ATWELL

August 15, 2024

Anne Arundel County
Office of Planning & Zoning
2664 Riva Road
Annapolis, MD 21401

RE: 3692 Eighth Ave, Edgewater, MD 21037
Selby on the Bay, Plat 8, Lot 98
Variance Application

Sir or Madam:

Enclosed please find a complete variance application submittal package for proposed development at 3692 Eighth Avenue in Edgewater. This property was previously denied a setback variance request under 2023-0193-V in a decision letter dated March 7, 2024. The subject property is rectangular in shape, is roughly 0.10 Ac in area, and is a corner lot, fronting on both Eighth Ave & Hillside Ave in the community of Selby on the Bay. The property is currently unimproved. It is mapped within the R5 zoning district and is not within the Chesapeake Bay Critical Area or any other overlay district. The property was created by plat, recorded in the plat records of Anne Arundel County (Book: 9, Pg: 5) on October 8, 1932, and therefore is a buildable lot. The property is identified as Lot 98 on the Selby on the Bay, Plat No. 8. The property is served by public sewer and a private well.

The owner proposes to develop the property with a single-family detached residential dwelling. A pre-file Site Plan was submitted on June 21, 2024. In an email response, OPZ noted that the scope of the project had been sufficiently revised from the dwelling proposed under 2023-0193-V. The proposed dwelling was revised to decrease the overall mass of the dwelling by making the footprint smaller, as well as reducing the height. Stormwater management will be provided via pervious pavement to treat the driveway, and a bio-swale to treat runoff from the rooftop. The bio-swale shall utilize stone check dams to slow runoff velocity and increase percolation and treatment. The slopes on-site are too steep to implement disconnections. The developer requests a zoning setback variance to Article 18-4-701 of 7ft to the 20ft corner-side yard setback, to construct a new single-family dwelling.

The proposed development meets all the criteria found in Article 18-16-305(a) of the Anne Arundel County Code for the granting of a zoning variance. The following discourse addresses those criteria.

1) The subject property is roughly 43.75 feet in width and 4,375sf in area; both measurements are less than the minimum width (60ft) and minimum area (7,000sf) for the R5 zoning district. Due to this substandard configuration, adherence to the 20ft corner-side yard setback would yield a dwelling 16.75ft in total width, which is not a realistic width for a dwelling, and would not be in keeping with the existing pattern of development within the neighborhood. The requested area variance is necessary to avoid the practical difficulty of designing an overly narrow house.

ATWELL

Additionally, the proposed work complies with the criteria contained in 18-16-305(c) for the granting of all variances. The following discourse addresses those criteria, as well.

1) The variance is the minimum necessary to afford relief. In accordance with the decision rendered in 2023-0193-V, the decision found that the proposed mass of the dwelling was too great. The revised dwelling in this application has reduced the footprint, as well as the height, to a standard two-story dwelling, with a height of roughly 26ft. This dwelling will better adhere to the character of the neighborhood.

2) The granting of the variance will not:

   i) The variance will not alter the essential character of the neighborhood, as the scope of work is single-family residential dwelling in a residential zoning district. The mass of the proposed dwelling has been reduced to more accurately reflect the character of the neighborhood.

   ii) The dwelling will not substantially impair the use or enjoyment of adjacent properties, as the proposed dwelling will adhere to zoning setbacks to other structures, and the proposed dwelling will not detrimentally affect clear sight lines at the intersection.

   iii) The property is not located within the Chesapeake Bay Critical Area.

   iv) The property is not located within the Chesapeake Bay Critical Area or Bog Protection Area overlay.

   v) The construction of a residential dwelling in a residential zoning district is not detrimental to the public health, safety, & welfare. The proposed dwelling will not affect clear sight lines at the intersection.

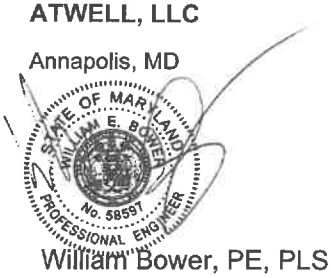
Article 18-13-305(d) is not applicable, as this variance request is not the subject of an outstanding Critical Area violation.

If you have any questions regarding this variance request, or any of the materials contained within this submittal package, please contact me at 667-204-8042 or wbower@atwell-group.com. Thank you.

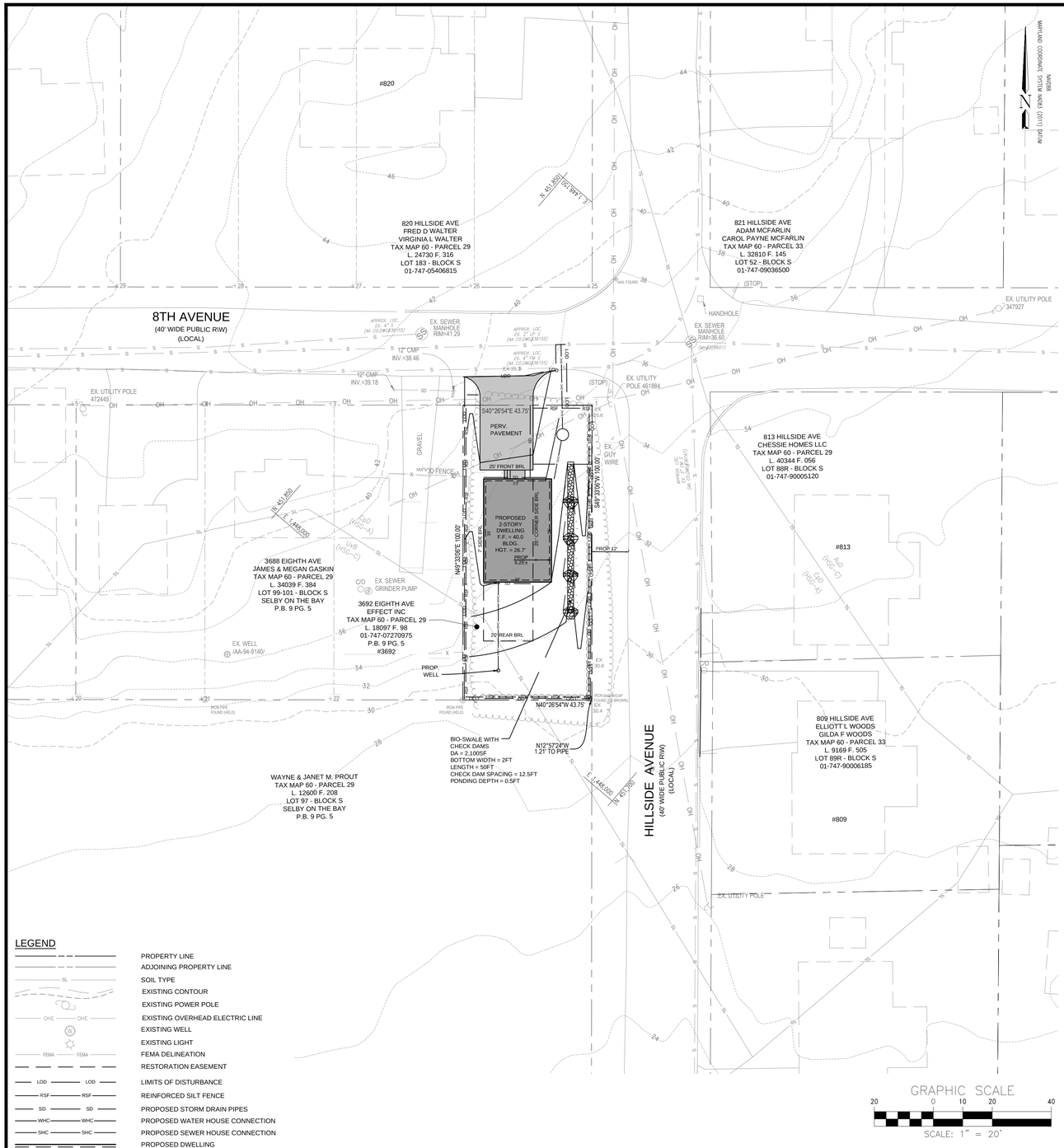
Respectfully,

ATWELL, LLC

Annapolis, MD



William Bower, PE, PLS
Sr. Project Manager

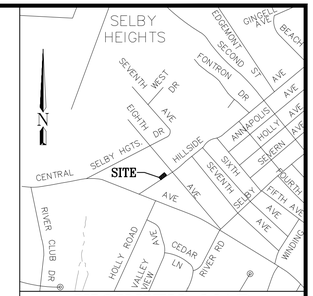


LEGEND

- PROPERTY LINE
- ADJOINING PROPERTY LINE
- SL — SOIL TYPE
- EXISTING CONTOUR
- EXISTING POWER POLE
- OHE — OHE — EXISTING OVERHEAD ELECTRIC LINE
- EXISTING WELL
- EXISTING LIGHT
- FEMA — FEMA — FEMA DELINEATION
- RESTORATION EASEMENT
- LOD — LOD — LIMITS OF DISTURBANCE
- RSF — RSF — REINFORCED SILT FENCE
- SD — SD — PROPOSED STORM DRAIN PIPES
- WHC — WHC — PROPOSED WATER HOUSE CONNECTION
- SHC — SHC — PROPOSED SEWER HOUSE CONNECTION
- PROPOSED DWELLING
- PROPOSED IMPERVIOUS AREAS
- PROPOSED STRUCTURE AREA

SURVEY CONTROL NOTE

THE COORDINATES AND ELEVATIONS SHOWN HEREON ARE BASED ON RTK (REAL TIME KINEMATIC) OBSERVATIONS UTILIZING KEYNET GPS NETWORK. THE HORIZONTAL DATUM IS REFERENCED TO MARYLAND STATE PLANE NAD (83/91) AND THE VERTICAL DATUM IS REFERENCED TO NAVD 88.



VICINITY MAP

SCALE: 1" = 2000'

SITE INFORMATION

1. EXISTING ZONING IS R5 - RESIDENTIAL DISTRICT
   SETBACKS: FRONT = 25'; SIDE = 7'; REAR = 20', CORNER SIDE = 20'.

3. SITE PLAN TABULATIONS:

TOTAL SITE AREA:	4,375 SQ. FT. OR 0.100 ACRES
EXISTING IMPERVIOUS COVERAGE IS:	0 SQ. FT. OR 0.000 AC.
PROPOSED IMPERVIOUSCOVERAGE:	1,420 SQ FT. OR 0.033 AC.

4. EXISTING DEVELOPED WOODLANDS ON SITE: 0 SQ. FT. OR 0.00 AC.
   PROPOSED CLEARING: 0 SQ. FT. OR 0.00 AC.
   PROPOSED AFFORESTATION: 900 SQ. FT. OR 0.021 AC.

NOTE: CUT AND FILL QUANTITIES PROVIDED DO NOT REPRESENT BID QUANTITIES. THESE QUANTITIES DO NOT DISTINGUISH BETWEEN TOPSOIL, STRUCTURAL FILL OR EMBANKMENT MATERIAL, NOR DO THEY REFLECT CONSIDERATION OF UNDERCUTTING OR REMOVAL OF UNSUITABLE MATERIAL. THE CONTRACTOR SHALL FAMILIARIZE HIMSELF WITH SITE CONDITIONS WHICH MAY AFFECT THE WORK.

PROPOSED IMPERVIOUS COVERAGE SUMMARY

DESCRIPTION

PROPOSED IMPERVIOUS COVERAGE..... 1,420 SQ FT. OR 0.033 AC.

NOTE: BREAKDOWN OF PROPOSED IMPERVIOUS COVERAGE IS AS FOLLOWS :

- PR. HOUSE..... 805 SQ. FT.
- PR. DRIVEWAY..... 594 SQ. FT.
- PR. CONCRETE..... 21 SQ. FT.

EXISTING COVERAGE SUMMARY

DESCRIPTION

EXISTING IMPERVIOUS COVERAGE..... 0 SQ. FT. OR 0.100 AC.
EXISTING COVERAGE BY STRUCTURES..... 0 SQ. FT. OR 0.000 AC.
MAXIMUM COVERAGE BY STRUCTURES (40%)..... 1,750 SQ. FT. OR 0.040 AC.

GENERAL NOTES

1. **OWNER:**
   EFFECT INC
   1350 BEVERLY RD, SUITE 115-316
   MCLEAN VA 22101
   ENGINEER: ATWELL 2661 RIVA ROAD, BUILDING 800
   ANNAPOLIS, MD 21401
   410-897-9290
2. THE PROPERTY IS KNOWN AS: TAX MAP 60, GRID 10, PARCEL 29, LOT 98; TOTAL AREA = 4,375 SQ. FT. OR 0.1 AC.±, DEED REF: 38521 / 348
3. EXISTING ZONING OF THE SITE IS: R5 (RESIDENTIAL DISTRICT)
4. THE SITE ADDRESS IS: **3692 EIGHTH AVE, EDGEWATER, MD 21037**
5. TAX ACCOUNT NO.: **#01-747-07270975**
6. THE SITE **IS NOT** LOCATED WITHIN THE CRITICAL AREA.
7. EXISTING SITE UTILITIES ARE NO PUBLIC WATER (W-9) AND PUBLIC SEWER (S-9) .
8. THE PROPERTY DESCRIBED HEREON IS LOCATED IN THE FLOOD HAZARD ZONE "X" (AREA OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN) AS DELINEATED ON THE FIRM FLOOD INSURANCE MAP #24003C0242F AND 24003C0244F DATED FEBRUARY 18, 2015 FOR SAID COUNTY AND DISTRIBUTED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY.
9. THE EXISTING UTILITIES AND OBSTRUCTIONS SHOWN ARE FROM THE BEST AVAILABLE RECORDS AND SHALL BE FIELD VERIFIED BY THE CONTRACTOR TO HIS OWN SATISFACTION PRIOR TO ANY CONSTRUCTION. ANY UTILITIES DAMAGED DUE TO THE CONTRACTOR'S NEGLIGENCE SHALL BE REPAIRED IMMEDIATELY AT THE CONTRACTOR'S EXPENSE.
10. THE CONTRACTOR SHALL CALL "MISS UTILITY" (1-800-257-7777) A MINIMUM OF 5 DAYS IN ADVANCE OF ANY EXCAVATION, BORING, PILE DRIVING, AND/OR DIGGING FOR THE LOCATION OF GAS, ELECTRIC, WATER, SEWER, AND TELEPHONE LINES.

SOILS TABLE

MAP UNIT SYMBOL	MAP UNIT NAME	HSG TYPE	K FACTOR, WHOLE SOIL	HYDRIC
CpD	COLLINGTON-WIST-URBAN LAND COMPLEX, 5-15% SLOPES	A	0.20	0%
UxB	UDORTHENTS, LOAMY, SULIDIC SUBSTRATUM, 0-5% SLOPES	C	0.28	0%

*SOILS THAT CONTAIN POTENTIALLY HYDRIC COMPONENTS

NOTE:

CONTRACTOR IS SOLELY RESPONSIBLE TO LOCATE ALL UTILITIES TO DETERMINE EXACT LOCATIONS, AND TO RELOCATE/RECONNECT AS REQUIRED.

UTILITY STATEMENT:

THE UNDERGROUND UTILITIES SHOWN HEREON (IF ANY) HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION, MAPS AS MAY BE AVAILABLE FROM MUNICIPALITIES OR UTILITY COMPANIES, AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED, ALTHOUGH HE DOES STATE THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE. UNLESS OTHERWISE NOTED, THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.

Revisions

Rev. #	By	Date	Description

ATWELL
866.850.4200 www.atwell-group.com
2661 RIVA ROAD, BUILDING 800
ANNAPOLIS, MARYLAND 21401
410-897-9290

Date 06/14/2024
Job Number 22-8492
Scale
Drawn By JCL
Approved By WB
Folder Reference 3692 EIGHTH AVENUE

ADMINISTRATIVE SITE PLAN

PROPERTY OF
EFFECT, INC. PROPERTY
TAX MAP 60, GRID 10, PARCEL 29, LOT 98
3692 EIGHTH AVENUE,
EDGEWATER, MD 21037,
FIRST DISTRICT ANNE ARUNDEL COUNTY ZONE R5

Sheet No. 01 OF 01

PLOTTED: Aug 19, 2024 - 5:11pm

P:\22-8492 Effect Inc. - 3692 Eighth Avenue\Drawing Files\22-8492-C-ADSP.dwg

VARIANCE APPLICATION

Stormwater Management Report
3692 Eighth Ave, Edgewater, MD 21037
G020***

Prepared for:

Effect Inc
1350 Beverly Rd, Suite 115-316
McLean, VA 22101

William Bower, PE, PLS
MDPE#58591
MDPLS#21589

Prepared by:

Atwell, LLC
2661 Riva Rd, Bldg 800
Annapolis, MD 21401

July 5, 2024

ATWELL

VARIANCE APPLICATION

Stormwater Management Report

TABLE OF CONTENTS

APPENDICES

1.0 EXISTING CONDITIONS

1.1 SITE DESCRIPTION

The subject property is rectangular in shape, is roughly 0.10 Ac in area, and is a corner lot, fronting on both Eighth Ave & Hillside Ave in the community of Selby on the Bay. The property is currently unimproved. It is mapped within the R5 zoning district and is not within the Chesapeake Bay Critical Area or any other overlay district. The property was created by plat, recorded in the plat records of Anne Arundel County (Book: 9, Pg: 5) on October 8, 1932, and therefore is a buildable lot. The property is identified as Lot 98 on the Selby on the Bay, Plat No. 8. The property is served by public sewer and a private well.

The property is stabilized with vegetation. The property is sloped from the highpoint at the northern property corner to the low point at the southern property corner, where the rear lot line intersects with the Hillside Ave road right-of-way. The average slope across the property is roughly 10%

1.2 ENVIRONMENTAL FEATURES

First, the resource mapping of the site was completed.

(a) **Primary Environmental Features identified on-site:**

(i) **Streams** – There are no streams on the subject property.

(ii) **Stream Order** - There are no streams on the subject property.

(iii) **Stream Buffers** – There are no stream buffers on the subject property.

(iv) **Wetlands & Wetland Buffers** - There are no wetlands or wetland buffers present on site.

(v) **Floodplain** – There are no mapped floodplains that affect the site.

(vi) **Steep Slopes** – There are no steep slopes or steep slope buffers affecting the subject property.

(b) **Secondary Environmental Features identified on-site:**

(i) **Critical Area** - The subject property is not located within the Chesapeake Bay Critical Area.

(ii) **Soils** - The soils types and corresponding hydrologic soil groups were mapped and tallied based on the available information from US Department of Agriculture's Natural Resource Conservation Service (NRCS). The soils are predominantly mapped as HSG type-A and Type-C soils.

(iii) **Forests** – The property has no forested area on-site.

(iv) **Cultural Resources** – There are no known cultural or historic resources on he property. There is no visible evidence of cemetaries.

(v) **Miscellaneous** – No miscellaneous or unusual topographic features are known to exist on-site.

1.3 SITE OUTFALL(S)

There is one existing site outfall:

- Site Outfall #1 is located along the southern property line. Runoff exits the site as shallow, concentrated flow, discharging onto the unimproved property to the south. There are no signs of flooding, sedimentation, or erosion at the Site Outfall

2.0 ENVIRONMENTAL SITE DESIGN

2.1 CONCEPT DESIGN

With no sensitive environmental features on-site the primary goal of stormwater management will be to capture and treat the impervious runoff from the site, and to allow for maximum percolation of runoff into the HSG-A type soils. Due to the 10% average slopes on-site, disconnections would be problematic. However, the low portion of the site, along Hillside Ave, has a longitudinal slope of about 4%, which through grading will allow for the construction of a small bio-swale. To ameliorate velocity in the swale, stone check dams shall be installed. The check dams will slow the runoff, promote ponding and infiltration, and will reduce runoff from the site.

2.2 ESD_V NARRATIVE

The overall concept for stormwater management is to utilize an interconnected series of disconnections and micro-scale practices to achieve management of the target rainfall depth (P_E) and associated volume (ESD_V). Through site fingerprinting, the sensitive environmental features identified in Section 2.1 of this report shall remain undisturbed. The property owner proposes to construct a new single-family dwelling. Accessory residential site amenities such a driveway is proposed to serve the new dwelling. The soils on-site are classified as HSG-A soils; therefore, pervious pavers are proposed to treat the runoff from the driveway, & a bioswale is proposed to treat runoff from the dwelling. The following is a summary of all ESD Practices that were considered for the proposed development, and the reasons why the practices were or were not utilized.

A. Alternative surfaces:

- **Green Roofs** shall not be utilized, as they are not included in the architectural design.
- **Pervious pavements** shall be utilized for the proposed development. The soils on-site are predominantly mapped as HSG Type-A soils.

B. Non-Structural Practices:

- **The Disconnection of Rooftop Runoff** shall not be provided as the average slope is too great for disconnections.
- **The Disconnection of Non-Rooftop Runoff** shall not be provided as the average slope is too great for disconnections..
- **The Sheetflow to Conservation Areas** shall not be utilized, as there are no conservation easements on the subject property, and none are proposed.

C. Micro-Scale Practices:

- **Rainwater Harvesting** shall not be utilized as a management practice for this site. No grey water reuse is proposed for this single-family residential project. Filters and infiltration devices are more appropriate.
- **Submerged gravel wetlands** shall not be utilized as the soils on-site are relatively permeable, especially at depths greater than two feet. SWM filters and infiltration devices would be more appropriate.
- **Landscape infiltration** was considered for this project, but was not utilized. The slopes on-site are generally not conducive to a traditional filter, as excessive grade manipulation would be necessary to implement this type of device.
- **Infiltration berms** were not considered for this project, as the surface soil layer is not conducive to infiltration, and impounding impervious runoff near a residential dwelling is not an acceptable design varient.
- **Drywells** shall be utilized in areas where the natural soils are conducive to their use, primarily managing rooftop runoff from the new dwelling.
- **Micro-Bioretention** was considered for this project, but was not utilized. The slopes on-site are generally not conducive to a traditional filter, as excessive grade manipulation would be necessary to implement this type of device.
- **Rain Gardens** was considered for this project, but was not utilized. The slopes on-site are generally not conducive to a traditional filter, as excessive grade manipulation would be necessary to implement this type of device.
- **Swales** shall be utilized for SWM, the grades along the Hillside Ave ROW are conducive to providing a bio-swale, with check dams to control velocities and maximize ponding.

The concept of converting filtration devices to **enhanced filters** shall be utilized. Six inches of stone shall be provided at the bottom of the device to meet recharge volume obligations, and to provide additional storage for Overbank Flood Protection (Q_P) obligations.

In conclusion, it is our opinion that the proposed design represents the best solution to overcome the unique complexities inherent in the subject property. Our primary environmental concern is protecting the existing site outfall and downstream properties. First, we sited the proposed improvements at the high point of the property, as close to Eighth Ave as possible. Next, we graduated to analyzing our stormwater management options. In considering stormwater management, due to the HSG-A soils, pervious pavement shall be utilized for the driveway. A bio-swale shall provide treatment of the runoff from the rooftop. Therefore, we feel that the proposed design minimizes the development footprint; maximizes groundwater recharge; captures and treats stormwater runoff to remove non-point pollution; restores, enhances, and maintains the chemical, physical, and biological integrity of receiving waters; protects public health; and enhances domestic, municipal, recreational, industrial, and other uses of water as specified by MDE.

2.3 ESD_V COMPUTATIONS

Environmental Site Design requirements for the proposed development was computed in accordance with Article 16, Title 4 of the Anne Arundel County Code, COMAR 26.17.02, and the Maryland Stormwater Design Manual, Volumes I & II.

Soils in the development area have a types A, & C hydrologic classifications; the Target RCN for "woods in good condition" is 46. The proposed imperviousness for the development area is 18%. Utilizing Table 5.3 from the State Manual, a target rainfall depth (P_E) of 1.4" and a target runoff depth (Q_E) of 0.31" were determined. From these initial computations, a minimum Environmental Site Design Volume (ESD_V) of 110 c.f. of runoff would need to be managed, of which 30 c.f. would need to be Recharge Volume (Re_V).

Qualitative stormwater management shall be achieved through alternative surfaces and micro-scale practices. Pervious pavement shall be utilized to reduce impervious surfaces, and to provide infiltration of runoff. A bio-swale shall provide treatment of runoff from the dwelling. The pervious pavement provides 73 cf of qualitative management. The Bio-swale is designed with a 4% longitudinal slope, a 2ft bottom width, and a 2ft filter media depth. Stone check dams will assist with velocity amelioration and to promote ponding, infiltration and sediment removal.

Designer:	WB	Date: July 5, 2024	Checked By:	Date:
Title:	3692 8th Ave, Edgewater			Job No.:
Subject:	ESD Design			Sheet No. of

Study Data:

Location: 3692 8th Ave, Edgewater, MD							
County: Anne Arundel							
Site Area:		4,375 sf	or	0.1 Ac.			
Study Area (A):		4,375 sf	or	0.1 Ac.			
Soils:	HSG 'A' =	3,605 sf	or	0.083 Ac.	or	82 %	of Site
	HSG 'B' =	0 sf	or	0 Ac.	or	0 %	of Site
	HSG 'C' =	770 sf	or	0.02 Ac.	or	18 %	of Site
	HSG 'D' =	0 sf	or	0 Ac.	or	0 %	of Site

Hard Surfaces	=	1,201 sf	or	0.03 Ac.	
Alternative Surfaces	=	396 sf	or	0.01 Ac.	*MDE, Chapter 5, Section 5.3*
Disconnections	=	0 sf	or	0.00 Ac.	*MDE, Chapter 5, Section 5.4.2*
Impervious Surfaces Requiring Treatment	**=**	**805 sf**	**or**	**0.02 Ac.**	

Step 1: Determine ESD Implementation Goals

A. Determine Pre-Developed Conditions:

Soil Conditions and RCNs for "woods in good condition"

HSG	RCN*	Area	Percent
A	38	0.08 Ac.	82.40
B	55	0.00 Ac.	0.00
C	70	0.02 Ac.	17.60
D	77	0.00 Ac.	0.00

* RCN for "woods in good condition" (*Table 2-2, TR-55*)

** Actual RCN is less than 30, use RCN = 38

Composite RCN for "woods in good condition"

RCN_{woods} = [(38x0.08ac)+(55x0.00ac)+(70x0.02ac)+(77x0.00ac)] / 0.10ac

RCN_{woods} = 46

Target RCN for "woods in good condition" = 46

B. Determine Target P_E Using Table 5.3

P_E = Rainfall used to size ESD practices

Proposed imperviousness (%I)

IART (as measured from site plan): 805 sf *from Site Data Table, above*

%I = Impervious Area / Drainage Area = 805sf / 4,375sf = 18.4 % = 18 %

- Determine P_E from Table

Hydrologic Soil Group 'A'										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	40									
5%	43									
10%	46									
15%	48	**38**								
20%	51	40	38	38						
25%	54	41	40	39						
30%	57	42	41	39	**38**					
35%	60	44	42	40	39					
40%	61	44	42	40	39					
45%	66	48	46	41	40					
50%	69	51	48	42	41	**38**				
55%	72	54	50	42	41	39				
60%	74	57	52	44	42	40	**38**			
65%	77	61	55	47	44	42	40			
70%	80	66	61	55	50	45	40			
75%	84	71	67	62	56	48	40	**38**		
80%	86	73	70	65	60	52	44	40		
85%	89	77	74	70	65	58	49	42	**38**	
90%	92	81	78	74	70	65	58	48	42	**38**
95%	95	85	82	78	75	70	65	57	50	39
100%	98	89	86	83	80	76	72	66	59	40

Use P_E = 1.4 inches of rainfall as the target for ESD implementation

Hydrologic Soil Group 'B'										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	61									
5%	63									
10%	65									
15%	67	**55**								
20%	68	60	**55**	**55**						
25%	70	64	61	58						
30%	72	65	62	59	**55**					
35%	74	66	63	60	56					
40%	75	66	63	60	56					
45%	78	68	66	62	58					
50%	80	70	67	64	60					
55%	81	71	68	65	61	**55**				
60%	83	73	70	67	63	58				
65%	85	75	72	69	65	60	**55**			
70%	87	77	74	71	67	62	57			
75%	89	79	76	73	69	65	59			
80%	91	81	78	75	71	66	61			
85%	92	82	79	76	72	67	62	**55**		
90%	94	84	81	78	74	70	65	59	**55**	
95%	96	87	84	81	77	73	69	63	57	
100%	98	89	86	83	80	76	72	66	59	**55**

Use P_E = 1.0 inches of rainfall as the target for ESD implementation

Hydrologic Soil Group 'C'										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	74									
5%	75									
10%	76									
15%	78									
20%	~~79~~	**70**								
25%	80	72	**70**	**70**						
30%	81	73	72	71						
35%	82	74	73	72	**70**					
40%	84	77	75	73	71					
45%	85	78	76	74	71					
50%	86	78	76	74	71					
55%	86	78	76	74	71	**70**				
60%	88	80	78	76	73	71				
65%	90	82	80	77	75	72				
70%	91	82	80	78	75	72				
75%	92	83	81	79	75	72				
80%	93	84	82	79	76	72				
85%	94	85	82	79	76	72				
90%	95	86	83	80	77	73	**70**			
95%	97	88	85	82	79	75	71			
100%	98	89	86	83	80	76	72	**70**		

Use P_E = 1.0 inches of rainfall as the target for ESD implementation

Hydrologic Soil Group 'D'										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	80									
5%	81									
10%	82									
15%	83									
20%	84	**77**								
25%	85	78								
30%	85	78	**77**	**77**						
35%	86	79	78	78						
40%	87	82	81	79	**77**					
45%	88	82	81	79	78					
50%	89	83	82	80	78					
55%	90	84	82	80	78					
60%	91	85	83	81	78					
65%	92	85	83	81	78					
70%	93	86	84	81	78					
75%	94	86	84	81	78					
80%	94	86	84	92	79					
85%	95	86	84	82	79					
90%	96	87	84	82	79	**77**				
95%	97	88	85	82	80	78				
100%	98	89	86	83	80	78	77			

Use P_E = 1.0 inches of rainfall as the target for ESD implementation

Compute Composite P_E:

HSG	Area	Target P_E		Net P_E
A	0.08 ac	1.4	0.08 ac x 1.40 / 0.10 ac =	1.2
B	0.00 ac	1.0	0.00 ac x 1.00 / 0.10 ac =	0.0
C	0.02 ac	1.0	0.02 ac x 1.00 / 0.10 ac =	0.2
D	0.00 ac	1.0	0.00 ac x 1.00 / 0.10 ac =	0.0
			Composite P_E =	**1.4**

C. Compute Q_E:

Q_E = Runoff depth used to size ESD practices

$Q_E = P_E * R_V$, where:

P_E = 1.4 in *(from above)*

$R_V = 0.05 + (0.009)(I)$; I = 18.40 %

= 0.05 + 0.009 x (18.40)

= 0.22

Q_E = 1.4 " x 0.22

= **0.31 inches**

ESD Target for the Project

P_E = 1.4 Inches *composite P_E, from above*

Q_E = 0.31 Inches

D. Compute Minimum ESD_V & Re_V for Site:

Required Environmental Site Design Volume (ESD_V) for Drainage Area:

ESD_V = [(P_E) x (R_V) x (LOD)]/ 12

P_E = 1.4 in. *(Composite P_E, from above)*

R_V = 0.22 *(from Q_E, above)*

Study Area (A) = 4,375 sf or 0.1 ac *(from Site Tabs)*

Target ESD_V = [(1.40 in.) x (0.22) x (4,375 sf)] / 12 =

= **110 cf**

Required Minimum Recharge Volume (Re_V) for Site:

Re_V = [(S) x (R_V) x (LOD)]/ 12

Where:

Composite 'S' =

HSG	Area	Recharge Factor		Net 'S'
A	0.08 ac	0.42	0.08 ac x 0.42 / 0.10 ac	0.35
B	0.00 ac	0.29	0.00 ac x 0.29 / 0.10 ac	0.00
C	0.02 ac	0.14	0.02 ac x 0.14 / 0.10 ac	0.03
D	0.00 ac	0.08	0.00 ac x 0.08 / 0.10 ac	0.00
			Composite 'S' =	**0.38**

R_V = 0.22 *from ESD_V, above*

Study Area (A) = 4,375 sf or 0.1 ac *(from Site Tabs)*

Min. Re_V = [(0.38) x (0.22) x (4,375)] /12

= **30 cf**

Alternative Surfaces:

A-1 ESD Practice A-1 Green Roof

Sub-DA #	Surface Description	DA	Thickness	Surface Area	RCN	ESD_V/ft^2	P_E	ESD_V
A-1A	Garage	0 sf	4 in.	0 sf	88	0.077	1.0	0 cf
		sf	3 in.	sf	92	0.050	0.6	0 cf
		sf	4 in.	sf	88	0.077	1.0	0 cf
	Totals:	**0 sf**		**0 sf**			**1.0 in.**	**0 cf**

Effective RCN from Table 5.5, p. 5.48 (MDE)

A-2 ESD Practice A-2 Permeable Pavement

Sub-DA #	Surface Description	DA	Subbase Depth	Surface Area	HSG	RCN	ESD_V/ft^2	P_E	ESD_V
A-2A	Driveway	396 sf	9 in.	396 sf	A	62	0.183	2.3	73 cf
		sf	12 in.	sf	B	55	0.196	2.5	0 cf
		sf	6 in.	sf	C	93	0.043	0.5	0 cf
	Totals:	**396 sf**		**396 sf**				**2.3**	**73 cf**

Effective RCN from Table 5.5, p. 5.48 (MDE)

M-6 **ESD Practice M-8 Bio-Swale**

Contributing Drainage Area (DA) = 2,100 sf or 0.05 Ac.
Impervious Surfaces in DA = 1,255 sf or 0.03 Ac.
%I = 1,255 sf / 2,100 sf = 60 %
Minimum Surface Area (A_f) = 2% of contributing DA
2,100 sf x 0.02 = 42 sf MINIMUM
Surface Area (A_f) = 100 sf

ESD_V Concept Design Estimate:

ESD_V = $[(P_E) \times (R_V) \times (DA)]/12$
where: P_E = 15 in x (A_f/DA) *(Eqn. 5.2, MDE)*
= 15 in x (100 sf / 2,100 sf)
P_E = 0.71 in. ***(Concept Design Estimate)***
R_V = 0.05 + (0.009 x %I)
= 0.05 + (0.009 x 60%)
= 0.59
ESD_V = (0.71 in. x 0.59 x 2,100 sf) / 12
= 73 cf ***(Concept Design Estimate)***
Re_V = $[(S) \times (R_V) \times (DA)]/ 12$ if $P_E \geq S$
S = 0.38 *Composite 'S' from site computations*
Re_V = [(0.38) x (0.59) x (2,100 sf)] /12 =
= 39 cf
Maximum Allowable ESD_V = (2.7in. x 0.59 x 2,100 sf) / 12
= 279 cf *based on 1yr design storm*

ESD_V based on volume stored

Bio-Swale Design:

Longitudinal Slope = 4 %
Bottom Width = 2 ft
Length = 50 ft
Filter Media Depth = 2.25 ft *(planting soil + 3" mulch)*
Pea Gravel Depth = 0.50 ft *(6" of #8 gravel)*
Media Porosity = 0.4
Media Storage Volume = [100sf x (2.25ft.+ 0.50ft. x 0.4]
= 110 cf

Ponding storage per cell:

Ponding Depth = 0.50 ft
Average Depth = 0.25 ft
Cell Length = 12.50 ft
Number of Cells = 4.00 ea
Side Slopes = 3:1
Max. Water Surface Area = 40 sf
Ponding Storage Volume = [(40sf + 25sf /2) x 0.25ft.]
= 8 cf per cell
32 cf total

Total Storage provided = 110cf + 32cf
= 142 cf
P_E Provided = $(ESD_V \times 12)/(R_V \times DA)$ *Based on ESD_V stored*
= (142cf x 12)/(0.59 x 2,100sf)
= 1.38 in.
ESD_V Provided = 142 cf

M-9 **ESD Practice M-9 Enhanced Filter**

Enhanced Filter Area	=	100 sf	
Enhanced Filter Depth	=	0.5 ft	*(#2 Gravel)*
Gravel Porosity	=	0.4	
Storage Provided	=	**20 cf**	
P_E Provided	=	**$(ESD_V \times 12)/(R_V \times DA)$**	*Based on storage provided*
	=	(20cf x 12)/(0.59 x 2,100sf)	
	=	**0.19 in.**	
ESD_V Provided	=	**20 cf**	***(Combined ESDV of filter + enhanced filter cannot exceed 279cf)***

Microscale & Non-Structural Practices							
DA #	ESD Practice	DA	ESD_V	Re_V	P_E Value	Q_P Storage	Total Storage
A	Permeable Pavement	396 sf	73 cf	73 cf	2.30 in.	0 cf	73 cf
B	Bio-Swale	2,100 sf	142 cf	39 cf	1.38 in.	0 cf	142 cf
B	Enhanced Filter	2,100 sf	0 cf	20 cf	0.19 in.	20 cf	20 cf
		Provided Totals:	**215 cf**	**132 cf**		**20 cf**	**235 cf**
		Targets:	**110 cf**	**30 cf**	**1.4 in.**		
P_E Achieved =	**$(12 \times ESD_V)/(R_V \times A)$**	**=**	**(12 x 215cf) / (0.22 x 4,375sf)**			**=**	**2.7 in.**

Step 2: Determine Stormwater Management Requirements after using ESD

A. Calculate Reduced RCN

- Determine reduced RCN from Table 5.3

Hydrologic Soil Group 'A'										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	40									
5%	43									
10%	46									
15%	48	38								
20%	51	40	38	38						
25%	54	41	40	39						
30%	57	42	41	39	38					
35%	60	44	42	40	39					
40%	61	44	42	40	39					
45%	66	48	46	41	40					
50%	69	51	48	42	41	38				
55%	72	54	50	42	41	39				
60%	74	57	52	44	42	40	38			
65%	77	61	55	47	44	42	40			
70%	80	66	61	55	50	45	40			
75%	84	71	67	62	56	48	40	38		
80%	86	73	70	65	60	52	44	40		
85%	89	77	74	70	65	58	49	42	38	
90%	92	81	78	74	70	65	58	48	42	38
95%	95	85	82	78	75	70	65	57	50	39
100%	98	89	86	83	80	76	72	66	59	40

Use RCN = 38

Hydrologic Soil Group 'B'										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	61									
5%	63									
10%	65									
15%	67	55								
20%	68	60	55	55						
25%	70	64	61	58						
30%	72	65	62	59	55					
35%	74	66	63	60	56					
40%	75	66	63	60	56					
45%	78	68	66	62	58					
50%	80	70	67	64	60					
55%	81	71	68	65	61	55				
60%	83	73	70	67	63	58				
65%	85	75	72	69	65	60	55			
70%	87	77	74	71	67	62	57			
75%	89	79	76	73	69	65	59			
80%	91	81	78	75	71	66	61			
85%	92	82	79	76	72	67	62	55		
90%	94	84	81	78	74	70	65	59	55	
95%	96	87	84	81	77	73	69	63	57	
100%	98	89	86	83	80	76	72	66	59	55

Use RCN = 55

Hydrologic Soil Group 'C'										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	74									
5%	75									
10%	76									
15%	78									
20%	~~79~~	**70**								
25%	80	72	**70**	**70**						
30%	81	73	72	71						
35%	82	74	73	72	**70**					
40%	84	77	75	73	71					
45%	85	78	76	74	71					
50%	86	78	76	74	71					
55%	86	78	76	74	71	**70**				
60%	88	80	78	76	73	71				
65%	90	82	80	77	75	72				
70%	91	82	80	78	75	72				
75%	92	83	81	79	75	72				
80%	93	84	82	79	76	72				
85%	94	85	82	79	76	72				
90%	95	86	83	80	77	73	**70**			
95%	97	88	85	82	79	75	71			
100%	98	89	86	83	80	76	72	**70**		

Use RCN = 70

Hydrologic Soil Group 'D'										
%I	RCN*	P_E = 1"	1.2"	1.4"	1.6"	1.8"	2.0"	2.2"	2.4"	2.6"
0%	80									
5%	81									
10%	82									
15%	83									
20%	84	**77**								
25%	85	78								
30%	85	78	**77**	**77**						
35%	86	79	78	78						
40%	87	82	81	79	**77**					
45%	88	82	81	79	78					
50%	89	83	82	80	78					
55%	90	84	82	80	78					
60%	91	85	83	81	78					
65%	92	85	83	81	78					
70%	93	86	84	81	78					
75%	94	86	84	81	78					
80%	94	86	84	92	79					
85%	95	86	84	82	79					
90%	96	87	84	82	79	**77**				
95%	97	88	85	82	80	78				
100%	98	89	86	83	80	78	**77**			

Use RCN = 77

Compute Composite RCN:

HSG	Area	RCN	Adjusted RCN
A	0.08 ac	38	0.08 ac x 38 / 0.10 ac = 32
B	0.00 ac	55	0.00 ac x 55 / 0.10 ac = 0
C	0.02 ac	70	0.02 ac x 70 / 0.10 ac = 14
D	0.00 ac	77	0.00 ac x 77 / 0.10 ac = 0
			Composite RCN = 46

Calculate Cp_V using design P_E = 2.7 in. (RCN 46)

Cp_V = Q_1 x A

Where:

$Q_1 = \frac{[P-(0.2S)^2]}{[P+(0.8S)]}$ Eqn. 2-3, TR-55, USDA NRCS 1986

P = **2.7 in.** *(Table 2.2)*

S = (1000/RCN) - 10 (Eqn. 2-4, TR-55)

= (1000/46) - 10

= **11.74**

$Q_1 = \frac{[2.7-(0.2 \times 11.7)]^2}{[2.7+(0.8 \times 11.7)]} = \frac{0.124}{12.09} =$ **0.01 in.**

A = 4,375 sf

Cp_V = 0.01 in. x 4,375 sf

= **0.00 cf** *ESD to the MEP has been met*

Cp_V Storage Requirements for: 3692 8th Ave, Edgewater, MD

Rainfall (P_E)	Additional Cp_V Required		Notes:
	ac-ft	ft^3	
$P_E \geq$ 1.4 in.	0	0	Target P_E for RCN = woods
P_E = 2.7 in.	0	0	

3.0 QUANTITATIVE ANALYSIS

3.1 CHANNEL PROTECTION VOLUME (CP_V)

Management of the Channel Protection Storage Volume (Cp_V) is not necessary, as the non-structural credit and interconnected micro-scale practices manage the target P_E, and therefore channel protection obligations are met through the Reduced Runoff Curve number Method.

3.2 OVERBANK FLOOD PROTECTION VOLUME (Q_P)

Management of the Overbank Flood Protection Volume (Q_P) is provided. A small amount of additional stone storage is provided in the enhanced filter to meet adequate outfall requirements. Additionally, the Site Outfall is stable and shows no sign of flooding, sedimentation, or erosion.

3.3 EXTREME FLOOD VOLUME (Q_F)

Management of the Extreme Flood Volume (Q_F) is not necessary. All Site Outfalls are adequate, and no floodplains exist downstream of the site. Additionally, all Site Outfalls are stable and show no signs of flooding, sedimentation, or erosion.

APPENDIX A

TR-55 Worksheets

Existing Condition

Worksheet 2: Runoff curve number and runoff

Project 3692 8th Ave, Edgewater By WB Date 7/5/2024

Location Anne Arundel County Checked WB Date 7/5/2024

Existing Conditions Site Outfall

1. Runoff Curve Number (CN)

Soil name and hydrologic group (Appendix A)	Cover Description No.		CN Table 2-2 Appx. 11-8	CN Figure 2-3	CN Figure 2-4	Area (SQ.FT.)	Product of CN x area
A	93	Lawn	39			3605	140595
C	93	Lawn	74			770	56980
Totals =						4,375	197,575

0.00016 mi^2

CN (weighted) = total product / total area = 197575 / 4375 = 45.2 Use CN = 45

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency . . . . . Yr	1	10	100
Rainfall, P (24-hour) . . . . . In	2.7	5.2	7.4
Runoff, Q = $(P-0.2S)^2/(P+0.8S)$ . . . . . In	0.01	0.51	1.43

S=(1000/CN)-10

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project	3692 8th Ave, Edgewater	By	WB	Date	7/5/2024
Location	Anne Arundel County	Checked	WB	Date	7/5/2024
	Existing Conditions			Site Outfall	
				0	

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments

Sheet flow (Applicable to T_c only)		Segment ID	A-B				
1. Surface description (table 3-1)			5 Grass - short	0			
2. Manning's roughness coeff., n (table 3-1)			0.15				
3. Flow Length, L (total L<= 100 ft)		ft	100				
4. Two-Year 24-hr rainfall, P_2		in	3.2				
5. Land Slope, s		ft / ft	0.07				
6. $T_t = 0.007(nL)^{0.8} / P_2^{0.5} s^{0.4}$		hr	0.099	+		=	0.099
Shallow concentrated flow		Segment ID					
7. Surface Description: paved (P) or unpaved (U) ?							
8. Flow Length, L		ft					
9. Watercourse slope, s		ft / ft					
10. Average velocity, V (figure 3-1)		ft / sec					
11. T_t = L / 3600V		hr		+		=	0.000
Channel flow		Segment ID					
a. Assumed Q:							
b. Pipe (P) or Channel (C) ?							
c. If pipe, enter D (in):							
d. If channel, enter bottom width:							
e. if channel, enter side slope 1 (_:1):							
f. If channel, enter side slope 2 (_:1):							
g. channel depth (ft)							
12. Cross sectional flow area, a		sq ft					
13. Wetted perimeter, wp		ft					
14. Hydraulic radius, r = a / wp		ft					
15. Channel slope, s		ft / ft					
16. Manning's roughness coeff., n							
17. $V = 1.49\, r^{0.67} s^{0.5} / n$		ft / sec					
18. Flow length, L		ft					
19. T_t = L / 3600V		hr		+		=	0.00
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)						hr	0.10

Worksheet 4: Graphical Peak Discharge Method

Project: 3692 8th Ave, Edgewater | By: WB | Date: 7/5/2024
Location: Anne Arundel County | Checked: WB | Date: 7/5/2024
Existing Conditions | Site Outfall | 0

1. Data:

Drainage Area	A_m	=	0.00016	sq mi
Runoff Curve Number	CN	=	45	(From Worksheet 2)
Time of Concentration	T_c	=	0.10	hr (From Worksheet 3)
Rainfall Distribution		=	II	(I, IA, II, III)
Pond and swamp areas spread throughout watershed		=	0.0%	of A_m (0 acres covered)

			Storm #1	Storm #2	Storm #3
2.	Frequency	yr	1	10	100
3.	Rainfall, P (24-hour)	in	2.7	5.2	7.4
4.	Initial abstraction, I_a (Use CN with table 4-1)	in	2.444	2.444	2.444
5.	Compute I_a/P		0.91	0.47	0.33
6.	Unit peak discharge, q_u (use T_c and I_a/P with Exhibit 4- II)	csm/in	508	611	905
7.	Runoff, Q (From Worksheet 2)	in	0.01	0.51	1.43
8.	Pond and swamp adjustment factor, F_p (Use % pond and swamp area with table 4-2. Factor 1.0 for 0 % pond and swamp area)		1	1	1
9.	Peak discharge, q_p (Where $q_p = q_u A_m Q F_p$)	cfs	0.00	0.05	0.20

Proposed Condition

Worksheet 2: Runoff curve number and runoff

Project 3692 8th Ave, Edgewater By WB Date 7/5/2024

Location Anne Arundel County Checked WB Date 7/5/2024

Proposed Conditions Site Outfall

1. Runoff Curve Number (CN) 0

Soil name and hydrologic group (Appendix A)	Cover Description No.		CN Table 2-2	CN Figure 2-3	CN Figure 2-4	Area (SQ.FT.)	Product of CN x area
A	95	Woods	30			900	27000.0
A	93	Lawn	39			1504	58656.0
A	92	Impervious	98			805	78890.0
A	99	Pervious Pavement (9in subbase)	62			396	24552.0
C	93	Lawn	74			770	56980.0
				Totals =		4,375	246,078

0.00016 mi^2

CN (weighted) = total product / total area = 246078 / 4375 = 56.2 Use CN = 56

WEIGHTED CN CANNOT BE LESS THAN 40

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency. . . . . Yr	1	10	100
Rainfall, P (24-hour) . . . . . In	2.7	5.2	7.4
Runoff, Q = $(P-0.2S)^2/(P+0.8S)$. . . . . In	0.14	1.15	2.48

S=(1000/CN)-10

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project	3692 8th Ave, Edgewater	By	WB	Date	7/5/2024
Location	Anne Arundel County	Checked	WB	Date	7/5/2024
	Proposed Conditions			Site Outfall	
				0	

NOTES: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments

Sheet flow (Applicable to T_c only)		Segment ID	A-B			
1.	Surface description (table 3-1)					
2.	Manning's roughness coeff., n (table 3-1)					
3.	Flow Length, L (total L<= 300 ft)	ft				
4.	Two-Year 24-hr rainfall, P_2	in	3.2			
5.	Land Slope, s	ft / ft				
6.	$T_t = 0.007(nL)^{0.8} / P_2^{0.5} s^{0.4}$	hr		+		=

Shallow concentrated flow		Segment ID	A-B			
7.	Surface Description: paved (P) or unpaved (U) ?		U			
8.	Flow Length, L	ft	100			
9.	Watercourse slope, s	ft / ft	0.07			
10.	Average velocity, V (figure 3-1)	ft / sec	4.3			
11.	$T_t = L / 3600V$	hr	0.006	+		= 0.006

Channel flow		Segment ID				
	a. Assumed Q:					
	b. Pipe (P) or Channel (C) ?					
	c. If pipe, enter D (in):					
	d. If channel, enter bottom width:					
	e. if channel, enter side slope 1 (_:1):					
	f. If channel, enter side slope 2 (_:1):					
	g. channel depth (ft)					
12.	Cross sectional flow area, a	sq ft				
13.	Wetted perimeter, wp	ft				
14.	Hydraulic radius, r = a / wp	ft				
15.	Channel slope, s	ft / ft				
16.	Manning's roughness coeff., n					
17.	$V = 1.49 r^{0.67} s^{0.5} / n$	ft / sec	0.0	0.0		
18.	Flow length, L	ft				
19.	$T_t = L / 3600V$	hr		+		= 0.00
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)				hr	0.10

Worksheet 4: Graphical Peak Discharge Method

Project	3692 8th Ave, Edgewater	By WB	Date 7/5/2024
Location	Anne Arundel County	Checked WB	Date 7/5/2024
	Proposed Conditions		Site Outfall
			0

1. Data:

Drainage Area	A_m	=	0.00016	sq mi
Runoff Curve Number	CN	=	56	(From Worksheet 2)
Time of Concentration	T_c	=	0.10	hr (From Worksheet 3)
Rainfall Distribution		=	II	(I, IA, II, III)
Pond and swamp areas spread throughout watershed		=	0.0%	of A_m (0 acres covered)

			Storm #1	Storm #2	Storm #3
2.	Frequency	yr	1	10	100
3.	Rainfall, P (24-hour)	in	2.7	5.2	7.4
4.	Initial abstraction, I_a (Use CN with table 4-1)	in	1.571	1.571	1.571
5.	Compute I_a/P		0.58	0.30	0.21
6.	Unit peak discharge, q_u (use T_c and I_a/P with Exhibit 4- II)	csm/in	508	936	969
7.	Runoff, Q (From Worksheet 2)	in	0.1	1.2	2.5
8.	Pond and swamp adjustment factor, F_p (Use % pond and swamp area with table 4-2. Factor 1.0 for 0 % pond and swamp area)		1	1	1
9.	Peak discharge, q_p (Where $q_p = q_u A_m Q F_p$)	cfs	0.01	0.17	0.38

Reduced Runoff Curve Number

STEP 3a: Peak Management Computations per AACo. SWM Manual Chapeter 7.2.3

Site Outfall A - Peak Management of the 10 year 24 hour Design Storm

Allowable Discharge ($Q_{allowable}$):

Discharge: *From TR-55 Worksheets*

Condition	Discharge, Q_P (cfs)
Pre	0.05
Post	0.17

ESD Practices - Total Storage Volume (V_{stored}) & Stored Runoff Depth (Q_{stored}):

Total Storage Volume (V_{stored}): *See ESD Design Worksheet*

ESD Practices	V_{stored}
Permeable Pavement	73 cf
Bio-Swale	142 cf
Enhanced Filter	20 cf
Total:	**235 cf**

Stored Runoff Depth (Q_{stored}):

$Q_{stored} = V_{stored} / DA$

Q_{stored} = (235 cf x 12 in/ft) / (0.10 ac x 43,560 sf/ac)

Q_{stored} = 0.65 in

Post Development Runoff Depth (Q_{dev}):

Q_{dev} for the 10 year 24 hour design Storm:

Q_{dev} = 1.15 in *(See TR-55 Worksheet 2)*

Change in Curve Number based on Storage (CN*):

CN*:

$CN^* = 200 / [(P + 2Q + 2) - (5PQ + 4Q^2)^{0.5}]$

where: $Q^* = Q_{dev} - Q_{stored} =$

Q^* = 1.15 in - 0.65 in = **0.50 in**

P = *10 year Rainfall Depth* = 5.20 in *(Table 2-2, MDE)*

CN* = 200 / [(5.20 in + 2 x 0.50 in + 2) - (5 x 5.20 in x 0.50 in + 4 x 0.50^2)^0.5]

CN* = 44.91 or **45**

Post Development Discharge (Q_p):

Q_{P10} w/ CN*:

Area =	4,375 sf
CN* =	45 *(from above)*
T_C =	0.100 hr. *(TR-55 Worksheet 3)*
Rainfall, P =	5.20 in. *(Table 2.2, MDE)*
Initial Abstraction, I_a =	2.444 in. *(TR-55, Table 4-1)*
I_a/P =	0.47
Unit Peak Discharge, q_u =	611 csm/in. *(TR-55, Exhibit 4-II)*
Runoff Depth, Q* =	0.50 in. *(from above)*

Peak Discharge, Q_{p10} = $[(q_u \times (A, acres) \times (Q^*, in.)] / 27,878,400 (sf/mi^2)$

$Q_{p10} = [(611) \times (4,375sf) \times (0.50in.)] / 27,878,400$

Q_{p10} =	**0.05 cfs**
$Q_{allowable}$ =	**0.05 cfs**

The post development discharge is less than/equal the allowable discharge rate. Peak management is adequately addressed via ESD.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