STORMWATER MANAGEMENT REPORT

FOR
BARNEGAT CROSSING II
MAJOR SITE PLAN

Block: 92.111 – Lot: 24.09
BARNEGAT TOWNSHIP
OCEAN COUNTY, NEW JERSEY

PREPARED BY:

PROFESSIONAL DESIGN SERVICES, LLC

1245 AIRPORT ROAD, SUITE 1
LAKEWOOD, NEW JERSEY 08701
PDS Ref. No. 16617

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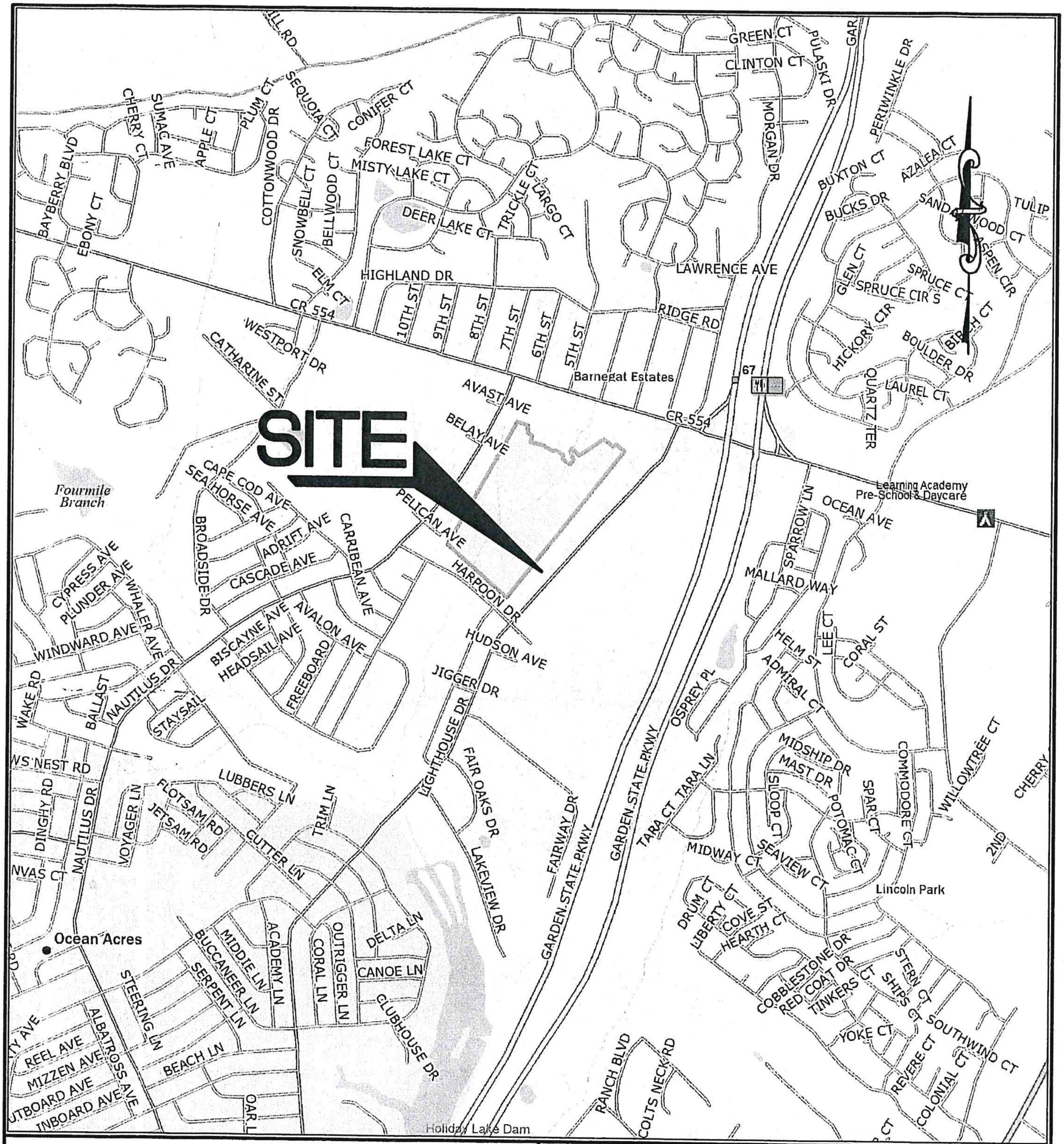

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FIGURE #1

LOCATION PLAN

FOR

TAX BLOCK 92.111 – TAX LOT 24.09

TOWNSHIP OF BARNEGAT
OCEAN COUNTY NEW JERSEY
PROJECT #16617

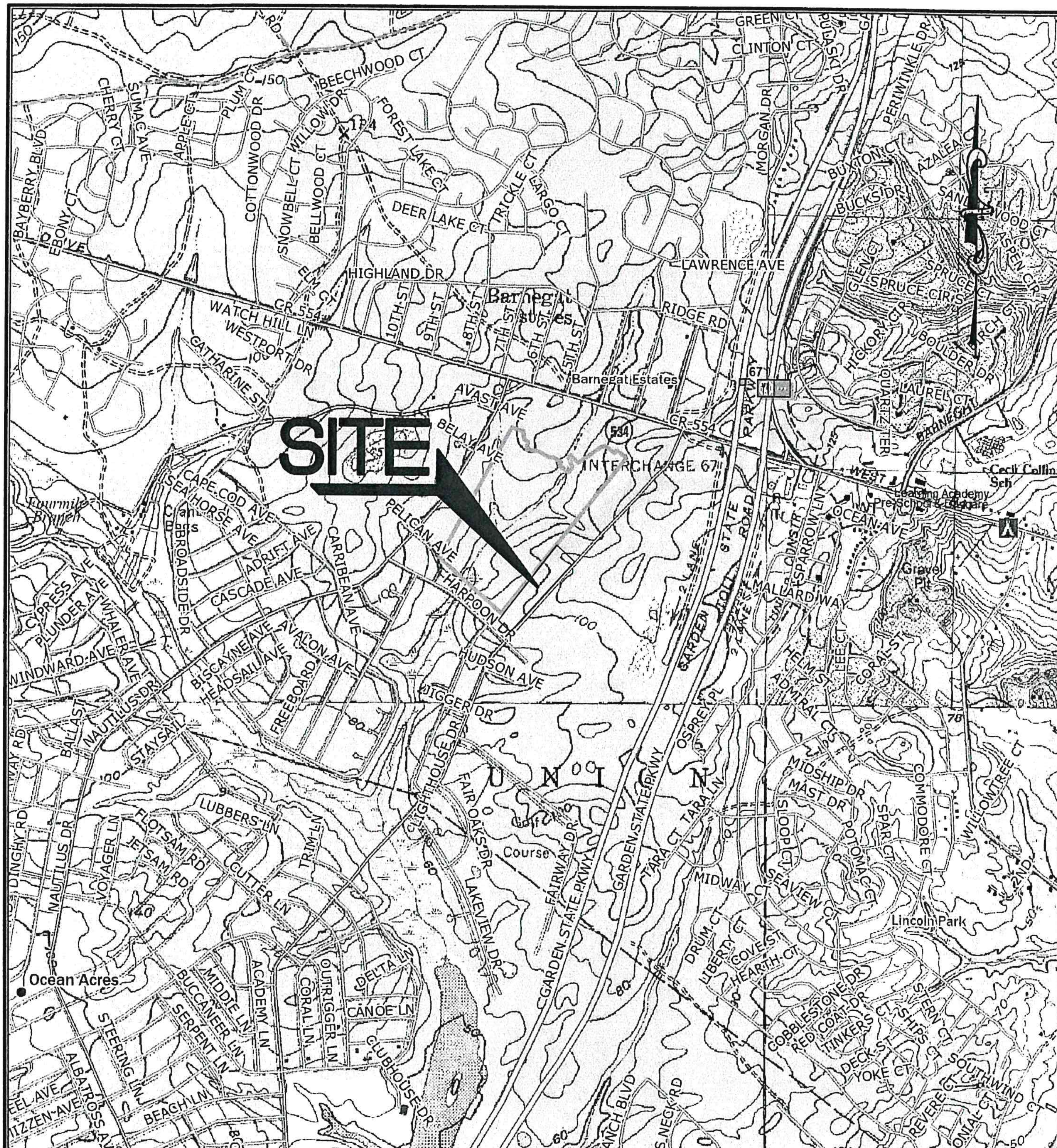

FIGURE #2

U.S.G.S. QUAD MAP

FOR

TAX BLOCK 92.111 – TAX LOT 24.09

TOWNSHIP OF BARNEGAT
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FIGURE #3

SOIL MAP

FOR

TAX BLOCK 92.111 – TAX LOT 24.09

TOWNSHIP OF BARNEGAT
OCEAN COUNTY NEW JERSEY
PROJECT #16617

1.0 PROJECT DESCRIPTION

It is proposed to develop age-restricted residential condominiums along the west side of Lighthouse Drive in Barnegat Township, Ocean County, New Jersey. Figure 1, enclosed, is a copy of the Ocean County Road Map illustrating the site's location.

The property contains 9.9 acres known as Block 92.111 Lot 24.09 as shown on in the Barnegat Township Tax Map. The project is located within the Regional Growth land capability area of the Pinelands National Reserve and must comply with the Pinelands Comprehensive Management Plan.

The project is depicted in detail on the Site Plans, prepared by Professional Design Services, LLC.

This report outlines the methodologies and results for management of the increased stormwater runoff created as a result of the development.

2.0 EXISTING SITE CONDITIONS

The following analysis describes the existing environmental conditions based upon literature review and field investigation.

2.1 TOPOGRAPHY AND HYDROLOGY

The project site lies within the outer coastal plain physiographic province. The topography of the site slopes from the north and east to the south and west. The property is forested. Figure 2 is a copy of the USGS Quadrangle Topography Map with the site located.

2.2 SOILS

The project site is underlain by the following soils as depicted by the U.S. Department of Agriculture; Ocean County Soil Survey. Figure 3 is a copy of the Soil Survey with the site located.

Soil Type	% Slope	Depth to SHWT*
DoA - Downer Loamy Sand	0-5	>6.0'
WoC - Woodmansie Loamy Sand	0-5	>6.0'

**SHWT = Seasonal High Water Table*

The permeability of this soil is typically rapid and the available water capacity is low. The depth to seasonal high water is typically greater than 6 feet. Both Downer and Woodmansie soils are hydrologic soil group "B". These soil types typically have an acidic reaction but are not acid-producing. The use of lime in landscaped areas is required to neutralize the soil to provide adequate growing conditions.

Soil test pits were performed throughout the site to assess soil conditions, depth to seasonal high water table and permeability tests were performed. The depth to seasonal high water occurs at a depth greater than five (5) feet. The permeability tests were performed at locations and depths to assess the permeability of the native soils for suitability to accept exfiltration of stormwater runoff from the management facilities. The tests include tube permeameter analysis of samples obtained from the test pits as well as 15 piezometer wells temporarily installed throughout the proposed infiltration facilities. The wells were installed so as to determine the permeability of the infiltrative layer and a falling head test performed at each well. The soil permeability test results are contained in this report and indicate a permeability of between 13 and 18 inches per hour, the soils are well-drained and suitable for the stormwater design. The location of each test pit and log are shown on the site plans.

3.0 REGULATORY STANDARDS

3.1 REGULATIONS

A. NJDEP

All increased stormwater runoff resulting from the proposed development must be managed both qualitatively and quantitatively in accordance with New Jersey Regulations.

On February 4, 2004, the New Jersey Department of Environmental Protection (DEP) adopted new Stormwater Management Rules (NJAC 7:8) which require all major developments to address stormwater-related water quality, groundwater recharge and water quantity impacts. The Pinelands Commission subsequently adopted amendments to the Comprehensive Management Plan (NJAC 7:50) which integrate the new DEP rules into the CMP stormwater runoff rules. These amendments became effective May 2007 and the project is required to comply with these standards as well as the DEP rules.

The stormwater regulations as administered by the Pinelands Commission require the utilization of best available technology to minimize the amount of stormwater runoff, maintain existing onsite infiltration, simulate natural drainage systems and minimize the discharge of pollutants to ground or surface waters. The overall goal of the post-construction stormwater management system design shall be to meet the erosion control, groundwater recharge, stormwater runoff quantity and quality standards at N.J.A.C. 7:8-5.4 and 5.5.

The stormwater management must be design to:

1. Reduce flood damage, including damage to life and property;
2. Minimize, to the extent practical, any increase in stormwater runoff from any new development;
3. Reduce soil erosion from any development or construction project;
4. Assure the adequacy of exiting and proposed culverts and bridges, and other in-stream structures;
5. Maintain groundwater recharge;
6. Prevent, to the greatest extent feasible, an increase in nonpoint pollution;
7. Maintain the integrity of stream channels for their biological functions, as well as for drainage;
8. Minimize pollutants in stormwater runoff from new and existing development in order to restore, enhance and maintain the chemical, physical, and biological integrity of the waters of the State, to protect public health, to safeguard fish and aquatic life and scenic and ecological values and to enhance the domestic, municipal, recreational, industrial and other uses of water; and
9. Protect public safety through the proper design and operation of stormwater management basins.

These standards shall be met by utilizing nonstructural stormwater management strategies (7:8-5.3) into the design. Structural measures (7:8-5.7) will be used as necessary where the nonstructural measures are not sufficient. Analysis of each strategy will utilize the New Jersey Stormwater Best Management Practices (BMP) Manual as guidance. An Appellate Court decision in September 2013 invalidated the use of the Nonstructural Strategies Point System (NSPS) spreadsheet system to determine compliance with low-impact development requirements.

Nonstructural stormwater management strategies incorporated into site design shall:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss;

2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;
3. Maximize the protection of natural drainage features and vegetation;
4. Minimize the decrease in the "time of concentration" from pre-construction to post-construction. "Time of Concentration" is defined as the time to takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed;
5. Minimize land disturbance including clearing and grading;
6. Minimize soil compaction;
7. Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;
8. Provide vegetated open-channel conveyance systems discharging into through stable vegetated areas; and
9. Provide other source controls to prevent or minimize the use or exposure of pollutants at the site in order to prevent or minimize the release of those pollutants into stormwater runoff.

B. Design and Performance Standards

1. Erosion Control

   The minimum design and performance standards for erosion control are those established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules.

2. Groundwater Recharge

   The minimum design and performance standards for groundwater recharge require compliance with either of the following:

   a. Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site.
   b. Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the two-year storm is infiltrated.

3. Runoff Quantity

   In order to control stormwater runoff quantity impacts one of the following must be demonstrated:

a. Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the two, 10 and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events;

b. Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the two, 10 and 100-year storm events and that the increase volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area;

c. Design stormwater management measures so that the post-construction peak runoff rates for the two, 10 and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed.

4. Water Quality

Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff generated from the water quality design storm by 80 percent of the anticipated load from the development site expressed as an annual average.

In accordance with the definition of FW1 at N.J.A.C. 7:9B-1.4, stormwater management measures shall be designed to prevent any increase in stormwater runoff to waters classified as FW1.

5. Mounding Analysis

In order to ensure design performance, the newly adopted Pinelands Commission regulations require a groundwater mounding analysis for the storm water management systems. Kaveh Zomorodi PhD, PE has developed a simplified solution for predicting groundwater mounding under stormwater infiltration facilities. These solutions were developed for the New Jersey Department of Agriculture and determine the maximum rise of the central mound and aerial extent of the mound. Equations were developed for recharge strips (2005 AWRA Conference paper) and round facilities (2009 ASCE Congress paper). These equations are intended for use by project such as this one because they do not require knowledge of the various hydrogeological parameters. In addition these equations have been developed considerate of the unsteady intermittent recharge in which the rate of infiltration and recharge are variable. These equations apply to infinite homogeneous acquifers with initially horizontal water table, conditions that are commonly found in New Jersey. Zomorodi reports that groundwater mounds below recharge basins are typically one to six feet after a rain event and the mound typically disappears within five days of the rainfall. The equations contained in Zomorodi's papers will be utilized to estimate the groundwater mounding.

C. Pinelands Comprehensive Management Plan

The Pinelands Comprehensive Management Plan (CMP) administered by the Pinelands Commission requires that the NJ Stormwater Management Rules be followed as well as additional standards. The total runoff generated by a 10 year storm from all impervious surfaces must be retained and infiltrated on-site. Stormwater runoff shall not be directed in such a way as to increase the volume and rate of discharge into any surface water body from that which existed prior to development of the parcel. The CMP further provides standards for permanent stormwater facility maintenance, and address management of onsite soils resources including post construction soil and site assessments to field verify that as-built site conditions are consistent with stormwater design assumptions. Notations describing these standards may be found on the site plans.

4.0 PROPOSED STORMWATER MANAGEMENT PLAN

As shown on the Site Plans, the proposed stormwater management plan consists of a sand filter basin. The basin will contain sufficient volume to perform water quality control, retain and recharge the increased runoff from the 2 and 10 year 24 hour storm, retain the increased runoff from impervious surfaces for the 10 year 24 hour storm event and control any increased runoff from the proposed development for the 2, 10 and 100 year 24 hour storm events as required.

The basin will outlet into an existing storm drainage pipe located within Lighthouse Drive. The basin will not discharge any increase in the runoff currently contributory to the Lighthouse Drive drainage system.

5.0 METHODOLOGY

The Low Impact Design techniques will be utilized to interact with the hydrologic process to control stormwater runoff and pollutants closer to their source while providing site design measures that can significantly reduce the overall impact of land development on stormwater runoff as required by the Stormwater Management Rules.

The methodology typically used to estimate the stormwater runoff peak flows and volumes for the required storm events is the 24-hour storm using the rainfall distribution recommended by the U.S. Department of Agriculture Soil Conservation Service as defined in Technical Release - 55 (TR-55) dated June 1986. The time of concentrations utilized will be calculated for each contributory area utilizing the TR-55 methodology.

For the purpose of calculating runoff coefficients and groundwater recharge, there is a presumption that the pre-construction condition of a site or portion thereof is a wooded land use with good hydrologic condition.

The project area does not contain any significant land features and structures, such as ponds, wetlands, depressions, hedgerows, or culverts that may reduce pre-construction stormwater runoff rates and volumes.

In computing stormwater runoff from all design storms, the computations consider the relative stormwater runoff rates and/or volumes of pervious and impervious surfaces separately to accurately compute the rates and volume of stormwater runoff from the site.

The water quality design storm is 1.25 inches of rainfall in two hours. Water quality calculations shall take into account the distribution of rain from the water quality design storm, as reflected in the New Jersey Stormwater Rules. The calculation of the volume of runoff may take into account the implementation of non-structural and structural stormwater management measures.

The management systems proposed consists of an excavated infiltration basin.

Based upon soil permeability testing performed by PDS the native soil has a permeability rate of between 13 and 15 inches per hour for the soils beneath the proposed management systems. For design purposes we have utilized a rate of 6 inches per hour for the exfiltration rate (0.00014 feet per second) to allow for a factor of safety of more than 2. This exfiltration rate is applied to each system to determine the time required to drain each system. No exfiltration is utilized as an outflow from the system during the flood routings, as such the routing is conservative since it does not rely upon such outflow during the storm but simply ensures the system will drain between storm events.

Soil erosion and sediment controls will also be employed as required by the "Standards for Soil Erosion and Sediment Control in New Jersey."

All hydrologic and flood routing computations will utilize the Haested Methods (1989) computer software.

Copies of the computations are contained within the appendices of this report.

6.0 SUMMARY

The stormwater basin has been designed to provide a minimum separation of two (2) feet between the bottom of any management facility and seasonal high water table. The existing soils have a permeability of less than 20 inches per hour and are not excessively drained. The site plans contain the performance and maintenance standards required to maintain maximum soil infiltration capacity.

Low Impact Design

An Appellate Court decision in September 2013 invalidated the use of the Nonstructural Strategies Point System (NSPS) spreadsheet system to determine compliance with low-impact development requirements. The project complies with the low impact design criteria to the maximum extent practicable given the design standards permitted by Municipal zoning and Pinelands CMP.

The project has implemented several low impact design techniques as follows:

A. Providing low maintenance landscaping by usage of native grasses and landscape plants.

Erosion Control

The project complies with the "New Jersey Standards for Soil Erosion and Sediment Control." Certification for the project must be granted by the Ocean County Soil Conservation District prior to commencement of construction.

Groundwater Recharge

It is required to retain and recharge runoff volume from the following storm events :

BASIN

Storm Event	Retention Volume Required	Retention Volume Provided
2	55,600 CF (1)	94,725 CF
10	87,555 CF (2)	94,725 CF
50	90,500 CF (3)	94,725 CF

(1) Increased volume from pre-developed to post developed condition per Stormwater Regulations.

(2) Runoff from new impervious surfaces per Pinelands regulations per hydrograph volume.

(3) Increased runoff from pre developed to post developed condition per Barnegat regulations.

Runoff Quantity

The following is a summary of the runoff from the project site for the flood storm events:

Storm Event	Pre-Developed Peak Flow	Allowable Peak Flow	Post-Developed Peak Flow
2	0	0	0
10	0	0	0
100	1.4	1.1	1.0

Water Quality

Water Quality control is provided by retention of the water quality storm event in the stormwater basin. All runoff from the water quality storm will be retained and infiltrated to groundwater.

Mounding
The mounding analysis was performed by utilizing The Zomordi equations and the mound in the center of the recharge system will be 1.1 ft, it will not adversely impact the functioning of the system.
The mounding that will occur beneath the site will only be temporary after large storm events and will not alter permanent groundwater levels. As a result, the stormwater management systems will not adversely impact wetlands, surface water bodies, septic systems or man-made structures. A certification is included in this report.

Time to Drain
The stormwater management basin will drain the retention volume in 13.4 hours

Downstream Drainage System Capacity
The stormwater basin will discharge into an existing storm drainage system located in Lighthouse Drive. The design storm for the downstream system is a 25 year storm. The 25 year storm has been routed through the proposed basin and generates an outflow of 0.33 cfs. Given this deminimis flow the project will have no adverse effect on the capacity of the downstream drainage system.

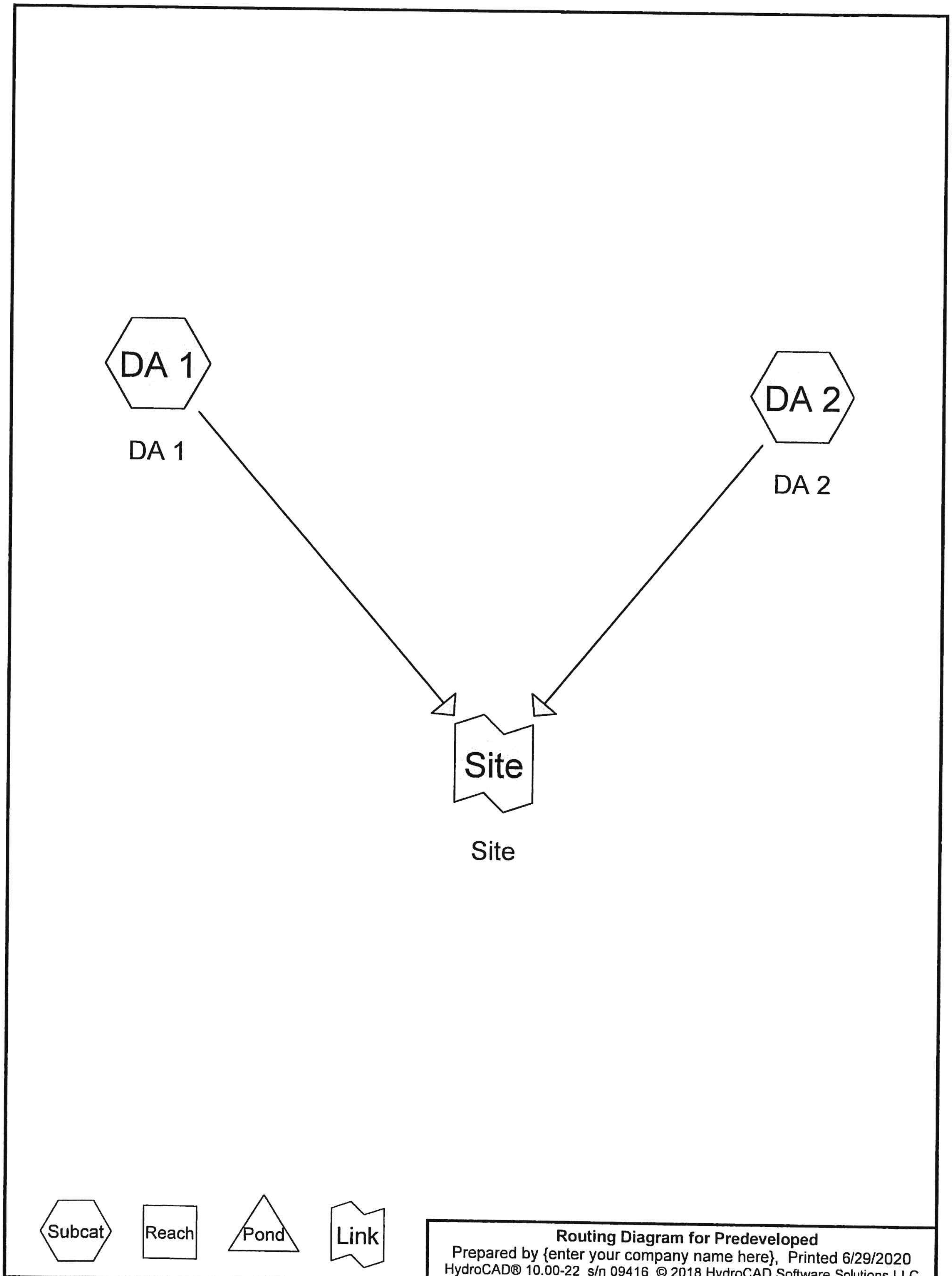
7.0 MAINTENANCE

All maintenance activities for the stormwater collection system and infiltration basin will be the responsibility of the property owner.

A performance bond, inspection fees and maintenance bond for the management system will be posted with Barnegat Township prior to the commencement of construction. There is a maintenance plan included in the site plans which contain a summary of the required maintenance activities and their estimated costs.

APPENDIX A

EXISTING CONDITION CALCULATIONS



Routing Diagram for Predeveloped
Prepared by {enter your company name here}, Printed 6/29/2020
HydroCAD® 10.00-22 s/n 09416 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.900	30	woods hsg A (DA 1, DA 2)
9.900	**30**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
9.900	Other	DA 1, DA 2
9.900		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	9.900	9.900	woods hsg A	DA 1, DA 2
0.000	**0.000**	**0.000**	**0.000**	**9.900**	**9.900**	**TOTAL AREA**	

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentDA 1: DA 1 Runoff Area=7.600 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=670' Tc=29.9 min CN=30 Runoff=0.00 cfs 0.000 af

SubcatchmentDA 2: DA 2 Runoff Area=2.300 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=405' Tc=29.5 min CN=30 Runoff=0.00 cfs 0.000 af

Link Site: Site Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 9.900 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 9.900 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment DA 1: DA 1

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2 year Rainfall=3.50"

	Area (ac)	CN	Description
*	7.600	30	woods hsg A
	7.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	75	0.0160	0.07		**Sheet Flow, sheet flow** Woods: Light underbrush n= 0.400 P2= 3.50"
2.5	150	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.6	445	0.0240	0.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	670	Total			

Summary for Subcatchment DA 2: DA 2

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2 year Rainfall=3.50"

	Area (ac)	CN	Description
*	2.300	30	woods hsg A
	2.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	75	0.0100	0.06		**Sheet Flow, sheet flow** Woods: Light underbrush n= 0.400 P2= 3.50"
8.0	330	0.0190	0.69		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.5	405	Total			

Summary for Link Site: Site

Inflow Area = 9.900 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2 year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DA 1: DA 1 Runoff Area=7.600 ac 0.00% Impervious Runoff Depth=0.02"
Flow Length=670' Tc=29.9 min CN=30 Runoff=0.03 cfs 0.014 af

Subcatchment DA 2: DA 2 Runoff Area=2.300 ac 0.00% Impervious Runoff Depth=0.02"
Flow Length=405' Tc=29.5 min CN=30 Runoff=0.01 cfs 0.004 af

Link Site: Site Inflow=0.04 cfs 0.018 af
Primary=0.04 cfs 0.018 af

Total Runoff Area = 9.900 ac Runoff Volume = 0.018 af Average Runoff Depth = 0.02"
100.00% Pervious = 9.900 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment DA 1: DA 1

Runoff = 0.03 cfs @ 23.80 hrs, Volume= 0.014 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10 year Rainfall=5.40"

	Area (ac)	CN	Description
*	7.600	30	woods hsg A
	7.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	75	0.0160	0.07		**Sheet Flow, sheet flow** Woods: Light underbrush n= 0.400 P2= 3.50"
2.5	150	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.6	445	0.0240	0.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	670	Total			

Summary for Subcatchment DA 2: DA 2

Runoff = 0.01 cfs @ 23.79 hrs, Volume= 0.004 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10 year Rainfall=5.40"

	Area (ac)	CN	Description
*	2.300	30	woods hsg A
	2.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	75	0.0100	0.06		**Sheet Flow, sheet flow** Woods: Light underbrush n= 0.400 P2= 3.50"
8.0	330	0.0190	0.69		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.5	405	Total			

Summary for Link Site: Site

Inflow Area = 9.900 ac, 0.00% Impervious, Inflow Depth = 0.02" for 10 year event
Inflow = 0.04 cfs @ 23.80 hrs, Volume= 0.018 af
Primary = 0.04 cfs @ 23.80 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment DA 1: DA 1 Runoff Area=7.600 ac 0.00% Impervious Runoff Depth=0.74"
Flow Length=670' Tc=29.9 min CN=30 Runoff=1.06 cfs 0.467 af

Subcatchment DA 2: DA 2 Runoff Area=2.300 ac 0.00% Impervious Runoff Depth=0.74"
Flow Length=405' Tc=29.5 min CN=30 Runoff=0.32 cfs 0.141 af

Link Site: Site Inflow=1.38 cfs 0.608 af
Primary=1.38 cfs 0.608 af

Total Runoff Area = 9.900 ac Runoff Volume = 0.608 af Average Runoff Depth = 0.74"
100.00% Pervious = 9.900 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment DA 1: DA 1

Runoff = 1.06 cfs @ 13.17 hrs, Volume= 0.467 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100 year Rainfall=9.20"

	Area (ac)	CN	Description
*	7.600	30	woods hsg A
	7.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	75	0.0160	0.07		**Sheet Flow, sheet flow** Woods: Light underbrush n= 0.400 P2= 3.50"
2.5	150	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
9.6	445	0.0240	0.77		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.9	670	Total			

Summary for Subcatchment DA 2: DA 2

Runoff = 0.32 cfs @ 13.16 hrs, Volume= 0.141 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100 year Rainfall=9.20"

	Area (ac)	CN	Description
*	2.300	30	woods hsg A
	2.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.5	75	0.0100	0.06		**Sheet Flow, sheet flow** Woods: Light underbrush n= 0.400 P2= 3.50"
8.0	330	0.0190	0.69		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
29.5	405	Total			

Summary for Link Site: Site

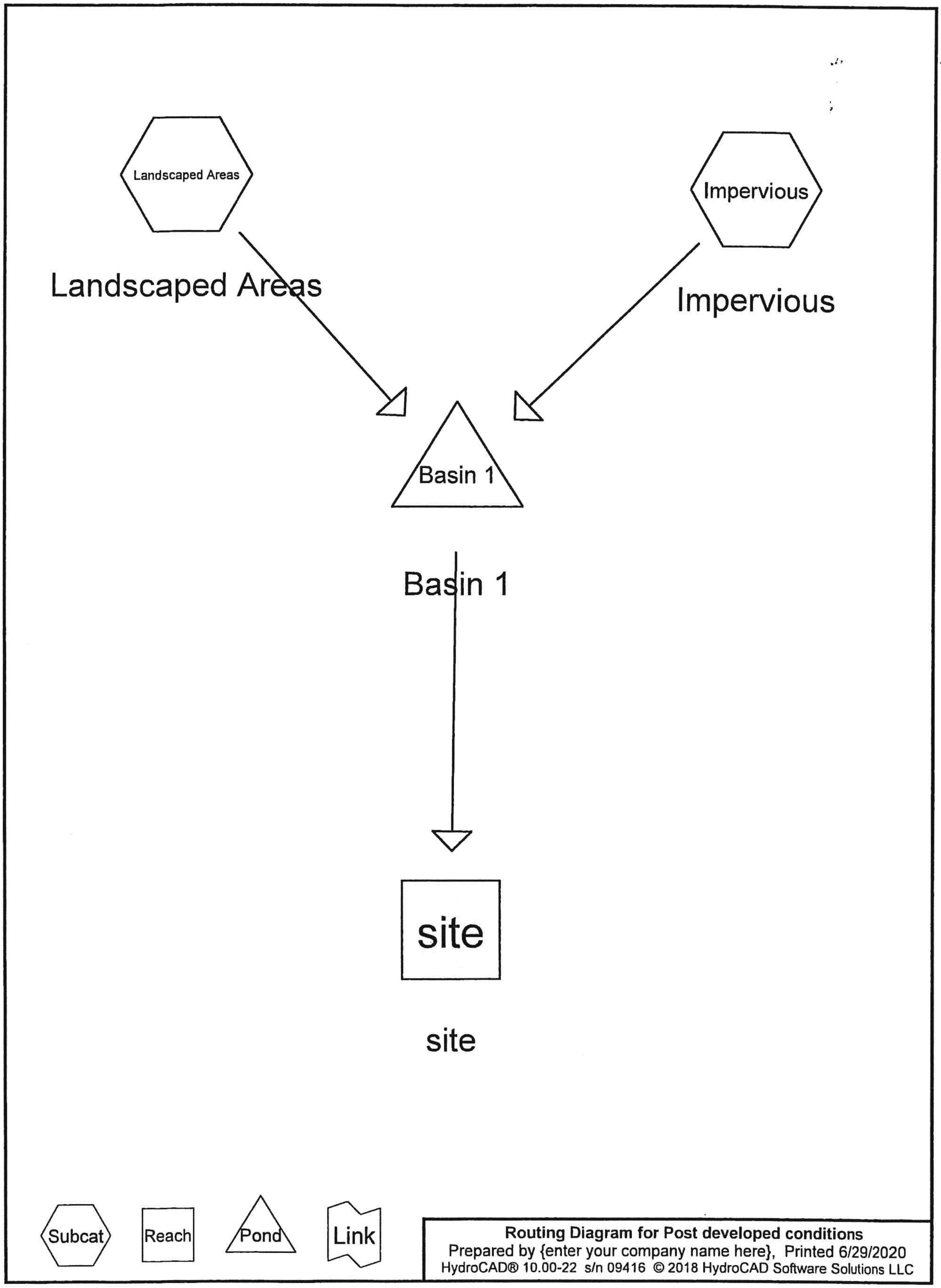
Inflow Area = 9.900 ac, 0.00% Impervious, Inflow Depth = 0.74" for 100 year event
Inflow = 1.38 cfs @ 13.17 hrs, Volume= 0.608 af
Primary = 1.38 cfs @ 13.17 hrs, Volume= 0.608 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

APPENDIX B

PROPOSED CONDITION CALCULATIONS

WATER QUALITY CALCULATIONS
- RETENTION BASIN CALCULATIONS
MOUNDING ANALYSIS
TIME TO DRAIN CALCULATIONS
DOWNSTREAM DRAINAGE SYSTEM CALCULATIONS



Routing Diagram for Post developed conditions
Prepared by {enter your company name here}, Printed 6/29/2020

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.500	98	Roof (Impervious)
3.200	98	impervious pavement & sidewalk (Impervious)
4.900	39	landscaped areas hsg A (Landscaped Areas)
0.300	30	woods hsg A (Landscaped Areas)
9.900	**67**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
9.900	Other	Impervious, Landscaped Areas
9.900		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	1.500	1.500	Roof	Impervious
0.000	0.000	0.000	0.000	3.200	3.200	impervious pavement & sidewalk	Impervious
0.000	0.000	0.000	0.000	4.900	4.900	landscaped areas hsg A	Landscaped Areas
0.000	0.000	0.000	0.000	0.300	0.300	woods hsg A	Landscaped Areas
0.000	**0.000**	**0.000**	**0.000**	**9.900**	**9.900**	**TOTAL AREA**	

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Impervious: Impervious Runoff Area=4.700 ac 100.00% Impervious Runoff Depth>3.25"
Tc=15.0 min CN=98 Runoff=8.55 cfs 1.274 af

Subcatchment Landscaped Areas: Runoff Area=5.200 ac 0.00% Impervious Runoff Depth>0.00"
Tc=15.0 min CN=38 Runoff=0.01 cfs 0.001 af

Reach site: site Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond Basin 1: Basin 1 Peak Elev=94.74' Storage=55,529 cf Inflow=8.55 cfs 1.275 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 9.900 ac Runoff Volume = 1.275 af Average Runoff Depth = 1.55"
52.53% Pervious = 5.200 ac 47.47% Impervious = 4.700 ac

Summary for Subcatchment Impervious: Impervious

Runoff = 8.55 cfs @ 12.25 hrs, Volume= 1.274 af, Depth> 3.25"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2 year Rainfall=3.50"

	Area (ac)	CN	Description
*	3.200	98	impervious pavement & sidewalk
*	1.500	98	Roof
	4.700	98	Weighted Average
	4.700		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Subcatchment Landscaped Areas: Landscaped Areas

Runoff = 0.01 cfs @ 24.00 hrs, Volume= 0.001 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2 year Rainfall=3.50"

	Area (ac)	CN	Description
*	4.900	39	landscaped areas hsg A
*	0.300	30	woods hsg A
	5.200	38	Weighted Average
	5.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Reach site: site

Inflow Area = 9.900 ac, 47.47% Impervious, Inflow Depth = 0.00" for 2 year event
Inflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond Basin 1: Basin 1

Inflow Area = 9.900 ac, 47.47% Impervious, Inflow Depth > 1.55" for 2 year event
Inflow = 8.55 cfs @ 12.25 hrs, Volume= 1.275 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 94.74' @ 24.00 hrs Surf.Area= 19,603 sf Storage= 55,529 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	91.50'	179,375 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.50	14,000	0	0
92.00	15,500	7,375	7,375
93.00	17,000	16,250	23,625
94.00	18,500	17,750	41,375
95.00	20,000	19,250	60,625
96.00	21,500	20,750	81,375
97.00	23,000	22,250	103,625
98.00	24,500	23,750	127,375
99.00	26,000	25,250	152,625
100.00	27,500	26,750	179,375

Device	Routing	Invert	Outlet Devices
#1	Primary	96.60'	**4.0" Vert. Orifice** C= 0.600
#2	Primary	98.60'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	99.00'	**48.0" W x 48.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 1.00 hrs HW=91.50' (Free Discharge)
—**1=Orifice** (Controls 0.00 cfs)
—**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
—**3=Orifice/Grate** (Controls 0.00 cfs)

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentImpervious: Impervious Runoff Area=4.700 ac 100.00% Impervious Runoff Depth>5.14"
Tc=15.0 min CN=98 Runoff=13.28 cfs 2.013 af

SubcatchmentLandscaped Areas: Runoff Area=5.200 ac 0.00% Impervious Runoff Depth>0.24"
Tc=15.0 min CN=38 Runoff=0.21 cfs 0.105 af

Reach site: site Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond Basin 1: Basin 1 Peak Elev=96.49' Storage=92,255 cf Inflow=13.28 cfs 2.119 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 9.900 ac Runoff Volume = 2.119 af Average Runoff Depth = 2.57"
52.53% Pervious = 5.200 ac 47.47% Impervious = 4.700 ac

Summary for Subcatchment Impervious: Impervious

Runoff = 13.28 cfs @ 12.25 hrs, Volume= 2.013 af, Depth> 5.14"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10 year Rainfall=5.40"

	Area (ac)	CN	Description
*	3.200	98	impervious pavement & sidewalk
*	1.500	98	Roof
	4.700	98	Weighted Average
	4.700		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Subcatchment Landscaped Areas: Landscaped Areas

Runoff = 0.21 cfs @ 13.22 hrs, Volume= 0.105 af, Depth> 0.24"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10 year Rainfall=5.40"

	Area (ac)	CN	Description
*	4.900	39	landscaped areas hsg A
*	0.300	30	woods hsg A
	5.200	38	Weighted Average
	5.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Reach site: site

Inflow Area = 9.900 ac, 47.47% Impervious, Inflow Depth = 0.00" for 10 year event
Inflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond Basin 1: Basin 1

Inflow Area = 9.900 ac, 47.47% Impervious, Inflow Depth > 2.57" for 10 year event
Inflow = 13.28 cfs @ 12.25 hrs, Volume= 2.119 af
Outflow = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 96.49' @ 24.00 hrs Surf.Area= 22,233 sf Storage= 92,255 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	91.50'	179,375 cf	**Custom Stage Data (Prismatic)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.50	14,000	0	0
92.00	15,500	7,375	7,375
93.00	17,000	16,250	23,625
94.00	18,500	17,750	41,375
95.00	20,000	19,250	60,625
96.00	21,500	20,750	81,375
97.00	23,000	22,250	103,625
98.00	24,500	23,750	127,375
99.00	26,000	25,250	152,625
100.00	27,500	26,750	179,375

Device	Routing	Invert	Outlet Devices
#1	Primary	96.60'	**4.0" Vert. Orifice** C= 0.600
#2	Primary	98.60'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	99.00'	**48.0" W x 48.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 1.00 hrs HW=91.50' (Free Discharge)
—**1=Orifice** (Controls 0.00 cfs)
—**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
—**3=Orifice/Grate** (Controls 0.00 cfs)

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentImpervious: Impervious Runoff Area=4.700 ac 100.00% Impervious Runoff Depth>8.92"
Tc=15.0 min CN=98 Runoff=22.71 cfs 3.493 af

SubcatchmentLandscaped Areas: Runoff Area=5.200 ac 0.00% Impervious Runoff Depth>1.57"
Tc=15.0 min CN=38 Runoff=3.50 cfs 0.679 af

Reach site: site Inflow=1.05 cfs 0.778 af
Outflow=1.05 cfs 0.778 af

Pond Basin 1: Basin 1 Peak Elev=98.87' Storage=149,447 cf Inflow=26.07 cfs 4.172 af
Outflow=1.05 cfs 0.778 af

Total Runoff Area = 9.900 ac Runoff Volume = 4.172 af Average Runoff Depth = 5.06"
52.53% Pervious = 5.200 ac 47.47% Impervious = 4.700 ac

Summary for Subcatchment Impervious: Impervious

Runoff = 22.71 cfs @ 12.25 hrs, Volume= 3.493 af, Depth> 8.92"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100 year Rainfall=9.20"

	Area (ac)	CN	Description
*	3.200	98	impervious pavement & sidewalk
*	1.500	98	Roof
	4.700	98	Weighted Average
	4.700		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Subcatchment Landscaped Areas: Landscaped Areas

Runoff = 3.50 cfs @ 12.33 hrs, Volume= 0.679 af, Depth> 1.57"

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100 year Rainfall=9.20"

	Area (ac)	CN	Description
*	4.900	39	landscaped areas hsg A
*	0.300	30	woods hsg A
	5.200	38	Weighted Average
	5.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Reach site: site

Inflow Area = 9.900 ac, 47.47% Impervious, Inflow Depth > 0.94" for 100 year event
Inflow = 1.05 cfs @ 19.45 hrs, Volume= 0.778 af
Outflow = 1.05 cfs @ 19.45 hrs, Volume= 0.778 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond Basin 1: Basin 1

Inflow Area = 9.900 ac, 47.47% Impervious, Inflow Depth > 5.06" for 100 year event
Inflow = 26.07 cfs @ 12.26 hrs, Volume= 4.172 af
Outflow = 1.05 cfs @ 19.45 hrs, Volume= 0.778 af, Atten= 96%, Lag= 431.6 min
Primary = 1.05 cfs @ 19.45 hrs, Volume= 0.778 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 98.87' @ 19.45 hrs Surf.Area= 25,811 sf Storage= 149,447 cf

Plug-Flow detention time= 681.5 min calculated for 0.778 af (19% of inflow)
Center-of-Mass det. time= 364.7 min (1,148.2 - 783.5)

Volume	Invert	Avail.Storage	Storage Description
#1	91.50'	179,375 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.50	14,000	0	0
92.00	15,500	7,375	7,375
93.00	17,000	16,250	23,625
94.00	18,500	17,750	41,375
95.00	20,000	19,250	60,625
96.00	21,500	20,750	81,375
97.00	23,000	22,250	103,625
98.00	24,500	23,750	127,375
99.00	26,000	25,250	152,625
100.00	27,500	26,750	179,375

Device	Routing	Invert	Outlet Devices
#1	Primary	96.60'	**4.0" Vert. Orifice** C= 0.600
#2	Primary	98.60'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	99.00'	**48.0" W x 48.0" H Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.05 cfs @ 19.45 hrs HW=98.87' (Free Discharge)
├─**1=Orifice** (Orifice Controls 0.61 cfs @ 6.99 fps)
├─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.44 cfs @ 1.71 fps)
└─**3=Orifice/Grate** (Controls 0.00 cfs)

MOUNDING ANALYSIS

The equation parameters are as follows:

Hc = Maximum saturated thickness (original plus mound rise) under the centerline (feet)
Hi = Initial thickness of the saturated layer (acquifer)(feet)
i = Average recharge rate in the facility (feet/day)
W = Infiltration Channel width (feet)
K = Horizontal Saturated hydraulic conductivity of the saturated layer (feet/day)
He = Maximum saturated thickness at the edge of channel (feet)
Lx = Any arbitrary distance from the channel edge (feet)
Lmax = Max Distance of influence of the mound beyond which mound rise is negligible (feet)
Hx = Thickness of saturated layer at distance Lx (feet)

Equation for central mound rise: (Hc – Hi) = 0.86 iW/ (K – i)
Hi = 35-100 ft, use 35 ft
i = 550 inches, 0.125 ft/day
W = 200'
K = 3-10 ft/day, use 3

Hc = 0.2'
Check conditions for equation application:
Check channel length/width, should be > 5, length = 900', width = 200' or 4.5
Verify if W < Hi ; W is 200', Hi is assumed to be 100'; W > Hi
Condition not met, try equation for rounded system.

Equation for central mound rise for rounded system: (Hc – Hi) = 1.56 iR/K-i
Hi = 35 – 100 ft, use 35 ft
i = 550 inches, 0.125 ft/day
K = 3-10 ft/day, use 3
R = 550', average of L and W
Hc = 1.1 ft
Check conditions for equation application:
Check 2R < Hi: , 2R is > Hi
Check I < K, 0.125 < 3
Check 2R/Hi; it is greater than 0.184

Hi & K are purposefully underestimated to render the conclusion conservative. While the recharge system is too large to meet each of the equation's sizing parameters the results should remain valid given the conservative constraints applied to Hi & K.

TIME TO DRAIN CALCULATIONS

Apply the rate of 0.00014 ft/sec to the bottom area of the basin to determine an exfiltration rate from the basin. Determine the Time to Drain based upon the system volume, assuming each system is full. Exfiltration rate based upon a bottom area of 14,000 SF is 1.96 cfs, time to drain full volume of 94,725 CF is 13.4 hours.

APPENDIX C

SOIL EROSION CALCULATION

OUTLET PROTECTION CALCULATIONS
SCD FLOOD ROUTING CALCULATIONS

Part 2: Review of Local Stormwater Management Regulations

Title and date of stormwater management regulations used in development design:

inelands Commission, May 2007, Barnegat Township Ordinance 55-330

Do regulations include nonstructural requirements? Yes: X No: ______

If yes, briefly describe: ______

List LID-BMPs prohibited by local regulations: ______

Pre-design meeting held? Yes: ______ Date: ______ No: X

Meeting held with: ______

Pre-design site walk held? Yes: ______ Date: ______ No: X

Site walk held with: ______

Other agencies with stormwater review jurisdiction:

Name: Barnegat Township Planning Board

Required approval: Site Plan Approval

Name: ______

Required approval: ______

Name: ______

Required approval: ______

Part 3: Nonstructural Strategies and LID-BMPs in Design

3.1 Vegetation and Landscaping

Effective management of both existing and proposed site vegetation can reduce a development's adverse impacts on groundwater recharges and runoff quality and quantity. This section of the checklist helps identify the vegetation and landscaping strategies and nonstructural LID-BMPs that have been incorporated into the proposed development's design to help maintain existing recharge rates and/or minimize or prevent increases in runoff quantity and pollutant loading.

A. Has an inventory of existing site vegetation been performed? Yes: X No: ____

If yes, was this inventory a factor in the site's layout and design? Yes: X No: ____

B. Does the site design utilize any of the following nonstructural LID-BMPs?

Preservation of natural areas? Yes: ____ No: X If yes, specify % of site: 0

Native ground cover? Yes: ____ No: X If yes, specify % of site: ____

Vegetated buffers? Yes: ____ No: X If yes, specify % of site: ____

C. Do the land development regulations require these nonstructural LID-BMPs?

Preservation of natural areas? Yes: ____ No: X If yes, specify % of site: ____

Native ground cover? Yes: ____ No: X If yes, specify % of site: ____

Vegetated buffers? Yes: X No: ____ If yes, specify % of site: 5

D. If vegetated filter strips or buffers are utilized, specify their functions: N/A

Reduce runoff volume increases through lower runoff coefficient: Yes: ____ No: ____

Reduce runoff pollutant loads through runoff treatment: Yes: ____ No: ____

Maintain groundwater recharge by preserving natural areas: Yes: ____ No: ____

3.2 Minimize Land Disturbance

Minimizing land disturbance is a nonstructural LID-BMP that can be applied during both the development's construction and post-construction phases. This section of the checklist helps identify those land disturbance strategies and nonstructural LID-BMPs that have been incorporated into the proposed development's design to minimize land disturbance and the resultant change in the site's hydrologic character.

A. Have inventories of existing site soils and slopes been performed? Yes: X No: ____

If yes, were these inventories factors in the site's layout and design? Yes: X No: ____

B. Does the development's design utilize any of the following nonstructural LID-BMPs?

Restrict permanent site disturbance by land owners? Yes: ____ No: X

If yes, how: ____

Restrict temporary site disturbance during construction? Yes: X No: ____

If yes, how: Soil Erosion Controls

Consider soils and slopes in selecting disturbance limits? Yes: X No: ____

If yes, how: Minimize disturbance these areas

C. Specify percentage of site to be cleared: 100 Regraded: 100

D. Specify percentage of cleared areas done so for buildings: 20

For driveways and parking: 80 For roadways: ____

E. What design criteria and/or site changes would be required to reduce the percentages in C and D above?

Site is located within Regional Growth land use zone, development intensity determined by zone

F. Specify site's hydrologic soil group (HSG) percentages:

HSG A: ________ HSG B: 100 HSG C: ________ HSG D: ________

G. Specify percentage of each HSG that will be permanently disturbed:

HSG A: ________ HSG B: 100 HSG C: 0 HSG D: 0

H. Locating site disturbance within areas with less permeable soils (HSG C and D) and minimizing disturbance within areas with greater permeable soils (HSG A and B) can help maintain groundwater recharge rates and reduce runoff volume increases. In light of the HSG percentages in F and G above, what other practical measures if any can be taken to achieve this?

None, only HSG B soils are present.

I. Does the site include Karst topography? Yes: ________ No: X

If yes, discuss measures taken to limit Karst impacts:

3.3 Impervious Area Management

New impervious surfaces at a development site can have the greatest adverse effect on groundwater recharge and stormwater quality and quantity. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into a proposed development's design to comprehensively manage the extent and impacts of new impervious surfaces.

A. Specify impervious cover at site: Existing: 0 Proposed: 3.6 acres

B. Specify maximum site impervious coverage allowed by regulations: no regulations

C. Compare proposed street cartway widths with those required by regulations:

Type of street	Proposed cartway width (feet)	Required cartway width (feet)
Residential access – low intensity		
Residential access – medium intensity		
Residential access – high intensity with parking		
Residential access – high intensity without parking		
Neighborhood		
Minor collector – low intensity without parking		
Minor collector – with one parking lane		
Minor collector – with two parking lanes		
Minor collector – without parking		
Major collector		

D. Compare proposed parking space dimensions with those required by regulations:

Proposed: 9x18 Regulations: 9x18

E. Compare proposed number of parking spaces with those required by regulations: **N/A**

Proposed: 604 Regulations: 832

F. Specify percentage of total site impervious cover created by buildings: 20

By driveways and parking: 80 By roadways: ______

G. What design criteria and/or site changes would be required to reduce the percentages in F above?

None

H. Specify percentage of total impervious area that will be unconnected:

Total site: ______ Buildings: 0 Driveways and parking: 0 Roads: 0

I. Specify percentage of total impervious area that will be porous:

Total site: 0 Buildings: ______ Driveways and parking: 0 Roads: 0

J. Specify percentage of total building roof area that will be vegetated: 0

K. Specify percentage of total parking area located beneath buildings: 0

L. Specify percentage of total parking located within multi-level parking deck: 0

3.4 Time of Concentration Modifications

Decreasing a site's time of concentration (Tc) can lead directly to increased site runoff rates which, in turn, can create new and/or aggravate existing erosion and flooding problems downstream. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into the proposed development's design to effectively minimize such Tc decreases.

When reviewing Tc modification strategies, it is important to remember that a drainage area's Tc should reflect the general conditions throughout the area. As a result, Tc modifications must generally be applied throughout a drainage area, not just along a specific Tc route.

A. Specify percentage of site's total stormwater conveyance system length that will be:

Storm sewer: 50 Vegetated swale: ______ Natural channel: ______

Stormwater management facility: 50 Other: ______

Note: the total length of the stormwater conveyance system should be measured from the site's downstream property line to the downstream limit of sheet flow at the system's headwaters.

B. What design criteria and/or site changes would be required to reduce the storm sewer percentages and increase the vegetated swale and natural channel percentages in A above?

______

______

______

C. In conveyance system subareas that have overland or sheet flow over impervious surfaces or turf grass, what practical and effective site changes can be made to:

Decrease overland flow slope: No overland or sheet flow over impervious surfaces.

______

______

Increase overland flow roughness: Use of meadow type vegetation in open space areas.

______

______

3.5 Preventative Source Controls

The most effective way to address water quality concerns is by pollution prevention. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into the proposed development's design to reduce the exposure of pollutants to prevent their release into the stormwater runoff.

A. Trash Receptacles

Specify the number of trash receptacles provided: refuse enclosures

Specify the spacing between the trash receptacles: ____________

Compare trash receptacles proposed with those required by regulations:

Proposed: 6 Regulations: N/A

B. Pet Waste Stations

Specify the number of pet waste stations provided: 0

Specify the spacing between the pet waste stations: ____________

Compare pet waste stations proposed with those required by regulations:

Proposed: ____________ Regulations: ____________

C. Inlets, Trash Racks, and Other Devices that Prevent Discharge of Large Trash and Debris

Specify percentage of total inlets that comply with the NJPDES storm drain inlet criteria: 100

D. Maintenance

Specify the frequency of the following maintenance activities:

Street sweeping: Proposed: bi-annual Regulations: annual

Litter collection: Proposed: bi-annual Regulations: annual

Identify other stormwater management measures on the site that prevent discharge of large trash and debris:

____

____

E. Prevention and Containment of Spills **N/A**

Identify locations where pollutants are located on the site, and the features that prevent these pollutants from being exposed to stormwater runoff:

Pollutant: ______________________ Location: ______________________

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: ______________________ Location: ______________________

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: ______________________ Location: ______________________

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: ______________________ Location: ______________________

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: ______________________ Location: ______________________

Part 4: Compliance with Nonstructural Requirements of NJDEP Stormwater Management Rules

1. Based upon the checklist responses above, indicate which nonstructural strategies have been incorporated into proposed development's design in accordance with NJAC 7:8-5.3(b):

No.	Nonstructural strategy	Yes	No
1.	Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss.	X	
2.	Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces.	X	
3.	Maximize the protection of natural drainage features and vegetation.		X
4.	Minimize the decrease in the pre-construction time of concentration.	X	
5.	Minimize land disturbance including clearing and grading.		X
6.	Minimize soil compaction.	X	
7.	Provide low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers, and pesticides.	X	
8.	Provide vegetated open-channel conveyance systems discharge into and through stable vegetated areas.		X
9.	Provide preventative source controls.	X	

2. Those strategies that have not been incorporated into the proposed development's design, provide engineering, environmental, and/or safety reasons. Attached additional pages as necessary.

APPENDIX E

SOIL PERMEABILITY TESTING

FORM 3b - TUBE PERMEAMETER TEST DATA

1. Test Number _1_ Replicate (Letter) ___ Date Collected _5/27/17_
2. Material Tested: ___ Fill _X_ Test in Native Soil - Indicate Depth _60",_
3. Type of Sample: ___ Undisturbed _X_ Disturbed
4. Sample Dimensions: Inside Radius of Sample Tube, R, in cm. 1.9
   Length of Sample, L, in inches 3.9
5. Bulk Density Determination (Disturbed Samples Only):
   Sample Weight (Wt. Tube Containing Sample - Wt. of Empty Tube), grams ___189___.
   Sample Volume (L x 2.54 cm./inch x 3.14R^2), cc. 115
   Bulk Density (Sample Wt./Sample Volume), grams/cc. 1.6
6. Standpipe Used: _X_ No ___ Yes
   Indicate Internal Radius, cm.
7. Height of Water Level Above Rim of Test Basin, in inches:
   At the Beginning of Each Test Interval, H_1 _5.6_
   At the End of Each Test Interval, H_2 _4.7_
8. Rate of Water Level Drop (Add additional lines if needed):

Time, Start of Test Interval, T_1	Time, End of Test Interval, T_2	Length of Test Interval, T, minutes
8:50	8:53	3 min

9. Calculation of Permeability:
   K, (in/hr) = 60 min/hr x r^2/R^2 x L(in)/T(min) x ln (H_1/H_2)
   = 60 min/hr x _____ / _____ x _____ /
   x ln (_5.6_ / _4.7_) = _13.7_
10. Defects in the Sample (Check appropriate items):
   _X_ None ___ Cracks ___ Worm Channels
   ___ Root Channels ___ Soil/Tube Contact
   ___ Large Gravel ___ Large Roots
   ___ Dry Soil ___ Smearing ___ Compaction
   ___ Other - Specify:

1. Test Number _2_ Replicate (Letter) ___ Date Collected _5/27/17_
2. Material Tested: ___ Fill _X_ Test in Native Soil - Indicate Depth _68",_
3. Type of Sample: ___ Undisturbed _X_ Disturbed
4. Sample Dimensions: Inside Radius of Sample Tube, R, in cm. 1.9
   Length of Sample, L, in inches 3.8
5. Bulk Density Determination (Disturbed Samples Only):
   Sample Weight (Wt. Tube Containing Sample - Wt. of Empty Tube), grams ___181___.
   Sample Volume (L x 2.54 cm./inch x 3.14R^2), cc. 112
   Bulk Density (Sample Wt./Sample Volume), grams/cc. 1.6
6. Standpipe Used: _X_ No ___ Yes
   Indicate Internal Radius, cm.
7. Height of Water Level Above Rim of Test Basin, in inches:
   At the Beginning of Each Test Interval, H_1 _5.4_
   At the End of Each Test Interval, H_2 _4.6_
8. Rate of Water Level Drop (Add additional lines if needed):

Time, Start of Test Interval, T_1	Time, End of Test Interval, T_2	Length of Test Interval, T, minutes
9:01	9:03	2 min

9. Calculation of Permeability:
   K, (in/hr) = 60 min/hr x r^2/R^2 x L(in)/T(min) x 1n (H_1/H_2)
   = 60 min/hr x _____/_____ x _____/
   x ln (_5.4_ / _4.7_) = _15.2_
10. Defects in the Sample (Check appropriate items):
   _X_ None ___ Cracks ___ Worm Channels
   ___ Root Channels ___ Soil/Tube Contact
   ___ Large Gravel ___ Large Roots
   ___ Dry Soil ___ Smearing ___ Compaction
   ___ Other - Specify:

APPENDIX F

STORM SEWER TABULATION

STORM SEWER TABULATION

PROFESSIONAL DESIGN SERVICES, L.L.C.
1245 Airport Road
Lakewood, New Jersey 08701
(732) 363-0060

COMPUTED BY: IMB DATE: 10/15/19
DESIGN STORM FREQUENCY: YEAR 25
INTENSITY CURVE: NJDEP
PDS PROJECT NO. 16617

LOCATION			RUNOFF DATA									SEWER DESIGN DATA				
STRUCTURE NUMBER						TIME OF CONCENTRATION						PIPE MATERIAL			MANNINGS AN@	
UPSTREAM	DOWNSTREAM	AREA	WEIGHT OF RUNOFF COEFFICIENT		TOTAL	OVERLAN D THROUGH AREA (T_A)	THROUGH AREA (T_P)	ACCUMULATED	RAINFALL INTENSITY	PEAK RUNOFF (inlet)	PEAK RUNOFF (pipe)	DIAMETER	LENGTH	SLOPE	CAPACITY AT FULL FLOW	VELOCITY AT FULL FLOW
		(AC)	C	A x C	(3A x C)	(MIN)	(MIN)	(MIN)	(IN/HR)	(CFS)	(CFS)	(INCHES)	(FT)	(%)	(CFS)	(FPS)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		(11)	(12)	(13)	(14)	(15)	(16)
9 *	8	1.58	0.90	1.42	1.42	10		10	6.8	9.6	9.6	24	138	0.5	18.9	
8	7	0.67	0.90	0.60	2.02	10		10	6.8	4.1	13.7	24	70	0.5	18.9	
7	6	0.17	0.90	0.15	2.17	10		10	6.8	1.0	14.8	24	136	0.5	18.9	
6	5	0.69	0.90	0.62	2.79	10		10	6.8	4.2	18.9	24	185	0.5	18.9	
5A	5	0.44	0.90	0.40	0.40	10		10	6.8	2.7	2.7	15	74	0.5	5.4	
5	4	0.18	0.90	0.16	3.35	10		10	6.8	1.1	22.8	30	100	0.5	34.3	
4	3	0.30	0.90	0.27	3.62	10		10	6.8	1.8	24.6	30	64	0.5	34.3	
3	2	0.68	0.90	0.61	4.23	10		10	6.8	4.1	28.8	30	151	0.5	34.3	
2	1	0.66	0.90	0.60	4.83	10		10	6.8	4.0	32.8	30	224	1.0	34.3	
1	Basin	0.40	0.90	0.36	5.19	10		10	6.8	2.4	35.3	36	32	2.8	75.5	

STORM SEWER TABULATION

PROFESSIONAL DESIGN SERVICES, L.L.C.
1245 Airport Road
Lakewood, New Jersey 08701
(732) 363-0060

COMPUTED BY: IMB DATE: 10/15/19
DESIGN STORM FREQUENCY: YEAR 25
INTENSITY CURVE: NJDEP
PDS PROJECT NO. 16617

LOCATION			RUNOFF DATA									SEWER DESIGN DATA				
STRUCTURE NUMBER						TIME OF CONCENTRATION						PIPE MATERIAL			MANNINGS AN@	
UPSTREAM	DOWNSTREAM	AREA	WEIGHT OF RUNOFF COEFFICIENT		TOTAL	OVERLAND THROUGH AREA (T_A)	THROUGH AREA (T_P)	ACCUMULATED	RAINFALL INTENSITY	PEAK RUNOFF (inlet)	PEAK RUNOFF (pipe)	DIAMETER	LENGTH	SLOPE	CAPACITY AT FULL FLOW	VELOCITY AT FULL FLOW
		(AC)	C	A x C	(3A x C)	(MIN)	(MIN)	(MIN)	(IN/HR)	(CFS)	(CFS)	(INCHES)	(FT)	(%)	(CFS)	(FPS)
12 *	11	1.2	0.90	1.08	1.08	10		10	6.8	7.3	7.3	18	580	0.50	8.8	
11	10	1.04	0.90	0.94	2.02	10		10	6.8	6.3	12.7	24	366	0.50	18.9	
10	Basin	0.52	0.90	0.47	2.49	10		10	6.8	3.2	16.9	24	29	2.45	11.9	
Basin	Ex. Inlet										0.33	15	117	1.64	9.8	

(1) Pipe Travel (Tp) not used in the Time Of Concentration in order to be conservative.
* To be double inlet

(2) Inlets # 5, 9 & 12 will be double inlet since each inlet has more than 5 cfs of surface flow into the inlet