPSC system is consistent with AA County’s design principles and uses a series of riffles and boulder cascades to traverse the steeper grades while elongating pools to the MEP. The riffles and cascades will be designed to safely convey the 100-year storm peak discharge.

4. PERMITTING & EASEMENTS

The project will require federal, state, and local permits for land disturbance associated with the shoreline protection and drainage improvements. A Joint Federal/State Application for the Alteration of any Tidal Wetland and/or Tidal Waters, submitted to the Maryland Department of the Environment (MDE) and U.S. Army Corps of Engineers (USACE), is required for the sand placement, marsh plantings, stone breakwaters and pier reconstruction and was submitted in February 2024. An Anne Arundel County Building Permit will be required, as will a Grading Permit because the land disturbance for this project is greater than 5,000 square feet. The proposed limit of disturbance is anticipated to exceed 1.0 acre; therefore, a Notice of Intent (NOI) for the General Permit for Stormwater Associated with Construction Activity from MDE will be required. The project limits are also within Critical Area Resource Conservation Area and will be subject to those mitigation regulations.

The project limits of disturbance will be contained within Anne Arundel County property and tidal waters; therefore, temporary, and permanent easements will not be required.

5. CONCLUSION

Based on the above analysis of existing site conditions (i.e. water levels, existing structures, and topography), the proposed improvements are intended to improve access to the facility, reduce shoreline erosion, replace deteriorated structures, increase coastal resiliency, and improve upland drainage. Replacement of the pier and addition of the boardwalk will increase docking capacity at the site, add Park amenities, and add ADA accessibility to a previously non-ADA accessible pier. Installation of the living shoreline will provide natural habitat for native species and improve water quality in the Chesapeake Bay by reducing pollutant loads and erosion. Finally, improvements to upland drainage will reduce on-site ponding and eroded channels and headcuts due to high velocity flows down the steep topography. The total estimated construction cost of this project is $ 3,713,220.00 and a detailed cost estimate is provided in Appendix A.

APPENDIX A

DESIGN DEVELOPEMENT COST ESTIMATE

HISTORIC LONDON TOWN AND GARDEN SITE IMPROVEMENTS

Appendix A - 60% DESIGN

PROBABLE COST ESTIMATE WORKSHEET

Project	Historic London Town and Garden Site Improvements	Project # P468700	Contract # P468717
Developer	Anne Arundel County DPW	Engineer:	BayLand Consultants & Designers, Inc
Address	2662 Riva Road, 3rd Floor	Address	7455 New Ridge, Suite T
	Annapolis, MD 21401		Hanover, Maryland 21076
Phone	(410) 222-7175	Phone	(410) 694-9401
Fax	(410) 222-7589	Fax	(410) 694-9405

Opinion of Probable Costs

Item No.	Description	Quantity		Unit Price	Extension
	Living Shoreline - Reach 1				
1	Mobilization/Demobilization	1	LS	$75,000	$75,000
2	Surveys, Stakeout, & As-Builts	1	LS	$6,000	$6,000
3	Erosion and Sediment Control	1	LS	$25,000	$25,000
4	Armor Stone	2,305	TN	$250	$576,250
5	Sand Fill	5,490	TN	$95	$521,550
6	50/50 Sand/Pea Gravel Mix	20	CY	$90	$1,800
7	Marsh Plantings	20,758	EA	$4	$83,032
8	Coastal Shrub Plantings	190	EA	$90	$17,100
	Sub-Total Estimated Living Shoreline Reach 1 Construction Cost				$1,305,732
	15% Contingency Total Estimated Living Shoreline Reach 1 Construction Cost				$195,860
	Total Estimated Living Shoreline Reach 1 Construction Cost				$1,501,592
	Living Shoreline - Reach 2				
1	Mobilization/Demobilization	1	LS	$25,000	$25,000
2	Surveys, Stakeout, & As-Builts	1	LS	$4,000	$4,000
3	Erosion and Sediment Control	1	LS	$4,000	$4,000
4	Armor Stone	385	TN	$300	$115,500
5	Sand Fill	550	TN	$95	$52,250
7	Marsh Plantings	6,081	EA	$4	$24,324
	Sub-Total Estimated Living Shoreline Reach 2 Construction Cost				$225,074
	15% Contingency Total Estimated Living Shoreline Reach 2 Construction Cost				$33,761
	Total Estimated Living Shoreline Reach 2 Construction Cost				$258,835
	Pier Replacement				
1	Mobilization/Demobilization	1	LS	$15,000	$15,000
2	Construction Stakeout	1	LS	$2,500	$2,500
3	Demolition of Existing Fixed Pier and Piles	1	LS	$10,000	$10,000
4	Fixed Timber Pier Decking and Substructure	4,360	SF	$125	$545,000
5	Timber Piles for Fixed Piers	102	EA	$1,750	$178,500
6	Timber Mooring Dolphins	4	EA	$5,240	$20,960
7	Aluminum Gangway	216	SF	$150	$32,400
8	Floating Pier	656	SF	$180	$118,080
9	Steel Piles	6	EA	$8,500	$51,000
	Sub-Total Estimated Pier Construction Cost				$973,440
	15% Contingency Total Estimated Pier Construction Cost				$146,016
	Total Estimated Pier Construction Cost				$1,119,456
	Land Improvements				
1	Mobilization/Demobilization	1	LS	$38,000	$38,000
2	Construction Stakeout	1	LS	$8,000	$8,000
3	Clearing & Grubbing	300	SY	$27.50	$8,250
4	Erosion and Sediment Control	1	LS	$22,500	$22,500
5	Boulder Cascades - 3 FT	2	EA	$16,650.00	$33,300
6	Boulder Cascades - 5 FT	1	EA	$23,750.00	$23,750
7	Cobble/Riprap Weir (D50=9"Silica Rock)	5	EA	$3,700.00	$18,500
8	Sandstone Boulder Wall	1	LS	$73,800.00	$73,800.00
9	Retaining Wall	1	LS	$27,930.00	$27,930.00
10	Earthwork & Haul Off	1	LS	$44,000.00	$44,000
11	SWM BMP (includes Type 'D' Inlet and outfall pipe)	1	LS	$25,000.00	$25,000
12	Telecommunication & Electrical Utility Relocation	1	LS	$10,000.00	$10,000
13	Gravel Driveway	1	LS	$4,250	$4,250
14	Timber Boardwalk	2,650	SF	$100	$265,000
15	Timber Piles for Boardwalk	70	EA	$1,200	$84,000
16	Stabilization and Landscaping	1	LS	$38,360.00	$38,360.00
	Sub-Total Estimated Land Improvements Construction Cost				$724,640.00
	15% Contingency Total Estimated Land Improvements Construction Cost				$108,696.00
	Total Estimated Land Improvements Construction Cost				$833,336.00
	Total Estimated Project Cost				**$3,713,218.90**

Estimate Prepared by:

BayLand **9/10/2024**

Print Name Signature Date

Approved: _____ Date

As Revised: _____ Date

APPENDIX B

STORMWATER MANAGEMENT CALCULATIONS

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London Town - Micro Bioretention

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STREAM REACH:
POND OUTLET POND

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2-YR 3.22 TYPE NO_C 2 3.22
5-YR 4.17 TYPE NO_C 2 3.22
10-YR 5. TYPE NO_C 2 3.22
50-YR 7.38 TYPE NO_C 2
100-YR 8.63 TYPE NO_C 2 3.22

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London Town - Micro Bioretention

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STORM 1-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		0.945		12.13	1.6	806.22
POND	0.002	Upstream	0.945		12.13	1.6	806.22
POND	0.002	Downstream	0.945	24.94	12.13	1.6	806.13

OUTLET	0.002		0.945		12.13	1.6	806.13

STORM 2-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		1.350		12.12	2.3	1161.40
POND	0.002	Upstream	1.350		12.12	2.3	1161.40
POND	0.002	Downstream	1.349	25.14	12.13	2.3	1159.88
OUTLET	0.002		1.349		12.13	2.3	1159.88

STORM 5-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		2.099		12.12	3.6	1807.74
POND	0.002	Upstream	2.099		12.12	3.6	1807.74
POND	0.002	Downstream	2.099	25.59	12.14	3.5	1741.40
OUTLET	0.002		2.099		12.14	3.5	1741.40

STORM 10-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		2.799		12.12	4.8	2396.66
POND	0.002	Upstream	2.799		12.12	4.8	2396.66
POND	0.002	Downstream	2.798	26.00	12.15	4.3	2144.40
OUTLET	0.002		2.798		12.15	4.3	2144.40

STORM 50-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		4.931		12.12	8.3	4129.36
POND	0.002	Upstream	4.931		12.12	8.3	4129.36
POND	0.002	Downstream	4.931	27.02	12.17	5.8	2900.18

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
OUTLET	0.002		4.931		12.17	5.8	2900.18

STORM 100-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		6.094		12.12	10.1	5052.25
POND	0.002	Upstream	6.094		12.12	10.1	5052.25
POND	0.002	Downstream	6.094	27.49	12.18	6.4	3187.19
OUTLET	0.002		6.094		12.18	6.4	3187.19

Area or Reach Identifier	Drainage Area (sq mi)	Peak Flow by Storm 1-YR (cfs)	2-YR (cfs)	5-YR (cfs)	10-YR (cfs)	50-YR (cfs)
DA01	0.002	1.6	2.3	3.6	4.8	8.3
POND	0.002	1.6	2.3	3.6	4.8	8.3
DOWNSTREAM		1.6	2.3	3.5	4.3	5.8
OUTLET	0.002	1.6	2.3	3.5	4.3	5.8

Area or Reach Identifier	Drainage Area (sq mi)	Peak Flow by Storm 100-YR (cfs)	(cfs)	(cfs)	(cfs)	(cfs)
DA01	0.002	10.1				
POND	0.002	10.1				
DOWNSTREAM		6.4				
OUTLET	0.002	6.4				

WinTR-20 Printed Page File Beginning of Input Data List
C:\Users\Pilarski\Desktop\LONDON TOWN\5 20002 LONDON TOWN EX SWM.inp

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WinTR-20: Version 3.20                  0         0         0.01      0
London Town - Micro Bioretention

SUB-AREA:
          DA01      POND                0.002     79.       0.1
          DA02      OUTLET              0.0016    84.       0.1


STREAM REACH:
          POND      OUTLET              POND


STORM ANALYSIS:
          1-YR                          2.66      TYPE NO_C 2         3.22
          2-YR                          3.22      TYPE NO_C 2         3.22
          5-YR                          4.17      TYPE NO_C 2         3.22
          10-YR                         5.        TYPE NO_C 2         3.22
          50-YR                         7.38      TYPE NO_C 2
          100-YR                        8.63      TYPE NO_C 2         3.22


STRUCTURE RATING:
          POND      24.54
                    24.54     0.000     0.00000
                    25.00     1.853     0.00003
                    25.25     2.677     0.00025
                    25.50     3.302     0.00084
                    25.75     3.826     0.00220
                    26.00     4.286     0.00472
                    26.25     4.701     0.00837
                    26.50     5.083     0.01315
                    26.75     5.438     0.01909
                    27.00     5.771     0.02625
                    27.25     6.086     0.03475
                    27.50     6.385     0.04470
                    27.75     6.671     0.05610
                    28.00     6.946     0.06897
                    28.25     7.209     0.08346
                    28.50     7.464     0.09973
                    28.75     7.710     0.11798
                    29.00     7.948     0.13840
                    29.25     8.180     0.16145
                    29.50     8.405     0.18758
                    29.75     8.624     0.21686
                    30.00     8.838     0.24934


GLOBAL OUTPUT:
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WinTR-20 Printed Page File End of Input Data List

London Town - Micro Bioretention

Name of printed page file:
C:\Users\Pilarski\Desktop\LONDON TOWN\5_20002_LONDON TOWN_EX SWM.out

STORM 1-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)

DA01	0.002		0.945		12.13	1.6	806.22
POND	0.002	Upstream	0.945		12.13	1.6	806.22
POND	0.002	Downstream	0.945	24.94	12.13	1.6	806.13
DA02	0.002		1.237		12.12	1.7	1068.84
OUTLET	0.004		1.075		12.13	3.3	922.27

STORM 2-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		1.350		12.12	2.3	1161.40
POND	0.002	Upstream	1.350		12.12	2.3	1161.40
POND	0.002	Downstream	1.349	25.14	12.13	2.3	1159.88
DA02	0.002		1.694		12.12	2.3	1458.65
OUTLET	0.004		1.502		12.13	4.7	1291.69

STORM 5-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		2.099		12.12	3.6	1807.74
POND	0.002	Upstream	2.099		12.12	3.6	1807.74
POND	0.002	Downstream	2.099	25.59	12.14	3.5	1741.40
DA02	0.002		2.516		12.12	3.4	2140.56
OUTLET	0.004		2.284		12.13	6.9	1905.58

STORM 10-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		2.799		12.12	4.8	2396.66
POND	0.002	Upstream	2.799		12.12	4.8	2396.66
POND	0.002	Downstream	2.798	26.00	12.15	4.3	2144.40
DA02	0.002		3.265		12.12	4.4	2750.96
OUTLET	0.004		3.006		12.13	8.6	2376.82

STORM 50-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		4.931		12.12	8.3	4129.36
POND	0.002	Upstream	4.931		12.12	8.3	4129.36
POND	0.002	Downstream	4.931	27.02	12.17	5.8	2900.18
DA02	0.002		5.498		12.12	7.2	4496.13
OUTLET	0.004		5.182		12.13	12.7	3523.93

STORM 100-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		6.094		12.12	10.1	5052.25
POND	0.002	Upstream	6.094		12.12	10.1	5052.25
POND	0.002	Downstream	6.094	27.49	12.18	6.4	3187.19
DA02	0.002		6.698		12.12	8.7	5412.68
OUTLET	0.004		6.362		12.13	14.7	4073.71

Area or Reach Identifier	Drainage Area (sq mi)	Peak Flow by Storm 1-YR (cfs)	2-YR (cfs)	5-YR (cfs)	10-YR (cfs)	50-YR (cfs)
DA01	0.002	1.6	2.3	3.6	4.8	8.3
DA02	0.002	1.7	2.3	3.4	4.4	7.2
POND	0.002	1.6	2.3	3.6	4.8	8.3
DOWNSTREAM		1.6	2.3	3.5	4.3	5.8
OUTLET	0.004	3.3	4.7	6.9	8.6	12.7

Area or Reach Identifier	Drainage Area (sq mi)	Peak Flow by Storm 100-YR (cfs)	(cfs)	(cfs)	(cfs)	(cfs)
DA01	0.002	10.1				
DA02	0.002	8.7				
POND	0.002	10.1				
DOWNSTREAM		6.4				
OUTLET	0.004	14.7				

NOAA Atlas 14, Volume 2, Version 3
Location name: Edgewater, Maryland, USA*
Latitude: 38.9412°, Longitude: -76.5402°
Elevation: 33 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.349** (0.316-0.385)	**0.418** (0.379-0.461)	**0.498** (0.450-0.549)	**0.555** (0.501-0.613)	**0.628** (0.562-0.694)	**0.682** (0.608-0.754)	**0.734** (0.652-0.814)	**0.784** (0.692-0.874)	**0.848** (0.740-0.950)	**0.897** (0.777-1.01)
10-min	**0.558** (0.505-0.615)	**0.669** (0.605-0.737)	**0.797** (0.720-0.879)	**0.887** (0.801-0.980)	**1.00** (0.896-1.10)	**1.09** (0.968-1.20)	**1.17** (1.04-1.29)	**1.24** (1.10-1.38)	**1.34** (1.17-1.50)	**1.41** (1.22-1.59)
15-min	**0.697** (0.632-0.769)	**0.841** (0.761-0.927)	**1.01** (0.911-1.11)	**1.12** (1.01-1.24)	**1.27** (1.14-1.40)	**1.37** (1.22-1.52)	**1.48** (1.31-1.64)	**1.57** (1.38-1.75)	**1.69** (1.47-1.89)	**1.77** (1.54-2.00)
30-min	**0.956** (0.866-1.06)	**1.16** (1.05-1.28)	**1.43** (1.29-1.58)	**1.63** (1.47-1.80)	**1.88** (1.68-2.08)	**2.07** (1.85-2.29)	**2.26** (2.01-2.50)	**2.44** (2.16-2.72)	**2.69** (2.34-3.01)	**2.87** (2.49-3.24)
60-min	**1.19** (1.08-1.32)	**1.46** (1.32-1.61)	**1.84** (1.66-2.02)	**2.12** (1.91-2.34)	**2.50** (2.24-2.76)	**2.80** (2.50-3.10)	**3.11** (2.76-3.45)	**3.42** (3.02-3.82)	**3.85** (3.36-4.32)	**4.19** (3.63-4.72)
2-hr	**1.41** (1.28-1.56)	**1.72** (1.56-1.90)	**2.18** (1.97-2.40)	**2.53** (2.28-2.79)	**3.03** (2.72-3.34)	**3.43** (3.06-3.78)	**3.86** (3.41-4.26)	**4.30** (3.77-4.76)	**4.92** (4.27-5.49)	**5.42** (4.66-6.09)
3-hr	**1.53** (1.39-1.69)	**1.86** (1.69-2.06)	**2.36** (2.13-2.61)	**2.76** (2.48-3.04)	**3.32** (2.96-3.66)	**3.78** (3.36-4.17)	**4.26** (3.76-4.72)	**4.78** (4.18-5.31)	**5.52** (4.76-6.17)	**6.13** (5.21-6.90)
6-hr	**1.89** (1.72-2.10)	**2.29** (2.08-2.53)	**2.89** (2.62-3.20)	**3.39** (3.05-3.75)	**4.12** (3.68-4.56)	**4.74** (4.20-5.25)	**5.42** (4.75-6.02)	**6.15** (5.33-6.85)	**7.23** (6.15-8.12)	**8.14** (6.82-9.21)
12-hr	**2.28** (2.06-2.57)	**2.76** (2.48-3.11)	**3.52** (3.15-3.95)	**4.16** (3.70-4.68)	**5.14** (4.53-5.78)	**6.01** (5.24-6.75)	**6.97** (6.00-7.85)	**8.05** (6.82-9.09)	**9.68** (8.03-11.0)	**11.1** (9.04-12.7)
24-hr	**2.66** (2.40-2.99)	**3.22** (2.91-3.63)	**4.17** (3.77-4.69)	**5.00** (4.49-5.61)	**6.26** (5.59-6.98)	**7.38** (6.53-8.20)	**8.63** (7.57-9.56)	**10.1** (8.72-11.1)	**12.2** (10.4-13.5)	**14.1** (11.9-15.5)
2-day	**3.07** (2.78-3.43)	**3.73** (3.38-4.17)	**4.82** (4.36-5.39)	**5.76** (5.19-6.43)	**7.18** (6.43-7.98)	**8.42** (7.48-9.33)	**9.80** (8.64-10.8)	**11.4** (9.92-12.5)	**13.7** (11.8-15.1)	**15.7** (13.4-17.4)
3-day	**3.24** (2.95-3.61)	**3.94** (3.58-4.39)	**5.07** (4.60-5.64)	**6.04** (5.47-6.71)	**7.50** (6.74-8.31)	**8.77** (7.84-9.69)	**10.2** (9.03-11.2)	**11.8** (10.3-13.0)	**14.1** (12.2-15.6)	**16.2** (13.8-17.8)
4-day	**3.42** (3.12-3.79)	**4.14** (3.78-4.60)	**5.32** (4.84-5.90)	**6.32** (5.74-7.00)	**7.82** (7.06-8.64)	**9.13** (8.19-10.0)	**10.6** (9.41-11.6)	**12.2** (10.8-13.4)	**14.6** (12.7-16.0)	**16.7** (14.3-18.3)
7-day	**3.97** (3.62-4.38)	**4.78** (4.37-5.28)	**6.05** (5.52-6.67)	**7.14** (6.49-7.85)	**8.74** (7.90-9.59)	**10.1** (9.10-11.1)	**11.6** (10.4-12.7)	**13.3** (11.8-14.6)	**15.8** (13.8-17.3)	**17.9** (15.5-19.6)
10-day	**4.51** (4.16-4.92)	**5.42** (5.01-5.91)	**6.76** (6.22-7.37)	**7.88** (7.23-8.57)	**9.50** (8.68-10.3)	**10.8** (9.87-11.8)	**12.3** (11.1-13.3)	**13.9** (12.5-15.0)	**16.1** (14.3-17.5)	**18.1** (16.0-19.6)
20-day	**6.07** (5.64-6.55)	**7.23** (6.72-7.78)	**8.74** (8.12-9.41)	**9.97** (9.25-10.7)	**11.7** (10.8-12.5)	**13.1** (12.0-14.0)	**14.5** (13.3-15.6)	**16.0** (14.6-17.2)	**18.1** (16.3-19.4)	**19.7** (17.7-21.2)
30-day	**7.51** (7.01-8.04)	**8.89** (8.30-9.52)	**10.6** (9.88-11.3)	**11.9** (11.1-12.8)	**13.8** (12.8-14.7)	**15.3** (14.2-16.3)	**16.8** (15.5-17.9)	**18.3** (16.8-19.5)	**20.4** (18.6-21.8)	**22.0** (20.0-23.6)
45-day	**9.44** (8.90-10.0)	**11.2** (10.5-11.8)	**13.0** (12.3-13.8)	**14.5** (13.6-15.4)	**16.4** (15.4-17.4)	**17.9** (16.8-18.9)	**19.3** (18.1-20.5)	**20.7** (19.3-22.0)	**22.5** (20.9-23.9)	**23.9** (22.1-25.4)
60-day	**11.2** (10.6-11.9)	**13.2** (12.5-14.0)	**15.3** (14.4-16.2)	**16.9** (15.8-17.8)	**18.8** (17.7-19.9)	**20.3** (19.0-21.5)	**21.7** (20.3-23.0)	**23.1** (21.5-24.4)	**24.7** (23.0-26.2)	**25.9** (24.1-27.6)

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

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

Please refer to NOAA Atlas 14 document for more information.

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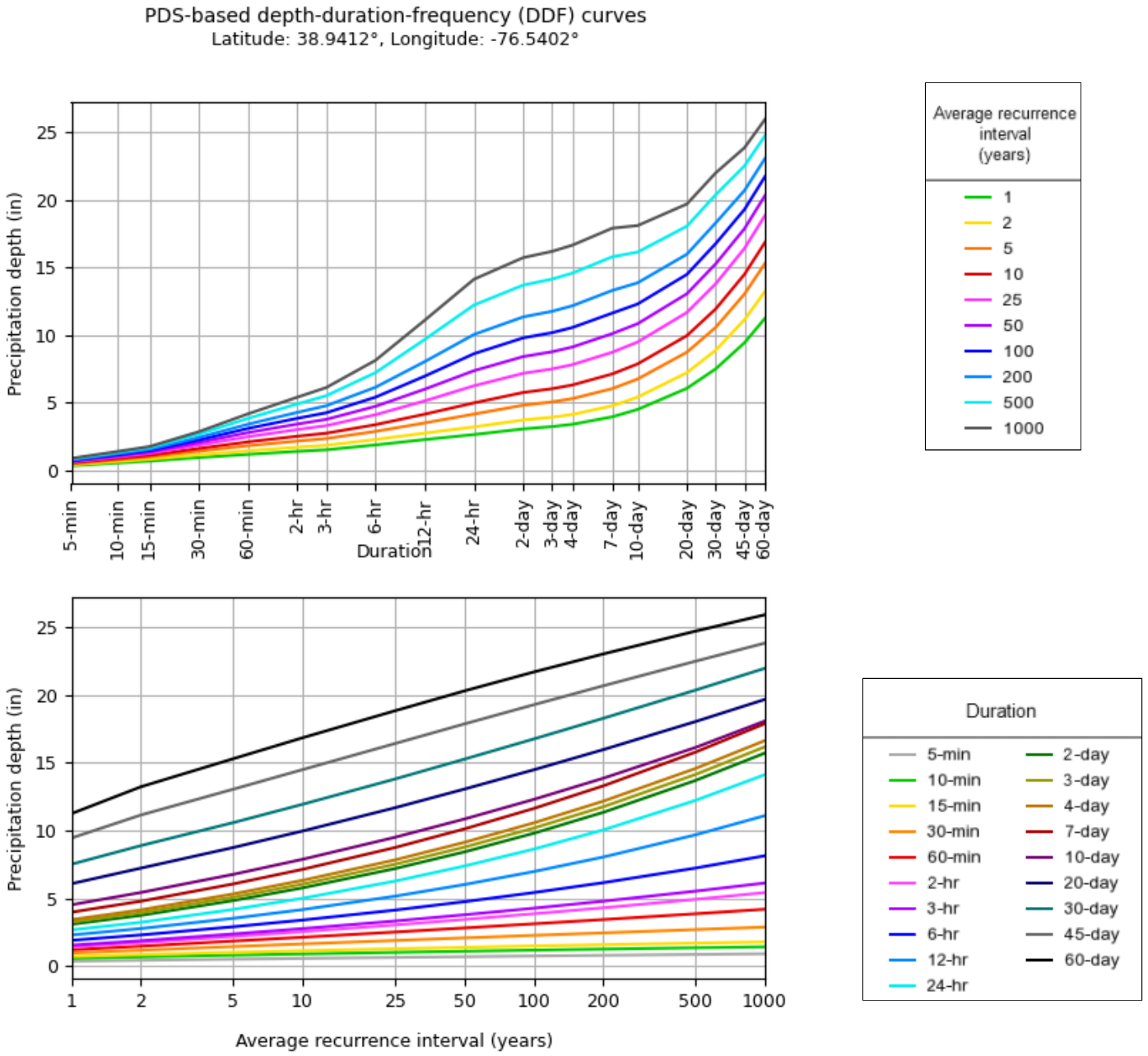
PF graphical



NOAA Atlas 14, Volume 2, Version 3

Created (GMT): Fri Sep 1 15:37:42 2023

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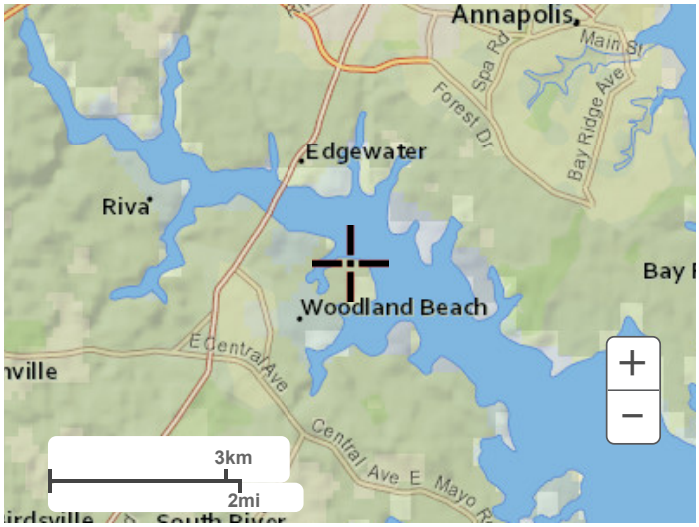
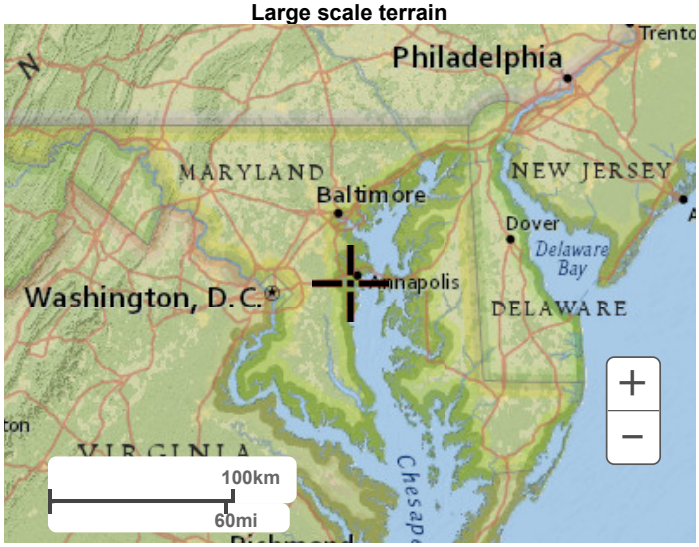
Maps & aerials

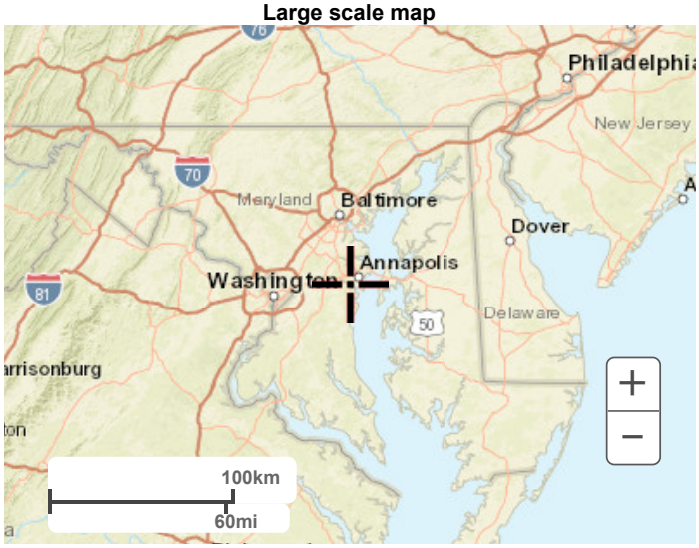
Small scale terrain



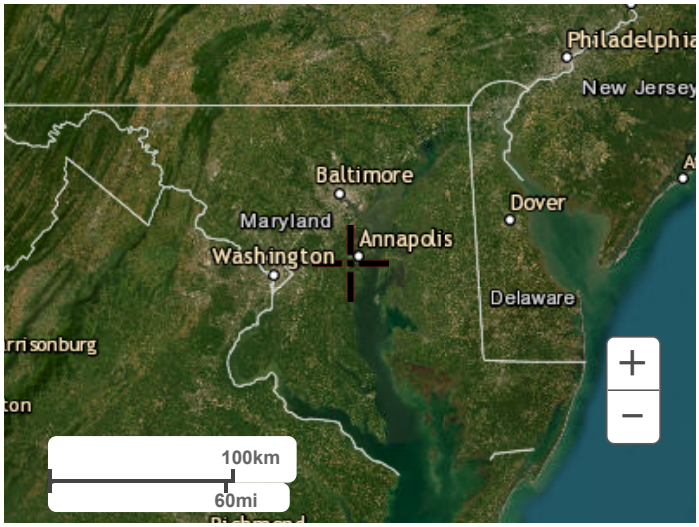
Large scale terrain



Large scale map



Large scale aerial



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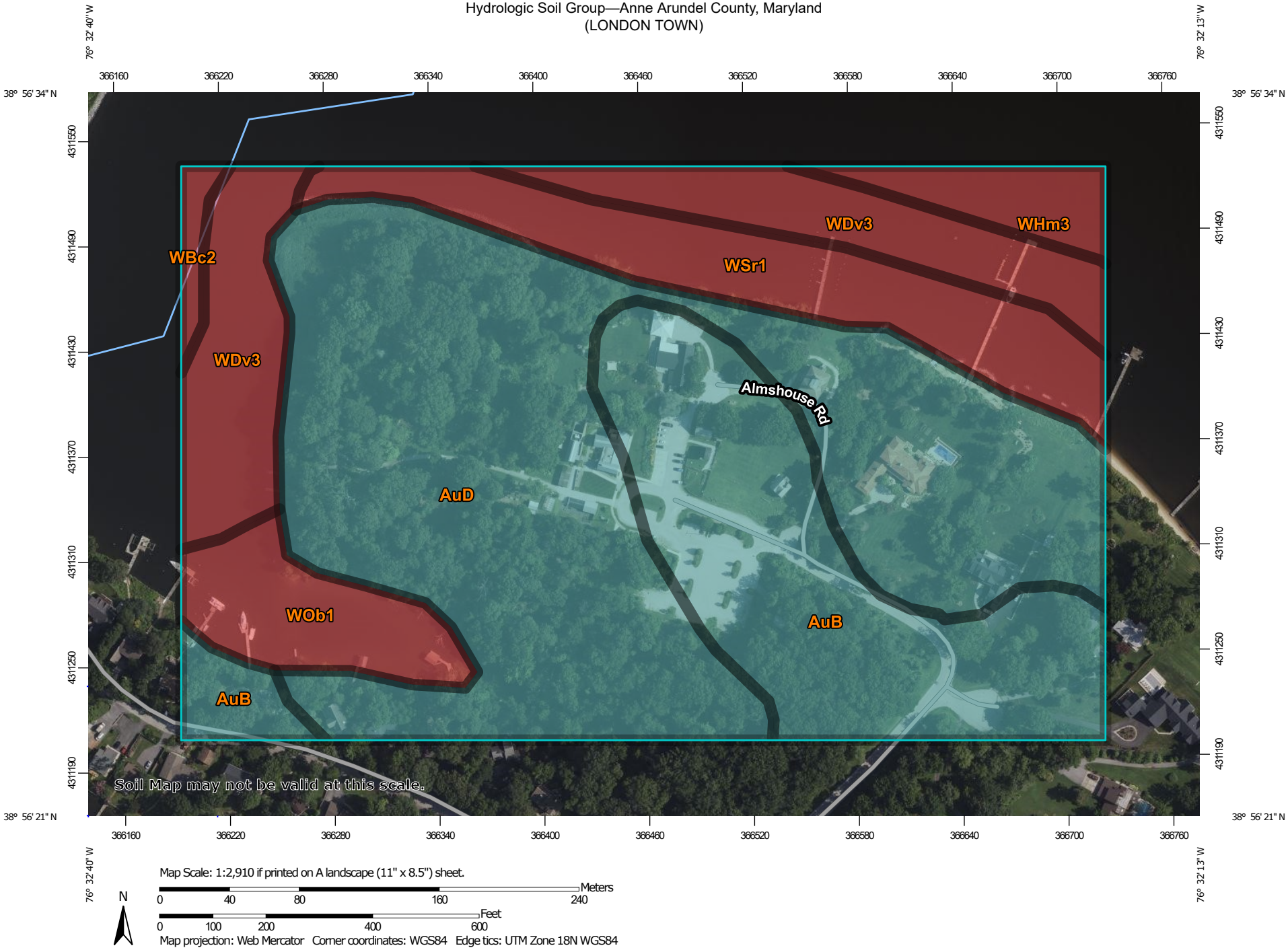
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Hydrologic Soil Group—Anne Arundel County, Maryland
(LONDON TOWN)



Map Scale: 1:2,910 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 40 80 160 240

Feet
0 100 200 400 600

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 21, Sep 14, 2022

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AuB	Annapolis-Urban land complex, 0 to 5 percent slopes	C	9.2	21.3%
AuD	Annapolis-Urban land complex, 5 to 15 percent slopes	C	20.0	46.6%
WBc2	Broad Creek loam, 2 to 3 meter water depth	D	0.4	0.9%
WDv3	Duvall Creek fine sand, 2 to 3 meter water depth	D	5.4	12.5%
WHm3	Hillsmere silt loam, 3 to 4 meter water depth	D	1.2	2.8%
WOb1	Overboard loam, 0 to 1 meter water depth	D	2.3	5.4%
WSr1	South River loamy sand, 0.5 to 1 meter water depth	D	4.5	10.5%
Totals for Area of Interest			**43.0**	**100.0%**

Description

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.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

HISTORIC LONDTON TOWN AND GARDEN SITE IMPROVEMENTS
ESDv SUMMARY FOR RE-GRADED PARKING LOT

London Town Parking Lot Re-grading - ESD_V Summary Table		
ESD Practice	**ESD_V Required (CF)**	**ESD_V Provided (CF)**
Ex. Microbioretentions	911.0	1,031.3
Total ESD_V Provided		**1,031**
Total ESD_V Required		**911**
ESD_V Provided > ESD_V Required		**YES**

LONDONTOWN
ESD LAND USE MATRIX
EXISTING/PROPOSED CONDITIONS

DRAINAGE AREA	**DA01**	CHECK	(to SWM Facility)		
TOTAL DA (ACRES)	1.078	1.078			
	HYDROLOGIC SOIL GROUP				Total
LAND USE	A	B	C	D	
OPEN SPACE	0.00	0.00	0.859	0.00	0.86
IMPERVIOUS	0.00	0.00	0.219	0.00	0.22
MEADOW	0.00	0.00	0.00	0.00	0.00
WOODS	0.00	0.00	0.00	0.00	0.00

SOIL AREAS	A	B	C	D	TOTAL
Total (Check)	0.00	0.00	1.08	0.00	1.08

DRAINAGE AREA	**DA02**	CHECK	(to outfall)		
TOTAL DA (ACRES)	1.048	1.048			
	HYDROLOGIC SOIL GROUP				Total
LAND USE	A	B	C	D	
OPEN SPACE	0.00	0.00	0.620	0.00	0.62
IMPERVIOUS	0.00	0.00	0.428	0.00	0.43
MEADOW	0.00	0.00	0.00	0.00	0.00
WOODS	0.00	0.00	0.00	0.00	0.00

SOIL AREAS	A	B	C	D	TOTAL
Total (Check)	0.00	0.00	1.05	0.00	1.05

TOTAL DRAINAGE AREA

SOIL AREAS	A	B	C	D	TOTAL
OPEN SPACE	0.0	0.0	1.5	0.0	1.5
IMPERVIOUS	0.0	0.0	0.6	0.0	0.6
Total	0.00	0.00	2.13	0.00	2.13

HISTORIC LONDON TOWN AND GARDEN SITE IMPROVEMENTS

Existing Conditions & ESD Requirements - POI-1

DRAINAGE AREA CHARACTERISTICS		
Total Area	1.08	Acres
Existing Impervious Area	0.22	Acres
Existing Impervious Area (to be removed)	0.00	Acres
Proposed New Impervious Area	0.00	Acres
Total Impervious Area	0.22	Acres
Percent Impervious Cover, I	20.3	Percent
SOILS		
Hydraulic Soil Group A	0.00	Acres
	0.0	Percent
Hydraulic Soil Group B	0.000	Acres
	0.0	Percent
Hydraulic Soil Group C	1.08	Acres
	100.0	Percent
Hydraulic Soil Group D	0.00	Acres
	0.0	Percent
RAINFALL TARGET, P_E		
Hydraulic Soil Group A	1.0	Inches
Hydraulic Soil Group B	1.0	Inches
Hydraulic Soil Group C	1.0	Inches
Hydraulic Soil Group D	1.0	Inches
Composite P_E	**1.0**	Inches
ENVIRONMENTAL SITE DESIGN CALCULATIONS		
Rainfall Target, P_E	**1.0**	Inches
Volumetric Runoff Coefficent, Rv	0.233	
Depth of Runoff to be treated with ESD, Q_E	**0.23**	Inches
Environmental Site Design Volume, ESDv	**0.021**	Acre-Feet
	911	Cubic-Feet
Minimum Environmental Site Design Volume, ESDv	**0.021**	Acre-Feet
	911	Cubic-Feet
RECHARGE CALCULATIONS		
Soil Specific Recharge Factor, S	0.13	
Recharge, Percent Volume	**0.0027**	Acre-Feet
	118.40	Cubic-Feet
Recharge, Percent Area	**0.028**	Acres
	1239.59	Sq-Feet

HISTORIC LONDON TOWN AND GARDEN SITE IMPROVEMENTS
PR. MICRO-BIORETENTION

PR. MICRO-BIORETENTION						
Elevation (ft)	Area (sq-ft)	Area (ac)	Δ H (ft)	Average Area (sq-ft)	Storage (sq-ft)	Cumulative Storage (sq-ft)
Ponding						
26.00	474	0.01				
27.00	862	0.02	1.00	668.09	668.09	668.09
Filter Media Storage = Af * df * n =						284.45
Total WQv						952.5

HISTORIC LONDTON TOWN AND GARDEN SITE IMPROVEMENTS
ESDv SUMMARY FOR PR. MICRO-BIORETENTION

London Town Drainage Improvements - ESD_V Summary Table		
ESD Practice	**ESD_V Required (CF)**	**ESD_V Provided (CF)**
Pr. Microbioretention		952.5
	Total ESD_V Provided	**953**
	Total ESD_V Required	**911**
	ESD_V Provided > ESD_V Required	**YES**

WinTR-20 Printed Page File Beginning of Input Data List
C:\Users\Pilarski\Desktop\LONDON TOWN\5 20002 LONDON TOWN PR SWM.inp

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WinTR-20: Version 3.20                0         0         0.01      0
London Town - Micro Bioretention

SUB-AREA:
          DA01      POND              0.002     70.       0.1


STREAM REACH:
          POND      OUTLET            POND


STORM ANALYSIS:
          1-YR                        2.66      TYPE NO_C 2         3.22
          2-YR                        3.22      TYPE NO_C 2         3.22
          5-YR                        4.17      TYPE NO_C 2         3.22
          10-YR                       5.        TYPE NO_C 2         3.22
          50-YR                       7.38      TYPE NO_C 2
          100-YR                      8.63      TYPE NO_C 2         3.22


STRUCTURE RATING:
          POND      27.00
                    27.00     0.00      0.000
                    27.25     3.01      0.006
                    27.50     4.26      0.015
                    27.75     5.21      0.025
                    28.00     6.02      0.037
                    28.25     6.73      0.050
                    28.50     7.37      0.066
                    28.75     7.96      0.083
                    29.00     8.51      0.103
                    29.25     9.03      0.126
                    29.50     9.21      0.152
                    29.75     9.39      0.180
                    30.00     9.56      0.212




GLOBAL OUTPUT:
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WinTR-20 Printed Page File End of Input Data List

London Town - Micro Bioretention

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STORM 1-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		0.533		12.13	0.8	404.25
POND	0.002	Upstream	0.533		12.13	0.8	404.25
POND	0.002	Downstream	0.533	27.06	12.15	0.8	380.22
OUTLET	0.002		0.533		12.15	0.8	380.22

STORM 2-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)

DA01	0.002		0.839		12.13	1.4	683.22
POND	0.002	Upstream	0.839		12.13	1.4	683.22
POND	0.002	Downstream	0.839	27.11	12.15	1.3	646.34
OUTLET	0.002		0.839		12.15	1.3	646.34

STORM 5-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		1.443		12.12	2.5	1227.54
POND	0.002	Upstream	1.443		12.12	2.5	1227.54
POND	0.002	Downstream	1.443	27.19	12.14	2.3	1166.42
OUTLET	0.002		1.443		12.14	2.3	1166.42

STORM 10-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		2.035		12.13	3.5	1747.51
POND	0.002	Upstream	2.035		12.13	3.5	1747.51
POND	0.002	Downstream	2.034	27.28	12.15	3.2	1578.80
OUTLET	0.002		2.034		12.15	3.2	1578.80

STORM 50-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		3.934		12.12	6.8	3377.06
POND	0.002	Upstream	3.934		12.12	6.8	3377.06
POND	0.002	Downstream	3.934	27.73	12.17	5.1	2573.13

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
OUTLET	0.002		3.934		12.17	5.1	2573.13

STORM 100-YR

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
DA01	0.002		5.008		12.12	8.5	4274.83
POND	0.002	Upstream	5.008		12.12	8.5	4274.83
POND	0.002	Downstream	5.008	28.01	12.18	6.0	3022.36
OUTLET	0.002		5.008		12.18	6.0	3022.36

Area or Reach Identifier	Drainage Area (sq mi)	Peak Flow by Storm 1-YR (cfs)	2-YR (cfs)	5-YR (cfs)	10-YR (cfs)	50-YR (cfs)
DA01	0.002	0.8	1.4	2.5	3.5	6.8
POND	0.002	0.8	1.4	2.5	3.5	6.8
DOWNSTREAM		0.8	1.3	2.3	3.2	5.1
OUTLET	0.002	0.8	1.3	2.3	3.2	5.1

Area or Reach Identifier	Drainage Area (sq mi)	Peak Flow by Storm 100-YR (cfs)	(cfs)	(cfs)	(cfs)	(cfs)
DA01	0.002	8.5				
POND	0.002	8.5				
DOWNSTREAM		6.0				
OUTLET	0.002	6.0				

12" HDPE Outfall Stone Sizing:
Q_{10} = 3.2 cfs
d = 12" HDPE Pipe

d_{50} = 0.2' = 2.4"
La = 6'
W = 7'

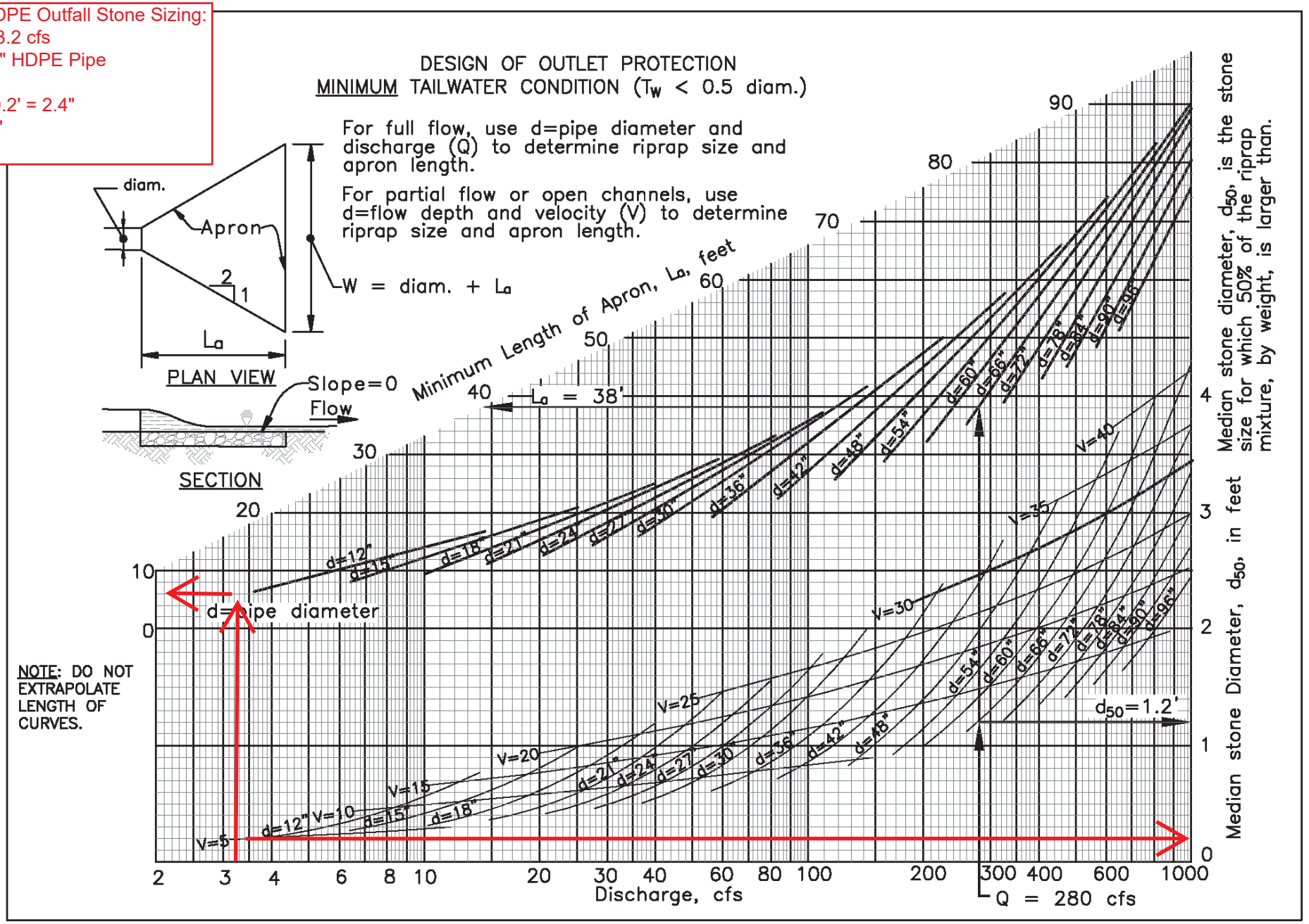

Figure D.2: Design of Outlet Protection – Minimum Tailwater Condition