TECHNICAL REPORT

181R SCHOOL STREET

GROVELAND, MASSACHUSETTS

JULY 31, 2024

SUBMITTED TO:

TOWN OF GROVELAND
PLANNING BOARD
183 MAIN STREET
GROVELAND, MA 01834

APPLICANT:

GROVELAND REDEVELOPMENT, LLC
231 SUTTON STREET, SUITE 1B
NORTH ANDOVER, MASSACHUSETTS, 01845

NARRATIVE

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TECHNICAL REPORT NARRATIVE
181R School Street Subdivision

I. Executive Summary

Groveland Redevelopment, LLC, the 'applicant,' proposes to develop the property located at 181R School Street in Groveland, Massachusetts ("site") to a six (6) lot subdivision with frontage on a new road. A preliminary subdivision plan entitled "Preliminary Subdivision for a Street to be Named in Groveland, Massachusetts at 181R School Street" dated March 2, 2023, was previously submitted to the Town of Groveland, and denied by the Planning Board on April 19, 2023. Comments from that process included notably concerns with the shape of the lots, insufficient buffering around the development and how stormwater would be managed. These comments were taken into consideration in the project design.

The project was designed for six (6) lots meeting the new Zoning Regulations for lot shape which makes all of the lots more regular in shape. Two (2) lots are large enough to accommodate a 2-family dwelling for a maximum number of eight (8) dwellings. The lots were engineered using conservative assumptions for house footprints, driveways and clearing limits to account for the impacts of the full buildout of the project. Stormwater management is addressed on site and fully complies with applicable Groveland stormwater regulations and the MassDEP Stormwater Management Handbook. The stormwater design will be discussed in more detail later in this report. In addition to the lot designs, the road was engineered in compliance with the Groveland Subdivision Regulations.

The road consists of a 575-foot-long road ending in a cul-de-sac. The design meets the geometric requirements and specifications for road construction per the Groveland Subdivision Regulations. A waiver has been requested to reduce the road-to-road intersection distance from 400-feet to 300-feet which is consistent with the neighborhood. Another waiver has been requested to provide permeable pavement for the sidewalks and driveways which is a best practice in keeping with sustainable design that will be required for the house construction under the current Massachusetts Building code. The waivers will be discussed later in this report. The road includes a sidewalk along one side and street trees per the Regulations.

The following report, supporting documents and definitive subdivision plans document how the project complies with Groveland regulations and bylaws, state regulations and best engineering and construction practices.

II. Existing Site Description

The site consists of a total land area of 245,945 square feet (5.65± acres) and is shown on the Town of Groveland Assessor's Map 34, Lot 13. It is situated in the Residential (R-2) District and the Aquifer Protection District (Zone III). The site is bounded to the east by School Street (Route 97), to the West by the Whitestone Village residential development and to the South by a developed single-family residence and to the north by a developed single-family. Refer to Figure 1: Ortho Map and Figure 2: USGS Locus Map for illustrations of the site and surrounding features.

The site can generally be described as undeveloped with most of it being wooded and a small portion near school street that is cleared, but overgrown. Topography on the site varies, with slopes ranging from 4% to 12%. The site has a high elevation of approximately 104.5 near School

Street and low elevation of approximately 72.0 along the rear/western side of the site. Soils on site are mapped as Canton fine sandy loam (420B, 420C & 421C) and Sutton Fine Sandy Loam (410C) according to the Natural Resources Conservation Service (NRCS). In situ soil testing performed on July 2, 2024, confirmed the soils throughout the site. The underlying parent soils are well drained loamy sands and sand. No refusal or estimated seasonal high-water table was encountered. See Figure 3: SCS Soils Map for an illustration of the soil types.

The applicant previously applied for a Request for Determination of Applicability (RDA) with the Conservation Commission for confirmation that there are no wetlands or buffer zones located on the property. The Conservation Commission issued a negative determination confirming this.

The entire site is shown to be within Zone X on the FEMA Federal Insurance Rate Map (FIRM) # 25009C0232F, dated June 03, 2012 (See Figure 4: FEMA Flood Map).

III. Proposed Site Description

The applicant proposes to divide the lot into six (6) residential lots, an unbuildable parcel, and the roadway. Two (2) of the lots are large enough to accommodate a2-family dwelling for a maximum of eight (8) dwelling units on the site. The proposed road will intersect with School Street and will be approximately 575 feet in length, as measured from School Street curb cut to the end of the proposed cul-de-sac. The road will be 24 feet wide, with planting strips, curb and a sidewalk situated within a 50 feet wide right-of-way. The development of the road will include street trees, stormwater management system and new water, sanitary sewer, electric, communications and natural gas.

The development on the individual lots will occur after the road is improved to a condition suitable to access them and will comply to the Town of Groveland Zoning Bylaw.

An 8" water main will be extended from School Street along the road. Two (2) fire hydrants will be constructed along the new road. A sewer main will be extended into the property, to receive wastewater from private ejector pumps that are necessary to lift the wastewater from the lots to School Street, which is higher in elevation. Electric, gas and individual communications will be underground and will be coordinated with their respective service providers. Closed drainage catch basins, manholes and pipes will convey runoff from the road and lots to a stormwater management system. The measures to be implemented at the site include two infiltration basins, four rain gardens, hydrodynamic separators from Contech (Refer to the Grading & Drainage Plan and associated construction details for more information). The stormwater flow will be treated and infiltrated within the property. The existing watershed characteristics, flow paths and drainage patterns were matched to the extent practicable in the proposed condition to demonstrate that there are no adverse impacts to adjacent properties.

The project will require Definitive Subdivision Approval and a Stormwater and Land Disturbance Permit by the Groveland Planning Board. As part of the project permitting, the proponent must demonstrate compliance with applicable stormwater best management practices and regulations. The following narrative contains a description of existing and proposed site conditions, stormwater management design methodology, result summaries and other supplemental information in support of the stormwater best management system design.

IV. Stormwater Management

A. Existing Watershed Characteristics

Stormwater runoff at the site in the existing condition flows to five (5) distinct location. Design Point 1 (DP1) is the public drainage system on School Street. Design Point 2 (DP2) is the southeastern abutting property, Design Points 3 and 4 (DP3 & DP4) are the southern abutting properties, and Design Point (5) is the eastern abutting property. The design point and the tributary watersheds (or subcatchments) are illustrated on Figure 5: Existing Site Development Watershed Plan, included herein. The table below lists the total area associated with the subcatchment area.

Summary of Existing Subcatchments

Existing Drainage Area (E)	Total Area (SF)	% Impervious	Composite Curve Number
ES-1	4,887	0.00	61
ES-2	96,774	2.02	57
ES-3	160,264	0.63	57
ES-4	33,665	0.00	55
ES-5	10,871	0.00	57
Total	**306,461 (7.04 acres)**	**0.97%**	**57**

Description of Existing Subcatchments

The subcatchments analyzed in the existing condition can be described as follows:

- **Subcatchment ES1:** Consists of a small portion of the property frontage, it comprises of lawn only. This area flows to School Street and towards to the public drainage system.
- **Subcatchment ES2:** Consists of the eastern portion of the site and the abutting property located at 181 School St. It includes roof, lawn, pavement, and woods.
- **Subcatchment ES3:** Consists of the central portion of the property, it comprises wood, lawn and roofs. This area flows towards the southern abutting property.
- **Subcatchment ES4:** Consists of the southwestern portion of the property, it comprises only wood. This area flows towards the abutting property southern of the site.
- **Subcatchment ES5:** Consists of a small portion on the northern side of the property, it includes lawn and wood. This area flows towards the abutting properties on the north side of the site.

B. Proposed Watershed Characteristics

The proposed development of the site will maintain the design points identified in the existing watershed analysis. To understand and analyze the proposed development, smaller subcatchments were delineated to analyze stormwater impacts on more detailed scale. The table below provides the total drainage area and the percentage that will be impervious in the post-development condition. The design points and the tributary watersheds (or subcatchments) are illustrated on Figure 6 – Proposed Watershed Plan.

Summary of Proposed Subcatchments:

Proposed Drainage Area	Total Area (SF)	% Impervious	Composite Curve Number
PS-1	2,750	15.45	67
PS-2	78,530	2.48	58
PS-3	21,059	0.00	56
PS-4	24,109	0.00	56
PS-5	8,836	0.00	57
PS-N1	42,026	21.66	69
PS-N2	9,120	57.13	82
PS-N3	51,063	37.90	74
PS-N4	28,998	35.50	74
PS-N5	13,982	36.60	75
PS-N6	14,114	18.29	68
PS-7	11,874	20.60	69
TOTALS	**306,461 (7.03 acres)**	**18.43%**	**66**

Description of Proposed Subcatchments

- **Subcatchment PS-1:** Includes a small portion of the frontage of lot 6 on School Street, includes landscape and a small area of the proposed road. The runoff from this area is di-minimus and flows towards School Street.
- **Subcatchment PS-2:** Includes the south and southern portion of the lot, it comprises the abutting property located at 181 School St, which contains buildings, pavement, woods, and landscape, it also comprises the undisturbed woods from the site, and new landscape. The runoff from this area will sheet flow through the site and discharge to DP2 on the southern abutting property.
- **Subcatchment PS-3:** Includes the southwestern portion of the site, it comprises of undisturbed woods and landscaped area. The runoff from this subcatchment sheet flows towards the southwestern abutting property (DP3).
- **Subcatchment PS-4:** Consists of the western portion of the site, it comprises undisturbed woods and a small, landscaped area. The runoff from this area flows towards the western abutting property.
- **Subcatchment PS-5:** Consists of the northern portion of the site, it comprises undisturbed woods and a small, landscaped area. The runoff from this rea flows towards the northern abutting properties.
- **Subcatchment PS-N1:** Consists of portion of the proposed road, landscaped areas from proposed lot 6 and existing abutting property (181 School St). The runoff from this area sheet flows through the abutting property towards the proposed infiltration basin (P1), and also sheet flows to a proposed catch basin, then through a water quality unit prior to entering the proposed infiltration basin (P1).
- **Subcatchment PS-N2:** Consists of the roof and some landscaped area of proposed Lot 2. The runoff from this area flows towards the proposed rain garden (P2) on lot 2.
- **Subcatchment PS-N3:** Consist of the cul-de-sac area at the end of the proposed road, and the front lawn of Lots 3, 4 and 5. The runoff from this area sheet flows from the higher point on the eastern side of Lot 4 towards the proposed catch basin at the end of the cul-de-sac, then to a water quality unit and then to the proposed infiltration basin (P4).
- **Subcatchment PS-N4:** Consists of the middle portion of the proposed road, and the front

lawns of Lots 2 and 5. The runoff from this areas sheet flow through catch basins and water quality units and then towards the proposed infiltration basin (P4).

- **Subcatchment PS-N5:** Consists of the roof and some landscaped area of proposed Lot 6. The runoff from this area flows towards the proposed rain garden (P5) on lot 6.
- **Subcatchment PS-N6:** Consists of the roof and some landscaped area of proposed Lot 5. The runoff from this area flows towards the proposed rain garden (P6) on lot 5.
- **Subcatchment PS-N7:** Consists of the roof and some landscaped area of proposed Lot 7. The runoff from this area flows towards the proposed rain garden (P7) on lot 7.

C. Hydrologic Analysis:

The purpose of the stormwater analysis is to demonstrate that the proposed development will not adversely impact the land or surrounding land. The industry standard for stormwater management design in Massachusetts is governed by the Massachusetts Stormwater Management Handbook ("Handbook") published by the Mass Department of Environmental Protection, January 2008. The City of Melrose Stormwater Rules and Regulations and associated Regulations including analyzing the 2, 10, and 100-year storm events.

The Handbook lists 10 standards covering both mitigation and renovation of stormwater runoff. A full discussion on compliance with the standards can be found at the end of this report. However, the following section will summarize the projects compliance with the mitigation standards 1 and 2 of the Handbook relating to reducing peak rates of runoff and creating no adverse down gradient impacts.

To demonstrate that there will be no downstream impacts as a result of the proposed project, a stormwater analysis was performed using the U.S. Soil Conservation Service (S.C.S) method of analysis contained in Technical Release #20 (TR-20) published by the U.S. Conservation Service. The software application HydroCAD was used to analyze the existing and proposed development watershed conditions. This application is widely used in the civil engineering industry and an accepted means of performing a TR-20 analysis. It is a computer aided design program for analyzing the hydrology and hydraulics of storm water runoff. It utilizes the latest techniques of both fields to accurately predict the consequences of any given storm event. This analysis allows the engineer to verify that a given drainage system is adequate for the area under consideration and further allows the engineer to predict where flooding or erosion could potentially occur. This model was used to analyze the storm drainage system designed for the development to demonstrate that the drainage system is in compliance with the City's Stormwater Rules and Regulation.

Although the Town of Groveland Subdivision Regulations Section 70-4.4(B) requires a specific rainfall depth for each storm, the hydrologic analysis was designed with a more conservative approach utilizing the NRCS2-Rain Table from HydroCAD, which provides the latest NRCS rainfall data based on Atlas 14 Volume 10 and implements the new rainfall distribution including NOAA10. The storm events are as follows, 3.24 inches on the 2-yr storm event, 5.12 on the 10-yr storm event, 6.30 on the 25-yr storm event and 8.11 on the 100-yr storm event.

The HydroCAD analysis was performed by examining the five design points that were previously referenced. The following is a listing of the total existing and proposed development rates and volume of stormwater runoff for the proposed development for the 2, 10, 25 and 100-year rainfall events:

DP1 Peak Discharge Rates (CFS)				
Storm Event		**Existing Conditions**	**Proposed Conditions**	**Change in Peak**
2-yr	Outflow	0	0	0
10-yr	Outflow	0.2	0.1	-0.1
25-yr	Outflow	0.2	0.2	0
100-yr	Outflow	0.4	0.3	-0.1

DP2 Peak Discharge Rates (CFS)				
Storm Event		**Existing Conditions**	**Proposed Conditions**	**Change in Peak**
2-yr	Outflow	0.4	0.4	0
10-yr	Outflow	2.9	2.5	-0.4
25-yr	Outflow	4.9	4.2	-0.7
100-yr	Outflow	8.4	7	-1.4

DP3 Peak Discharge Rates (CFS)				
Storm Event		**Existing Conditions**	**Proposed Conditions**	**Change in Peak**
2-yr	Outflow	0.4	0.4	0
10-yr	Outflow	3.3	3.1	-0.2
25-yr	Outflow	5.7	4.9	-0.8
100-yr	Outflow	9.9	8.2	-0.7

DP4 Peak Discharge Rates (CFS)				
Storm Event		**Existing Conditions**	**Proposed Conditions**	**Change in Peak**
2-yr	Outflow	0	0	0
10-yr	Outflow	0.5	0.5	0
25-yr	Outflow	1	0.9	-0.1
100-yr	Outflow	1.8	1.8	0

DP5 Peak Discharge Rates (CFS)				
Storm Event		**Existing Conditions**	**Proposed Conditions**	**Change in Peak**
2-yr	Outflow	0	0	0
10-yr	Outflow	0.2	0.1	-0.1
25-yr	Outflow	0.3	0.2	-0.1
100-yr	Outflow	0.5	0.4	-0.1

DP1 Volume (CF)				
Storm Event		Existing Conditions	Proposed Conditions	Change in Volume
2-yr	Outflow	188	162	-26
10-yr	Outflow	587	432	-155
25-yr	Outflow	900	632	-268
100-yr	Outflow	1437	965	-472

DP2 Volume (CF)				
Storm Event		Existing Conditions	Proposed Conditions	Change in Volume
2-yr	Outflow	2606	2326	-280
10-yr	Outflow	9428	8084	-1344
25-yr	Outflow	15008	12738	-2270
100-yr	Outflow	28844	20889	-7955

DP3 Volume (CF)				
Storm Event		Existing Conditions	Proposed Conditions	Change in Volume
2-yr	Outflow	4316	1425	-2891
10-yr	Outflow	15613	9839	-5774
25-yr	Outflow	24855	17437	-7418
100-yr	Outflow	41143	31689	-9454

DP4 Volume (CF)				
Storm Event		Existing Conditions	Proposed Conditions	Change in Volume
2-yr	Outflow	737	587	-150
10-yr	Outflow	2919	2776	-143
25-yr	Outflow	4750	4748	-2
100-yr	Outflow	8022	8336	314

DP5 Volume (CF)				
Storm Event		Existing Conditions	Proposed Conditions	Change in Volume
2-yr	Outflow	293	238	-55
10-yr	Outflow	1059	861	-198
25-yr	Outflow	1686	1370	-316
100-yr	Outflow	2791	2268	-523

D. Review of Stormwater Management Standards

The project is considered a new development and therefore must fully comply with the stormwater regulations. The proposed drainage system has been designed to attenuate peak rates of stormwater runoff and volume for all storm events up to and including the 100-year event. Measures will be implemented to provide the required 90% total suspended solids (TSS) removal and 60% total phosphorous (TP) removal, to ensure stormwater runoff is renovated prior to discharge. The following is an assessment of each Standard as it relates to the proposed subdivision development:

1. No stormwater conveyance system discharges untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

The project meets this standard. All stormwater runoff from the impervious areas on site will receive at least 90% Total Suspended Solids removal and 60 to 70% phosphorous treatment prior to discharge.

2. The stormwater management system shall be designed such that post-development peak rates of stormwater runoff do not exceed pre-development rates for the 2- and 10-year storm events.

The project meets this standard. Two infiltration basins and 4 rain gardens will be implemented to promote groundwater recharge and to mitigate the post development rate of runoff and volume prior to discharging to the design points.

3. Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater handbook.

The project meets this standard. Groundwater will be recharged within the proposed infiltration basins and rain gardens. See "Appendix D - Stormwater Calculations" attached herewith.

4. Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

The project meets this standard. All stormwater runoff from paved areas of the site will pass through a treatment train consisting of catch basins, proprietary pretreatment CDS units and infiltration basins.

5. For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

This standard is not applicable.

6. Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Management handbook.

This standard is not applicable.

7. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5 and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

This standard is not applicable.

8. A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented).

The project meets this standard. Refer to "Appendix E - Construction Phase Best Management Practices" prepared by The Morin-Cameron Group, Inc., dated July 31, 2024. A SWPPP will be submitted prior to the beginning of the construction.

9. A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

The project meets this standard. Refer to "Appendix F - Long-Term Best Management Practices Operation and Maintenance Plan prepared by The Morin-Cameron Group, Inc., dated July 31, 2024.

10. There shall be no new illicit discharges created as a result of the project.

The project meets this standard. To the best of our knowledge and belief there are no illicit discharges being created as a result of the proposed project. An illicit discharge statement is included herein.

V. Conclusion

The proposed definitive subdivision has been carefully designed, with input from the public, to comply with applicable regulations and following best engineering and construction practices. The housing type and variety fits with the surrounding neighborhood. The two-family dwellings offer a more economically accessible housing option for young families. The project will generate more tax revenue for the town than the current, undeveloped condition. Finally, best stormwater management practices were implemented throughout the project to meet and exceed current standards for stormwater design to ensure that there are no impacts to abutting properties or the environment.

FIGURES

THE MORIN-CAMERON GROUP, INC.
66 ELM STREET, DANVERS, MA 01923
P: **978-777-8586**
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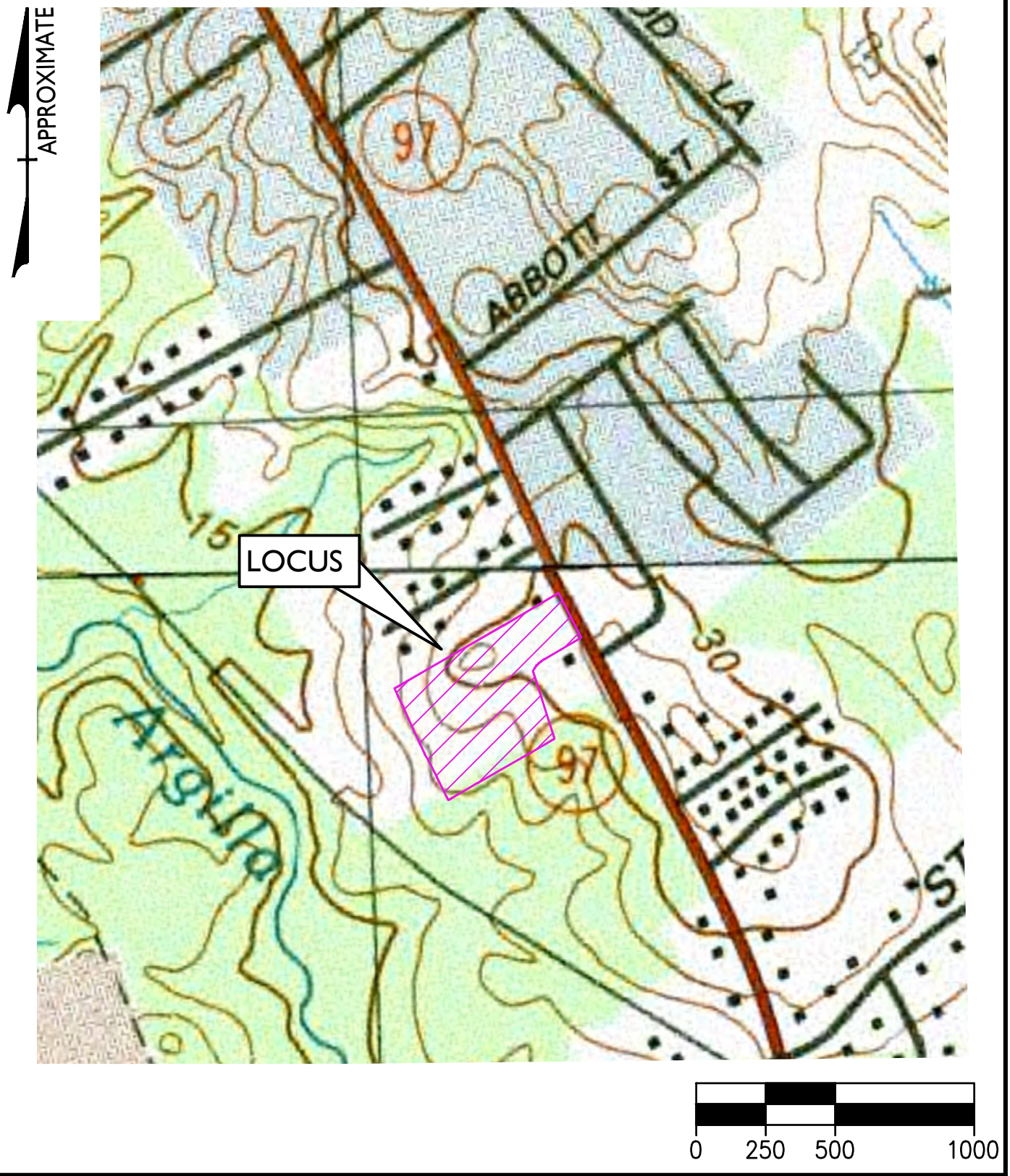
ORTHO MAP

181R SCHOOL STREET
IN
GROVELAND, MA

DATE: JULY 31, 2024

Scale: 1" = 300'

FIGURE #1



THE MORIN-CAMERON GROUP, INC.
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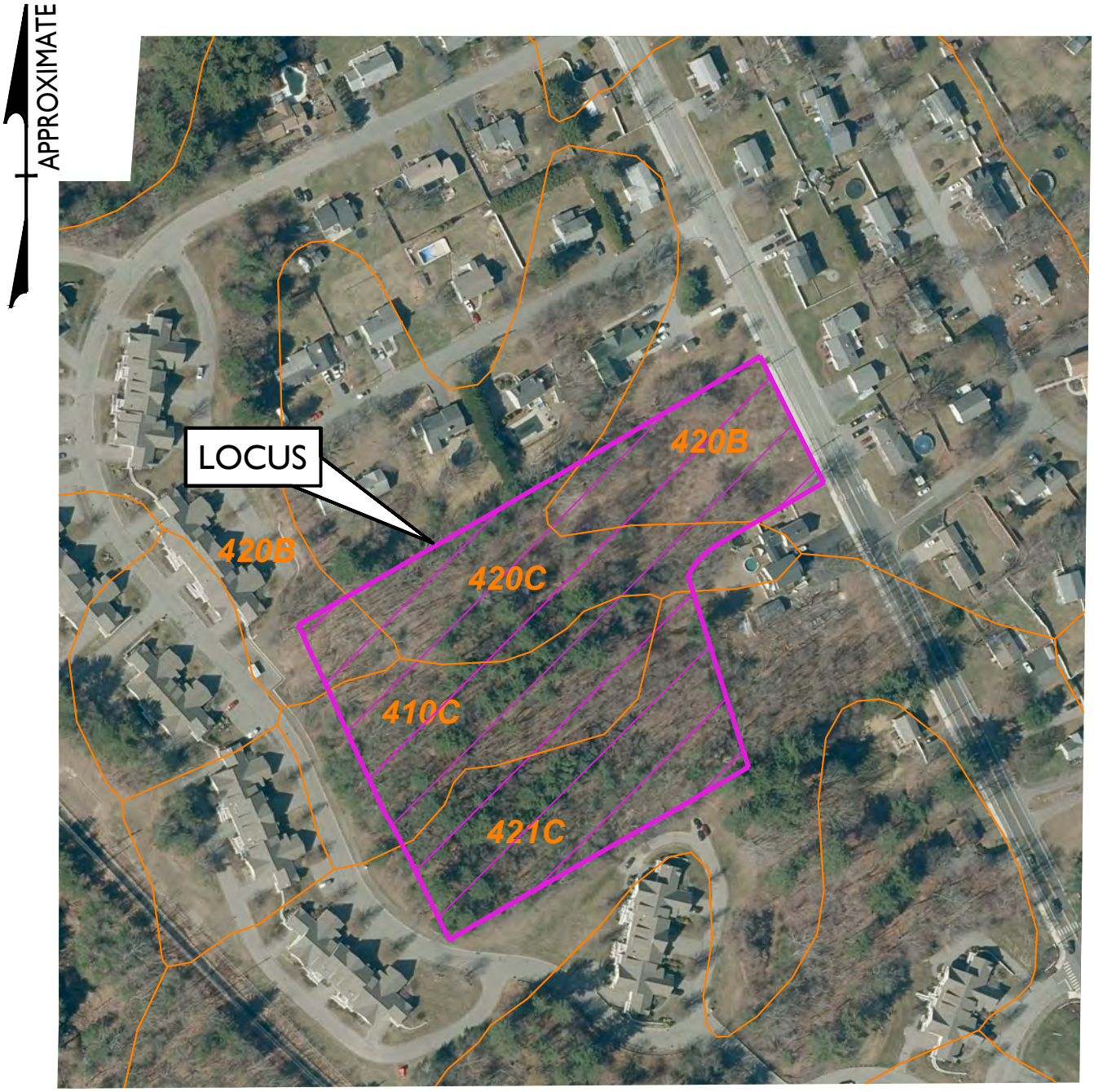
USGS MAP

181R SCHOOL STREET IN GROVELAND, MA

DATE: JULY 31, 2024

SCALE: 1" = 500'

FIGURE #2



SCS SOIL LEGEND:

410C SUTTON FINE SANDY LOAM, 8 TO 15% SLOPES
420B CANTON FINE SANDY LOAM, 3 TO 8% SLOPES
420C CANTON FINE SANDY LOAM, 8 TO 15% SLOPES
421C CANTON FINE SANDY LOAM, 8 TO 15% SLOPES

0 100 200 400

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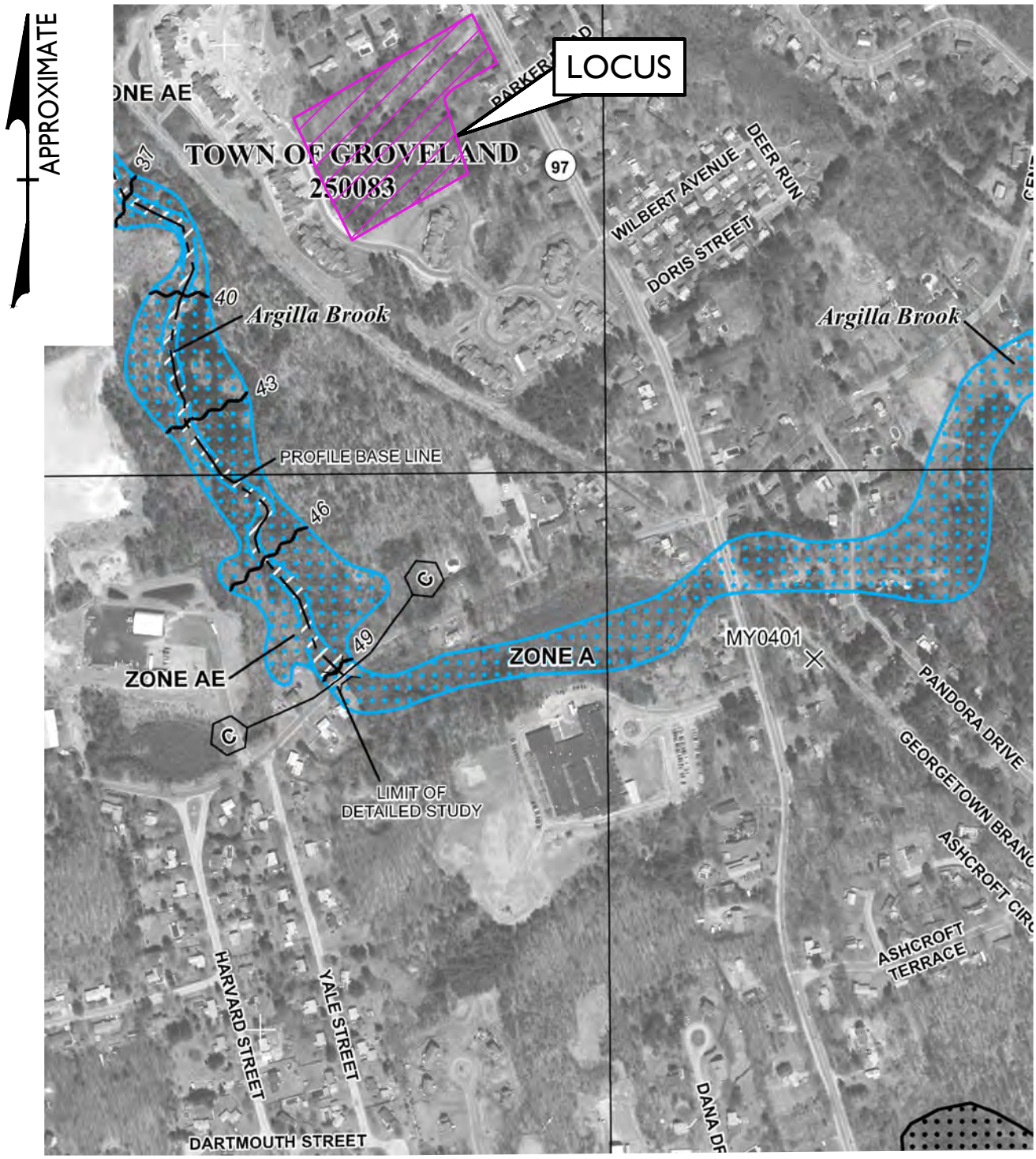
SCS SOILS MAP
181R SCHOOL STREET
GROVELAND, MA

DATE: JULY 31, 2024

SCALE: 1" =200'

FIGURE #3



FEMA MAP No: 25009C0232F
EFFECTIVE DATE JULY 3, 2012

0 250 500 1000

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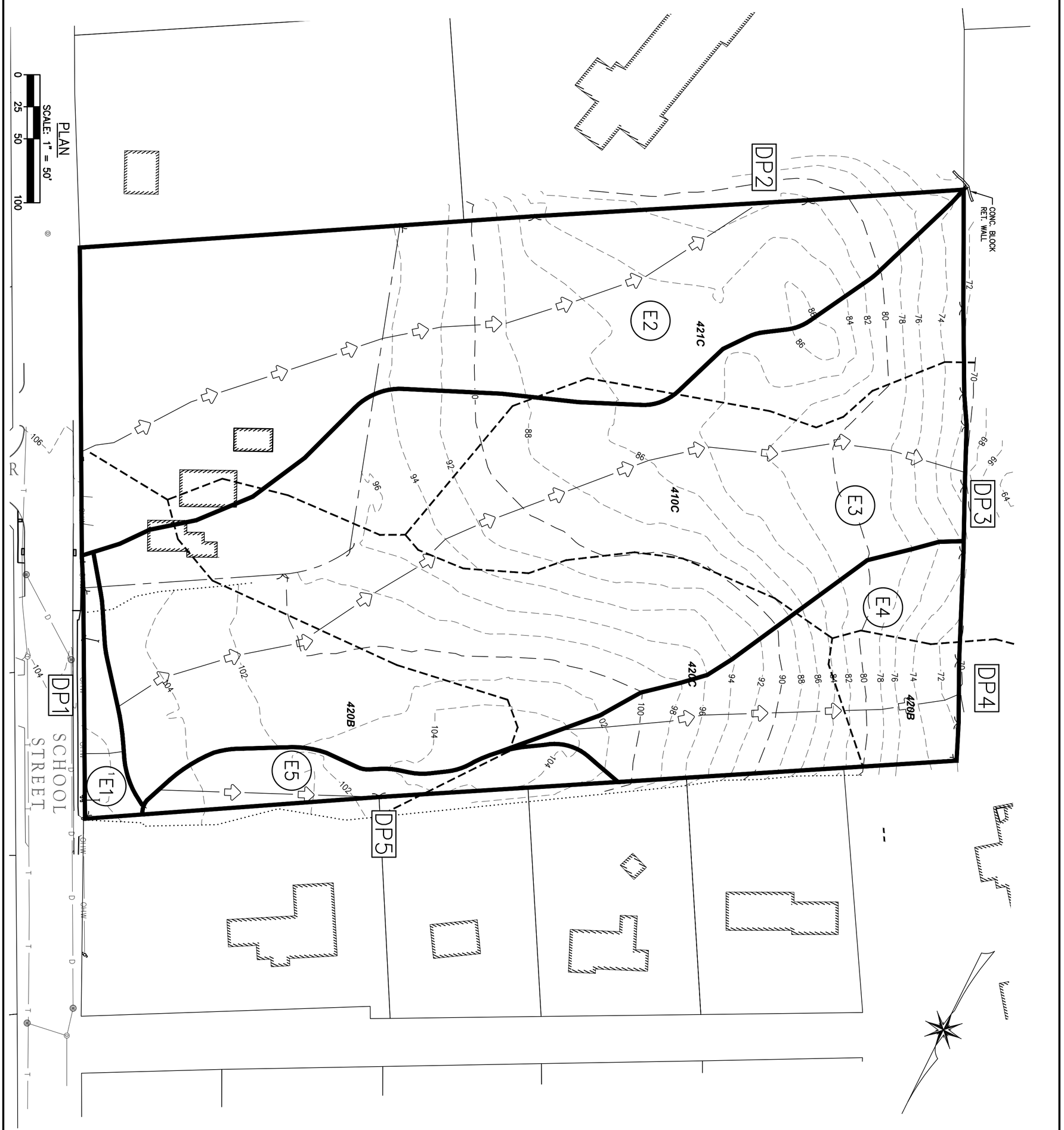
FEMA MAP

181R SCHOOL STREET IN
GROVELAND, MA

DATE: JULY 31, 2024

Scale: 1" = 500'

FIGURE #4



PROJ. NO. 3634	FIGURE 5: EXISTING WATERSHED PLAN IN GROVELAND, MASSACHUSETTS 181R SCHOOL ST	REVISIONS: NO. / DESCRIPTION / DATE
SHEET NO. 1 OF 1		FIELD SURVEY BY: MCG DRAFTED BY: LNO CHECKED BY: SPC APPROVED BY: SPC SCALE: 1"=50' DATE: JULY 31, 2024

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
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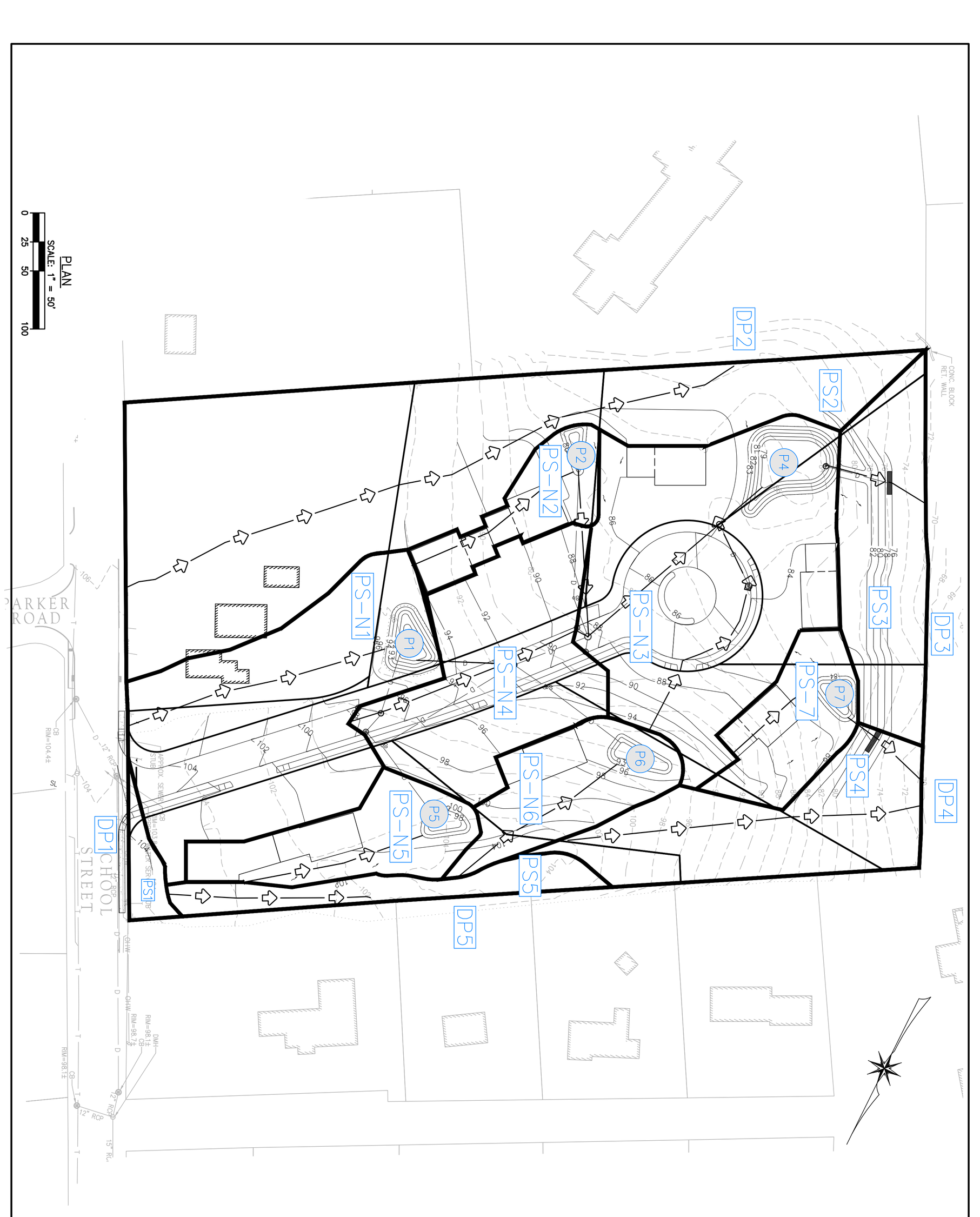
DRAWING: 3634 Watersheds.dwg

PLAN
SCALE: 1" = 50'
0 25 50 100



PROJ. NO. 3634	FIGURE 6: PROPOSED WATERSHED PLAN IN GROVELAND, MASSACHUSETTS 181R SCHOOL ST	FIELD SURVEY BY: MCG
SHEET NO. 1 OF 1		DRAFTED BY: LNO
		CHECKED BY: SPC
		APPROVED BY: SPC
		SCALE: 1"=50'
		DATE: JULY 31, 2024

REVISIONS

NO.	DESCRIPTION	DATE

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS I ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS I LAND USE PLANNERS
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DRAWING: 3634 Watersheds.dwg

APPENDIX A:

MASSDEP STORMWATER

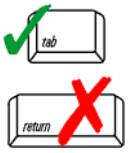
MANAGEMENT REPORT CHECKLIST

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

7/31/24

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☒ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☒ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☒ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☒ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

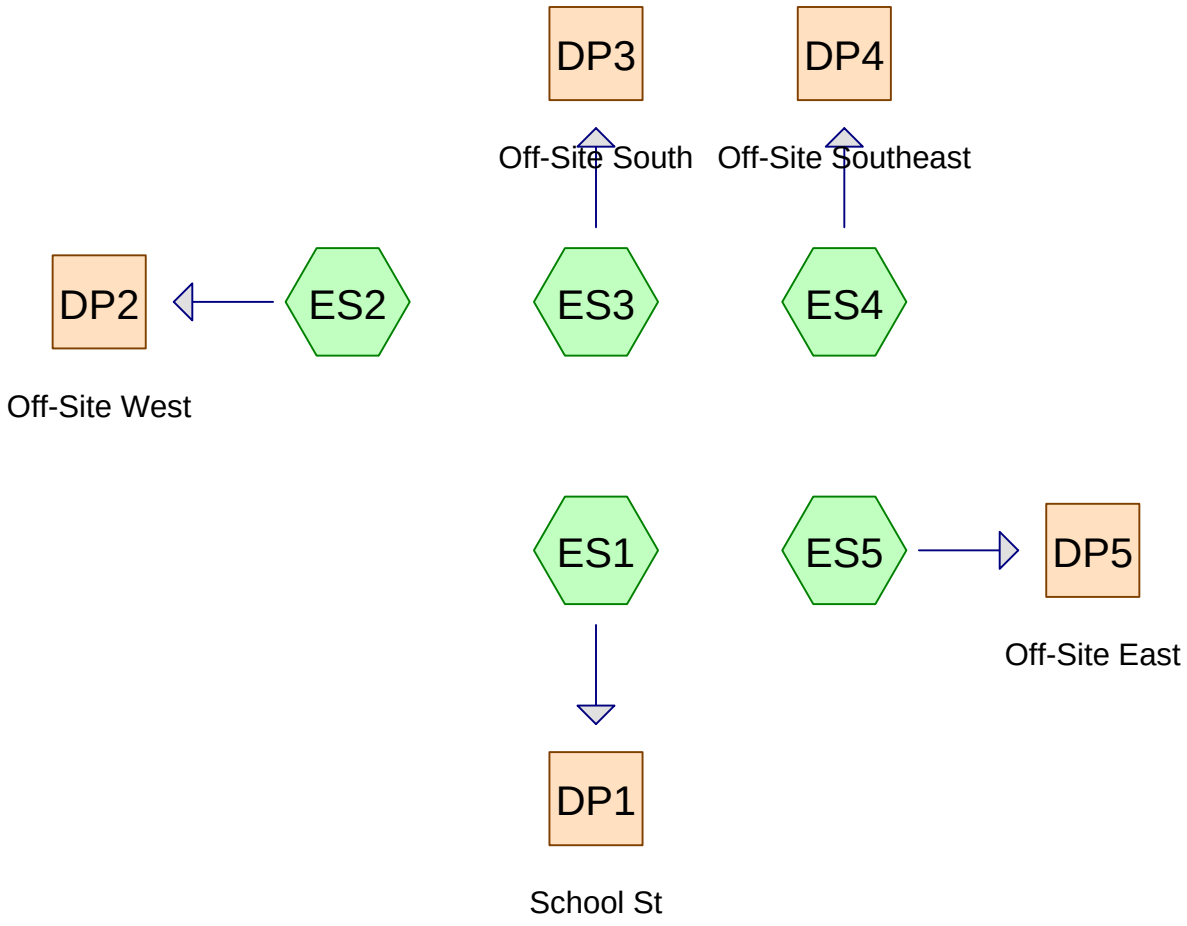
☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

APPENDIX B:

EXISTING CONDITIONS

HYDROLOGIC ANALYSIS



Subcat Reach Pond Link

Routing Diagram for 3634 Existing
Prepared by The Morin-Cameron Group, Inc, Printed 7/30/2024

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NOAA10 24-hr	D	Default	24.00	1	3.24	2
2	10-Year	NOAA10 24-hr	D	Default	24.00	1	5.12	2
3	25-Year	NOAA10 24-hr	D	Default	24.00	1	6.30	2
4	100-Year	NOAA10 24-hr	D	Default	24.00	1	8.11	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
72,530	61	>75% Grass cover, Good, HSG B (ES1, ES2, ES3, ES5)
2,961	98	Roofs, HSG B (ES2, ES3)
230,970	55	Woods, Good, HSG B (ES2, ES3, ES4, ES5)
306,461	**57**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
306,461	HSG B	ES1, ES2, ES3, ES4, ES5
0	HSG C	
0	HSG D	
0	Other	
306,461		**TOTAL AREA**

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=4,887 sf 0.00% Impervious Runoff Depth=0.46"
Flow Length=30' Slope=0.0100 '/' Tc=10.7 min CN=61 Runoff=0.0 cfs 188 cf

Subcatchment ES2: Runoff Area=96,774 sf 2.02% Impervious Runoff Depth=0.32"
Flow Length=553' Tc=6.3 min CN=57 Runoff=0.4 cfs 2,606 cf

Subcatchment ES3: Runoff Area=160,264 sf 0.63% Impervious Runoff Depth=0.32"
Flow Length=728' Tc=14.2 min CN=57 Runoff=0.4 cfs 4,316 cf

Subcatchment ES4: Runoff Area=33,665 sf 0.00% Impervious Runoff Depth=0.26"
Flow Length=315' Tc=16.4 min CN=55 Runoff=0.0 cfs 737 cf

Subcatchment ES5: Runoff Area=10,871 sf 0.00% Impervious Runoff Depth=0.32"
Flow Length=172' Tc=25.6 min CN=57 Runoff=0.0 cfs 293 cf

Reach DP1: School St Inflow=0.0 cfs 188 cf
Outflow=0.0 cfs 188 cf

Reach DP2: Off-Site West Inflow=0.4 cfs 2,606 cf
Outflow=0.4 cfs 2,606 cf

Reach DP3: Off-Site South Inflow=0.4 cfs 4,316 cf
Outflow=0.4 cfs 4,316 cf

Reach DP4: Off-Site Southeast Inflow=0.0 cfs 737 cf
Outflow=0.0 cfs 737 cf

Reach DP5: Off-Site East Inflow=0.0 cfs 293 cf
Outflow=0.0 cfs 293 cf

Total Runoff Area = 306,461 sf Runoff Volume = 8,139 cf Average Runoff Depth = 0.32"
99.03% Pervious = 303,500 sf 0.97% Impervious = 2,961 sf

Summary for Subcatchment ES1:

Runoff = 0.0 cfs @ 12.21 hrs, Volume= 188 cf, Depth= 0.46"
Routed to Reach DP1 : School St

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
4,887	61	>75% Grass cover, Good, HSG B
4,887		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	30	0.0100	0.05		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.24"

Summary for Subcatchment ES2:

Runoff = 0.4 cfs @ 12.16 hrs, Volume= 2,606 cf, Depth= 0.32"
Routed to Reach DP2 : Off-Site West

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
1,951	98	Roofs, HSG B
18,408	61	>75% Grass cover, Good, HSG B
76,415	55	Woods, Good, HSG B
96,774	57	Weighted Average
94,823		97.98% Pervious Area
1,951		2.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.0600	0.23		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.24"
0.4	100	0.0700	4.26		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.6	303	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
6.3	553	Total			

Summary for Subcatchment ES3:

Runoff = 0.4 cfs @ 12.29 hrs, Volume= 4,316 cf, Depth= 0.32"
Routed to Reach DP3 : Off-Site South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
1,010	98	Roofs, HSG B
45,860	61	>75% Grass cover, Good, HSG B
113,394	55	Woods, Good, HSG B
160,264	57	Weighted Average
159,254		99.37% Pervious Area
1,010		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.24"
1.8	359	0.0440	3.38		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.7	319	0.0390	3.18		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
14.2	728	Total			

Summary for Subcatchment ES4:

Runoff = 0.0 cfs @ 12.37 hrs, Volume= 737 cf, Depth= 0.26"
Routed to Reach DP4 : Off-Site Southeast

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
33,665	55	Woods, Good, HSG B
33,665		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	50	0.0440	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.24"
0.8	265	0.1100	5.34		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
16.4	315	Total			

Summary for Subcatchment ES5:

Runoff = 0.0 cfs @ 12.49 hrs, Volume= 293 cf, Depth= 0.32"
Routed to Reach DP5 : Off-Site East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
3,375	61	>75% Grass cover, Good, HSG B
7,496	55	Woods, Good, HSG B
10,871	57	Weighted Average
10,871		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.6	50	0.0140	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.24"
1.0	122	0.0155	2.00		**Shallow Concentrated Flow, Shallow** Unpaved Kv= 16.1 fps
25.6	172	Total			

Summary for Reach DP1: School St

Inflow Area = 4,887 sf, 0.00% Impervious, Inflow Depth = 0.46" for 2-Year event
Inflow = 0.0 cfs @ 12.21 hrs, Volume= 188 cf
Outflow = 0.0 cfs @ 12.21 hrs, Volume= 188 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: Off-Site West

Inflow Area = 96,774 sf, 2.02% Impervious, Inflow Depth = 0.32" for 2-Year event
Inflow = 0.4 cfs @ 12.16 hrs, Volume= 2,606 cf
Outflow = 0.4 cfs @ 12.16 hrs, Volume= 2,606 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: Off-Site South

Inflow Area = 160,264 sf, 0.63% Impervious, Inflow Depth = 0.32" for 2-Year event
Inflow = 0.4 cfs @ 12.29 hrs, Volume= 4,316 cf
Outflow = 0.4 cfs @ 12.29 hrs, Volume= 4,316 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 DP4: Off-Site Southeast

Inflow Area = 33,665 sf, 0.00% Impervious, Inflow Depth = 0.26" for 2-Year event
Inflow = 0.0 cfs @ 12.37 hrs, Volume= 737 cf
Outflow = 0.0 cfs @ 12.37 hrs, Volume= 737 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 DP5: Off-Site East

Inflow Area = 10,871 sf, 0.00% Impervious, Inflow Depth = 0.32" for 2-Year event
Inflow = 0.0 cfs @ 12.49 hrs, Volume= 293 cf
Outflow = 0.0 cfs @ 12.49 hrs, Volume= 293 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=4,887 sf 0.00% Impervious Runoff Depth=1.44"
Flow Length=30' Slope=0.0100 '/' Tc=10.7 min CN=61 Runoff=0.2 cfs 587 cf

Subcatchment ES2: Runoff Area=96,774 sf 2.02% Impervious Runoff Depth=1.17"
Flow Length=553' Tc=6.3 min CN=57 Runoff=2.9 cfs 9,428 cf

Subcatchment ES3: Runoff Area=160,264 sf 0.63% Impervious Runoff Depth=1.17"
Flow Length=728' Tc=14.2 min CN=57 Runoff=3.3 cfs 15,613 cf

Subcatchment ES4: Runoff Area=33,665 sf 0.00% Impervious Runoff Depth=1.04"
Flow Length=315' Tc=16.4 min CN=55 Runoff=0.5 cfs 2,919 cf

Subcatchment ES5: Runoff Area=10,871 sf 0.00% Impervious Runoff Depth=1.17"
Flow Length=172' Tc=25.6 min CN=57 Runoff=0.2 cfs 1,059 cf

Reach DP1: School St Inflow=0.2 cfs 587 cf
Outflow=0.2 cfs 587 cf

Reach DP2: Off-Site West Inflow=2.9 cfs 9,428 cf
Outflow=2.9 cfs 9,428 cf

Reach DP3: Off-Site South Inflow=3.3 cfs 15,613 cf
Outflow=3.3 cfs 15,613 cf

Reach DP4: Off-Site Southeast Inflow=0.5 cfs 2,919 cf
Outflow=0.5 cfs 2,919 cf

Reach DP5: Off-Site East Inflow=0.2 cfs 1,059 cf
Outflow=0.2 cfs 1,059 cf

Total Runoff Area = 306,461 sf Runoff Volume = 29,606 cf Average Runoff Depth = 1.16"
99.03% Pervious = 303,500 sf 0.97% Impervious = 2,961 sf

Summary for Subcatchment ES1:

Runoff = 0.2 cfs @ 12.19 hrs, Volume= 587 cf, Depth= 1.44"
Routed to Reach DP1 : School St

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
4,887	61	>75% Grass cover, Good, HSG B
4,887		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	30	0.0100	0.05		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.24"

Summary for Subcatchment ES2:

Runoff = 2.9 cfs @ 12.14 hrs, Volume= 9,428 cf, Depth= 1.17"
Routed to Reach DP2 : Off-Site West

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
1,951	98	Roofs, HSG B
18,408	61	>75% Grass cover, Good, HSG B
76,415	55	Woods, Good, HSG B
96,774	57	Weighted Average
94,823		97.98% Pervious Area
1,951		2.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.0600	0.23		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.24"
0.4	100	0.0700	4.26		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.6	303	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
6.3	553	Total			

Summary for Subcatchment ES3:

Runoff = 3.3 cfs @ 12.23 hrs, Volume= 15,613 cf, Depth= 1.17"
Routed to Reach DP3 : Off-Site South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
1,010	98	Roofs, HSG B
45,860	61	>75% Grass cover, Good, HSG B
113,394	55	Woods, Good, HSG B
160,264	57	Weighted Average
159,254		99.37% Pervious Area
1,010		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.24"
1.8	359	0.0440	3.38		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.7	319	0.0390	3.18		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
14.2	728	Total			

Summary for Subcatchment ES4:

Runoff = 0.5 cfs @ 12.27 hrs, Volume= 2,919 cf, Depth= 1.04"
Routed to Reach DP4 : Off-Site Southeast

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
33,665	55	Woods, Good, HSG B
33,665		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	50	0.0440	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.24"
0.8	265	0.1100	5.34		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
16.4	315	Total			

Summary for Subcatchment ES5:

Runoff = 0.2 cfs @ 12.38 hrs, Volume= 1,059 cf, Depth= 1.17"
Routed to Reach DP5 : Off-Site East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
3,375	61	>75% Grass cover, Good, HSG B
7,496	55	Woods, Good, HSG B
10,871	57	Weighted Average
10,871		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.6	50	0.0140	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.24"
1.0	122	0.0155	2.00		**Shallow Concentrated Flow, Shallow** Unpaved Kv= 16.1 fps
25.6	172	Total			

Summary for Reach DP1: School St

Inflow Area = 4,887 sf, 0.00% Impervious, Inflow Depth = 1.44" for 10-Year event
Inflow = 0.2 cfs @ 12.19 hrs, Volume= 587 cf
Outflow = 0.2 cfs @ 12.19 hrs, Volume= 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

Summary for Reach DP2: Off-Site West

Inflow Area = 96,774 sf, 2.02% Impervious, Inflow Depth = 1.17" for 10-Year event
Inflow = 2.9 cfs @ 12.14 hrs, Volume= 9,428 cf
Outflow = 2.9 cfs @ 12.14 hrs, Volume= 9,428 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: Off-Site South

Inflow Area = 160,264 sf, 0.63% Impervious, Inflow Depth = 1.17" for 10-Year event
Inflow = 3.3 cfs @ 12.23 hrs, Volume= 15,613 cf
Outflow = 3.3 cfs @ 12.23 hrs, Volume= 15,613 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 DP4: Off-Site Southeast

Inflow Area = 33,665 sf, 0.00% Impervious, Inflow Depth = 1.04" for 10-Year event
Inflow = 0.5 cfs @ 12.27 hrs, Volume= 2,919 cf
Outflow = 0.5 cfs @ 12.27 hrs, Volume= 2,919 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 DP5: Off-Site East

Inflow Area = 10,871 sf, 0.00% Impervious, Inflow Depth = 1.17" for 10-Year event
Inflow = 0.2 cfs @ 12.38 hrs, Volume= 1,059 cf
Outflow = 0.2 cfs @ 12.38 hrs, Volume= 1,059 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=4,887 sf 0.00% Impervious Runoff Depth=2.21"
Flow Length=30' Slope=0.0100 '/' Tc=10.7 min CN=61 Runoff=0.2 cfs 900 cf

Subcatchment ES2: Runoff Area=96,774 sf 2.02% Impervious Runoff Depth=1.86"
Flow Length=553' Tc=6.3 min CN=57 Runoff=4.9 cfs 15,008 cf

Subcatchment ES3: Runoff Area=160,264 sf 0.63% Impervious Runoff Depth=1.86"
Flow Length=728' Tc=14.2 min CN=57 Runoff=5.7 cfs 24,855 cf

Subcatchment ES4: Runoff Area=33,665 sf 0.00% Impervious Runoff Depth=1.69"
Flow Length=315' Tc=16.4 min CN=55 Runoff=1.0 cfs 4,750 cf

Subcatchment ES5: Runoff Area=10,871 sf 0.00% Impervious Runoff Depth=1.86"
Flow Length=172' Tc=25.6 min CN=57 Runoff=0.3 cfs 1,686 cf

Reach DP1: School St Inflow=0.2 cfs 900 cf
Outflow=0.2 cfs 900 cf

Reach DP2: Off-Site West Inflow=4.9 cfs 15,008 cf
Outflow=4.9 cfs 15,008 cf

Reach DP3: Off-Site South Inflow=5.7 cfs 24,855 cf
Outflow=5.7 cfs 24,855 cf

Reach DP4: Off-Site Southeast Inflow=1.0 cfs 4,750 cf
Outflow=1.0 cfs 4,750 cf

Reach DP5: Off-Site East Inflow=0.3 cfs 1,686 cf
Outflow=0.3 cfs 1,686 cf

Total Runoff Area = 306,461 sf Runoff Volume = 47,198 cf Average Runoff Depth = 1.85"
99.03% Pervious = 303,500 sf 0.97% Impervious = 2,961 sf

Summary for Subcatchment ES1:

Runoff = 0.2 cfs @ 12.19 hrs, Volume= 900 cf, Depth= 2.21"
Routed to Reach DP1 : School St

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
4,887	61	>75% Grass cover, Good, HSG B
4,887		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	30	0.0100	0.05		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.24"

Summary for Subcatchment ES2:

Runoff = 4.9 cfs @ 12.14 hrs, Volume= 15,008 cf, Depth= 1.86"
Routed to Reach DP2 : Off-Site West

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
1,951	98	Roofs, HSG B
18,408	61	>75% Grass cover, Good, HSG B
76,415	55	Woods, Good, HSG B
96,774	57	Weighted Average
94,823		97.98% Pervious Area
1,951		2.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.0600	0.23		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.24"
0.4	100	0.0700	4.26		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.6	303	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
6.3	553	Total			

Summary for Subcatchment ES3:

Runoff = 5.7 cfs @ 12.23 hrs, Volume= 24,855 cf, Depth= 1.86"
Routed to Reach DP3 : Off-Site South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
1,010	98	Roofs, HSG B
45,860	61	>75% Grass cover, Good, HSG B
113,394	55	Woods, Good, HSG B
160,264	57	Weighted Average
159,254		99.37% Pervious Area
1,010		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.24"
1.8	359	0.0440	3.38		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.7	319	0.0390	3.18		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
14.2	728	Total			

Summary for Subcatchment ES4:

Runoff = 1.0 cfs @ 12.26 hrs, Volume= 4,750 cf, Depth= 1.69"
Routed to Reach DP4 : Off-Site Southeast

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
33,665	55	Woods, Good, HSG B
33,665		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	50	0.0440	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.24"
0.8	265	0.1100	5.34		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
16.4	315	Total			

Summary for Subcatchment ES5:

Runoff = 0.3 cfs @ 12.37 hrs, Volume= 1,686 cf, Depth= 1.86"
Routed to Reach DP5 : Off-Site East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
3,375	61	>75% Grass cover, Good, HSG B
7,496	55	Woods, Good, HSG B
10,871	57	Weighted Average
10,871		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.6	50	0.0140	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.24"
1.0	122	0.0155	2.00		**Shallow Concentrated Flow, Shallow** Unpaved Kv= 16.1 fps
25.6	172	Total			

Summary for Reach DP1: School St

Inflow Area = 4,887 sf, 0.00% Impervious, Inflow Depth = 2.21" for 25-Year event
Inflow = 0.2 cfs @ 12.19 hrs, Volume= 900 cf
Outflow = 0.2 cfs @ 12.19 hrs, Volume= 900 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: Off-Site West

Inflow Area = 96,774 sf, 2.02% Impervious, Inflow Depth = 1.86" for 25-Year event
Inflow = 4.9 cfs @ 12.14 hrs, Volume= 15,008 cf
Outflow = 4.9 cfs @ 12.14 hrs, Volume= 15,008 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: Off-Site South

Inflow Area = 160,264 sf, 0.63% Impervious, Inflow Depth = 1.86" for 25-Year event
Inflow = 5.7 cfs @ 12.23 hrs, Volume= 24,855 cf
Outflow = 5.7 cfs @ 12.23 hrs, Volume= 24,855 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 DP4: Off-Site Southeast

Inflow Area = 33,665 sf, 0.00% Impervious, Inflow Depth = 1.69" for 25-Year event
Inflow = 1.0 cfs @ 12.26 hrs, Volume= 4,750 cf
Outflow = 1.0 cfs @ 12.26 hrs, Volume= 4,750 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 DP5: Off-Site East

Inflow Area = 10,871 sf, 0.00% Impervious, Inflow Depth = 1.86" for 25-Year event
Inflow = 0.3 cfs @ 12.37 hrs, Volume= 1,686 cf
Outflow = 0.3 cfs @ 12.37 hrs, Volume= 1,686 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=4,887 sf 0.00% Impervious Runoff Depth=3.53"
Flow Length=30' Slope=0.0100 '/' Tc=10.7 min CN=61 Runoff=0.4 cfs 1,437 cf

Subcatchment ES2: Runoff Area=96,774 sf 2.02% Impervious Runoff Depth=3.08"
Flow Length=553' Tc=6.3 min CN=57 Runoff=8.4 cfs 24,844 cf

Subcatchment ES3: Runoff Area=160,264 sf 0.63% Impervious Runoff Depth=3.08"
Flow Length=728' Tc=14.2 min CN=57 Runoff=9.9 cfs 41,143 cf

Subcatchment ES4: Runoff Area=33,665 sf 0.00% Impervious Runoff Depth=2.86"
Flow Length=315' Tc=16.4 min CN=55 Runoff=1.8 cfs 8,022 cf

Subcatchment ES5: Runoff Area=10,871 sf 0.00% Impervious Runoff Depth=3.08"
Flow Length=172' Tc=25.6 min CN=57 Runoff=0.5 cfs 2,791 cf

Reach DP1: School St Inflow=0.4 cfs 1,437 cf
Outflow=0.4 cfs 1,437 cf

Reach DP2: Off-Site West Inflow=8.4 cfs 24,844 cf
Outflow=8.4 cfs 24,844 cf

Reach DP3: Off-Site South Inflow=9.9 cfs 41,143 cf
Outflow=9.9 cfs 41,143 cf

Reach DP4: Off-Site Southeast Inflow=1.8 cfs 8,022 cf
Outflow=1.8 cfs 8,022 cf

Reach DP5: Off-Site East Inflow=0.5 cfs 2,791 cf
Outflow=0.5 cfs 2,791 cf

Total Runoff Area = 306,461 sf Runoff Volume = 78,237 cf Average Runoff Depth = 3.06"
99.03% Pervious = 303,500 sf 0.97% Impervious = 2,961 sf

Summary for Subcatchment ES1:

Runoff = 0.4 cfs @ 12.18 hrs, Volume= 1,437 cf, Depth= 3.53"
Routed to Reach DP1 : School St

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
4,887	61	>75% Grass cover, Good, HSG B
4,887		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	30	0.0100	0.05		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.24"

Summary for Subcatchment ES2:

Runoff = 8.4 cfs @ 12.14 hrs, Volume= 24,844 cf, Depth= 3.08"
Routed to Reach DP2 : Off-Site West

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
1,951	98	Roofs, HSG B
18,408	61	>75% Grass cover, Good, HSG B
76,415	55	Woods, Good, HSG B
96,774	57	Weighted Average
94,823		97.98% Pervious Area
1,951		2.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.0600	0.23		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.24"
0.4	100	0.0700	4.26		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.6	303	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
6.3	553	Total			

Summary for Subcatchment ES3:

Runoff = 9.9 cfs @ 12.23 hrs, Volume= 41,143 cf, Depth= 3.08"
Routed to Reach DP3 : Off-Site South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
1,010	98	Roofs, HSG B
45,860	61	>75% Grass cover, Good, HSG B
113,394	55	Woods, Good, HSG B
160,264	57	Weighted Average
159,254		99.37% Pervious Area
1,010		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.24"
1.8	359	0.0440	3.38		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.7	319	0.0390	3.18		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
14.2	728	Total			

Summary for Subcatchment ES4:

Runoff = 1.8 cfs @ 12.26 hrs, Volume= 8,022 cf, Depth= 2.86"
Routed to Reach DP4 : Off-Site Southeast

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
33,665	55	Woods, Good, HSG B
33,665		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.6	50	0.0440	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.24"
0.8	265	0.1100	5.34		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
16.4	315	Total			

Summary for Subcatchment ES5:

Runoff = 0.5 cfs @ 12.37 hrs, Volume= 2,791 cf, Depth= 3.08"
Routed to Reach DP5 : Off-Site East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
3,375	61	>75% Grass cover, Good, HSG B
7,496	55	Woods, Good, HSG B
10,871	57	Weighted Average
10,871		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.6	50	0.0140	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.24"
1.0	122	0.0155	2.00		**Shallow Concentrated Flow, Shallow** Unpaved Kv= 16.1 fps
25.6	172	Total			

Summary for Reach DP1: School St

Inflow Area = 4,887 sf, 0.00% Impervious, Inflow Depth = 3.53" for 100-Year event
Inflow = 0.4 cfs @ 12.18 hrs, Volume= 1,437 cf
Outflow = 0.4 cfs @ 12.18 hrs, Volume= 1,437 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: Off-Site West

Inflow Area = 96,774 sf, 2.02% Impervious, Inflow Depth = 3.08" for 100-Year event
Inflow = 8.4 cfs @ 12.14 hrs, Volume= 24,844 cf
Outflow = 8.4 cfs @ 12.14 hrs, Volume= 24,844 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Reach DP3: Off-Site South

Inflow Area = 160,264 sf, 0.63% Impervious, Inflow Depth = 3.08" for 100-Year event
Inflow = 9.9 cfs @ 12.23 hrs, Volume= 41,143 cf
Outflow = 9.9 cfs @ 12.23 hrs, Volume= 41,143 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 DP4: Off-Site Southeast

Inflow Area = 33,665 sf, 0.00% Impervious, Inflow Depth = 2.86" for 100-Year event
Inflow = 1.8 cfs @ 12.26 hrs, Volume= 8,022 cf
Outflow = 1.8 cfs @ 12.26 hrs, Volume= 8,022 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 DP5: Off-Site East

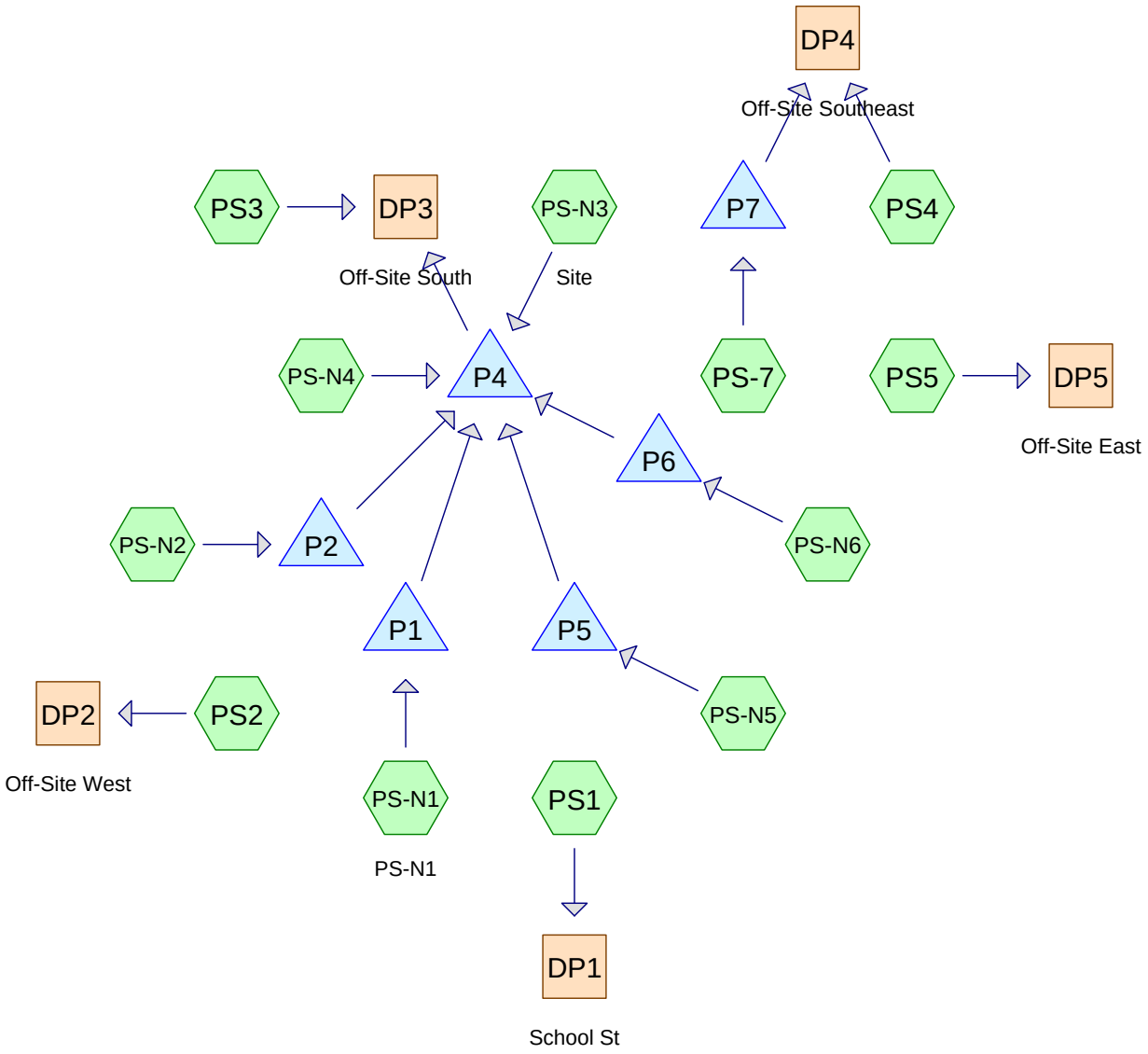
Inflow Area = 10,871 sf, 0.00% Impervious, Inflow Depth = 3.08" for 100-Year event
Inflow = 0.5 cfs @ 12.37 hrs, Volume= 2,791 cf
Outflow = 0.5 cfs @ 12.37 hrs, Volume= 2,791 cf, Atten= 0%, Lag= 0.0 min

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

APPENDIX C:

PROPOSED CONDITIONS

HYDROLOGIC ANALYSIS



Subcat Reach Pond Link

Routing Diagram for 3634 Proposed

Prepared by The Morin-Cameron Group, Inc, Printed 7/31/2024

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NOAA10 24-hr	D	Default	24.00	1	3.24	2
2	10-Year	NOAA10 24-hr	D	Default	24.00	1	5.12	2
3	25-Year	NOAA10 24-hr	D	Default	24.00	1	6.30	2
4	100-Year	NOAA10 24-hr	D	Default	24.00	1	8.11	2

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
168,765	61	>75% Grass cover, Good, HSG B (PS-7, PS-N1, PS-N2, PS-N3, PS-N4, PS-N5, PS-N6, PS1, PS2, PS3, PS4, PS5)
33,347	98	Paved parking, HSG B (PS-N1, PS-N3, PS-N4, PS1)
23,131	98	Roofs, HSG B (PS-7, PS-N1, PS-N2, PS-N3, PS-N5, PS-N6, PS2)
81,218	55	Woods, Good, HSG B (PS2, PS3, PS4, PS5)
306,461	**66**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
306,461	HSG B	PS-7, PS-N1, PS-N2, PS-N3, PS-N4, PS-N5, PS-N6, PS1, PS2, PS3, PS4, PS5
0	HSG C	
0	HSG D	
0	Other	
306,461		**TOTAL AREA**

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 PS-7: Runoff Area=11,874 sf 20.60% Impervious Runoff Depth=0.80"
Flow Length=95' Slope=0.0200 '/' Tc=10.0 min CN=69 Runoff=0.2 cfs 794 cf

Subcatchment PS-N1: PS-N1 Runoff Area=42,026 sf 21.66% Impervious Runoff Depth=0.80"
Flow Length=204' Tc=10.0 min CN=69 Runoff=0.7 cfs 2,809 cf

Subcatchment PS-N2: Runoff Area=9,120 sf 57.13% Impervious Runoff Depth=1.57"
Tc=10.0 min CN=82 Runoff=0.3 cfs 1,193 cf

Subcatchment PS-N3: Site Runoff Area=51,063 sf 37.90% Impervious Runoff Depth=1.12"
Tc=0.0 min CN=75 Runoff=2.1 cfs 4,771 cf

Subcatchment PS-N4: Runoff Area=28,998 sf 35.50% Impervious Runoff Depth=1.06"
Tc=10.0 min CN=74 Runoff=0.7 cfs 2,571 cf

Subcatchment PS-N5: Runoff Area=13,982 sf 36.60% Impervious Runoff Depth=1.12"
Tc=6.0 min CN=75 Runoff=0.4 cfs 1,306 cf

Subcatchment PS-N6: Runoff Area=14,114 sf 18.29% Impervious Runoff Depth=0.75"
Tc=0.0 min CN=68 Runoff=0.4 cfs 887 cf

Subcatchment PS1: Runoff Area=2,750 sf 15.45% Impervious Runoff Depth=0.71"
Tc=10.0 min CN=67 Runoff=0.0 cfs 162 cf

Subcatchment PS2: Runoff Area=78,530 sf 2.48% Impervious Runoff Depth=0.36"
Flow Length=553' Tc=6.4 min CN=58 Runoff=0.4 cfs 2,326 cf

Subcatchment PS3: Runoff Area=21,059 sf 0.00% Impervious Runoff Depth=0.36"
Flow Length=728' Tc=14.5 min CN=58 Runoff=0.1 cfs 624 cf

Subcatchment PS4: Runoff Area=24,109 sf 0.00% Impervious Runoff Depth=0.29"
Flow Length=315' Tc=16.7 min CN=56 Runoff=0.0 cfs 587 cf

Subcatchment PS5: Runoff Area=8,836 sf 0.00% Impervious Runoff Depth=0.32"
Flow Length=172' Tc=26.2 min CN=57 Runoff=0.0 cfs 238 cf

Reach DP1: School St Inflow=0.0 cfs 162 cf
Outflow=0.0 cfs 162 cf

Reach DP2: Off-Site West Inflow=0.4 cfs 2,326 cf
Outflow=0.4 cfs 2,326 cf

Reach DP3: Off-Site South Inflow=0.4 cfs 1,425 cf
Outflow=0.4 cfs 1,425 cf

Reach DP4: Off-Site Southeast Inflow=0.0 cfs 587 cf
Outflow=0.0 cfs 587 cf

Reach DP5: Off-Site East Inflow=0.0 cfs 238 cf
Outflow=0.0 cfs 238 cf

Pond P1: Peak Elev=90.92' Storage=469 cf Inflow=0.7 cfs 2,809 cf
Discarded=0.2 cfs 2,809 cf Primary=0.0 cfs 0 cf Outflow=0.2 cfs 2,809 cf

Pond P2: Peak Elev=85.22' Storage=319 cf Inflow=0.3 cfs 1,193 cf
Discarded=0.0 cfs 1,052 cf Primary=0.1 cfs 141 cf Outflow=0.1 cfs 1,193 cf

Pond P4: Peak Elev=79.55' Storage=1,092 cf Inflow=2.5 cfs 7,618 cf
Discarded=0.5 cfs 6,817 cf Primary=0.4 cfs 802 cf Outflow=0.8 cfs 7,618 cf

Pond P5: Peak Elev=98.84' Storage=399 cf Inflow=0.4 cfs 1,306 cf
Discarded=0.0 cfs 1,306 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 1,306 cf

Pond P6: Peak Elev=92.39' Storage=148 cf Inflow=0.4 cfs 887 cf
Discarded=0.0 cfs 752 cf Primary=0.1 cfs 136 cf Outflow=0.1 cfs 887 cf

Pond P7: Peak Elev=81.76' Storage=211 cf Inflow=0.2 cfs 794 cf
Discarded=0.0 cfs 794 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 794 cf

Total Runoff Area = 306,461 sf Runoff Volume = 18,269 cf Average Runoff Depth = 0.72"
81.57% Pervious = 249,983 sf 18.43% Impervious = 56,478 sf

Summary for Subcatchment PS-7:

Runoff = 0.2 cfs @ 12.18 hrs, Volume= 794 cf, Depth= 0.80"
Routed to Pond P7 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
2,446	98	Roofs, HSG B
9,428	61	>75% Grass cover, Good, HSG B
11,874	69	Weighted Average
9,428		79.40% Pervious Area
2,446		20.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.18		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.10"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow, Roof Drain Pipe** Paved Kv= 20.3 fps
9.0					**Direct Entry, Adjustment for 0.16 hr**
10.0	95	Total			

Summary for Subcatchment PS-N1: PS-N1

Runoff = 0.7 cfs @ 12.18 hrs, Volume= 2,809 cf, Depth= 0.80"
Routed to Pond P1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

	Area (sf)	CN	Description
	8,115	98	Paved parking, HSG B
	32,925	61	>75% Grass cover, Good, HSG B
*	986	98	Roofs, HSG B
	42,026	69	Weighted Average
	32,925		78.34% Pervious Area
	9,101		21.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3					**Direct Entry, Adjusted 0.1 hr**
1.1	50	0.0060	0.73		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.10"
0.6	154	0.0380	3.96		**Shallow Concentrated Flow, Shallow** Paved Kv= 20.3 fps
10.0	204	Total			

Summary for Subcatchment PS-N2:

Runoff = 0.3 cfs @ 12.18 hrs, Volume= 1,193 cf, Depth= 1.57"
Routed to Pond P2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
5,210	98	Roofs, HSG B
3,910	61	>75% Grass cover, Good, HSG B
9,120	82	Weighted Average
3,910		42.87% Pervious Area
5,210		57.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment for 0.1 hr**

Summary for Subcatchment PS-N3: Site

Runoff = 2.1 cfs @ 12.09 hrs, Volume= 4,771 cf, Depth= 1.12"
Routed to Pond P4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
31,712	61	>75% Grass cover, Good, HSG B
14,512	98	Paved parking, HSG B
4,839	98	Roofs, HSG B
51,063	75	Weighted Average
31,712		62.10% Pervious Area
19,351		37.90% Impervious Area

Summary for Subcatchment PS-N4:

Runoff = 0.7 cfs @ 12.18 hrs, Volume= 2,571 cf, Depth= 1.06"
Routed to Pond P4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
18,703	61	>75% Grass cover, Good, HSG B
10,295	98	Paved parking, HSG B
28,998	74	Weighted Average
18,703		64.50% Pervious Area
10,295		35.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment for 0.16 hrs**

Summary for Subcatchment PS-N5:

Runoff = 0.4 cfs @ 12.14 hrs, Volume= 1,306 cf, Depth= 1.12"
Routed to Pond P5 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
5,117	98	Roofs, HSG B
8,865	61	>75% Grass cover, Good, HSG B
13,982	75	Weighted Average
8,865		63.40% Pervious Area
5,117		36.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Adjustment to 0.1 hr**

Summary for Subcatchment PS-N6:

Runoff = 0.4 cfs @ 12.09 hrs, Volume= 887 cf, Depth= 0.75"
Routed to Pond P6 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
2,582	98	Roofs, HSG B
11,532	61	>75% Grass cover, Good, HSG B
14,114	68	Weighted Average
11,532		81.71% Pervious Area
2,582		18.29% Impervious Area

Summary for Subcatchment PS1:

Runoff = 0.0 cfs @ 12.19 hrs, Volume= 162 cf, Depth= 0.71"
Routed to Reach DP1 : School St

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
2,325	61	>75% Grass cover, Good, HSG B
425	98	Paved parking, HSG B
2,750	67	Weighted Average
2,325		84.55% Pervious Area
425		15.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment to 0.16 hr**

Summary for Subcatchment PS2:

Runoff = 0.4 cfs @ 12.16 hrs, Volume= 2,326 cf, Depth= 0.36"
Routed to Reach DP2 : Off-Site West

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
1,951	98	Roofs, HSG B
31,697	61	>75% Grass cover, Good, HSG B
44,882	55	Woods, Good, HSG B
78,530	58	Weighted Average
76,579		97.52% Pervious Area
1,951		2.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"
0.4	100	0.0700	4.26		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.6	303	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
6.4	553	Total			

Summary for Subcatchment PS3:

Runoff = 0.1 cfs @ 12.29 hrs, Volume= 624 cf, Depth= 0.36"
Routed to Reach DP3 : Off-Site South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
11,614	61	>75% Grass cover, Good, HSG B
9,445	55	Woods, Good, HSG B
21,059	58	Weighted Average
21,059		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.10"
1.8	359	0.0440	3.38		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.7	319	0.0390	3.18		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
14.5	728	Total			

Summary for Subcatchment PS4:

Runoff = 0.0 cfs @ 12.34 hrs, Volume= 587 cf, Depth= 0.29"
Routed to Reach DP4 : Off-Site Southeast

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

	Area (sf)	CN	Description
	20,799	55	Woods, Good, HSG B
*	3,310	61	>75% Grass cover, Good, HSG B
	24,109	56	Weighted Average
	24,109		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	50	0.0440	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.10"
0.8	265	0.1100	5.34		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
16.7	315	Total			

Summary for Subcatchment PS5:

Runoff = 0.0 cfs @ 12.49 hrs, Volume= 238 cf, Depth= 0.32"
Routed to Reach DP5 : Off-Site East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-Year Rainfall=3.24"

Area (sf)	CN	Description
2,744	61	>75% Grass cover, Good, HSG B
6,092	55	Woods, Good, HSG B
8,836	57	Weighted Average
8,836		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.2	50	0.0140	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.10"
1.0	122	0.0150	1.97		**Shallow Concentrated Flow, Shallow** Unpaved Kv= 16.1 fps
26.2	172	Total			

Summary for Reach DP1: School St

Inflow Area = 2,750 sf, 15.45% Impervious, Inflow Depth = 0.71" for 2-Year event
Inflow = 0.0 cfs @ 12.19 hrs, Volume= 162 cf
Outflow = 0.0 cfs @ 12.19 hrs, Volume= 162 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: Off-Site West

Inflow Area = 78,530 sf, 2.48% Impervious, Inflow Depth = 0.36" for 2-Year event
Inflow = 0.4 cfs @ 12.16 hrs, Volume= 2,326 cf
Outflow = 0.4 cfs @ 12.16 hrs, Volume= 2,326 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: Off-Site South

Inflow Area = 180,362 sf, 28.64% Impervious, Inflow Depth = 0.09" for 2-Year event
Inflow = 0.4 cfs @ 12.30 hrs, Volume= 1,425 cf
Outflow = 0.4 cfs @ 12.30 hrs, Volume= 1,425 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 DP4: Off-Site Southeast

Inflow Area = 35,983 sf, 6.80% Impervious, Inflow Depth = 0.20" for 2-Year event
Inflow = 0.0 cfs @ 12.34 hrs, Volume= 587 cf
Outflow = 0.0 cfs @ 12.34 hrs, Volume= 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

Summary for Reach DP5: Off-Site East

Inflow Area = 8,836 sf, 0.00% Impervious, Inflow Depth = 0.32" for 2-Year event
Inflow = 0.0 cfs @ 12.49 hrs, Volume= 238 cf
Outflow = 0.0 cfs @ 12.49 hrs, Volume= 238 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 Pond P1:

Inflow Area = 42,026 sf, 21.66% Impervious, Inflow Depth = 0.80" for 2-Year event
Inflow = 0.7 cfs @ 12.18 hrs, Volume= 2,809 cf
Outflow = 0.2 cfs @ 12.42 hrs, Volume= 2,809 cf, Atten= 68%, Lag= 14.3 min
Discarded = 0.2 cfs @ 12.42 hrs, Volume= 2,809 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 90.92' @ 12.42 hrs Surf.Area= 657 sf Storage= 469 cf

Plug-Flow detention time= 19.3 min calculated for 2,809 cf (100% of inflow)
Center-of-Mass det. time= 19.3 min (946.8 - 927.5)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	4,348 cf	**Infiltration-Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
90.00	372	372.0	0	0	372
91.00	684	108.0	520	520	10,459
92.00	1,056	130.0	863	1,383	10,892
93.00	1,474	149.0	1,259	2,643	11,337
94.00	1,947	168.0	1,705	4,348	11,841

Device	Routing	Invert	Outlet Devices
#1	Primary	90.00'	**12.0" Round Culvert** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 90.00' / 89.20' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	91.00'	**5.0" Vert. Orifice/Grate-10yr X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	92.20'	**4.0" Vert. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	92.90'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	90.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.2 cfs @ 12.42 hrs HW=90.92' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=90.00' TW=79.00' (Dynamic Tailwater)
└**1=Culvert** (Controls 0.0 cfs)
  └**2=Orifice/Grate-10yr** (Controls 0.0 cfs)
  └**3=Orifice/Grate-25yr** (Controls 0.0 cfs)
  └**4=Orifice/Grate-25yr** (Controls 0.0 cfs)

Summary for Pond P2:

Inflow Area = 9,120 sf, 57.13% Impervious, Inflow Depth = 1.57" for 2-Year event
Inflow = 0.3 cfs @ 12.18 hrs, Volume= 1,193 cf
Outflow = 0.1 cfs @ 12.39 hrs, Volume= 1,193 cf, Atten= 68%, Lag= 12.9 min
Discarded = 0.0 cfs @ 12.39 hrs, Volume= 1,052 cf
Primary = 0.1 cfs @ 12.39 hrs, Volume= 141 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 85.22' @ 12.39 hrs Surf.Area= 435 sf Storage= 319 cf

Plug-Flow detention time= 71.8 min calculated for 1,193 cf (100% of inflow)
Center-of-Mass det. time= 71.8 min (942.7 - 870.9)

Volume	Invert	Avail.Storage	Storage Description
#1	84.00'	755 cf	**P1 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
84.00	114	45.0	0	0	114
85.00	375	93.0	232	232	646
86.00	687	113.0	523	755	989

Device	Routing	Invert	Outlet Devices
#1	Primary	84.00'	**18.0" Round Culvert** L= 135.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 84.00' / 81.97' S= 0.0150 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	85.00'	**3.0" Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	85.45'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Discarded	84.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.39 hrs HW=85.22' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.39 hrs HW=85.22' TW=79.53' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.1 cfs of 4.5 cfs potential flow)
  └**2=Orifice/Grate-2yr** (Orifice Controls 0.1 cfs @ 1.58 fps)
  └**3=Orifice/Grate-25yr** (Controls 0.0 cfs)

Summary for Pond P4:

Inflow Area = 159,303 sf, 32.43% Impervious, Inflow Depth = 0.57" for 2-Year event
Inflow = 2.5 cfs @ 12.09 hrs, Volume= 7,618 cf
Outflow = 0.8 cfs @ 12.30 hrs, Volume= 7,618 cf, Atten= 67%, Lag= 12.8 min
Discarded = 0.5 cfs @ 12.30 hrs, Volume= 6,817 cf
Primary = 0.4 cfs @ 12.30 hrs, Volume= 802 cf
Routed to Reach DP3 : Off-Site South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 79.55' @ 12.30 hrs Surf.Area= 2,160 sf Storage= 1,092 cf

Plug-Flow detention time= 8.9 min calculated for 7,616 cf (100% of inflow)
Center-of-Mass det. time= 8.9 min (900.3 - 891.4)

Volume	Invert	Avail.Storage	Storage Description
#1	79.00'	12,611 cf	**Infiltration Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
79.00	1,850	170.0	0	0	1,850
80.00	2,436	205.0	2,136	2,136	2,911
81.00	3,112	235.0	2,767	4,903	3,984
82.00	3,846	254.0	3,473	8,376	4,763
83.00	4,637	273.0	4,235	12,611	5,602

Device	Routing	Invert	Outlet Devices
#1	Primary	79.00'	**15.0" Round 15" Pipe** L= 66.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 79.00' / 76.00' S= 0.0455 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Device 1	79.20'	**8.0" W x 3.0" H Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	79.65'	**14.0" W x 5.0" H Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	80.90'	**12.0" W x 5.0" H Vert. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Device 1	81.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#6	Discarded	79.00'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.5 cfs @ 12.30 hrs HW=79.55' (Free Discharge)
└**6=Exfiltration** (Exfiltration Controls 0.5 cfs)

Primary OutFlow Max=0.4 cfs @ 12.30 hrs HW=79.55' TW=0.00' (Dynamic Tailwater)
└**1=15" Pipe** (Passes 0.4 cfs of 1.0 cfs potential flow)
- **2=Orifice/Grate-2yr** (Orifice Controls 0.4 cfs @ 2.23 fps)
- **3=Orifice/Grate-10yr** (Controls 0.0 cfs)
- **4=Orifice/Grate-25yr** (Controls 0.0 cfs)
- **5=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond P5:

Inflow Area = 13,982 sf, 36.60% Impervious, Inflow Depth = 1.12" for 2-Year event
Inflow = 0.4 cfs @ 12.14 hrs, Volume= 1,306 cf
Outflow = 0.0 cfs @ 13.45 hrs, Volume= 1,306 cf, Atten= 92%, Lag= 79.2 min
Discarded = 0.0 cfs @ 13.45 hrs, Volume= 1,306 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 98.84' @ 13.45 hrs Surf.Area= 598 sf Storage= 399 cf

Plug-Flow detention time= 112.0 min calculated for 1,306 cf (100% of inflow)
Center-of-Mass det. time= 112.0 min (1,009.4 - 897.3)

Volume	Invert	Avail.Storage	Storage Description
#1	98.00'	1,309 cf	**P5 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
98.00	361	77.0	0	0	361
99.00	650	102.0	498	498	728
100.00	983	125.0	811	1,309	1,159

Device	Routing	Invert	Outlet Devices
#1	Primary	98.00'	**12.0" Round Culvert** L= 195.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 98.00' / 89.00' S= 0.0462 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	98.90'	**4.0" Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	99.20'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Discarded	98.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 13.45 hrs HW=98.84' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=98.00' TW=79.00' (Dynamic Tailwater)
└**1=Culvert** (Controls 0.0 cfs)
  ├**2=Orifice/Grate-10yr** (Controls 0.0 cfs)
  └**3=Orifice/Grate-25yr** (Controls 0.0 cfs)

Summary for Pond P6:

Inflow Area = 14,114 sf, 18.29% Impervious, Inflow Depth = 0.75" for 2-Year event
Inflow = 0.4 cfs @ 12.09 hrs, Volume= 887 cf
Outflow = 0.1 cfs @ 12.20 hrs, Volume= 887 cf, Atten= 75%, Lag= 6.7 min
Discarded = 0.0 cfs @ 12.20 hrs, Volume= 752 cf
Primary = 0.1 cfs @ 12.20 hrs, Volume= 136 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 92.39' @ 12.20 hrs Surf.Area= 441 sf Storage= 148 cf

Plug-Flow detention time= 25.1 min calculated for 887 cf (100% of inflow)
Center-of-Mass det. time= 25.1 min (948.0 - 922.9)

Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	1,355 cf	**Rain Garden P6 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
92.00	318	80.0	0	0	318
93.00	670	122.0	483	483	1,001
94.00	1,091	141.0	872	1,355	1,419

Device	Routing	Invert	Outlet Devices
#1	Primary	92.00'	**12.0" Round Culvert** L= 112.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.00' / 87.50' S= 0.0402 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	92.20'	**3.0" Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	92.50'	**4.0" Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	93.00'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	92.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.20 hrs HW=92.39' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.20 hrs HW=92.39' TW=79.51' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.1 cfs of 0.5 cfs potential flow)
  ├**2=Orifice/Grate-2yr** (Orifice Controls 0.1 cfs @ 1.49 fps)
  ├**3=Orifice/Grate-10yr** (Controls 0.0 cfs)
  └**4=Orifice/Grate-25yr** (Controls 0.0 cfs)

Summary for Pond P7:

Inflow Area = 11,874 sf, 20.60% Impervious, Inflow Depth = 0.80" for 2-Year event
Inflow = 0.2 cfs @ 12.18 hrs, Volume= 794 cf
Outflow = 0.0 cfs @ 13.43 hrs, Volume= 794 cf, Atten= 88%, Lag= 74.8 min
Discarded = 0.0 cfs @ 13.43 hrs, Volume= 794 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Reach DP4 : Off-Site Southeast

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 81.76' @ 13.43 hrs Surf.Area= 370 sf Storage= 211 cf

Plug-Flow detention time= 92.3 min calculated for 794 cf (100% of inflow)
Center-of-Mass det. time= 92.3 min (1,019.8 - 927.5)

Volume	Invert	Avail.Storage	Storage Description
#1	81.00'	1,798 cf	**Rain Garden (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
81.00	194	55.0	0	0	194
82.00	436	86.0	307	307	549
83.00	741	105.0	582	889	853
84.00	1,089	125.0	909	1,798	1,237

Device	Routing	Invert	Outlet Devices
#1	Primary	81.00'	**8.0" Round Culvert** L= 29.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 81.00' / 80.00' S= 0.0345 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Device 1	81.90'	**2.0" Vert. Orifice/Grate 10-yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	82.60'	**3.0" Vert. Orifice/Grate 25-yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	83.30'	**12.0" Horiz. Orifice/Grate 100-yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	81.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 13.43 hrs HW=81.76' (Free Discharge)
└─**5=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=81.00' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.0 cfs)
  ├─**2=Orifice/Grate 10-yr** (Controls 0.0 cfs)
  ├─**3=Orifice/Grate 25-yr** (Controls 0.0 cfs)
  └─**4=Orifice/Grate 100-yr** (Controls 0.0 cfs)

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 PS-7: Runoff Area=11,874 sf 20.60% Impervious Runoff Depth=2.05"
Flow Length=95' Slope=0.0200 '/' Tc=10.0 min CN=69 Runoff=0.6 cfs 2,024 cf

Subcatchment PS-N1: PS-N1 Runoff Area=42,026 sf 21.66% Impervious Runoff Depth=2.05"
Flow Length=204' Tc=10.0 min CN=69 Runoff=2.0 cfs 7,162 cf

Subcatchment PS-N2: Runoff Area=9,120 sf 57.13% Impervious Runoff Depth=3.19"
Tc=10.0 min CN=82 Runoff=0.7 cfs 2,422 cf

Subcatchment PS-N3: Site Runoff Area=51,063 sf 37.90% Impervious Runoff Depth=2.55"
Tc=0.0 min CN=75 Runoff=4.4 cfs 10,838 cf

Subcatchment PS-N4: Runoff Area=28,998 sf 35.50% Impervious Runoff Depth=2.46"
Tc=10.0 min CN=74 Runoff=1.7 cfs 5,945 cf

Subcatchment PS-N5: Runoff Area=13,982 sf 36.60% Impervious Runoff Depth=2.55"
Tc=6.0 min CN=75 Runoff=1.0 cfs 2,968 cf

Subcatchment PS-N6: Runoff Area=14,114 sf 18.29% Impervious Runoff Depth=1.97"
Tc=0.0 min CN=68 Runoff=1.0 cfs 2,312 cf

Subcatchment PS1: Runoff Area=2,750 sf 15.45% Impervious Runoff Depth=1.89"
Tc=10.0 min CN=67 Runoff=0.1 cfs 432 cf

Subcatchment PS2: Runoff Area=78,530 sf 2.48% Impervious Runoff Depth=1.24"
Flow Length=553' Tc=6.4 min CN=58 Runoff=2.5 cfs 8,084 cf

Subcatchment PS3: Runoff Area=21,059 sf 0.00% Impervious Runoff Depth=1.24"
Flow Length=728' Tc=14.5 min CN=58 Runoff=0.5 cfs 2,168 cf

Subcatchment PS4: Runoff Area=24,109 sf 0.00% Impervious Runoff Depth=1.10"
Flow Length=315' Tc=16.7 min CN=56 Runoff=0.4 cfs 2,218 cf

Subcatchment PS5: Runoff Area=8,836 sf 0.00% Impervious Runoff Depth=1.17"
Flow Length=172' Tc=26.2 min CN=57 Runoff=0.1 cfs 861 cf

Reach DP1: School St Inflow=0.1 cfs 432 cf
Outflow=0.1 cfs 432 cf

Reach DP2: Off-Site West Inflow=2.5 cfs 8,084 cf
Outflow=2.5 cfs 8,084 cf

Reach DP3: Off-Site South Inflow=3.1 cfs 9,839 cf
Outflow=3.1 cfs 9,839 cf

Reach DP4: Off-Site Southeast Inflow=0.5 cfs 2,776 cf
Outflow=0.5 cfs 2,776 cf

Reach DP5: Off-Site East Inflow=0.1 cfs 861 cf
Outflow=0.1 cfs 861 cf

Pond P1: Peak Elev=91.73' Storage=1,115 cf Inflow=2.0 cfs 7,162 cf
Discarded=0.3 cfs 5,703 cf Primary=1.0 cfs 1,459 cf Outflow=1.2 cfs 7,162 cf

Pond P2: Peak Elev=85.56' Storage=489 cf Inflow=0.7 cfs 2,422 cf
Discarded=0.0 cfs 1,620 cf Primary=0.6 cfs 802 cf Outflow=0.6 cfs 2,422 cf

Pond P4: Peak Elev=80.48' Storage=3,371 cf Inflow=6.1 cfs 20,919 cf
Discarded=0.7 cfs 13,248 cf Primary=2.7 cfs 7,671 cf Outflow=3.3 cfs 20,919 cf

Pond P5: Peak Elev=99.31' Storage=712 cf Inflow=1.0 cfs 2,968 cf
Discarded=0.0 cfs 2,093 cf Primary=0.6 cfs 875 cf Outflow=0.6 cfs 2,968 cf

Pond P6: Peak Elev=92.92' Storage=429 cf Inflow=1.0 cfs 2,312 cf
Discarded=0.1 cfs 1,312 cf Primary=0.4 cfs 999 cf Outflow=0.4 cfs 2,312 cf

Pond P7: Peak Elev=82.52' Storage=572 cf Inflow=0.6 cfs 2,024 cf
Discarded=0.0 cfs 1,466 cf Primary=0.1 cfs 558 cf Outflow=0.1 cfs 2,024 cf

Total Runoff Area = 306,461 sf Runoff Volume = 47,434 cf Average Runoff Depth = 1.86"
81.57% Pervious = 249,983 sf 18.43% Impervious = 56,478 sf

Summary for Subcatchment PS-7:

Runoff = 0.6 cfs @ 12.18 hrs, Volume= 2,024 cf, Depth= 2.05"
Routed to Pond P7 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
2,446	98	Roofs, HSG B
9,428	61	>75% Grass cover, Good, HSG B
11,874	69	Weighted Average
9,428		79.40% Pervious Area
2,446		20.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.18		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.10"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow, Roof Drain Pipe** Paved Kv= 20.3 fps
9.0					**Direct Entry, Adjustment for 0.16 hr**
10.0	95	Total			

Summary for Subcatchment PS-N1: PS-N1

Runoff = 2.0 cfs @ 12.18 hrs, Volume= 7,162 cf, Depth= 2.05"
Routed to Pond P1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

	Area (sf)	CN	Description
	8,115	98	Paved parking, HSG B
	32,925	61	>75% Grass cover, Good, HSG B
*	986	98	Roofs, HSG B
	42,026	69	Weighted Average
	32,925		78.34% Pervious Area
	9,101		21.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3					**Direct Entry, Adjusted 0.1 hr**
1.1	50	0.0060	0.73		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.10"
0.6	154	0.0380	3.96		**Shallow Concentrated Flow, Shallow** Paved Kv= 20.3 fps
10.0	204	Total			

Summary for Subcatchment PS-N2:

Runoff = 0.7 cfs @ 12.17 hrs, Volume= 2,422 cf, Depth= 3.19"
Routed to Pond P2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
5,210	98	Roofs, HSG B
3,910	61	>75% Grass cover, Good, HSG B
9,120	82	Weighted Average
3,910		42.87% Pervious Area
5,210		57.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment for 0.1 hr**

Summary for Subcatchment PS-N3: Site

Runoff = 4.4 cfs @ 12.09 hrs, Volume= 10,838 cf, Depth= 2.55"
Routed to Pond P4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
31,712	61	>75% Grass cover, Good, HSG B
14,512	98	Paved parking, HSG B
4,839	98	Roofs, HSG B
51,063	75	Weighted Average
31,712		62.10% Pervious Area
19,351		37.90% Impervious Area

Summary for Subcatchment PS-N4:

Runoff = 1.7 cfs @ 12.18 hrs, Volume= 5,945 cf, Depth= 2.46"
Routed to Pond P4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
18,703	61	>75% Grass cover, Good, HSG B
10,295	98	Paved parking, HSG B
28,998	74	Weighted Average
18,703		64.50% Pervious Area
10,295		35.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment for 0.16 hrs**

Summary for Subcatchment PS-N5:

Runoff = 1.0 cfs @ 12.13 hrs, Volume= 2,968 cf, Depth= 2.55"
Routed to Pond P5 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
5,117	98	Roofs, HSG B
8,865	61	>75% Grass cover, Good, HSG B
13,982	75	Weighted Average
8,865		63.40% Pervious Area
5,117		36.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Adjustment to 0.1 hr**

Summary for Subcatchment PS-N6:

Runoff = 1.0 cfs @ 12.09 hrs, Volume= 2,312 cf, Depth= 1.97"
Routed to Pond P6 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
2,582	98	Roofs, HSG B
11,532	61	>75% Grass cover, Good, HSG B
14,114	68	Weighted Average
11,532		81.71% Pervious Area
2,582		18.29% Impervious Area

Summary for Subcatchment PS1:

Runoff = 0.1 cfs @ 12.18 hrs, Volume= 432 cf, Depth= 1.89"
Routed to Reach DP1 : School St

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
2,325	61	>75% Grass cover, Good, HSG B
425	98	Paved parking, HSG B
2,750	67	Weighted Average
2,325		84.55% Pervious Area
425		15.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment to 0.16 hr**

Summary for Subcatchment PS2:

Runoff = 2.5 cfs @ 12.14 hrs, Volume= 8,084 cf, Depth= 1.24"
Routed to Reach DP2 : Off-Site West

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
1,951	98	Roofs, HSG B
31,697	61	>75% Grass cover, Good, HSG B
44,882	55	Woods, Good, HSG B
78,530	58	Weighted Average
76,579		97.52% Pervious Area
1,951		2.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"
0.4	100	0.0700	4.26		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.6	303	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
6.4	553	Total			

Summary for Subcatchment PS3:

Runoff = 0.5 cfs @ 12.24 hrs, Volume= 2,168 cf, Depth= 1.24"
Routed to Reach DP3 : Off-Site South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
11,614	61	>75% Grass cover, Good, HSG B
9,445	55	Woods, Good, HSG B
21,059	58	Weighted Average
21,059		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.10"
1.8	359	0.0440	3.38		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.7	319	0.0390	3.18		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
14.5	728	Total			

Summary for Subcatchment PS4:

Runoff = 0.4 cfs @ 12.27 hrs, Volume= 2,218 cf, Depth= 1.10"
Routed to Reach DP4 : Off-Site Southeast

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

	Area (sf)	CN	Description
	20,799	55	Woods, Good, HSG B
*	3,310	61	>75% Grass cover, Good, HSG B
	24,109	56	Weighted Average
	24,109		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	50	0.0440	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.10"
0.8	265	0.1100	5.34		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
16.7	315	Total			

Summary for Subcatchment PS5:

Runoff = 0.1 cfs @ 12.40 hrs, Volume= 861 cf, Depth= 1.17"
Routed to Reach DP5 : Off-Site East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
2,744	61	>75% Grass cover, Good, HSG B
6,092	55	Woods, Good, HSG B
8,836	57	Weighted Average
8,836		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.2	50	0.0140	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.10"
1.0	122	0.0150	1.97		**Shallow Concentrated Flow, Shallow** Unpaved Kv= 16.1 fps
26.2	172	Total			

Summary for Reach DP1: School St

Inflow Area = 2,750 sf, 15.45% Impervious, Inflow Depth = 1.89" for 10-Year event
Inflow = 0.1 cfs @ 12.18 hrs, Volume= 432 cf
Outflow = 0.1 cfs @ 12.18 hrs, Volume= 432 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: Off-Site West

Inflow Area = 78,530 sf, 2.48% Impervious, Inflow Depth = 1.24" for 10-Year event
Inflow = 2.5 cfs @ 12.14 hrs, Volume= 8,084 cf
Outflow = 2.5 cfs @ 12.14 hrs, Volume= 8,084 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: Off-Site South

Inflow Area = 180,362 sf, 28.64% Impervious, Inflow Depth = 0.65" for 10-Year event
Inflow = 3.1 cfs @ 12.29 hrs, Volume= 9,839 cf
Outflow = 3.1 cfs @ 12.29 hrs, Volume= 9,839 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 DP4: Off-Site Southeast

Inflow Area = 35,983 sf, 6.80% Impervious, Inflow Depth = 0.93" for 10-Year event
Inflow = 0.5 cfs @ 12.27 hrs, Volume= 2,776 cf
Outflow = 0.5 cfs @ 12.27 hrs, Volume= 2,776 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 DP5: Off-Site East

Inflow Area = 8,836 sf, 0.00% Impervious, Inflow Depth = 1.17" for 10-Year event
Inflow = 0.1 cfs @ 12.40 hrs, Volume= 861 cf
Outflow = 0.1 cfs @ 12.40 hrs, Volume= 861 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 Pond P1:

Inflow Area = 42,026 sf, 21.66% Impervious, Inflow Depth = 2.05" for 10-Year event
Inflow = 2.0 cfs @ 12.18 hrs, Volume= 7,162 cf
Outflow = 1.2 cfs @ 12.29 hrs, Volume= 7,162 cf, Atten= 41%, Lag= 6.5 min
Discarded = 0.3 cfs @ 12.29 hrs, Volume= 5,703 cf
Primary = 1.0 cfs @ 12.29 hrs, Volume= 1,459 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 91.73' @ 12.29 hrs Surf.Area= 948 sf Storage= 1,115 cf

Plug-Flow detention time= 21.0 min calculated for 7,160 cf (100% of inflow)
Center-of-Mass det. time= 21.0 min (909.9 - 888.9)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	4,348 cf	**Infiltration-Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
90.00	372	372.0	0	0	372
91.00	684	108.0	520	520	10,459
92.00	1,056	130.0	863	1,383	10,892
93.00	1,474	149.0	1,259	2,643	11,337
94.00	1,947	168.0	1,705	4,348	11,841

Device	Routing	Invert	Outlet Devices
#1	Primary	90.00'	**12.0" Round Culvert** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 90.00' / 89.20' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	91.00'	**5.0" Vert. Orifice/Grate-10yr X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	92.20'	**4.0" Vert. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	92.90'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	90.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.3 cfs @ 12.29 hrs HW=91.73' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.3 cfs)

Primary OutFlow Max=0.9 cfs @ 12.29 hrs HW=91.73' TW=80.47' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.9 cfs of 3.3 cfs potential flow)
  ├**2=Orifice/Grate-10yr** (Orifice Controls 0.9 cfs @ 3.48 fps)
  ├**3=Orifice/Grate-25yr** (Controls 0.0 cfs)
  └**4=Orifice/Grate-25yr** (Controls 0.0 cfs)

Summary for Pond P2:

Inflow Area = 9,120 sf, 57.13% Impervious, Inflow Depth = 3.19" for 10-Year event
Inflow = 0.7 cfs @ 12.17 hrs, Volume= 2,422 cf
Outflow = 0.6 cfs @ 12.22 hrs, Volume= 2,422 cf, Atten= 13%, Lag= 2.9 min
Discarded = 0.0 cfs @ 12.22 hrs, Volume= 1,620 cf
Primary = 0.6 cfs @ 12.22 hrs, Volume= 802 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 85.56' @ 12.22 hrs Surf.Area= 540 sf Storage= 489 cf

Plug-Flow detention time= 64.2 min calculated for 2,421 cf (100% of inflow)
Center-of-Mass det. time= 64.2 min (907.0 - 842.8)

Volume	Invert	Avail.Storage	Storage Description
#1	84.00'	755 cf	**P1 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
84.00	114	45.0	0	0	114
85.00	375	93.0	232	232	646
86.00	687	113.0	523	755	989

Device	Routing	Invert	Outlet Devices
#1	Primary	84.00'	**18.0" Round Culvert** L= 135.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 84.00' / 81.97' S= 0.0150 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	85.00'	**3.0" Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	85.45'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Discarded	84.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.22 hrs HW=85.56' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.6 cfs @ 12.22 hrs HW=85.56' TW=80.39' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.6 cfs of 6.1 cfs potential flow)
  ├**2=Orifice/Grate-2yr** (Orifice Controls 0.2 cfs @ 3.19 fps)
  └**3=Orifice/Grate-25yr** (Weir Controls 0.4 cfs @ 1.11 fps)

Summary for Pond P4:

Inflow Area = 159,303 sf, 32.43% Impervious, Inflow Depth = 1.58" for 10-Year event
Inflow = 6.1 cfs @ 12.09 hrs, Volume= 20,919 cf
Outflow = 3.3 cfs @ 12.31 hrs, Volume= 20,919 cf, Atten= 45%, Lag= 13.4 min
Discarded = 0.7 cfs @ 12.31 hrs, Volume= 13,248 cf
Primary = 2.7 cfs @ 12.31 hrs, Volume= 7,671 cf
Routed to Reach DP3 : Off-Site South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 80.48' @ 12.31 hrs Surf.Area= 2,748 sf Storage= 3,371 cf

Plug-Flow detention time= 12.4 min calculated for 20,913 cf (100% of inflow)
Center-of-Mass det. time= 12.4 min (856.0 - 843.6)

Volume	Invert	Avail.Storage	Storage Description
#1	79.00'	12,611 cf	**Infiltration Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
79.00	1,850	170.0	0	0	1,850
80.00	2,436	205.0	2,136	2,136	2,911
81.00	3,112	235.0	2,767	4,903	3,984
82.00	3,846	254.0	3,473	8,376	4,763
83.00	4,637	273.0	4,235	12,611	5,602

Device	Routing	Invert	Outlet Devices
#1	Primary	79.00'	**15.0" Round 15" Pipe** L= 66.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 79.00' / 76.00' S= 0.0455 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Device 1	79.20'	**8.0" W x 3.0" H Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	79.65'	**14.0" W x 5.0" H Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	80.90'	**12.0" W x 5.0" H Vert. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Device 1	81.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#6	Discarded	79.00'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.7 cfs @ 12.31 hrs HW=80.48' (Free Discharge)
└**6=Exfiltration** (Exfiltration Controls 0.7 cfs)

Primary OutFlow Max=2.7 cfs @ 12.31 hrs HW=80.48' TW=0.00' (Dynamic Tailwater)
└**1=15" Pipe** (Passes 2.7 cfs of 4.3 cfs potential flow)
- **2=Orifice/Grate-2yr** (Orifice Controls 0.9 cfs @ 5.16 fps)
- **3=Orifice/Grate-10yr** (Orifice Controls 1.8 cfs @ 3.77 fps)
- **4=Orifice/Grate-25yr** (Controls 0.0 cfs)
- **5=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond P5:

Inflow Area = 13,982 sf, 36.60% Impervious, Inflow Depth = 2.55" for 10-Year event
Inflow = 1.0 cfs @ 12.13 hrs, Volume= 2,968 cf
Outflow = 0.6 cfs @ 12.20 hrs, Volume= 2,968 cf, Atten= 41%, Lag= 4.1 min
Discarded = 0.0 cfs @ 12.20 hrs, Volume= 2,093 cf
Primary = 0.6 cfs @ 12.20 hrs, Volume= 875 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 99.31' @ 12.20 hrs Surf.Area= 745 sf Storage= 712 cf

Plug-Flow detention time= 108.7 min calculated for 2,968 cf (100% of inflow)
Center-of-Mass det. time= 108.7 min (973.3 - 864.6)

Volume	Invert	Avail.Storage	Storage Description
#1	98.00'	1,309 cf	**P5 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
98.00	361	77.0	0	0	361
99.00	650	102.0	498	498	728
100.00	983	125.0	811	1,309	1,159

Device	Routing	Invert	Outlet Devices
#1	Primary	98.00'	**12.0" Round Culvert** L= 195.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 98.00' / 89.00' S= 0.0462 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	98.90'	**4.0" Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	99.20'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Discarded	98.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.20 hrs HW=99.31' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.6 cfs @ 12.20 hrs HW=99.31' TW=80.34' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.6 cfs of 2.7 cfs potential flow)
  ├**2=Orifice/Grate-10yr** (Orifice Controls 0.2 cfs @ 2.35 fps)
  └**3=Orifice/Grate-25yr** (Weir Controls 0.4 cfs @ 1.06 fps)

Summary for Pond P6:

Inflow Area = 14,114 sf, 18.29% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 1.0 cfs @ 12.09 hrs, Volume= 2,312 cf
Outflow = 0.4 cfs @ 12.10 hrs, Volume= 2,312 cf, Atten= 54%, Lag= 0.9 min
Discarded = 0.1 cfs @ 12.10 hrs, Volume= 1,312 cf
Primary = 0.4 cfs @ 12.10 hrs, Volume= 999 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 92.92' @ 12.10 hrs Surf.Area= 636 sf Storage= 429 cf

Plug-Flow detention time= 31.9 min calculated for 2,311 cf (100% of inflow)
Center-of-Mass det. time= 31.9 min (914.9 - 883.1)

Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	1,355 cf	**Rain Garden P6 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
92.00	318	80.0	0	0	318
93.00	670	122.0	483	483	1,001
94.00	1,091	141.0	872	1,355	1,419

Device	Routing	Invert	Outlet Devices
#1	Primary	92.00'	**12.0" Round Culvert** L= 112.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.00' / 87.50' S= 0.0402 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	92.20'	**3.0" Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	92.50'	**4.0" Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	93.00'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	92.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.1 cfs @ 12.10 hrs HW=92.91' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.4 cfs @ 12.10 hrs HW=92.91' TW=80.15' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.4 cfs of 1.9 cfs potential flow)
  ├**2=Orifice/Grate-2yr** (Orifice Controls 0.2 cfs @ 3.70 fps)
  ├**3=Orifice/Grate-10yr** (Orifice Controls 0.2 cfs @ 2.40 fps)
  └**4=Orifice/Grate-25yr** (Controls 0.0 cfs)

Summary for Pond P7:

Inflow Area = 11,874 sf, 20.60% Impervious, Inflow Depth = 2.05" for 10-Year event
Inflow = 0.6 cfs @ 12.18 hrs, Volume= 2,024 cf
Outflow = 0.1 cfs @ 12.53 hrs, Volume= 2,024 cf, Atten= 80%, Lag= 21.1 min
Discarded = 0.0 cfs @ 12.53 hrs, Volume= 1,466 cf
Primary = 0.1 cfs @ 12.53 hrs, Volume= 558 cf
Routed to Reach DP4 : Off-Site Southeast

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 82.52' @ 12.53 hrs Surf.Area= 585 sf Storage= 572 cf

Plug-Flow detention time= 105.4 min calculated for 2,023 cf (100% of inflow)
Center-of-Mass det. time= 105.4 min (994.3 - 888.9)

Volume	Invert	Avail.Storage	Storage Description
#1	81.00'	1,798 cf	**Rain Garden (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
81.00	194	55.0	0	0	194
82.00	436	86.0	307	307	549
83.00	741	105.0	582	889	853
84.00	1,089	125.0	909	1,798	1,237

Device	Routing	Invert	Outlet Devices
#1	Primary	81.00'	**8.0" Round Culvert** L= 29.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 81.00' / 80.00' S= 0.0345 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Device 1	81.90'	**2.0" Vert. Orifice/Grate 10-yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	82.60'	**3.0" Vert. Orifice/Grate 25-yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	83.30'	**12.0" Horiz. Orifice/Grate 100-yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	81.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.53 hrs HW=82.52' (Free Discharge)
└─**5=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.53 hrs HW=82.52' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.1 cfs of 1.4 cfs potential flow)
  ├─**2=Orifice/Grate 10-yr** (Orifice Controls 0.1 cfs @ 3.53 fps)
  ├─**3=Orifice/Grate 25-yr** (Controls 0.0 cfs)
  └─**4=Orifice/Grate 100-yr** (Controls 0.0 cfs)

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 PS-7: Runoff Area=11,874 sf 20.60% Impervious Runoff Depth=2.95"
Flow Length=95' Slope=0.0200 '/' Tc=10.0 min CN=69 Runoff=0.8 cfs 2,918 cf

Subcatchment PS-N1: PS-N1 Runoff Area=42,026 sf 21.66% Impervious Runoff Depth=2.95"
Flow Length=204' Tc=10.0 min CN=69 Runoff=3.0 cfs 10,327 cf

Subcatchment PS-N2: Runoff Area=9,120 sf 57.13% Impervious Runoff Depth=4.26"
Tc=10.0 min CN=82 Runoff=0.9 cfs 3,241 cf

Subcatchment PS-N3: Site Runoff Area=51,063 sf 37.90% Impervious Runoff Depth=3.54"
Tc=0.0 min CN=75 Runoff=6.0 cfs 15,060 cf

Subcatchment PS-N4: Runoff Area=28,998 sf 35.50% Impervious Runoff Depth=3.44"
Tc=10.0 min CN=74 Runoff=2.4 cfs 8,310 cf

Subcatchment PS-N5: Runoff Area=13,982 sf 36.60% Impervious Runoff Depth=3.54"
Tc=6.0 min CN=75 Runoff=1.4 cfs 4,124 cf

Subcatchment PS-N6: Runoff Area=14,114 sf 18.29% Impervious Runoff Depth=2.85"
Tc=0.0 min CN=68 Runoff=1.4 cfs 3,356 cf

Subcatchment PS1: Runoff Area=2,750 sf 15.45% Impervious Runoff Depth=2.76"
Tc=10.0 min CN=67 Runoff=0.2 cfs 632 cf

Subcatchment PS2: Runoff Area=78,530 sf 2.48% Impervious Runoff Depth=1.95"
Flow Length=553' Tc=6.4 min CN=58 Runoff=4.2 cfs 12,738 cf

Subcatchment PS3: Runoff Area=21,059 sf 0.00% Impervious Runoff Depth=1.95"
Flow Length=728' Tc=14.5 min CN=58 Runoff=0.8 cfs 3,416 cf

Subcatchment PS4: Runoff Area=24,109 sf 0.00% Impervious Runoff Depth=1.78"
Flow Length=315' Tc=16.7 min CN=56 Runoff=0.7 cfs 3,569 cf

Subcatchment PS5: Runoff Area=8,836 sf 0.00% Impervious Runoff Depth=1.86"
Flow Length=172' Tc=26.2 min CN=57 Runoff=0.2 cfs 1,370 cf

Reach DP1: School St Inflow=0.2 cfs 632 cf
Outflow=0.2 cfs 632 cf

Reach DP2: Off-Site West Inflow=4.2 cfs 12,738 cf
Outflow=4.2 cfs 12,738 cf

Reach DP3: Off-Site South Inflow=4.9 cfs 17,437 cf
Outflow=4.9 cfs 17,437 cf

Reach DP4: Off-Site Southeast Inflow=0.9 cfs 4,748 cf
Outflow=0.9 cfs 4,748 cf

Reach DP5: Off-Site East Inflow=0.2 cfs 1,370 cf
Outflow=0.2 cfs 1,370 cf

Pond P1: Peak Elev=92.24' Storage=1,650 cf Inflow=3.0 cfs 10,327 cf
Discarded=0.3 cfs 7,384 cf Primary=1.3 cfs 2,943 cf Outflow=1.6 cfs 10,327 cf

Pond P2: Peak Elev=85.61' Storage=515 cf Inflow=0.9 cfs 3,241 cf
Discarded=0.0 cfs 1,926 cf Primary=0.8 cfs 1,315 cf Outflow=0.9 cfs 3,241 cf

Pond P4: Peak Elev=81.17' Storage=5,427 cf Inflow=10.0 cfs 31,181 cf
Discarded=0.8 cfs 17,160 cf Primary=4.2 cfs 14,021 cf Outflow=5.0 cfs 31,181 cf

Pond P5: Peak Elev=99.41' Storage=790 cf Inflow=1.4 cfs 4,124 cf
Discarded=0.0 cfs 2,400 cf Primary=1.2 cfs 1,724 cf Outflow=1.3 cfs 4,124 cf

Pond P6: Peak Elev=93.13' Storage=575 cf Inflow=1.4 cfs 3,356 cf
Discarded=0.1 cfs 1,526 cf Primary=1.0 cfs 1,830 cf Outflow=1.1 cfs 3,356 cf

Pond P7: Peak Elev=82.91' Storage=822 cf Inflow=0.8 cfs 2,918 cf
Discarded=0.0 cfs 1,739 cf Primary=0.2 cfs 1,178 cf Outflow=0.2 cfs 2,918 cf

Total Runoff Area = 306,461 sf Runoff Volume = 69,061 cf Average Runoff Depth = 2.70"
81.57% Pervious = 249,983 sf 18.43% Impervious = 56,478 sf

Summary for Subcatchment PS-7:

Runoff = 0.8 cfs @ 12.18 hrs, Volume= 2,918 cf, Depth= 2.95"
Routed to Pond P7 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
2,446	98	Roofs, HSG B
9,428	61	>75% Grass cover, Good, HSG B
11,874	69	Weighted Average
9,428		79.40% Pervious Area
2,446		20.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.18		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.10"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow, Roof Drain Pipe** Paved Kv= 20.3 fps
9.0					**Direct Entry, Adjustment for 0.16 hr**
10.0	95	Total			

Summary for Subcatchment PS-N1: PS-N1

Runoff = 3.0 cfs @ 12.18 hrs, Volume= 10,327 cf, Depth= 2.95"
Routed to Pond P1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

	Area (sf)	CN	Description
	8,115	98	Paved parking, HSG B
	32,925	61	>75% Grass cover, Good, HSG B
*	986	98	Roofs, HSG B
	42,026	69	Weighted Average
	32,925		78.34% Pervious Area
	9,101		21.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3					**Direct Entry, Adjusted 0.1 hr**
1.1	50	0.0060	0.73		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.10"
0.6	154	0.0380	3.96		**Shallow Concentrated Flow, Shallow** Paved Kv= 20.3 fps
10.0	204	Total			

Summary for Subcatchment PS-N2:

Runoff = 0.9 cfs @ 12.17 hrs, Volume= 3,241 cf, Depth= 4.26"
Routed to Pond P2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
5,210	98	Roofs, HSG B
3,910	61	>75% Grass cover, Good, HSG B
9,120	82	Weighted Average
3,910		42.87% Pervious Area
5,210		57.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment for 0.1 hr**

Summary for Subcatchment PS-N3: Site

Runoff = 6.0 cfs @ 12.09 hrs, Volume= 15,060 cf, Depth= 3.54"
Routed to Pond P4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
31,712	61	>75% Grass cover, Good, HSG B
14,512	98	Paved parking, HSG B
4,839	98	Roofs, HSG B
51,063	75	Weighted Average
31,712		62.10% Pervious Area
19,351		37.90% Impervious Area

Summary for Subcatchment PS-N4:

Runoff = 2.4 cfs @ 12.17 hrs, Volume= 8,310 cf, Depth= 3.44"
Routed to Pond P4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
18,703	61	>75% Grass cover, Good, HSG B
10,295	98	Paved parking, HSG B
28,998	74	Weighted Average
18,703		64.50% Pervious Area
10,295		35.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment for 0.16 hrs**

Summary for Subcatchment PS-N5:

Runoff = 1.4 cfs @ 12.13 hrs, Volume= 4,124 cf, Depth= 3.54"
Routed to Pond P5 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
5,117	98	Roofs, HSG B
8,865	61	>75% Grass cover, Good, HSG B
13,982	75	Weighted Average
8,865		63.40% Pervious Area
5,117		36.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Adjustment to 0.1 hr**

Summary for Subcatchment PS-N6:

Runoff = 1.4 cfs @ 12.09 hrs, Volume= 3,356 cf, Depth= 2.85"
Routed to Pond P6 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
2,582	98	Roofs, HSG B
11,532	61	>75% Grass cover, Good, HSG B
14,114	68	Weighted Average
11,532		81.71% Pervious Area
2,582		18.29% Impervious Area

Summary for Subcatchment PS1:

Runoff = 0.2 cfs @ 12.18 hrs, Volume= 632 cf, Depth= 2.76"
Routed to Reach DP1 : School St

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
2,325	61	>75% Grass cover, Good, HSG B
425	98	Paved parking, HSG B
2,750	67	Weighted Average
2,325		84.55% Pervious Area
425		15.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment to 0.16 hr**

Summary for Subcatchment PS2:

Runoff = 4.2 cfs @ 12.14 hrs, Volume= 12,738 cf, Depth= 1.95"
Routed to Reach DP2 : Off-Site West

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
1,951	98	Roofs, HSG B
31,697	61	>75% Grass cover, Good, HSG B
44,882	55	Woods, Good, HSG B
78,530	58	Weighted Average
76,579		97.52% Pervious Area
1,951		2.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"
0.4	100	0.0700	4.26		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.6	303	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
6.4	553	Total			

Summary for Subcatchment PS3:

Runoff = 0.8 cfs @ 12.23 hrs, Volume= 3,416 cf, Depth= 1.95"
Routed to Reach DP3 : Off-Site South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
11,614	61	>75% Grass cover, Good, HSG B
9,445	55	Woods, Good, HSG B
21,059	58	Weighted Average
21,059		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.10"
1.8	359	0.0440	3.38		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.7	319	0.0390	3.18		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
14.5	728	Total			

Summary for Subcatchment PS4:

Runoff = 0.7 cfs @ 12.26 hrs, Volume= 3,569 cf, Depth= 1.78"
Routed to Reach DP4 : Off-Site Southeast

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

	Area (sf)	CN	Description
	20,799	55	Woods, Good, HSG B
*	3,310	61	>75% Grass cover, Good, HSG B
	24,109	56	Weighted Average
	24,109		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	50	0.0440	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.10"
0.8	265	0.1100	5.34		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
16.7	315	Total			

Summary for Subcatchment PS5:

Runoff = 0.2 cfs @ 12.38 hrs, Volume= 1,370 cf, Depth= 1.86"
Routed to Reach DP5 : Off-Site East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-Year Rainfall=6.30"

Area (sf)	CN	Description
2,744	61	>75% Grass cover, Good, HSG B
6,092	55	Woods, Good, HSG B
8,836	57	Weighted Average
8,836		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.2	50	0.0140	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.10"
1.0	122	0.0150	1.97		**Shallow Concentrated Flow, Shallow** Unpaved Kv= 16.1 fps
26.2	172	Total			

Summary for Reach DP1: School St

Inflow Area = 2,750 sf, 15.45% Impervious, Inflow Depth = 2.76" for 25-Year event
Inflow = 0.2 cfs @ 12.18 hrs, Volume= 632 cf
Outflow = 0.2 cfs @ 12.18 hrs, Volume= 632 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: Off-Site West

Inflow Area = 78,530 sf, 2.48% Impervious, Inflow Depth = 1.95" for 25-Year event
Inflow = 4.2 cfs @ 12.14 hrs, Volume= 12,738 cf
Outflow = 4.2 cfs @ 12.14 hrs, Volume= 12,738 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: Off-Site South

Inflow Area = 180,362 sf, 28.64% Impervious, Inflow Depth = 1.16" for 25-Year event
Inflow = 4.9 cfs @ 12.28 hrs, Volume= 17,437 cf
Outflow = 4.9 cfs @ 12.28 hrs, Volume= 17,437 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 DP4: Off-Site Southeast

Inflow Area = 35,983 sf, 6.80% Impervious, Inflow Depth = 1.58" for 25-Year event
Inflow = 0.9 cfs @ 12.28 hrs, Volume= 4,748 cf
Outflow = 0.9 cfs @ 12.28 hrs, Volume= 4,748 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 DP5: Off-Site East

Inflow Area = 8,836 sf, 0.00% Impervious, Inflow Depth = 1.86" for 25-Year event
Inflow = 0.2 cfs @ 12.38 hrs, Volume= 1,370 cf
Outflow = 0.2 cfs @ 12.38 hrs, Volume= 1,370 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 Pond P1:

Inflow Area = 42,026 sf, 21.66% Impervious, Inflow Depth = 2.95" for 25-Year event
Inflow = 3.0 cfs @ 12.18 hrs, Volume= 10,327 cf
Outflow = 1.6 cfs @ 12.30 hrs, Volume= 10,327 cf, Atten= 46%, Lag= 7.3 min
Discarded = 0.3 cfs @ 12.30 hrs, Volume= 7,384 cf
Primary = 1.3 cfs @ 12.30 hrs, Volume= 2,943 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 92.24' @ 12.30 hrs Surf.Area= 1,151 sf Storage= 1,650 cf

Plug-Flow detention time= 21.4 min calculated for 10,327 cf (100% of inflow)
Center-of-Mass det. time= 21.4 min (895.7 - 874.3)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	4,348 cf	**Infiltration-Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
90.00	372	372.0	0	0	372
91.00	684	108.0	520	520	10,459
92.00	1,056	130.0	863	1,383	10,892
93.00	1,474	149.0	1,259	2,643	11,337
94.00	1,947	168.0	1,705	4,348	11,841

Device	Routing	Invert	Outlet Devices
#1	Primary	90.00'	**12.0" Round Culvert** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 90.00' / 89.20' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	91.00'	**5.0" Vert. Orifice/Grate-10yr X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	92.20'	**4.0" Vert. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	92.90'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	90.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.3 cfs @ 12.30 hrs HW=92.24' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.3 cfs)

Primary OutFlow Max=1.3 cfs @ 12.30 hrs HW=92.24' TW=81.16' (Dynamic Tailwater)
└**1=Culvert** (Passes 1.3 cfs of 3.9 cfs potential flow)
  ├**2=Orifice/Grate-10yr** (Orifice Controls 1.3 cfs @ 4.89 fps)
  ├**3=Orifice/Grate-25yr** (Orifice Controls 0.0 cfs @ 0.69 fps)
  └**4=Orifice/Grate-25yr** (Controls 0.0 cfs)

Summary for Pond P2:

Inflow Area = 9,120 sf, 57.13% Impervious, Inflow Depth = 4.26" for 25-Year event
Inflow = 0.9 cfs @ 12.17 hrs, Volume= 3,241 cf
Outflow = 0.9 cfs @ 12.20 hrs, Volume= 3,241 cf, Atten= 4%, Lag= 1.5 min
Discarded = 0.0 cfs @ 12.20 hrs, Volume= 1,926 cf
Primary = 0.8 cfs @ 12.20 hrs, Volume= 1,315 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 85.61' @ 12.20 hrs Surf.Area= 555 sf Storage= 515 cf

Plug-Flow detention time= 60.5 min calculated for 3,241 cf (100% of inflow)
Center-of-Mass det. time= 60.5 min (891.8 - 831.4)

Volume	Invert	Avail.Storage	Storage Description
#1	84.00'	755 cf	**P1 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
84.00	114	45.0	0	0	114
85.00	375	93.0	232	232	646
86.00	687	113.0	523	755	989

Device	Routing	Invert	Outlet Devices
#1	Primary	84.00'	**18.0" Round Culvert** L= 135.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 84.00' / 81.97' S= 0.0150 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	85.00'	**3.0" Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	85.45'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Discarded	84.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.20 hrs HW=85.61' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.8 cfs @ 12.20 hrs HW=85.61' TW=81.03' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.8 cfs of 6.2 cfs potential flow)
  ├**2=Orifice/Grate-2yr** (Orifice Controls 0.2 cfs @ 3.36 fps)
  └**3=Orifice/Grate-25yr** (Weir Controls 0.7 cfs @ 1.31 fps)

Summary for Pond P4:

Inflow Area = 159,303 sf, 32.43% Impervious, Inflow Depth = 2.35" for 25-Year event
Inflow = 10.0 cfs @ 12.09 hrs, Volume= 31,181 cf
Outflow = 5.0 cfs @ 12.30 hrs, Volume= 31,181 cf, Atten= 50%, Lag= 12.6 min
Discarded = 0.8 cfs @ 12.30 hrs, Volume= 17,160 cf
Primary = 4.2 cfs @ 12.30 hrs, Volume= 14,021 cf
Routed to Reach DP3 : Off-Site South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 81.17' @ 12.30 hrs Surf.Area= 3,228 sf Storage= 5,427 cf

Plug-Flow detention time= 14.0 min calculated for 31,172 cf (100% of inflow)
Center-of-Mass det. time= 14.0 min (844.7 - 830.7)

Volume	Invert	Avail.Storage	Storage Description
#1	79.00'	12,611 cf	**Infiltration Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
79.00	1,850	170.0	0	0	1,850
80.00	2,436	205.0	2,136	2,136	2,911
81.00	3,112	235.0	2,767	4,903	3,984
82.00	3,846	254.0	3,473	8,376	4,763
83.00	4,637	273.0	4,235	12,611	5,602

Device	Routing	Invert	Outlet Devices
#1	Primary	79.00'	**15.0" Round 15" Pipe** L= 66.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 79.00' / 76.00' S= 0.0455 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Device 1	79.20'	**8.0" W x 3.0" H Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	79.65'	**14.0" W x 5.0" H Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	80.90'	**12.0" W x 5.0" H Vert. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Device 1	81.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#6	Discarded	79.00'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.8 cfs @ 12.30 hrs HW=81.16' (Free Discharge)
└**6=Exfiltration** (Exfiltration Controls 0.8 cfs)

Primary OutFlow Max=4.2 cfs @ 12.30 hrs HW=81.16' TW=0.00' (Dynamic Tailwater)
└**1=15" Pipe** (Passes 4.2 cfs of 5.8 cfs potential flow)
- **2=Orifice/Grate-2yr** (Orifice Controls 1.1 cfs @ 6.53 fps)
- **3=Orifice/Grate-10yr** (Orifice Controls 2.7 cfs @ 5.50 fps)
- **4=Orifice/Grate-25yr** (Orifice Controls 0.4 cfs @ 1.65 fps)
- **5=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond P5:

Inflow Area = 13,982 sf, 36.60% Impervious, Inflow Depth = 3.54" for 25-Year event
Inflow = 1.4 cfs @ 12.13 hrs, Volume= 4,124 cf
Outflow = 1.3 cfs @ 12.16 hrs, Volume= 4,124 cf, Atten= 10%, Lag= 1.7 min
Discarded = 0.0 cfs @ 12.16 hrs, Volume= 2,400 cf
Primary = 1.2 cfs @ 12.16 hrs, Volume= 1,724 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 99.41' @ 12.16 hrs Surf.Area= 778 sf Storage= 790 cf

Plug-Flow detention time= 94.5 min calculated for 4,123 cf (100% of inflow)
Center-of-Mass det. time= 94.5 min (946.0 - 851.5)

Volume	Invert	Avail.Storage	Storage Description
#1	98.00'	1,309 cf	**P5 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
98.00	361	77.0	0	0	361
99.00	650	102.0	498	498	728
100.00	983	125.0	811	1,309	1,159

Device	Routing	Invert	Outlet Devices
#1	Primary	98.00'	**12.0" Round Culvert** L= 195.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 98.00' / 89.00' S= 0.0462 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	98.90'	**4.0" Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	99.20'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Discarded	98.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.16 hrs HW=99.41' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=1.2 cfs @ 12.16 hrs HW=99.41' TW=80.89' (Dynamic Tailwater)
└**1=Culvert** (Passes 1.2 cfs of 2.8 cfs potential flow)
├**2=Orifice/Grate-10yr** (Orifice Controls 0.2 cfs @ 2.82 fps)
└**3=Orifice/Grate-25yr** (Weir Controls 1.0 cfs @ 1.50 fps)

Summary for Pond P6:

Inflow Area = 14,114 sf, 18.29% Impervious, Inflow Depth = 2.85" for 25-Year event
Inflow = 1.4 cfs @ 12.09 hrs, Volume= 3,356 cf
Outflow = 1.1 cfs @ 12.10 hrs, Volume= 3,356 cf, Atten= 24%, Lag= 0.4 min
Discarded = 0.1 cfs @ 12.10 hrs, Volume= 1,526 cf
Primary = 1.0 cfs @ 12.10 hrs, Volume= 1,830 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 93.13' @ 12.10 hrs Surf.Area= 720 sf Storage= 575 cf

Plug-Flow detention time= 28.8 min calculated for 3,355 cf (100% of inflow)
Center-of-Mass det. time= 28.8 min (897.0 - 868.2)

Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	1,355 cf	**Rain Garden P6 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
92.00	318	80.0	0	0	318
93.00	670	122.0	483	483	1,001
94.00	1,091	141.0	872	1,355	1,419

Device	Routing	Invert	Outlet Devices
#1	Primary	92.00'	**12.0" Round Culvert** L= 112.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.00' / 87.50' S= 0.0402 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	92.20'	**3.0" Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	92.50'	**4.0" Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	93.00'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	92.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.1 cfs @ 12.10 hrs HW=93.13' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=1.0 cfs @ 12.10 hrs HW=93.13' TW=80.64' (Dynamic Tailwater)
└**1=Culvert** (Passes 1.0 cfs of 2.4 cfs potential flow)
  ├**2=Orifice/Grate-2yr** (Orifice Controls 0.2 cfs @ 4.32 fps)
  ├**3=Orifice/Grate-10yr** (Orifice Controls 0.3 cfs @ 3.28 fps)
  └**4=Orifice/Grate-25yr** (Weir Controls 0.5 cfs @ 1.18 fps)

Summary for Pond P7:

Inflow Area = 11,874 sf, 20.60% Impervious, Inflow Depth = 2.95" for 25-Year event
Inflow = 0.8 cfs @ 12.18 hrs, Volume= 2,918 cf
Outflow = 0.2 cfs @ 12.41 hrs, Volume= 2,918 cf, Atten= 71%, Lag= 14.2 min
Discarded = 0.0 cfs @ 12.41 hrs, Volume= 1,739 cf
Primary = 0.2 cfs @ 12.41 hrs, Volume= 1,178 cf
Routed to Reach DP4 : Off-Site Southeast

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 82.91' @ 12.41 hrs Surf.Area= 709 sf Storage= 822 cf

Plug-Flow detention time= 96.0 min calculated for 2,918 cf (100% of inflow)
Center-of-Mass det. time= 96.0 min (970.3 - 874.3)

Volume	Invert	Avail.Storage	Storage Description
#1	81.00'	1,798 cf	**Rain Garden (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
81.00	194	55.0	0	0	194
82.00	436	86.0	307	307	549
83.00	741	105.0	582	889	853
84.00	1,089	125.0	909	1,798	1,237

Device	Routing	Invert	Outlet Devices
#1	Primary	81.00'	**8.0" Round Culvert** L= 29.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 81.00' / 80.00' S= 0.0345 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Device 1	81.90'	**2.0" Vert. Orifice/Grate 10-yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	82.60'	**3.0" Vert. Orifice/Grate 25-yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	83.30'	**12.0" Horiz. Orifice/Grate 100-yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	81.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.41 hrs HW=82.91' (Free Discharge)
└─**5=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.41 hrs HW=82.91' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.2 cfs of 1.7 cfs potential flow)
  ├─**2=Orifice/Grate 10-yr** (Orifice Controls 0.1 cfs @ 4.63 fps)
  ├─**3=Orifice/Grate 25-yr** (Orifice Controls 0.1 cfs @ 2.06 fps)
  └─**4=Orifice/Grate 100-yr** (Controls 0.0 cfs)

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 PS-7: Runoff Area=11,874 sf 20.60% Impervious Runoff Depth=4.44"
Flow Length=95' Slope=0.0200 '/' Tc=10.0 min CN=69 Runoff=1.3 cfs 4,397 cf

Subcatchment PS-N1: PS-N1 Runoff Area=42,026 sf 21.66% Impervious Runoff Depth=4.44"
Flow Length=204' Tc=10.0 min CN=69 Runoff=4.5 cfs 15,561 cf

Subcatchment PS-N2: Runoff Area=9,120 sf 57.13% Impervious Runoff Depth=5.96"
Tc=10.0 min CN=82 Runoff=1.3 cfs 4,533 cf

Subcatchment PS-N3: Site Runoff Area=51,063 sf 37.90% Impervious Runoff Depth=5.14"
Tc=0.0 min CN=75 Runoff=8.6 cfs 21,876 cf

Subcatchment PS-N4: Runoff Area=28,998 sf 35.50% Impervious Runoff Depth=5.02"
Tc=10.0 min CN=74 Runoff=3.5 cfs 12,141 cf

Subcatchment PS-N5: Runoff Area=13,982 sf 36.60% Impervious Runoff Depth=5.14"
Tc=6.0 min CN=75 Runoff=2.0 cfs 5,990 cf

Subcatchment PS-N6: Runoff Area=14,114 sf 18.29% Impervious Runoff Depth=4.33"
Tc=0.0 min CN=68 Runoff=2.1 cfs 5,090 cf

Subcatchment PS1: Runoff Area=2,750 sf 15.45% Impervious Runoff Depth=4.21"
Tc=10.0 min CN=67 Runoff=0.3 cfs 965 cf

Subcatchment PS2: Runoff Area=78,530 sf 2.48% Impervious Runoff Depth=3.19"
Flow Length=553' Tc=6.4 min CN=58 Runoff=7.0 cfs 20,889 cf

Subcatchment PS3: Runoff Area=21,059 sf 0.00% Impervious Runoff Depth=3.19"
Flow Length=728' Tc=14.5 min CN=58 Runoff=1.3 cfs 5,602 cf

Subcatchment PS4: Runoff Area=24,109 sf 0.00% Impervious Runoff Depth=2.97"
Flow Length=315' Tc=16.7 min CN=56 Runoff=1.3 cfs 5,967 cf

Subcatchment PS5: Runoff Area=8,836 sf 0.00% Impervious Runoff Depth=3.08"
Flow Length=172' Tc=26.2 min CN=57 Runoff=0.4 cfs 2,268 cf

Reach DP1: School St Inflow=0.3 cfs 965 cf
Outflow=0.3 cfs 965 cf

Reach DP2: Off-Site West Inflow=7.0 cfs 20,889 cf
Outflow=7.0 cfs 20,889 cf

Reach DP3: Off-Site South Inflow=8.2 cfs 31,689 cf
Outflow=8.2 cfs 31,689 cf

Reach DP4: Off-Site Southeast Inflow=1.8 cfs 8,336 cf
Outflow=1.8 cfs 8,336 cf

Reach DP5: Off-Site East Inflow=0.4 cfs 2,268 cf
Outflow=0.4 cfs 2,268 cf

Pond P1: Peak Elev=92.92' Storage=2,530 cf Inflow=4.5 cfs 15,561 cf
Discarded=0.3 cfs 9,786 cf Primary=2.1 cfs 5,775 cf Outflow=2.3 cfs 15,561 cf

Pond P2: Peak Elev=85.66' Storage=543 cf Inflow=1.3 cfs 4,533 cf
Discarded=0.0 cfs 2,291 cf Primary=1.2 cfs 2,242 cf Outflow=1.2 cfs 4,533 cf

Pond P4: Peak Elev=81.99' Storage=8,340 cf Inflow=16.0 cfs 48,630 cf
Discarded=0.9 cfs 22,542 cf Primary=6.9 cfs 26,088 cf Outflow=7.8 cfs 48,630 cf

Pond P5: Peak Elev=99.49' Storage=853 cf Inflow=2.0 cfs 5,990 cf
Discarded=0.1 cfs 2,721 cf Primary=1.9 cfs 3,269 cf Outflow=1.9 cfs 5,990 cf

Pond P6: Peak Elev=93.26' Storage=667 cf Inflow=2.1 cfs 5,090 cf
Discarded=0.1 cfs 1,763 cf Primary=1.9 cfs 3,327 cf Outflow=1.9 cfs 5,090 cf

Pond P7: Peak Elev=83.37' Storage=1,188 cf Inflow=1.3 cfs 4,397 cf
Discarded=0.1 cfs 2,028 cf Primary=0.5 cfs 2,369 cf Outflow=0.6 cfs 4,397 cf

Total Runoff Area = 306,461 sf Runoff Volume = 105,279 cf Average Runoff Depth = 4.12"
81.57% Pervious = 249,983 sf 18.43% Impervious = 56,478 sf

Summary for Subcatchment PS-7:

Runoff = 1.3 cfs @ 12.17 hrs, Volume= 4,397 cf, Depth= 4.44"
Routed to Pond P7 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
2,446	98	Roofs, HSG B
9,428	61	>75% Grass cover, Good, HSG B
11,874	69	Weighted Average
9,428		79.40% Pervious Area
2,446		20.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.18		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.10"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow, Roof Drain Pipe** Paved Kv= 20.3 fps
9.0					**Direct Entry, Adjustment for 0.16 hr**
10.0	95	Total			

Summary for Subcatchment PS-N1: PS-N1

Runoff = 4.5 cfs @ 12.17 hrs, Volume= 15,561 cf, Depth= 4.44"
Routed to Pond P1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

	Area (sf)	CN	Description
	8,115	98	Paved parking, HSG B
	32,925	61	>75% Grass cover, Good, HSG B
*	986	98	Roofs, HSG B
	42,026	69	Weighted Average
	32,925		78.34% Pervious Area
	9,101		21.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3					**Direct Entry, Adjusted 0.1 hr**
1.1	50	0.0060	0.73		**Sheet Flow, Sheet Flow** Smooth surfaces n= 0.011 P2= 3.10"
0.6	154	0.0380	3.96		**Shallow Concentrated Flow, Shallow** Paved Kv= 20.3 fps
10.0	204	Total			

Summary for Subcatchment PS-N2:

Runoff = 1.3 cfs @ 12.17 hrs, Volume= 4,533 cf, Depth= 5.96"
Routed to Pond P2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
5,210	98	Roofs, HSG B
3,910	61	>75% Grass cover, Good, HSG B
9,120	82	Weighted Average
3,910		42.87% Pervious Area
5,210		57.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment for 0.1 hr**

Summary for Subcatchment PS-N3: Site

Runoff = 8.6 cfs @ 12.09 hrs, Volume= 21,876 cf, Depth= 5.14"
Routed to Pond P4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
31,712	61	>75% Grass cover, Good, HSG B
14,512	98	Paved parking, HSG B
4,839	98	Roofs, HSG B
51,063	75	Weighted Average
31,712		62.10% Pervious Area
19,351		37.90% Impervious Area

Summary for Subcatchment PS-N4:

Runoff = 3.5 cfs @ 12.17 hrs, Volume= 12,141 cf, Depth= 5.02"
Routed to Pond P4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
18,703	61	>75% Grass cover, Good, HSG B
10,295	98	Paved parking, HSG B
28,998	74	Weighted Average
18,703		64.50% Pervious Area
10,295		35.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment for 0.16 hrs**

Summary for Subcatchment PS-N5:

Runoff = 2.0 cfs @ 12.13 hrs, Volume= 5,990 cf, Depth= 5.14"
Routed to Pond P5 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
5,117	98	Roofs, HSG B
8,865	61	>75% Grass cover, Good, HSG B
13,982	75	Weighted Average
8,865		63.40% Pervious Area
5,117		36.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Adjustment to 0.1 hr**

Summary for Subcatchment PS-N6:

Runoff = 2.1 cfs @ 12.09 hrs, Volume= 5,090 cf, Depth= 4.33"
Routed to Pond P6 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
2,582	98	Roofs, HSG B
11,532	61	>75% Grass cover, Good, HSG B
14,114	68	Weighted Average
11,532		81.71% Pervious Area
2,582		18.29% Impervious Area

Summary for Subcatchment PS1:

Runoff = 0.3 cfs @ 12.17 hrs, Volume= 965 cf, Depth= 4.21"
Routed to Reach DP1 : School St

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
2,325	61	>75% Grass cover, Good, HSG B
425	98	Paved parking, HSG B
2,750	67	Weighted Average
2,325		84.55% Pervious Area
425		15.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry, Adjustment to 0.16 hr**

Summary for Subcatchment PS2:

Runoff = 7.0 cfs @ 12.14 hrs, Volume= 20,889 cf, Depth= 3.19"
Routed to Reach DP2 : Off-Site West

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
1,951	98	Roofs, HSG B
31,697	61	>75% Grass cover, Good, HSG B
44,882	55	Woods, Good, HSG B
78,530	58	Weighted Average
76,579		97.52% Pervious Area
1,951		2.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0600	0.23		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"
0.4	100	0.0700	4.26		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.6	303	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
6.4	553	Total			

Summary for Subcatchment PS3:

Runoff = 1.3 cfs @ 12.23 hrs, Volume= 5,602 cf, Depth= 3.19"
Routed to Reach DP3 : Off-Site South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
11,614	61	>75% Grass cover, Good, HSG B
9,445	55	Woods, Good, HSG B
21,059	58	Weighted Average
21,059		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	50	0.0100	0.08		**Sheet Flow, Sheet Flow** Grass: Dense n= 0.240 P2= 3.10"
1.8	359	0.0440	3.38		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.7	319	0.0390	3.18		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
14.5	728	Total			

Summary for Subcatchment PS4:

Runoff = 1.3 cfs @ 12.26 hrs, Volume= 5,967 cf, Depth= 2.97"
Routed to Reach DP4 : Off-Site Southeast

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

	Area (sf)	CN	Description
	20,799	55	Woods, Good, HSG B
*	3,310	61	>75% Grass cover, Good, HSG B
	24,109	56	Weighted Average
	24,109		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	50	0.0440	0.05		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.10"
0.8	265	0.1100	5.34		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
16.7	315	Total			

Summary for Subcatchment PS5:

Runoff = 0.4 cfs @ 12.37 hrs, Volume= 2,268 cf, Depth= 3.08"
Routed to Reach DP5 : Off-Site East

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 100-Year Rainfall=8.11"

Area (sf)	CN	Description
2,744	61	>75% Grass cover, Good, HSG B
6,092	55	Woods, Good, HSG B
8,836	57	Weighted Average
8,836		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.2	50	0.0140	0.03		**Sheet Flow, Sheet Flow** Woods: Dense underbrush n= 0.800 P2= 3.10"
1.0	122	0.0150	1.97		**Shallow Concentrated Flow, Shallow** Unpaved Kv= 16.1 fps
26.2	172	Total			

Summary for Reach DP1: School St

Inflow Area = 2,750 sf, 15.45% Impervious, Inflow Depth = 4.21" for 100-Year event
Inflow = 0.3 cfs @ 12.17 hrs, Volume= 965 cf
Outflow = 0.3 cfs @ 12.17 hrs, Volume= 965 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: Off-Site West

Inflow Area = 78,530 sf, 2.48% Impervious, Inflow Depth = 3.19" for 100-Year event
Inflow = 7.0 cfs @ 12.14 hrs, Volume= 20,889 cf
Outflow = 7.0 cfs @ 12.14 hrs, Volume= 20,889 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: Off-Site South

Inflow Area = 180,362 sf, 28.64% Impervious, Inflow Depth = 2.11" for 100-Year event
Inflow = 8.2 cfs @ 12.26 hrs, Volume= 31,689 cf
Outflow = 8.2 cfs @ 12.26 hrs, Volume= 31,689 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 DP4: Off-Site Southeast

Inflow Area = 35,983 sf, 6.80% Impervious, Inflow Depth = 2.78" for 100-Year event
Inflow = 1.8 cfs @ 12.30 hrs, Volume= 8,336 cf
Outflow = 1.8 cfs @ 12.30 hrs, Volume= 8,336 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 DP5: Off-Site East

Inflow Area = 8,836 sf, 0.00% Impervious, Inflow Depth = 3.08" for 100-Year event
Inflow = 0.4 cfs @ 12.37 hrs, Volume= 2,268 cf
Outflow = 0.4 cfs @ 12.37 hrs, Volume= 2,268 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 Pond P1:

Inflow Area = 42,026 sf, 21.66% Impervious, Inflow Depth = 4.44" for 100-Year event
Inflow = 4.5 cfs @ 12.17 hrs, Volume= 15,561 cf
Outflow = 2.3 cfs @ 12.30 hrs, Volume= 15,561 cf, Atten= 48%, Lag= 7.6 min
Discarded = 0.3 cfs @ 12.30 hrs, Volume= 9,786 cf
Primary = 2.1 cfs @ 12.30 hrs, Volume= 5,775 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 92.92' @ 12.30 hrs Surf.Area= 1,439 sf Storage= 2,530 cf

Plug-Flow detention time= 22.2 min calculated for 15,557 cf (100% of inflow)
Center-of-Mass det. time= 22.2 min (880.3 - 858.0)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	4,348 cf	**Infiltration-Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
90.00	372	372.0	0	0	372
91.00	684	108.0	520	520	10,459
92.00	1,056	130.0	863	1,383	10,892
93.00	1,474	149.0	1,259	2,643	11,337
94.00	1,947	168.0	1,705	4,348	11,841

Device	Routing	Invert	Outlet Devices
#1	Primary	90.00'	**12.0" Round Culvert** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 90.00' / 89.20' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	91.00'	**5.0" Vert. Orifice/Grate-10yr X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	92.20'	**4.0" Vert. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	92.90'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	90.00'	**1.020 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.3 cfs @ 12.30 hrs HW=92.92' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.3 cfs)

Primary OutFlow Max=2.1 cfs @ 12.30 hrs HW=92.92' TW=81.98' (Dynamic Tailwater)
└**1=Culvert** (Passes 2.1 cfs of 4.6 cfs potential flow)
  ├**2=Orifice/Grate-10yr** (Orifice Controls 1.7 cfs @ 6.30 fps)
  ├**3=Orifice/Grate-25yr** (Orifice Controls 0.3 cfs @ 3.59 fps)
  └**4=Orifice/Grate-25yr** (Weir Controls 0.0 cfs @ 0.49 fps)

Summary for Pond P2:

Inflow Area = 9,120 sf, 57.13% Impervious, Inflow Depth = 5.96" for 100-Year event
Inflow = 1.3 cfs @ 12.17 hrs, Volume= 4,533 cf
Outflow = 1.2 cfs @ 12.19 hrs, Volume= 4,533 cf, Atten= 3%, Lag= 1.2 min
Discarded = 0.0 cfs @ 12.19 hrs, Volume= 2,291 cf
Primary = 1.2 cfs @ 12.19 hrs, Volume= 2,242 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 85.66' @ 12.19 hrs Surf.Area= 571 sf Storage= 543 cf

Plug-Flow detention time= 54.9 min calculated for 4,532 cf (100% of inflow)
Center-of-Mass det. time= 54.9 min (873.3 - 818.4)

Volume	Invert	Avail.Storage	Storage Description
#1	84.00'	755 cf	**P1 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
84.00	114	45.0	0	0	114
85.00	375	93.0	232	232	646
86.00	687	113.0	523	755	989

Device	Routing	Invert	Outlet Devices
#1	Primary	84.00'	**18.0" Round Culvert** L= 135.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 84.00' / 81.97' S= 0.0150 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf
#2	Device 1	85.00'	**3.0" Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	85.45'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Discarded	84.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.0 cfs @ 12.19 hrs HW=85.66' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=1.2 cfs @ 12.19 hrs HW=85.66' TW=81.88' (Dynamic Tailwater)
└**1=Culvert** (Passes 1.2 cfs of 6.4 cfs potential flow)
  ├**2=Orifice/Grate-2yr** (Orifice Controls 0.2 cfs @ 3.53 fps)
  └**3=Orifice/Grate-25yr** (Weir Controls 1.0 cfs @ 1.51 fps)

Summary for Pond P4:

Inflow Area = 159,303 sf, 32.43% Impervious, Inflow Depth = 3.66" for 100-Year event
Inflow = 16.0 cfs @ 12.09 hrs, Volume= 48,630 cf
Outflow = 7.8 cfs @ 12.27 hrs, Volume= 48,630 cf, Atten= 51%, Lag= 11.2 min
Discarded = 0.9 cfs @ 12.27 hrs, Volume= 22,542 cf
Primary = 6.9 cfs @ 12.27 hrs, Volume= 26,088 cf
Routed to Reach DP3 : Off-Site South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 81.99' @ 12.27 hrs Surf.Area= 3,839 sf Storage= 8,340 cf

Plug-Flow detention time= 16.1 min calculated for 48,616 cf (100% of inflow)
Center-of-Mass det. time= 16.1 min (835.6 - 819.6)

Volume	Invert	Avail.Storage	Storage Description
#1	79.00'	12,611 cf	**Infiltration Basin (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
79.00	1,850	170.0	0	0	1,850
80.00	2,436	205.0	2,136	2,136	2,911
81.00	3,112	235.0	2,767	4,903	3,984
82.00	3,846	254.0	3,473	8,376	4,763
83.00	4,637	273.0	4,235	12,611	5,602

Device	Routing	Invert	Outlet Devices
#1	Primary	79.00'	**15.0" Round 15" Pipe** L= 66.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 79.00' / 76.00' S= 0.0455 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf
#2	Device 1	79.20'	**8.0" W x 3.0" H Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	79.65'	**14.0" W x 5.0" H Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	80.90'	**12.0" W x 5.0" H Vert. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Device 1	81.90'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#6	Discarded	79.00'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.9 cfs @ 12.27 hrs HW=81.99' (Free Discharge)
└**6=Exfiltration** (Exfiltration Controls 0.9 cfs)

Primary OutFlow Max=6.9 cfs @ 12.27 hrs HW=81.99' TW=0.00' (Dynamic Tailwater)
└**1=15" Pipe** (Passes 6.9 cfs of 7.2 cfs potential flow)
- **2=Orifice/Grate-2yr** (Orifice Controls 1.3 cfs @ 7.86 fps)
- **3=Orifice/Grate-10yr** (Orifice Controls 3.4 cfs @ 7.03 fps)
- **4=Orifice/Grate-25yr** (Orifice Controls 1.9 cfs @ 4.51 fps)
- **5=Broad-Crested Rectangular Weir** (Weir Controls 0.3 cfs @ 0.84 fps)

Summary for Pond P5:

Inflow Area = 13,982 sf, 36.60% Impervious, Inflow Depth = 5.14" for 100-Year event
Inflow = 2.0 cfs @ 12.13 hrs, Volume= 5,990 cf
Outflow = 1.9 cfs @ 12.15 hrs, Volume= 5,990 cf, Atten= 6%, Lag= 1.3 min
Discarded = 0.1 cfs @ 12.15 hrs, Volume= 2,721 cf
Primary = 1.9 cfs @ 12.15 hrs, Volume= 3,269 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 99.49' @ 12.15 hrs Surf.Area= 804 sf Storage= 853 cf

Plug-Flow detention time= 76.7 min calculated for 5,988 cf (100% of inflow)
Center-of-Mass det. time= 76.7 min (913.5 - 836.7)

Volume	Invert	Avail.Storage	Storage Description
#1	98.00'	1,309 cf	**P5 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
98.00	361	77.0	0	0	361
99.00	650	102.0	498	498	728
100.00	983	125.0	811	1,309	1,159

Device	Routing	Invert	Outlet Devices
#1	Primary	98.00'	**12.0" Round Culvert** L= 195.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 98.00' / 89.00' S= 0.0462 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	98.90'	**4.0" Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	99.20'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#4	Discarded	98.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.1 cfs @ 12.15 hrs HW=99.49' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=1.9 cfs @ 12.15 hrs HW=99.49' TW=81.73' (Dynamic Tailwater)
└**1=Culvert** (Passes 1.9 cfs of 3.0 cfs potential flow)
  ├**2=Orifice/Grate-10yr** (Orifice Controls 0.3 cfs @ 3.13 fps)
  └**3=Orifice/Grate-25yr** (Weir Controls 1.6 cfs @ 1.76 fps)

Summary for Pond P6:

Inflow Area = 14,114 sf, 18.29% Impervious, Inflow Depth = 4.33" for 100-Year event
Inflow = 2.1 cfs @ 12.09 hrs, Volume= 5,090 cf
Outflow = 1.9 cfs @ 12.09 hrs, Volume= 5,090 cf, Atten= 6%, Lag= 0.0 min
Discarded = 0.1 cfs @ 12.09 hrs, Volume= 1,763 cf
Primary = 1.9 cfs @ 12.09 hrs, Volume= 3,327 cf
Routed to Pond P4 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 93.26' @ 12.09 hrs Surf.Area= 768 sf Storage= 667 cf

Plug-Flow detention time= 24.4 min calculated for 5,089 cf (100% of inflow)
Center-of-Mass det. time= 24.4 min (876.0 - 851.7)

Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	1,355 cf	**Rain Garden P6 (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
92.00	318	80.0	0	0	318
93.00	670	122.0	483	483	1,001
94.00	1,091	141.0	872	1,355	1,419

Device	Routing	Invert	Outlet Devices
#1	Primary	92.00'	**12.0" Round Culvert** L= 112.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 92.00' / 87.50' S= 0.0402 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Device 1	92.20'	**3.0" Vert. Orifice/Grate-2yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	92.50'	**4.0" Vert. Orifice/Grate-10yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	93.00'	**12.0" Horiz. Orifice/Grate-25yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	92.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.1 cfs @ 12.09 hrs HW=93.25' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=1.9 cfs @ 12.09 hrs HW=93.25' TW=81.43' (Dynamic Tailwater)
└**1=Culvert** (Passes 1.9 cfs of 2.6 cfs potential flow)
  ├**2=Orifice/Grate-2yr** (Orifice Controls 0.2 cfs @ 4.64 fps)
  ├**3=Orifice/Grate-10yr** (Orifice Controls 0.3 cfs @ 3.69 fps)
  └**4=Orifice/Grate-25yr** (Weir Controls 1.3 cfs @ 1.65 fps)

Summary for Pond P7:

Inflow Area = 11,874 sf, 20.60% Impervious, Inflow Depth = 4.44" for 100-Year event
Inflow = 1.3 cfs @ 12.17 hrs, Volume= 4,397 cf
Outflow = 0.6 cfs @ 12.32 hrs, Volume= 4,397 cf, Atten= 55%, Lag= 8.9 min
Discarded = 0.1 cfs @ 12.32 hrs, Volume= 2,028 cf
Primary = 0.5 cfs @ 12.32 hrs, Volume= 2,369 cf
Routed to Reach DP4 : Off-Site Southeast

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 83.37' @ 12.32 hrs Surf.Area= 863 sf Storage= 1,188 cf

Plug-Flow detention time= 81.3 min calculated for 4,395 cf (100% of inflow)
Center-of-Mass det. time= 81.3 min (939.4 - 858.0)

Volume	Invert	Avail.Storage	Storage Description
#1	81.00'	1,798 cf	**Rain Garden (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
81.00	194	55.0	0	0	194
82.00	436	86.0	307	307	549
83.00	741	105.0	582	889	853
84.00	1,089	125.0	909	1,798	1,237

Device	Routing	Invert	Outlet Devices
#1	Primary	81.00'	**8.0" Round Culvert** L= 29.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 81.00' / 80.00' S= 0.0345 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.35 sf
#2	Device 1	81.90'	**2.0" Vert. Orifice/Grate 10-yr** C= 0.600 Limited to weir flow at low heads
#3	Device 1	82.60'	**3.0" Vert. Orifice/Grate 25-yr** C= 0.600 Limited to weir flow at low heads
#4	Device 1	83.30'	**12.0" Horiz. Orifice/Grate 100-yr** C= 0.600 Limited to weir flow at low heads
#5	Discarded	81.00'	**2.410 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.1 cfs @ 12.32 hrs HW=83.37' (Free Discharge)
└─**5=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.5 cfs @ 12.32 hrs HW=83.37' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.5 cfs of 1.9 cfs potential flow)
  ├─**2=Orifice/Grate 10-yr** (Orifice Controls 0.1 cfs @ 5.68 fps)
  ├─**3=Orifice/Grate 25-yr** (Orifice Controls 0.2 cfs @ 3.88 fps)
  └─**4=Orifice/Grate 100-yr** (Weir Controls 0.2 cfs @ 0.89 fps)

APPENDIX D:

STORMWATER

MANAGEMENT CALCULATIONS

July 31, 2024

Stormwater Management Calculations

STANDARD 3: Recharge To Groundwater: Static Method

- Calculate Impervious Area *(From HydroCAD Model)*
  New Impervious Area (HSG B Soil) = 56,478 SF

  The HydroCAD Model was designed utilizing a conservative approach. Although the sidewalk and driveways are proposed to be pervious surfaces, they were modelled as impervious.

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

Hydrologic Soil Group	Recharge Rainfall Depth
B	0.35"

- Calculate Recharge Volume
  '*Rv*' = [0.35" x (56,478SF)] / 12 SF-In = 1647.27 CF
  '*Rv*' = 1648 CF

- Calculate Provided Recharge
  Proposed Recharge System provided in infiltration basins and rain gardens:

HCAD System ID	Bottom of System	Lowest System Outlet	Total Recharge Volume Provided
P1	90	91.0	**520**
P2	84	85.0	**232**
P4	79	79.20	**381**
P5	98	98.90	**435**
P6	92	92.20	**70**
P7	81	81.90	**265**

The table above depicts the recharge volume provided measured to lowest system outlet. The total volume provided is 1903 CF.

Verify Drawdown, Maximum 72-Hours: Static Method

HCAD System ID	Recharge Volume (CF)	Bottom Surface Area (SF)	Infiltration Rate Inches/Hour	Drawdown Time Rv / (K x A) (Hours)	Description
P1	520	684	1.02	9.30	Infiltration Basin
P2	232	375	2.41	3.08	Rain Garden
P4	381	1961	8.27	0.28	Infiltration Basin
P5	435	617	2.41	3.51	Rain Garden
P6	70	378	2.41	0.92	Rain Garden
P7	265	407	2.41	0.27	Rain Garden

Design Complies with Recharge Volume Standard*

STANDARD 4: Water Quality Volume

The Town of Groveland Stormwater Management and Erosion Control Bylaw, section 14.11 requires 60% removal of Total Phosphorous and 90% of Total Suspended Solids from redevelopment sites.

The proposed development will utilize two hydrodynamic separators from Contech) to remove TSS. For Total Phosphorous, the project will install best management practices, such as infiltration basins, which can remove 60 to 70% of phosphorous, rain gardens and will hold a volume of 1,903 cubic feet of stormwater runoff. See calculations attached.

Stage-Area-Storage for Pond P1:

Elevation (feet)	Surface (sq-ft)	Wetted (sq-ft)	Storage (cubic-feet)
90.00	372	372	0
90.10	399	1,880	39
90.20	427	3,277	80
90.30	456	4,563	124
90.40	485	5,738	171
90.50	516	6,802	221
90.60	548	7,756	274
90.70	580	8,598	331
90.80	614	9,329	390
90.90	649	9,950	454
91.00	684	10,459	520
91.10	718	10,499	590
91.20	752	10,539	664
91.30	787	10,580	741
91.40	823	10,623	821
91.50	860	10,666	905
91.60	898	10,709	993
91.70	936	10,754	1,085
91.80	975	10,799	1,180
91.90	1,015	10,845	1,280
92.00	1,056	10,892	1,383
92.10	1,095	10,934	1,491
92.20	1,134	10,976	1,602
92.30	1,174	11,019	1,718
92.40	1,215	11,063	1,837
92.50	1,256	11,107	1,961
92.60	1,298	11,152	2,089
92.70	1,341	11,197	2,221
92.80	1,385	11,243	2,357
92.90	1,429	11,289	2,497
93.00	1,474	11,337	2,643
93.10	1,518	11,384	2,792
93.20	1,563	11,433	2,946
93.30	1,609	11,482	3,105
93.40	1,655	11,531	3,268
93.50	1,702	11,581	3,436
93.60	1,750	11,632	3,609
93.70	1,798	11,684	3,786
93.80	1,847	11,736	3,968
93.90	1,897	11,788	4,155
94.00	**1,947**	**11,841**	**4,348**

Stage-Area-Storage for Pond P2:

Elevation (feet)	Surface (sq-ft)	Wetted (sq-ft)	Storage (cubic-feet)
84.00	114	114	0
84.05	123	132	6
84.10	133	151	12
84.15	144	170	19
84.20	154	191	27
84.25	165	212	35
84.30	176	235	43
84.35	188	258	52
84.40	200	282	62
84.45	213	307	72
84.50	226	334	83
84.55	239	361	95
84.60	252	389	107
84.65	266	417	120
84.70	281	447	134
84.75	296	478	148
84.80	311	510	163
84.85	326	542	179
84.90	342	576	196
84.95	358	610	214
85.00	375	646	232
85.05	388	661	251
85.10	402	677	271
85.15	416	693	291
85.20	430	709	312
85.25	444	725	334
85.30	459	742	357
85.35	474	758	380
85.40	489	775	404
85.45	504	792	429
85.50	519	809	455
85.55	535	826	481
85.60	551	844	508
85.65	567	861	536
85.70	584	879	565
85.75	600	897	594
85.80	617	915	625
85.85	634	933	656
85.90	652	952	688
85.95	669	971	721
86.00	**687**	**989**	**755**

Stage-Area-Storage for Pond P4:

Elevation (feet)	Surface (sq-ft)	Wetted (sq-ft)	Storage (cubic-feet)
79.00	1,850	1,850	0
79.10	1,905	1,947	188
79.20	1,961	2,046	381
79.30	2,017	2,148	580
79.40	2,075	2,251	785
79.50	2,133	2,356	995
79.60	2,192	2,463	1,211
79.70	2,252	2,572	1,433
79.80	2,312	2,683	1,662
79.90	2,374	2,796	1,896
80.00	2,436	2,911	2,136
80.10	2,500	3,012	2,383
80.20	2,565	3,114	2,636
80.30	2,630	3,218	2,896
80.40	2,696	3,323	3,162
80.50	2,764	3,429	3,435
80.60	2,832	3,538	3,715
80.70	2,901	3,647	4,002
80.80	2,970	3,758	4,295
80.90	3,041	3,870	4,596
81.00	3,112	3,984	4,903
81.10	3,182	4,060	5,218
81.20	3,253	4,135	5,540
81.30	3,324	4,212	5,869
81.40	3,396	4,289	6,205
81.50	3,469	4,366	6,548
81.60	3,543	4,444	6,899
81.70	3,618	4,523	7,257
81.80	3,693	4,603	7,622
81.90	3,769	4,683	7,995
82.00	3,846	4,763	8,376
82.10	3,922	4,844	8,764
82.20	3,998	4,926	9,160
82.30	4,076	5,009	9,564
82.40	4,154	5,092	9,975
82.50	4,232	5,175	10,395
82.60	4,312	5,259	10,822
82.70	4,392	5,344	11,257
82.80	4,473	5,430	11,700
82.90	4,555	5,516	12,152
83.00	**4,637**	**5,602**	**12,611**

Stage-Area-Storage for Pond P5:

Elevation (feet)	Surface (sq-ft)	Wetted (sq-ft)	Storage (cubic-feet)
98.00	361	361	0
98.05	373	377	18
98.10	386	393	37
98.15	399	410	57
98.20	412	426	77
98.25	425	443	98
98.30	439	460	120
98.35	453	478	142
98.40	466	496	165
98.45	481	514	189
98.50	495	532	213
98.55	510	550	238
98.60	524	569	264
98.65	539	588	291
98.70	554	607	318
98.75	570	627	346
98.80	585	647	375
98.85	601	667	405
98.90	617	687	435
98.95	634	707	466
99.00	650	728	498
99.05	665	748	531
99.10	680	767	565
99.15	696	787	599
99.20	711	807	635
99.25	727	828	670
99.30	743	848	707
99.35	759	869	745
99.40	775	890	783
99.45	791	911	822
99.50	808	933	862
99.55	825	954	903
99.60	842	976	945
99.65	859	998	987
99.70	876	1,021	1,031
99.75	893	1,043	1,075
99.80	911	1,066	1,120
99.85	929	1,089	1,166
99.90	947	1,112	1,213
99.95	965	1,135	1,261
100.00	**983**	**1,159**	**1,309**

Stage-Area-Storage for Pond P6:

Elevation (feet)	Surface (sq-ft)	Wetted (sq-ft)	Storage (cubic-feet)
92.00	318	318	0
92.05	333	345	16
92.10	347	373	33
92.15	363	402	51
92.20	378	432	70
92.25	394	462	89
92.30	410	493	109
92.35	426	525	130
92.40	443	557	152
92.45	460	590	174
92.50	478	624	198
92.55	496	658	222
92.60	514	694	247
92.65	532	729	273
92.70	551	766	300
92.75	570	803	328
92.80	589	841	357
92.85	609	880	387
92.90	629	920	418
92.95	649	960	450
93.00	670	1,001	483
93.05	689	1,020	517
93.10	708	1,040	552
93.15	727	1,060	588
93.20	746	1,080	625
93.25	766	1,100	663
93.30	786	1,120	701
93.35	806	1,140	741
93.40	826	1,161	782
93.45	847	1,182	824
93.50	868	1,202	867
93.55	889	1,224	910
93.60	910	1,245	955
93.65	932	1,266	1,002
93.70	954	1,287	1,049
93.75	976	1,309	1,097
93.80	999	1,331	1,146
93.85	1,021	1,353	1,197
93.90	1,044	1,375	1,248
93.95	1,068	1,397	1,301
94.00	**1,091**	**1,419**	**1,355**

Stage-Area-Storage for Pond P7:

Elevation (feet)	Surface (sq-ft)	Wetted (sq-ft)	Storage (cubic-feet)
81.00	194	194	0
81.10	214	222	20
81.20	235	252	43
81.30	256	284	67
81.40	279	317	94
81.50	303	352	123
81.60	328	388	155
81.70	353	426	189
81.80	380	465	225
81.90	407	506	265
82.00	436	549	307
82.10	463	577	352
82.20	491	605	400
82.30	519	634	450
82.40	548	663	503
82.50	578	693	560
82.60	609	724	619
82.70	641	755	682
82.80	674	787	747
82.90	707	820	816
83.00	741	853	889
83.10	773	888	964
83.20	805	924	1,043
83.30	838	961	1,126
83.40	872	999	1,211
83.50	907	1,037	1,300
83.60	942	1,075	1,392
83.70	978	1,115	1,488
83.80	1,014	1,155	1,588
83.90	1,051	1,195	1,691
84.00	**1,089**	**1,237**	**1,798**

THE MORIN-CAMERON GROUP, INC.
25 Kenoza Avenue,
Haverhill, MA 01830
p | 978.373.0310 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for P1

Name:
Location: 181R School St
Groveland, MA
County: Essex
Applicant: Groveland Redevelopment, LLC

Proj. No.: 3634
Date: 7/30/2024
Revised:
Computed by: Leticia Oliveira
Checked by: Scott P. Cameron, 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)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Proprietary Treatment Practice	**0.95**	**0.75**	**0.71**	**0.04**
Infiltration Basin	**0.80**	**0.04**	**0.03**	**0.01**
	0.00	**0.01**	**0.00**	**0.01**
	0.00	**0.01**	**0.00**	**0.01**

Total TSS Removal = **99%**

Note: Subsurface Infiltration Structures are precast concrete galleys

*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.
25 Kenoza Avenue,
Haverhill, MA 01830
p | 978.373.0310 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for P4

Name:
Location: 181R School St
Groveland, MA
County: Essex
Applicant: Groveland Redevelopment, LLC

Proj. No.: 3634
Date: 7/30/2024
Revised:
Computed by: Leticia Oliveira
Checked by: Scott P. Cameron, 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)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Proprietary Treatment Practice	**0.94**	**0.75**	**0.70**	**0.05**
Infiltration Basin	**0.80**	**0.05**	**0.04**	**0.01**
	0.00	**0.01**	**0.00**	**0.01**
	0.00	**0.01**	**0.00**	**0.01**

Total TSS Removal = **99%**

Note: Subsurface Infiltration Structures are precast concrete galleys

*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

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

181R SCHOOL ST SUBDIVISION
GROVELAND, MA

Area	**0.18 ac**	Unit Site Designation	**WQU 1**
Weighted C	**0.9**	Rainfall Station #	**67**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.08	41.0%	41.0%	0.01	0.01	39.5
0.16	23.9%	64.9%	0.03	0.03	22.8
0.24	11.5%	76.5%	0.04	0.04	10.9
0.32	7.4%	83.9%	0.05	0.05	7.0
0.40	4.4%	88.3%	0.06	0.06	4.1
0.48	2.9%	91.2%	0.08	0.08	2.7
0.56	1.8%	93.0%	0.09	0.09	1.6
0.64	1.2%	94.2%	0.10	0.10	1.1
0.72	1.6%	95.8%	0.12	0.12	1.4
0.80	0.8%	96.6%	0.13	0.13	0.7
1.00	0.6%	97.1%	0.16	0.16	0.5
1.40	1.4%	98.6%	0.23	0.23	1.2
1.80	0.9%	99.5%	0.29	0.29	0.7
2.20	0.5%	100.0%	0.36	0.36	0.4
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					94.5
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	100.0%
				Predicted Net Annual Load Removal Efficiency =	**94.5%**

1 - Based on 7 years of data from NCDC station #3276, Groveland, Essex County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

181R SCHOOL ST SUBDIVISION GROVELAND, MA

Area	**0.24 ac**	Unit Site Designation	**WQU 2**
Weighted C	**0.9**	Rainfall Station #	**67**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.08	41.0%	41.0%	0.02	0.02	39.4
0.16	23.9%	64.9%	0.03	0.03	22.7
0.24	11.5%	76.5%	0.05	0.05	10.8
0.32	7.4%	83.9%	0.07	0.07	6.9
0.40	4.4%	88.3%	0.09	0.09	4.1
0.48	2.9%	91.2%	0.10	0.10	2.6
0.56	1.8%	93.0%	0.12	0.12	1.6
0.64	1.2%	94.2%	0.14	0.14	1.0
0.72	1.6%	95.8%	0.16	0.16	1.4
0.80	0.8%	96.6%	0.17	0.17	0.7
1.00	0.6%	97.1%	0.22	0.22	0.5
1.40	1.4%	98.6%	0.30	0.30	1.1
1.80	0.9%	99.5%	0.39	0.39	0.6
2.20	0.5%	100.0%	0.48	0.48	0.3
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					93.6
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	100.0%
				Predicted Net Annual Load Removal Efficiency =	**93.6%**

1 - Based on 7 years of data from NCDC station #3276, Groveland, Essex County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Project: 181R School St Subdivision
Location: Groveland, MA
Prepared For: The Morin-Cameron Group

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
WQU 1	0.18	0.0002813	6.0	0.100	1.00	774.00	0.22
WQU 2	0.24	0.0003750	6.0	0.100	1.00	774.00	0.29

The WQf sizing calculation selects the minimum size CDS/Cascade/StormCeptor model capable of operating at the computed WQf peak flowrate prior to bypassing. It assumes free discharge of the WQf through the unit and ignores the routing effect of any upstream storm drain piping. As with all hydrodynamic separators, there will be some impact to the Hydraulic Gradient of the corresponding drainage system, and evaluation of this impact should be considered in the design.

VERIFY PIP+A12:X67E CAPACITY-100 YEAR STORM

Pipe Sizing Calculation Spreadsheet:

THE MORIN-CAMERON GROUP, INC.
66 Elm Street
Danvers, MA 01923
P: (978) 777-8586
F: (978) 774-3488
W: www.morincameron.com

Name: Groveland Subdivision
Location: 181R School St
Groveland, MA
County: Essex County

Proj. No.: 3634
Date: 7/24/2024
Revised:
Computed by: Leticia Oliveira
Checked by: Scott P, Cameron, P.E.

Design Parameters:
IDF Curve
25 **Year Storm** Boston, MA
k_e= **0.2**

DESCRIPTION	LOCATION		AREA (AC.)	C	C x A	SUM C x A	FLOW TIME (MIN)		i*	DESIGN					CAPACITY		PIPE PROFILE				
	FROM	TO					PIPE	CONC. TIME		Q cfs	V fps	n	PIPE SIZE	SLOPE	Q full ft^3/s	V full ft/s	LENGTH ft	FALL ft	RIM	INV UPPER	INV LOWER
CB-1	CB-1	WQU-1	0.23	0.50	0.11	0.11	0.08	10.0	4.9	0.6	3.5	0.012	12	0.020	5.5	6.9	17	0.34	97.55	93.50	93.10
CB-2	CB-2	WQU-1	0.32	0.56	0.18	0.18	0.07	10.0	4.9	0.9	4.2	0.012	12	0.020	5.5	6.9	17	0.34	97.55	93.50	93.10
WQU-1	WQU-1	P1	-	-	-	0.30	0.17	10.1	4.9	1.4	4.9	0.012	12	0.020	5.5	6.9	50	1.00	97.14	91.04	90.00
P1	P1	DMH-1	-	-	-	-	0.30	10.0	4.9	1.1	4.5	0.012	12	0.020	5.5	6.9	82	1.64	94.00	90.00	88.36
P5	P5	DMH-1	-	-	-	-	0.68	10.0	4.9	0.7	4.8	0.012	12	0.040	7.7	9.8	197	7.88	100.00	97.00	89.12
P6	P6	DMH-1	-	-	-	-	0.53	10.0	4.9	0.6	3.5	0.012	12	0.020	5.5	6.9	112	2.24	94.00	92.00	89.76
DMH-1	DMH-1	DMH-2	-	-	-	-	0.15	10.7	4.8	2.4	7.3	0.012	12	0.041	7.8	9.9	64	2.60	91.92	87.70	85.10
CB-3	CB-3	DMH-2	0.30	0.56	0.17	0.17	0.03	10.0	4.9	0.8	4.1	0.012	12	0.020	5.5	6.9	8	0.16	89.40	85.20	85.04
CB-4	CB-4	DMH-2	0.36	0.53	0.19	0.19	0.04	10.0	4.9	0.9	4.2	0.012	12	0.020	5.5	6.9	9	0.18	89.40	85.20	85.02
P2	P2	DMH-2	-	-	-	-	0.72	10.0	4.9	2.0	3.3	0.012	12	0.005	2.7	3.5	142	0.71	86.00	84.00	82.58
DMH-2	DMH-2	WQU-2	-	-	-	0.36	0.38	10.0	4.9	3.8	6.4	0.012	12	0.019	5.4	6.9	148	2.88	89.10	82.48	79.60
CB-5	CB-5	WQU-2	0.85	0.56	0.48	0.48	0.17	5.0	6.0	2.9	5.3	0.012	12	0.015	4.7	5.9	55	0.80	83.90	79.90	79.10
WQU-2	WQU-2	P4	-	-	-	-	0.08	6.0	5.7	6.7	9.2	0.012	15	0.037	13.5	11.0	46	1.70	84.00	79.70	78.00

Weighted Runoff Coefficients "C" for Rational Method

THE MORIN-CAMERON GROUP, INC.

66 Elm Street
Danvers, MA 01923
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F: (978) 774-3488
W: www.morincameron.com

C'- Coefficients

Pervious Soil	0.35
Impervious	0.9

Description of Area CB-1	Area (acres)	Runoff Coefficient	A x C
Pervious	0.169	0.35	0.06
Impervious	0.062	0.90	0.06
Totals =	**0.231**		0.11

Weighted Runoff Coefficient = **S(AxC) / SA = 0.50**

Description of Area CB-2	Area (acres)	Runoff Coefficient	A x C
Pervious	0.199	0.35	0.07
Impervious	0.123	0.90	0.11
Totals =	**0.322**		0.18

Weighted Runoff Coefficient = **S(AxC) / SA = 0.56**

Description of Area CB-3	Area (acres)	Runoff Coefficient	A x C
Pervious	0.184	0.35	0.06
Impervious	0.118	0.90	0.11
Totals =	**0.302**		0.17

Weighted Runoff Coefficient = **S(AxC) / SA = 0.56**

Description of Area CB-4	Area (acres)	Runoff Coefficient	A x C
Pervious	0.241	0.35	0.08
Impervious	0.118	0.90	0.11
Totals =	**0.359**		0.19

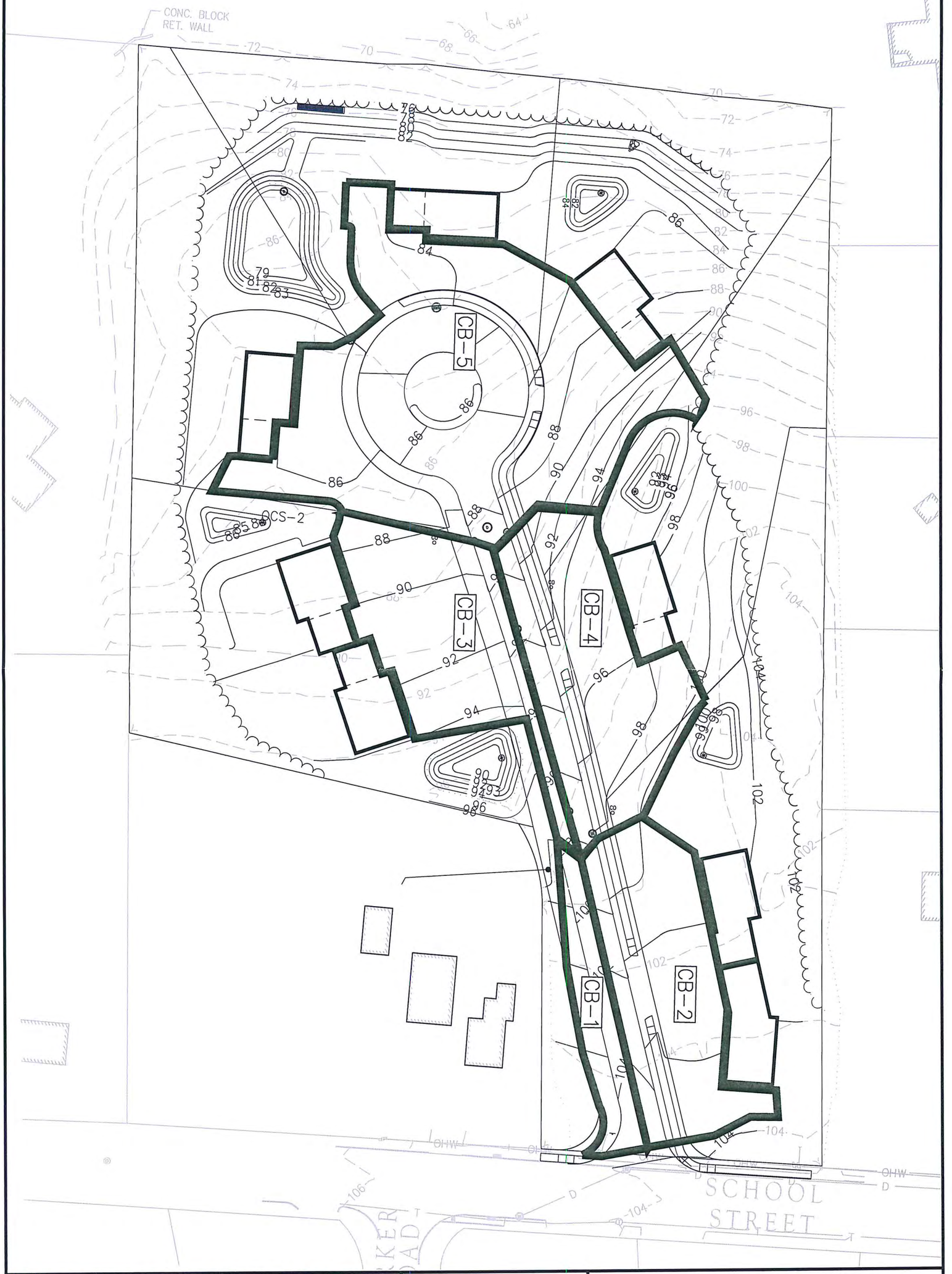
Weighted Runoff Coefficient = **S(AxC) / SA = 0.53**

Description of Area CB-5	Area (acres)	Runoff Coefficient	A x C
Pervious	0.519	0.35	0.18
Impervious	0.331	0.90	0.30
Totals =	**0.850**		0.48

Weighted Runoff Coefficient = **S(AxC) / SA = 0.56**

Description of Area	Area (acres)	Runoff Coefficient	A x C
Pervious			
Impervious			
Totals =	**0.000**		0.00

Weighted Runoff Coefficient = **S(AxC) / SA =**



RATIONAL CALCULATION PLAN

AT:

181R SCHOOL ST
GROVELAND, MASSACHUSETTS

PREPARED FOR

GROVELAND REDEVELOPMENT, LLC

DATE: JULY 31, 2024
SCALE: 1" = 60'

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
66 ELM STREET, DANVERS, MASSACHUSETTS 01923
P: 978-777-8586, W: WWW.MORINCAMERON.COM

DRAWING: 3634 Watersheds.dwg PROJ. #????

APPENDIX E:

CONSTRUCTION PHASE

BEST MANAGEMENT PRACTICES PLAN

Construction Period Pollution Prevention Plan

Erosion and Sedimentation will be controlled at the site by utilizing Structural Practices, Stabilization Practices, and Dust Control. These practices correspond with plans entitled "Definitive Subdivision Plan for a Street to be Named in Groveland, Massachusetts at 181R School Street (Groveland Assessors Map 34 Lot 13)"" prepared by The Morin-Cameron Group, Inc. dated July 31, 2024 .

Responsible Party Contact Information:

Stormwater Management System Owner:	Groveland Redevelopment, LLC 231 Sutton Street, Suite 1B North Andover, MA 01945 P: (978) 687-6200
Groveland Planning Board:	Groveland Town Hall 183 Main Street Groveland, MA 01834 P: (781) 665-0142

*The stormwater management system owner shall be responsible for implementation and compliance of the construction period pollution prevention plan or may choose to designate a responsible party prior to the start of construction (i.e. site contractor, site supervisor).

Structural Practices:

1) **Silt Sock** – A silt sock barrier shall be installed in accordance with the approved plans where high rates of stormwater runoff are anticipated.
   a) Installation Schedule: Prior to Start of land disturbance.
   b) Maintenance and Inspection: The site supervisor shall inspect the barrier at least once per week or after a major storm (1.0 inch of rainfall within a twenty-four-hour period). event and shall repair any damaged or affected areas of the barrier at the time they are noted. Remove sediment deposits promptly after storm events to provide adequate storage volume for the next rain and to reduce pressure on the barrier. Sediment will be removed from in front of the barrier when it becomes about 4" deep at the barrier. Take care to avoid undermining the barrier during cleanout.

(2) **Sediment Track-Out** – Stabilized Construction Entrance/Exit: Prior to the commencement of site work, crushed stone anti-tracking pads will be installed at the entrance to the site. This will prevent trucks from tracking material onto the road from the construction site. If, at any point during the project, the tracking pad becomes ineffective due to accumulation of soil, the crushed stone shall be replaced. Details for construction of the stabilized entrance can be found in the Construction Details sheet that is part of the plan set associated with the project. The site supervisor will inspect the tracking pads weekly to ensure that they are properly limiting the tracking of soil onto the road. If tracking onto the roadway is noted, it shall be removed immediately via a mechanical street sweeper.

(3) **Inlet Protection** – Inlet Protection will be utilized around the catch basin grates in the street layout in the closest down gradient structure and existing onsite catch basins. The inlet protection will allow the storm drain inlets to be used before final stabilization. This structural practice will allow early use of the drainage system. Siltsack or equivalent will be utilized for the inlet protection. Siltsack is manufactured by ACF Environmental. The telephone number is 800-448-3636. Regular flow siltsack will be utilized, and if it does not allow enough storm water flow, hi-flow siltsack will be utilized.

Silt Sack (or equivalent) Inlet Protection Inspection/Maintenance Requirements *

a) The silt sack trapping devices and the catch basins should be inspected after every rain storm and repairs made as necessary.
b) Sediment should be removed from the silt sack after the sediment has reached a maximum depth of one-half the depth of the trap.
c) Sediment should be disposed of in a suitable area and protected from erosion by either structural or vegetative means. Sediment material removed shall be disposed of in accordance with all applicable local, state, and federal regulations.
d) The silt sack must be replaced if it is ripped or torn in any way.
e) Temporary traps should be removed and the area repaired as soon as the contributing drainage area to the inlet has been completely stabilized.

Stabilization Practices:

Stabilization measures shall be implemented as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased, with the following exceptions.

- Where the initiation of stabilization measures by the 14th day after construction activity temporary or permanently cease is precluded by snow cover, stabilization measures shall be initiated as soon as practicable.
- Where construction activity will resume on a portion of the site within 21 days from when activities ceased, (e.g. the total time period that construction activity is temporarily ceased is less than 21 days) then stabilization measures do not have to be initiated on that portion of the site by the 14th day after construction activity temporarily ceased.

1) **Temporary Seeding** – Temporary seeding will allow a short-term vegetative cover on disturbed site areas that may be in danger of erosion. Temporary seeding will be done at stock piles and disturbed portions of the site where construction activity will temporarily cease for at least 21 days. The temporary seedings will stabilize cleared and unvegetated areas that will not be brought into final grade for several weeks or months.

   Temporary Seeding Planting Procedures *

   a) Planting should preferably be done between April 1st and June 30th, and September 1st through September 31st. If planting is done in the months of July and August, irrigation may be required. If planting is done between October 1st and March 31st, mulching should be applied immediately after planting. If seeding is done during the summer months, irrigation of some sort will probably be necessary.
   b) Before seeding, install structural practice controls. Utilize Amoco supergro or equivalent.
   c) Select the appropriate seed species for temporary cover from the following table.

Species	Seeding Rate (lbs/1,000 sq.ft.)	Seeding Rate (lbs/acre)	Recommended Seeding Dates	Seed Cover required
Annual Ryegrass	1	40	April 1st to June 1st August 15th to Sept. 15th	¼ inch
Foxtail Millet	0.7	30	May 1st to June 30th	½ to ¾ inch
Oats	2	80	April 1st to July 1st August 15th to Sept. 15th	1 to 1-½ inch
Winter Rye	3	120	August 15th to Oct. 15th	1 to 1-½ inch

Apply the seed uniformly by hydroseeding, broadcasting, or by hand.

d) Use effective mulch, such as clean grain straw; tacked and/or tied with netting to protect seedbed and encourage plant growth.

Temporary Seeding Inspection/Maintenance *

a) Inspect within 6 weeks of planting to see if stands are adequate. Check for damage within 24 hours of the end to a heavy rainfall, defined as a 2-year storm event (i.e., 3.2 inches of rainfall within a twenty-four hour period). Stands should be uniform and dense. Reseed and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary.
b) Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather. Water application rates should be controlled to prevent runoff.

2) **Geotextiles** - Geotextiles such as jute netting will be used in combination with other practices such as mulching to stabilize slopes. The following geotextile materials or equivalent are to be utilized for structural and nonstructural controls as shown in the following table.

Practice	Manufacturer	Product	Remarks
Sediment Fence	Amoco	Woven polypropylene 1198 or equivalent	0.425 mm opening
Construction Entrance	Amoco	Woven polypropylene 2002 or equivalent	0.300 mm opening
Outlet Protection	Amoco	Nonwoven polypropylene 4551 or equivalent	0.150 mm opening
Erosion Control (slope stability)	Amoco	Supergro or equivalent	Erosion control revegetation mix, open polypropylene fiber on degradable polypropylene net scrim

Amoco may be reached at (800) 445-7732

Geotextile Installation

a) Netting and matting require firm, continuous contact between the materials and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material.

Geotextile Inspection/Maintenance *

a) In the field, regular inspections should be made to check for cracks, tears, or breaches in the fabric. The appropriate repairs should be made.

3) **Mulching and Netting** – Mulching will provide immediate protection to exposed soils during the period of short construction delays, or over winter months through the

application of plant residues, or other suitable materials, to exposed soil areas. In areas, which have been seeded either for temporary or permanent cover, mulching should immediately follow seeding. On steep slopes, mulch must be supplemented with netting. The preferred mulching material is straw.

Mulch (Straw) Materials and Installation

a) Straw has been found to be one of the most effective organic mulch materials. The specifications for straw are described below, but other material may be appropriate. The straw should be air-dried; free of undesirable seeds & coarse materials. The application rate per 1,000 sq.ft. is 90-100 lbs. (2-3 bales) and the application rate per acre is 2 tons (100-120 bales). The application should cover about 90% of the surface. The use of straw mulch is appropriate where mulch is maintained for more than three months. Straw mulch is subject to wind blowing unless anchored, is the most commonly used mulching material, and has the best microenvironment for germinating seeds.

Mulch Maintenance *

a) Inspect after rainstorms to check for movement of mulch or erosion. If washout, breakage, or erosion occurs, repair surface, reseed, remulch, and install new netting.
b) Straw or grass mulches that blow or wash away should be repaired promptly.
c) If plastic netting is used to anchor mulch, care should be taken during initial mowings to keep the mower height high. Otherwise, the netting can wrap up on the mower blade shafts. After a period of time, the netting degrades and becomes less of a problem.
d) Continue inspections until vegetation is well established.

4) **Land Grading** – Grading on fill slopes, cut slopes, and stockpile areas will be done with full siltation controls in place.

Land Grading Design/Installation Requirements

a) Areas to be graded should be cleared and grubbed of all timber, logs, brush, rubbish, and vegetated matter that will interfere with the grading operation. Topsoil should be stripped and stockpiled for use on critical disturbed areas for establishment of vegetation. Cut slopes to be topsoiled should be thoroughly scarified to a minimum depth of 3-inches prior to placement of topsoil.
b) Fill materials should be generally free of brush, rubbish, rocks, and stumps. Frozen materials or soft and easily compressible materials should not be used in fills intended to support buildings, parking lots, roads, conduits, or other structures.
c) Earth fill intended to support structural measures should be compacted to a minimum of 90 percent of Standard Proctor Test density with proper moisture control, or as otherwise specified by the engineer responsible for the design. Compaction of other fills should be to the density required to control sloughing, erosion or excessive moisture content. Maximum thickness of fill layers prior to compaction should not exceed 9 inches.
d) The uppermost one foot of fill slopes should be compacted to at least 85 percent of the maximum unit weight (based on the modified AASHTO compaction test). This is usually accomplished by running heavy equipment over the fill.
e) Fill should consist of material from borrow areas and excess cut will be stockpiled in areas shown on the Site Plans. All disturbed areas should be free draining, left with a neat and finished appearance, and should be protected from erosion.

Land Grading Stabilization Inspection/Maintenance *

a) All slopes should be checked periodically to see that vegetation is in good condition. Any rills or damage from erosion and animal burrowing should be repaired immediately to avoid further damage.
b) If seeps develop on the slopes, the area should be evaluated to determine if the seep will cause an unstable condition. Subsurface drains or a gravel mulch may be required to solve seep problems. However, no seeps are anticipated.
c) Areas requiring revegetation should be repaired immediately. Control undesirable vegetation such as weeds and woody growth to avoid bank stability problems in the future.

5) **Topsoiling *** – Topsoiling will help establish vegetation on all disturbed areas throughout the site during the seeding process. The soil texture of the topsoil to be used will be a sandy loam to a silt loam texture with 15% to 20% organic content.

Topsoiling Placement

a) Topsoil should not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed seeding.
b) Do not place topsoil on slopes steeper than 2.5:1, as it will tend to erode.
c) If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method is to actually work the topsoil into the layer below for a depth of at least 6 inches.

6) **Permanent Seeding** – Permanent Seeding should be done immediately after the final design grades are achieved. Native species of plants should be used to establish perennial vegetative cover on disturbed areas. The revegetation should be done early enough in the fall so that a good cover is established before cold weather comes and growth stops until the spring. A good cover is defined as vegetation covering 75 percent or more of the ground surface.

Permanent Seeding Seedbed Preparation

a) In infertile or coarse-textured subsoil, it is best to stockpile topsoil and re-spread it over the finished slope at a minimum 2 to 6-inch depth and roll it to provide a firm seedbed. The topsoil must have a sandy loam to silt loam texture with 15% to 20% organic content. If construction fill operations have left soil exposed with a loose, rough, or irregular surface, smooth with blade and roll.
b) Loosen the soil to a depth of 3-5 inches with suitable agricultural or construction equipment.
c) Areas not to receive topsoil shall be treated to firm the seedbed after incorporation of the lime and fertilizer so that it is depressed no more than ½ - 1 inch when stepped on with a shoe. Areas to receive topsoil shall not be firmed until after topsoiling and lime and fertilizer is applied and incorporated, at which time it shall be treated to firm the seedbed as described above.

Permanent Seeding Grass Selection/Application

a) Select an appropriate cool or warm season grass based on site conditions and seeding date. Apply the seed uniformly by hydro-seeding, broadcasting, or by hand. Uniform seed distribution is essential. On steep slopes, hydroseeding may be the most effective

seeding method. Surface roughening is particularly important when preparing slopes for hydroseeding.

b) Lime and fertilize. Organic fertilizer shall be utilized in areas within the 100 foot buffer zone to a wetland resource area.
c) Mulch the seedings with straw applied at the rate of ½ tons per acre. Anchor the mulch with erosion control netting or fabric on sloping areas. Amoco supergro or equivalent should be utilized.

Permanent Seeding Inspection/Maintenance *

a) Frequently inspect seeded areas for failure and make necessary repairs and reseed immediately. Conduct or follow-up survey after one year and replace failed plants where necessary.
b) If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results.
c) If a stand has less than 40% cover, reevaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations, omitting lime and fertilizer in the absence of soil test results. If the season prevents resowing, mulch or jute netting is an effective temporary cover.
d) Seeded areas should be fertilized during the second growing season. Lime and fertilize thereafter at periodic intervals, as needed. Organic fertilizer shall be utilized in areas within the 100-foot buffer zone to a wetland resource area.

Dust Control:

Dust control will be utilized throughout the entire construction process of the site. For example, keeping disturbed surfaces moist during windy periods will be an effective control measure, especially for construction access roads. The use of dust control will prevent the movement of soil to offsite areas. However, care must be taken to not create runoff from excessive use of water to control dust. The following are methods of Dust Control that may be used on-site:

- Vegetative Cover – The most practical method for disturbed areas not subject to traffic.
- Calcium Chloride – Calcium chloride may be applied by mechanical spreader as loose, dry granules or flakes at a rate that keeps the surface moist but not so high as to cause water pollution or plant damage.
- Sprinkling – The site may be sprinkled until the surface is wet. Sprinkling will be effective for dust control on haul roads and other traffic routes.
- Stone – Stone will be used to stabilize construction access; will also be effective for dust control.

The general contractor shall employ an on-site water vehicle for the control of dust as necessary.

Non-Stormwater Discharges:

The construction de-watering and all non-stormwater discharges will be directed into a sediment dirt bag (or equivalent inlet protection) or a sediment basin. Sediment material removed shall be disposed of in accordance with all applicable local, state, and federal regulations.

Inspection/Maintenance:

Operator personnel must inspect the construction site at least once every 14 calendar days and within 24 hours of a storm event of ½-inch or greater. The applicant shall be responsible to secure the services of a design professional or similar professional (inspector) on an on-going basis throughout all phases of the project. Refer to the Inspection/Maintenance Requirements presented earlier in the "Structural and Stabilization Practices." The inspector should review the erosion and sediment controls with respect to the following:

- Whether or not the measure was installed/performed correctly.
- Whether or not there has been damage to the measure since it was installed or performed.
- What should be done to correct any problems with the measure.

The inspector should complete the Construction Period Inspection and Maintenance Log Form, as attached, for documenting the findings and should request the required maintenance or repair for the pollution prevention measures when the inspector finds that it is necessary for the measure to be effective. The inspector should notify the appropriate person to make the changes as required.

It is essential that the inspector document the inspection of the pollution prevention measures. These records will be used to request maintenance and repair and to prove that the inspection and maintenance were performed. The forms list each of the measures to be inspected on the site, the inspector's name, the date of the inspection, the condition of the measure/area inspected, maintenance or repair performed and any changes which should be made to the Operation and Maintenance Plan to control or eliminate unforeseen pollution of storm water.

APPENDIX F:

LONG TERM BEST MANAGEMENT PRACTICES O&M PLAN

Long Term Stormwater Best Management Practices
Operation and Maintenance Plan
for
181R School Street
Groveland, Massachusetts
July 31, 2024

The following operation and maintenance plan has been provided to satisfy the requirements of Standard 9 of the Mass DEP Stormwater Management Handbook 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 stormwater management system shall be inspected and maintained as indicated below.
3. Effective erosion control measurers during and after construction shall be maintained until a stable turf is established on all altered areas.
4. A Stormwater Management Maintenance Log is included at the end of this Appendix.

Basic Information

Stormwater Management System Owner:	Groveland Redevelopment, LLC 231 Sutton Street, Suite 1B North Andover, MA 01945 P: (978) 687-6200
Groveland Planning Board:	Groveland Town Hall 183 Main Street Groveland, MA 01834 P: (781) 665-0142

Erosion and Sedimentation Controls during Construction:

The site and drainage construction contractor shall be responsible for managing stormwater during construction. Routine monitoring of disturbed soils shall be performed to ensure adequate runoff and pollution control during construction.

A sediment and erosion control barrier will be placed as shown on the Site 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 side slopes have been loamed and seeded and vegetation has been established. Silt sacks shall be placed in new catch basins once constructed while construction activities are ongoing.

Operations and maintenance plans for the Stormwater Management construction phase and long term operation of the system have been attached to this report.

General Conditions

1. The site contractor shall be responsible for scheduling regular inspections and maintenance of the stormwater BMP's until the project has been completed. The BMP maintenance shall be conducted as detailed in the following long-term pollution prevention plan and on the approved design plans:
   Definitive Subdivision Plan for a Street to be Named in Groveland, Massachusetts at 181R School Street (Groveland Assessors Map 34 Lot 13)", prepared for Groveland Redevelopment, LLC by The Morin-Cameron Group, Inc. dated July 31, 2024.
2. All Stormwater BMP's shall be operated and maintained in accordance with the design plans and the following Long-Term Pollution Prevention Plan.
3. 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 Melrose Planning Board and Department of Public Works upon request;
   c. Allow members and agents of the Melrose Planning Board and Department of Public Works to enter the premises and ensure that the Owner has complied with the Operation and Maintenance Plan requirements for each BMP.
4. 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 commencement of the first year of service, a more accurate inspection/maintenance schedule shall be determined based on the level of service for this site.

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.

Cost: Included with annual landscaping budget. Consult with local landscape contractors.

Paved Areas:

Sweepers shall sweep paved areas periodically during dry weather to remove excess sediments and to reduce the amount of sediments that the drainage system shall have to remove from the runoff. The sweeping shall be conducted primarily between March 15th and November 15th. Special attention should be made to sweeping paved surfaces in March and April before spring rains wash residual sand into the drainage system.

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

Salt used for de-icing on the roadway during winter months shall be limited as much as possible as this will reduce the need for removal and treatment. Sand containing the minimum amount of calcium chloride (or approved equivalent) needed for handling may be applied as part of the routine winter maintenance activities.

Debris & Litter:

All debris and litter shall be removed from the roadway and parking lots as necessary to prevent migration into the drainage system.

Roof Leaders, Gutters and Downspouts :

The roof leaders, gutters and downspouts shall be inspected after every major storm event for the first 3 months after construction; a major storm event is 3.30 inches of rainfall in a 24-hour period (2 year storm). Thereafter, the gutters and downspouts shall be inspected and cleaned at least once per year to remove any debris accumulation (i.e. leafs, sticks). The roof leaders shall be inspected and cleaned at least twice per year (April and October) to confirm that the roof leaders are not obstructed by debris. The outlet control devices (2 total) located on the building downspouts shall be inspected and cleaned to ensure there are no obstructions, the screens are in place and there is no damage to the devices.

Cost: $200-300 per cleaning for the gutters as needed. The owner should consult local contractors for a detailed cost estimate.

CDS Water Quality Units:

The CDS water quality pretreatment units shall be inspected twice per year in April and October. The unit shall be cleaned per manufacturer instructions included herein.
Cost: Consult with local landscaping or pumping companies for associated costs if necessary.

Subsurface Infiltration Chambers:

The subsurface infiltration chambers 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 covers 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.

Rain Gardens:

The best management practices shall be inspected after every major storm event for the first 3 months after construction; a major storm event is 3.30 inches of rainfall in a 24 hour period (2 year storm). Thereafter, the basin shall be inspected twice per year, typically in the spring and fall. If erosion or loss of vegetation is observed in the basin, it shall be repaired immediately and new vegetation shall be established. Trash, leaves, branches, etc. shall be removed from basins. The infiltration basin shall be mowed twice per year. Reseed as required. Inspect swales to make sure vegetation is adequate, check dams are in place and functioning and slopes are not eroding. Check for rilling and gullying. Repair eroded areas and revegetate as needed.

The outlet structures shall be inspected annually for obstructions, structural integrity and trash accumulations. The inspections shall be conducted by qualified personnel.

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

Rip-Rap Outfalls:

The rip-rap outfalls shall be checked for debris accumulation twice per year. Additional inspections should be scheduled during the first few months to make sure that the outfall is functioning as intended. Trash, leaves, branches, etc. shall be removed from outfall. Silt, sand and sediment, if significant accumulation occurs, shall be removed as required by means of mechanical excavation. Material removed shall be disposed of in accordance with all applicable local, state, and federal regulations. The outfall shall be kept free of woody vegetation and removal of woody vegetation shall be conducted between October 15th and April 15th. Any slope erosion within the outfall shall be stabilized and repaired immediately and additional rip-rap added as required.

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

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.

Cost: Included in the routine landscaping maintenance schedule. The Owner shall consult local landscaping contractors for details.

Public Safety Concerns: Chemicals shall be stored in a secure area to prevent children from obtaining access to them. Any major spills shall be reported to municipal officials.

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 in accordance with the Long-Term Pollution Prevention Plan 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.

Snow Storage:

Property owner shall inform their snow removal contractor of the designated areas for snow storage.

TABLE 1: MAINTENANCE SCHEDULE FOR DRAINAGE STRUCTURES

Structure	Inspection	Maintenance
Infiltration Basins, Rain Graden, Water Quality Units, Outlet Control Structures Drain Manhole, Catch Basins	Inspect after every major storm event for first 3 months after construction to ensure the structures are working properly.* Thereafter, twice a year (April / October) Inspections should include the following: • Signs of differential settlement • Erosion • Tree growth on the embankments that were not part of the design plan • Sediment accumulation • Health of turf • Cracked/Disconnected Roof Leaders • Clogged orifices, pipe obstructions	Rehabilitate structure if it fails due to clogging as generally evidenced by retention of water for more than 72 hours after a storm event Remove any obstructions from outlets/pipes Remove accumulated sediment

* Major storm event: 3.2 inches of rainfall in a 24 hour period (2 year storm)

Stormwater System Maintenance Log

181R School St, Groveland, MA

The Following structures shall be inspected and maintained by the owner.

BMP STRUCTURE	INSPECTION DATE	WORK PERFORMED	DATE WORK PERFORMED	COMMENTS
Stormwater Management Infrastructure				
CB-1				
CB-2				
Water Quality Unit 1 (WQU-1)				
Outlet Control Structure (OCS-1)				
Infiltration Basin (P1)				
Rain Garden (P2)				

Infiltration Basin (P4)				
Rain Garden (P5)				
Rain Garden (P6)				
Rain Garden (P7)				
CB-3				
CB-4				
CB-5				

DMH-1				
DMH-2				
Water Quality Unit 2 (WQU-2)				
OCS-2				
OCS-4				
OCS-5				
OCS-6				

OCS-7				

APPENDIX G:

ILLICIT DISCHARGE STATEMENT

Illicit Discharge Compliance Statement

I, Scott P. Cameron, P.E., hereby notify the Groveland Planning Board that I have not witnessed, nor am aware of any existing illicit discharges at the site known as 181R School Street in Groveland, Massachusetts. I also hereby certify that the development of said property as illustrated on the final plans entitled "Definitive Subdivision Plan for a Street to be Named in Groveland, Massachusetts at 181R School Street (Groveland Assessors Map 34 Lot 13) prepared for/applicant Groveland Redevelopment, LLC," prepared by The Morin-Cameron Group, Inc. dated August 1, 2024 and as revised and approved by the Town of Groveland Planning Board and maintenance thereof in accordance with the "Construction Phase Pollution Prevention Plan" and "Long-Term Pollution Prevention Plan" prepared by The Morin-Cameron Group, Inc dated July 31, 2024 and as revised and approved by the Groveland Planning Board will not create any new illicit discharges. There is no warranty implied regarding future illicit discharges that may occur as a result of improper construction or maintenance of the stormwater management system or unforeseen accidents.

Name: Scott P. Cameron, P.E.

Company: The Morin-Cameron Group, Inc.

Title: Owner's Representative

Signature: _____

Date: 7/31/24

APPENDIX H:
SOIL REPORT

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

181R School Street LLC
Owner Name

181R School Street
Street Address

Map 34, Lot 13
Map/Lot #

Groveland
City

MA
State

01834
Zip Code

B. Site Information

1. (Check one) ☐ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: NRCS (Source) 420B,420C,410C,421C (Soil Map Unit)

Sutton fine sandy loam, Canton fine sandy loam
Soil Name

None
Soil Limitations

Loamy sand/ sandy loam
Soil Parent material

Moraine
Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018/Stone, Stone, DiGiacomo-Cohen; Coarse deposits (Map Unit)

Gravel deposits, sand and gravel deposits, and sand deposits.
Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: N/A (Wetland Type)

7. Current Water Resource Conditions (USGS): 07/2024 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed: MassMapper

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP 24-1 (Hole #) | 7/2/24 (Date) | 8:30 am (Time) | 80°F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Overgrowth (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-3% (Slope (%))

Description of Location: East side of lot, 5 feet off sidewalk

2. Soil Parent Material: Loamy sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: ___ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-16	FILL	Loamy sand	10YR4/4								
16-22	Ab	Loamy sand	10YR3/2						Granular	Friable	
22-32	Bw	Loamy sand	10YR5/6						Massive	Friable	
32-96	C	Loamy sand	2.5Y5/4						Massive	Friable	

Additional Notes:
No refusal – boulder @ 96", Roots to 60"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-2 (Hole #) | 7/2/24 (Date) | 9:06 am (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Overgrowth (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-3% (Slope (%))

Description of Location: East side of lot

2. Soil Parent Material: Loamy sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit __ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-8	Ap	Loamy fine sand	10YR4/4						Granular	Friable	
8-20	Bw	Loamy fine sand	10YR5/6						Massive	Friable	
20-84	C	Loamy sand	2.5Y6/3						Weak blocky	Friable	

Additional Notes:
Refusal @ 84", roots to 24"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-3 (Hole #) | 7/2/24 (Date) | 9:40 am (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: East side of lot

2. Soil Parent Material: Loamy sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well ____ feet | Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 96" Depth Weeping from Pit ____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-16	Ap	Loamy fine sand	10YR4/4						Granular	Friable	
16-24	Bw	Loamy fine sand	10YR5/6						Massive	Friable	
24-96	C	Loamy sand	2.5Y5/4						Weak blocky	Friable	

Additional Notes:
No refusal, roots to 36"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-4 (Hole #) | 7/2/24 (Date) | 11:00 am (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: East side of lot

2. Soil Parent Material: Sandy loam | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-16	Ap	Loamy fine sand	10YR4/4						Granular	Friable	
16-30	Bw	Loamy fine sand	10YR5/6						Massive	Friable	
30-48	C1	Fine sand	2.5Y6/3						Single grain	Loose	
48-96	C2	Sandy loam	2.5Y4/3	42"	C: 7.5YR5/8 D: 5Y 6/2				Weak blocky	Firm	

Additional Notes:
No refusal, Roots to 30"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-5 (Hole #) | 7/2/24 (Date) | 11:55 am (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: Northeast side of lot

2. Soil Parent Material: Loamy sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Ap	Fine sand	10YR4/4						Granular	Friable	
12-22	Bw	Fine sand	10YR5/6						Single grain	Loose	
22-48	C1	Fine sand	2.5Y6/3						Single grain	Loose	
48-108	C2	Loamy sand	2.5Y5/3				10%		Massive	Friable	

Additional Notes:
No refusal, Roots to 48"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-6 (Hole #) | 7/2/24 (Date) | 12:40 pm (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: North/ center of lot

2. Soil Parent Material: Sandy loam | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Ap	Fine sandy loamy	10YR4/4						Granular	Friable	
12-32	Bw	Fine sandy loam	10YR5/6						Massive	Friable	
32-112	C	Sandy loam	2.5Y5/4				5%		Massive	Friable	

Additional Notes:
No refusal, Roots to 48"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-7 (Hole #) | 7/2/24 (Date) | 1:15 pm (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: Center of lot

2. Soil Parent Material: Sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 60" Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Ap	Fine sand	10YR4/4						Granular	Friable	
12-28	Bw	Fine sand	10YR5/6						Single grain	Loose	
28-112	C	Sand	2.5Y5/3	32"	C: 7.5YR5/8 D: 2.5Y6/2				Single grain	Loose	

Additional Notes:
No refusal

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-8 (Hole #) | 7/2/24 (Date) | 2:00 pm (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude:)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: North side of lot

2. Soil Parent Material: Sandy loam | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-10	Ap	Fine sand	10YR3/3						Granular	Friable	
10-28	Bw	Fine sand	10YR4/6						Single grain	Loose	
28-60	C1	Very fine sand	2.5Y6/4						Single grain	Loose	
60-108	C2	Loamy sand	2.5Y5/4				10%		Massive	Friable	

Additional Notes:
No refusal, Roots to 48"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-9 (Hole #) | 7/2/24 (Date) | 2:30 pm (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude:)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: Center of lot

2. Soil Parent Material: Sandy loam | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-14	Ap	Loamy sand	10YR3/2						Granular	Friable	
14-26	Bw	Loamy sand	10YR5/6						Massive	Friable	
26-60	C1	Sand	2.5Y6/4						Single grain	Loose	
60-80	C2	Sandy loam	2.5Y5/3	30"	C: 7.5YR5/8 D: 5Y 6/2		10%		Massive	Friable	

Additional Notes:
No refusal, Roots to 24"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-10 (Hole #) | 7/2/24 (Date) | 3:00 pm (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: Northwest side of lot

2. Soil Parent Material: Loamy sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Ap	Fine sand	10YR4/4						Granular	Friable	
12-28	Bw	Fine sand	10YR5/6						Single grain	Loose	
28-48	C1	Very fine sand	2.5Y6/4						Single grain	Loose	
48-96	C2	Loamy sand	2.5Y5/4				10%		Massive	Friable	

Additional Notes:
No refusal, Roots to 55"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-11 (Hole #) | 7/2/24 (Date) | 3:25 pm (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude:)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: West side of lot

2. Soil Parent Material: Loamy sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Ap	Fine sand	10YR4/4						Granular	Friable	
12-28	Bw	Fine sand	10YR5/6						Single grain	Loose	
28-48	C1	Very fine sand	2.5Y6/4	36"	C: 7.5YR5/8 D: 5Y 6/2				Single grain	Loose	
48-96	C2	Loamy sand	2.5Y5/4				10%		Massive	Friable	

Additional Notes:
No refusal, Roots to 44"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-12 (Hole #) | 7/2/24 (Date) | 3:50 pm (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude:)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: West side of lot

2. Soil Parent Material: Gravelly loamy sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Ap	Fine sand	10YR3/3						Granular	Friable	
12-20	Bw	Fine sand	10YR5/6						Massive	Friable	
20-80	C	Gravelly loamy sand	2.5Y5/4	32"	C: 7.5YR5/8 D: 5Y 6/2		20%		Massive	Friable	
									Massive	Friable	

Additional Notes:
No refusal, Roots to 24"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-13 (Hole #) | 7/3/24 (Date) | 8:39 am (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude:)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: Southwest side of lot

2. Soil Parent Material: Gravelly sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-6	Ap	Fine sand	10YR4/4						Granular	Friable	
6-16	Bw	Fine sand	10YR5/6						Single grain	Loose	
16-36	C1	Fine sand	2.5Y6/4						Single grain	Loose	
36-84	C2	Gravelly sand	2.5Y5/4				20%		Single grain	Loose	

Additional Notes:
No refusal, Roots to 64"

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-14 (Hole #) | 7/3/24 (Date) | 9:10 am (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude:)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: South side of lot

2. Soil Parent Material: Fine sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-18	Ap	Fine sand	10YR3/3						Granular	Friable	
18-24	Bw	Fine sand	10YR5/6						Single grain	Loose	
24-80	C	Fine sand	2.5Y5/6	48"	C: 7.5YR5/8 D: 2.5Y 6/2				Single grain	Loose	
									Massive	Friable	

Additional Notes:
No refusal – boulder @ 80", Roots to 32"

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Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-15 (Hole #) | 7/3/24 (Date) | 9:40 am (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude:)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: West side of lot

2. Soil Parent Material: Loamy sand | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-18	Ap	Fine sand	10YR3/3						Granular	Friable	
18-28	Bw	Fine sand	10YR5/6						Single grain	Loose	
28-60	C1	Fine sand	2.5Y5/6	48"	C: 7.5YR5/8 D: 5Y 6/2				Single grain	Loose	
60-96	C2	Gravelly loamy sand	2.5Y5/4						Massive	Friable	

Additional Notes:
No refusal, Roots to 36"

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Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP24-16 (Hole #) | 7/3/24 (Date) | 10:20 am (Time) | 80° F, Sunny (Weather) | 42.7493 (Latitude) | -71.0256° (Longitude:)

1. Land Use: Vacant lot (e.g., woodland, agricultural field, vacant lot, etc.) | Oak, white pine (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5-10% (Slope (%))

Description of Location: South side of lot

2. Soil Parent Material: Sandy loam | Moraine (Landform) | Midslope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line >10 feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 94" Depth Weeping from Pit | Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-18	Ap	Fine sand	10YR3/3						Single grain	Loose	
18-28	Bw	Fine sand	10YR5/6						Single grain	Loose	
28-50	C1	Fine sand	2.5Y6/3	42"	C: 7.5YR5/8 D: 5Y 6/2				Single grain	Loose	
50-108	C2	Sandy loam	2.5Y4/3						Massive	Friable	

Additional Notes:
No refusal, Roots to 56"

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole TP24-7	Obs. Hole TP24-9
☐ Depth observed standing water in observation hole	_____ inches	inches
☐ Depth weeping from side of observation hole	inches	inches
☒ Depth to soil redoximorphic features (mottles)	32 inches	30 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: 20 inches Lower boundary: 112 inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Groveland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Eric Brown — 7/26/2024

Signature of Soil Evaluator — Date

Eric Brown, SE #14653 — 11/1/2025

Typed or Printed Name of Soil Evaluator / License # — Expiration Date of License

Name of Approving Authority Witness — Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

SEE DESIGN PLAN

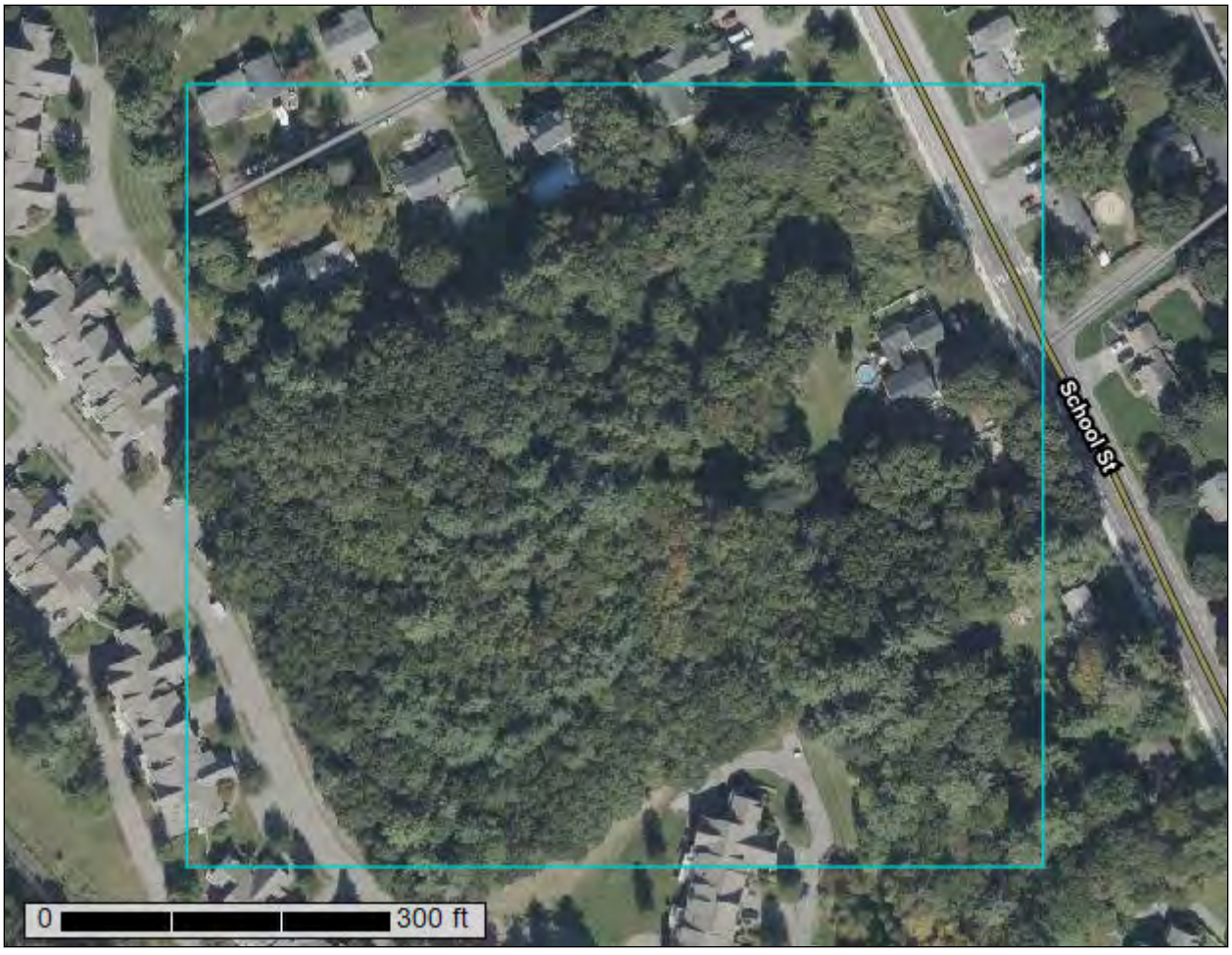
United States Department of Agriculture

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



July 31, 2024

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: 1:1,830 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 25 50 100 150

Feet
0 50 100 200 300

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 19, Sep 10, 2023

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

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
255B	Windsor loamy sand, 3 to 8 percent slopes	0.0	0.1%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	0.3	2.2%
410C	Sutton fine sandy loam, 8 to 15 percent slopes	1.8	14.2%
411B	Sutton fine sandy loam, 0 to 8 percent slopes, very stony	0.6	4.5%
420B	Canton fine sandy loam, 3 to 8 percent slopes	2.6	20.4%
420C	Canton fine sandy loam, 8 to 15 percent slopes	3.5	27.8%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	3.9	30.8%
Totals for Area of Interest		**12.7**	**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

255B—Windsor loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svkf
Elevation: 0 to 1,210 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Windsor

Setting

Landform: Outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or schist and/or gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F145XY008MA - Dry Outwash
Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 10 percent
Landform: Eskers
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: F145XY008MA - Dry Outwash
Hydric soil rating: No

Deerfield, loamy sand

Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

256A—Deerfield loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xfg8
Elevation: 0 to 1,100 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: Farmland of statewide importance

Map Unit Composition

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

Description of Deerfield

Setting

Landform: Outwash terraces, outwash deltas, outwash plains, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy outwash derived from granite, gneiss, and/or quartzite

Typical profile

Ap - 0 to 9 inches: loamy fine sand
Bw - 9 to 25 inches: loamy fine sand
BC - 25 to 33 inches: fine sand
Cg - 33 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 15 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 11.0
Available water supply, 0 to 60 inches: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 7 percent
Landform: Outwash terraces, kame terraces, outwash deltas, outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Wareham

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sudbury

Percent of map unit: 2 percent
Landform: Outwash plains, kame terraces, outwash deltas, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Ninigret

Percent of map unit: 1 percent
Landform: Kame terraces, outwash plains, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, concave
Hydric soil rating: No

410C—Sutton fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2xffk
Elevation: 10 to 260 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

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

Description of Sutton

Setting

Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 5 inches: fine sandy loam
Bw1 - 5 to 17 inches: fine sandy loam
Bw2 - 17 to 25 inches: sandy loam
C1 - 25 to 39 inches: gravelly sandy loam
C2 - 39 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 12 to 27 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B/D

Ecological site: F144AY008CT - Moist Till Uplands
Hydric soil rating: No

Minor Components

Charlton
Percent of map unit: 5 percent
Landform: Ridges, ground moraines, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

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

Canton
Percent of map unit: 3 percent
Landform: Hills, moraines, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Leicester
Percent of map unit: 2 percent
Landform: Drainageways, depressions, ground moraines, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

411B—Sutton fine sandy loam, 0 to 8 percent slopes, very stony

Map Unit Setting
National map unit symbol: 2xfff
Elevation: 0 to 1,410 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

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

Description of Sutton, Very Stony

Setting

Landform: Ground moraines, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: fine sandy loam
Bw1 - 7 to 19 inches: fine sandy loam
Bw2 - 19 to 27 inches: sandy loam
C1 - 27 to 41 inches: gravelly sandy loam
C2 - 41 to 62 inches: gravelly 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: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 12 to 27 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B/D
Ecological site: F144AY008CT - Moist Till Uplands
Hydric soil rating: No

Minor Components

Charlton, very stony

Percent of map unit: 7 percent
Landform: Ridges, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Canton, very stony

Percent of map unit: 4 percent
Landform: Moraines, hills, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Leicester, very stony

Percent of map unit: 3 percent
Landform: Depressions, ground moraines, drainageways, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman, very stony

Percent of map unit: 1 percent
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
Hydric soil rating: Yes

420B—Canton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w81b
Elevation: 0 to 1,180 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: All areas are prime farmland

Map Unit Composition

Canton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton

Setting

Landform: Hills, moraines, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex

Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: gravelly fine sandy loam
2C - 26 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Scituate

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

Montauk

Percent of map unit: 5 percent
Landform: Moraines, 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: Convex
Hydric soil rating: No

Charlton

Percent of map unit: 4 percent
Landform: Ridges, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 1 percent
Landform: Marshes, depressions, bogs, swamps, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

420C—Canton fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w817
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

Canton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton

Setting

Landform: Hills, moraines, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: gravelly fine sandy loam
2C - 26 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Montauk

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

Scituate

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

Charlton

Percent of map unit: 4 percent
Landform: Ridges, ground moraines, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Newfields

Percent of map unit: 4 percent
Landform: Ground moraines, hills, moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

421C—Canton fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w814

Elevation: 0 to 1,160 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

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

Description of Canton, Very Stony

Setting

Landform: Moraines, ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 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 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Montauk, very stony

Percent of map unit: 6 percent
Landform: Recessionial moraines, ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Scituate, very stony

Percent of map unit: 5 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Chatfield, very stony

Percent of map unit: 3 percent
Landform: Hills, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 1 percent
Landform: Marshes, depressions, bogs, swamps, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

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APPENDIX I:
BROCHURES

CONTECH®
ENGINEERED SOLUTIONS

CDS®
Hydrodynamic Separator

The experts you need to solve your stormwater management challenges

Contech is the leader in stormwater management solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

Your Contech Team

STORMWATER CONSULTANT

It's my job to recommend the best solution to meet permitting requirements.

STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.

REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.

SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

Contech is your partner in stormwater management solutions

Unique screening technology for stormwater runoff – CDS®

The CDS hydrodynamic separator uses swirl concentration and continuous deflective separation to screen, separate and trap trash, debris, sediment, and hydrocarbons from stormwater runoff.

At the heart of the CDS system is a unique screening technology used to capture and retain trash and debris. The screen face is louvered so that it is smooth in the downstream direction. The effect created is called "Continuous Deflective Separation." The power of the incoming flow is harnessed to continually shear debris off the screen and to direct trash and sediment toward the center of the separation cylinder. This results in a screen that is self-cleaning and provides 100% removal of floatables and neutrally buoyant material debris 4.7 mm or larger, without blinding.

CDS is used to meet trash Total Maximum Daily Load (TMDL) requirements, for stormwater quality control, inlet and outlet pollution control, and as pretreatment for filtration, detention/infiltration, bioretention, rainwater harvesting systems, and a variety of green infrastructure practices.

CDS® Features and Benefits

FEATURE	BENEFIT
Captures and retains 100% of floatables and neutrally buoyant debris 4.7mm or larger	Superior pollutant removal
Self-cleaning screen	Ease of maintenance
Isolated storage sump eliminates scour potential	Excellent pollutant retention
Internal bypass	Eliminates the need for additional structures
Multiple pipe inlets and 90-180º angles	Design flexibility
Clear access to sump and stored pollutants	Fast, easy maintenance

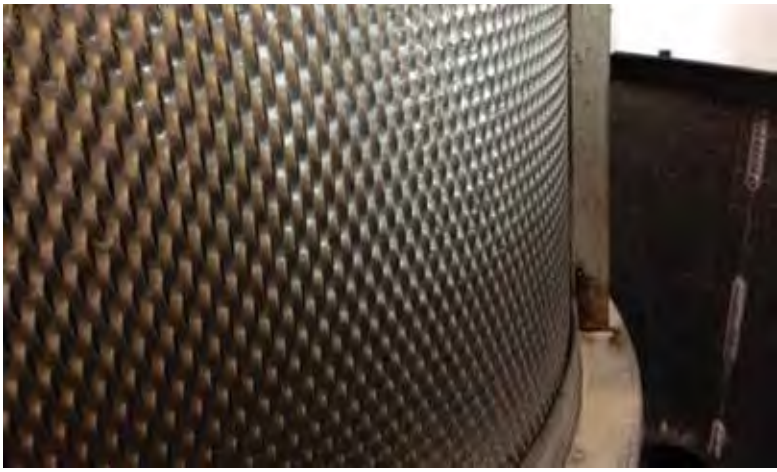
APPLICATION TIPS

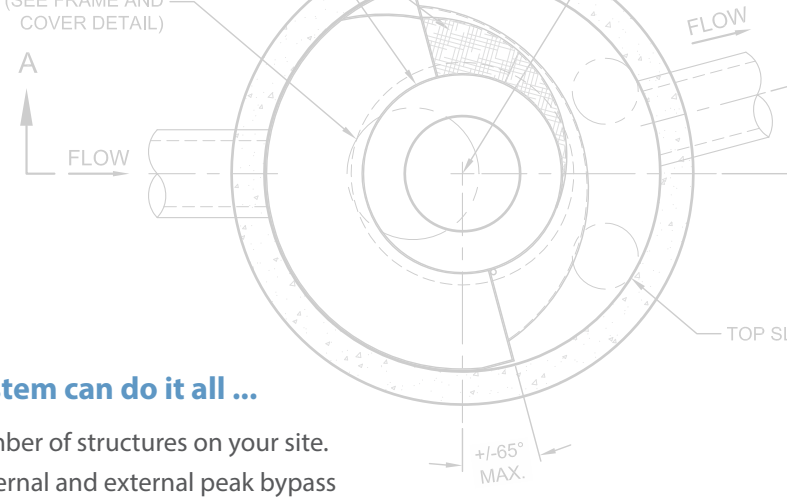
- Because of its internal peak bypass weirs, CDS systems can provide cost savings by eliminating the need for additional structures.
- Pretreating detention, infiltration, and green infrastructure practices with CDS can protect downstream structures and provide for easy maintenance.
- The CDS an ideal solution for retrofit applications due to its compact footprint and configuration flexibility.

The CDS® Screen

A fundamentally different approach to trash control ...

Traditional approaches to trash control typically involve "direct screening" that can easily become clogged, as trash is pinned to the screen as water passes through. Clogged screens can lead to flooding as water backs up. The design of the CDS screen is fundamentally different. Flow is introduced to the screen face which is louvered so that it is smooth in the downstream direction. The effect created is called "Continuous Deflective Separation." The power of the incoming flow is harnessed to continually shear debris off the screen and to direct trash and sediment toward the center of the separation cylinder.

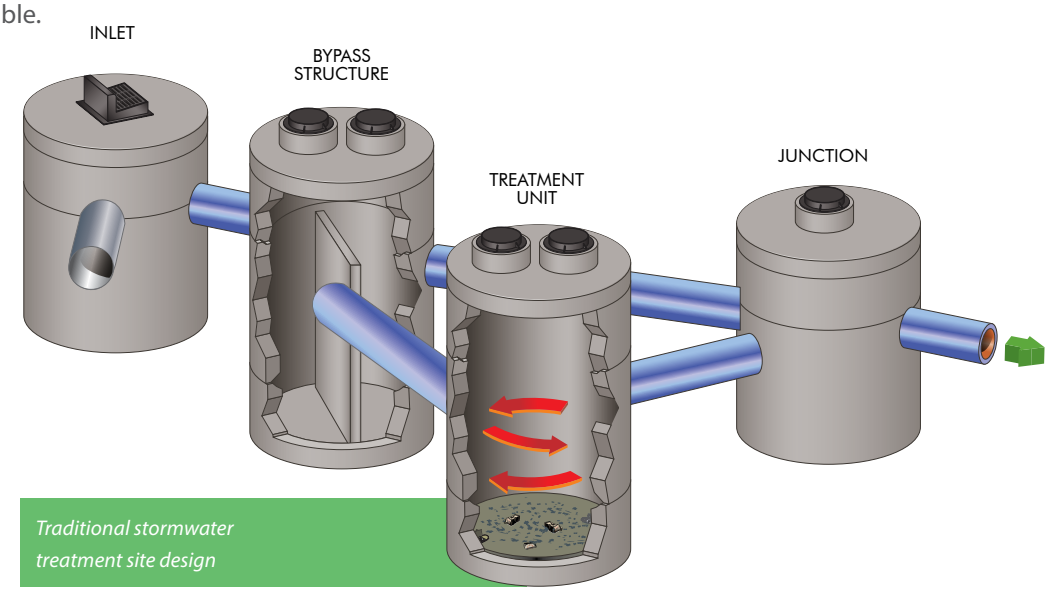




CDS® Design Configuration

Why use traditional stormwater design when ONE system can do it all ...

The CDS effectively treats stormwater runoff while reducing the number of structures on your site. Inline, offline, grate inlet, and drop inlet configurations available. Internal and external peak bypass options also available.

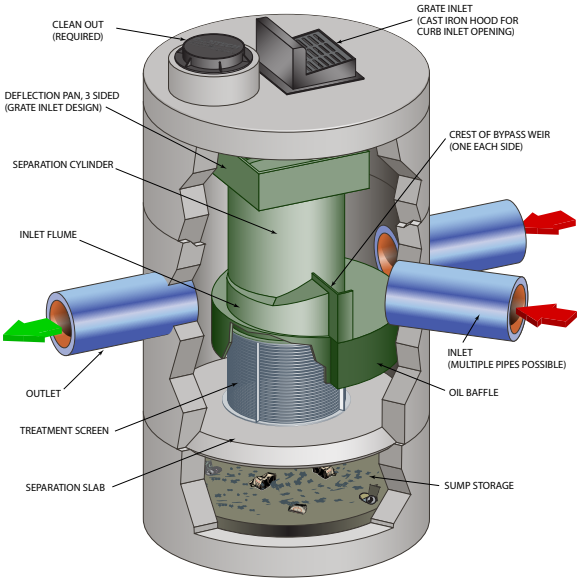


Traditional stormwater treatment site design

A Traditional Stormwater Treatment Site Design would require several structures on your site. With CDS, one system can do it all!

CDS® Advantages

- Grate inlet option available
- Internal bypass weir
- Accepts multiple inlets at a variety of angles
- Advanced hydrodynamic separator
- Captures and retains 100% of floatables and neutrally buoyant debris 4.7 mm or larger
- Indirect screening capability keeps screen from clogging
- Retention of all captured pollutants, even at high flows
- Performance verified by NJCAT, WA Ecology, and ETV Canada



Learn More:
www.ContechES.com/cds

CDS® Applications

CDS is commonly used in the following stormwater applications:

- Stormwater quality control – trash, debris, sediment, and hydrocarbon removal
- Urban retrofit and redevelopment
- Inlet and outlet protection
- Pretreatment for filtration, detention/infiltration, bioretention, rainwater harvesting systems, and Low Impact Development designs

CDS® provides trash control

CDS® pretreats a bioswale

Select CDS® Certifications and Verifications

CDS has been verified by some of the most stringent stormwater technology evaluation organizations in North America, including:

- Washington State Department of Ecology (GULD) - Pretreatment
- Canadian Environmental Technology Verification (ETV)
- California Statewide Trash Amendments Full Capture System Certified*

**The CDS System has been certified by the California State Water Resources Control Board as a Full Capture System provided that it is sized to treat the peak flow rate from the region specific 1-year, 1-hour design storm, or the peak flow capacity of the corresponding storm drain, whichever is less.*

Save time, space and money with CDS

CDS® Maintenance

Select a cost-effective and easy-to-access treatment system ...

Systems vary in their maintenance needs, and the selection of a cost-effective and easy-to-access treatment system can mean a huge difference in maintenance expenses for years to come.

A CDS unit is designed to minimize maintenance and make it as easy and inexpensive as possible to keep our systems working properly.

INSPECTION

Inspection is the key to effective maintenance. Pollutant deposition and transport may vary from year to year and site to site. Semi-annual inspections will help ensure that the system is cleaned out at the appropriate time. Inspections should be performed more frequently where site conditions may cause rapid accumulation of pollutants.

Most CDS® units can easily be cleaned within thirty minutes.

RECOMMENDATIONS FOR CDS MAINTENANCE

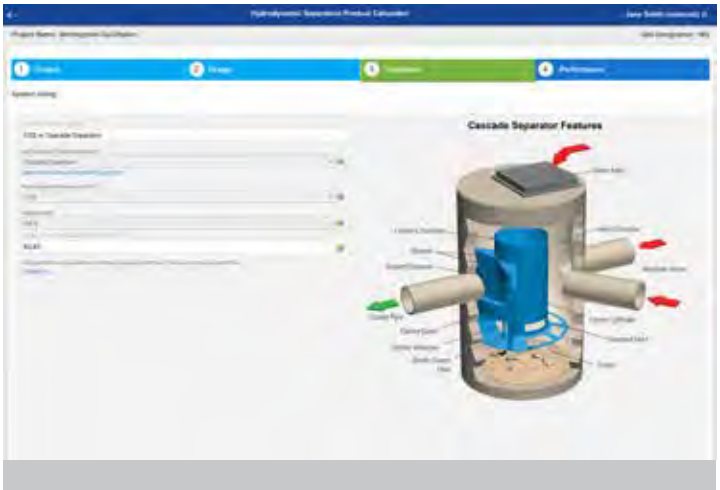
The recommended cleanout of solids within the CDS unit's sump should occur at 75% of the sump capacity. Access to the CDS unit is typically achieved through two manhole access covers – one allows inspection and cleanout of the separation chamber and sump, and another allows inspection and cleanout of sediment captured and retained behind the screen. A vacuum truck is recommended for cleanout of the CDS unit and can be easily accomplished in less than 30 minutes for most installations.

Hydrodynamic Separator Selection & Sizing Tool

Quickly prepare designs for estimates and project meetings ...

Part of the Contech Design Center, this free, online tool fully automates the layout process for identifying the proper hydrodynamic separator for your site.

- Multiple sizing methods available.
- Site-specific questions ensure the selected unit will comply with site constraints.
- Multiple treatment options may be available based on regulations and site parameters.
- Follow up reports contain a site-specific design, sizing summary, standard detail, and specification.



Learn More:
www.ContechES.com/designcenter

A partner you can rely on

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

Few companies offer the wide range of high-quality stormwater resources you can find with us — state-of-the-art products, decades of expertise, and all the maintenance support you need to operate your system cost-effectively.

THE CONTECH WAY

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

TAKE THE NEXT STEP

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CONTECH®
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

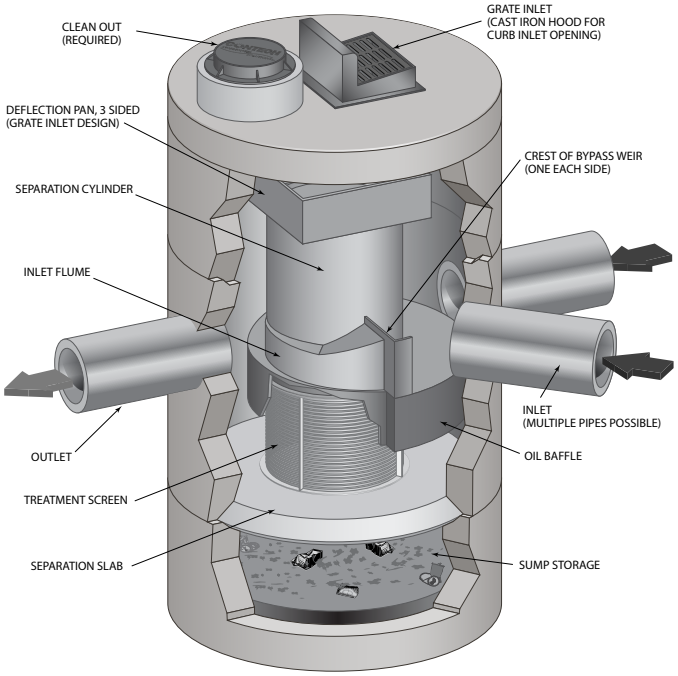
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are

determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

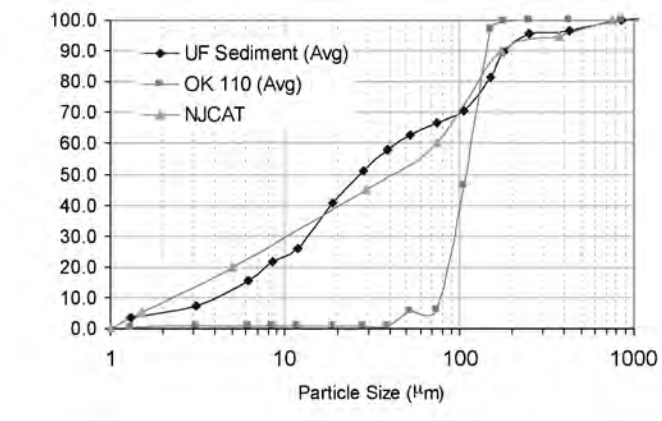


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect

to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

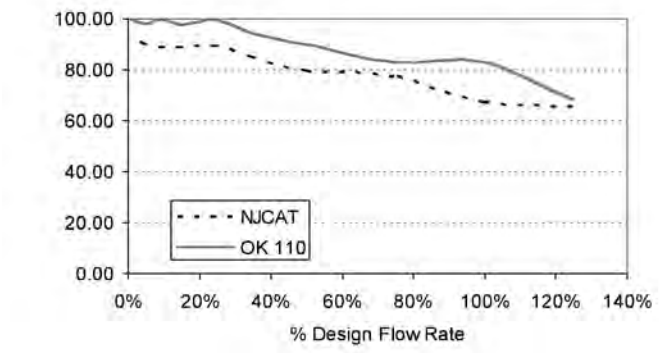


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

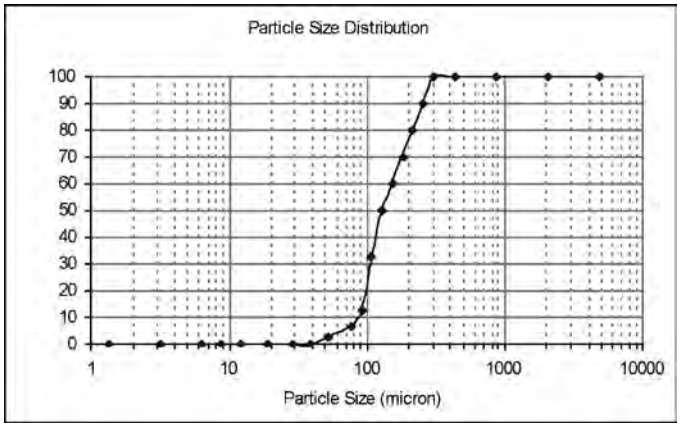


Figure 3. WASDOE PSD

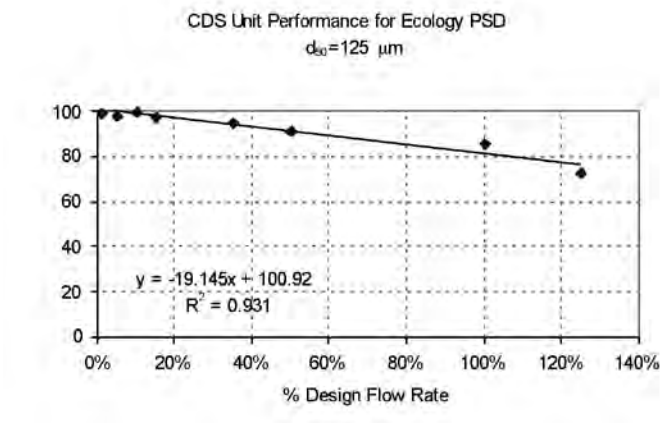


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

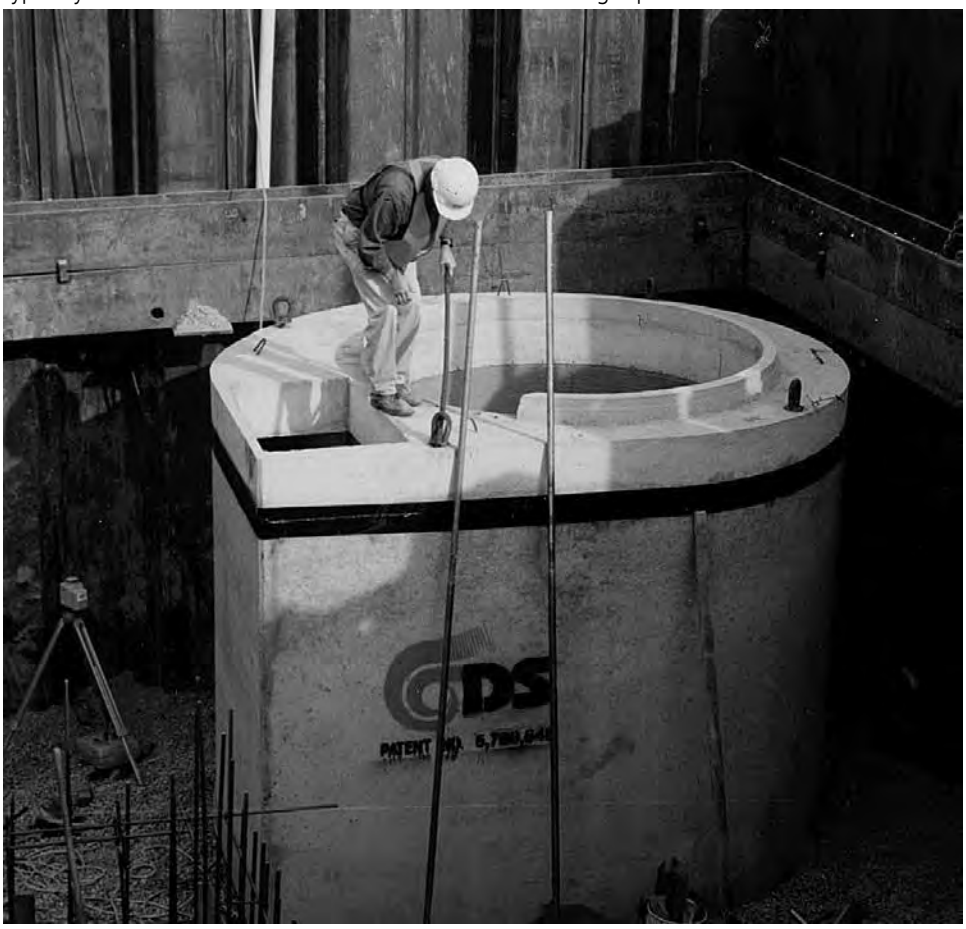
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile**.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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APPENDIX I:
REFERENCES AND SOURCES

References and Sources:

- Massachusetts Stormwater Handbook and Stormwater Standards – Massachusetts Department of Environmental Protection

- Town of Groveland Bylaws & Regulations

- Town of Groveland GIS database

- United States Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey

- "A policy On Geometric Design of Highways and Streets; 2018" - American Association of Highway and Transportation Officials (AASHTO)