

STORMWATER MANAGEMENT  
REPORT

FOR

BLOCK 261, LOT 15.02  
DENNIS TOWNSHIP  
CAPE MAY COUNTY, NJ

EDA #9826

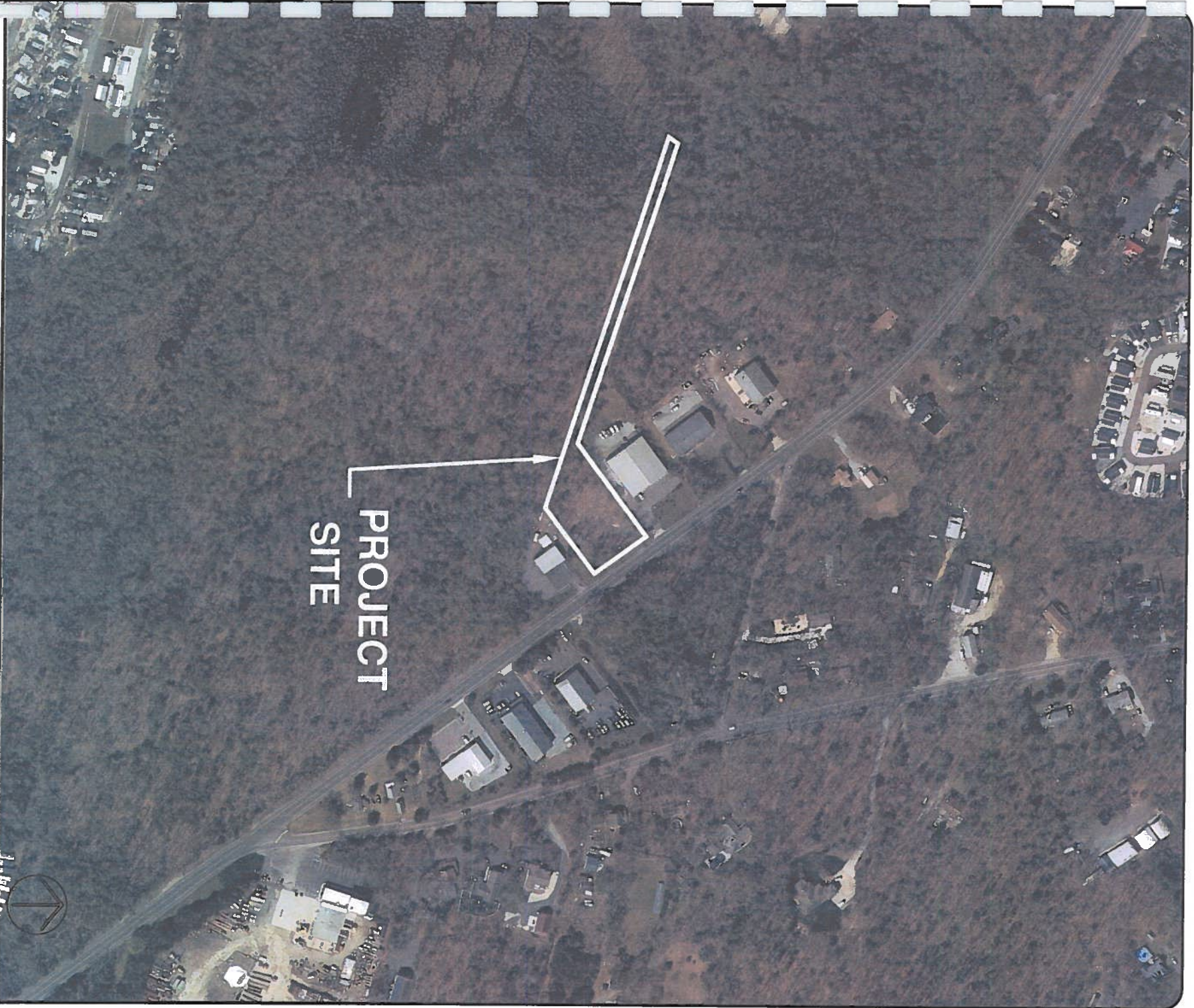


Vincent C. Orlando

3.28.23

Date  
N.J.P.E. #32498





AERIAL MAP  
BLOCK 261, LOT 15.02  
DENNIS TOWNSHIP, CAPE MAY COUNTY, NJ

DATE: 3/27/2023  
SCALE: 1" = 300'

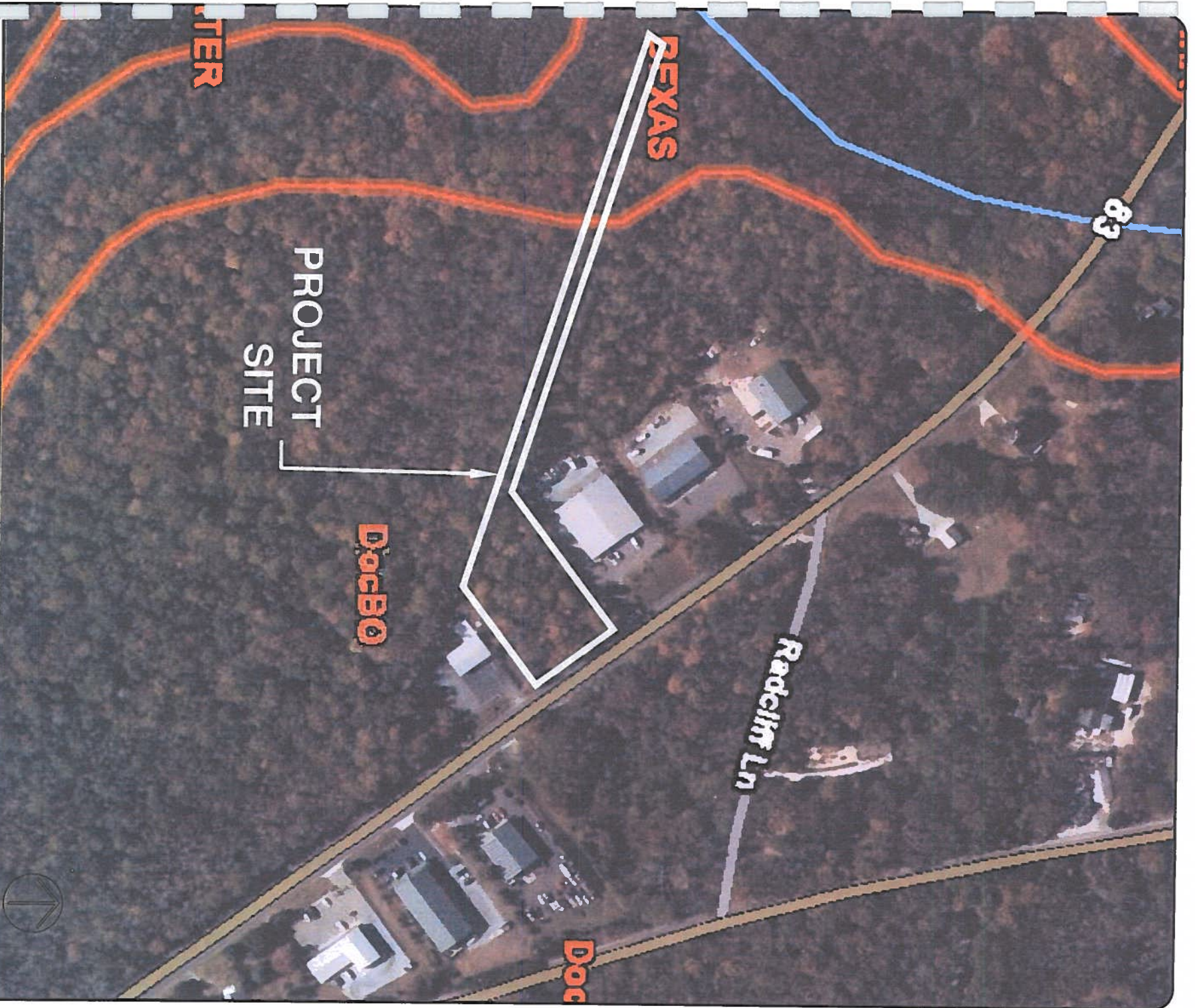
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5 Cambridge Drive Ocean View, NJ 08230  
(609) 390-0332 FAX (609) 390-9204





SOILS MAP  
BLOCK 261, LOT 15.02  
DENNIS TOWNSHIP, CAPE MAY COUNTY, NJ

DATE: 3/27/2023  
SCALE: 1" = 200'

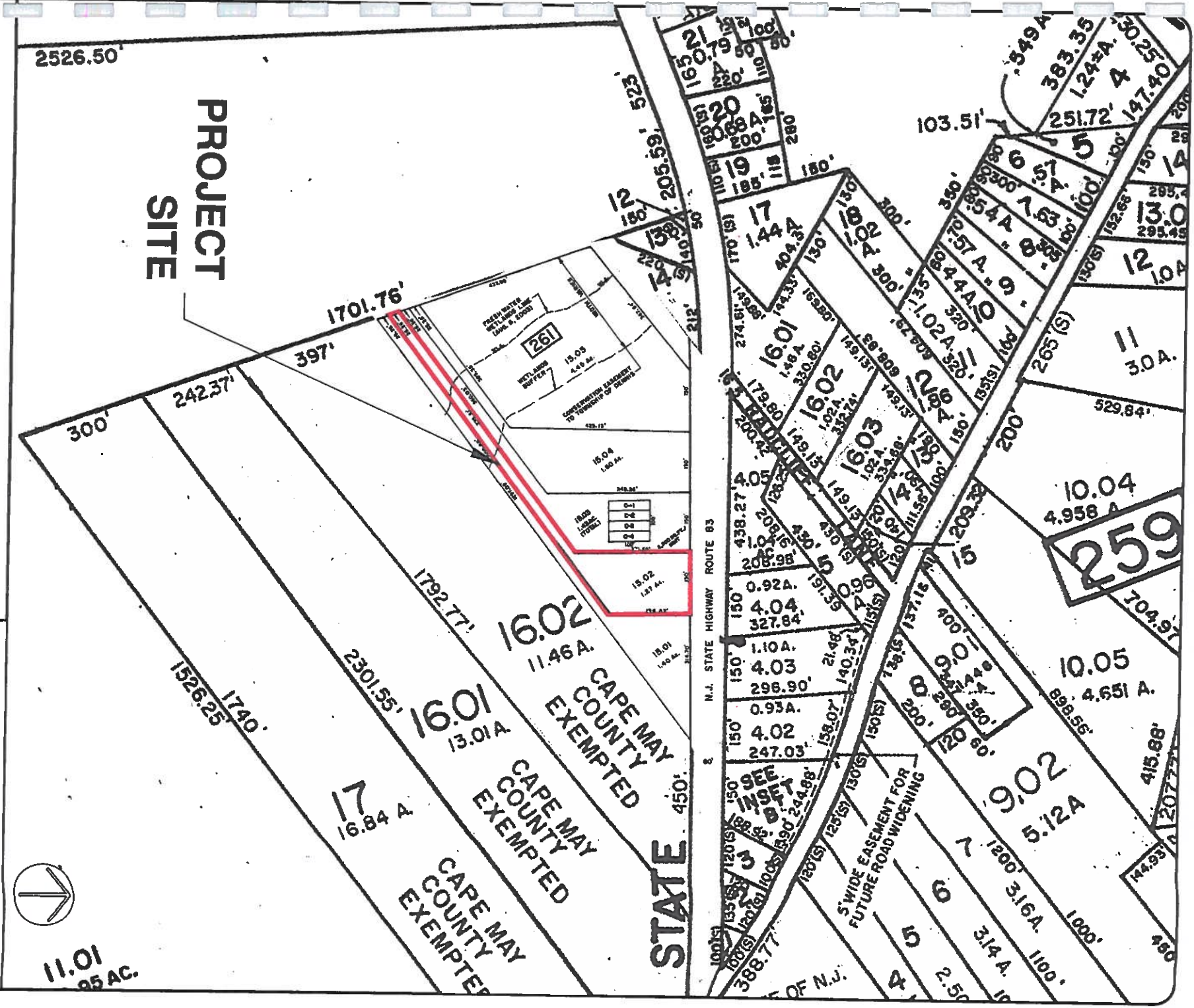
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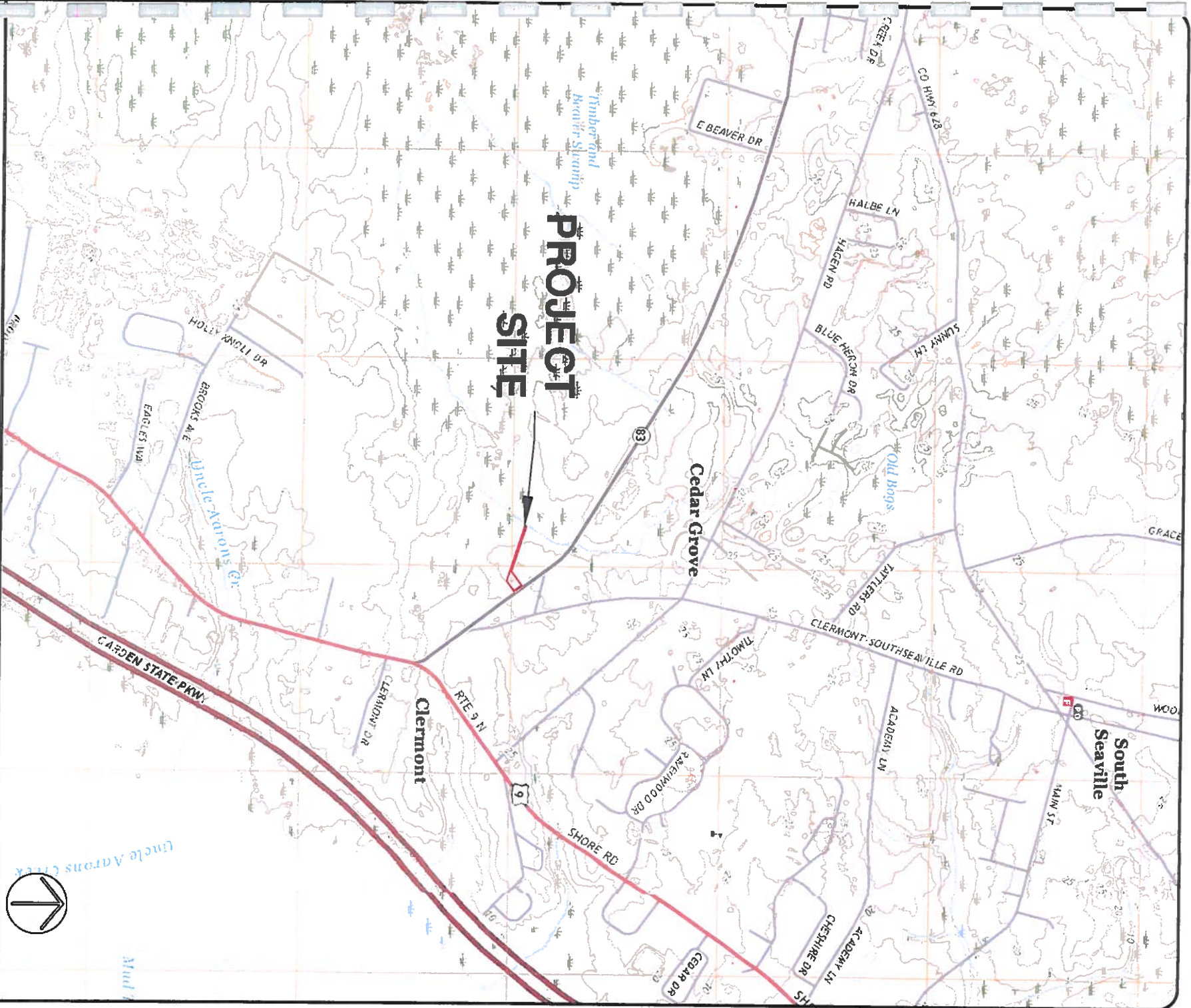


TAX MAP  
BLOCK 261, LOT 15.02  
DENNIS TOWNSHIP, CAPE MAY COUNTY, NJ

DATE: 3/27/2023  
SCALE: 1" = 300'  
DRAWN BY: MSB  
PROJECT #: 9826

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USGS MAP  
BLOCK 261, LOT 15.02  
DENNIS TOWNSHIP, CAPE MAY COUNTY, NJ

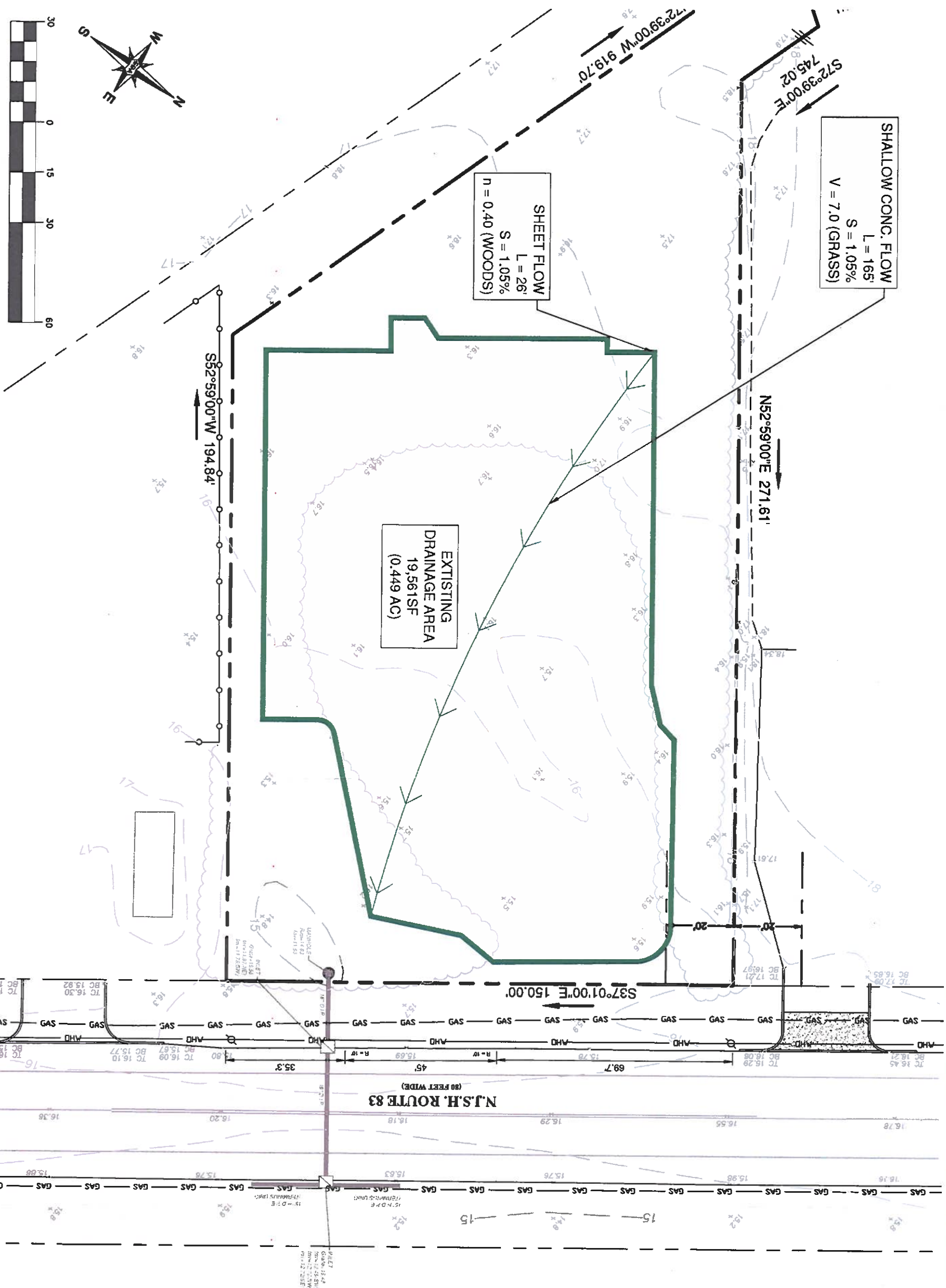
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SCALE: 1" = 200'

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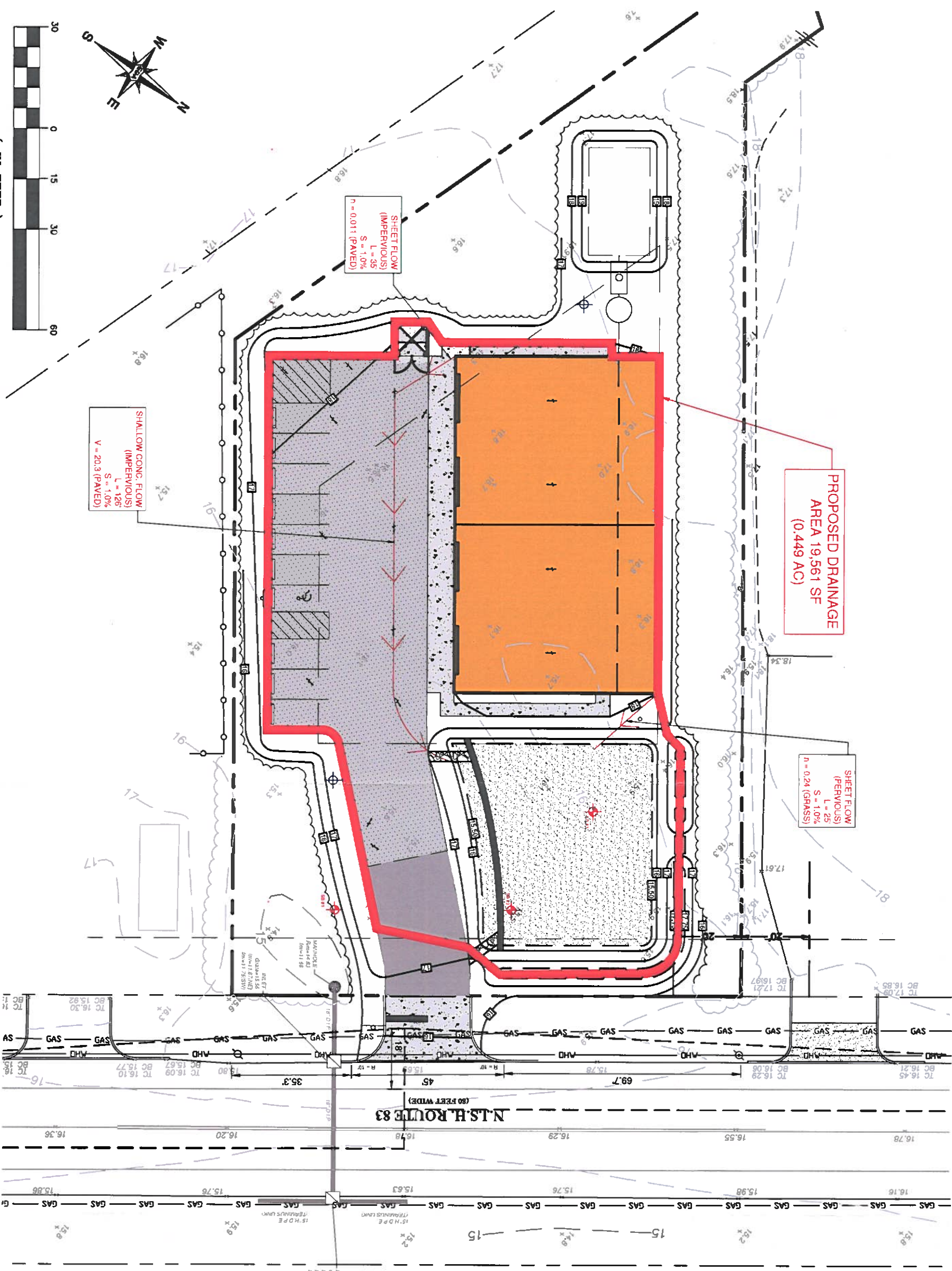


# EXISTING DRAINAGE MAP

**EDA** Engineers - Landscape Architects - Planners

<b>EDA</b> Engineering Design Associates, P.A. Cambridge Professional Offices 5 Cambridge Drive Ocean View New Jersey 08220 (809) 390-0332 • Fax (809) 390-9204 • www.engineeringdesign.com • CERTIFICATE OF AUTHORIZATION #2403767000		<b>VINCENT C. ORLANDO</b> PROFESSIONAL ENGINEER N.J.P.E. LIC. #32498		IF THIS PLAN OR DOCUMENT DOES NOT CONTAIN A RAISED SEAL IMPRESSION BEARING THE NAME AND PROFESSIONAL SEAL OF THE ENGINEER, IT MAY NOT BE REPRODUCED OR COPIED FOR ANY PURPOSE, IN WHOLE OR IN PART, WITHOUT THE WRITTEN PERMISSION OF ENGINEERING DESIGN ASSOCIATES, P.A.	
DATE: 3/27/2023 SCALE: 1" = 30' (1"X 17") PROJECT #: 9828	DRAWN BY: MSB CHECKED BY: VCO SHEET: 1 OF 2	<b>EXISTING DRAINAGE MAP</b> BLOCK 261 LOT 15.02 DENNIS TOWNSHIP CAPE MAY COUNTY, NEW JERSEY			



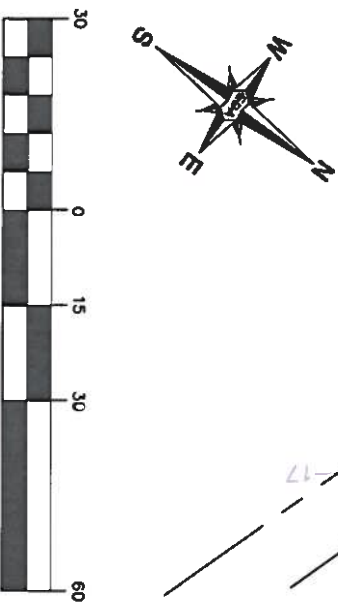


# PROPOSED DRAINAGE MAP



Engineers - Landscape Architects - Planners

( IN FEET )  
1 inch = 30 ft.



		<b>PROPOSED DRAINAGE MAP</b> BLOCK 261 LOT 15.02 DENNIS TOWNSHIP CAPE MAY COUNTY, NEW JERSEY	
DATE: 3/27/2023 SCALE: 1" = 30' (11x17) PROJECT #: 9926	DRAWN BY: MBS CHECKED BY: VCO SHEET: 2 OF 2	 <b>VINCENT C. ORLANDO</b> PROFESSIONAL ENGINEER N.J.P.E. LIC. #32498	 <b>VINCENT C. ORLANDO</b> PROFESSIONAL ENGINEER N.J.P.E. LIC. #32498



## STORMWATER MANAGEMENT CALCULATIONS

### Existing Conditions

The project site consists of an area of 1.28 Acres (0.648 Acre disturbance). The parcel consists of woodland conditions. The soil type for the project site is (DocBO) Downer Loamy Sand 0 to 5% slopes.

### Drainage Design

The project site consists of One (1) watershed areas:

- The Existing Watershed consists of woodland conditions. This watershed drains to the front of the property as a low point for the site. No discharge offsite occurs; therefore, the basin is designed to detain and infiltrate the entire 100-year storm event.

There is one (1) proposed small-scale infiltration stormwater basin within this watershed to mitigate stormwater runoff.

### Post Development Design Storm Groundwater Recharge (See attached Groundwater Recharge Spreadsheet)

- Total Storage Required: 3,613 CF
- Total Storage Available: 5,549 CF

Basin Schedule to 100 Year Elevation  
Small-Scale Infiltration Basin 3,680 CF (Elev. 15.50 – 16.54)

### Meteorological Data

(New Jersey 24 Hour Rainfall Frequency Data – Dennis Township)

2-Year	3.32 Inches
10-Year	5.17 Inches
100-Year	8.92 Inches



**Pre-Development Conditions – Existing Watershed – 19,561 SF**

<u>Cover Type</u>	<u>CN Value</u>	<u>Area</u>
Woodland – A	30	6,380 SF
Grass – A	39	13,181 SF

Tc (Pervious) = 13.1 Minutes;

<u>Design Storm</u>	<u>Pre-Development Peak Inflow</u>	<u>Pre-Development Peak Outflow</u>
2-YR	0.00 CFS	0.00 CFS
10-YR	0.00 CFS	0.00 CFS
100-YR	0.00 CFS	0.00 CFS

**Post-Development Conditions – Proposed Watershed – 19,561 SF**

<u>Cover Type</u>	<u>CN Value</u>	<u>Area</u>
Grass – A	39	5,521 SF
Impervious*	98	14,040 SF

\*For design purposes this includes asphalt, roof, concrete and the stone driveway. All 4 entities are designed with a 98 curve number.

Tc (Pervious) = 2.4 Minutes; Tc (Impervious) = 1.7 Minutes

<u>Design Storm</u>	<u>Pre-Development Peak Inflow</u>	<u>Pre-Development Peak Outflow</u>	<u>Exfiltration</u>
2-YR	1.20 CFS	0.00 CFS	0.25 CFS
10-YR	1.88 CFS	0.00 CFS	0.29 CFS
100-YR	3.46 CFS	0.00 CFS	0.37 CFS



Point of Discharge Analysis

Existing Watershed #1 vs Proposed Watershed #1 & #2

<u>Design Storm</u>	<u>Pre-Development</u>	<u>Post-Development</u>
	<u>Peak Flows Ext WS</u>	<u>Peak Flows Prop WS</u>
2-YR	0.00 CFS	0.00 CFS
10-YR	0.00 CFS	0.00 CFS
100-YR	0.00 CFS	0.00 CFS
		0%
		0%
		0%

The proposed stormwater storage facility has been designed to release the post-development peak flows for the 2-YR, 10-YR and 100-YR Design Storms below their respective pre-development peak flows. Due to no runoff coming off the site in existing conditions the basins have the volume to detain all 3 storms.

The proposed stormwater storage facilities have been designed to incorporate Green Infrastructure measures by capturing, filtering and infiltrating stormwater to help restore the natural water cycle. Specifically, the stormwater system incorporates grassland areas to provide a simple disconnection of flows and to infiltrate clean runoff close to the initial source.

All of the proposed watershed areas have been created to be less than the 2.50 acre maximum required for small scale structures.

The proposed stormwater system has been designed to meet the NJDEP Stormwater Management Rules. The Stormwater Management System has been designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff generated from the Water Quality Design Storm by 80% utilizing a treatment train of infiltration basins. All water quality storms have been designed to infiltrate into their respective basin (see tables below).

Small-Scale Infiltration Basin #1 – Storage Volumes

<u>Elevation</u>	<u>Storage Volume</u>	<u>Elevation</u>
15.50	0 CF	
16.00	1,675 CF	
17.00	5,549 CF	
<u>Water Quality Design Storm.....</u>		
<u>2-Year Design Storm .....</u>		
<u>10-Year Design Storm .....</u>		
<u>100-Year Design Storm .....</u>		
		15.66
		15.74
		15.97
		16.54





NOAA Atlas 14, Volume 2, Version 3  
Location name: Cape May Court House, New Jersey, USA\*  
Latitude: 39.155° Longitude: -74.7668°  
Elevation: 14.36 ft\*\*  
\* source: ESRI Maps  
\*\* source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bornin, 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) <sup>1</sup>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.348 (0.312-0.387)	0.404 (0.363-0.447)	0.460 (0.412-0.509)	0.533 (0.477-0.591)	0.600 (0.536-0.667)	0.662 (0.589-0.736)	0.715 (0.633-0.798)	0.765 (0.672-0.855)	0.820 (0.713-0.922)	0.876 (0.755-0.990)
10-min	0.556 (0.498-0.616)	0.547 (0.488-0.606)	0.736 (0.659-0.813)	0.853 (0.763-0.945)	0.957 (0.854-1.06)	1.06 (0.937-1.17)	1.14 (1.01-1.26)	1.21 (1.07-1.36)	1.30 (1.13-1.46)	1.38 (1.18-1.58)
15-min	0.694 (0.622-0.772)	0.813 (0.729-0.900)	0.932 (0.834-1.03)	1.08 (0.965-1.20)	1.21 (1.08-1.35)	1.34 (1.19-1.49)	1.44 (1.27-1.60)	1.53 (1.34-1.71)	1.63 (1.42-1.84)	1.73 (1.49-1.98)
30-min	0.952 (0.853-1.05)	1.12 (1.01-1.24)	1.32 (1.19-1.47)	1.56 (1.40-1.73)	1.80 (1.60-2.00)	2.01 (1.79-2.24)	2.20 (1.96-2.45)	2.38 (2.09-2.66)	2.60 (2.26-2.92)	2.81 (2.42-3.17)
60-min	1.19 (1.06-1.32)	1.41 (1.26-1.56)	1.70 (1.52-1.88)	2.04 (1.82-2.26)	2.39 (2.13-2.66)	2.73 (2.42-3.03)	3.03 (2.68-3.37)	3.34 (2.94-3.73)	3.73 (3.24-4.19)	4.10 (3.53-4.63)
2-hr	1.45 (1.28-1.63)	1.72 (1.52-1.93)	2.08 (1.84-2.34)	2.52 (2.22-2.83)	2.98 (2.63-3.36)	3.42 (3.00-3.86)	3.84 (3.34-4.34)	4.28 (3.69-4.86)	4.81 (4.11-5.49)	5.33 (4.50-6.12)
3-hr	1.59 (1.41-1.80)	1.88 (1.67-2.12)	2.29 (2.03-2.57)	2.77 (2.45-3.12)	3.31 (2.90-3.73)	3.82 (3.33-4.31)	4.31 (3.73-4.87)	4.83 (4.14-5.47)	5.49 (4.65-6.26)	6.13 (5.13-7.03)
6-hr	1.96 (1.75-2.24)	2.32 (2.07-2.58)	2.80 (2.48-3.16)	3.40 (3.01-3.86)	4.10 (3.60-4.64)	4.79 (4.17-5.42)	5.45 (4.72-6.19)	6.17 (5.28-7.03)	7.14 (6.00-8.17)	8.08 (6.89-9.32)
12-hr	2.36 (2.10-2.68)	2.78 (2.48-3.15)	3.36 (3.00-3.81)	4.12 (3.66-4.58)	5.04 (4.44-5.69)	5.97 (5.21-6.75)	6.91 (5.96-7.85)	7.96 (6.78-9.07)	9.40 (7.81-10.8)	10.9 (9.84-12.5)
24-hr	2.73 (2.47-3.03)	3.32 (3.01-3.69)	4.31 (3.80-4.79)	5.17 (4.66-5.73)	6.48 (5.79-7.15)	7.63 (6.78-8.39)	8.92 (7.85-9.80)	10.4 (9.04-11.4)	12.5 (10.8-13.8)	14.6 (12.3-15.9)
2-day	3.13 (2.83-3.49)	3.82 (3.44-4.25)	4.96 (4.47-5.51)	5.94 (5.34-6.59)	7.42 (6.63-8.20)	8.72 (7.73-9.63)	10.2 (8.85-11.2)	11.8 (10.3-13.0)	14.3 (12.3-15.7)	16.4 (14.0-18.1)
3-day	3.30 (3.00-3.64)	4.01 (3.66-4.42)	5.19 (4.72-5.71)	6.19 (5.62-6.81)	7.70 (6.85-8.44)	9.01 (8.08-9.87)	10.5 (9.32-11.5)	12.1 (10.7-13.2)	14.6 (12.7-15.9)	16.7 (14.6-18.3)
4-day	3.46 (3.16-3.78)	4.20 (3.87-4.50)	5.42 (4.97-5.91)	6.44 (5.80-7.03)	7.98 (7.27-8.69)	9.31 (8.43-10.1)	10.8 (9.69-11.7)	12.4 (11.1-13.5)	14.9 (13.1-16.1)	17.0 (15.1-18.4)
7-day	4.01 (3.71-4.36)	4.84 (4.47-5.28)	6.13 (5.66-6.67)	7.23 (6.66-7.85)	8.65 (8.10-9.59)	10.2 (9.33-11.1)	11.8 (10.8-12.7)	13.4 (12.1-14.5)	15.9 (14.1-17.2)	18.1 (15.8-19.5)
10-day	4.50 (4.16-4.86)	5.40 (5.02-5.84)	6.73 (6.26-7.27)	7.84 (7.26-8.45)	9.43 (8.70-10.2)	10.8 (9.88-11.6)	12.2 (11.1-13.1)	13.7 (12.5-14.8)	16.1 (14.6-17.3)	18.2 (16.1-19.5)
20-day	6.01 (5.65-6.41)	7.15 (6.72-7.62)	8.66 (8.11-9.22)	9.86 (9.24-10.5)	11.6 (10.8-12.3)	12.9 (12.0-13.6)	14.3 (13.3-15.3)	15.8 (14.6-16.8)	17.9 (16.4-19.0)	19.5 (17.7-20.9)
30-day	7.50 (7.07-7.95)	8.89 (8.37-9.43)	10.6 (9.97-11.2)	11.9 (11.2-12.7)	13.8 (12.9-14.6)	15.3 (14.3-16.2)	16.7 (15.6-17.7)	18.2 (17.0-19.3)	20.3 (18.8-21.5)	21.9 (20.1-23.3)
45-day	9.49 (9.01-10.0)	11.2 (10.6-11.8)	13.1 (12.5-13.8)	14.8 (13.6-15.4)	16.5 (15.6-17.4)	18.0 (17.0-18.9)	19.4 (18.3-20.5)	20.8 (19.6-22.0)	22.7 (21.2-23.9)	24.0 (22.4-25.4)
60-day	11.3 (10.7-11.9)	13.3 (12.6-13.9)	15.4 (14.6-16.1)	16.9 (16.1-17.8)	18.9 (17.9-19.8)	20.3 (19.3-21.4)	21.7 (20.6-22.8)	23.0 (21.7-24.2)	24.7 (23.2-26.0)	26.9 (24.3-27.3)

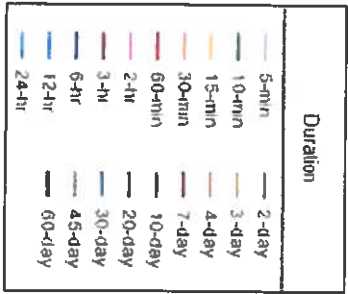
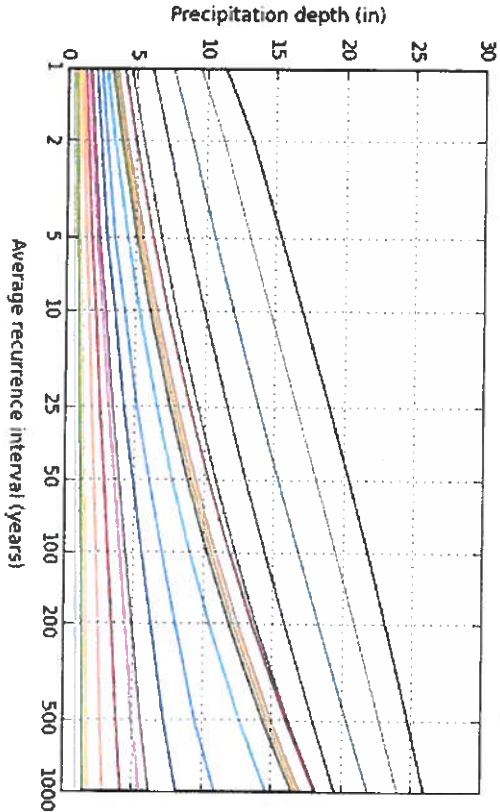
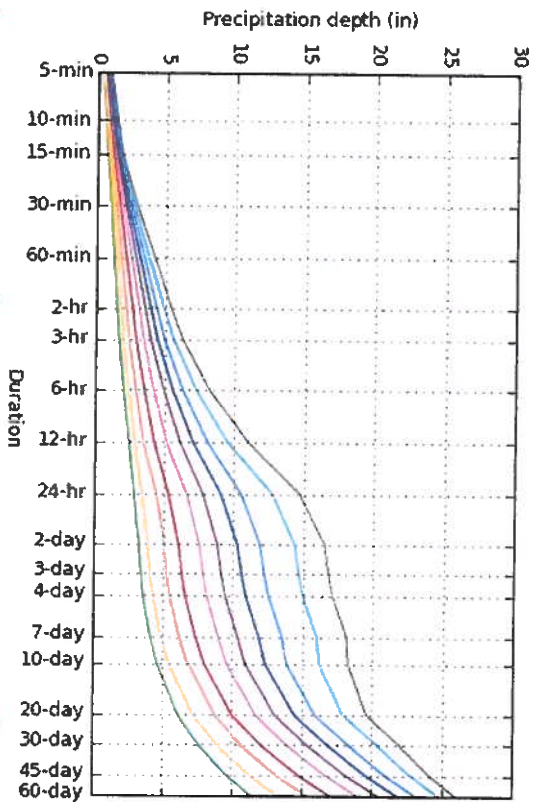
<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parentheses are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration 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](#)



PDS-based depth-duration-frequency (DDF) curves  
Latitude: 39.1550°, Longitude: -74.7668°



NOAA Atlas 14, Volume 2, Version 3

Created (GMT): Thu Aug 18 13:37:10 2022

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Maps & aeriats

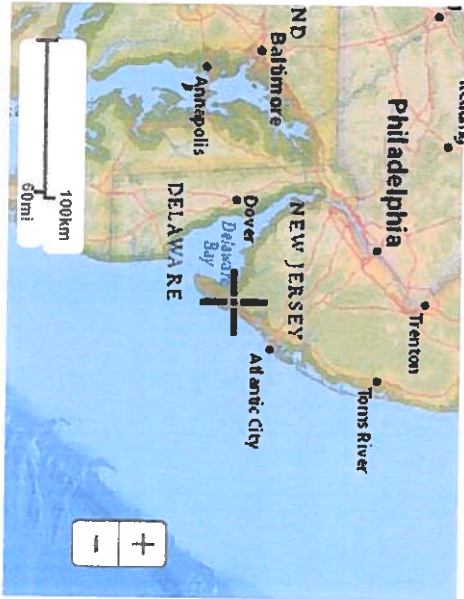
Small scale terrain



Large scale terrain



Precipitation Frequency Data Server



Large scale map



Large scale aerial

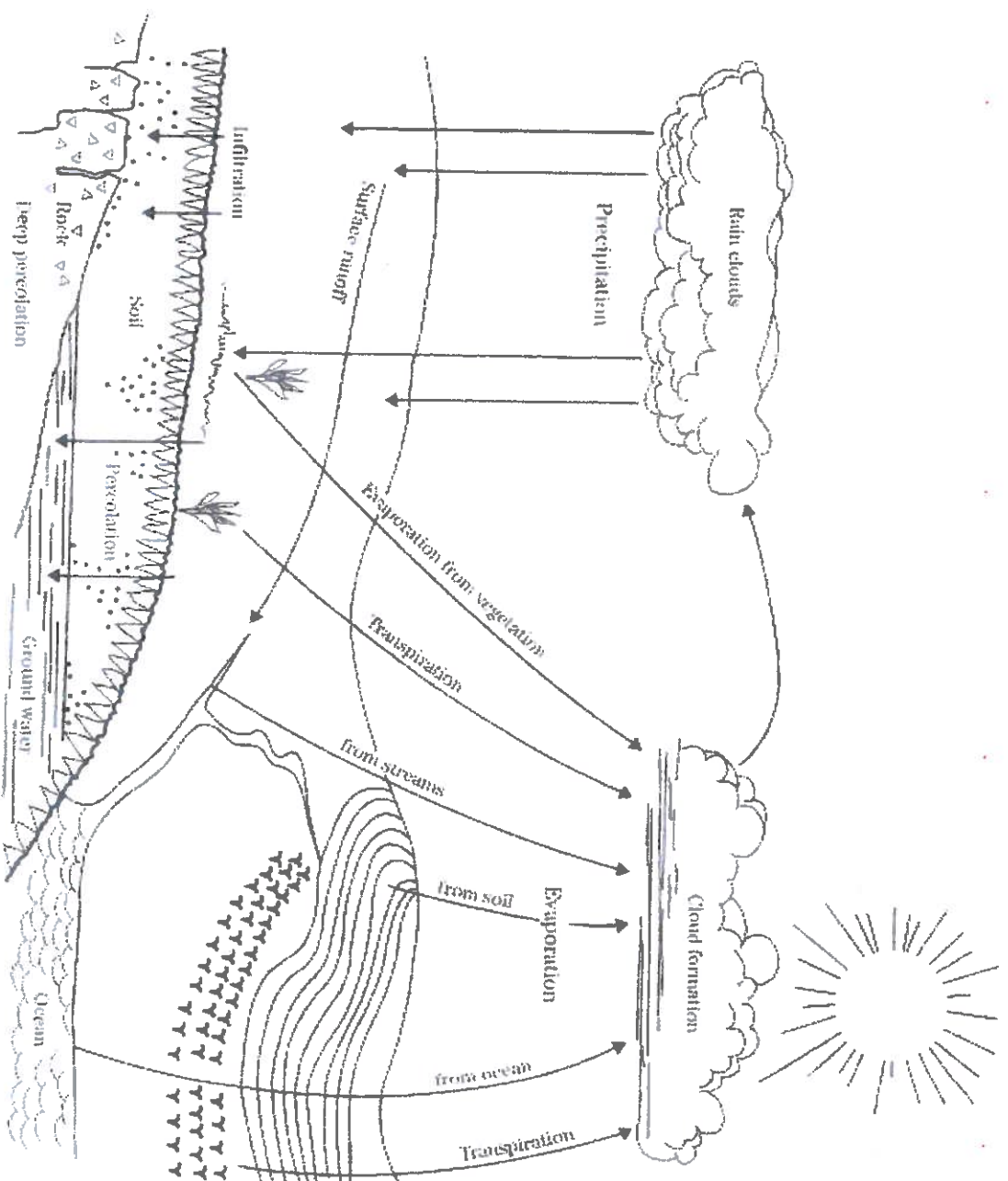


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Silver Spring, MD 20910  
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## Chapter 15 Time of Concentration





Thick mulches in forests are associated with low retardance factors and reflect high degrees of retardance, as well as high infiltration rates. Hay meadows have relatively low retardance factors. Like thick mulches in forests, stem densities in meadows provide a high degree of retardance to overland flow in small watersheds. Conversely, bare surfaces with little retardance to overland flows are represented by high retardance factors.

The retardance factor is approximately the same as the curve number (CN) as defined in NEH630.09.

Hydrologic Soil-Cover Complexes. In practical usage, CN is used as a surrogate for  $c_n$ , and the CN tables in NEH 630.09 may be used to approximate  $c_n$  in equations 15-4a and 15-4b. A CN of less than 50, or greater than 95 should not be used in the solution of equations 15-4a and 15-4b (Mockus 1961).

**Applications and limitations.**—The watershed lag equation was developed using data from 24 watersheds ranging in size from 1.3 acres to 9.2 square miles, with the majority of the watersheds being less than 2,000 acres in size (Mockus 1961). Polmar and Miller (2000) revisited the development of this equation using additional watershed data and found that a reasonable upper limit may be as much as 19 square miles.

### (b) Velocity method

Another method for determining time of concentration normally used within the NRCS is called the velocity method. The velocity method assumes that time of concentration is the sum of travel times for segments along the hydraulically most distant flow path.

$$T_c = T_u + T_v + T_o + \dots T_m \quad (\text{eq. 15-7})$$

where:

$T_u$  = time of concentration, h

$T_m$  = travel time of a segment  $m$ , h

$n$  = number of segments comprising the total hydraulic length

The segments used in the velocity method may be of three types: sheet flow, shallow concentrated flow, and open channel flow.

**Sheet flow.**—Sheet flow is defined as flow over plane surfaces. Sheet flow usually occurs in the headwaters of a stream near the ridgepole that elevates the

watershed boundary. Typically, sheet flow occurs for no more than 100 feet before transitioning to shallow concentrated flow (Merkel 2001).

A simplified version of the Manning's kinematic solution may be used to compute travel time for sheet flow. This simplified form of the kinematic equation was developed by Welle and Woodward (1986) after studying the impact of various parameters on the estimates.

$$T_t = \frac{0.007 (n \ell)^{0.6}}{(P_2)^{0.4} S^{0.4}} \quad (\text{eq. 15-8})$$

where:

$T_t$  = travel time, h

$n$  = Manning's roughness coefficient (table 15-1)

$\ell$  = sheet flow length, ft

$P_2$  = 2-year, 24-hour rainfall, in

$S$  = slope of land surface, ft/ft

**Table 15-1** Manning's roughness coefficients for sheet flow (flow depth generally  $\leq 0.1$  ft)

Surface description	$n$ , <sup>a</sup>
Smooth surface (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover $\leq 20\%$	0.06
Residue cover $> 20\%$	0.17
Grass:	
Short-grass prairie	0.15
Dense grasses <sup>b</sup>	0.21
Bermudagrass	0.41
Range (natural)	0.13
Woods, <sup>c</sup>	
Light underbrush	0.40
Dense underbrush	0.90

<sup>a</sup> The Manning's  $n$  values are a composite of information compiled by Benjamin (1986).

<sup>b</sup> Includes species such as weeping lovegrass, biggrass, bufford grass, late quina grass, and native grass mixtures.

<sup>c</sup> When selecting  $n$ , roughness cover to a height of about 2 ft. This is the only part of the plant cover that will obstruct sheet flow.



This simplification is based on the following assumptions:

- shallow steady uniform flow
- constant rainfall excess intensity (that part of a rain available for runoff) both temporally and spatially
- 2-year, 24-hour rainfall assuming standard NRCS rainfall intensity-duration relations apply (Types I, II, and III)
- minor effect of infiltration on travel time

For sheet flow, the roughness coefficient includes the effects of roughness and the effects of raindrop impact including drag over the surface; obstacles such as litter, crop ridges, and rocks; and erosion and transport of sediment. These  $n$  values are only applicable for flow depths of approximately 0.1 foot or less, where sheet flow occurs. Table 15-1 gives roughness coefficient values for sheet flow for various surface conditions.

Kibler and Aron (1982) and others indicated the **maximum sheet flow length is less than 100 feet**. To support the sheet flow limit of 100 feet, Merkel (2001) reviewed a number of technical papers on sheet flow. McCuen and Spiess (1985) indicated that use of flow length as the limiting variable in the equation 15-8 could lead to less accurate designs, and proposed that the limitation should instead be based on:

$$f = \frac{100\sqrt{S}}{n} \quad (\text{eq. 15-9})$$

*~ 9.6 min or 0.16 hr*

**Table 15-2** Maximum sheet flow lengths using the McCuen-Spiess limitation criterion

Cover type	$n$ values	Slope (ft/n)	Length (n)
Range	0.13	0.01	77
Grass	0.11	0.01	24
Woods	0.80	0.01	12.5
Range	0.13	0.05	172
Grass	0.11	0.05	65
Woods	0.80	0.05	28

where:  
 $n$  = Manning's roughness coefficient  
 $f$  = limiting length of flow, ft  
 $S$  = slope, ft/ft

Table 15-2 provides maximum sheet flow lengths based on the McCuen-Spiess limiting criteria for various cover type— $n$  value—slope combinations.

**Shallow concentrated flow**—After approximately 100 feet, sheet flow usually becomes shallow concentrated flow collecting in swales, small rills, and gullies. Shallow concentrated flow is assumed not to have a well-defined channel and has flow depths of 0.1 to 0.5 feet. It is assumed that shallow concentrated flow can be represented by one of seven flow types. The curves in figure 15-4 were used to develop the information in table 15-3.

To estimate shallow concentrated flow travel time, velocities are developed using figure 15-4, in which average velocity is a function of watercourse slope and type of channel (Kent 1964). For slopes less than 0.005 foot per foot, the equations in table 15-3 may be used.

After estimating average velocity using figure 15-4, use equation 15-1 to estimate travel time for the shallow concentrated flow segment.

**Open channel flow**—Shallow concentrated flow is assumed to occur after sheet flow ends at shallow depths of 0.1 to 0.5 feet. Beyond that channel flow is assumed to occur. Open channels are assumed to begin where surveyed cross-sectional information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on U.S. Geological Survey (USGS) quadrangle sheets.

Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for the bankfull elevation.

Manning's equation is:

$$V = \frac{1.49 R^{2/3} S^{1/2}}{n} \quad (\text{eq. 15-10})$$



Engineering Design Associates

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JOB Sheet Flow Limits

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE \_\_\_\_\_

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_

Existing Unaltered

$$S = 2' / 1.9' = 1.05'$$

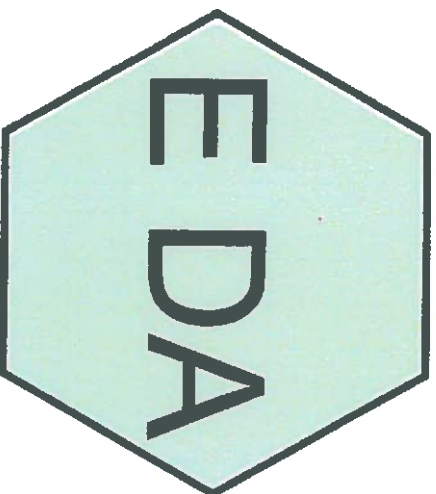
$$n = 0.40$$

$$L = \frac{1.05 \sqrt{S}}{n} = \frac{1.05 \sqrt{1.05}}{0.40} = \boxed{25.62'}$$

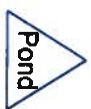


# **PRE-DEVELOPMENT RUNOFF**





# Ext. Drainage Area



**Routing Diagram for Rt 83 Storage Keith**  
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**Rt 83 Storage Keith**

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Page 2

**Rainfall Events Listing (selected events)**

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2 Year Storm	NOAA 24-hr	C	Default	24.00	1	3.32	2
2	10 Year Storm	NOAA 24-hr	C	Default	24.00	1	5.17	2
3	100 Year Storm	NOAA 24-hr	C	Default	24.00	1	8.92	2
4	WQ	NJ DEP 2-hr		Default	2.00	1	1.25	2



**Rt 83 Storage Keith**

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**Area Listing (selected nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
13,181	39	>75% Grass cover, Good, HSG A (E DA)
6,380	30	Woods, Good, HSG A (E DA)
19,561	36	TOTAL AREA



Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
19,561	HSG A	E DA
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
19,561	TOTAL AREA	



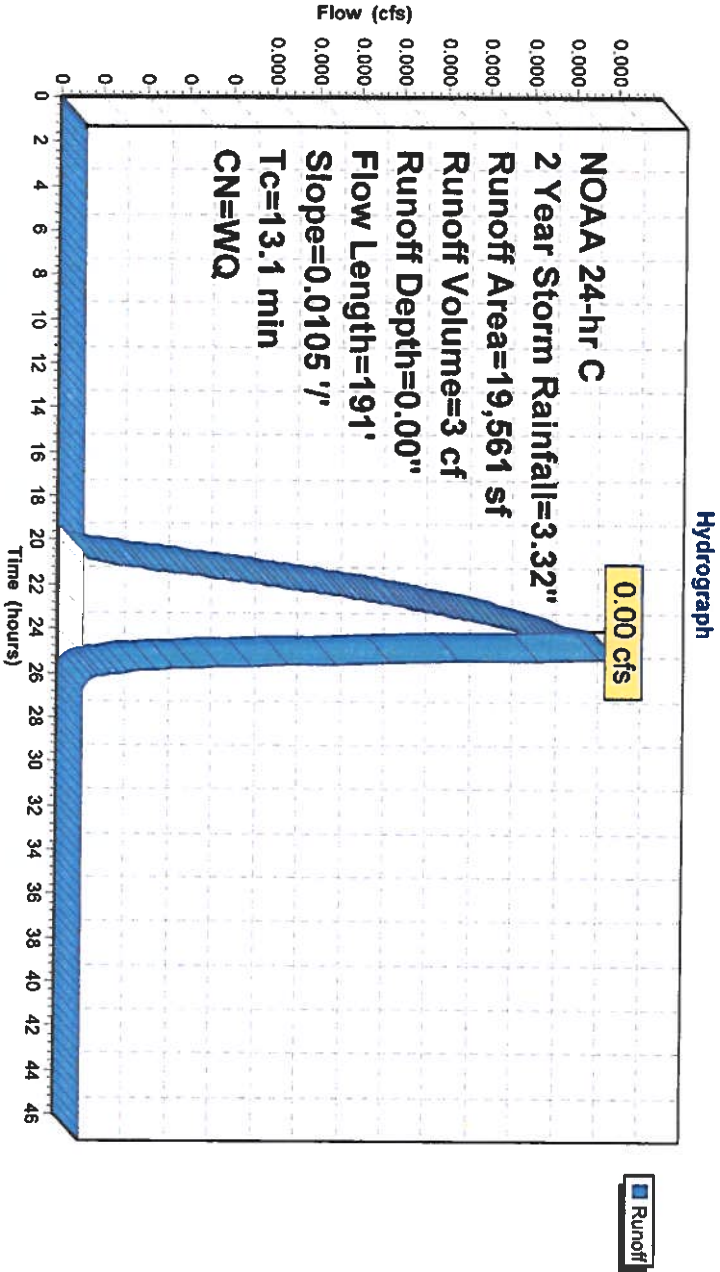
Summary for Subcatchment E DA: Ext. Drainage Area

Runoff = 0.00 cfs @ 24.04 hrs, Volume= 3 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
NOAA 24-hr C 2 Year Storm Rainfall=3.32"

Area (sf)		CN	Description		
6,380	30	Woods, Good, HSG A			
13,181	39	>75% Grass cover, Good, HSG A			
19,561	Weighted Average				
19,561	100.00% Pervious Area				
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	26	0.0105	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.31"
3.8	165	0.0105	0.72		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
13.1	191	Total			

Subcatchment E DA: Ext. Drainage Area





Summary for Subcatchment E DA: Ext. Drainage Area

Runoff = 0.01 cfs @ 13.00 hrs, Volume= 265 cf, Depth= 0.16"

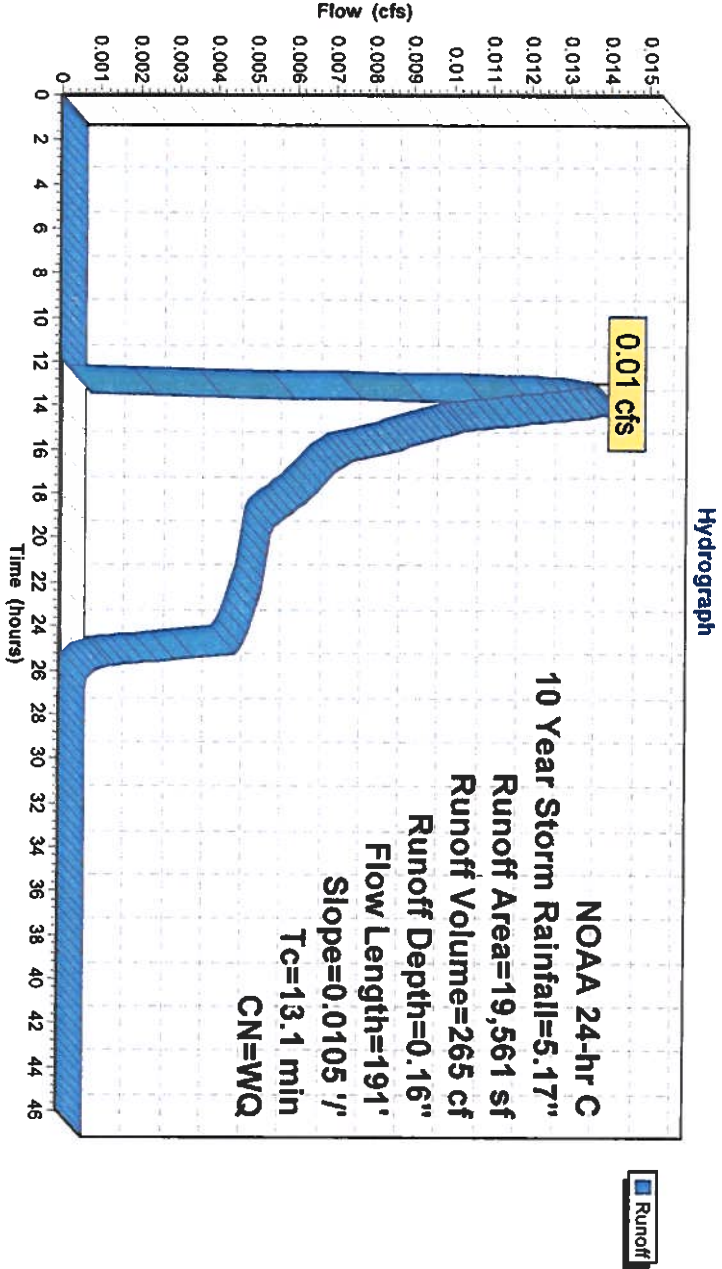
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs

NOAA 24-hr C 10 Year Storm Rainfall=5.17"

Area (sf)	CN	Description
6,380	30	Woods, Good, HSG A
13,181	39	>75% Grass cover, Good, HSG A
19,561		Weighted Average
19,561		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	26	0.0105	0.05		Sheet Flow, Woods: Light underbrush n=0.400 P2=3.31"
3.8	165	0.0105	0.72		Shallow Concentrated Flow, Short Grass Pasture Kv=7.0 fps
13.1	191	Total			

Subcatchment E DA: Ext. Drainage Area





Summary for Subcatchment E DA: Ext. Drainage Area

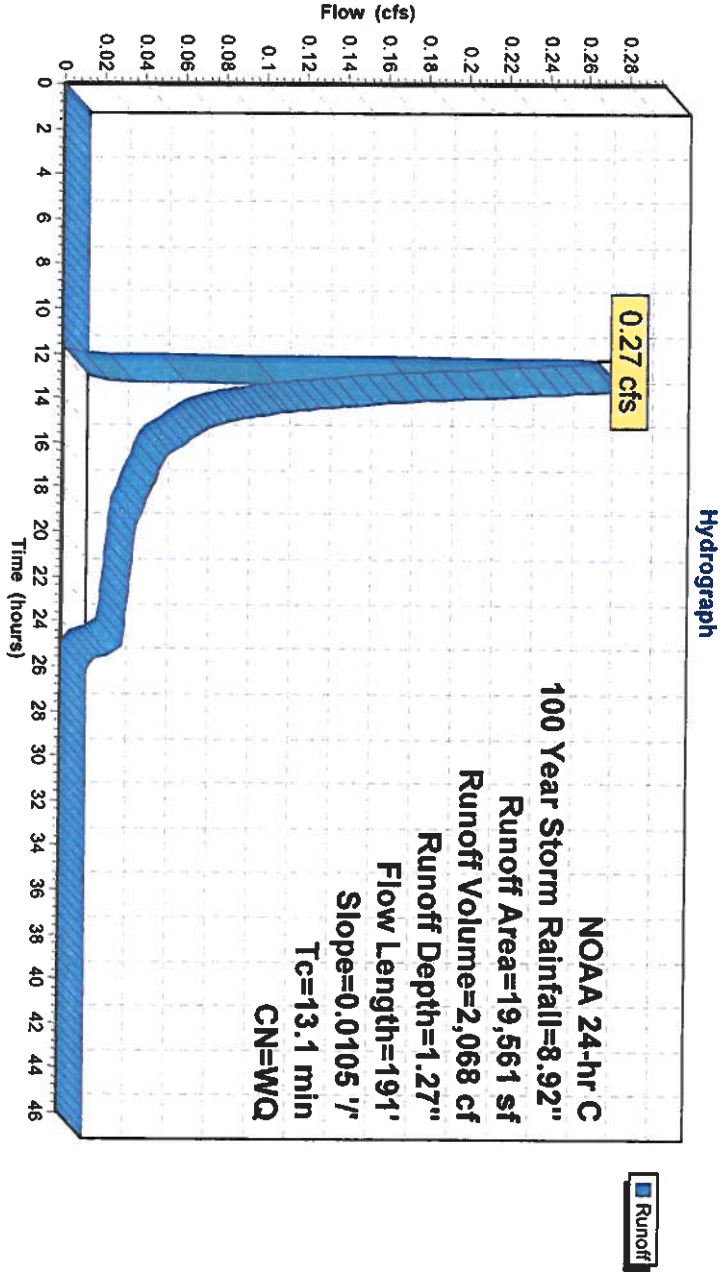
Runoff = 0.27 cfs @ 12.32 hrs, Volume= 2,068 cf, Depth= 1.27"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs

NOAA 24-hr C 100 Year Storm Rainfall=8.92"

Area (sf)		CN	Description		
6,380	30	Woods, Good, HSG A			
13,181	39	>75% Grass cover, Good, HSG A			
19,561		Weighted Average			
19,561		100.00% Pervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	26	0.0105	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.31"
3.8	165	0.0105	0.72		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
13.1	191	Total			

Subcatchment E DA: Ext. Drainage Area





Summary for Subcatchment E DA: Ext. Drainage Area

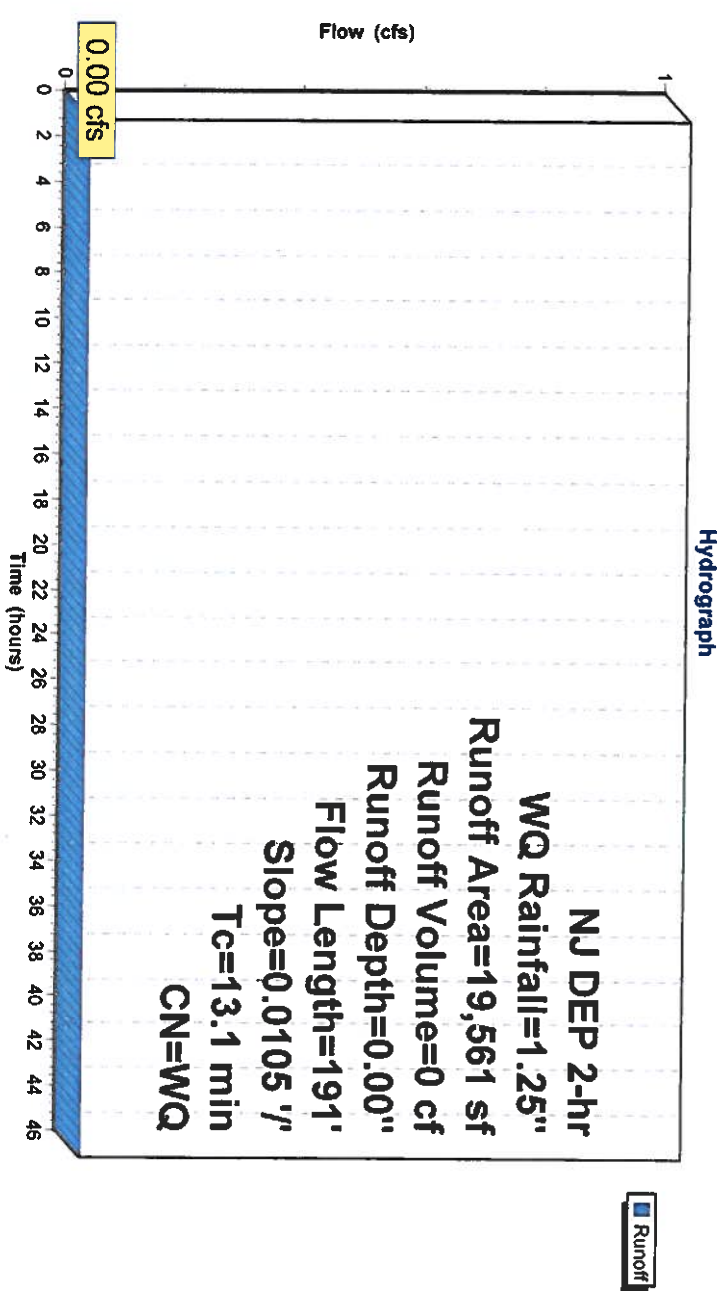
[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
NJ DEP 2-hr WQ Rainfall=1.25"

Area (sf)		CN	Description		
6,380	30	Woods, Good, HSG A			
13,181	39	>75% Grass cover, Good, HSG A			
19,561		Weighted Average			
19,561		100.00% Pervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	26	0.0105	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.31"
3.8	165	0.0105	0.72		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps

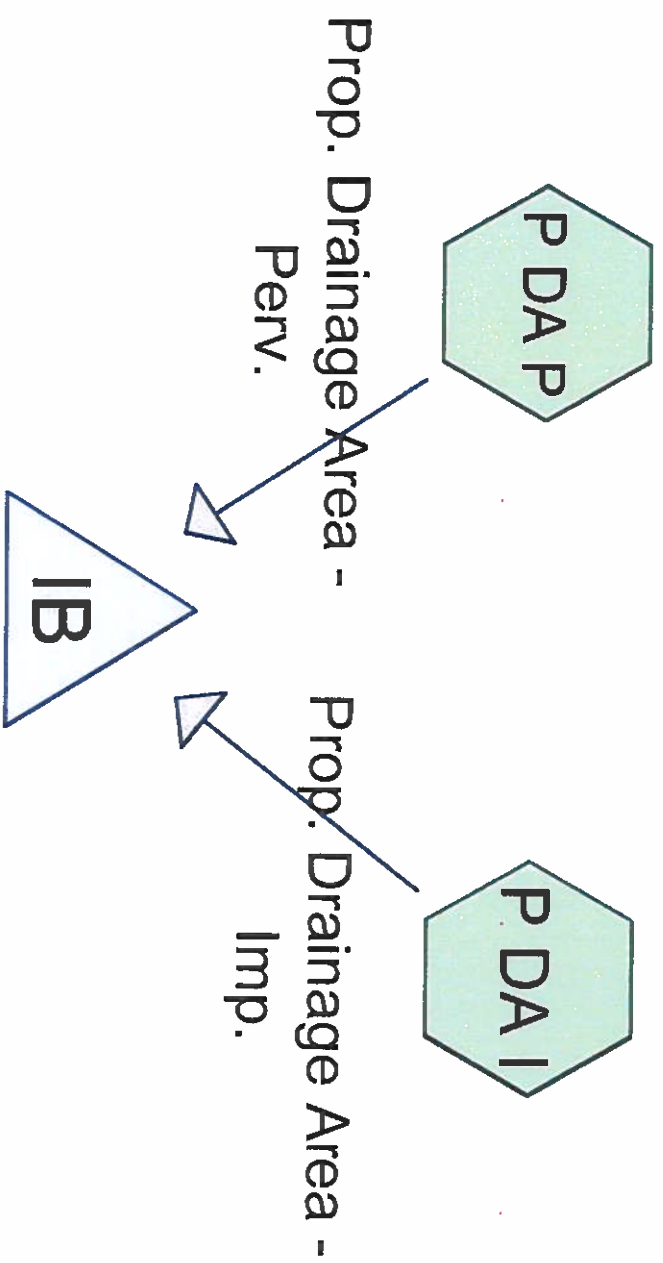
Subcatchment E DA: Ext. Drainage Area





# POST-DEVELOPMENT RUNOFF





- Subcat
- Reach
- Pond
- Link



**Rt 83 Storage Keith**

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**Rainfall Events Listing (selected events)**

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2 Year Storm	NOAA 24-hr	C	Default	24.00	1	3.32	2
2	10 Year Storm	NOAA 24-hr	C	Default	24.00	1	5.17	2
3	100 Year Storm	NOAA 24-hr	C	Default	24.00	1	8.92	2
4	WQ	NJ DEP 2-hr		Default	2.00	1	1.25	2



**Rt 83 Storage Keith**

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Page 3

**Area Listing (selected nodes)**

Area (sq-ft)	CN	Description (subcatchment-numbers)
5,521	39	>75% Grass cover, Good, HSG A (P DA P)
14,040	98	Paved parking, HSG A - Gravel (P DA I)
19,561	81	TOTAL AREA



Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
19,561	HSG A	P DA I, P DA P
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
19,561	TOTAL AREA	



Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
5,521	0	0	0	0	5,521	>75% Grass cover, Good
14,040	0	0	0	0	14,040	Paved parking
19,561	0	0	0	0	19,561	TOTAL AREA

S  
N



Time span=0.00-46.00 hrs, dt=0.05 hrs, 921 points

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentP DA I: Prop. Drainage**

Runoff Area=14,040 sf 100.00% Impervious Runoff Depth=3.09"  
Flow Length=161' Slope=0.0100 1/ Slope=0.0100 1/ Tc=1.7 min CN=98 Runoff=1.20 cfs 3,612 cf

**SubcatchmentP DA P: Prop. Drainage**

Runoff Area=5,521 sf 0.00% Impervious Runoff Depth=0.00"  
Flow Length=25' Slope=0.1000 1/ Tc=2.4 min CN=39 Runoff=0.00 cfs 1 cf

**Pond IB: Infiltration Basin**

Peak Elev=15.74' Storage=777 cf Inflow=1.20 cfs 3,613 cf  
Outflow=0.25 cfs 3,613 cf

**Total Runoff Area = 19,561 sf Runoff Volume = 3,613 cf Average Runoff Depth = 2.22"**  
**28.22% Pervious = 5,521 sf 71.78% Impervious = 14,040 sf**



Summary for Subcatchment P DA I: Prop. Drainage Area - Imp.

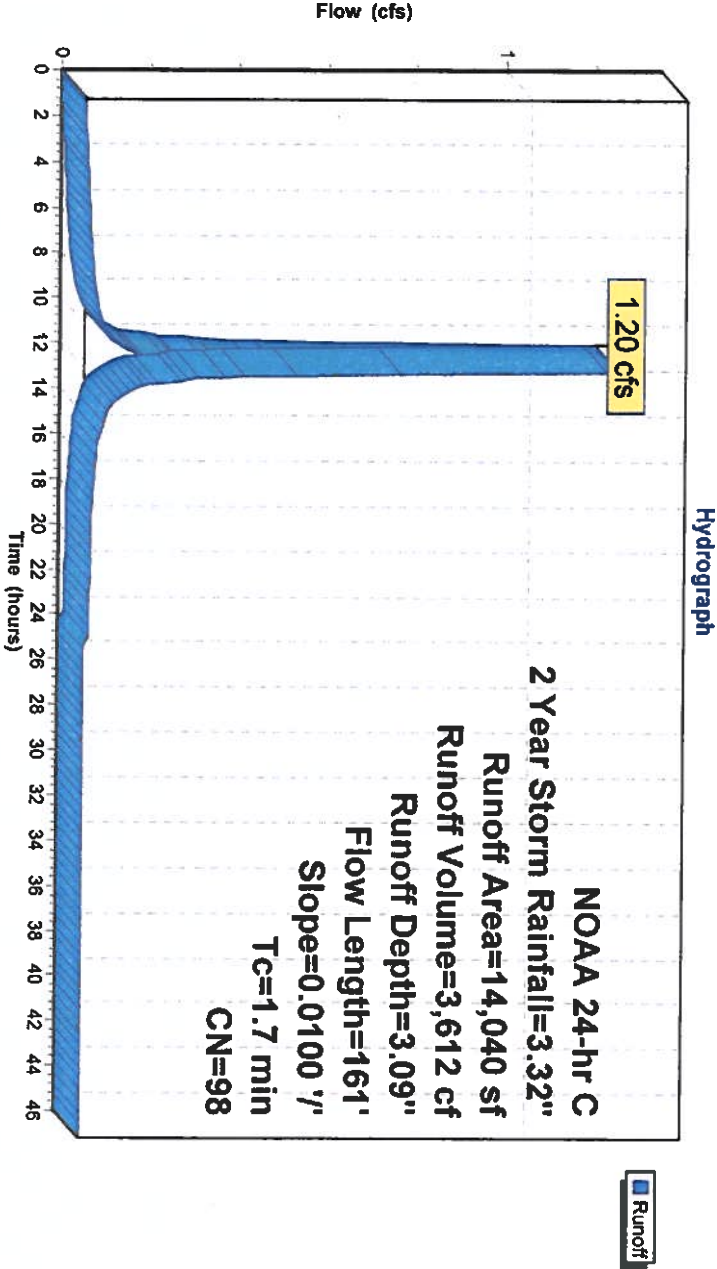
[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.20 cfs @ 12.08 hrs, Volume= 3,612 cf, Depth= 3.09"  
Routed to Pond IB : Infiltration Basin

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
NOAA 24-hr C 2 Year Storm Rainfall=3.32"

Area (sf)		CN	Description		
14,040		98	Paved parking, HSG A - Gravel		
14,040			100.00% Impervious Area		
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	35	0.0100	0.86		Sheet Flow, Pavement
					Smooth surfaces n= 0.011 P2= 3.31"
1.0	126	0.0100	2.03		Shallow Concentrated Flow,
					Paved Kv= 20.3 fps
1.7	161	Total			

Subcatchment P DA I: Prop. Drainage Area - Imp.





Summary for Subcatchment P DA P: Prop. Drainage Area - Perv.

[49] Hint: Tc<2dt may require smaller dt

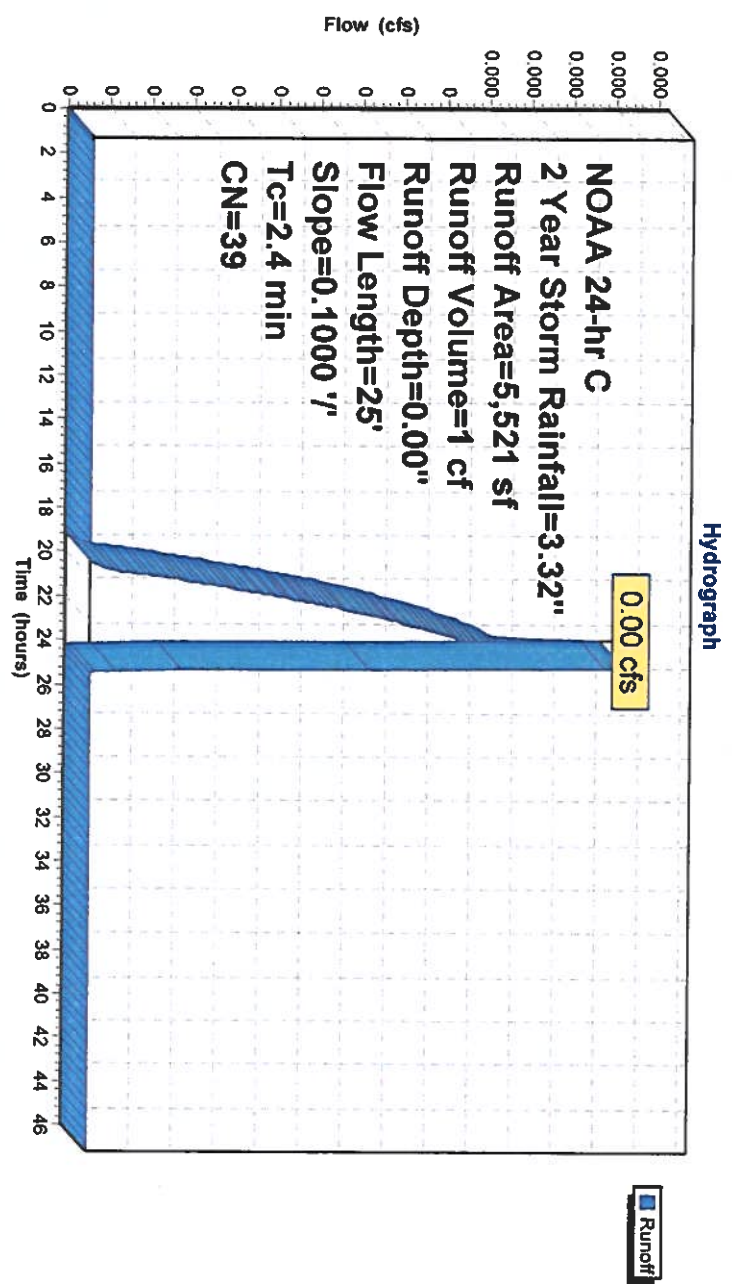
Runoff = 0.00 cfs @ 23.98 hrs, Volume= 1 cf, Depth= 0.00"  
Routed to Pond IB : Infiltration Basin

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
NOAA 24-hr C 2 Year Storm Rainfall=3.32"

Area (sf)						CN	Description
5,521						39	>75% Grass cover, Good, HSG A
5,521							100.00% Pervious Area
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description		

Sheet Flow,  
Grass: Dense n= 0.240 P2= 3.31"

Subcatchment P DA P: Prop. Drainage Area - Perv.





Summary for Pond IB: infiltration Basin

Inflow Area = 19,561 sf, 71.78% Impervious, Inflow Depth = 2.22" for 2 Year Storm event  
 Inflow = 1.20 cfs @ 12.08 hrs, Volume= 3,613 cf  
 Outflow = 0.25 cfs @ 12.37 hrs, Volume= 3,613 cf, Atten= 79%, Lag= 16.9 min  
 Discarded = 0.25 cfs @ 12.37 hrs, Volume= 3,613 cf

Routing by Stor-Ind method, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
 Peak Elev= 15.74' @ 12.37 hrs Surf.Area= 3,342 sf Storage= 777 cf

Plug-Flow detention time= 17.6 min calculated for 3,609 cf (100% of inflow)  
 Center-of-Mass det. time= 17.6 min ( 771.6 - 754.0 )

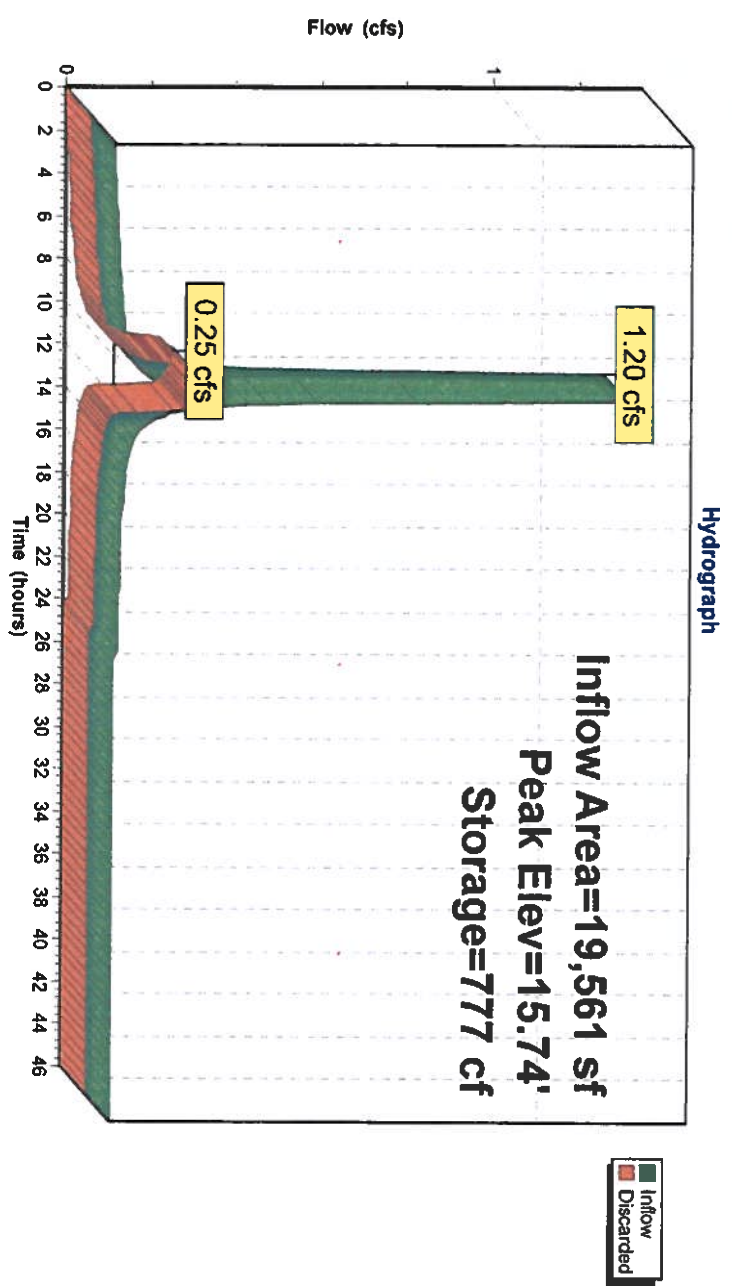
Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	5,549 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.50	3,175	0	0
17.00	4,223	5,549	5,549

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.50'	3,000 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 13.00'

Discarded OutFlow Max=0.25 cfs @ 12.37 hrs HW=15.74' (Free Discharge)  
 1=Exfiltration ( Controls 0.25 cfs)



Pond IB: infiltration Basin





Time span=0.00-46.00 hrs, dt=0.05 hrs, 921 points  
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P DA I: Prop. Drainage**    Runoff Area=14,040 sf    100.00% Impervious    Runoff Depth=4.93"  
Flow Length=161'    Slope=0.0100 y'    Tc=1.7 min    CN=98    Runoff=1.88 cfs    5,772 cf

**Subcatchment P DA P: Prop. Drainage Area** - Runoff Area=5,521 sf    0.00% Impervious    Runoff Depth=0.24"  
Flow Length=25'    Slope=0.1000 y'    Tc=2.4 min    CN=39    Runoff=0.01 cfs    108 cf

**Pond IB: infiltration Basin**    Peak Elev=15.97'    Storage=1,583 cf    Inflow=1.88 cfs    5,880 cf  
Outflow=0.29 cfs    5,880 cf

**Total Runoff Area = 19,561 sf    Runoff Volume = 5,880 cf    Average Runoff Depth = 3.61"**  
**28.22% Pervious = 5,521 sf    71.78% Impervious = 14,040 sf**



Summary for Subcatchment P DA I: Prop. Drainage Area - Imp.

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.88 cfs @ 12.08 hrs, Volume= 5,772 cf, Depth= 4.93"

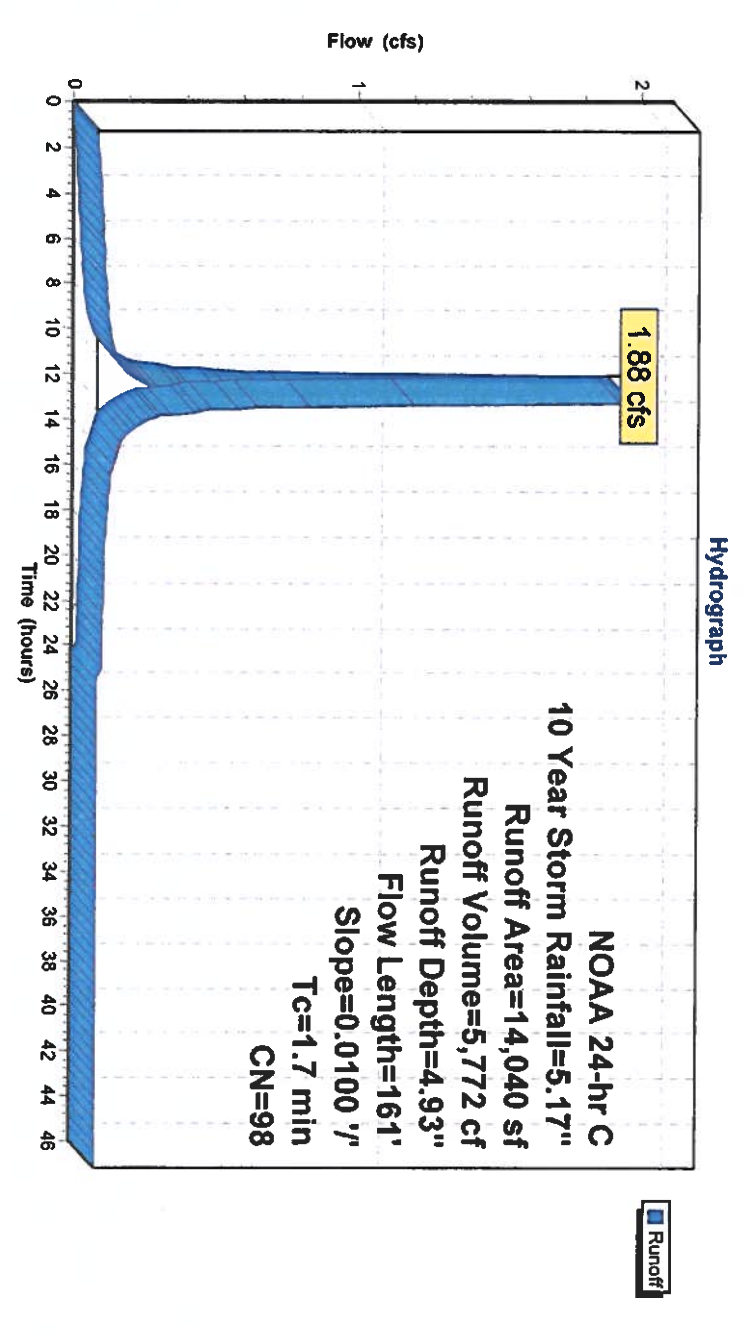
Routed to Pond IB : Infiltration Basin

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs

NOAA 24-hr C 10 Year Storm Rainfall=5.17"

Area (sf)						CN	Description	
14,040						98	Paved parking, HSG A - Gravel	
14,040							100.00% Impervious Area	
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description			
0.7	35	0.0100	0.86		Sheet Flow, Pavement			
					Smooth surfaces n= 0.011 P2= 3.31"			
1.0	126	0.0100	2.03		Shallow Concentrated Flow,			
					Paved Kv= 20.3 fps			
1.7	161	Total						

Subcatchment P DA I: Prop. Drainage Area - Imp.





Summary for Subcatchment P DA P: Prop. Drainage Area - Perv.

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.01 cfs @ 12.50 hrs, Volume= 108 cf, Depth= 0.24"  
Routed to Pond IB : infiltration Basin

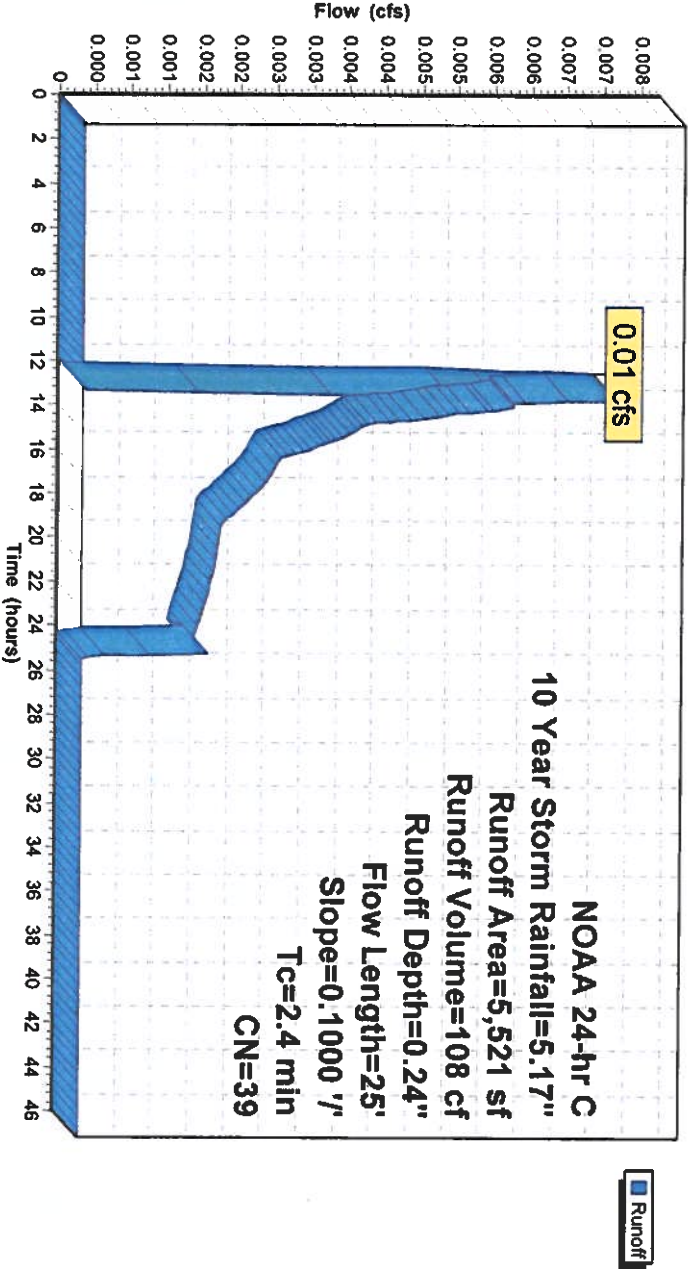
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
NOAA 24-hr C 10 Year Storm Rainfall=5.17"

Area (sf)	CN	Description
5,521	39	>75% Grass cover, Good, HSG A
5,521		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.1000	0.17		

Sheet Flow,  
Grass: Dense n=0.240 P2=3.31"

Subcatchment P DA P: Prop. Drainage Area - Perv.





Summary for Pond IB: infiltration Basin

Inflow Area = 19,561 sf, 71.78% Impervious, Inflow Depth = 3.61" for 10 Year Storm event  
Inflow = 1.88 cfs @ 12.08 hrs, Volume= 5,880 cf  
Outflow = 0.29 cfs @ 12.54 hrs, Volume= 5,880 cf, Atten= 85%, Lag= 27.4 min  
Discarded = 0.29 cfs @ 12.54 hrs, Volume= 5,880 cf

Routing by Stor-Ind method, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
Peak Elev= 15.97' @ 12.54 hrs Surf.Area= 3,506 sf Storage= 1,583 cf

Plug-Flow detention time= 34.6 min calculated for 5,874 cf (100% of inflow)  
Center-of-Mass det. time= 34.6 min ( 784.7 - 750.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	5,549 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.50	3,175	0	0
17.00	4,223	5,549	5,549

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.50'	3,000 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 13.00'

Discarded OutFlow Max=0.29 cfs @ 12.54 hrs HW=15.97' (Free Discharge)  
1=Exfiltration ( Controls 0.29 cfs)



NOAA 24-hr C 10 Year Storm Rainfall=5.17"

Printed 3/30/2023

### Hydrograph





Time span=0.00-46.00 hrs, dt=0.05 hrs, 921 points  
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P DA I: Prop. Drainage** Runoff Area=14,040 sf 100.00% Impervious Runoff Depth=8.68"  
Flow Length=161' Slope=0.0100 '/' Tc=1.7 min CN=98 Runoff=3.26 cfs 10,155 cf

**Subcatchment P DA P: Prop. Drainage Area** - Runoff Area=5,521 sf 0.00% Impervious Runoff Depth=1.57"  
Flow Length=25' Slope=0.1000 '/' Tc=2.4 min CN=39 Runoff=0.22 cfs 720 cf

**Pond IB: Infiltration Basin** Peak Elev=16.54' Storage=3,665 cf Inflow=3.46 cfs 10,875 cf  
Outflow=0.37 cfs 10,875 cf

**Total Runoff Area = 19,561 sf Runoff Volume = 10,875 cf Average Runoff Depth = 6.67"**  
**28.22% Pervious = 5,521 sf 71.78% Impervious = 14,040 sf**



Summary for Subcatchment P DA I: Prop. Drainage Area - Imp.

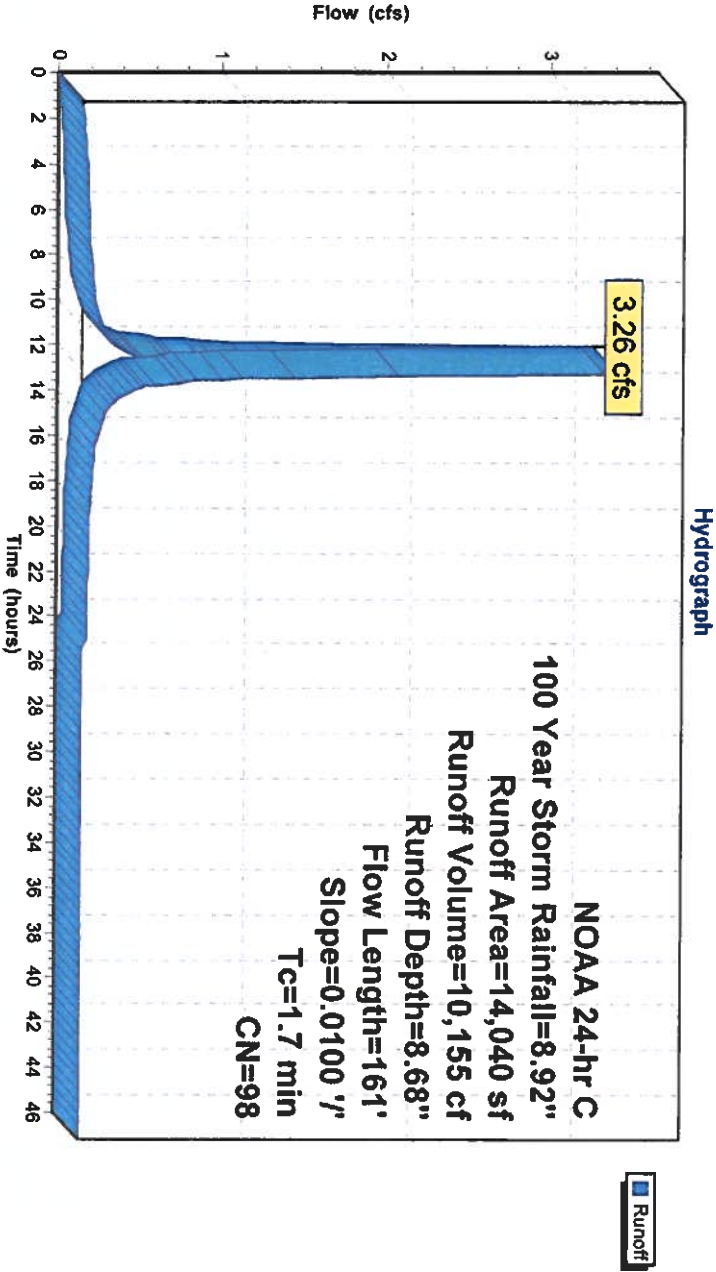
[49] Hint: Tc<2dt may require smaller dt

Runoff = 3.26 cfs @ 12.08 hrs, Volume= 10,155 cf, Depth= 8.68"  
Routed to Pond IB : Infiltration Basin

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
NOAA 24-hr C 100 Year Storm Rainfall=8.92"

Area(sf)		CN	Description		
*	14,040	98	Paved parking, HSG A - Gravel		
	14,040		100.00% Impervious Area		
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	35	0.0100	0.86		Sheet Flow, Pavement
					Smooth surfaces n= 0.011 P2= 3.31"
1.0	126	0.0100	2.03		Shallow Concentrated Flow,
					Paved Kv= 20.3 fps
1.7	161	Total			

Subcatchment P DA I: Prop. Drainage Area - Imp.





Summary for Subcatchment P DA P: Prop. Drainage Area - Perv.

[49] Hint: Tc<2dt may require smaller dt

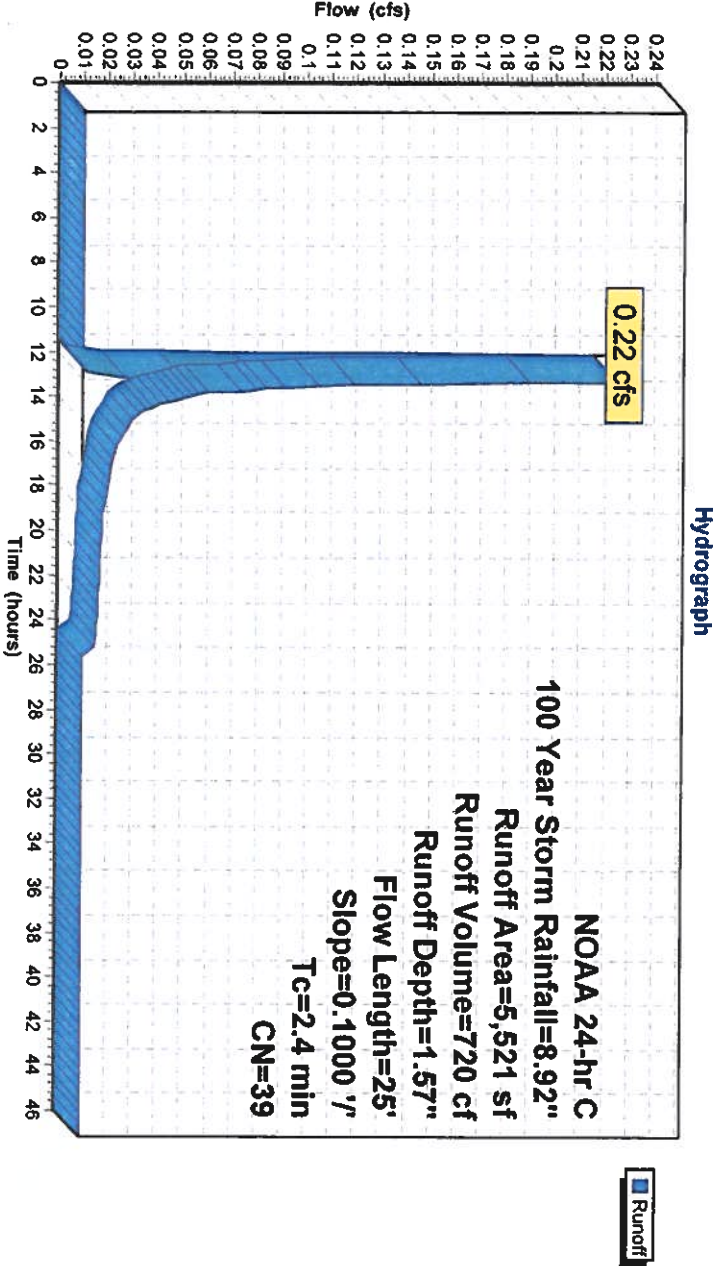
Runoff = 0.22 cfs @ 12.11 hrs, Volume= 720 cf, Depth= 1.57"  
Routed to Pond 1B : Infiltration Basin

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
NOAA 24-hr C 100 Year Storm Rainfall=8.92"

Area (sf)		CN	Description		
5,521		39	>75% Grass cover, Good, HSG A		
5,521			100.00% Pervious Area		
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.1000	0.17		
Sheet Flow,					

Sheet Flow,  
Grass: Dense n= 0.240 P2= 3.31"

Subcatchment P DA P: Prop. Drainage Area - Perv.





Summary for Pond IB: Infiltration Basin

Inflow Area = 19,561 sf, 71.78% Impervious, Inflow Depth = 6.67" for 100 Year Storm event  
Inflow = 3.46 cfs @ 12.09 hrs, Volume= 10,875 cf  
Outflow = 0.37 cfs @ 12.78 hrs, Volume= 10,875 cf, Atten= 89%, Lag= 41.4 min  
Discarded = 0.37 cfs @ 12.78 hrs, Volume= 10,875 cf

Routing by Stor-Ind method, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
Peak Elev= 16.54' @ 12.78 hrs Surf.Area= 3,899 sf Storage= 3,665 cf

Plug-Flow detention time= 74.6 min calculated for 10,864 cf (100% of inflow)  
Center-of-Mass det. time= 74.6 min ( 823.0 - 748.4 )

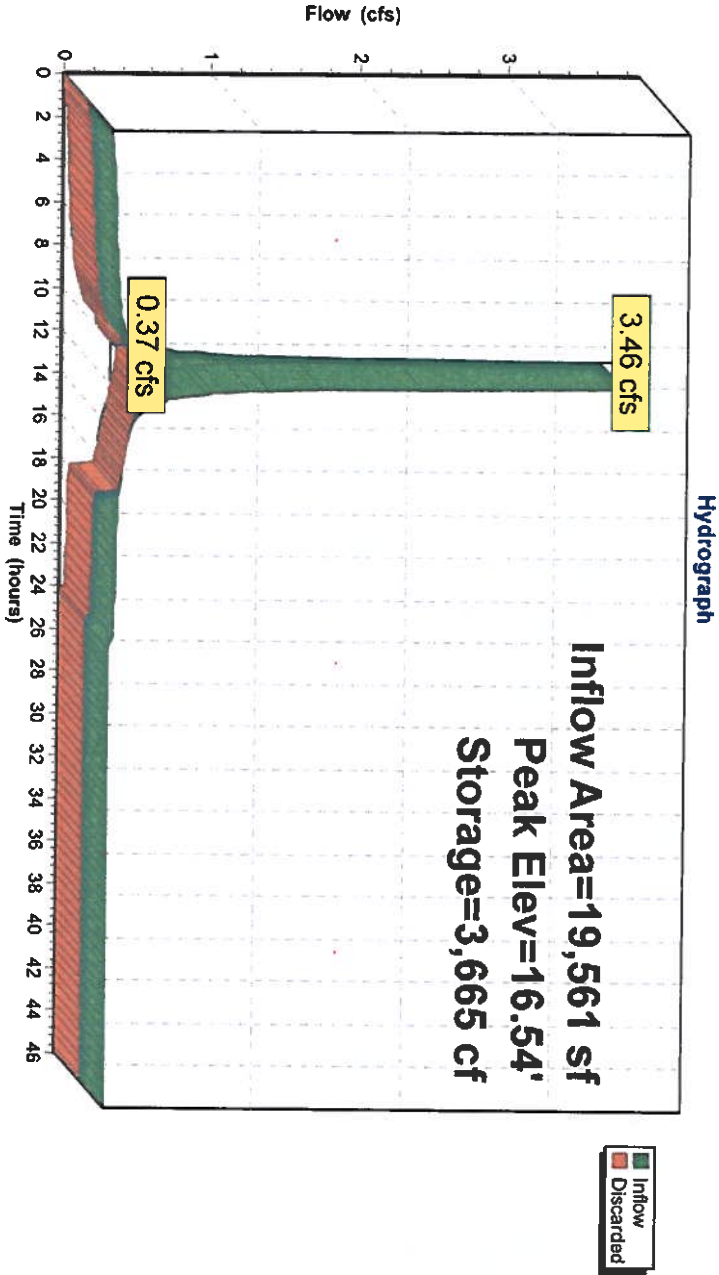
Volume Invert Avail.Storage Storage Description				
#1	15.50'	5,549 cf	Custom Stage Data (Prismatic) listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
15.50	3,175	0	0	
17.00	4,223	5,549	5,549	

Device Routing Invert Outlet Devices		
#1	Discarded 15.50'	3,000 In/hr Exfiltration over Surface area
Conductivity to Groundwater Elevation = 13.00'		

Discarded OutFlow Max=0.37 cfs @ 12.78 hrs HW=16.54' (Free Discharge)  
1=Exfiltration ( Controls 0.37 cfs)



Pond IB: Infiltration Basin





Time span=0.00-46.00 hrs, dt=0.05 hrs, 921 points

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P DA I: Prop. Drainage** Runoff Area=14,040 sf 100.00% Impervious Runoff Depth=1.03"  
Flow Length=161' Slope=0.0100 1' Tc=1.7 min CN=98 Runoff=0.96 cfs 1,210 cf

**Subcatchment P DA P: Prop. Drainage** Area - Runoff Area=5,521 sf 0.00% Impervious Runoff Depth=0.00"  
Flow Length=25' Slope=0.1000 1' Tc=2.4 min CN=39 Runoff=0.00 cfs 0 cf

**Pond IB: infiltration Basin** Peak Elev=15.66' Storage=533 cf Inflow=0.96 cfs 1,210 cf  
Outflow=0.24 cfs 1,210 cf

**Total Runoff Area = 19,561 sf Runoff Volume = 1,210 cf Average Runoff Depth = 0.74"**  
**28.22% Pervious = 5,521 sf 71.78% Impervious = 14,040 sf**



Summary for Subcatchment P DA I: Prop. Drainage Area - Imp.

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.96 cfs @ 1.05 hrs, Volume= 1,210 cf, Depth= 1.03"

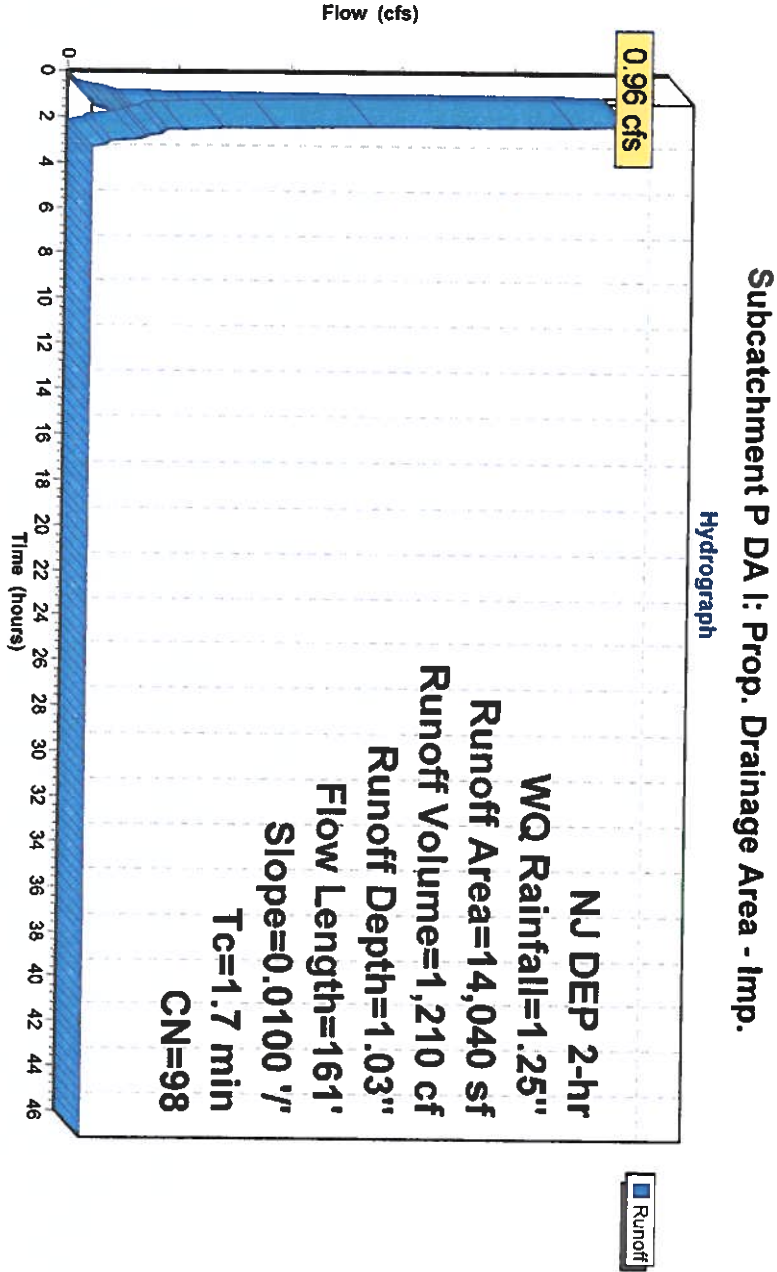
Routed to Pond IB : Infiltration Basin

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs

NJ DEP 2-hr WQ Rainfall=1.25"

Area (sf)	CN	Description
* 14,040	98	Paved parking, HSG A - Gravel
14,040		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	35	0.0100	0.86		Sheet Flow, Pavement
1.0	126	0.0100	2.03		Smooth surfaces n= 0.011 P2= 3.31"
					Shallow Concentrated Flow,
					Paved Kv= 20.3 fps
1.7	161	Total			





Summary for Subcatchment P DA P: Prop. Drainage Area - Perv.

[49] Hint: Tc<2dt may require smaller dt  
[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"  
Routed to Pond IB : infiltration Basin

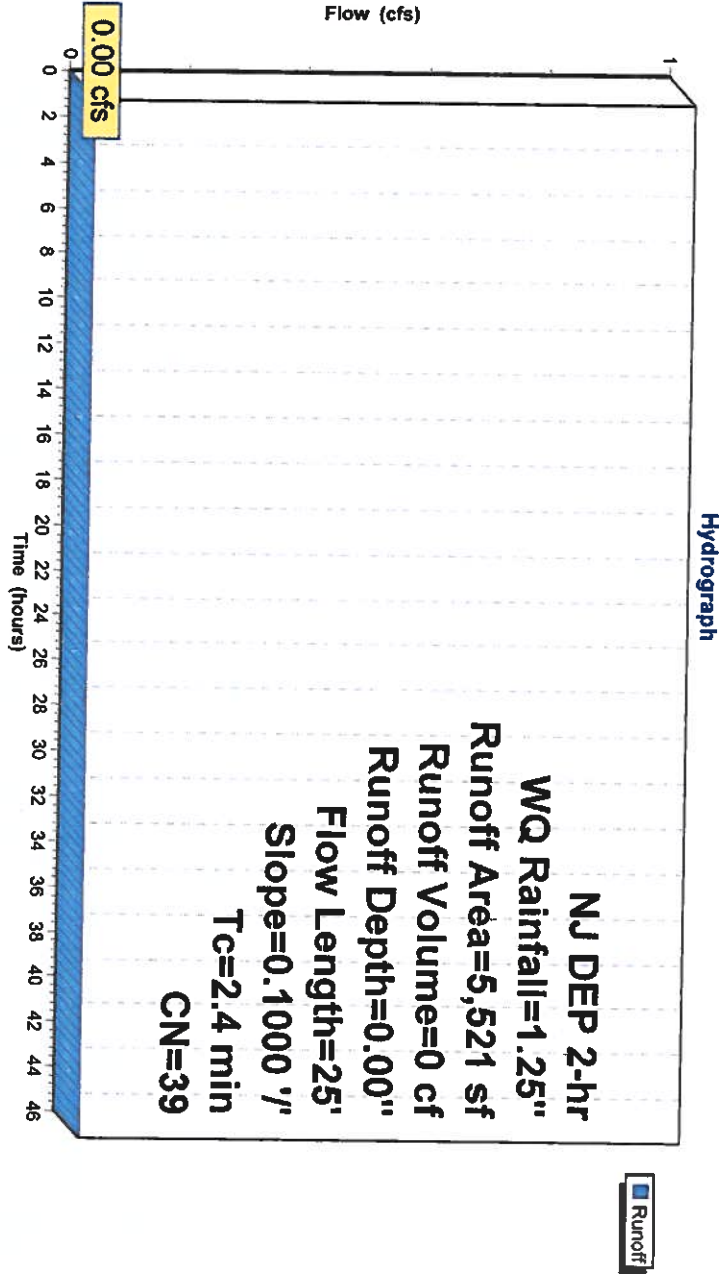
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
NJ DEP 2-hr WQ Rainfall=1.25"

Area (sf)		CN	Description	
5,521		39	>75% Grass cover, Good, HSG A	
5,521			100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.1000	0.17		

Sheet Flow,  
Grass: Dense n= 0.240 P2= 3.31"

Subcatchment P DA P: Prop. Drainage Area - Perv.





Summary for Pond IB: infiltration Basin

Inflow Area = 19,561 sf, 71.78% Impervious, Inflow Depth = 0.74" for WQ event  
Inflow = 0.96 cfs @ 1.05 hrs, Volume= 1,210 cf  
Outflow = 0.24 cfs @ 1.25 hrs, Volume= 1,210 cf, Atten= 75%, Lag= 12.0 min  
Discarded = 0.24 cfs @ 1.25 hrs, Volume= 1,210 cf

Routing by Stor-Ind method, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
Peak Elev= 15.66' @ 1.25 hrs Surf.Area= 3,290 sf Storage= 533 cf

Plug-Flow detention time= 20.8 min calculated for 1,209 cf (100% of inflow)  
Center-of-Mass det. time= 20.8 min ( 88.1 - 67.3 )

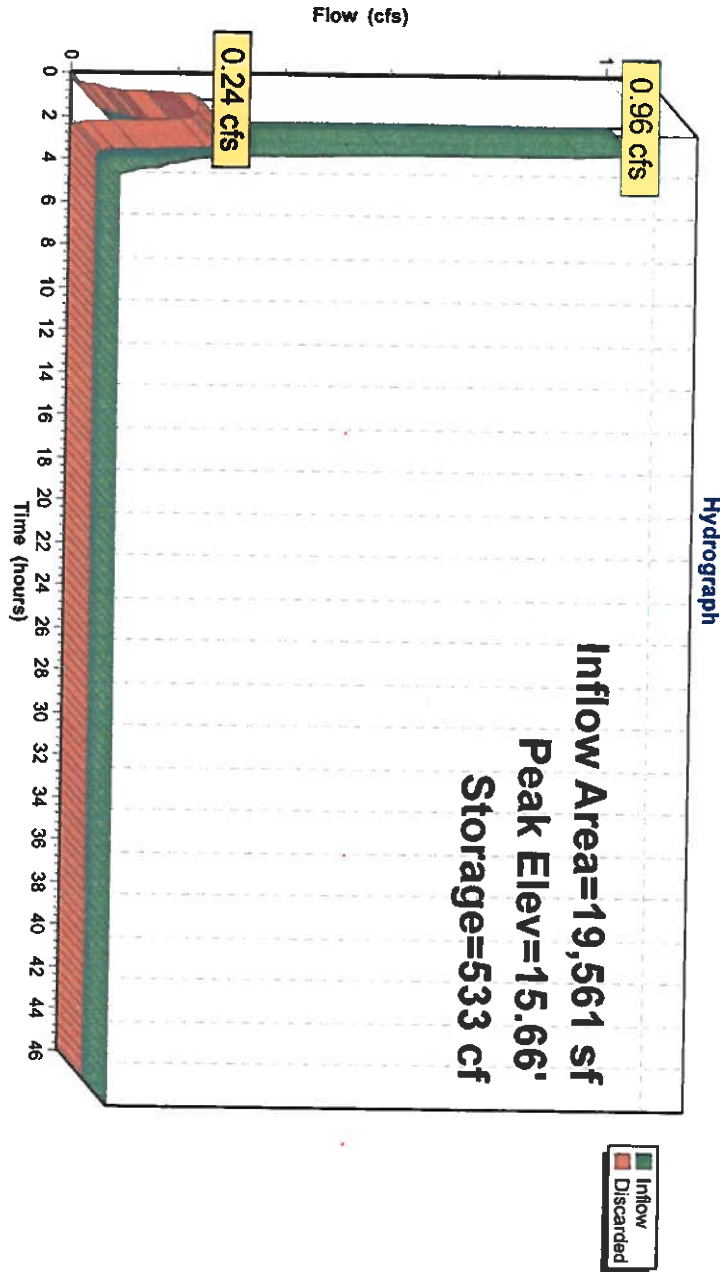
Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	5,549 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.50	3,175	0	0
17.00	4,223	5,549	5,549

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.50'	3,000 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 13.00'

Discarded OutFlow Max=0.24 cfs @ 1.25 hrs HW=15.66' (Free Discharge)  
1=Exfiltration ( Controls 0.24 cfs)



Pond IB: Infiltration Basin

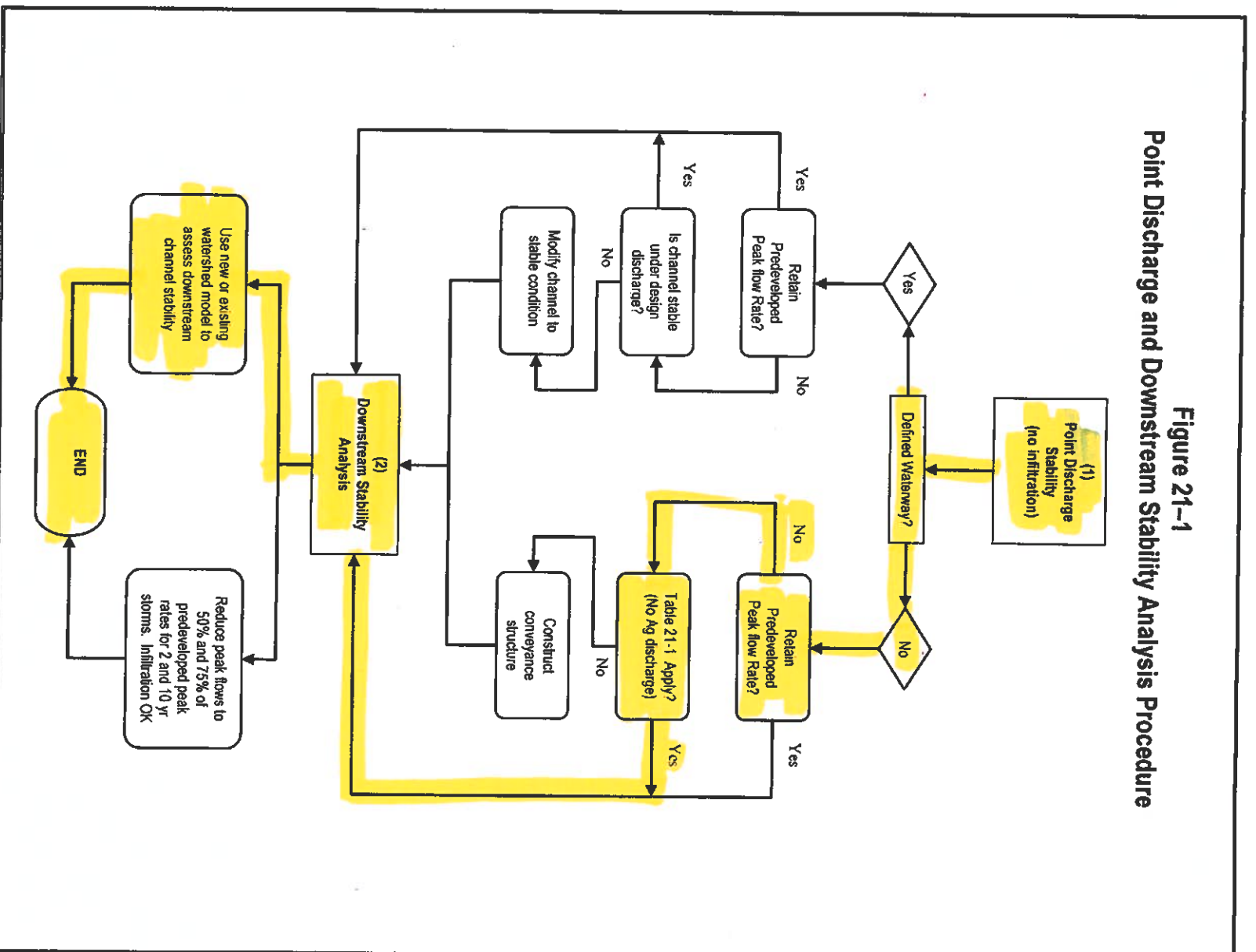




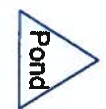
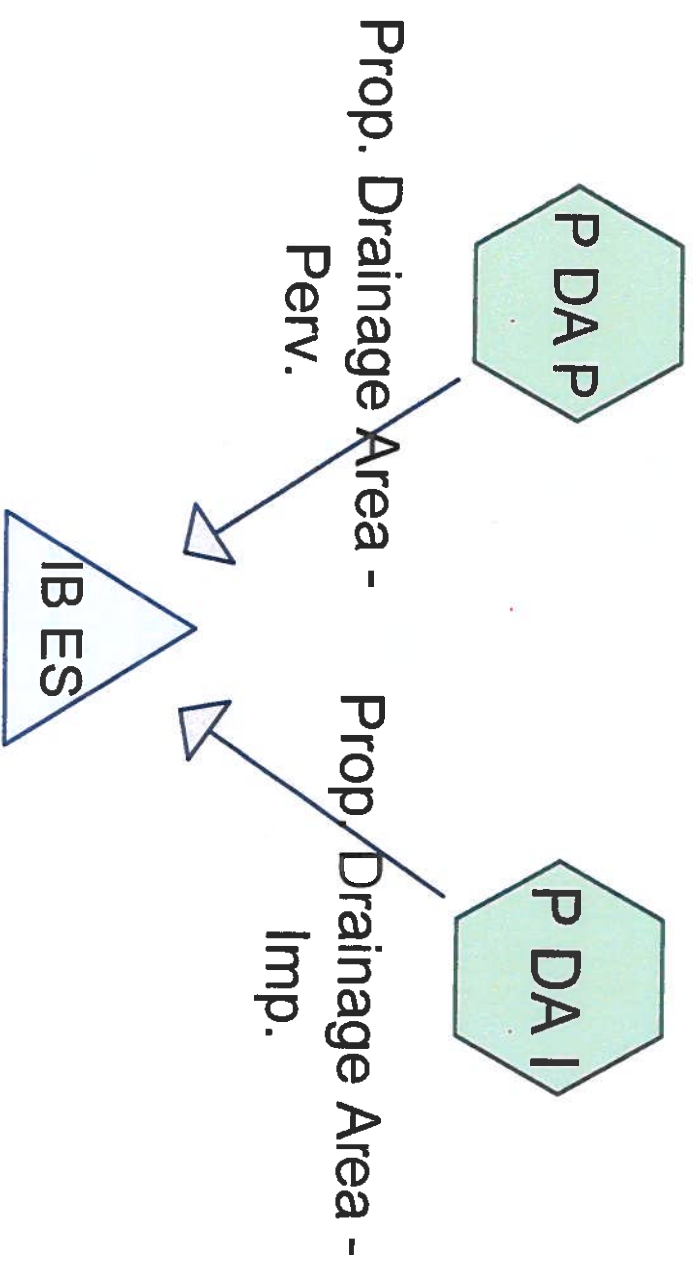
# EMERGENCY SPILLWAY CALCULATIONS



**Figure 21-1**  
**Point Discharge and Downstream Stability Analysis Procedure**







Routing Diagram for Rt 83 Storage Kelt  
Prepared by Engineering Design Associates, Printed 3/30/2023  
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**Rainfall Events Listing (selected events)**

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25 Year Storm	NOAA 24-hr	C	Default	24.00	1	6.48	2



Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
5,521	39	>75% Grass cover, Good, HSG A (P DA P)
14,040	98	Paved parking, HSG A - Gravel (P DA I)
19,561	81	TOTAL AREA



**Rt 83 Storage Keith**

Prepared by Engineering Design Associates  
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Page 4

**Soil Listing (selected nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
19,561	HSG A	P DA I, P DA P
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
19,561	TOTAL AREA	



Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
5,521	0	0	0	0	5,521	>75% Grass cover, Good
14,040	0	0	0	0	14,040	Paved parking
19,561	0	0	0	0	19,561	TOTAL AREA



Time span=0.00-46.00 hrs, dt=0.05 hrs, 921 points

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment P DA I: Prop. Drainage** Runoff Area=14,040 sf 100.00% Impervious Runoff Depth=6.24"  
Flow Length=161' Slope=0.0100 1' Tc=1.7 min CN=98 Runoff=2.37 cfs 7,302 cf

**Subcatchment P DA P: Prop. Drainage Area** - Runoff Area=5,521 sf 0.00% Impervious Runoff Depth=0.59"  
Flow Length=25' Slope=0.1000 1' Tc=2.4 min CN=39 Runoff=0.04 cfs 272 cf

**Pond IB ES: Infiltration Basin Emergency** Peak Elev=16.98' Storage=5,476 cf Inflow=2.39 cfs 7,575 cf  
Outflow=1.74 cfs 7,575 cf

**Total Runoff Area = 19,561 sf Runoff Volume = 7,575 cf Average Runoff Depth = 4.65"**  
**28.22% Pervious = 5,521 sf 71.78% Impervious = 14,040 sf**



Summary for Subcatchment P DA I: Prop. Drainage Area - Imp.

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.37 cfs @ 12.08 hrs, Volume= 7,302 cf, Depth= 6.24"

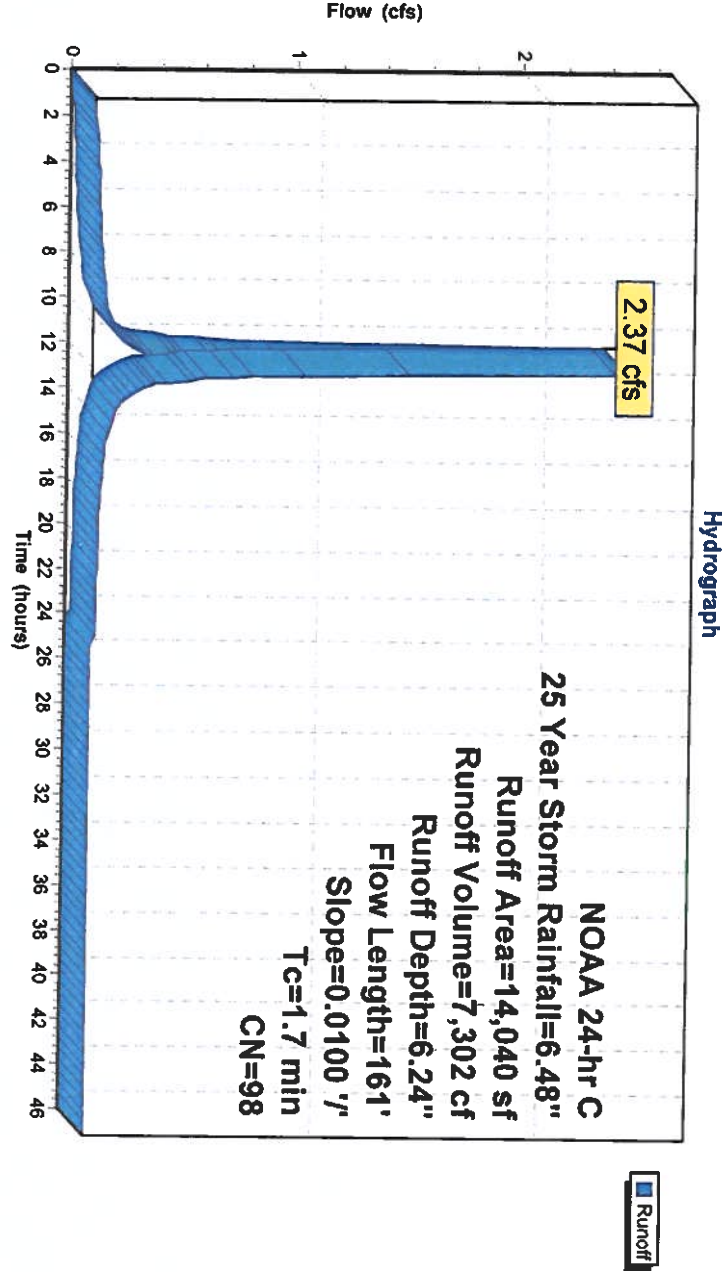
Routed to Pond IB ES : Infiltration Basin Emergency Spillway

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs

NOAA 24-hr C 25 Year Storm Rainfall=6.48"

Area (sf)						CN	Description
*	14,040	98	Paved parking, HSG A - Gravel				
	14,040		100.00% Impervious Area				
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description		
0.7	35	0.0100	0.86		Sheet Flow, Pavement		
1.0	126	0.0100	2.03		Smooth surfaces n= 0.011 P2= 3.31"		
					Shallow Concentrated Flow,		
					Paved Kv= 20.3 fps		
1.7	161	Total					

Subcatchment P DA I: Prop. Drainage Area - Imp.





Summary for Subcatchment P DA P: Prop. Drainage Area - Perv.

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.04 cfs @ 12.15 hrs, Volume= 272 cf, Depth= 0.59"  
Routed to Pond IB ES : Infiltration Basin Emergency Spillway

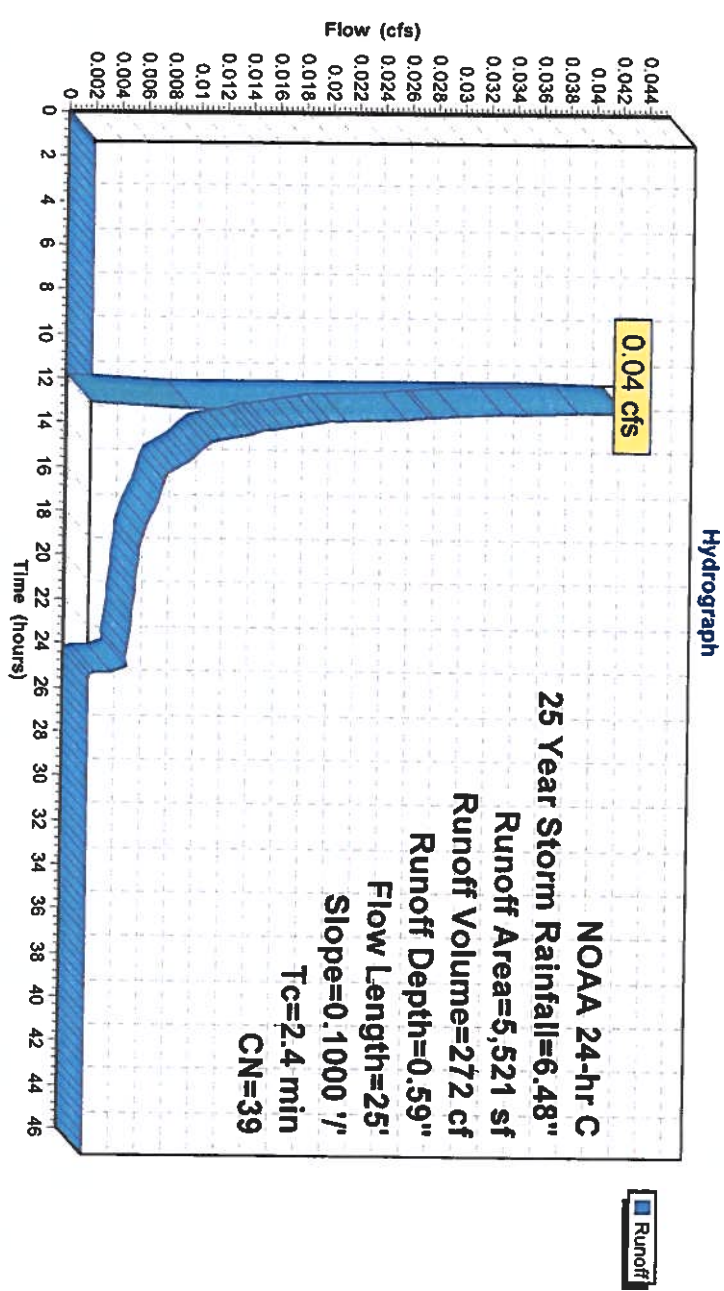
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-Q, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
NOAA 24-hr C 25 Year Storm Rainfall=6.48"

Area (sf)		CN	Description	
5,521		39	>75% Grass cover, Good, HSG A	
5,521			100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.1000	0.17		

Sheet Flow,  
Grass: Dense n= 0.240 P2= 3.31"

Subcatchment P DA P: Prop. Drainage Area - Perv.





Summary for Pond IB ES: Infiltration Basin Emergency Spillway

Inflow Area = 19,561 sf, 71.78% Impervious, Inflow Depth = 4.65" for 25 Year Storm event  
Inflow = 2.39 cfs @ 12.09 hrs, Volume= 7,575 cf  
Outflow = 1.74 cfs @ 12.14 hrs, Volume= 7,575 cf, Atten= 27%, Lag= 3.4 min  
Primary = 1.74 cfs @ 12.14 hrs, Volume= 7,575 cf

Routing by Stor-Ind method, Time Span= 0.00-46.00 hrs, dt= 0.05 hrs  
Starting Elev= 16.75' Surf.Area= 4,048 sf Storage= 4,515 cf  
Peak Elev= 16.98' @ 12.14 hrs Surf.Area= 4,211 sf Storage= 5,476 cf (961 cf above start)  
Plug-Flow detention time= 367.9 min calculated for 3,060 cf (40% of inflow)  
Center-of-Mass del. time= 21.5 min ( 770.7 - 749.2 )

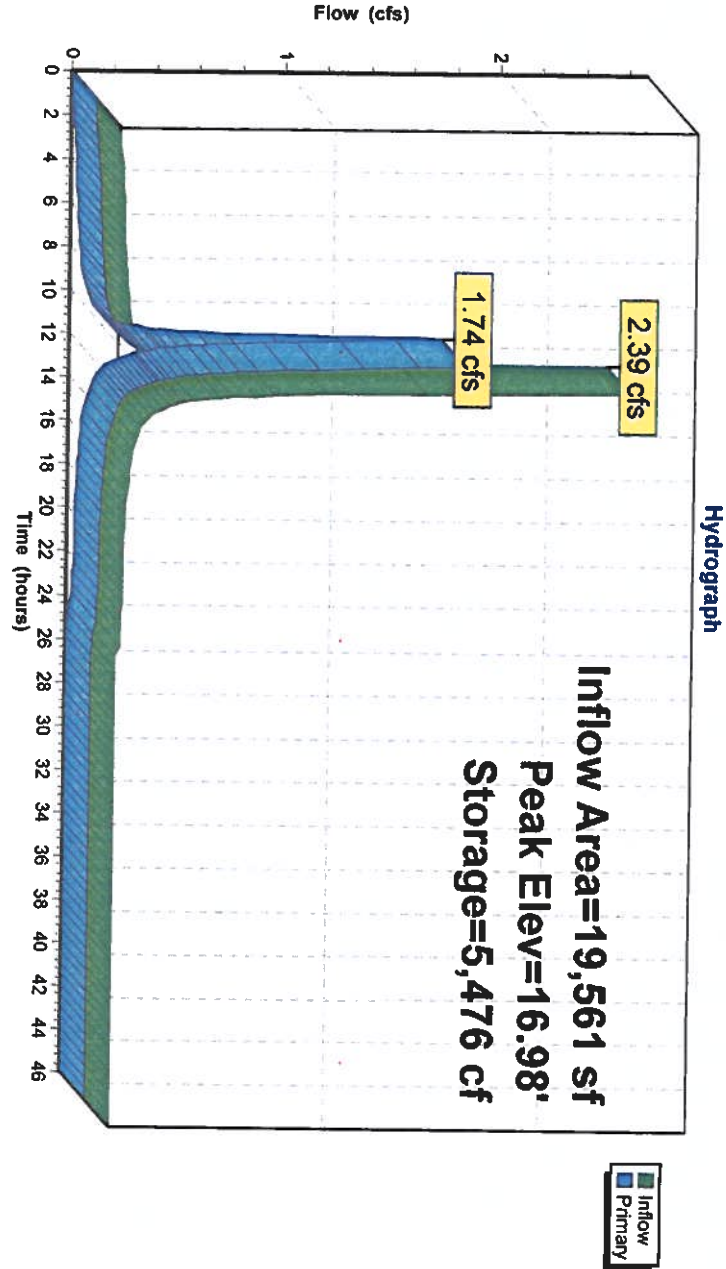
Volume		Invert	Avail. Storage	Storage Description
#1	15.50'	5,549 cf	Custom Stage Data (Prismatic) Listed below (Recalc)	
Elevation (feet)	Surf. Area (sq-ft)	Inc. Store (cubic-feet)	Cum. Store (cubic-feet)	
15.50	3,175	0	0	
17.00	4,223	5,549	5,549	

Device		Routing	Invert	Outlet Devices										
#1	Primary	16.75'	5.0' long + 4.0" SideZ x 1.0' breadth	Broad-Crested Rectangular Weir										
				Head (feet)	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
				2.50	3.00									
				Coef. (English)	2.69	2.72	2.75	2.85	2.98	3.08	3.20	3.28	3.31	
				3.30	3.31 3.32									

Primary Outflow Max=1.72 cfs @ 12.14 hrs HW=16.98' (Free Discharge)  
1=Broad-Crested Rectangular Weir (Weir Controls 1.72 cfs @ 1.25 fps)



Pond IB ES: Infiltration Basin Emergency Spillway





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5 Cambridge Drive  
Ocean View, NJ 08230  
(609)390-0332

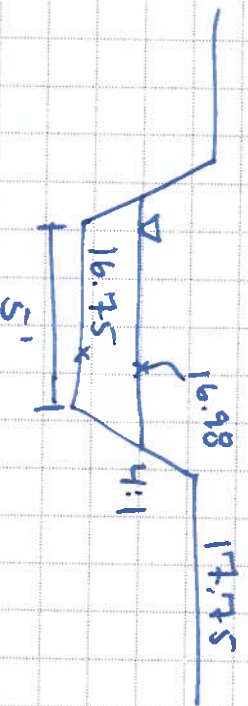
JOB Spillway 9823 Keith

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE \_\_\_\_\_

CHECKED BY \_\_\_\_\_ DATE 3/27/23

SCALE \_\_\_\_\_



25 year  
Storm

$$Q = 1.72 \text{ cfs}$$
$$V = 1.25 \text{ FPS}$$

$$\text{Flow} = 1.72 \text{ cfs} < 1.8 \text{ cfs} \checkmark$$

$$\frac{1.72 \text{ cfs}}{5 \text{ ft}} = 0.34 \frac{\text{cfs}}{\text{ft}} < 0.5 \text{ cfs/ft} \checkmark$$

$$\text{Velo} = 1.25 \text{ FPS} < 2 \text{ FPS} \checkmark$$



**Point of Discharge - Methods for Achieving Stability****1. No well-defined waterway below the point of discharge:**

Stability cannot be achieved by the allowable velocity method since there can be no determination where the runoff will concentrate. A land-form not previously subjected to concentrated water flow will become unstable.

Stability can be achieved by one of the following alternatives:

- Retain pre-existing runoff characteristics. Do not increase the amount and rate of runoff for the development and do not concentrate flows.
- Where there is no well defined channel, no sandy condition, no trees or brush to substantially concentrate the flows and it can be reasonably assumed that the flow will disperse over a broad area. The combinations of slopes and soils in table 21-1 and the following criteria are considered stable for flows of 10cfs or less for a 25 year, 24hr design storm.

Table 21-1 Non-Erosive Velocities for Point Discharges

Maximum Stable Slope for Point Discharges for Various Soils	
Soil Type	Perennial, Natural Vegetation Maximum Slope (%)
Sands	1.8
Sandy loam	2.0
Silt loam, loam	2.5
Sandy clay loam	3.5
Clay loam	5.0
Graded loam to gravel	8.0

elw 16.4 → 16.3  
@ 13'  
= 8.17%  
Maximum ✓

**Stability Criteria (in conjunction with table 21-1)**

- The maximum discharge rate shall be 10 cfs or less for the twenty-five (25) year storm.
- Multiple outlets may be utilized to reduce individual outlet flow rates to levels below the thresholds noted above. Outlets should be spaced no closer than 50 ft horizontally to avoid re-mixing of flows
- Flow over the outlet area shall be less than 0.5 cfs/ft. Designers shall not design excessive widths which will cause flows to concentrate.
- Conduit outlet protection shall be provided in accordance with that Standard and may include: flat aprons, preformed scour holes, impact basins, stilling wells, plunge pools, etc. **Level spreaders are not an acceptable design.**
- Topography shows broad uniform outlet area where flows will not concentrate.



# SEDIMENT BAY CALCULATIONS



Engineering Design Associates

5 Cambridge Drive  
Ocean View, NJ 08230  
(609)390-0332

JOB Forebay Sizing

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE 3/27/2023

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE \_\_\_\_\_

Forebay

WQ Volume = 1218 cf

1218 cf x 10% = 121 cf

Basin Length = 50'

Forebay height = 1/2', 6"

∴ Size = 5'

Forebay = 61' x 4' x 6"

= 122 cf

>

121

cf

✓



# **RIP-RAP SLOPE PROTECTION**



RIP RAP SLOPE PROTECTION DESIGN

Project: Keith Storage  
EDA#: 9826  
Date: 3/30/2023

FLUMES WITH TRAPEZOIDAL AND RECTANGULAR SECTIONS

Bottom Widths And Drainage Area For Trapezoidal Flumes With Flow Depths Equal to 10 Inches	
Bottom Width (feet)	Drainage Area (acres)
2	7
4	10
6	13
8	16
10	19
12	24

Bottom Widths And Drainage Area For Rectangular Flumes With Flow Depths Equal to 10 Inches	
Bottom Width (feet)	Drainage Area (acres)
2	3
4	5
6	10
8	13
10	16
12	20

For channel slopes between 10% and 40%:

$$D_{50} = [q(S)^{0.58}/3.93(10)^{-2}]^{1.18}$$
$$z = [n(q)^{0.1486}(S)^{0.3425}]$$

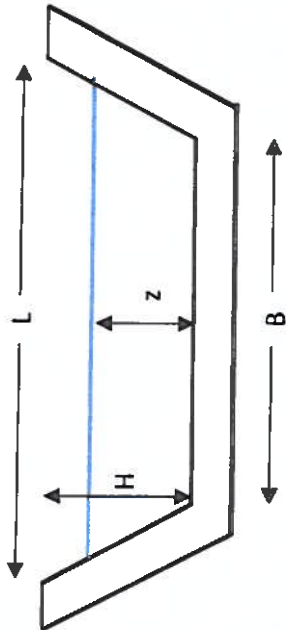
where  $n = 0.047(D_{50})^{0.117}$

$D_{50}$  = Particle (stone) size for which 50% of the sample is finer, in.  
 $S$  = Bed slope, ft./ft.  
 $z$  = Flow depth, ft.  
 $q$  = Unit discharge, ft<sup>3</sup>/s/ft  
(Total discharge÷Bottom width)

Rip Rap Slope # Largest Area

B =	3 Ft	(Bottom Width)
C =	0.9	(Land Cover)
i =	7.8 in/hr	(Rainfall Intensity, 25 yr, 6 Min)
a =	0.25 Ac	(Area)
S =	0.25 Ft/Ft	(Slope)
Q =	1.76 Cfs	
q =	0.59 Cfs/Ft	
D50 =	2.73 in	
n =	0.04	
z =	0.13 Ft	

USE	
D50 =	3 in
Thickness =	6 in
H =	2 in
B =	3 Ft
L =	7 Ft





# **GROUNDWATER RECHARGE ANALYSIS**



## Annual Groundwater Recharge Analysis (based on GSR-32)

Select Township ↓	Average Annual P (in)	Climatic Factor
CAPE_MAY CO., DENNIS TWP	43.2	1.33

Project Name: Rt 83 Storage - Keith

Description: 9826 - Groundwater Recharge

Analysis Date: 03/27/23

### Pre-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	0.14646	Woods	Downer	11.6	6,189
2	0.30259	Open space	Downer	12.5	13,719
3	0				
4	0				
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
Total =	0.4			Total Annual Recharge (in)	Total Annual Recharge (cu.ft)
				12.2	19,909

### Post-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	0.12674	Open space	Downer	12.5	5,746
2	0.32231	Impervious areas	Downer	0.0	-
3	0				
4	0				
5	0				
6	0				
7	0				
8	0				
9	0				
10	0				
11	0				
12	0				
13	0				
14	0				
15	0				
Total =	0.4			Total Annual Recharge (in)	Total Annual Recharge (cu.ft)
				3.5	5,746

### Annual Recharge Requirements Calculation ↓

% of Pre-Developed Annual Recharge to Preserve = 100%

Post-Development Annual Recharge Deficit= 14,162

### Recharge Efficiency Parameters Calculations (area averages)

RWC= #N/A	(in)	DRWC= #N/A	(in)
ERWC= #N/A	(in)	EDRWC= #N/A	(in)

#### Procedure to fill the Pre-Development and Post-Development Conditions Tables

For each land segment, first enter the area, then select TR-55 Land Cover, then select Soil. Start from the top of the table and proceed downward. Don't leave blank rows (with A=0) in between your segment entries. Rows with A=0 will not be displayed or used in calculations. For impervious areas outside of standard lots select "Impervious Areas" as the Land Cover. Soil type for impervious areas are only required if an infiltration facility will be built within these areas.



Project Name		Description		Analysis Date		BMP or LID Type						
Rt 83 Storage - Keith		9826 - Groundwater Recharge		03/27/23		Infiltration Basin						
Recharge BMP Input Parameters				Root Zone Water capacity Calculated Parameters				Recharge Design Parameters				
Parameter	Symbol	Value	Unit	Parameter	Symbol	Value	Unit	Parameter	Symbol	Value	Unit	
BMP Area	ABMP	3200.0	sq.ft	Empty Portion of RWC under Post-D Natural Recharge	ERWC	0.64	in	Inches of Runoff to capture	Qdesign	0.21	in	
BMP Effective Depth, this is the design variable	dBMP	0.2	in	ERWC Modified to consider dEXC	EDRWC	0.02	in	Inches of Rainfall to capture	Pdesign	0.28	in	
Upper level of the BMP surface (negative if above ground)	dBMPu	12.0	in	Empty Portion of RWC under Infiltr. BMP	RERWC	0.01	in	Recharge Provided Avg. over Imp. Area		12.1	in	
Depth of lower surface of BMP, must be >= dBMPu	dEXC	27.0	in					Runoff Captured Avg. over imp. Area		12.9	in	
Post-development Land Segment Location of BMP, Input Zero if Location is distributed or undetermined	SegBMP	2	unitless									
Parameters from Annual Recharge Worksheet				BMP Calculated Size Parameters				CALCULATION CHECK MESSAGES				
Post-D Deficit Recharge (or desired recharge volume)	Vdef	3,936	cu.ft	ABMP/Aimp	Aratio	0.82	unitless	Volume Balance--> OK dBMP Check--> OK dEXC Check--> OK BMP Location--> OK				
Post-D Impervious Area (or target Impervious Area)	Aimp	3,912	sq.ft	BMP Volume	VBMP	66	cu.ft					
System Performance Calculated Parameters												
Root Zone Water Capacity	RWC	1.91	in	Annual BMP Recharge Volume		3,936	cu.ft	<b>OTHER NOTES</b> Pdesign is accurate only after BMP dimensions are updated to make rech volume= deficit volume. The portion of BMP infiltration prior to filling and the area occupied by BMP are ignored in these calculations. Results are sensitive to dBMP, make sure dBMP selected is small enough for BMP to empty in less than 3 days. For land Segment Location of BMP if you select "impervious areas" RWC will be minimal but not zero as determined by the soil type and a shallow root zone for this Land Cover allowing consideration of lateral flow and other losses.				
RWC Modified to consider dEXC	DRWC	0.05	in	Avg BMP Recharge Efficiency		93.7%	Represents % Infiltration Recharged					
Climatic Factor	C-factor	1.33	no units	%Rainfall became Runoff		77.4%	%					
Average Annual P	Pavg	43.2	in	%Runoff Infiltrated		38.5%	%					
Recharge Requirement over Imp. Area	dr	3.4	in	%Runoff Recharged		10.1%	%					
								%				
<b>How to solve for different recharge volumes:</b> By default the spreadsheet assigns the values of total deficit recharge volume "Vdef" and total proposed impervious area "Aimp" from the "Annual Recharge" sheet to "Vdef" and "Aimp" on this page. This allows solution for a single BMP to handle the entire recharge requirement assuming the runoff from entire impervious area is available to the BMP. To solve for a smaller BMP or a LID-IMP to recharge only part of the recharge requirement, set Vdef to your target value and Aimp to impervious area directly connected to your infiltration facility and then solve for ABMP or dBMP. To go back to the default configuration click the "Default Vdef & Aimp" button.												



# **GROUNDWATER MOUNDING**



**GROUNDWATER RECHARGE MOUNDING ANALYSIS**  
**BLOCK 261 LOT 15.02**  
**DENNIS TOWNSHIP, CAPE MAY COUNTY, NJ**  
**STORMWATER BASIN**

**EDA 9826**

1. Recharge Rate (in./hr) = 3 in/hr (K-4, with factor of safety = 2)
2. Specific yield = 0.15
3. Horizontal Hydraulic Conductivity (ft/day) = 15 in/hr
4. Basin Dimensions =  
50' x 50'  
X = 25  
Y = 25
5. Initial Thickness of Saturated Zone = 10'
6. Duration of infiltration Period (days) =  $\frac{(100 - \gamma I \text{ storm volume, CF}) \times (12 \text{ in/ft})}{(\text{Infiltration Area, SF}) \times (\text{Recharge Rate, in/hr})}$   
 $t = (10,554 \times 12) / (3200 \times 3) = 13.19 \text{ Hrs}$

Recharge Rate = 3 in/hr  
Specific yield = 0.15  
Horizontal Hydraulic Conductivity = 15 in/hr  
Width = 25'  
Length = 25'  
Duration of infiltration = 13.19 Hrs  
Thickness of Saturation Zone = 10.00'

Seasonal High Water Elevation = 13.00  
Max Ground Water Mounding Height (SHWT + Δh) = 15.465\*  
Bottom of Basin Elevation = 15.50

\*Basin mounding modified to adjusted recharge rate and duration of infiltration as per Chapter 13 of the NJBMP. See table below for initial and other adjusted model values.

Recharge Rate, R (in/hr)	Duration of infiltration, t (Hrs)	Mounding Height (Ft)
3.00	13.19	7.261
1.50	26.38	4.890
0.53	72.00	2.465

**Groundwater Mounding Analysis**

A groundwater mounding analysis was performed in association with the proposed infiltration basin. It has been determined that at distance of 100 feet that the height or elevation of the seasonal highwater elevation will increase by 0.489 feet (6 inches) during the 100 year storm event.

This slight increase will have little impact on the basin bottom or the surrounding adjacent properties, buildings, adjacent water bodies, wetlands or subsurface structures. It has been determined that seasonal high water is at elevation 13.00. Groundwater mounding associated with the proposed basin will increase this elevation to 15.47 for the 100 year storm event at 72 hours, with an adjusted recharge rate, below the proposed basin bottom elevation of 15.50.



Input Values	
R	0.53
Sy	0.150
kh	15.00
x	25,000
y	72.00
t	10.00

Recharge rate (permeability rate) (in/hr)  
Specific yield, Sy (dimensionless)  
default value is 0.15; max value is 0.2 provided that a lab test data is submitted  
Horizontal hydraulic conductivity (in/hr)  
Kh = SRecharge Rate (R) in the coastal plan; Kh=R outside the coastal plan  
1/2 length of basin (x direction, in feet)  
1/2 width of basin (y direction, in feet)  
Duration of infiltration period (hours)  
Initial thickness of saturated zone (feet)

h(max)	12.465
dh(max)	2.465

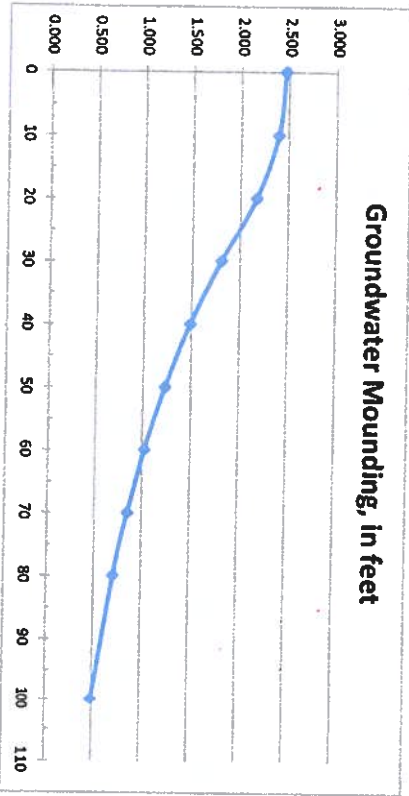
Distance from  
center of basin in x

Ground-water  
mounding, in feet

2.465	0
2.393	10
2.169	20
1.807	30
1.486	40
1.230	50
1.022	60
0.851	70
0.708	80
0.489	100

Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)  
Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Re-Calculate Now



### Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.



# BASIN DRAIN TIME



# Engineering Design Associates

5 Cambridge Drive  
Ocean View, NJ 08230  
(609)390-0332

JOB Basin Drain Time - Kelly

SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_

CALCULATED BY \_\_\_\_\_ DATE 3/27/23

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE 9826

Basin

T =

$$\text{Volume} \times 12 \frac{\text{in}}{\text{ft}}$$

\* 104 yr storm

Area x Recrump Rate

=

$$\frac{14,885 \text{ ft} \times 12 \frac{\text{in}}{\text{ft}}}{3,200 \text{ SF} \times 3 \frac{\text{in}}{\text{hr}}}$$

$$= 13.19 \text{ hrs}$$

$$= 13.19 \text{ HRS}$$

< 72 hours &

100 year event



# SOILS DATA



**TEST PIT #1**

<u>DEPTH</u>	<u>DESCRIPTION</u>
0" - 6"	10YR 4/2 Dark Grayish Brown, Sandy Loam, Subangular Blocky, Friable
6" - 25"	10YR 6/4 Light Yellowish Brown, Sandy Loam, Subangular Blocky, Friable
25" - 36"	10YR 7/6 Yellow, Loamy Sand, Subangular Blocky, Friable
36" - 120"	10YR 6/2 Light Brownish Gray, Fine Sand, Single Grain, Loose w/mottles of 10YR 8/1 White, Few, Fine & Faint

Depth of Seasonal High Water: 36"  
Depth of Groundwater: 76"  
Date Performed: 3/3/2023  
Performed By: Christopher J. Carey, LLA

**TEST PIT #2**

<u>DEPTH</u>	<u>DESCRIPTION</u>
0" - 5"	10YR 4/1 Dark Gray, Sandy Loam, Subangular Blocky, Friable
5" - 19"	10YR 6/4 Light Yellowish Brown, Sandy Loam, Subangular Blocky, Friable
19" - 23"	10YR 7/6 Yellow, Sandy Loam, Subangular Blocky, Friable
23" - 30"	10YR 6/6 Brownish Yellow, Loamy Sand, Subangular Blocky, Friable
30" - 41"	10YR 6/4 Light Yellowish Brown, Loamy Sand, Subangular Blocky, Friable w/mottles of 10YR 7/1 Light Gray, Few, Fine & Faint
41" - 120"	10YR 7/2 Light Gray, Fine Sand, Single Grain, Loose w/mottles of 10YR 7/6 Yellow, Few, Fine & Faint

Depth of Seasonal High Water: 30"  
Depth of Groundwater: 63"  
Date Performed: 3/3/2023  
Performed By: Christopher J. Carey, LLA

**TEST PIT #3**

<u>DEPTH</u>	<u>DESCRIPTION</u>
0" - 6"	10YR 4/2 Dark Grayish Brown, Sandy Loam, Subangular Blocky, Friable
6" - 18"	10YR 6/4 Light Yellowish Brown, Sandy Loam, Subangular Blocky, Friable
18" - 29"	10YR 5/6 Yellowish Brown, Sandy Loam, Subangular Blocky, Friable
29" - 36"	10YR 7/6 Yellow, Loamy Sand, Subangular Blocky, Friable
36" - 87"	10YR 6/4 Light Yellowish Brown, Fine Sand, Single Grain, Loose w/mottles of 10YR 8/1 White, Few, Fine & Faint
87" - 120"	10YR 7/1 Light Gray, Fine Sand, Single Grain, Loose w/mottles of 10YR 7/6 Yellow, Common, Medium & Distinct

Depth of Seasonal High Water: 36"  
Depth of Groundwater: 72"  
Date Performed: 3/3/2023  
Performed By: Christopher J. Carey, LLA



Keith - EDA #9826  
Block 261, Lot 15.02

CAPE MAY COUNTY DEPARTMENT OF HEALTH  
SEWAGE DISPOSAL SYSTEM APPLICATION - ATTACHMENT "B"

SOIL PERMEABILITY CLASS RATING DATA

MUNICIPALITY - Dennis Township

1. Test Number 1 Replicate Letter A

2. Sample Depth 63" Soil Pit Boring Number TP#1 Date Collected 3/3/2023

3. Coarse Fragment Content

Total Wt. of Sample, W.T., Grams (g) 406.9

Wt. of Material Retained on 2 mm Sieve, W.C.F., g 10.5

Wt. % Coarse Fragment (W.C.F./W.T. x 100): 2.6%

4. Oven Dry Weight (24 Hrs., 105° C) of 40 g Air Dry Sample, g. Wt. 39.8

5. Hydrometer Calibration, Rc 4

Temperature of Suspension, °F 71°

6. Hydrometer Reading - 40 Sec., g, R1 7

Temperature of Suspension, °F 71°

7. Corrected Hydrometer Reading, g, R1' 3.6

8. Hydrometer Reading - 2 Hrs., g, R2 5

Temperature of Suspension, °F 71°

9. Corrected Hydrometer Reading, g, R2' 1.6

10. % Sand = (39.8 - 3.6)/39.8 x 100 = 90.9%

11. % Clay = 1.6/39.8 x 100 = 4%

12. Sieve Analysis:

(a) Oven Dry Wt. (2 Hrs., 105° C) Total Sand Fraction  
(Soil Retained in 0.047 mm Sieve), g 36.8

(b) Wt. of Fine Plus Very Fine Sand Fraction  
(Sand Passing 0.25 mm Sieve), g 35.7

(c) % Fine Plus Very Fine Sand (b/a) 97%

13. Soil Morphology (Natural Soil Samples Only):

Structure of Soil Horizon Tested \_\_\_\_\_

Consistence of Soil Horizon Tested: \_\_\_\_\_ Dry \_\_\_\_\_ Moist

14. Soil Permeability Class Rating (Based upon Average Textural Analysis of this Replicate and other Replicate Samples)

K-4 (Adjusted)

15. I HEREBY CERTIFY THAT THE INFORMATION FURNISHED ON THIS ATTACHMENT "B" IS TRUE AND ACCURATE. I AM AWARE THAT FALSIFICATION OF DATA IS A VIOLATION OF THE WATER POLLUTION CONTROL ACT (N.J.S.A.) 58:10A-1 et seq.) AND IS SUBJECT TO PENALTIES AS PRESCRIBED IN N.J.A.C. 7:14-8.

SIGNATURE OF SOIL EVALUATOR Charles J. P.

DATE 4/5/23

SIGNATURE OF PROFESSIONAL ENGINEER Matthew A.

LICENSE NUMBER 32498



Keith - EDA #9826  
Block 261, Lot 15.02

CAPE MAY COUNTY DEPARTMENT OF HEALTH  
SEWAGE DISPOSAL SYSTEM APPLICATION - ATTACHMENT "B"

SOIL PERMEABILITY CLASS RATING DATA

MUNICIPALITY - Dennis Township

1. Test Number 1 Replicate Letter B

2. Sample Depth 63" Soil Pit Boring Number TP#1 Date Collected 3/3/2023

3. Coarse Fragment Content

Total Wt. of Sample, W.T., Grams (g) 406.9

Wt. of Material Retained on 2 mm Sieve, W.C.F., g. 10.5

Wt. % Coarse Fragment (W.C.F./W.T. x 100): 2.6%

4. Oven Dry Weight (24 Hrs., 105° C) of 40 g Air Dry Sample, g. Wt. 39.8

5. Hydrometer Calibration, Rc 4

Temperature of Suspension, °F 71°

6. Hydrometer Reading - 40 Sec., g, R1 7

Temperature of Suspension, °F 71°

7. Corrected Hydrometer Reading, g, R1' 3.6

8. Hydrometer Reading - 2 Hrs., g, R2 6

Temperature of Suspension, °F 71°

9. Corrected Hydrometer Reading, g, R2' 2.6

10. % Sand = (39.8 - 3.6)/39.8 x 100 = 90.9%

11. % Clay = 2.6/39.8 x 100 = 4%

12. Sieve Analysis:

(a) Oven Dry Wt. (2 Hrs., 105° C) Total Sand Fraction  
(Soil Retained in 0.047 mm Sieve), g. 36.3

(b) Wt. of Fine Plus Very Fine Sand Fraction  
(Sand Passing 0.25 mm Sieve), g 32.6

(c) % Fine Plus Very Fine Sand (b/a) 89.8%

13. Soil Morphology (Natural Soil Samples Only):

Structure of Soil Horizon Tested                     

Consistence of Soil Horizon Tested:                      Dry                      Moist                     

14. Soil Permeability Class Rating (Based upon Average Textural Analysis of this Replicate and other Replicate Samples)  
K-4 (Adjusted)

15. I HEREBY CERTIFY THAT THE INFORMATION FURNISHED ON THIS ATTACHMENT "B" IS TRUE AND ACCURATE. I AM AWARE THAT FALSIFICATION OF DATA IS A VIOLATION OF THE WATER POLLUTION CONTROL ACT (N.J.S.A.) 58:10A-1 et seq.) AND IS SUBJECT TO PENALTIES AS PRESCRIBED IN N.J.A.C. 7:14-8.

SIGNATURE OF SOIL EVALUATOR Christy 2

DATE 4/5/23

SIGNATURE OF PROFESSIONAL ENGINEER                     

LICENSE NUMBER 32498



Keith - EDA #9826  
Block 261, Lot 15.02

CAPE MAY COUNTY DEPARTMENT OF HEALTH  
SEWAGE DISPOSAL SYSTEM APPLICATION - ATTACHMENT "B"

SOIL PERMEABILITY CLASS RATING DATA

MUNICIPALITY - Dennis Township

1. Test Number 1 Replicate Letter A

2. Sample Depth 60" Soil Pit Boring Number TP#2 Date Collected 3/3/2023

3. Coarse Fragment Content

Total Wt. of Sample, W.T., Grams (g) 380

Wt. of Material Retained on 2 mm Sieve, W.C.F., g 13.4

Wt. % Coarse Fragment (W.C.F./W.T. x 100): 3.5%

4. Oven Dry Weight (24 Hrs., 105° C) of 40 g Air Dry Sample, g. Wt. 40

5. Hydrometer Calibration, Rc 4

Temperature of Suspension, °F 71°

6. Hydrometer Reading - 40 Sec., g, R1 6

Temperature of Suspension, °F 71°

7. Corrected Hydrometer Reading, g, R1' 2.6

8. Hydrometer Reading - 2 Hrs., g, R2 5

Temperature of Suspension, °F 71°

9. Corrected Hydrometer Reading, g, R2' 1.6

10. % Sand =  $(40 - 2.6)/40 \times 100 =$  93.5%

11. % Clay =  $1.6/40 \times 100 =$  4%

12. Sieve Analysis:

(a) Oven Dry Wt. (2 Hrs., 105° C) Total Sand Fraction

(Soil Retained in 0.047 mm Sieve), g 37.5

(b) Wt. of Fine Plus Very Fine Sand Fraction

(Sand Passing 0.25 mm Sieve), g 35.4

(c) % Fine Plus Very Fine Sand (b/a) 94.4%

13. Soil Morphology (Natural Soil Samples Only):

Structure of Soil Horizon Tested

Consistence of Soil Horizon Tested: Dry Moist

14. Soil Permeability Class Rating (Based upon Average Textural Analysis of this Replicate and other Replicate Samples)

K-4 (Adjusted)

15. I HEREBY CERTIFY THAT THE INFORMATION FURNISHED ON THIS ATTACHMENT "B" IS TRUE AND ACCURATE. I AM AWARE THAT FALSIFICATION OF DATA IS A VIOLATION OF THE WATER POLLUTION CONTROL ACT (N.J.S.A.) 58:10A-1 et seq.) AND IS SUBJECT TO PENALTIES AS PRESCRIBED IN N.J.A.C. 7:14-8.

SIGNATURE OF SOIL EVALUATOR Chad R. 2

DATE 4/5/23

SIGNATURE OF PROFESSIONAL ENGINEER David

LICENSE NUMBER 32498



Keith - EDA #9826  
Block 261, Lot 15.02

CAPE MAY COUNTY DEPARTMENT OF HEALTH  
SEWAGE DISPOSAL SYSTEM APPLICATION - ATTACHMENT "B"

SOIL PERMEABILITY CLASS RATING DATA

MUNICIPALITY - Dennis Township

1. Test Number 1 Replicate Letter B

2. Sample Depth 60" Soil Pit Boring Number TP#2 Date Collected 3/3/2023

3. Coarse Fragment Content

Total Wt. of Sample, W.T., Grams (g) 380

Wt. of Material Retained on 2 mm Sieve, W.C.F., g 13.4

Wt. % Coarse Fragment (W.C.F./W.T. x 100): 3.5%

4. Oven Dry Weight (24 Hrs., 105° C) of 40 g Air Dry Sample, g. Wt. 40

5. Hydrometer Calibration, Rc 4  
Temperature of Suspension, °F 71°

6. Hydrometer Reading - 40 Sec., g, R1 6  
Temperature of Suspension, °F 71°

7. Corrected Hydrometer Reading, g, R1' 2.6

8. Hydrometer Reading - 2 Hrs., g, R2 5  
Temperature of Suspension, °F 71°

9. Corrected Hydrometer Reading, g, R2' 1.6

10. % Sand =  $(40 - 2.6)/40 \times 100 =$  93.5%

11. % Clay =  $1.6/40 \times 100 =$  4%

12. Sieve Analysis:

- (a) Oven Dry Wt. (2 Hrs., 105° C) Total Sand Fraction  
(Soil Retained in 0.047 mm Sieve), g 37.7  
(b) Wt. of Fine Plus Very Fine Sand Fraction  
(Sand Passing 0.25 mm Sieve), g 36.4  
(c) % Fine Plus Very Fine Sand (b/a) 96.5%

13. Soil Morphology (Natural Soil Samples Only):

Structure of Soil Horizon Tested \_\_\_\_\_  
Consistence of Soil Horizon Tested: \_\_\_\_\_ Dry \_\_\_\_\_ Moist \_\_\_\_\_

14. Soil Permeability Class Rating (Based upon Average Textural Analysis of this Replicate and other Replicate Samples)  
K-4 (Adjusted)

15. I HEREBY CERTIFY THAT THE INFORMATION FURNISHED ON THIS ATTACHMENT "B" IS TRUE AND ACCURATE. I AM AWARE THAT FALSIFICATION OF DATA IS A VIOLATION OF THE WATER POLLUTION CONTROL ACT (N.J.S.A.) 58:10A-1 et seq.) AND IS SUBJECT TO PENALTIES AS PRESCRIBED IN N.J.A.C. 7:14-8.

SIGNATURE OF SOIL EVALUATOR Christy R  
DATE 3/5/23  
SIGNATURE OF PROFESSIONAL ENGINEER Amulth  
LICENSE NUMBER 32498



Keith - EDA #9826  
Block 261, Lot 15.02

CAPE MAY COUNTY DEPARTMENT OF HEALTH  
SEWAGE DISPOSAL SYSTEM APPLICATION - ATTACHMENT "B"

SOIL PERMEABILITY CLASS RATING DATA      MUNICIPALITY - Dennis Township

1. Test Number 1      Replicate Letter A

2. Sample Depth 58"      Soil Pit Boring Number TP#3      Date Collected 3/3/2023

3. Coarse Fragment Content

Total Wt. of Sample, W.T., Grams (g) 471.1

Wt. of Material Retained on 2 mm Sieve, W.C.F., g 10

Wt. % Coarse Fragment (W.C.F./W.T. x 100): 2.1%

4. Oven Dry Weight (24 Hrs., 105° C) of 40 g Air Dry Sample, g. Wt. 39.8

5. Hydrometer Calibration, Rc 4

Temperature of Suspension, °F 71°

6. Hydrometer Reading - 40 Sec., g, R1 6

Temperature of Suspension, °F 71°

7. Corrected Hydrometer Reading, g, R1' 2.6

8. Hydrometer Reading - 2 Hrs., g, R2 5

Temperature of Suspension, °F 71°

9. Corrected Hydrometer Reading, g, R2' 1.6

10. % Sand =  $(39.8 - 2.6) / 39.8 \times 100 =$  93.5%

11. % Clay =  $1.6 / 39.8 \times 100 =$  4%

12. Sieve Analysis:

(a) Oven Dry Wt. (2 Hrs., 105° C) Total Sand Fraction

(Soil Retained in 0.047 mm Sieve), g 34.9

(b) Wt. of Fine Plus Very Fine Sand Fraction

(Sand Passing 0.25 mm Sieve), g 33.4

(c) % Fine Plus Very Fine Sand (b/a) 95.7%

13. Soil Morphology (Natural Soil Samples Only):

Structure of Soil Horizon Tested

Consistence of Soil Horizon Tested:                      Dry                      Moist

14. Soil Permeability Class Rating (Based upon Average Textural Analysis of this Replicate and other Replicate Samples)

K-4 (Adjusted)

15. I HEREBY CERTIFY THAT THE INFORMATION FURNISHED ON THIS ATTACHMENT "B" IS TRUE AND ACCURATE. I AM AWARE THAT FALSIFICATION OF DATA IS A VIOLATION OF THE WATER POLLUTION CONTROL ACT (N.J.S.A.) 58:10A-1 et seq.) AND IS SUBJECT TO PENALTIES AS PRESCRIBED IN N.J.A.C. 7:14-8.

SIGNATURE OF SOIL EVALUATOR                     

DATE 4/5/23

SIGNATURE OF PROFESSIONAL ENGINEER                     

LICENSE NUMBER 32498



Keith - EDA #9826  
Block 261, Lot 15.02

CAPE MAY COUNTY DEPARTMENT OF HEALTH  
SEWAGE DISPOSAL SYSTEM APPLICATION - ATTACHMENT "B"

SOIL PERMEABILITY CLASS RATING DATA

MUNICIPALITY - Dennis Township

1. Test Number 1 Replicate Letter B

2. Sample Depth 58" Soil Pit Boring Number TP#3 Date Collected 3/3/2023

3. Coarse Fragment Content

Total Wt. of Sample, W.T., Grams (g) 471.1

Wt. of Material Retained on 2 mm Sieve, W.C.F., g 10

Wt. % Coarse Fragment (W.C.F./W.T. x 100): 2.1%

4. Oven Dry Weight (24 Hrs., 105° C) of 40 g Air Dry Sample, g. Wt. 39.8

5. Hydrometer Calibration, Rc 4

Temperature of Suspension, °F 71°

6. Hydrometer Reading - 40 Sec., g, R1 6

Temperature of Suspension, °F 71°

7. Corrected Hydrometer Reading, g, R1' 2.6

8. Hydrometer Reading - 2 Hrs., g, R2 6

Temperature of Suspension, °F 71°

9. Corrected Hydrometer Reading, g, R2' 2.6

10. % Sand =  $(39.8 - 2.6) / 39.8 \times 100 =$  93.5%

11. % Clay =  $2.6 / 39.8 \times 100 =$  6.5%

12. Sieve Analysis:

(a) Oven Dry Wt. (2 Hrs., 105° C) Total Sand Fraction

(Soil Retained in 0.047 mm Sieve), g 35.1

(b) Wt. of Fine Plus Very Fine Sand Fraction

(Sand Passing 0.25 mm Sieve), g 33.1

(c) % Fine Plus Very Fine Sand (b/a) 94.3%

13. Soil Morphology (Natural Soil Samples Only):

Structure of Soil Horizon Tested

Consistence of Soil Horizon Tested: Dry Moist

14. Soil Permeability Class Rating (Based upon Average Textural Analysis of this Replicate and other Replicate Samples)

K-4 (Adjusted)

15. I HEREBY CERTIFY THAT THE INFORMATION FURNISHED ON THIS ATTACHMENT "B" IS TRUE AND ACCURATE. I AM AWARE THAT FALSIFICATION OF DATA IS A VIOLATION OF THE WATER POLLUTION CONTROL ACT (N.J.S.A.) 58:10A-1 et seq.) AND IS SUBJECT TO PENALTIES AS PRESCRIBED IN N.J.A.C. 7:14-8.

SIGNATURE OF SOIL EVALUATOR Christy J.

DATE 4/5/23

SIGNATURE OF PROFESSIONAL ENGINEER Butt

LICENSE NUMBER 32498