STORMWATER MANAGEMENT REPORT NARRATIVE
20R & 25 Johns Lane – Lot 3A
November 7, 2023
Revised December 13, 2023

I. Executive Summary

The applicant, Raymond Lawton, is proposing to develop the parcel located at 20R & 25 Johns Lane (Lot 3A). This includes the construction of a new single-family dwelling, paved and gravel driveway, patio, new septic system, utilities and stormwater management system. The proposed project will have an approximate 16,450 square foot net increase in impervious area on the site compared to existing conditions. The parcel is shown on Assessor's Map 76 as Lot 3/portion of Lot 4 and is located within the Outlying Residential & Agricultural (ORA) Zoning District. An Approval Not Required (ANR) Plan has been submitted to the Topsfield Planning Board to create Lot 3A.

II. Existing Site Description

The development parcel is situated at 20R & 25 Johns Lane (Lot 3A) and has an aggregate land area of 14.263 acres. The property is currently undeveloped and consists of wooded and vegetated areas with bordering vegetated wetlands to the south, north and east of the proposed dwelling. The proposed development will be located within areas of existing field and previously cleared woodlands. A compacted gravel roadway exists running from northwest, around the south of the proposed dwelling, and reconnects to another gravel roadway to the east. Soil conditions are sandy loams on top of gravelly coarse sand and sandy loams, which were confirmed through soil testing in the vicinity of the proposed septic system. The surface runoff from the project area flows from the northeastern side of the site to the southwestern side of the site.

According to the USDA Soils Conservation Services Soil Resource Report, soils in the area of the proposed work are classified as Paxton fine sandy loam (305D) classified as Hydrologic Soil Group "C", Paxton fine sandy loam (306C) classified as Hydrologic Soil Group "C", and Paxton fine sandy loam (307D) classified as Hydrologic Soil Group "C". The site is located within the Topsfield, MA Map of Areas of Severe Soil Limitations and is shown as an area considered to be severe-slow perc. Percolation rates from testing on October 4, 2023 in the area of the proposed septic system ranged from <2 minutes per inch to 35 minutes per inch.

The site is shown to be in a Zone "X" (area determined to be outside the 0.2% chance floodplain) on the FEMA Federal Insurance Rate Maps (FIRM) #25009C0402F, dated July 3, 2012. The parcel is not mapped within a Natural Heritage estimated habitat of rare wildlife, certified vernal pool, or priority habitat of rare species.

III. Proposed Site Description

The proposed project will include the construction of a new house, permeable paver patio, new gravel driveway, paved driveway, a septic system, installation of utilities and stormwater recharge systems. The dwelling will be served by a domestic well, located to the west of the proposed dwelling. The existing compacted gravel roadway that wraps around the site is considered an impervious surface and a portion will be removed and replaced with a permeable loam/seed mix. The total area of compacted gravel driveway to be removed totals approximately 6,700 square feet. As previously stated, the project will create an approximate 15,925 square foot increase in impervious surfaces. The proposed development will disturb greater than 1 acre therefore a

NPDES permit will be applied for. The project also falls under the jurisdiction of the Town of Topsfield Stormwater and Erosion Control Regulations.

IV. Stormwater Best Management Practices

- **Subsurface Recharge System:** A Cultec 280HD recharge system (consisting of a single unit) will be placed to the west of the proposed dwelling in the driveway island. Runoff from the proposed dwelling roof will be directed to this system. The recharge system will provide a portion pf the required groundwater recharge volume for the site. The applicable calculations are provided on the Site Development Plan.
- **Grassed Swale:** A grassed swale will be constructed alongside the northern side of the driveway. The swale will be used to convey runoff from the driveway to downstream grassed recharge basins.
- **Sediment Forebay:** A series of sediment forebays will be constructed upstream of the grassed infiltration basins. The forebays will be used to pretreat runoff from the driveway prior to discharging to the downstream grassed infiltration basins.
- **Vegetated Filter Strip:** Two vegetated filter strips consisting of a stone diaphragm and minimum 50' long grass strip will be constructed upstream of grassed infiltration basins #1 and #3. The filter strips will be used to provide pretreatment of runoff from the paved areas prior to discharging downstream to grassed infiltration basins.
- **Grassed Infiltration Basins:** Three grassed infiltration basins will be constructed alongside the northern side of the driveway. Runoff from the proposed paved driveway servicing the dwelling will be directed through a swale to the basins. The basins will provide storage for the water quality volume and the remainder of the required groundwater recharge volume for the site. They will also provide the required phosphorus and nitrogen removal for the proposed paved areas. The applicable calculations are provided on the Site Development Plan.

The Topsfield Stormwater and Erosion Control Regulations require a minimum of 80% total suspended solids (TSS) removal, 40% total phosphorus (TP) removal and 30% total nitrogen (TN) removal. The calculations for the required TSS removal can be found attached to this document. The TP and TN removal will be provided in the grassed infiltration basins. The Massachusetts Stormwater Handbook (Volume 2, Chapter 2, Stormwater Best Management Practices) states that Infiltration basins removal between 60% to 70% of the TP and 50% to 60% of the TN. The required pretreatment will be met through the use of the sediment forebays and vegetated filter strips. A minimum of 44% is provided for systems that have tributary impervious area located within the Zone A (Infiltration Basin #1 and #3) and 25% is provided for systems that do not (Infiltration Basin #2). This meets the requirements set forth by the Topsfield Stormwater and Erosion Control Regulations.

The proposed stormwater management system is designed to provide sufficient storage for the groundwater recharge volume and water quality volume based on the increase in impervious coverage for the project and paved areas tributary to the stormwater facilities. Water quality volume calculations are based on using a 1" depth for impervious areas within the Zone A and a 0.5" depth for impervious areas outside the Zone A as required by the Topsfield Stormwater and Erosion Control Regulations. As proposed it also meets the required treatment standards for TSS, TP and TN as required by the Topsfield Stormwater and Erosion Control Regulations. The project consists of the construction of a single-family dwelling, which is considered to be exempt from

the requirements of the Massachusetts DEP Stormwater Management Policy and Stormwater Standards.

Areas not flowing to the stormwater BMPs will be directed overland across at least 100' of pervious ground cover prior to discharging offsite.

V. Stormwater Management

A HydroCAD analysis was performed using U.S. Soil Conservation Service (S.C.S.) methods of analysis contained in Technical Release #20 (TR-20) published by the U.S. Conservation Service. The model used for this calculation is referred to as HydroCAD. The rainfall data used in the analysis was taken from the NOAA Atlas 14 for the 2-, 10- and 100-year storm events. The HydroCAD analysis was performed by examined using three Design Points. For the locations of these design points and depictions of all watershed areas refer to the attached Existing Watershed Figure and Proposed Watershed Figure. A summary of the peak flow rates and runoff volumes from the HydroCAD analysis is as follows:

Summary of Peak Flow Rates

Event (Frequency in Years)	Existing Conditions (Peak CFS)	Proposed Conditions (Peak CFS)	Change in Peak (CFS)
DP1			
2	7.3	6.4	-0.9
10	16.6	16.6	0.0
100	41.9	44.6	+2.7
DP2			
2	1.9	1.5	-0.4
10	4.2	3.3	-0.9
100	10.5	8.5	-2.0
DP3			
2	2.1	2.1	0.0
10	4.8	4.7	-0.1
100	12.5	12.0	-0.5

Summary of Runoff Volumes

Event (Frequency in Years)	Existing Conditions (CF)	Proposed Conditions (CF)	Change in Volume (CF)
DP1			
2	33,352	29,527	-3,825
10	72,734	68,464	-4,270
100	185,513	186,587	+1,074

DP2			
2	6,257	4,887	-1,370
10	13,646	10,844	-2,802
100	34,806	29,087	-5,719
DP3			
2	9,069	8,894	-175
10	20,123	19,395	-728
100	52,119	49,469	-2,650

As shown on the above tables these will be no increase in peak flow rates or runoff volumes for all storm events considered at DP2 or DP3. There are also no increases for the 2- and 10-year storm events at DP1. While there is an increase in peak flow rate of 2.7 cfs (6.4%) the runoff volume is increased by only 1,075 cf (0.6%). This increase is negligible and will not create any increased flooding impacts off-site as DP1 drains to undeveloped conservation land that is part of the Putnamville Reservoir Watershed.

VI. Erosion and Sedimentation Control

To manage the on-site sedimentation control during construction a proposed silt sock shall be placed along the downstream limit of work for the driveway, dwelling, septic system and associated site grading (see Site Development Plan for location) prior to the commencement of construction activity. The integrity of the erosion control barrier will be maintained by periodic inspection and replacement as necessary. The erosion control barrier will remain in place until all the disturbed areas have been paved or loamed and seeded and vegetation has been established. Construction stockpile areas will be provided in locations determined by the site contractor upstream of the erosion control barrier. An Operations and Maintenance Plan for the long-term operation (Long Term Stormwater Best Management Practices Operation and Maintenance Plan) of the site have been included with this letter.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Essex County, Massachusetts, Northern Part

March 15, 2023

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,880 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

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

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 18, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	0.3	1.9%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	2.6	18.3%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	3.6	25.3%
306C	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	4.1	29.0%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	0.2	1.5%
307D	Paxton fine sandy loam, 15 to 25 percent slopes, extremely stony	2.6	18.0%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	0.9	6.1%
Totals for Area of Interest		**14.3**	**100.0%**

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas

are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

Essex County, Massachusetts, Northern Part

73A—Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w695
Elevation: 0 to 1,580 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Whitman, extremely stony, and similar soils: 81 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Whitman, Extremely Stony

Setting

Landform: Drumlins, ground moraines, hills, drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 1 inches: peat
A - 1 to 10 inches: fine sandy loam
Bg - 10 to 17 inches: gravelly fine sandy loam
Cdg - 17 to 61 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 7 to 38 inches to densic material
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY041MA - Very Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Ridgebury, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions, outwash terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Marshes, bogs, swamps
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Woodbridge, extremely stony

Percent of map unit: 1 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

305C—Paxton fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w66y
Elevation: 0 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Paxton and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 7 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge

Percent of map unit: 6 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 2 percent
Landform: Drumlins, drainageways, depressions, ground moraines, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

305D—Paxton fine sandy loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2w67j
Elevation: 0 to 1,450 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None

Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge

Percent of map unit: 6 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 1 percent
Landform: Drumlins, depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

306C—Paxton fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w677
Elevation: 0 to 1,330 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Paxton, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Very Stony

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge, very stony

Percent of map unit: 8 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Charlton, very stony

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 2 percent
Landform: Drumlins, depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

306D—Paxton fine sandy loam, 15 to 25 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w67h
Elevation: 0 to 1,400 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton, very stony, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Very Stony

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge, very stony

Percent of map unit: 5 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Charlton, very stony

Percent of map unit: 4 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 1 percent
Landform: Drumlins, depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

307D—Paxton fine sandy loam, 15 to 25 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w67l
Elevation: 0 to 1,570 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton, extremely stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Extremely Stony

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s

Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Charlton, extremely stony
Percent of map unit: 9 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge, extremely stony
Percent of map unit: 5 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury, extremely stony
Percent of map unit: 1 percent
Landform: Drumlins, depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

311B—Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony

Map Unit Setting
National map unit symbol: 2t2qr
Elevation: 0 to 1,440 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Woodbridge, very stony, and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge, Very Stony

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 9 inches: fine sandy loam
Bw1 - 9 to 20 inches: fine sandy loam
Bw2 - 20 to 32 inches: fine sandy loam
Cd - 32 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 19 to 27 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton, very stony

Percent of map unit: 10 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 8 percent
Landform: Hills, drainageways, drumlins, depressions, ground moraines
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave

Across-slope shape: Concave
Hydric soil rating: Yes

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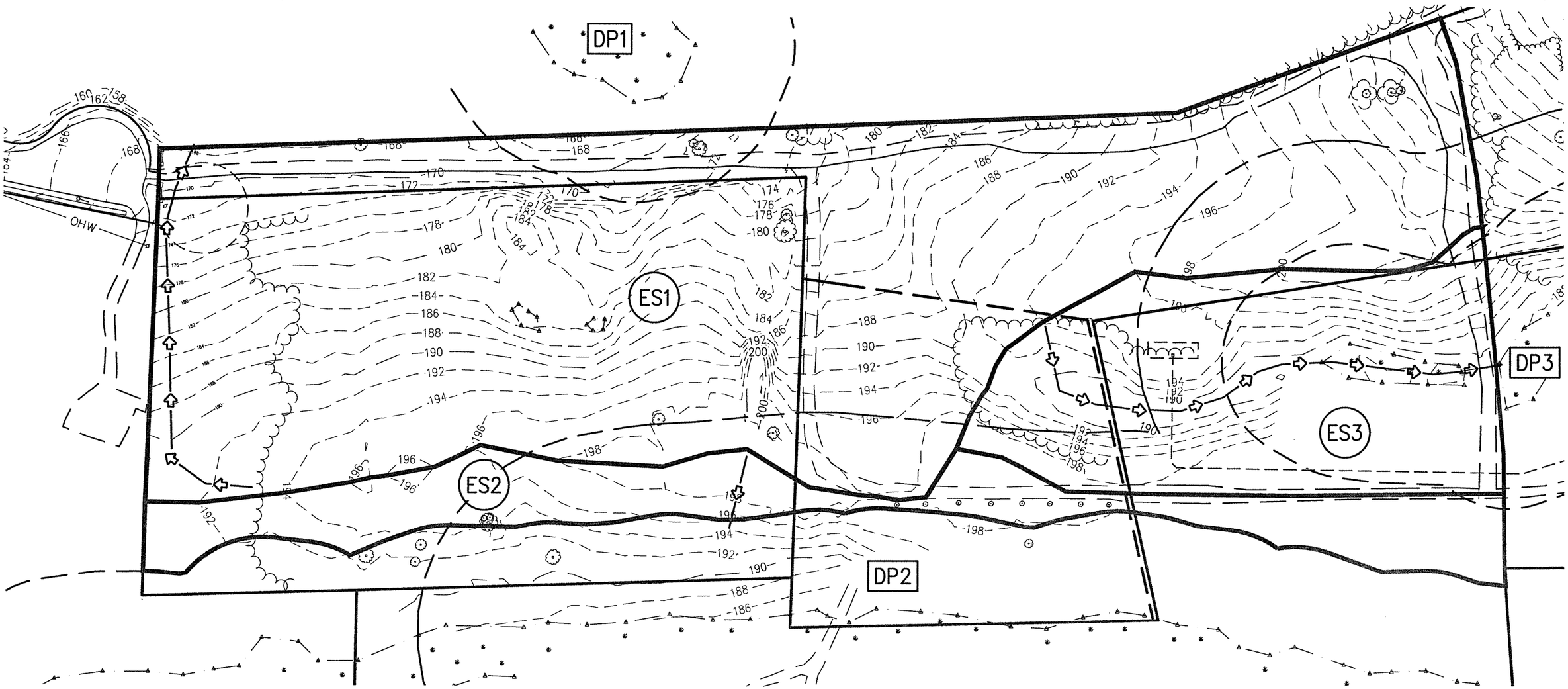
EXISTING WATERSHED FIGURE

AT:

20R & 25 JOHN'S LANE
TOPSFIELD, MASSACHUSETTS

DECEMBER 13, 2023



PLAN

SCALE: 1" = 100'

0 50 100 200

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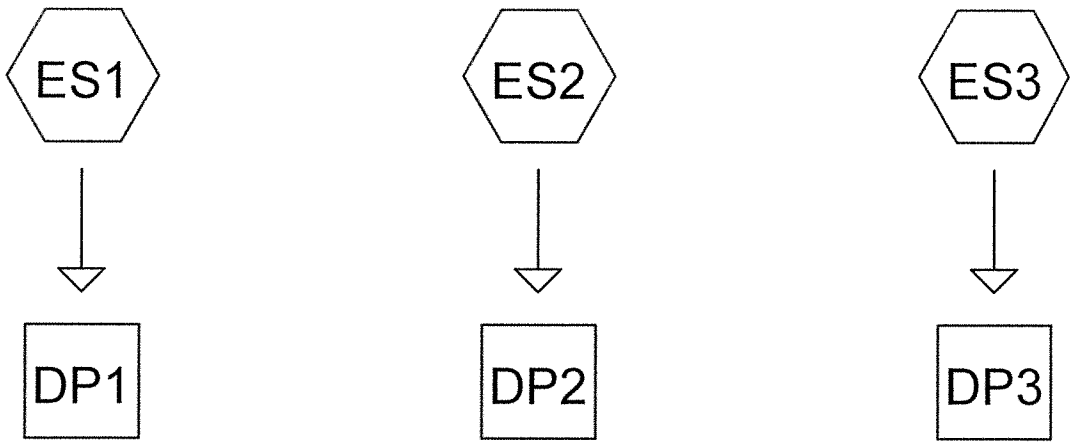


Subcat Reach Pond Link

Routing Diagram for Johns Lane Existing Hydrologic Analysis
Prepared by The Morin-Cameron Group, Inc, Printed 12/13/2023

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
426,128	74	>75% Grass cover, Good, HSG C (ES1, ES2, ES3)
40,510	96	Gravel surface, HSG C (ES1, ES2, ES3)
89,986	70	Woods, Good, HSG C (ES1, ES2, ES3)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ES1: Runoff Area=377,488 sf 0.00% Impervious Runoff Depth=1.06"
Flow Length=405' Tc=13.9 min CN=75 Runoff=7.4 cfs 33,352 cf

Subcatchment ES2: Runoff Area=70,824 sf 0.00% Impervious Runoff Depth=1.06"
Tc=6.0 min CN=75 Runoff=1.9 cfs 6,257 cf

Subcatchment ES3: Runoff Area=108,312 sf 0.00% Impervious Runoff Depth=1.00"
Flow Length=520' Tc=12.3 min CN=74 Runoff=2.1 cfs 9,069 cf

Reach DP1: Inflow=7.4 cfs 33,352 cf
Outflow=7.4 cfs 33,352 cf

Reach DP2: Inflow=1.9 cfs 6,257 cf
Outflow=1.9 cfs 6,257 cf

Reach DP3: Inflow=2.1 cfs 9,069 cf
Outflow=2.1 cfs 9,069 cf

Summary for Subcatchment ES1:

Runoff = 7.4 cfs @ 12.22 hrs, Volume= 33,352 cf, Depth= 1.06"
Routed to Reach DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
312,548	74	>75% Grass cover, Good, HSG C
35,846	70	Woods, Good, HSG C
29,094	96	Gravel surface, HSG C
377,488	75	Weighted Average
377,488		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	355	0.0680	4.20		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.9	405	Total			

Summary for Subcatchment ES2:

Runoff = 1.9 cfs @ 12.14 hrs, Volume= 6,257 cf, Depth= 1.06"
Routed to Reach DP2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
60,375	74	>75% Grass cover, Good, HSG C
6,242	70	Woods, Good, HSG C
4,207	96	Gravel surface, HSG C
70,824	75	Weighted Average
70,824		100.00% Pervious Area

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

Summary for Subcatchment ES3:

Runoff = 2.1 cfs @ 12.21 hrs, Volume= 9,069 cf, Depth= 1.00"
Routed to Reach DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
53,205	74	>75% Grass cover, Good, HSG C
47,898	70	Woods, Good, HSG C
7,209	96	Gravel surface, HSG C
108,312	74	Weighted Average
108,312		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
5.1	470	0.0090	1.53		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.3	520	Total			

Summary for Reach DP1:

Inflow Area = 377,488 sf, 0.00% Impervious, Inflow Depth = 1.06" for 2-Year event
Inflow = 7.4 cfs @ 12.22 hrs, Volume= 33,352 cf
Outflow = 7.4 cfs @ 12.22 hrs, Volume= 33,352 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2:

Inflow Area = 70,824 sf, 0.00% Impervious, Inflow Depth = 1.06" for 2-Year event
Inflow = 1.9 cfs @ 12.14 hrs, Volume= 6,257 cf
Outflow = 1.9 cfs @ 12.14 hrs, Volume= 6,257 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP3:

Inflow Area = 108,312 sf, 0.00% Impervious, Inflow Depth = 1.00" for 2-Year event
Inflow = 2.1 cfs @ 12.21 hrs, Volume= 9,069 cf
Outflow = 2.1 cfs @ 12.21 hrs, Volume= 9,069 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ES1: Runoff Area=377,488 sf 0.00% Impervious Runoff Depth=2.31"
Flow Length=405' Tc=13.9 min CN=75 Runoff=16.7 cfs 72,734 cf

Subcatchment ES2: Runoff Area=70,824 sf 0.00% Impervious Runoff Depth=2.31"
Tc=6.0 min CN=75 Runoff=4.2 cfs 13,646 cf

Subcatchment ES3: Runoff Area=108,312 sf 0.00% Impervious Runoff Depth=2.23"
Flow Length=520' Tc=12.3 min CN=74 Runoff=4.8 cfs 20,123 cf

Reach DP1: Inflow=16.7 cfs 72,734 cf
Outflow=16.7 cfs 72,734 cf

Reach DP2: Inflow=4.2 cfs 13,646 cf
Outflow=4.2 cfs 13,646 cf

Reach DP3: Inflow=4.8 cfs 20,123 cf
Outflow=4.8 cfs 20,123 cf

Summary for Subcatchment ES1:

Runoff = 16.7 cfs @ 12.22 hrs, Volume= 72,734 cf, Depth= 2.31"
Routed to Reach DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
312,548	74	>75% Grass cover, Good, HSG C
35,846	70	Woods, Good, HSG C
29,094	96	Gravel surface, HSG C
377,488	75	Weighted Average
377,488		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	355	0.0680	4.20		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.9	405	Total			

Summary for Subcatchment ES2:

Runoff = 4.2 cfs @ 12.13 hrs, Volume= 13,646 cf, Depth= 2.31"
Routed to Reach DP2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
60,375	74	>75% Grass cover, Good, HSG C
6,242	70	Woods, Good, HSG C
4,207	96	Gravel surface, HSG C
70,824	75	Weighted Average
70,824		100.00% Pervious Area

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

Summary for Subcatchment ES3:

Runoff = 4.8 cfs @ 12.20 hrs, Volume= 20,123 cf, Depth= 2.23"
Routed to Reach DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
53,205	74	>75% Grass cover, Good, HSG C
47,898	70	Woods, Good, HSG C
7,209	96	Gravel surface, HSG C
108,312	74	Weighted Average
108,312		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
5.1	470	0.0090	1.53		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.3	520	Total			

Summary for Reach DP1:

Inflow Area = 377,488 sf, 0.00% Impervious, Inflow Depth = 2.31" for 10-Year event
Inflow = 16.7 cfs @ 12.22 hrs, Volume= 72,734 cf
Outflow = 16.7 cfs @ 12.22 hrs, Volume= 72,734 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2:

Inflow Area = 70,824 sf, 0.00% Impervious, Inflow Depth = 2.31" for 10-Year event
Inflow = 4.2 cfs @ 12.13 hrs, Volume= 13,646 cf
Outflow = 4.2 cfs @ 12.13 hrs, Volume= 13,646 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP3:

Inflow Area = 108,312 sf, 0.00% Impervious, Inflow Depth = 2.23" for 10-Year event
Inflow = 4.8 cfs @ 12.20 hrs, Volume= 20,123 cf
Outflow = 4.8 cfs @ 12.20 hrs, Volume= 20,123 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ES1: Runoff Area=377,488 sf 0.00% Impervious Runoff Depth=5.90"
Flow Length=405' Tc=13.9 min CN=75 Runoff=42.1 cfs 185,513 cf

Subcatchment ES2: Runoff Area=70,824 sf 0.00% Impervious Runoff Depth=5.90"
Tc=6.0 min CN=75 Runoff=10.5 cfs 34,806 cf

Subcatchment ES3: Runoff Area=108,312 sf 0.00% Impervious Runoff Depth=5.77"
Flow Length=520' Tc=12.3 min CN=74 Runoff=12.5 cfs 52,119 cf

Reach DP1: Inflow=42.1 cfs 185,513 cf
Outflow=42.1 cfs 185,513 cf

Reach DP2: Inflow=10.5 cfs 34,806 cf
Outflow=10.5 cfs 34,806 cf

Reach DP3: Inflow=12.5 cfs 52,119 cf
Outflow=12.5 cfs 52,119 cf

Summary for Subcatchment ES1:

Runoff = 42.1 cfs @ 12.22 hrs, Volume= 185,513 cf, Depth= 5.90"
Routed to Reach DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
312,548	74	>75% Grass cover, Good, HSG C
35,846	70	Woods, Good, HSG C
29,094	96	Gravel surface, HSG C
377,488	75	Weighted Average
377,488		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	355	0.0680	4.20		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.9	405	Total			

Summary for Subcatchment ES2:

Runoff = 10.5 cfs @ 12.13 hrs, Volume= 34,806 cf, Depth= 5.90"
Routed to Reach DP2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
60,375	74	>75% Grass cover, Good, HSG C
6,242	70	Woods, Good, HSG C
4,207	96	Gravel surface, HSG C
70,824	75	Weighted Average
70,824		100.00% Pervious Area

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

Summary for Subcatchment ES3:

Runoff = 12.5 cfs @ 12.20 hrs, Volume= 52,119 cf, Depth= 5.77"
Routed to Reach DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
53,205	74	>75% Grass cover, Good, HSG C
47,898	70	Woods, Good, HSG C
7,209	96	Gravel surface, HSG C
108,312	74	Weighted Average
108,312		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
5.1	470	0.0090	1.53		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.3	520	Total			

Summary for Reach DP1:

Inflow Area = 377,488 sf, 0.00% Impervious, Inflow Depth = 5.90" for 100-Year event
Inflow = 42.1 cfs @ 12.22 hrs, Volume= 185,513 cf
Outflow = 42.1 cfs @ 12.22 hrs, Volume= 185,513 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2:

Inflow Area = 70,824 sf, 0.00% Impervious, Inflow Depth = 5.90" for 100-Year event
Inflow = 10.5 cfs @ 12.13 hrs, Volume= 34,806 cf
Outflow = 10.5 cfs @ 12.13 hrs, Volume= 34,806 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP3:

Inflow Area = 108,312 sf, 0.00% Impervious, Inflow Depth = 5.77" for 100-Year event
Inflow = 12.5 cfs @ 12.20 hrs, Volume= 52,119 cf
Outflow = 12.5 cfs @ 12.20 hrs, Volume= 52,119 cf, Atten= 0%, Lag= 0.0 min

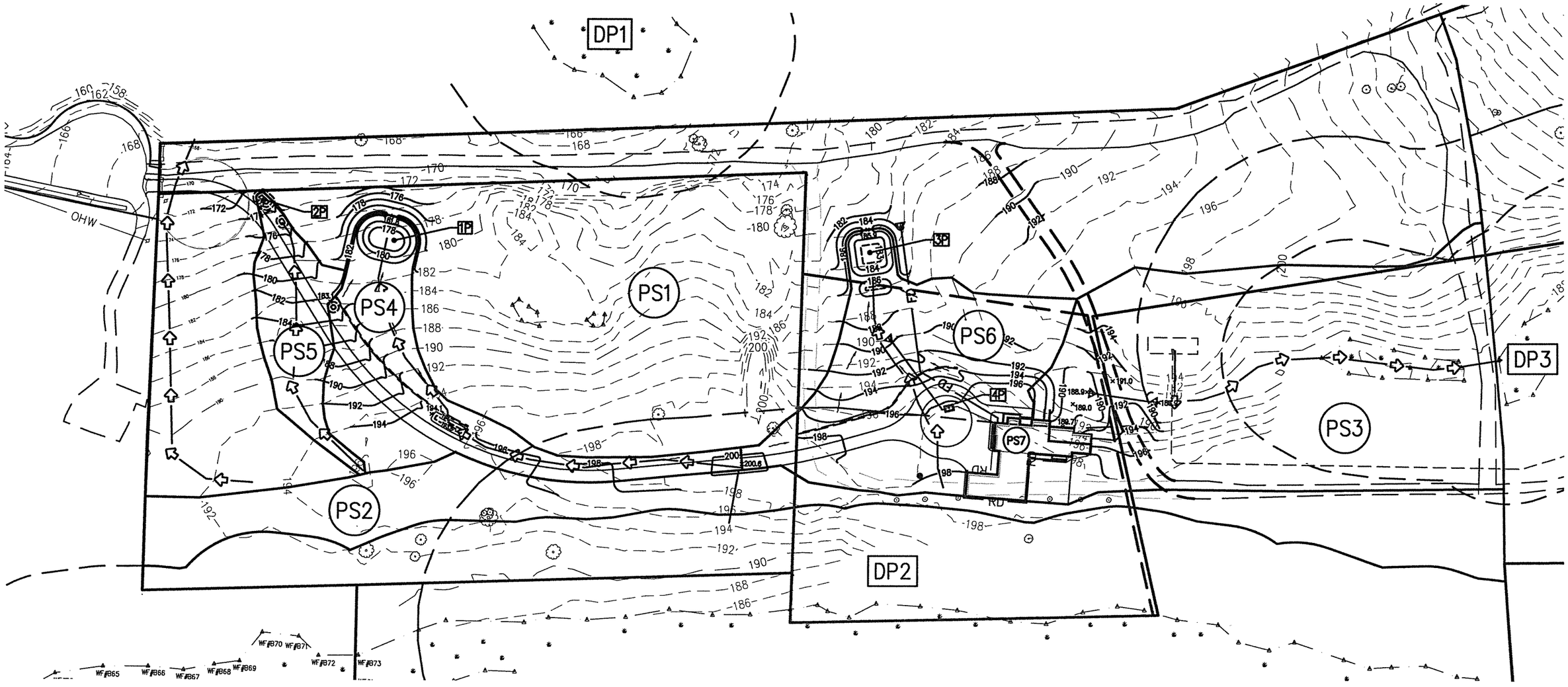
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

PROPOSED WATERSHED FIGURE

AT:

20R & 25 JOHN'S LANE
TOPSFIELD, MASSACHUSETTS

DECEMBER 13, 2023



PLAN

SCALE: 1" = 100'

0 50 100 200

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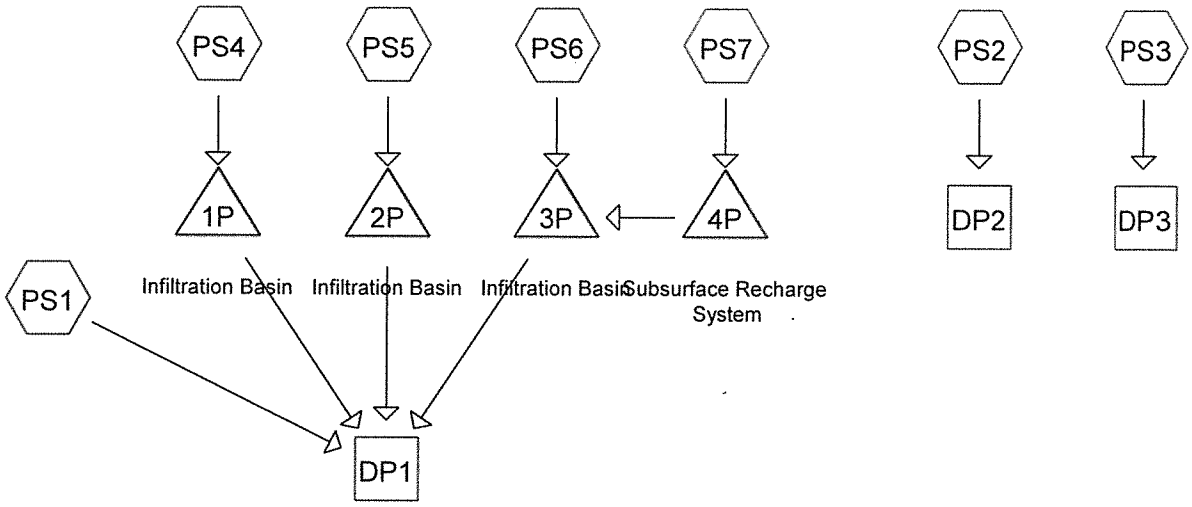

Subcat Reach Pond Link

Routing Diagram for Johns Lane Proposed Hydrologic Analysis
Prepared by The Morin-Cameron Group, Inc, Printed 12/13/2023

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
434,508	74	>75% Grass cover, Good, HSG C (PS1, PS2, PS3, PS4, PS5, PS6)
36,662	96	Gravel surface, HSG C (PS1, PS2, PS3)
4,388	98	Roofs, HSG C (PS7)
14,856	98	Unconnected pavement, HSG C (PS1, PS4, PS5, PS6)
525	98	Unconnected roofs, HSG C (PS3)
65,687	70	Woods, Good, HSG C (PS1, PS2, PS3, PS5)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PS1: Runoff Area=300,800 sf 0.44% Impervious Runoff Depth=1.12"
Flow Length=405' Tc=13.9 min CN=76 Runoff=6.2 cfs 28,008 cf

Subcatchment PS2: Runoff Area=58,369 sf 0.00% Impervious Runoff Depth=1.00"
Tc=6.0 min CN=74 Runoff=1.5 cfs 4,887 cf

Subcatchment PS3: Runoff Area=100,661 sf 0.52% Impervious Runoff Depth=1.06"
Flow Length=390' Tc=11.8 min CN=75 Runoff=2.1 cfs 8,894 cf

Subcatchment PS4: Runoff Area=30,842 sf 17.95% Impervious Runoff Depth=1.12"
Tc=6.0 min UI Adjusted CN=76 Runoff=0.9 cfs 2,872 cf

Subcatchment PS5: Runoff Area=13,999 sf 11.65% Impervious Runoff Depth=1.06"
Tc=6.0 min UI Adjusted CN=75 Runoff=0.4 cfs 1,237 cf

Subcatchment PS6: Runoff Area=47,567 sf 13.37% Impervious Runoff Depth=1.12"
Tc=6.0 min UI Adjusted CN=76 Runoff=1.3 cfs 4,429 cf

Subcatchment PS7: Runoff Area=4,388 sf 100.00% Impervious Runoff Depth=2.92"
Tc=6.0 min CN=98 Runoff=0.3 cfs 1,067 cf

Reach DP1: Inflow=6.4 cfs 29,527 cf
Outflow=6.4 cfs 29,527 cf

Reach DP2: Inflow=1.5 cfs 4,887 cf
Outflow=1.5 cfs 4,887 cf

Reach DP3: Inflow=2.1 cfs 8,894 cf
Outflow=2.1 cfs 8,894 cf

Pond 1P: Infiltration Basin Peak Elev=179.76' Storage=1,607 cf Inflow=0.9 cfs 2,872 cf
Discarded=0.0 cfs 2,385 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 2,385 cf

Pond 2P: Infiltration Basin Peak Elev=173.09' Storage=103 cf Inflow=0.4 cfs 1,237 cf
Discarded=0.0 cfs 264 cf Primary=0.4 cfs 973 cf Outflow=0.4 cfs 1,237 cf

Pond 3P: Infiltration Basin Peak Elev=185.92' Storage=2,941 cf Inflow=1.6 cfs 5,317 cf
Discarded=0.0 cfs 3,346 cf Primary=0.1 cfs 546 cf Outflow=0.1 cfs 3,892 cf

Pond 4P: Subsurface Recharge System Peak Elev=194.41' Storage=91 cf Inflow=0.3 cfs 1,067 cf
Discarded=0.0 cfs 174 cf Primary=0.3 cfs 888 cf Outflow=0.3 cfs 1,062 cf

Summary for Subcatchment PS1:

Runoff = 6.2 cfs @ 12.22 hrs, Volume= 28,008 cf, Depth= 1.12"
Routed to Reach DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
244,809	74	>75% Grass cover, Good, HSG C
28,712	70	Woods, Good, HSG C
25,947	96	Gravel surface, HSG C
1,332	98	Unconnected pavement, HSG C
300,800	76	Weighted Average
299,468		99.56% Pervious Area
1,332		0.44% Impervious Area
1,332		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	355	0.0680	4.20		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.9	405	Total			

Summary for Subcatchment PS2:

Runoff = 1.5 cfs @ 12.14 hrs, Volume= 4,887 cf, Depth= 1.00"
Routed to Reach DP2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
50,328	74	>75% Grass cover, Good, HSG C
6,242	70	Woods, Good, HSG C
1,799	96	Gravel surface, HSG C
58,369	74	Weighted Average
58,369		100.00% Pervious Area

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

Summary for Subcatchment PS3:

Runoff = 2.1 cfs @ 12.20 hrs, Volume= 8,894 cf, Depth= 1.06"
Routed to Reach DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
60,968	74	>75% Grass cover, Good, HSG C
30,252	70	Woods, Good, HSG C
8,916	96	Gravel surface, HSG C
525	98	Unconnected roofs, HSG C
100,661	75	Weighted Average
100,136		99.48% Pervious Area
525		0.52% Impervious Area
525		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	25	0.0400	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.1	25	0.1600	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.2	340	0.0120	1.76		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.8	390	Total			

Summary for Subcatchment PS4:

Runoff = 0.9 cfs @ 12.14 hrs, Volume= 2,872 cf, Depth= 1.12"
Routed to Pond 1P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Adj	Description
25,307	74		>75% Grass cover, Good, HSG C
5,535	98		Unconnected pavement, HSG C
30,842	78	76	Weighted Average, UI Adjusted
25,307			82.05% Pervious Area
5,535			17.95% Impervious Area
5,535			100.00% Unconnected

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

Summary for Subcatchment PS5:

Runoff = 0.4 cfs @ 12.14 hrs, Volume= 1,237 cf, Depth= 1.06"
Routed to Pond 2P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Adj	Description
11,887	74		>75% Grass cover, Good, HSG C
481	70		Woods, Good, HSG C
1,631	98		Unconnected pavement, HSG C
13,999	77	75	Weighted Average, UI Adjusted
12,368			88.35% Pervious Area
1,631			11.65% Impervious Area
1,631			100.00% Unconnected

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

Summary for Subcatchment PS6:

Runoff = 1.3 cfs @ 12.14 hrs, Volume= 4,429 cf, Depth= 1.12"
Routed to Pond 3P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Adj	Description
41,209	74		>75% Grass cover, Good, HSG C
6,358	98		Unconnected pavement, HSG C
47,567	77	76	Weighted Average, UI Adjusted
41,209			86.63% Pervious Area
6,358			13.37% Impervious Area
6,358			100.00% Unconnected

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

Summary for Subcatchment PS7:

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 1,067 cf, Depth= 2.92"
Routed to Pond 4P : Subsurface Recharge System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.15"

Area (sf)	CN	Description
4,388	98	Roofs, HSG C
4,388		100.00% Impervious Area

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

Summary for Reach DP1:

Inflow Area = 397,596 sf, 4.84% Impervious, Inflow Depth = 0.89" for 2-Year event
Inflow = 6.4 cfs @ 12.22 hrs, Volume= 29,527 cf
Outflow = 6.4 cfs @ 12.22 hrs, Volume= 29,527 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Summary for Reach DP2:

Inflow Area = 58,369 sf, 0.00% Impervious, Inflow Depth = 1.00" for 2-Year event
Inflow = 1.5 cfs @ 12.14 hrs, Volume= 4,887 cf
Outflow = 1.5 cfs @ 12.14 hrs, Volume= 4,887 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Summary for Reach DP3:

Inflow Area = 100,661 sf, 0.52% Impervious, Inflow Depth = 1.06" for 2-Year event
Inflow = 2.1 cfs @ 12.20 hrs, Volume= 8,894 cf
Outflow = 2.1 cfs @ 12.20 hrs, Volume= 8,894 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: Infiltration Basin

Inflow Area = 30,842 sf, 17.95% Impervious, Inflow Depth = 1.12" for 2-Year event
Inflow = 0.9 cfs @ 12.14 hrs, Volume= 2,872 cf
Outflow = 0.0 cfs @ 18.27 hrs, Volume= 2,385 cf, Atten= 97%, Lag= 368.4 min
Discarded = 0.0 cfs @ 18.27 hrs, Volume= 2,385 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach DP1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 179.76' @ 18.27 hrs Surf.Area= 1,222 sf Storage= 1,607 cf

Plug-Flow detention time= 568.7 min calculated for 2,385 cf (83% of inflow)
Center-of-Mass det. time= 489.1 min (1,377.0 - 887.9)

Volume	Invert	Avail.Storage	Storage Description
#1	178.00'	6,010 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
178.00	634	94.8	0	0	634
180.00	1,316	132.5	1,909	1,909	1,353
182.00	2,225	170.2	3,501	5,410	2,310
182.25	2,578	182.8	600	6,010	2,667

Device	Routing	Invert	Outlet Devices
#1	Primary	181.80'	**10.0' long 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
#2	Discarded	178.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 18.27 hrs HW=179.76' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=178.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond 2P: Infiltration Basin

Inflow Area = 13,999 sf, 11.65% Impervious, Inflow Depth = 1.06" for 2-Year event
Inflow = 0.4 cfs @ 12.14 hrs, Volume= 1,237 cf
Outflow = 0.4 cfs @ 12.14 hrs, Volume= 1,237 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 12.14 hrs, Volume= 264 cf
Primary = 0.4 cfs @ 12.14 hrs, Volume= 973 cf
Routed to Reach DP1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 173.09' @ 12.14 hrs Surf.Area= 201 sf Storage= 103 cf

Plug-Flow detention time= 73.6 min calculated for 1,236 cf (100% of inflow)
Center-of-Mass det. time= 73.7 min (965.7 - 892.0)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	299 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
172.00	39	26.4	0	0	39
173.00	147	45.2	87	87	152
173.25	311	64.1	56	143	317
173.50	1,000	150.0	156	299	1,781

Device	Routing	Invert	Outlet Devices
#1	Primary	173.00'	**5.0' long x 2.0' 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 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Discarded	172.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.14 hrs HW=173.09' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.4 cfs @ 12.14 hrs HW=173.09' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.4 cfs @ 0.78 fps)

Summary for Pond 3P: Infiltration Basin

Inflow Area = 51,955 sf, 20.68% Impervious, Inflow Depth = 1.23" for 2-Year event
Inflow = 1.6 cfs @ 12.14 hrs, Volume= 5,317 cf
Outflow = 0.1 cfs @ 14.56 hrs, Volume= 3,892 cf, Atten= 94%, Lag= 145.6 min
Discarded = 0.0 cfs @ 14.56 hrs, Volume= 3,346 cf
Primary = 0.1 cfs @ 14.56 hrs, Volume= 546 cf
Routed to Reach DP1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 185.92' @ 14.56 hrs Surf.Area= 1,623 sf Storage= 2,941 cf

Plug-Flow detention time= 561.1 min calculated for 3,890 cf (73% of inflow)
Center-of-Mass det. time= 449.6 min (1,321.8 - 872.2)

Volume	Invert	Avail.Storage	Storage Description
#1	183.00'	4,023 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
183.00	323	70.3	0	0	323
184.00	879	111.4	578	578	924
186.00	1,660	149.1	2,498	3,076	1,748
186.50	2,136	168.0	947	4,023	2,231

Device	Routing	Invert	Outlet Devices
#1	Primary	185.90'	**10.0' long x 2.0' 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 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Discarded	183.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 14.56 hrs HW=185.92' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 14.56 hrs HW=185.92' TW=0.00' (Dynamic Tailwater)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 0.1 cfs @ 0.33 fps)

Summary for Pond 4P: Subsurface Recharge System

Inflow Area = 4,388 sf,100.00% Impervious, Inflow Depth = 2.92" for 2-Year event
Inflow = 0.3 cfs @ 12.13 hrs, Volume= 1,067 cf
Outflow = 0.3 cfs @ 12.15 hrs, Volume= 1,062 cf, Atten= 6%, Lag= 1.4 min
Discarded = 0.0 cfs @ 3.21 hrs, Volume= 174 cf
Primary = 0.3 cfs @ 12.15 hrs, Volume= 888 cf
Routed to Pond 3P : Infiltration Basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 194.41' @ 12.15 hrs Surf.Area= 59 sf Storage= 91 cf

Plug-Flow detention time= 90.0 min calculated for 1,061 cf (99% of inflow)
Center-of-Mass det. time= 86.8 min (847.6 - 760.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	191.80'	57 cf	**5.92'W x 10.00'L x 3.21'H Field A** 190 cf Overall - 49 cf Embedded = 141 cf x 40.0% Voids
#2A	192.30'	49 cf	**Cultec R-280HD** Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 1 rows
#3	194.90'	4 cf	**0.50'D x 20.00'H Roof Drains** -Impervious
		109 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	193.60'	**4.0" Round Culvert** L= 130.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 193.60' / 190.00' S= 0.0277 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Discarded	191.80'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#3	Primary	200.00'	**4.0" Vert. Roof Drain Outlets X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 3.21 hrs HW=192.03' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.15 hrs HW=194.40' TW=184.73' (Dynamic Tailwater)
├**1=Culvert** (Inlet Controls 0.3 cfs @ 3.04 fps)
└**3=Roof Drain Outlets** (Controls 0.0 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PS1: Runoff Area=300,800 sf 0.44% Impervious Runoff Depth=2.40"
Flow Length=405' Tc=13.9 min CN=76 Runoff=13.8 cfs 60,063 cf

Subcatchment PS2: Runoff Area=58,369 sf 0.00% Impervious Runoff Depth=2.23"
Tc=6.0 min CN=74 Runoff=3.3 cfs 10,844 cf

Subcatchment PS3: Runoff Area=100,661 sf 0.52% Impervious Runoff Depth=2.31"
Flow Length=390' Tc=11.8 min CN=75 Runoff=4.7 cfs 19,395 cf

Subcatchment PS4: Runoff Area=30,842 sf 17.95% Impervious Runoff Depth=2.40"
Tc=6.0 min UI Adjusted CN=76 Runoff=1.9 cfs 6,158 cf

Subcatchment PS5: Runoff Area=13,999 sf 11.65% Impervious Runoff Depth=2.31"
Tc=6.0 min UI Adjusted CN=75 Runoff=0.8 cfs 2,697 cf

Subcatchment PS6: Runoff Area=47,567 sf 13.37% Impervious Runoff Depth=2.40"
Tc=6.0 min UI Adjusted CN=76 Runoff=2.9 cfs 9,498 cf

Subcatchment PS7: Runoff Area=4,388 sf 100.00% Impervious Runoff Depth=4.59"
Tc=6.0 min CN=98 Runoff=0.4 cfs 1,680 cf

Reach DP1: Inflow=16.6 cfs 68,464 cf
Outflow=16.6 cfs 68,464 cf

Reach DP2: Inflow=3.3 cfs 10,844 cf
Outflow=3.3 cfs 10,844 cf

Reach DP3: Inflow=4.7 cfs 19,395 cf
Outflow=4.7 cfs 19,395 cf

Pond 1P: Infiltration Basin Peak Elev=181.33' Storage=4,034 cf Inflow=1.9 cfs 6,158 cf
Discarded=0.0 cfs 3,882 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 3,882 cf

Pond 2P: Infiltration Basin Peak Elev=173.16' Storage=118 cf Inflow=0.8 cfs 2,697 cf
Discarded=0.0 cfs 293 cf Primary=0.8 cfs 2,404 cf Outflow=0.8 cfs 2,697 cf

Pond 3P: Infiltration Basin Peak Elev=186.12' Storage=3,276 cf Inflow=3.4 cfs 10,996 cf
Discarded=0.0 cfs 3,557 cf Primary=2.6 cfs 5,997 cf Outflow=2.6 cfs 9,554 cf

Pond 4P: Subsurface Recharge System Peak Elev=198.11' Storage=106 cf Inflow=0.4 cfs 1,680 cf
Discarded=0.0 cfs 177 cf Primary=0.5 cfs 1,498 cf Outflow=0.5 cfs 1,674 cf

Summary for Subcatchment PS1:

Runoff = 13.8 cfs @ 12.22 hrs, Volume= 60,063 cf, Depth= 2.40"
Routed to Reach DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
244,809	74	>75% Grass cover, Good, HSG C
28,712	70	Woods, Good, HSG C
25,947	96	Gravel surface, HSG C
1,332	98	Unconnected pavement, HSG C
300,800	76	Weighted Average
299,468		99.56% Pervious Area
1,332		0.44% Impervious Area
1,332		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	355	0.0680	4.20		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.9	405	Total			

Summary for Subcatchment PS2:

Runoff = 3.3 cfs @ 12.13 hrs, Volume= 10,844 cf, Depth= 2.23"
Routed to Reach DP2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
50,328	74	>75% Grass cover, Good, HSG C
6,242	70	Woods, Good, HSG C
1,799	96	Gravel surface, HSG C
58,369	74	Weighted Average
58,369		100.00% Pervious Area

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

Summary for Subcatchment PS3:

Runoff = 4.7 cfs @ 12.20 hrs, Volume= 19,395 cf, Depth= 2.31"
Routed to Reach DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
60,968	74	>75% Grass cover, Good, HSG C
30,252	70	Woods, Good, HSG C
8,916	96	Gravel surface, HSG C
525	98	Unconnected roofs, HSG C
100,661	75	Weighted Average
100,136		99.48% Pervious Area
525		0.52% Impervious Area
525		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	25	0.0400	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.1	25	0.1600	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.2	340	0.0120	1.76		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.8	390	Total			

Summary for Subcatchment PS4:

Runoff = 1.9 cfs @ 12.13 hrs, Volume= 6,158 cf, Depth= 2.40"
Routed to Pond 1P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Adj	Description
25,307	74		>75% Grass cover, Good, HSG C
5,535	98		Unconnected pavement, HSG C
30,842	78	76	Weighted Average, UI Adjusted
25,307			82.05% Pervious Area
5,535			17.95% Impervious Area
5,535			100.00% Unconnected

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

Summary for Subcatchment PS5:

Runoff = 0.8 cfs @ 12.13 hrs, Volume= 2,697 cf, Depth= 2.31"
Routed to Pond 2P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Adj	Description
11,887	74		>75% Grass cover, Good, HSG C
481	70		Woods, Good, HSG C
1,631	98		Unconnected pavement, HSG C
13,999	77	75	Weighted Average, UI Adjusted
12,368			88.35% Pervious Area
1,631			11.65% Impervious Area
1,631			100.00% Unconnected

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

Summary for Subcatchment PS6:

Runoff = 2.9 cfs @ 12.13 hrs, Volume= 9,498 cf, Depth= 2.40"
Routed to Pond 3P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Adj	Description
41,209	74		>75% Grass cover, Good, HSG C
6,358	98		Unconnected pavement, HSG C
47,567	77	76	Weighted Average, UI Adjusted
41,209			86.63% Pervious Area
6,358			13.37% Impervious Area
6,358			100.00% Unconnected

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

Summary for Subcatchment PS7:

Runoff = 0.4 cfs @ 12.13 hrs, Volume= 1,680 cf, Depth= 4.59"
Routed to Pond 4P : Subsurface Recharge System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.83"

Area (sf)	CN	Description
4,388	98	Roofs, HSG C
4,388		100.00% Impervious Area

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

Summary for Reach DP1:

Inflow Area = 397,596 sf, 4.84% Impervious, Inflow Depth = 2.07" for 10-Year event
Inflow = 16.6 cfs @ 12.20 hrs, Volume= 68,464 cf
Outflow = 16.6 cfs @ 12.20 hrs, Volume= 68,464 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Summary for Reach DP2:

Inflow Area = 58,369 sf, 0.00% Impervious, Inflow Depth = 2.23" for 10-Year event
Inflow = 3.3 cfs @ 12.13 hrs, Volume= 10,844 cf
Outflow = 3.3 cfs @ 12.13 hrs, Volume= 10,844 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Summary for Reach DP3:

Inflow Area = 100,661 sf, 0.52% Impervious, Inflow Depth = 2.31" for 10-Year event
Inflow = 4.7 cfs @ 12.20 hrs, Volume= 19,395 cf
Outflow = 4.7 cfs @ 12.20 hrs, Volume= 19,395 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: Infiltration Basin

Inflow Area = 30,842 sf, 17.95% Impervious, Inflow Depth = 2.40" for 10-Year event
Inflow = 1.9 cfs @ 12.13 hrs, Volume= 6,158 cf
Outflow = 0.0 cfs @ 21.56 hrs, Volume= 3,882 cf, Atten= 98%, Lag= 565.8 min
Discarded = 0.0 cfs @ 21.56 hrs, Volume= 3,882 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach DP1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 181.33' @ 21.56 hrs Surf.Area= 1,895 sf Storage= 4,034 cf

Plug-Flow detention time= 646.9 min calculated for 3,881 cf (63% of inflow)
Center-of-Mass det. time= 515.5 min (1,374.7 - 859.3)

Volume	Invert	Avail.Storage	Storage Description
#1	178.00'	6,010 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
178.00	634	94.8	0	0	634
180.00	1,316	132.5	1,909	1,909	1,353
182.00	2,225	170.2	3,501	5,410	2,310
182.25	2,578	182.8	600	6,010	2,667

Device	Routing	Invert	Outlet Devices
#1	Primary	181.80'	**10.0' long 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
#2	Discarded	178.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 21.56 hrs HW=181.33' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=178.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond 2P: Infiltration Basin

Inflow Area = 13,999 sf, 11.65% Impervious, Inflow Depth = 2.31" for 10-Year event
Inflow = 0.8 cfs @ 12.13 hrs, Volume= 2,697 cf
Outflow = 0.8 cfs @ 12.14 hrs, Volume= 2,697 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 12.14 hrs, Volume= 293 cf
Primary = 0.8 cfs @ 12.14 hrs, Volume= 2,404 cf
Routed to Reach DP1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 173.16' @ 12.14 hrs Surf.Area= 245 sf Storage= 118 cf

Plug-Flow detention time= 37.4 min calculated for 2,697 cf (100% of inflow)
Center-of-Mass det. time= 37.3 min (899.9 - 862.6)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	299 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
172.00	39	26.4	0	0	39
173.00	147	45.2	87	87	152
173.25	311	64.1	56	143	317
173.50	1,000	150.0	156	299	1,781

Device	Routing	Invert	Outlet Devices
#1	Primary	173.00'	**5.0' long x 2.0' 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 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Discarded	172.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.14 hrs HW=173.16' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.8 cfs @ 12.14 hrs HW=173.16' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.8 cfs @ 1.02 fps)

Summary for Pond 3P: Infiltration Basin

Inflow Area = 51,955 sf, 20.68% Impervious, Inflow Depth = 2.54" for 10-Year event
Inflow = 3.4 cfs @ 12.13 hrs, Volume= 10,996 cf
Outflow = 2.6 cfs @ 12.18 hrs, Volume= 9,554 cf, Atten= 23%, Lag= 3.0 min
Discarded = 0.0 cfs @ 12.18 hrs, Volume= 3,557 cf
Primary = 2.6 cfs @ 12.18 hrs, Volume= 5,997 cf
Routed to Reach DP1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 186.12' @ 12.18 hrs Surf.Area= 1,766 sf Storage= 3,276 cf

Plug-Flow detention time= 263.0 min calculated for 9,554 cf (87% of inflow)
Center-of-Mass det. time= 197.1 min (1,045.1 - 848.0)

Volume	Invert	Avail.Storage	Storage Description
#1	183.00'	4,023 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
183.00	323	70.3	0	0	323
184.00	879	111.4	578	578	924
186.00	1,660	149.1	2,498	3,076	1,748
186.50	2,136	168.0	947	4,023	2,231

Device	Routing	Invert	Outlet Devices
#1	Primary	185.90'	**10.0' long x 2.0' 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 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Discarded	183.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.18 hrs HW=186.12' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=2.6 cfs @ 12.18 hrs HW=186.12' TW=0.00' (Dynamic Tailwater)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 2.6 cfs @ 1.18 fps)

Summary for Pond 4P: Subsurface Recharge System

Inflow Area = 4,388 sf,100.00% Impervious, Inflow Depth = 4.59" for 10-Year event
Inflow = 0.4 cfs @ 12.13 hrs, Volume= 1,680 cf
Outflow = 0.5 cfs @ 12.13 hrs, Volume= 1,674 cf, Atten= 0%, Lag= 0.2 min
Discarded = 0.0 cfs @ 1.96 hrs, Volume= 177 cf
Primary = 0.5 cfs @ 12.13 hrs, Volume= 1,498 cf
Routed to Pond 3P : Infiltration Basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 198.11' @ 12.13 hrs Surf.Area= 59 sf Storage= 106 cf

Plug-Flow detention time= 62.3 min calculated for 1,674 cf (100% of inflow)
Center-of-Mass det. time= 60.3 min (811.4 - 751.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	191.80'	57 cf	**5.92'W x 10.00'L x 3.21'H Field A** 190 cf Overall - 49 cf Embedded = 141 cf x 40.0% Voids
#2A	192.30'	49 cf	**Cultec R-280HD** Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 1 rows
#3	194.90'	4 cf	**0.50'D x 20.00'H Roof Drains** -Impervious
		109 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	193.60'	**4.0" Round Culvert** L= 130.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 193.60' / 190.00' S= 0.0277 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Discarded	191.80'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#3	Primary	200.00'	**4.0" Vert. Roof Drain Outlets X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 1.96 hrs HW=192.03' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.5 cfs @ 12.13 hrs HW=197.80' TW=186.02' (Dynamic Tailwater)
├**1=Culvert** (Barrel Controls 0.5 cfs @ 5.33 fps)
└**3=Roof Drain Outlets** (Controls 0.0 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PS1: Runoff Area=300,800 sf 0.44% Impervious Runoff Depth=6.02"
Flow Length=405' Tc=13.9 min CN=76 Runoff=34.2 cfs 150,907 cf

Subcatchment PS2: Runoff Area=58,369 sf 0.00% Impervious Runoff Depth=5.77"
Tc=6.0 min CN=74 Runoff=8.5 cfs 28,087 cf

Subcatchment PS3: Runoff Area=100,661 sf 0.52% Impervious Runoff Depth=5.90"
Flow Length=390' Tc=11.8 min CN=75 Runoff=12.0 cfs 49,469 cf

Subcatchment PS4: Runoff Area=30,842 sf 17.95% Impervious Runoff Depth=6.02"
Tc=6.0 min UI Adjusted CN=76 Runoff=4.7 cfs 15,473 cf

Subcatchment PS5: Runoff Area=13,999 sf 11.65% Impervious Runoff Depth=5.90"
Tc=6.0 min UI Adjusted CN=75 Runoff=2.1 cfs 6,880 cf

Subcatchment PS6: Runoff Area=47,567 sf 13.37% Impervious Runoff Depth=6.02"
Tc=6.0 min UI Adjusted CN=76 Runoff=7.2 cfs 23,864 cf

Subcatchment PS7: Runoff Area=4,388 sf 100.00% Impervious Runoff Depth=8.70"
Tc=6.0 min CN=98 Runoff=0.8 cfs 3,181 cf

Reach DP1: Inflow=44.6 cfs 186,587 cf
Outflow=44.6 cfs 186,587 cf

Reach DP2: Inflow=8.5 cfs 28,087 cf
Outflow=8.5 cfs 28,087 cf

Reach DP3: Inflow=12.0 cfs 49,469 cf
Outflow=12.0 cfs 49,469 cf

Pond 1P: Infiltration Basin Peak Elev=182.05' Storage=5,519 cf Inflow=4.7 cfs 15,473 cf
Discarded=0.1 cfs 4,753 cf Primary=3.3 cfs 7,691 cf Outflow=3.4 cfs 12,444 cf

Pond 2P: Infiltration Basin Peak Elev=173.29' Storage=159 cf Inflow=2.1 cfs 6,880 cf
Discarded=0.0 cfs 351 cf Primary=2.0 cfs 6,529 cf Outflow=2.1 cfs 6,880 cf

Pond 3P: Infiltration Basin Peak Elev=186.34' Storage=3,697 cf Inflow=8.0 cfs 26,861 cf
Discarded=0.0 cfs 3,951 cf Primary=7.7 cfs 21,460 cf Outflow=7.7 cfs 25,411 cf

Pond 4P: Subsurface Recharge System Peak Elev=200.28' Storage=106 cf Inflow=0.8 cfs 3,181 cf
Discarded=0.0 cfs 179 cf Primary=0.8 cfs 2,997 cf Outflow=0.8 cfs 3,176 cf

Summary for Subcatchment PS1:

Runoff = 34.2 cfs @ 12.22 hrs, Volume= 150,907 cf, Depth= 6.02"
Routed to Reach DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
244,809	74	>75% Grass cover, Good, HSG C
28,712	70	Woods, Good, HSG C
25,947	96	Gravel surface, HSG C
1,332	98	Unconnected pavement, HSG C
300,800	76	Weighted Average
299,468		99.56% Pervious Area
1,332		0.44% Impervious Area
1,332		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.5	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.4	355	0.0680	4.20		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.9	405	Total			

Summary for Subcatchment PS2:

Runoff = 8.5 cfs @ 12.13 hrs, Volume= 28,087 cf, Depth= 5.77"
Routed to Reach DP2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
50,328	74	>75% Grass cover, Good, HSG C
6,242	70	Woods, Good, HSG C
1,799	96	Gravel surface, HSG C
58,369	74	Weighted Average
58,369		100.00% Pervious Area

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

Summary for Subcatchment PS3:

Runoff = 12.0 cfs @ 12.19 hrs, Volume= 49,469 cf, Depth= 5.90"
Routed to Reach DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
60,968	74	>75% Grass cover, Good, HSG C
30,252	70	Woods, Good, HSG C
8,916	96	Gravel surface, HSG C
525	98	Unconnected roofs, HSG C
100,661	75	Weighted Average
100,136		99.48% Pervious Area
525		0.52% Impervious Area
525		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	25	0.0400	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.1	25	0.1600	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.2	340	0.0120	1.76		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.8	390	Total			

Summary for Subcatchment PS4:

Runoff = 4.7 cfs @ 12.13 hrs, Volume= 15,473 cf, Depth= 6.02"
Routed to Pond 1P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Adj	Description
25,307	74		>75% Grass cover, Good, HSG C
5,535	98		Unconnected pavement, HSG C
30,842	78	76	Weighted Average, UI Adjusted
25,307			82.05% Pervious Area
5,535			17.95% Impervious Area
5,535			100.00% Unconnected

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

Summary for Subcatchment PS5:

Runoff = 2.1 cfs @ 12.13 hrs, Volume= 6,880 cf, Depth= 5.90"
Routed to Pond 2P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Adj	Description
11,887	74		>75% Grass cover, Good, HSG C
481	70		Woods, Good, HSG C
1,631	98		Unconnected pavement, HSG C
13,999	77	75	Weighted Average, UI Adjusted
12,368			88.35% Pervious Area
1,631			11.65% Impervious Area
1,631			100.00% Unconnected

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

Summary for Subcatchment PS6:

Runoff = 7.2 cfs @ 12.13 hrs, Volume= 23,864 cf, Depth= 6.02"
Routed to Pond 3P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Adj	Description
41,209	74		>75% Grass cover, Good, HSG C
6,358	98		Unconnected pavement, HSG C
47,567	77	76	Weighted Average, UI Adjusted
41,209			86.63% Pervious Area
6,358			13.37% Impervious Area
6,358			100.00% Unconnected

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

Summary for Subcatchment PS7:

Runoff = 0.8 cfs @ 12.13 hrs, Volume= 3,181 cf, Depth= 8.70"
Routed to Pond 4P : Subsurface Recharge System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.94"

Area (sf)	CN	Description
4,388	98	Roofs, HSG C
4,388		100.00% Impervious Area

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

Summary for Reach DP1:

Inflow Area = 397,596 sf, 4.84% Impervious, Inflow Depth = 5.63" for 100-Year event
Inflow = 44.6 cfs @ 12.19 hrs, Volume= 186,587 cf
Outflow = 44.6 cfs @ 12.19 hrs, Volume= 186,587 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Summary for Reach DP2:

Inflow Area = 58,369 sf, 0.00% Impervious, Inflow Depth = 5.77" for 100-Year event
Inflow = 8.5 cfs @ 12.13 hrs, Volume= 28,087 cf
Outflow = 8.5 cfs @ 12.13 hrs, Volume= 28,087 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Summary for Reach DP3:

Inflow Area = 100,661 sf, 0.52% Impervious, Inflow Depth = 5.90" for 100-Year event
Inflow = 12.0 cfs @ 12.19 hrs, Volume= 49,469 cf
Outflow = 12.0 cfs @ 12.19 hrs, Volume= 49,469 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2

Summary for Pond 1P: Infiltration Basin

Inflow Area = 30,842 sf, 17.95% Impervious, Inflow Depth = 6.02" for 100-Year event
Inflow = 4.7 cfs @ 12.13 hrs, Volume= 15,473 cf
Outflow = 3.4 cfs @ 12.18 hrs, Volume= 12,444 cf, Atten= 27%, Lag= 3.2 min
Discarded = 0.1 cfs @ 12.18 hrs, Volume= 4,753 cf
Primary = 3.3 cfs @ 12.18 hrs, Volume= 7,691 cf
Routed to Reach DP1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 182.05' @ 12.18 hrs Surf.Area= 2,291 sf Storage= 5,519 cf

Plug-Flow detention time= 305.0 min calculated for 12,441 cf (80% of inflow)
Center-of-Mass det. time= 216.0 min (1,041.1 - 825.1)

Volume	Invert	Avail.Storage	Storage Description
#1	178.00'	6,010 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
178.00	634	94.8	0	0	634
180.00	1,316	132.5	1,909	1,909	1,353
182.00	2,225	170.2	3,501	5,410	2,310
182.25	2,578	182.8	600	6,010	2,667

Device	Routing	Invert	Outlet Devices
#1	Primary	181.80'	**10.0' long 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
#2	Discarded	178.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.1 cfs @ 12.18 hrs HW=182.05' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=3.3 cfs @ 12.18 hrs HW=182.05' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 3.3 cfs @ 1.34 fps)

Summary for Pond 2P: Infiltration Basin

Inflow Area = 13,999 sf, 11.65% Impervious, Inflow Depth = 5.90" for 100-Year event
Inflow = 2.1 cfs @ 12.13 hrs, Volume= 6,880 cf
Outflow = 2.1 cfs @ 12.14 hrs, Volume= 6,880 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.0 cfs @ 12.14 hrs, Volume= 351 cf
Primary = 2.0 cfs @ 12.14 hrs, Volume= 6,529 cf
Routed to Reach DP1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 173.29' @ 12.14 hrs Surf.Area= 402 sf Storage= 159 cf

Plug-Flow detention time= 17.4 min calculated for 6,878 cf (100% of inflow)
Center-of-Mass det. time= 17.6 min (845.4 - 827.9)

Volume	Invert	Avail.Storage	Storage Description
#1	172.00'	299 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
172.00	39	26.4	0	0	39
173.00	147	45.2	87	87	152
173.25	311	64.1	56	143	317
173.50	1,000	150.0	156	299	1,781

Device	Routing	Invert	Outlet Devices
#1	Primary	173.00'	**5.0' long x 2.0' 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 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Discarded	172.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.14 hrs HW=173.29' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=2.0 cfs @ 12.14 hrs HW=173.29' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 2.0 cfs @ 1.39 fps)

Summary for Pond 3P: Infiltration Basin

Inflow Area = 51,955 sf, 20.68% Impervious, Inflow Depth = 6.20" for 100-Year event
Inflow = 8.0 cfs @ 12.13 hrs, Volume= 26,861 cf
Outflow = 7.7 cfs @ 12.15 hrs, Volume= 25,411 cf, Atten= 3%, Lag= 1.0 min
Discarded = 0.0 cfs @ 12.15 hrs, Volume= 3,951 cf
Primary = 7.7 cfs @ 12.15 hrs, Volume= 21,460 cf
Routed to Reach DP1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 186.34' @ 12.15 hrs Surf.Area= 1,979 sf Storage= 3,697 cf

Plug-Flow detention time= 120.1 min calculated for 25,404 cf (95% of inflow)
Center-of-Mass det. time= 89.1 min (906.6 - 817.5)

Volume	Invert	Avail.Storage	Storage Description
#1	183.00'	4,023 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
183.00	323	70.3	0	0	323
184.00	879	111.4	578	578	924
186.00	1,660	149.1	2,498	3,076	1,748
186.50	2,136	168.0	947	4,023	2,231

Device	Routing	Invert	Outlet Devices
#1	Primary	185.90'	**10.0' long x 2.0' 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 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Discarded	183.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.15 hrs HW=186.34' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=7.6 cfs @ 12.15 hrs HW=186.34' TW=0.00' (Dynamic Tailwater)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 7.6 cfs @ 1.73 fps)

Summary for Pond 4P: Subsurface Recharge System

Inflow Area = 4,388 sf,100.00% Impervious, Inflow Depth = 8.70" for 100-Year event
Inflow = 0.8 cfs @ 12.13 hrs, Volume= 3,181 cf
Outflow = 0.8 cfs @ 12.12 hrs, Volume= 3,176 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.0 cfs @ 1.02 hrs, Volume= 179 cf
Primary = 0.8 cfs @ 12.12 hrs, Volume= 2,997 cf
Routed to Pond 3P : Infiltration Basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 200.28' @ 12.12 hrs Surf.Area= 59 sf Storage= 106 cf

Plug-Flow detention time= 35.5 min calculated for 3,175 cf (100% of inflow)
Center-of-Mass det. time= 34.5 min (775.7 - 741.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	191.80'	57 cf	**5.92'W x 10.00'L x 3.21'H Field A** 190 cf Overall - 49 cf Embedded = 141 cf x 40.0% Voids
#2A	192.30'	49 cf	**Cultec R-280HD** Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 1 rows
#3	194.90'	4 cf	**0.50'D x 20.00'H Roof Drains** -Impervious
		109 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	193.60'	**4.0" Round Culvert** L= 130.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 193.60' / 190.00' S= 0.0277 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Discarded	191.80'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#3	Primary	200.00'	**4.0" Vert. Roof Drain Outlets X 2.00** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 1.02 hrs HW=192.03' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.8 cfs @ 12.12 hrs HW=200.28' TW=186.33' (Dynamic Tailwater)
├**1=Culvert** (Barrel Controls 0.5 cfs @ 6.15 fps)
└**3=Roof Drain Outlets** (Orifice Controls 0.3 cfs @ 1.79 fps)

December 13, 2023

Stormwater Management Calculations

20R & 25 Johns Lane (Lot 3A)– Topsfield, MA Date: 12/13/2023

STANDARD 3: Recharge To Groundwater: Static Method

1. Calculate Impervious Area *(From HydroCAD Model)*
   - New Impervious Area (HSG C Soil) = 15,921 SF

2. Determine Rainfall Depth to be Recharged
   (MassDEP Stormwater Management Handbook: Table 2.3.2)

Hydrologic Soil Group	Recharge Rainfall Depth
C	0.25"

3. Calculate Recharge Volume
   'Rv' = [(0.25" x 15,921 SF) / 12 SF-In] = 332 CF
   'Rv' **= 332 CF**

Capture Area Adjustment
Schedule of Areas Tributary to Recharge Systems

HCAD Node ID	Tributary Impervious Area
1P	5,535 sf
2P	1,631 sf
3P	6,358 sf
4P	4,388 sf
Total:	**17,912 sf**

Total New Impervious Area = 15,921 SF
Capture Area Adjustment = 15,921 sf / 17,912 sf = **0.88 < 1**

4. Calculate Provided Recharge

HCAD System ID	Bottom of Infiltration	Lowest System Outlet	Total Recharge Volume Provided (cf)	10-YR Storm Event Peak Elevation
1P	180.0	181.8	**4,976**	**181.33**
2P	172.0	173.0	**87**	**173.16**
3P	183.0	185.9	**2,912**	**186.12**
4P	191.8	193.6	**64**	**198.11**
TOTAL			**8,039**	

Required Recharge Volume Summary
Total Volume Provided Below Outlets = 8,039 CF
Total Volume Required = 332 CF
8,039 cf provided > 332 cf required

STANDARD 4: Water Quality Volume

*Roof area considered to be clean runoff and does not require treatment

- **1P – Infiltration Basin**
- Tributary Impervious Area inside Zone A= 2,899 SF
- Tributary Impervious Area outside Zone A= 2,636 SF
    - Calculate required water quality volume (1" & 0.5" depth)
        WQV = [(1" x 2,899 SF) + (0.5" x 2,636 SF)] / 12 SF-In = **351 CF**
- Lowest outlet elevation = 181.8'
    WQV provided below lowest outlet = **4,976 CF (OK)**

- **2P – Infiltration Basin**
- Tributary Impervious Area outside Zone A= 1,631 SF
    - Calculate required water quality volume (1" depth)
        WQV = [0.5" x 1,631 SF] / 12 SF-In = **68 CF**
- Lowest outlet elevation = 173.0'
    WQV provided below lowest outlet = **87 CF (OK)**

- **3P – Infiltration Basin**
- Tributary Impervious Area inside Zone A= 4,694 SF
- Tributary Impervious Area outside Zone A= 1,664 SF
    - Calculate required water quality volume (1" & 0.5" depth)
        WQV = [(1" x 4,694 SF) + (0.5" x 1,664 SF)] / 12 SF-In = **461 CF**
    - Lowest outlet elevation = 185.8'
    WQV provided below lowest outlet = **2,912 CF (OK)**

Pretreatment Calculations

Pond 1P (SF1)

- Volume = 0.1" × 3,683 SF / 12 = 31 CF required
- 85 CF of storage provided at 193.9'

Pond 1P (SF2)

- Volume = 0.1" × 1,852 SF / 12 = 16 CF required
- 65 CF of storage provided at 182.9'

Pond 2P (SF3)

- Volume = 0.1" × 1,631 SF / 12 = 8 CF required
- 52 CF of storage provided at 174.9'

Pond 3P (SF4)

- Volume = 0.1" × 9,257 SF / 12 = 78 CF required
- 249 CF of storage provided at 186.0'

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66 Elm Street,
Danvers, MA 01923
p | 978.777.8586

Standard 4: Total Suspended Solids Calculation (1P)

Name: 20R & 25 Johns Lane
Location: 20R & 25 Johns Lane (Lot 3A)
Topsfield, MA
County: Essex
Applicant: Ray Lawton

Proj. No.: 4176
Date: 12/13/2023
Revised:
Computed by: Daniel Powers, P.E.
Checked by: John Morin, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Sediment Forebay	**0.25**	**1.00**	**0.25**	**0.75**
Vegetated Filter Strip >50 feet	**0.45**	**0.75**	**0.34**	**0.41**
Infiltration Basin	**0.80**	**0.41**	**0.33**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**

Total TSS Removal = **92%**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

THE MORIN-CAMERON GROUP, INC.
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Danvers, MA 01923
p | 978.777.8586

Standard 4: Total Suspended Solids Calculation (2P)

Name: 20R & 25 Johns Lane
Location: 20R & 25 Johns Lane (Lot 3A)
Topsfield, MA
County: Essex
Applicant: Ray Lawton

Proj. No.: 4176
Date: 12/13/2023
Revised:
Computed by: Daniel Powers, P.E.
Checked by: John Morin, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Sediment Forebay	**0.25**	**1.00**	**0.25**	**0.75**
Infiltration Basin	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

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Danvers, MA 01923
p | 978.777.8586

Standard 4: Total Suspended Solids Calculation (3P)

Name: 20R & 25 Johns Lane
Location: 20R & 25 Johns Lane (Lot 3A)
Topsfield, MA
County: Essex
Applicant: Ray Lawton

Proj. No.: 4176
Date: 12/13/2023
Revised:
Computed by: Daniel Powers, P.E.
Checked by: John Morin, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Vegetated Filter Strip >50 feet	**0.45**	**1.00**	**0.45**	**0.55**
Sediment Forebay	**0.25**	**0.55**	**0.14**	**0.41**
Infiltration Basin	**0.80**	**0.41**	**0.33**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**

Total TSS Removal = **92%**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Long Term Stormwater Best Management Practices
Operation and Maintenance Plan
for the
Residential Development
of
20R & 25 Johns Lane (Lot 3A)
Topsfield, Massachusetts
November 7, 2023
Revised: December 13, 2023

The following operation and maintenance plan has been provided associated with development of the site and associated infrastructure. The success of the Stormwater Management Plan depends on the proper implementation, operation and maintenance of several management components. The following procedures shall be implemented to ensure success of the Stormwater Management Plan:

1. The contractor shall comply with the details of construction of the site as shown on the approved plans.
2. The drainage systems shall be inspected and maintained as indicated below.
3. Effective erosion control measurers during and after construction shall be maintained until a stabilized finished surface is established on all altered areas.

Basic Information

Stormwater Management System Owner:	Ray Lawton 240 Boston Street Topsfield, MA 01983 P: (617) 908-1814
Topsfield Department of Public Works:	279 Boston Street Topsfield, MA 01983 P: (978) 887-1517
Topsfield Planning Board:	Topsfield Town Offices 8 West Common Street Topsfield, MA 01983 P: (978) 887-1504

Erosion and Sedimentation Controls During Construction:

The site and drainage construction contractor shall be responsible for maintaining the stormwater system during construction. Routine maintenance of all items shall be performed to ensure adequate runoff and pollution control during construction.

Proposed erosion controls will be placed as shown on the Site Development Plan prior to the commencement of any clearing, grubbing, and earth removal or construction activity. The integrity of the erosion control barrier will be maintained by periodic inspection and replacement as necessary. The erosion control barrier will remain in place until the first course of pavement has been placed and all disturbed areas have been loamed and seeded and vegetation has been established.

General Conditions

1. The developer shall be responsible for scheduling regular inspections and maintenance of the stormwater BMP's. The BMP maintenance shall be conducted as detailed in the following long-term pollution prevention plan and illustrated on the approved design plans:

   "Site Development Plan in Topsfield, Massachusetts, 20R John's Lane (Lot 3A) & 42R Boston Street (Lot 3B)", prepared by The Morin-Cameron Group, Inc. dated December 7, 2023 and as revised and approved by the Topsfield Planning Board.

2. The owner shall:
   a. Maintain an Operation and Maintenance Log for the last three years. The Log shall include all BMP inspections, repairs, replacement activities and disposal activities (disposal material and disposal location shall be included in the Log);
   b. Make the log available to the Topsfield Department of Public Works and Planning Board upon request;
   c. Allow members and agents of the Topsfield Department of Public Works and Planning Board to enter the premises and ensure that the Owner has complied with the Operation and Maintenance Plan requirements for each BMP.

3. A recommended inspection and maintenance schedule is outlined below based on statewide averages. This inspection and maintenance schedule shall be adhered to at a minimum for the first year of service of all BMP's referenced in this document. At the conclusion of the first year of service, a more accurate inspection/maintenance schedule shall be determined based on the level of service for this site.

4. Inspections and maintenance activities for this residential development will generally be performed by the developer or future homeowner. If major repairs are required, then detailed cost estimates will be provided by local landscaping companies prior to commencement of work.

Long-Term Pollution Prevention Plan (LTPPP)

Vegetated Areas:

Immediately after construction, monitoring of the erosion control systems shall occur until establishment of natural vegetation. Afterwards, vegetated areas shall be maintained as such. Vegetation shall be replaced as necessary to ensure proper stabilization of the site.

Subsurface Recharge Chamber:

The subsurface recharge chamber shall be checked for debris accumulation twice per year. Each system is equipped with an inspection port. Additional inspections should be scheduled during the first few months to make sure that the facility is functioning as intended. Trash, leaves, branches, etc. shall be removed from facility. Silt, sand and sediment, if significant accumulation occurs, shall be removed annually. Material removed from the system shall be disposed of in accordance with all applicable local, state, and federal regulations. In the case that water remains in the infiltration facilities for greater than three (3) days after a storm event an inspection is warranted, and necessary maintenance or repairs should be addressed as necessary.

Cost: Consult with local landscaping companies for associated costs if necessary.

Public Safety Concerns: The inspection port cover shall not be left open and unattended at any time during inspection, cleaning or otherwise. Broken covers or frames shall be replaced immediately. At no time shall any person enter the subsurface structure unless measures have been taken to ensure safe access in accordance with OSHA enclosed space regulations.

Grassed Infiltration Basins:

The grassed infiltration basins shall be inspected after every major storm event for first 3 months after construction to ensure the facilities are working properly and thereafter, twice a year (April/ October). The basins shall be checked for debris accumulation twice per year. Additional inspections should be scheduled during the first few months to make sure that the vegetation becomes adequately established in the basins and that the facilities are functioning as intended. Trash, leaves, branches, etc. shall be removed from the facilities. Silt, sand and sediment, if significant accumulation occurs, shall be removed. Material removed from the basins shall be disposed of in accordance with all applicable local, state, and federal regulations. Reseeding, weed control, and invasive species removal may need to be performed periodically to maintain healthy vegetation. Verify no standing water is present 72 hours after a storm event to verify basins are draining and overflow berms are properly functioning. Rehabilitate facilities if failure is evident. In the case that water remains in the basins for greater than three (3) days after a storm event, an inspection is warranted, and necessary maintenance or repairs should be addressed as necessary. Any slope erosion within the basins shall be stabilized and repaired as soon as practical.

Cost: Consult with local landscaping companies for associated costs if necessary.

Grassed Swale:

The grassed swale shall be inspected after every major storm event for first 3 months after construction to ensure the structures are working properly and thereafter, twice a year (April/ October). The swale shall be checked for debris accumulation twice per year. Additional inspections should be scheduled during the first few months to make sure that the vegetation becomes adequately established in the swale and that the facility is functioning as intended. Trash, leaves, branches, etc. shall be removed. Silt, sand and sediment, if significant accumulation occurs, shall be removed. Material removed from the swale shall be disposed of in accordance with all applicable local, state, and federal regulations. Reseeding, weed control, and invasive species removal may need to be performed periodically to

maintain healthy vegetation. Any erosion within the swale shall be stabilized and repaired as soon as practical.

Cost: Consult with local landscaping companies for associated costs if necessary.

Sediment Forebays:
The forebays shall be inspected after every major storm event for the first 3 months after construction; a major storm event is 3.9 inches of rainfall in a 24 hour period (2 year storm). Thereafter, the sediment forebays shall be inspected at a minimum of twice per year (at the same time as the inspection of the infiltration basin). All forebays shall be inspected on an annual basis, typically in the spring months, and sediment shall be removed when depth exceeds 6 inches.

Cost: Consult with local landscaping or pumping companies for associated costs if necessary.

Stone Diaphragms/Vegetative Filter Strips:
The stone diaphragms/vegetated filter strips shall be checked for debris accumulation twice per year. Additional inspections should be scheduled during the first few months to make sure that the filter strips are functioning as intended. Trash, leaves, branches, etc. shall be removed from surface. Silt, sand and sediment, if significant accumulation occurs, shall be removed as required. Material removed from the filter strips shall be disposed of in accordance with all applicable local, state, and federal regulations. If the stone because full of sediment, it shall be removed and replaced with clean washed stone. The filter strips shall be kept free of woody vegetation and removal of woody vegetation shall be conducted between October 15th and April 15th. Any slope erosion shall be stabilized and repaired immediately, and additional rip-rap added as required. Damaged sections of vegetation shall be stabilized and repaired as soon as possible.

Cost: Consult with local landscaping for associated costs if necessary.

Debris & Litter:
All debris and litter shall be removed from the site as necessary to prevent migration into the drainage system.

Pesticides, Herbicides, and Fertilizers:
Pesticides and herbicides shall be used sparingly. Fertilizers shall be restricted to the use of organic fertilizers only. All fertilizers, herbicides, pesticides, sand and salt for deicing and the like shall be stored in dry area that is protected from weather.

Prevention of Illicit Discharges:
Illicit discharges to the stormwater management system are not allowed. Illicit discharges are discharges that are not comprised entirely of stormwater. Pursuant to Mass DEP Stormwater Standards the following activities or facilities are not considered illicit discharges: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, De-chlorinated water from swimming pools, water used for street washing and water used to clean residential building without detergents.

To prevent illicit discharges to the stormwater management system the following policies should be implemented:

1. Good Housekeeping Practices
    - The site shall be kept clean of litter and debris and continuously maintained as noted above. All chemicals shall be covered and stored in secured location. Any land disturbances that change drainage characteristics shall be remedied to pre-disturbance characteristics (i.e.

shoulder rutting from vehicles, land disturbance from plowing, etc.) as soon as possible to ensure proper treatment of all stormwater runoff.

2. Provisions for Storing Materials and Waste Products Inside or Under Cover
   - All chemicals and chemical waste products shall be stored inside or in a secured covered location to prevent potential discharge. Any major spills shall be reported to municipal officials and a remediation plan shall be implemented immediately.
3. Vehicle Maintenance
   - Any vehicle maintenance shall be done with care to prevent discharge of illicit fluids. If fluids are accidentally spilled, immediate action shall be implemented to clean and remove the fluid to prevent discharge into the stormwater management system and/or infiltrating into the groundwater.
4. Pet Waste Management Provisions
   - Pet waste shall be picked up and disposed of in an appropriate individual waste refuse area.
5. Spill Prevention and Response Plans
   - If a major spill of an illicit substance occurs, town officials (including but not limited to the Fire Department and Police Department) shall be notified immediately. A response plan shall then be implemented immediately to prevent any illicit discharges from entering the stormwater management system and ultimately surface waters of the Commonwealth.
6. Solid waste
   - All domestic solid waste shall be disposed of in accordance with all applicable local, state and federal regulations. Waste shall be placed into covered dumpsters and/or covered waste bins to prevent water intrusion and potentially contaminated runoff. No household chemicals, hazardous materials, construction debris or non-household generated refuse shall be disposed of in the on-site waste disposal containers.

Stormwater Management Maintenance Log

20R and 25 Johns Lane - Lot 3A, Topsfield, MA

The following facilities shall be inspected and maintained by the owner

BMP STRUCTURE	INSPECTION DATE	DATE WORK PERFORMED	WORK PERFORMED	COMMENTS
SUBSURFACE RECHARGE SYSTEM				
ROOF LEADERS, GUTTERS AND DOWNSPOUTS				
GRASSED INFILTRATION BASIN #1				
GRASSED INFILTRATION BASIN #2				
GRASSED INFILTRATION BASIN #3				
GRASSED SWALE				
SEDIMENT FOREBAY #1				
SEDIMENT FOREBAY #2				
SEDIMENT FOREBAY #3				
SEDIMENT FOREBAY #4				
VEGETATED FILTER STRIP #1				
VEGETATED FILTER STRIP #2				