# Town of Groveland

**Economic Development**
**Planning & Conservation Department**
***Planning Board***
183 Main Street
Groveland, MA 01834



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**MEETING NOTICE**
*(M.G.L Chapter 30A Sections 18-25)*



| | |
|---|---|
| Board/Committee Name: | PLANNING BOARD |
| Date: | TUESDAY, October 15, 2024 |
| Time of Meeting: | 7:00 PM |
| Location: | Public Safety 181 Main Street Groveland, MA 01834 |
| Signature: | *Annie Schindler* |

**AGENDA**

*For discussion and possible vote:*

**PUBLIC HEARING**
***CONTINUED* 181R SCHOOL STREET**:
A hearing in accordance with M.G.L. Chapter 41, Section 81T, the Town of Groveland Subdivision Rules and Regulations and Article 14 of the Groveland General Bylaws, to hear the application of Groveland Redevelopment LLC. c/o Louis Minicucci Jr, 231 Sutton St, Suite 1B, North Andover MA 01845, requesting approval of a six (6) lot Definitive Subdivision Plan labeled 181R School Street, Groveland, Massachusetts and associated Stormwater Management & Land Disturbance Permit. The site is located in the Residential 2 (R-2) Zoning District. The proposed subdivision is located at 181R School Street Groveland, MA 01834. (Assessors Map 34, Parcel 13).

**4 APPLE BLOSSOM WAY**
Lot Release on 4 Apple Blossom Way.

**MEETING MINUTES**
Approval of April 23, 2024, meeting minutes.

**TOWN PLANNER UPDATE**
Zoning Changes for the 2025 Town Meeting.
102 King Street TRC.

**OTHER ITEMS NOT REASONABLE ANTICIPATED AT TIME OF POSTING**

**NEXT MEETING**: To be determined.

**ADJOURNMENT**

NOTE - Notices and agendas are to be posted 48 hours in advance of the meeting excluding Saturdays, Sundays, and legal holidays.

**FORM C**

**APPLICATION FOR APPROVAL OF A DEFINITIVE PLAN**

TOWN OF GROVELAND
2024 AUG -1 AM 11:04
POSTED

PLANNING BOARD - TOWN OF GROVELAND, MASSACHUSETTS
DATE August 1, 2024

SUBDIVISION NAME 181R School Street PLAN#______

To the Planning Board of the Town of Groveland

The undersigned, being the Applicant as defined under Chapter 41, Section 81-L, for approval of a proposed subdivision shown on a plan entitled "Definitive Subdivision for a Street to be Named in Groveland, Massachusetts at 181R School Street by The Morin-Cameron Group, Inc. dated August 1, 2024 being bounded by land as follows:
See Exhibit A.

Assessor Maps dated 01/01/2019 Plan (s) # 34 lots(s) # 13
Hereby submits said plan as a Definitive Subdivision Plan in accordance with the Rules and Regulations of the Groveland Planning Board and makes application to the Board for approval of said plan.

The undersigned's title to said land is derived from Frank J Franzone
by deed dated 06/28/2017, and recorded in the Essex South Country Registry of Deeds. Book 35976, Pate (s) 077 registered in the Essex South Registry District Of the Land Court, Certificate of Title No. n/a and is free of encumbrances except for the following:

Said plan has (x) has not () evolved from a preliminary plan submitted to the Board on And approved (with modifications) (x) disapproved ( ) on (date) 04/19/2023

The undersigned hereby applies for the approval of said Definitive Plan by the Board, and in furtherance thereof hereby agrees to abide by the Board's Rules and Regulations. The undersigned hereby further covenants and agrees with the Town of Groveland, upon the approval of said Definitive Plan by the Board:

1. to install utilities in accordance with the Rules and Regulations of the Planning Board, Road Commissioner/Public Works Director, the Board of Health, Water and Sewer Board, Municipal Light Department, all general bylaws, and all Zoning Bylaws of the Town of Groveland, as are applicable to the subdivision of land and installation of utilities within the limits of ways and streets:

2. to complete and construct the streets or ways shown thereon in accordance with the Rules and Regulations of the Planning Board and the approved Definitive plan, profiles, and cross sections of the same. Said plan, profiles, cross sections, and construction specifications are specifically, by reference, incorporated herein ail d made a part of the application. This application and the covenants and agreements herein shall be binding

**FORMC**

**APPLICATION FOR APPROVAL OF A DEFINITIVE PLAN**

upon all heirs, executors, administrators, successors, grantees of the whole or part of said land, and assigns of the undersigned; and

3.

(a) to complete, except in the case of any portion of the subdivision for which a surety company performance bond, or a performance bond secured by a deposit of money or negotiable securities, or a tripartite agreement shall have been filed pursuant to these regulations, the required improvements for the subdivisions within three (3) years of the date of such approval, or

(b) to complete the required improvement for any portion of the subdivision, for which a surety company performance bond, or a performance bond secured by a deposit of money or negotiable securities, or a tripartite agreement shall have been filed , within two (2) years of the date of the performance surety or within three (3) years of the date of the Board's approval of the Definitive Plan, whichever date shall occur the earlier, and

(c) that no structure will be occupied until at least the base course of the bituminous concrete has been applied to the streets which serve those structures.

Received by Town Clerk

Date 8/1/2024

Time 11:05 AM

Signature [signature]

Applicant's Signature [signature]
Louis Minicucci Jr Manager

Applicant's Address Groveland Redevelopment, LLC
231 Sutton Street, Suite 1B
North Andover, MA 01845

Andover Real Property Management, Inc., Mgr

Owner's Signature (If not the applicant) [signature]

Owner's Address 181R School Street, LLC
5 Atkinson Farm Road
Atkinson, NH 03811

Received by Planning Board

Date 8/1/2024

Signature Anne Schinella

2024 AUG -1 AM 11:05

# Exhibit A

An undeveloped parcel of land in Groveland, Essex County, Massachusetts, situated on the Westerly side of School Street, bounded and described as follows:

Beginning at the Westerly corner thereof on said School Street at land now or formerly of Ricker and thence running

SOUTHEASTERLY, by School Street to land now or formerly of Donald McGlew; thence

SOUTHWESTERLY, by said land of Donald McGlew in two courses, 212.73 feet to a point; thence

SOUTHEASTERLY, still by said land of Donald McGlew, 250 feet to land now or formerly of Mitchell and land now or formerly of Drew; thence

SOUTHWESTERLY, by land now or formerly of Mitchell and Drew to land now or formerly of Benjamin Morse; thence

NORTHWESTERLY, by land now or formerly of Benjamin Morse to land now or formerly of Thomas Jacques; thence

NORTHEASTERLY, by land now or formerly of Jacques and land now or formerly of Picker to School Street and the point begun at.

## FORM D

## LAND SURVEYOR'S CERTIFICATE

PLANNING BOARD - TOWN OF GROVELAND, MASSACHUSETTS
DATE August 1, 2024

SUBDIVISION NAME 181R School Street PLAN# ____

To the Planning Board of the Town of Groveland

In preparing the plan entitled "Definitive Subdivision for a Street To Be Named in Groveland, Massachusetts at 181R School Street", I hereby certify that the above named plan and accompanying data are true and correct to the accuracy required by the current Rules and Regulations Governing the Subdivision of Land in Groveland, Massachusetts, and my source of information about the location of boundaries shown on said plan was one or more of the following:

1. Deed from Frank J. Franzone to 181R School Street, LLC dated 06/28/17 and recorded in the Essex South Registry in Book 35976 Page(s) 77

2. Other plans, as follows:
1984 E.C.L.O. #3203

3. Oral information furnished by:
N/A

4. Actual measurements on the ground from a starting point established by:
1989 Essex County, Layout

5. Other sources:
N/A

Seal of Professional Land Surveyor

COMMONWEALTH OF MASSACHUSETTS
MICHAEL J. SERGI
No.33191
PROFESSIONAL LAND SURVEYOR

Signed ______________________
(Professional Land Surveyor)

Address ______________________

______________________

**FORMD-1**

## PROFESSIONAL ENGINEER'S CERTIFICATE

PLANNING BOARD - TOWN OF GROVELAND, MASSACHUSETTS
DATE August 1, 2024

SUBDIVISION NAME 181R School Street PLAN# ______

To the Planning Board of the Town of Groveland

In preparing the plan entitled "Definitive Subdivision for a Street To Be Named in Groveland, Massachusetts at 181R School Street". I hereby certify that the above named plan and accompanying data are true and correct to the accuracy required by the current Rules and Regulations Governing the Subdivision of Land in Groveland, Massachusetts, and that the designs contained herein are in accordance with cornn10nly accepted engineering practice and in compliance with applicable laws and regulations of the Commonwealth of Massachusetts and Bylaws of the Town.

1. Sources of data are listed as follows:
Existing topography, natural features and utilities are based on an instrument survey by The Morin-Cameron Group Inc. Dimensional controls are per the Groveland Zoning By-law & Subdivision Regulation.

2. Oral information furnished by:
Scott P. Cameron, P.E.

3. Actual basis of designs, source of soil and groundwater determinations, and other field determinations made:
Soil determination is as per the Natural Resources Conservation Service (NRCS) by the United States Department of Agriculture (USDA) & in-situ soil testing.

4. Other sources
Sight Distances information are as per American Association of State Highway and Transportation Officials (AASHTO). Traffic memo data are as per Institute of Transportation Engineers (ITE). Massachusetts Stormwater Handbook for stormwater design.

Seal of Professional Engineer

Signed ______________________
(Registered Professional Engineer)

Address 25 Kenoza Ave
Haverhill MA 01830

D.1.1.

**FORM E**

**CERTIFIED LIST OF ABUTTERS**

PLANNING BOARD - TOWN OF GROVELAND, MASSACHUSETTS
DATE August 1, 2024

SUBDIVISION NAME 181R School Street PLAN#___

To the Planning Board of the Town of Groveland:

The undersigned, being an applicant for approval of Preliminary/Definitive Plan of a proposed subdivision entitled

Definitive Subdivision for a Street to be Named at 181R School Street, Groveland, Massachusetts.

submits the following sketch of the land in the subdivision listing the names of the adjoining owners and the abutters to the adjoining owners in their relative positions and indicating the address of each abutter on the sketch and in a separate list, including owners of land separated from the subdivision only by a street. **The owners of all parcels within three hundred feet (300') of the applicants property shall be included on the certified list.**

Andover Real Property Management Inc. Manager

[signature]

Signature of Applicant

Groveland Redevelopment, LLC
231 Sutton Street, Suite 1B
North Andover, MA 01845

Address

To the Planning Board of the Town of Groveland

This is to certify that at the time of the last assessment for taxation made by the Town of Groveland the names and addresses of the parties assessed as adjoining owners to the parcel of land including all owners within three hundred feet (300'), shown above are as indicated on the attach list.

Date ____________ Assessor ____________

**E.1.**

# FORM E

## CERTIFIED LIST OF ABUTTERS

PLANNING BOARD - TOWN OF GROVELAND, MASSACHUSETTS
DATE August 1, 2024

SUBDIVISION NAME 181R School Street PLAN#___

To the Planning Board of the Town of Groveland:

The undersigned, being an applicant for approval of Preliminary/Definitive Plan of a proposed subdivision entitled

Definitive Subdivision for a Street to be Named at 181R School Street, Groveland, Massachusetts.

submits the following sketch of the land in the subdivision listing the names of the adjoining owners and the abutters to the adjoining owners in their relative positions and indicating the address of each abutter on the sketch and in a separate list, including owners of land separated from the subdivision only by a street. **The owners of all parcels within three hundred feet (300') of the applicants property shall be included on the certified list.**

Andover Real Property Management Inc.
Manager

Signature of Applicant
Groveland Redevelopment, LLC
231 Sutton Street, Suite 1B
North Andover, MA 01845
Address

To the Planning Board of the Town of Groveland

This is to certify that at the time of the last assessment for taxation made by the Town of Groveland the names and addresses of the parties assessed as adjoining owners to the parcel of land including all owners within three hundred feet (300'), shown above are as indicated on the attach list.

Date ____________

Julie Gebba
Assessor

July 31, 2024

Groveland Planning Board
183 Main Street
Groveland, MA 01834

RE: Definitive Subdivision Application
181R School Street
Groveland, MA 01834

Dear members of the Board:

As authorized signer for, 181R School Street LLC, I grant permission to the Planning Board and its agents to enter the property for necessary on-site walks and visits.

Sincerely,
Frank J. Franzone, Manager

181R School Street, LLC
5 Atkison Farm Rd
Atkison, NH

The Morin-Cameron
GROUP, INC.

August 1, 2024

Groveland Planning Board
c/o Annie Schindler, Town Planner
Groveland Town Hall – 183 Main Street
Groveland, MA 01834

**RE: Definitive Subdivision Application**
**181R School Street, Groveland, Massachusetts**
**Map 34, Lot 13**

Dear Members of the Board:

On behalf of the applicant, Groveland Redevelopment, LLC and 181R School Street, LLC, The Morin-Cameron Group, Inc. (MCG) herby submits by hand delivery, in accordance with Groveland Subdivision Regulations (Chapter 70-3.4), the following:

- 3 copies of Form C, Application for Approval of a Definitive Plan
- 3 copies of Form D-1, Professional Engineer's Certificate
- 3 copies of Form D, Land Surveyor's Certificate
- 3 copies of Form E, Certified list of Abutters
- 12 copies of plans entitled "Definitive Subdivision for a Street to be Named in Groveland, Massachusetts at 181R School Street – (Groveland Assessor's Map 34 Lot 13) – Prepared for Groveland Redevelopment, LLC dated 7/31/24.
- Letter from owner granting permission to the Planning Board and its agents to enter the property for necessary on-site walks and visits.
- Check for $8,000.00 made payable to Town of Groveland
- Transportation Report dated 08/01/24.
- 7 copies of Technical Report dated 07/31/24.
- 7 copies of Environmental Statement Assessment dated 08/01/24.
- Waiver Request Letter dated 08/01/24.

Please contact the undersigned at (978) 373-0310 if you have any questions or comments.

Sincerely,
**THE MORIN-CAMERON GROUP, INC.**

Scott P. Cameron, P.E.

The Morin-Cameron GROUP, INC.

**PLANNING BOARD FEE CALCULATION SHEET:**

In accordance the Town of Groveland Planning Board fee schedule, the fee for a Definitive Subdivision Plan if the Preliminary Plan was not approved or more than seven months has elapsed since approval is:

**$ 2,000 + $1,000 per lot**

The proposed Definitive Subdivision plan proposes six lots:

Fee = $2,000 + $1,000 x 6 lots
Fee = $2,000 + $6,000

**Fee = $8,000**

A check for $8,000.00 made payable to Town of Groveland has been included with the Form C herewith.

Town of Groveland
Economic Development Planning & Conservation Department
183 Main Street
Groveland, MA 01834

MONEY RECEIVED

| | |
|---|---|
| DATE | 8/1/2024 |
| AMOUNT | $8,000.00 |
| NAME ON CHECK | Minco Development Corp |
| ADDRESS ON CHECK | 231 Sutton St, Ste 1B, North Andover MA |
| CHECK NUMBER | 4591 |
| PROJECT NAME | 181R School St Def. Subdivision App |
| PROJECT ACCOUNT | 1001-040-43204-800-000-000 |
| CONTACT | |
| NOTES | |

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**MINCO DEVELOPMENT CORPORATION**
231 SUTTON ST., STE 1B
NORTH ANDOVER, MA 01845

SalemFive
53-7055/2113

4591

7/30/2024

PAY TO THE ORDER OF Town of Groveland

$ **8,000.00

Eight Thousand and 00/100*************************************************************************************** DOLLARS

Town of Groveland

Security features. Details on back.

MEMO

AUTHORIZED SIGNATURE

⑈004591⑈ ⑆211370558⑆ 10000764864⑈

The Morin-Cameron GROUP, INC.

July 31, 2024

Groveland Planning Board
c/o Annie Schindler, Town Planner
Groveland Town Hall – 183 Main Street
Groveland, MA 01834

**RE: Definitive Subdivision – Municipality Application Notification**
**181R School Street, Groveland, Massachusetts**
**Map 31, Lot 13**

Dear Members of the Board:

On behalf of the applicant, Groveland Redevelopment, LLC and 181R School Street, LLC, The Morin-Cameron Group, Inc. (MCG) has sent notice of the Application to all Municipalities abutting the Town of Groveland including the following:

- **Town of Boxford** - Planning Board, 7A Spofford Road Boxford, MA 01921
- **Town of Georgetown** – Planning Board, 1 Library Street Georgetown, MA 01833
- **City of Haverhill** - Planning Board, City Hall, 4 Summer Street, Room 201, Haverhill MA 01830
- **Town of Newbury** – Planning Board, Town Hall, 12 Kent Way, Byfield MA 01922
- **Town of West Newbury** – Planning Board, 381 Main Street, West Newbury, MA 01985

Please contact the undersigned at (978) 373-0310 if you have any questions or comments.

Sincerely,
**THE MORIN-CAMERON GROUP, INC.**

Lindsay Ferlauto
Executive Assistant

# Town of Groveland

07/09/202


Data Sources: Produced by Merrimack Valley Planning Commission (MVPC) using data provided by the Town of Groveland & MassIT/MassGIS

MVPC AND THE TOWN OF GROVELAND MAKES NO WARRANTIES EXPRESSED OR IMPLIED, CONCERNING THE ACCURACY, COMPLETENESS, RELIABILITY, OR SUITABILITY OF THESE DATA. THE TOWN OF GROVELAND AND MVPC DOES NOT ASSUME ANY LIABILITY ASSOCIATED WITH THE USE OR MISUSE OF THIS INFORMATION

Legend

| | | | | | |
|---|---|---|---|---|---|
| MVPC Boundary | Parcels | Building Footprint | Roads | Interstate | Major Road |
| Local Road | Easements | Road Right of Way | Hydrographic Features | Streams | Wetlands |

Merrimack Valley Planning Commi

**25-001-0**
WINNING JR EDWARD
WINNING JULIE
3 ANNE ST
GROVELAND, MA 01834

**25-002-0**
PAROLISI JEFFREY
PAROLISI SHANNON
1 ANNE ST
GROVELAND, MA 01834

**25-003-0**
CONDON ELAINE M
CONDON WAYNE M
169 SCHOOL ST
GROVELAND, MA 01834

**25-012-701**
SILVA CARLA
701 ALYSSA DR
GROVELAND, MA 01834

**25-012-702**
SMITH LIFE ESTATE EUGENE E
SMITH LIFE ESTATE PATRICIA P
702 ALYSSA DR
GROVELAND, MA 01834

**25-012-703**
LEONARDI DAVID TRS
LEONARDI CYNTHIA TRS
703 ALYSSA DR
GROVELAND, MA 01834

**25-012-704**
WILSON TRS RONALD J
WILSON FAMILY TRUST
704 ALYSSA DR
GROVELAND, MA 01834

**25-012-705**
TRULL AUDREY B
TRULL H BAILEY JR
705 ALYSSA DR
GROVELAND, MA 01834

**25-012-706**
FLYNN PAUL
FLYNN GAYLE
706 ALYSSA DR
GROVELAND, MA 01834

**25-012-707**
DUVALL ELIZABETH
707 ALYSSA DR
GROVELAND, MA 01834

**25-012-708**
REID BENJAMIN G
SMITH REID JUDITH A
708 ALYSSA DR
GROVELAND, MA 01834

**25-012-801**
TWOMEY GERALDINE
DOHERTY MAUREEN
801 ALYSSA DR
GROVELAND, MA 01834

**25-012-802**
MARTIN PATRICIA
802 ALYSSA DR
GROVELAND, MA 01834

**25-012-803**
DEWOLFE JANUS I
803 ALYSSA DR
GROVELAND, MA 01834

**25-012-804**
AUCOIN SANDRA A TRS
THE SANDRA A AUCOIN REV TRUST
804 ALYSSA DR
GROVELAND, MA 01834

**25-012-805**
FIELDS FAMILY TRUST
FIELDS DAVID M
805 ALYSSA DR
GROVELAND, MA 01834

**25-012-806**
DIFELICE TR MARY
MARY P DIFELICE TRUST
806 ALYSSA DR
GROVELAND, MA 01834

**25-012-807**
SCHEPIS JR TR PAUL A
SCHEPIS TR ANN M
807 ALYSSA DR
GROVELAND, MA 01834

**25-012-808**
BUCCO TRS MICHAEL D
BUCCO TRS PATRICK J
808 ALYSSA DR
GROVELAND, MA 01834

**25-012-901**
CAPELSON ROBERTA
901 ALYSSA DR
Groveland, MA 01834

**25-012-902**
KAGAN KIRCHICK ROBIN
KIRCHICK STEVEN JEFFERY
902 ALYSSA DR
GROVELAND, MA 01834

**25-012-903**
RODENHISER HOWARD C
RODENHISER MARGARET L
903 ALYSSA DR
GROVELAND, MA 01834

**25-012-904**
RIVA SUZANNE L
RIVA ANGELO JR
904 ALYSSA DR
GROVELAND, MA 01834

**25-012-905**
LENZIE A DAVID
LENZIE JACKIE G
905 ALYSSA DR
GROVELAND, MA 01834

**25-012-906**
GRAHAM ANN M
906 ALYSSA DR
GROVELAND, MA 01834

**25-012-1001**
MOORE TRS LINDA A
MOORE TRS DONALD P
1001 ALYSSA DR
GROVELAND, MA 01834

**25-012-1002**
RUSSO DONALD T
RUSSO DONNA MARIE
1002 ALYSSA DR
GROVELAND, MA 01834

**25-012-1003**
GAUVIN RICHARD
GAUVIN BARBARA ANN
1003 ALYSSA DR
GROVELAND, MA 01834

**25-012-1004**
FRIEL TRS CHARLES M
FRIEL TRS LINDA DE LYON
1004 ALYSSA DR
GROVELAND, MA 01834

**25-012-1005**
LOMBARDI DAVID A TRS
DAVID A LOMBARDI TRUST
1005 ALYSSA DR
GROVELAND, MA 01834

**25-012-1006**
STRAUSS ROGER C
STRAUSS RITA R
1006 ALYSSA DR
GROVELAND, MA 01834

**25-012-1007**
TOMASELLI LINDA A
1007 ALYSSA DR
GROVELAND, MA 01834

**25-012-1008**
SHERIDAN REV TRUST 2022 RICHARD P
SHERIDAN REV TRUST 2022 PATRICIA A
1008 ALYSSA DR
GROVELAND, MA 01834

**25-012-1101**
PARADY-TONDREAU ELAINE
TONDREAU LAWRENCE
1101 ALYSSA DR
GROVELAND, MA 01834

**25-012-1102**
DELMONACO JR THOMAS M
1102 ALYSSA DR
GROVELAND, MA 01834

**25-012-1103**
SZCZECHOWICZ JOSEPH
SZCZECHOWICZ KAREN L
1103 ALYSSA DR
GROVELAND, MA 01834

**25-012-1104**
SMITH TRS MICHELLE C
RONALD P SHWETZ IRV TRUST 2021
1104 ALYSSA DR
GROVELAND, MA 01834

**25-012-1105**
FAZELL JOANNE Y
1105 ALYSSA DR
GROVELAND, MA 01834

**25-012-1106**
MATHEWS DAVID
MATHEWS MARYBETH
1106 ALYSSA DR
GROVELAND, MA 01834

**25-012-1107**
FRANCIS SHEILA A
1107 ALYSSA DR
GROVELAND, MA 01834

**25-012-1108**
SAVASTA TRS JUDY
SAVATA FAMILY TRUST
1108 ALYSSA DR
GROVELAND, MA 01834

**25-012-1201**
MORAN ROCHE TRS PAMELA
JOANNE L MORAN IRREV TRUST
1201 ALYSSA DR
GROVELAND, MA 01834

**25-012-1202**
DARDENO (LF EST) BEVERLY R
1202 ALYSSA DR REALTY TRUST
1202 ALYSSA DR
GROVELAND, MA 01834

**25-012-1203**
STEHLIN TRS KEVIN T
MAMAKOS TRS KARA E
1203 ALYSSA DR
GROVELAND, MA 01834

**25-012-1204**
GAVIN TRS KERI
MCCOY TRS JAKE M
1204 ALYSSA DR
GROVELAND, MA 01834

**25-012-1205**
FIANDACA FRANK A
FIANDACA JACKIE A
1205 ALYSSA DR
GROVELAND, MA 01834

**25-012-1206**
FANDEL TRS ILANA M
SHUMAN TRS BARNET
1206 ALYSSA DR
GROVELAND, MA 01834

**25-012-1301**
MCGRANACHAN CATHERINE
MCGRANACHAN CATHY
1301 ALYSSA DR
GROVELAND, MA 01834

**25-012-1302**
RUSSO PHILIP LIF EST
RUSSO PATRICIA LIF EST
1302 ALYSSA DR
GROVELAND, MA 01834

**25-012-1303**
CHADWICK CATHLEEN
1303 ALYSSA DR
GROVELAND, MA 01834

**25-012-1304**
MOULISON TR MICHAEL W
MOULISON IRV TRUST
1304 ALYSSA DR
GROVELAND, MA 01834

**25-012-1305**
MCDEVITT CATHLEEN
1305 ALYSSSA DR
GROVELAND, MA 01834

**25-012-1306**
FEMINO LIFE EST PAUL A
FEMINO LIFE EST BERNADETTE M
1306 ALYSSA DR
GROVELAND, MA 01834

**25-012-1307**
MEDUGNO JAMES
MEDUGNO JANET
1307 ALYSSA DR
GROVELAND, MA 01834

**25-012-1308**
RUSSO MARY L LIF EST
RUSSO MICHAEL
1308 ALYSSA DR
GROVELAND, MA 01834

**25-012-1401**
CONNOR TRS THOMAS P
CONNOR TRS MARY B
1401 ALYSSA DR
GROVELAND, MA 01834

**25-012-1402**
KENT 2021 TRUST
KENT TR MARIE ARTHUR H
1402 ALYSSA DR
GROVELAND, MA 01834

**25-012-1403**
MARTINDALE TRS ANITA C
ANITA C MARTINDALE TRUST
1403 ALYSSA DR
GROVELAND, MA 01834

**25-012-1404**
LUCCA MARIE
FISCHER CURTIS
1404 ALYSSA DR
GROVELAND, MA 01834

**25-012-1405**
DRISCOLL (LF EST) DIANE T
DIANE T DRISCOLL IRV TRUST
1405 ALYSSA DR
GROVELAND, MA 01834

25-012-1406
GRAOZZO (LF EST) PRISCO
GRAOZZO (LF EST) CATERINA
1406 ALYSSA DR
GROVELAND, MA 01834

25-012-1407
FORD PAUL N
FORD MURIEL
1407 ALYSSA DR
GROVELAND, MA 01834

25-012-1408
COGLIANO TRS IDA R
SCOTINA TRS DIANE
1408 ALYSSA DR
GROVELAND, MA 01834

25-141-0
LIGOLS ALEXANDRA
SMITH DYLAN R
16 EVERGREEN LN
GROVELAND, MA 01834

25-142-0
BURKE DANA
BURKE MEMARIE
6 PARKER RD
GROVELAND, MA 01834

25-143-0
HOOD JOHN P
HOOD SUSAN M
8 PARKER RD
GROVELAND, MA 01834

25-147-0
FITZGERALD RICHARD D LIF EST
FITZGERALD NANCY J LIF EST
180 SCHOOL ST
GROVELAND, MA 01834

25-148-0
PROVENCAL TRS GEORGE R
PROVENCAL TRS MARY R
182 SCHOOL ST
GROVELAND, MA 01834

25-149-0
GORE JASON E
MACHIA-GORE HEATHER A
184 SCHOOL ST
GROVELAND, MA 01834

34-010-101
TOPHAM TRS LAURA R
LAURA R TOPHAM 2020 REV TR
101 DIANE CR
GROVELAND, MA 01834

34-010-102
ENSTAD SONJA L TRS
MCDONALD MARY BETH TRS
102 DIANE CR
GROVELAND, MA 01834

34-010-103
BEIDLER GARY
BEIDLER MARY F
103 DIANE CR
GROVELAND, MA 01834

34-010-104
SALOIS TR PATRICIA M
104 DIANE CIRCLE NOMINEE TR
104 DIANE CR
GROVELAND, MA 01834

34-010-105
PEABODY AUDREY J
105 DIANE CR
GROVELAND, MA 01834

34-010-106
MURRAY LIFE ESTATE RICHARD J
MURRAY LIFE ESTATE D ELIZABETH
106 DIANE CR
GROVELAND, MA 01834

34-010-201
CEDORCHUK TRS KARA B
MCWALTERS FAMILY IRREV TRUST LINDA J
201 DIANE CIR
GROVELAND, MA 01834

34-010-202
SHEEHAN HOLLY
SHEEHAN JOHN
202 DIANE CR
Groveland, MA 01834

34-010-203
SHIMMIN CANDENCE E
BUCCHIERE CANDICE A
203 DIANE CR
GROVELAND, MA 01834

34-010-204
HALUPOWSKI TRS NOEL J
JANET NOLAN IRREV TRUST
204 DIANE CIR
GROVELAND, MA 01834

34-010-205
SELLERS TRS ROBERT J
COOKE TRS KAREN L
205 DIANE CR
GROVELAND, MA 01834

34-010-206
SADOWSKI SUSAN R
SADOWSKI FRANCIS J
206 DIANE CR
GROVELAND, MA 01834

34-010-301
PERRY TR DAVID C
JOHN C PERRY LIVING TRUST
9 SUMMER ST APT 314
DANVERS, MA 01923

34-010-302
DIORIO JOHN C TRS
DIORIO MARLENE L TRS
302 DIANE CR
GROVELAND, MA 01834

34-010-303
GARABEDIAN RICHARD
GARABEDIAN SHIRLEY
303 DIANE CR
GROVELAND, MA 01834

34-010-304
WHITE JOSEPH A LIF EST
WHITE ANN L LIF EST
304 DIANE CR
GROVELAND, MA 01834

34-010-305
BAXTER (LE EST) LEAMAN
BAXTER (LF EST) PATRICIA M
305 DIANE CR
GROVELAND, MA 01834

34-010-306
DORLANDO KAREN
306 DIANE CIR
GROVELAND, MA 01834

34-010-401
MCCORMACK HELEN L
401 DIANE CR
GROVELAND, MA 01834

34-010-402
CASEY WILLIAM J
CASEY ELAINE R
402 DIANE CR
GROVELAND, MA 01834

34-010-403
KERIVAN JOHN E
KERIVAN DIANE M
403 DIANE CIR
GROVELAND, MA 01834

34-010-404
OCONNOR LIFE ESTATE ROBERT J
OCONNOR LIFE ESTATE JOAN K
404 DIANE CIR
GROVELAND, MA 01834

34-010-405
WALLACE MARGARET
WALLACE RICHARD H
405 DIANE CR
GROVELAND, MA 01834

34-010-406
GREEN LORRAINE
406 DIANE CIR
GROVELAND, MA 01834

34-010-407
LUCEY SUSAN
407 DIANE CR
GROVELAND, MA 01834

34-010-408
LEONE MICHAEL
LEONE MELINDA
408 DIANE CR
GROVELAND, MA 01834

34-010-501
DOHERTY PAUL E
DOHERTY JOAN M
501 DIANE CR
GROVELAND, MA 01834

34-010-502
DEWHIRST PATRICIA
C/O DONALD GREANEY
2 MILL ST EXT
GROVELAND, MA 01834

34-010-503
MARTINESE ANN MARIE
503 DIANE CR
GROVELAND, MA 01834

34-010-504
CHOUINARD TRS MARTIN
CHOUINARD TRS JOCELYN E
504 DIANE CIR
GROVELAND, MA 01834

34-010-505
MCCAFFREY TRS JUDITH A
MCCAFFREY 2013 FAMILY TRUST
505 DIANE CR
GROVELAND, MA 01834

34-010-506
GOLDEN JOSEPH TRS
GOLDEN IRENE TRS
506 DIANE CR
GROVELAND, MA 01834

34-010-601
REID WILLIAM
REID NANCY
601 DIANE CIR
GROVELAND, MA 01834

34-010-602
MELCHER JOHN
MELCHER CAROL
602 ALYSSA DR
GROVELAND, MA 01834

34-010-603
FROST SHAWN
MICHELE E FROST REV TRUST
603 DIANE CR
GROVELAND, MA 01834

34-010-604
COSTELLO JOHN J
COSTELLO MARY LOU
604 ALYSSA DR
GROVELAND, MA 01834

34-010-605
DEVOE TR ANDREA
BARBARA GIANNATTASIO IRV TRUST
605 ALYSSA DR
GROVELAND, MA 01834

34-010-606
CARDINALE TRS PAUL A
JOAN F CARDINALE TRUST 2015
606 DIANE CR
GROVELAND, MA 01834

34-010-607
EGENBERG JANICE D TRS
THE HARVEY IRREVOCABLE TRUST
607 DIANE CR
GROVELAND, MA 01834

34-010-608
BRUGMAN TRS TERESA
TERESA BRUGMAN REV TRUST
608 ALYSSA
GROVELAND, MA 01834

34-010-A
HILEMAN REALTY TRUST
HILEMAN TR BARBARA
185 SCHOOL ST
GROVELAND, MA 01834

34-010-B
HART NEIL
187 SCHOOL ST
GROVELAND, MA 01834

34-012-0
DEVEAU DERRICK M
RHOADES ANDREA M
181 SCHOOL ST
GROVELAND, MA 01834

34-013-0
181R SCHOOL STREET LLC
5 ATKINSON FARM RD
ATKINSON, NH 03811

34-014-0
HOMES OF CARE III INC
102 GLENN ST
LAWRENCE, MA 01843

34-015-0
MASSERO STEVEN
MASSERO JESSICA
4 ANNE ST
GROVELAND, MA 01834

34-016-0
MANISCALCO JEFFREY
MANISCALCO ASHLEY KATE
6 ANNE ST
GROVELAND, MA 01834

34-017-0
RHODES GARY
8 ANNE ST
GROVELAND, MA 01834

34-018-0
STAUBLE ERIC
120 MADBURY RD
DURHAM, NH 03824

34-019-0
SANFORD WARREN R (LF EST)
SANFORD ROSEMARIE (LF EST)
5 ANNE ST
GROVELAND, MA 01834

34-020-0
BERUBE TRS SCOTT
BERUBE REALTY TRUST
186 SCHOOL ST
GROVELAND, MA 01834

34-021-0
KOWALICK KEITH C
KOWALICK ANNE MARIE
188 SCHOOL ST
GROVELAND, MA 01834

34-022-0
ARSENAULT KENNETH J
ARSENAULT GAIL A
2 PARKER RD
GROVELAND, MA 01834

34-023-0
COPELAS ALETHEA B
COPELAS CHAD
3 PARKER RD
GROVELAND, MA 01834

34-024-0
PERKINS WILLIAM L
PERKINS JANICE
1 PARKER RD
GROVELAND, MA 01834

34-025-0
SCOTT JR ALFRED A
SCOTT MAUREEN C
190 SCHOOL ST
GROVELAND, MA 01834

34-026-0
BEDARD BRUCE R
192 SCHOOL ST
GROVELAND, MA 01834

34-027-0
WINNINGHAM JAMES T
WINNINGHAM ERIN G
1 PARKER CR
GROVELAND, MA 01834

41-041-0
NEIMAR FARM LLC
2 ORCHARD RD
GLOUCESTER, MA 01930

42-062-0
MASSACHUSETTS ELECTRIC CO
PROPERTY TAX DEPT
40 SYLVAN RD
WALTHAM, MA 02451

CERTIFIED
Board of Assessors
Groveland, MA

H. Dana Moody

**ENVIRONMENTAL ASSESSMENT**
**181R School Street Subdivision**

The following environmental impact assessment has been prepared in accordance with the Groveland Subdivision Regulations "Schedule A".

*A. Physical Environment*

- ***Describe the general physical conditions of the site, including amounts and varieties of vegetation; general topography; unusual geologic, scenic, and historical features; trails, and open space links; and indigenous wildlife.***
  The existing site consists of a parcel located at 181R School Street, which encompasses a total area of approximately 345,495 square feet (5.65 acres). The site is comprised by a mix of deciduous and evergreen trees, and understory vegetation such as shrubs and grasses. The site topography is generally uniform and features slopes varying from 4% to 12%, with no steep slopes, making the area suitable for residential development while maintaining the natural drainage patterns. Soil testing has been performed on-site and no unusual geologic formations were noted. The soil composition is primarily sandy loam, but loamy sand and gravelly sand soils have been encountered as well. There are no known historical landmarks or features on the site, nor designated trails and open space links within the site itself. The site contains some indigenous wildlife mammals and birds.

- ***Describe how the project will affect these features.***
  The project will involve the construction of a road, installation of a stormwater management system, installation of new utilities and landscape improvements to service the proposed six lots. Associated with the construction of the items mentioned previously some disturbance will need to occur, including the removal of existing vegetation, grading, and earthwork. Although the proposed project will impact some of the site features, some measures will be taken to mitigate the adverse effects on the site features, such as preserving a wooded buffer to the extent possible around the perimeter of the property and, planting native tree species and landscaping throughout the site; maintaining natural drainage patterns to maximum extent practicable including incorporation of sustainable best management practices permeable pavement and rain gardens; and managing stormwater runoff on-site, that will reduce the volume and peak rates of stormwater running off to abutting properties.

- ***Provide a complete physical description of the project and relationship to surrounding area***.
  The site is located within a predominantly residential area of Groveland. The surrounding proprieties are single-family and multi-family homes on similar or smaller lots than what is proposed. The lots fully comply with the Groveland Zoning and Subdivision regulations (note 2 waivers requested to better conform to neighborhood and sustainable practices) and best practices.

*B. Surface Water and Soil*

- ***Describe location, extent, and type of existing water and wetland, including existing surface drainage characteristics, both within and adjacent to the project.***
  The project site does not contain wetlands or major water bodies. The nearest wetlands and a small stream are located on an open-space area more than 500 feet to the west of the site. The stream carries stormwater runoff to the Merrimack River, which is located more than 4,000 feet north of the property. The adjacent properties exhibit similar drainage characteristics, with stormwater runoff flowing west towards the stream referenced previously. The proposed project will alter the existing surface drainage patterns temporarily during development. The stormwater management system has been designed to mitigate any impacts and replicate or improve existing stormwater conditions. The project will maintain the drainage characteristics to the maximum extent practicable, will utilize of best management practices (BMPs), will provide groundwater recharge and, attenuate the peak flow and volume of stormwater flowing to the adjacent properties.

- ***Describe the methods to be used during construction to control erosion and sedimentation i.e. use of sediment -basins and type of mulching, matting, or temporary vegetation.***
  The project proposes to clear approximately 4.4 acres of land, and maintain a tree buffer around the perimeter, to the extent possible. During construction, disturbed soils within this area will need to be managed to ensure that dust and erosion are contained on site. Erosion control details are included in the Definitive Subdivision Plans and Construction Phase Best Management Practices Operations and Maintenance Plan is included within the Technical Report. The plan contains provisions for erosion and sediment control measures including, silt fence, mulch sock, inlet protection, grading, topsoiling, seeding, dust control and inspection/maintenance. These good housekeeping and oversight measures have a long-standing track record, endorsed by the EPA and DEP for effectively managing erosion and pollution sources during construction.

  The project falls under the Environmental Protection Agency (EPA) Construction General Permit (CGP). An eNOI from the EPA will be required and obtained prior to construction. This will involve preparation Stormwater Pollution Prevention Plan and weekly inspections of erosion and sediment controls that will ensure the controls are effective throughout construction. Minimum weekly monitoring by a licensed SWPPP Inspector is required throughout the duration of construction until the site reaches a stabilized condition.

- ***Describe approximate size and location of land to be cleared at any given time and length of time and exposure; covering of soil; stockpiles; and other control methods used. Evaluate effectiveness of proposed methods on the site and on the surrounding areas.***
  The road is expected to take 3-4 months to construct to binder. Each home will take up to 12-months to construct, multiple homes will be constructed concurrently. The total duration of the road and home construction is expected to take 2 to 3 years depending on market conditions, supply of materials and availability of labor.

- ***Describe the permanent methods to be used to control erosion and sedimentation. Include description of:***
  (1) ***Any areas subject to flooding or ponding.***
  A surface drainage system with capacity to convey the 100-year storm event has been designed to prevent flooding or ponding within the site and abutting properties, and to minimize erosion.
  (2) ***Proposed surface drainage system.***
  Two infiltration basins and four rain gardens are being proposed to mitigate, renew, and infiltrate stormwater runoff to avoid flooding or ponding on site and surrounding areas. These systems will feature appropriate treatment BMPs to remove sediment from stormwater prior to discharge.
  (3) ***Proposed land grading and permanent vegetative cover.***
  All vegetated areas will be loamed and seeded to stabilize exposed soils and will feature plantings with root systems that will provide further stabilization. Slopes are intended to be no steeper than three horizontal to one vertical unless a retaining wall, rock or manufactured product is used.
  (4) ***Methods to be used to protect existing vegetation.***
  A limit of work has been established and a silt fence will be installed around it. A mulch sock fence and a temporary sediment forebay are being proposed to manage sedimentation control. A wooded tree buffer is intended to be preserved to the maximum extent possible. The silt fence will be installed at the start of construction to establish the limit of work for the road and lots. Some lots may desire to clear more or less trees based on owner preference. A conservative limit of clearing and impervious coverage was presumed for the design to account for this variability in the lot construction.
  (5) ***The relationship of the development to the topography.***
  Throughout the site, the topography has been maintained to the maximum extent practicable, with finished grades varying no more than two feet from existing conditions to proposed conditions.
  (6) ***Any proposed alterations of shorelines, marshes or seasonal wet areas.***
  No alteration of shorelines, marshes or seasonal wet areas are proposed.
  (7) ***Any existing or proposed flood control or wetland easements.***
  There are no flood controls or wetlands within the site.
  (8) ***Estimated increase of peak runoff caused by altered surface conditions, and methods to be used to return water to the soils and best management practices (BMP's) to be used to meet the requirements of the Massachusetts Stormwater Policy Act [Handbook].***
  The stormwater management system has been designed to decrease the peak rate of runoff from all storm events. The project will provide a total of 1,903 cubic feet of ground water recharge where 1,648 cubic feet is required through the proposed infiltration basins and rain gardens, see Stormwater Management Calculations within the Technical Report. Additionally, water quality volume will be provided by the utilization of hydrodynamic separators and infiltration.

- ***Completely describe sewage disposal methods. Evaluate impact of disposal methods on surface water, soils, and vegetation.***
  The design will utilize individual ejector pumps to a common force main in the new road. A manhole near School Street will receive the wastewater and by gravity, direct it to the

municipal main in School Street. All sewage is expected to be domestic wastewater and will comply with any Town of Groveland requirements.

*C. Subsurface Conditions*

- ***Describe any limitations on the proposed project caused by sub-surface soil and water conditions, and methods to be used to overcome them.***
  The soils encountered on-site are very well drained soils with medium to high infiltration rates. Therefore, limitations on the proposed project caused by sub-surface soil and water conditions are not anticipated.
- ***Describe procedures and findings of percolation tests conducted on the site.***
  Test holes were excavated to determine soil type, consistency, and depth to seasonal high-water table. A high-water table was not identified in any test holes, so it occurs below the depth of the test hole excavation. Percolation tests are for onsite wastewater disposal systems and not applicable to this development because it has municipal sewer available.
- ***Evaluate impact of sewage disposal methods on quality of subsurface water.***
  The proposed sewage disposal method utilized is via a closed system to the municipal sewer. There are no impacts to subsurface water quality at the site due to wastewater.

*D. Town Services*

- ***Describe estimated traffic flow at peak periods and proposed circulation pattern.***
  A Transportation Report dated July 31, 2024, has been included within this submittal. The results of the trip generation estimate that the proposed subdivision will generate a negligible impact on the public network.
- ***Describe locations and number of vehicles accommodated in off street parking areas.***
  The final lot design has not yet been completed. However, the road was designed in full compliance with the Groveland Zoning regulations and will comply with the required off-street parking.
- ***Describe effect of project on police and fire protection services.***
  The project will not have a measurable impact on police and fire due to its small size. Both police and fire departments are located nearby the site so in the event of an emergency, response time will be minimal. Two fire hydrants have been proposed on-site and the road was designed to ensure emergency vehicle access to facilitate these services.
- ***Describe effect of project on educational services.***
  The proposed subdivision will likely increase the number of school-aged children in the area, resulting in a modest rise in demand for educational services. Tax revenue generated from the new homes will offset some of the cost of new school children entering the school system. According to US census data from 2020, Groveland has approximately 2.58 persons per household and 21.8% of its population is under 18 years old. Assuming all children go to Groveland elementary or Pentucket Regional High School, it is expected that 4 to 5 school age children reside in this development at a given time. It should be noted that the Regional Whittier Technical High School is nearby, and some children are placed in private schools. This estimate is conservative.
- ***Describe effect of project on public works department services.***
  The road, once constructed, would be sought to become a public road. Plowing and maintenance will be required by the public works department thereafter. New tax revenue

generated by the homes will offset the cost of maintenance of the road. The new road would also be subject to additional state funds under Ch.90.

- ***Describe the effect of the project on the Town water supply and distribution system.*** Based on a conservative five bedrooms per dwelling, water consumption is expected to be no more than 2,200 gallons per day based on 50% of the Title 5 flows. Water utility bills will offset the cost of this water consumption.

- ***Describe the effect of the project on the Town sewer system if the area is to be sewered.***
  Based on title 5 flows, the project will generate approximately 4,400 gallons per day of total wastewater flow. Sewer impacts will be mitigated with sewer fees that the homeowners pay based on usage.

*E. Human Environment*

- ***Provide a tabulation of proposed buildings by type, size (number of bedrooms, floor area), ground coverage, and a summary showing the percentage of the tract to be occupied by buildings, parking and other paved vehicular areas, and usable open space.***
  Final lot design has not yet been completed; therefore, the type and size of buildings have not been established. The Site Plan on the Definitive Subdivision Plan depicts conceptual lot improvements for the purpose of demonstrating constructability. Sheet C-3 includes dimensional and lot coverage information for each lot. Each lot complies with the zoning bylaw with respect to shape, size, and frontage. Open space will be private on each lot.

- ***Describe type of construction, building materials used, location of common areas, location and types of service facilities (laundry, trash. garbage disposal).***
  The homes are not designed until after the road is constructed when a building permit can be obtained. It is anticipated that they will be of wood frame construction in a style that is marketable for the region. They will include all services available including natural gas.

- ***State proximity to transportation, shopping, and educational facilities, including active and passive types; and age groups participating, and state whether recreational facilities and open space are available to all residents.***
  School Street connects southerly Main Street, Route 113, providing access to Interstate 95. Northerly, School Street connects with Route 133 and Interstate 95. The Haverhill MBTA is located approximately 4 miles from the site and there is a bus stop less than a mile away from the site on Main Street. Grocery stores are located less than 3 miles away. Dr. Elmer Bagnall Elementary school is located about 0.6 miles from the site, Pentucket Regional Middle and High Schools are located approximately 3.5 miles from the site. There are various parks nearby the property such as Veasey Memorial Park and Groveland Pines Recreation Area, both within 2 miles from the property.

## *F. General Impact*

- ***Summarize briefly the environmental impact on the entire Town with supporting reasons.***

  According to US Census data, Groveland has a 2023 population of 6,743 residents and 2,613 households. The project will add 8 new dwellings and approximately 20 new residents. This represents only a 0.12% increase in population and 0.3% increase in households. It is a very small project that will have a de minimis impact on the community when compared to the additional tax revenue that it generates for 8 dwellings compared to undeveloped land in the current condition. Housing is also in severe demand regionally and this project provides a positive step towards adding this housing. The mix of single- and two-family dwellings provides a variety of housing options. The two-family dwellings are within financial reach of more families than a single-family dwelling. The project fully complies with current stormwater regulations and best practices.

The Morin-Cameron GROUP, INC.

August 1, 2024

Groveland Planning Board
c/o Annie Schindler, Town Planner
Groveland Town Hall – 183 Main Street
Groveland, MA 01834

**RE: Waiver Request Letter – Definitive Subdivision Application**
**181R School Street, Groveland, Massachusetts**
**Map 34, Lot 13**

Dear Members of the Board:

On behalf of the applicant, Groveland Redevelopment, LLC and 181R School Street, LLC, The Morin-Cameron Group, Inc. (MCG) hereby requests for the following waivers from the Town of Groveland Subdivision Rules and Regulations:

- ***70-4.3. (H)(5) "Proposed new intersections along one side of an existing street shall, wherever practicable, coincide with any existing intersections on the opposite side of such street. Where streets intersect major streets, their alignment shall be continuous. Intersections of major streets shall be at least 800 feet apart, and minor streets shall be at least 400 feet apart."***
The applicant requests a waiver to reduce the intersection separation of 400 feet to 300 feet. This waiver is in the public interest by allowing access to land for development of much needed housing. The housing types include two-family dwellings which are more economically accessible to younger families. It is in keeping with the neighborhood in that adjacent intersections with adjacent minor streets range from 217 feet (Doris to Wilbert), 300 feet (Anne to Georgia) to 320' (Carilda to Abbott). The proposed intersection meets AASHTO standard for stopping sight distance, is a very low volume minor road and is geometrically designed in accordance with the Groveland Subdivision Regulations.

- ***70-4.9(B) "Bituminous concrete sidewalks shall conform to the material and construction methods as specified in Section 701 of the MassDOT Standard Specifications."***
A waiver is requested from the technical requirements for sidewalk and driveway apron construction to install permeable pavement. Modern best engineering practice weighs heavily on sustainable design, and this is in the public interest of environmental protection. The homes will be constructed to the current Mass Building Code which is highly energy and water efficient. The road and site design also took into consideration sustainable measures in implementing bioretention rain gardens and infiltration basins as well as proprietary treatment practices to meet and exceed the state and Groveland stormwater standards. As part of this effort of sustainable design, the sidewalks and driveways were earmarked to be permeable pavement. This are low volume or no traffic volume surfaces that will hold up well as permeable pavement. Permeable pavement typically stays drier which means less chance of ice forming on sidewalk/pedestrian areas.

Finally, as a conservative design measure, the sidewalks and driveways were assumed to be impervious, so granting of this waiver does not reduce size of other infiltration stormwater practices in the project.

Please contact the undersigned at (978) 777-8586 if you have any questions or comments.

Sincerely,
**THE MORIN-CAMERON GROUP, INC.**

Scott P. Cameron, P.E.
Vice President

The Morin-Cameron
GROUP, INC.

August 1, 2023

Groveland Planning Board
c/o Annie Schindler, Town Planner
Groveland Town Hall – 183 Main Street
Groveland, MA 01834

**RE: Transportation Report**
**Definitive Subdivision - 181R School Street**

Dear Members of the Board:

On behalf of the applicant, Groveland Redevelopment, LLC & 181R School Street, The Morin-Cameron Group, Inc. (MCG) hereby submits this Transportation Report associated with a 6-lot Definitive Subdivision located at 181R School Street in Groveland, Massachusetts. The project proposes to subdivide the existing parcel into 4 single-family and 2 two-family residence lots with frontage to a proposed road for a total of 8 potential dwellings. The access and egress will be through a 'Proposed Street to be Named' that will intersect with School Street. This report is intended to satisfy the points of Section 70-43-.4(A)(20) of the Groveland Subdivision Regulations.

**Trip Generation**

The Institute of Transportation Engineers (ITE) publication Trip Generation Manual, 11th Edition – Volume 3, is the industry accepted source for trip generation information for various land uses throughout the United States. Trip rates from the ITE Land Use Code (LUC) 210 – Single-family detached housing – was utilized to estimate the trips generated by the proposed subdivision during the weekday and weekend morning and evening peak hours. The single-family attached housing includes any single-family housing detached homes on individual lots. A two-family dwelling may have less trips so for this analysis, they were conservatively assumed to have the same trips as a larger, single-family dwelling. A typical site surveyed is a suburban subdivision. The trip data is attached to this document. Calculations and a summary of the ITE Trip Generation is noted below:

| Average Rate (by ITE) x Number of Dwellings = Average Trip number |
|---|

Average Weekday Daily:

Average Rate = 9.43

Number of dwellings = 8

Average trip number = 9.43 x 8 => Average trip number = 75 (vehicles entering and exiting)

<u>Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m.:</u>

Average Rate = 0.70

Number of dwellings = 8

Average trip number = 0.7 x 8 => Average trip number = 6

<u>Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.:</u>

Average Rate = 0.94

Number of dwellings = 8

Average trip number = 0.94 x 8 => Average trip number = 8

<u>Saturday Entire Day:</u>

Average Rate = 9.48

Number of dwellings = 8

Average trip number = 9.48 x 8 => Average trip number = 76

<u>Sunday Entire Day:</u>

Average Rate = 8.48

Number of dwellings = 8

Average trip number = 8.48 x 8 => Average trip number = 68

| **Time Period/Direction** | **ITE LUC 210** |
|---|---|
| Average Weekday Daily | 75 vehicle trips |
| Weekday AM Peak Hour | |
| Enter | 1 vehicle trips |
| Exit | 5 vehicle trips |
| Total | 6 vehicle trips |
| Weekday PM Peak Hour | |
| Enter | 5 vehicle trips |
| Exit | 3 vehicle trips |
| Total | 8 vehicle trips |
| Saturday Entire Day | |
| Enter | 38 vehicle trips |
| Exit | 38 vehicle trips |
| Total | 76 vehicle trips |
| Sunday Entire Day | |
| Enter | 34 vehicle trips |
| Exit | 34 vehicle trips |
| Total | 68 vehicle trips |

The number of vehicle trips depicted in the table hereon are calculated based on the number of dwellings. According to those calculations, the proposed development is anticipated to generate an average of 75 new vehicle trips entering and exiting during a weekday. During the peak hours, 1 new car every 20 minutes or 6 trips in the AM peak hour, 8 new trips or 1 car every 15 minutes in the PM peak hour. During weekend days, 76 daily trips on Saturday and 68 daily trips on Sunday.

**Sight Distance**

To identify possible safety hazards associated with site access and egress, MCG has prepared a sight distance evaluation at the proposed intersection. This evaluation is to determine if the available sight distances for vehicles exiting the site are adequate. The available sight distances were compared with minimum requirements established by the American Association of Highway and Transportation Officials (AASHTO) – "A policy On Geometric Design of Highways and Streets; 2018 & 2004". Vehicle speeds were not measured for this site due to the small size of the project. Conservatively, the posted speed limit of 40 miles per hour (MPH) was utilized. The site is also near the Bagnell School which has a lower posted speed limit of 20 MPH during school hours (commuter hours). This section of road is also heavily monitored by local law enforcement. Therefore, the posted speed limit is an acceptable design speed for this analysis.

Stopping Sight Distance (SSD) is the minimum distance required for a vehicle traveling at a certain speed to safely stop before reaching a stationary object in the road. It is measured from an eye height of 3.5 feet to an object height of 2 feet above the street level.

The SSD at the proposed intersection was measured and compared to minimum requirements as established by AASHTO based on the posted speed limit of 40 MPH. A left-turn from stop requires the longest SSD.

| Location/Direction | Required SSD (40 MPH) | Measured |
|---|---|---|
| North of Prop. Street | 305 feet | >500 feet |
| South of Prop. Street | 305 feet | >500 feet |

Intersection Sight Distance (ISD) measures a line of sight from the height of driver's eye (3.5 feet), seated 15 feet back from the fog line or edge of a travelled way, to the right and to the left, to an object in the highway that is 3.5 feet high.

The ISD at the proposed intersection was measured and compared to minimum requirements as established by AASHTO based on the posted speed limit of 40 MPH.

| Location/Direction | Required ISD (40 MPH) | Measured |
|---|---|---|
| North of Prop. Street | 445 feet | >500 feet |
| South of Prop. Street | 445 feet | >500 feet |

As shown on the tables, the available SSD and ISD exceeds AASHTO's minimum recommendations for safe operations at the site driveway.

**Conclusion**

The results of the trip generation estimate indicate that the proposed 6-lot single-family and two-family subdivision will be not have noticeable impact on School Street. Given the very small scale of this project, only 1 new car every 20 minutes will be generated in the AM peak hour and 7 new trips, or 1 car every 15 min will be generated in the PM peak hour: averaging 76 vehicle trips during a weekday. During the weekend entire day, 76 daily trips on Saturday and 68 daily trips on Sunday. These minimal increases will not be noticeable on the adjacent roadway network. Sight lines at the proposed driveway will exceed AASHTO recommendations for safe operations, indicating no safety issues at the proposed driveway.

Should you have any questions or require additional information, please contact the undersigned at (978) 373-0310.

Sincerely,
**THE MORIN-CAMERON GROUP, INC.**

Scott P. Cameron, PE
Vice-President

Enclosures

Cc: Groveland Redevelopment, LLC

# Land Use: 210
# Single-Family Detached Housing

## Description

A single-family detached housing site includes any single-family detached home on an individual lot. A typical site surveyed is a suburban subdivision.

## Specialized Land Use

Data have been submitted for several single-family detached housing developments with homes that are commonly referred to as patio homes. A patio home is a detached housing unit that is located on a small lot with little (or no) front or back yard. In some subdivisions, communal maintenance of outside grounds is provided for the patio homes. The three patio home sites total 299 dwelling units with overall weighted average trip generation rates of 5.35 vehicle trips per dwelling unit for weekday, 0.26 for the AM adjacent street peak hour, and 0.47 for the PM adjacent street peak hour. These patio home rates based on a small sample of sites are lower than those for single-family detached housing (Land Use 210), lower than those for single-family attached housing (Land Use 251), and higher than those for senior adult housing -- single-family (Land Use 251). Further analysis of this housing type will be conducted in a future edition of *Trip Generation Manual.*

## Additional Data

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (https://www.ite.org/technical-resources/topics/trip-and-parking-generation/).

For 30 of the study sites, data on the number of residents and number of household vehicles are available. The overall averages for the 30 sites are 3.6 residents per dwelling unit and 1.5 vehicles per dwelling unit.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in Arizona, California, Connecticut, Delaware, Illinois, Indiana, Kentucky, Maryland, Massachusetts, Minnesota, Montana, New Jersey, North Carolina, Ohio, Ontario (CAN), Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Vermont, Virginia, and West Virginia.

## Source Numbers

100, 105, 114, 126, 157, 167, 177, 197, 207, 211, 217, 267, 275, 293, 300, 319, 320, 356, 357, 367, 384, 387, 407, 435, 522, 550, 552, 579, 598, 601, 603, 614, 637, 711, 716, 720, 728, 735, 868, 869, 903, 925, 936, 1005, 1007, 1008, 1010, 1033, 1066, 1077,1078, 1079

# Single-Family Detached Housing
(210)

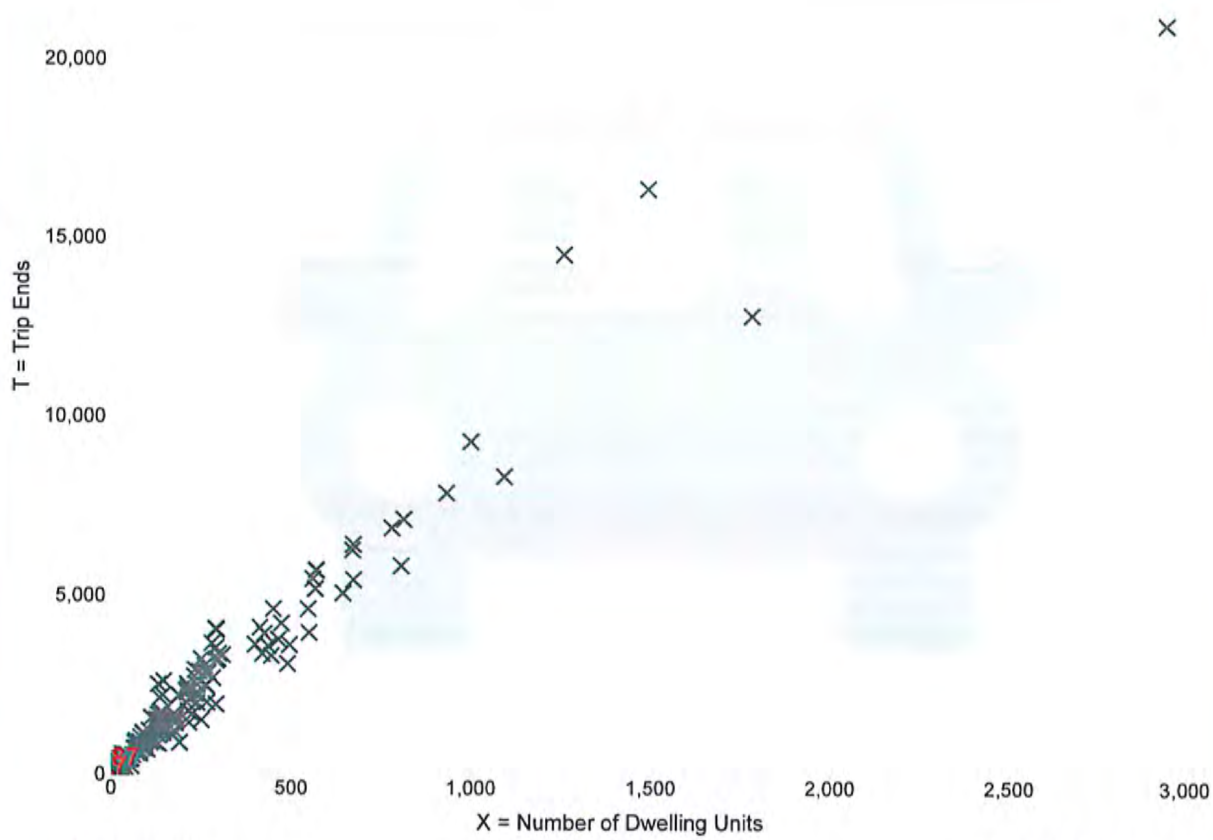
**Vehicle Trip Ends vs:** **Dwelling Units**
**On a:** **Weekday**

**Setting/Location:** **General Urban/Suburban**
Number of Studies: 174
Avg. Num. of Dwelling Units: 246
Directional Distribution: 50% entering, 50% exiting

## Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 9.43 | 4.45 - 22.61 | 2.13 |

## Data Plot and Equation




X **Study Site** ——— **Fitted Curve** **Average Rate**

**Fitted Curve Equation: Ln(T) = 0.92 Ln(X) + 2.68** **$R^2$= 0.95**

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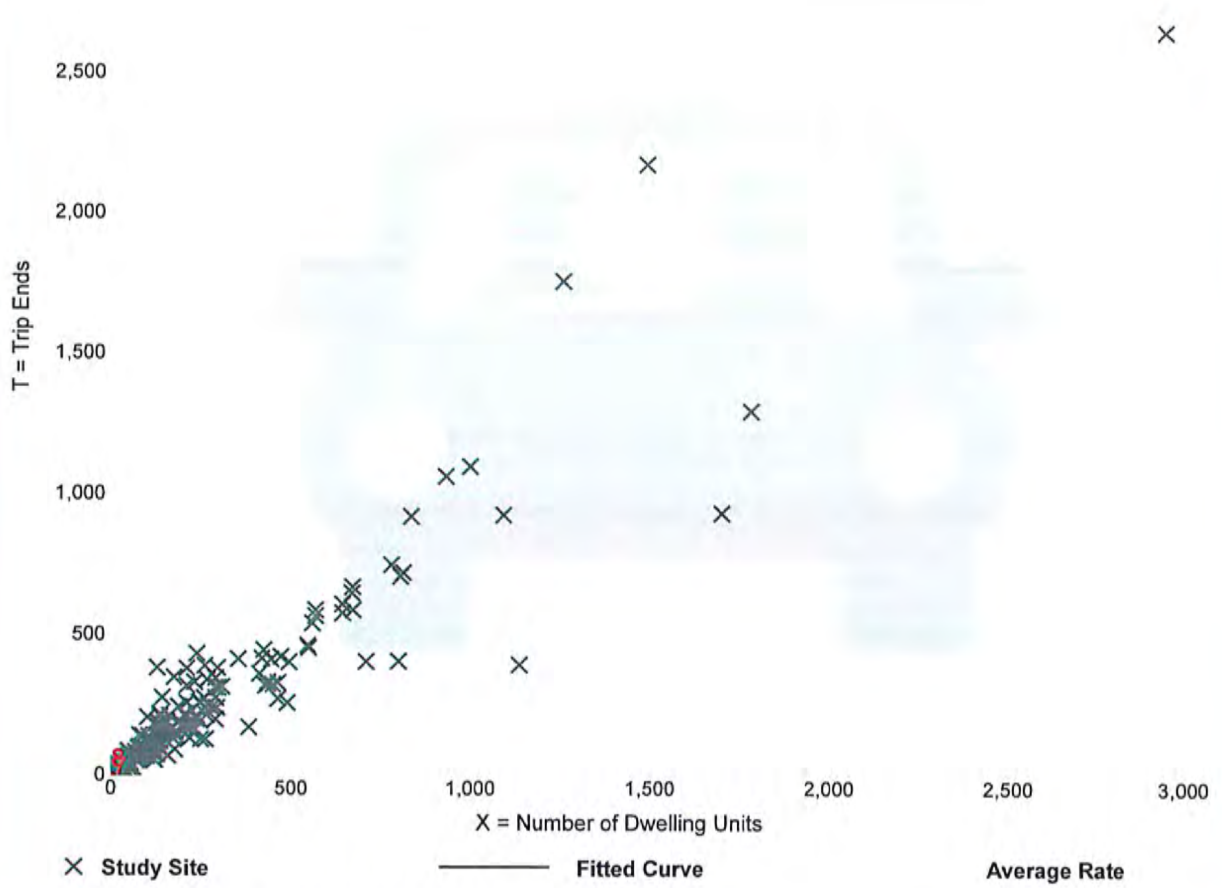
# Single-Family Detached Housing
(210)

| | |
|---|---|
| **Vehicle Trip Ends vs:** | **Dwelling Units** |
| **On a:** | **Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.** |
| **Setting/Location:** | **General Urban/Suburban** |
| Number of Studies: | 208 |
| Avg. Num. of Dwelling Units: | 248 |
| Directional Distribution: | 63% entering, 37% exiting |

## Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 0.94 | 0.35 - 2.98 | 0.31 |

## Data Plot and Equation




**Fitted Curve Equation: Ln(T) = 0.94 Ln(X) + 0.27**

**$R^2$= 0.92**

*Trip Gen Manual*, 11th Edition • Institute of Transportation Engineers

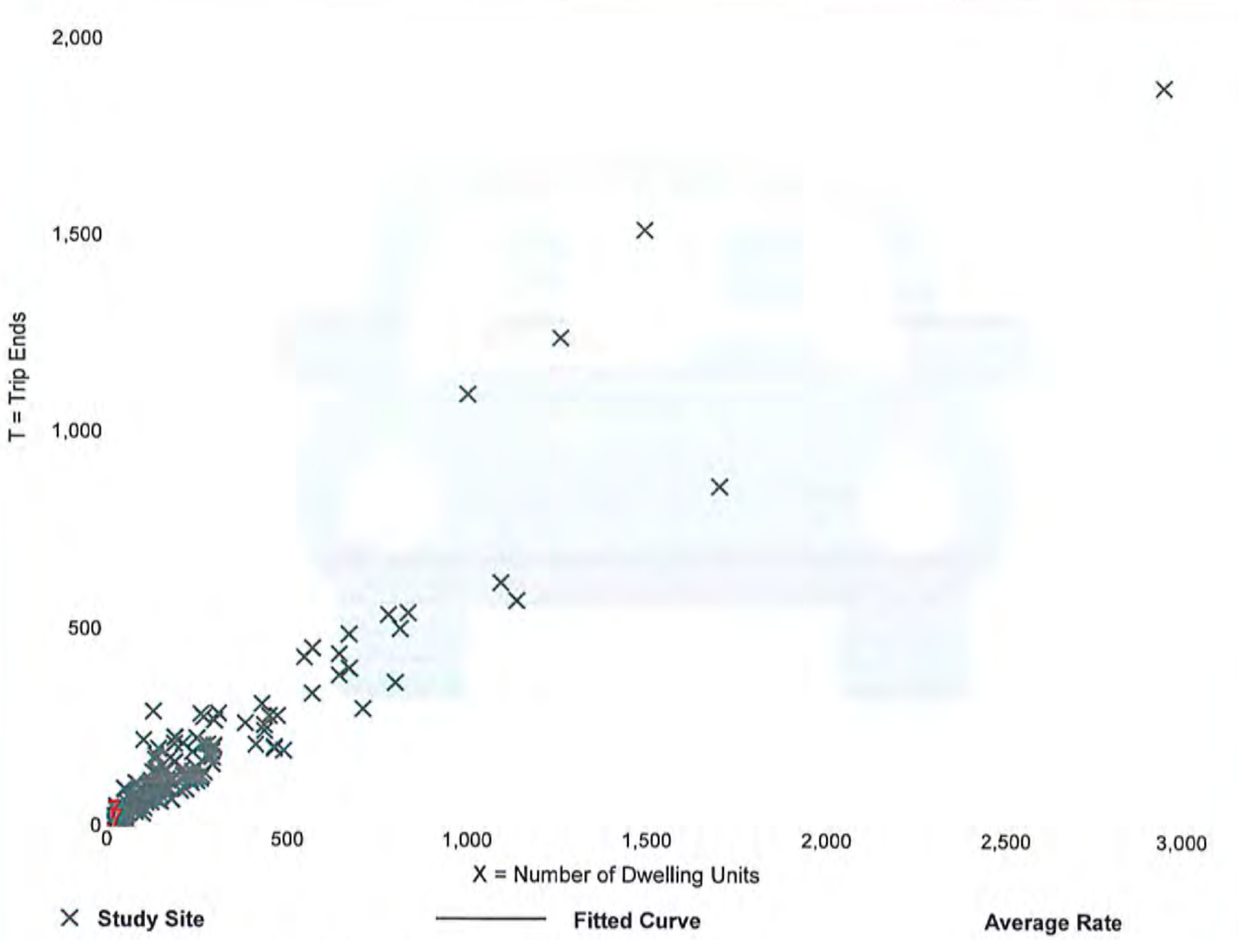
# Single-Family Detached Housing
## (210)

| | |
|---|---|
| **Vehicle Trip Ends vs:** | **Dwelling Units** |
| **On a:** | **Weekday, Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m.** |
| **Setting/Location:** | **General Urban/Suburban** |
| Number of Studies: | 192 |
| Avg. Num. of Dwelling Units: | 226 |
| Directional Distribution: | 25% entering, 75% exiting |

## Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 0.70 | 0.27 - 2.27 | 0.24 |

## Data Plot and Equation




**Fitted Curve Equation: Ln(T) = 0.91 Ln(X) + 0.12** **$R^2$= 0.90**

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# Single-Family Detached Housing
## (210)

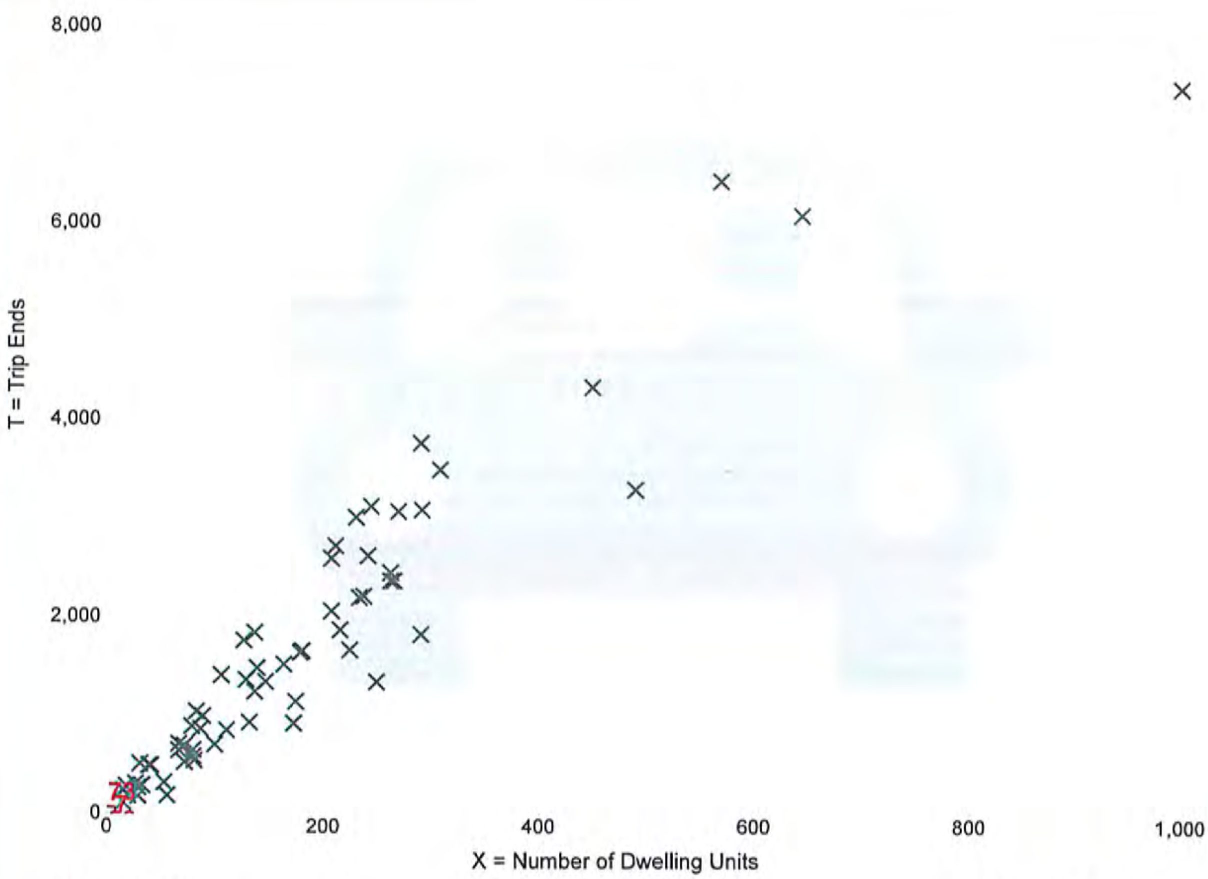
**Vehicle Trip Ends vs:** **Dwelling Units**
**On a:** **Saturday**

**Setting/Location:** **General Urban/Suburban**
Number of Studies: 63
Avg. Num. of Dwelling Units: 179
Directional Distribution: 50% entering, 50% exiting

## Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 9.48 | 3.36 - 16.52 | 2.26 |

## Data Plot and Equation




× **Study Site** ——— **Fitted Curve** **Average Rate**

**Fitted Curve Equation: Ln(T) = 0.97 Ln(X) + 2.40** **$R^2$= 0.91**

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# Single-Family Detached Housing
(210)

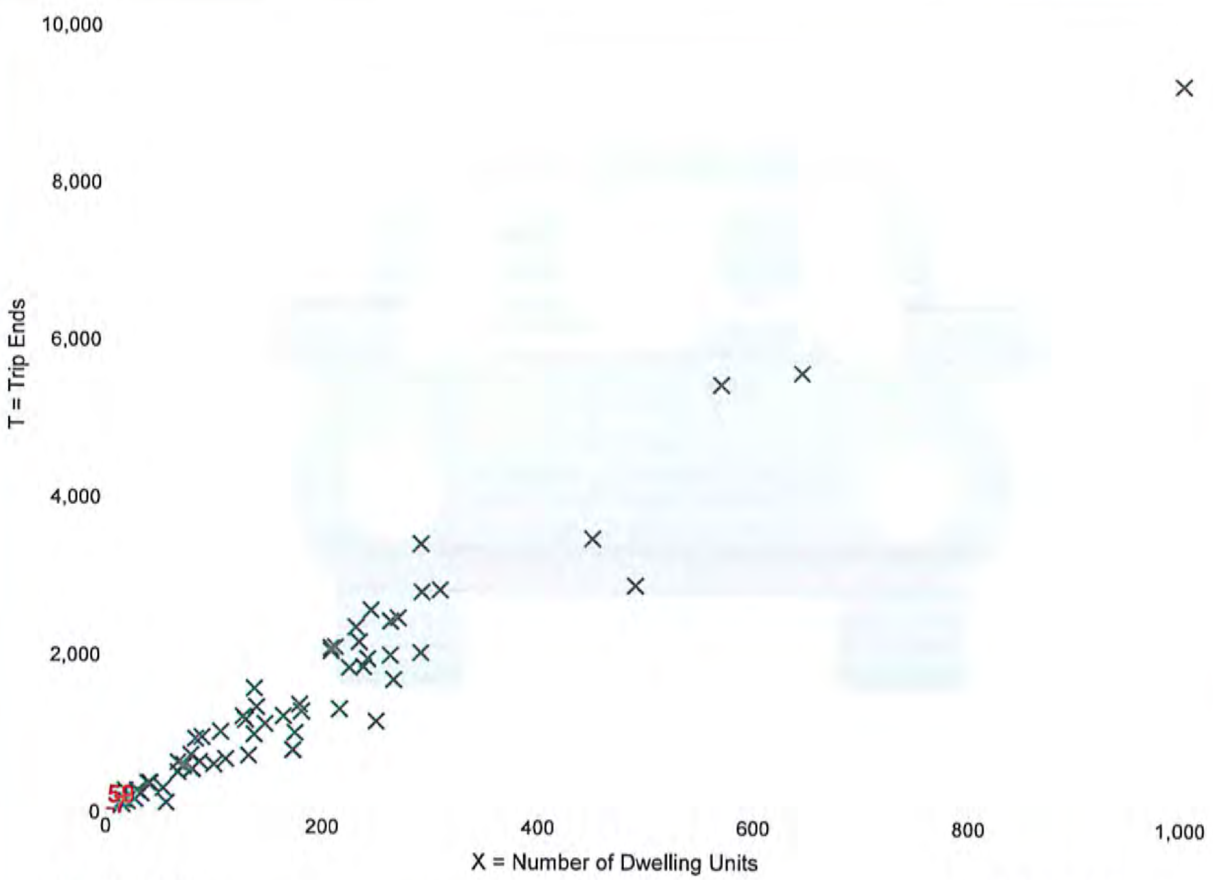
**Vehicle Trip Ends vs:** **Dwelling Units**
**On a:** **Sunday**

**Setting/Location:** **General Urban/Suburban**
Number of Studies: 60
Avg. Num. of Dwelling Units: 186
Directional Distribution: 50% entering, 50% exiting

## Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 8.48 | 2.61 - 16.44 | 1.74 |

## Data Plot and Equation




× **Study Site** —— **Fitted Curve** **Average Rate**

**Fitted Curve Equation: T = 8.86(X) - 70.09** **$R^2$= 0.94**

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# DEFINITIVE SUBDIVISION
## 181R SCHOOL STREET
## GROVELAND, MASSACHUSETTS
(ASSESSOR'S MAP 34 LOT 13)

FOR REGISTRY USE ONLY

I HEREBY CERTIFY THAT THIS PLAN HAS BEEN PREPARED IN CONFORMANCE WITH THE RULES AND REGULATIONS OF THE REGISTERS OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS.

7/31/24
DATE

SCHEDULE OF PLAN SET DRAWINGS:


| | |
|---|---|
| C-1 | COVER SHEET |
| C-2 | EXISTING CONDITIONS PLAN |
| C-3 | LOTTING PLAN |
| C-4 | EROSION CONTROL & DEMOLITION PLAN |
| C-5 | SITE PLAN |
| C-6 | GRADING AND DRAINAGE PLAN |
| C-7 | UTILITIES & PROFILE PLAN |
| C-8 | SITE DETAILS PLAN |
| C-9 | UTILITY DETAILS PLAN |
| C-10 | DRAINAGE DETAILS PLAN |
| C-11 | DRAINAGE DETAILS PLAN |


LEGEND:

| | |
|---|---|
| 100 | MAJOR TOPOGRAPHIC CONTOUR |
| 98 | MINOR TOPOGRAPHIC CONTOUR |
| x x x | CHAIN LINK FENCE |
| | EDGE OF LAWN |
| G | GAS MAIN |
| OHW | OVERHEAD WIRES |
| S | SEWER MAIN |
| D | STORM DRAIN |
| T | TELEPHONE SERVICE |
| | TREE LINE |
| W | WATER MAIN |
| | CATCH BASIN |
| | DRAIN MANHOLE |
| | GUY WIRE |
| | HYDRANT |
| | SEWER MANHOLE |
| | SIGN |
| | TELEPHONE MANHOLE |
| | UTILITY POLE |
| | WATER GATE |

ABBREVIATIONS:

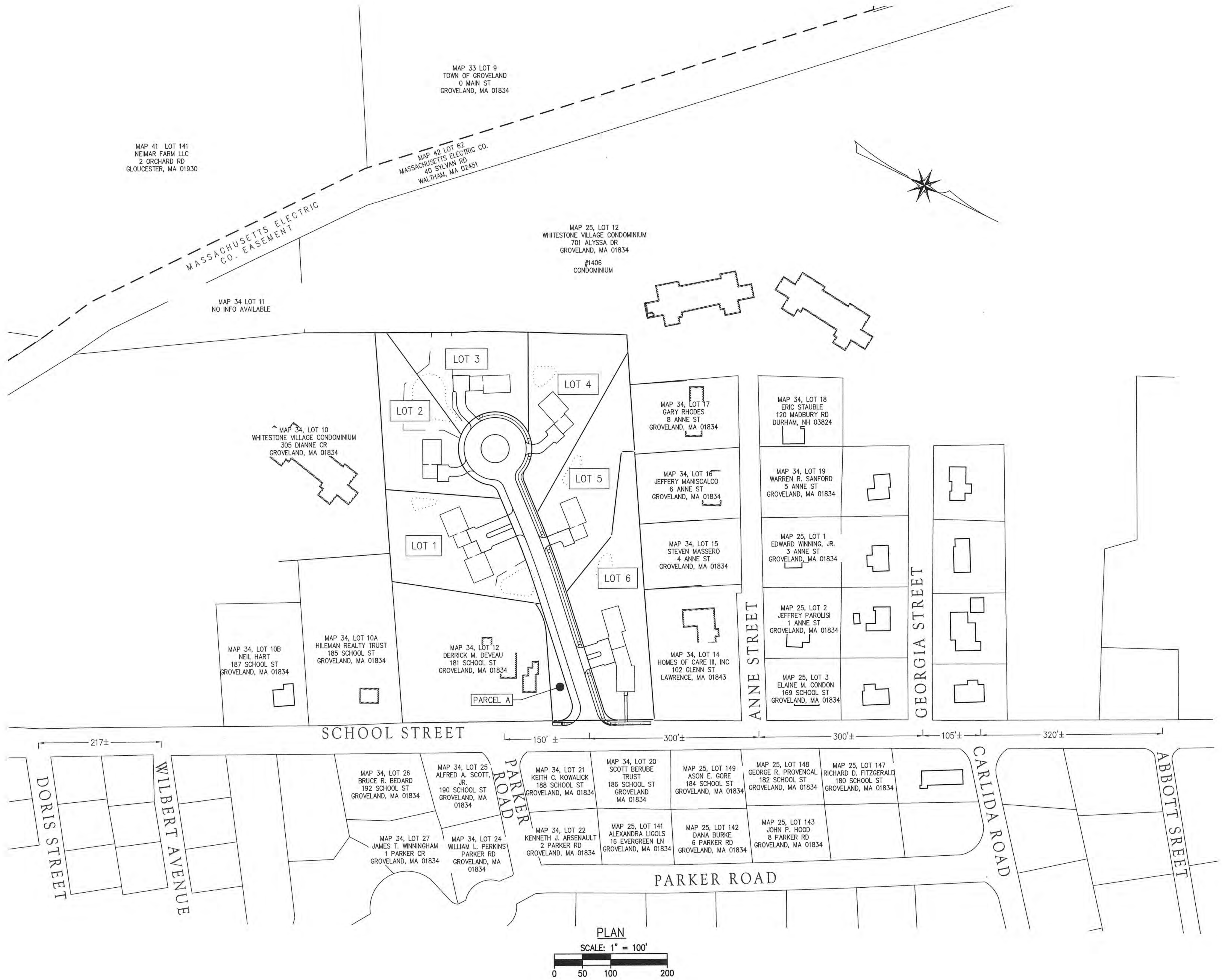
| | |
|---|---|
| AC | ACRES |
| ACR | ACCESSIBLE RAMP |
| APPROX | APPROXIMATE |
| BIT | BITUMINOUS |
| CB | CATCH BASIN |
| CLF | CHAIN LINK FENCE |
| CO | CLEAN OUT |
| CONC | CONCRETE |
| DMH | DRAIN MANHOLE |
| DYL | DOUBLE YELLOW LINE |
| EOL | EDGE OF LAWN |
| EP | EDGE OF PAVEMENT |
| INV | INVERT |
| MAX | MAXIMUM |
| MIN | MINIMUM |
| M/F | NOW OR FORMERLY |
| PVC | POLYVINYL CHLORIDE |
| RCP | REINFORCED CONCRETE PIPE |
| RET | RETAINING |
| S | SLOPE |
| SF | SQUARE FEET |
| SL | STOP LINE |
| SMH | SEWER MANHOLE |
| SWL | SINGLE WHITE LINE |
| TMH | TELEPHONE MANHOLE |
| TYP | TYPICAL |
| VGC | VERTICAL GRANITE CURB |
| WSO | WATER SHUT-OFF |

WAIVERS:

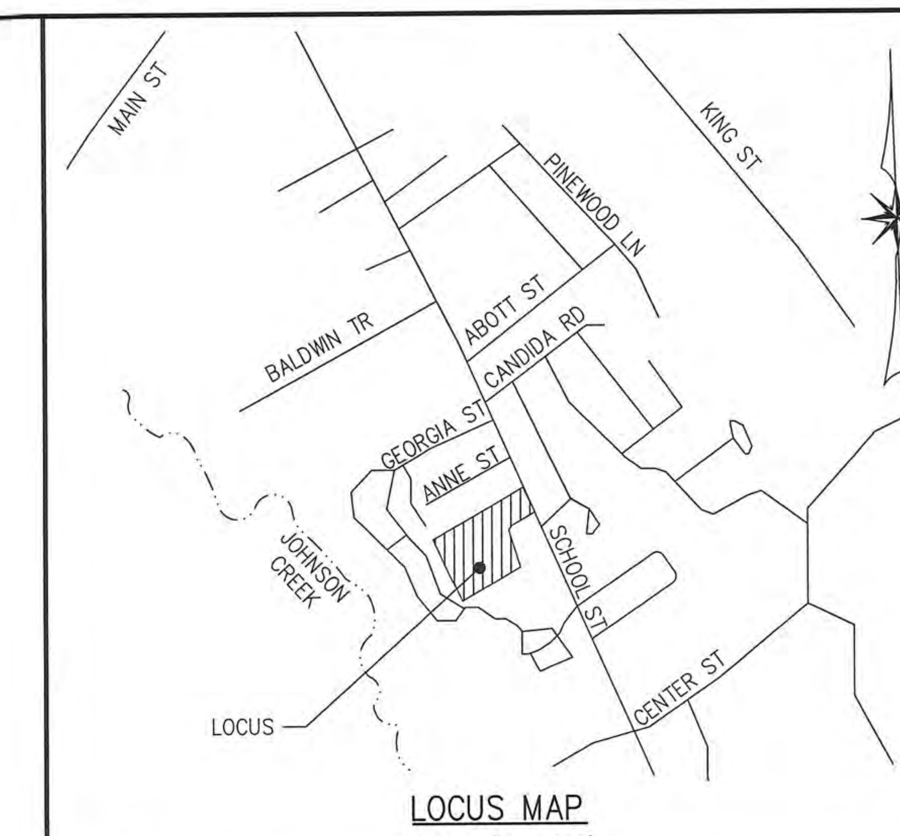
- SUBDIVISION REGULATION – CHAPTER 70: 70.4.3.(H)(5): NEW INTERSECTIONS ALONG ONE SIDE OF AN EXISTING STREET
  REQUIRED: 400 FEET APART FROM A MINOR STREET
  PROPOSED: 300 FEET APART FROM ANNE STREET
- SUBDIVISION REGULATION – CHAPTER 70: 70-4.9:
  REQUIRED: SIDEWALKS SHALL BE BITUMINOUS CONCRETE OR CEMENT CONCRETE
  PROPOSED: PERVIOUS BITUMINOUS CONCRETE

GENERAL NOTE:
THESE PLANS ARE PREPARED FOR PERMITTING WITH THE TOWN OF GROVELAND. THE PLANS SHALL NOT BE USED FOR CONSTRUCTION OR FOR ANY OTHER PURPOSES WITHOUT WRITTEN PERMISSION FROM THE MORIN-CAMERON GROUP, INC.

DRAWING: 3634 MAIN.dwg




# JULY 31, 2024




LOCUS MAP
SCALE: 1" = 1000'

TOWN OF GROVELAND OFFICE OF THE TOWN CLERK

THIS IS TO CERTIFY THAT ON ____________ I RECEIVED FROM THE GROVELAND PLANNING BOARD CERTICATION OF TIS APPROVAL OF THIS PLAN AND THAT DURING THE TWENTY (20) DAYS NEXT FOLLWOGIN I HAVE RECEIVED NO NOTICE OF ANY APPEAL FROM SAID DECISION.

CLERK DATE

APPROVED UNDER SUBDIVISION CONTROL LAW M.G.L. CHAPT. 141 SEC. 81U
DATE:
APPROVED BY:

APPROVED ________, ________ SUBJECT TO TERMS AND CONDITIONS STATED IN A MEMORANDUM OF DECISION DATED ________ ________ BETWEEN THE GROVELAND PLANNING BOARD, ON BEHALF OF THE TOWN OF GROVELAND, ________, A COPY OF WHICH DECISION IS RECORDED HEREWITH AND SUBJECT ALSO TO RECORDING OF THIS PLAN AND SAID DECISION IN THE SOUTH ESSEX REGISTRY OF DEED ON OR BEFORE ________, ________, SUBJECT TO TERMS AND CONDITIONS OF A COVENANT DATED ________, ________
________, ________ GROVELAND PLANNING BOARD.

COMMONWEALTH OF MASSACHUSETTS
SCOTT P. CAMERON
CIVIL
No. 47601
REGISTERED
PROFESSIONAL ENGINEER
7/31/24

## DEFINITIVE SUBDIVISION
FOR A
## STREET TO BE NAMED
IN
GROVELAND, MASSACHUSETTS
AT
## 181R SCHOOL STREET
(GROVELAND ASSESSOR'S MAP 34 LOT 13)
PREPARED FOR/APPLICANT:
GROVELAND REDEVELOPMENT, LLC
231 SUTTON STREET, SUITE 1B
NORTH ANDOVER, MA 01845
OWNER:
181R SCHOOL STREET, LLC
5 ATKINSON FARM ROAD
ATKINSON, NH 03811
JULY 31, 2024

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
25 KENOZA AVENUE, MASSACHUSETTS 01830
P: 978-373-0310, W: WWW.MORINCAMERON.COM

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

COVER SHEET

DRAWING NO.
C-1

FOR REGISTRY USE ONLY

I HEREBY CERTIFY THAT THIS PLAN HAS BEEN PREPARED IN CONFORMANCE WITH THE RULES AND REGULATIONS OF THE REGISTERS OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS.

7/31/24
DATE

## RECORD OWNER:

181R SCHOOL STREET, LLC
5 ATKINSON FARM RD
ATKINSON, NH 03811
DEED BOOK 35976 PAGE 77
ASSESSORS MAP 34 LOT 13

## GENERAL NOTES:

1. THIS PLAN IS PREPARED FOR OUR CLIENTS USE ONLY FOR THE SPECIFIC PURPOSE OF DEPICTING EXISTING CONDITIONS OBTAINED BY AN ON-THE-GROUND FIELD SURVEY BY THE MORIN-CAMERON GROUP IN MARCH 2019.
2. ABUTTER INFORMATION SHOW HEREON WAS TAKEN FROM THE GROVELAND GIS DATABASE.

## FLOOD NOTE:

THE SUBJECT PROPERTY IS LOCATED ENTIRELY WITHIN A ZONE X: AREA OF MINIMAL FLOOD HAZARD ABOVE THE 500-YEAR FLOOD LEVEL AS ILLUSTRATED ON THE FLOOD INSURANCE RATE MAP COMMUNITY PANEL NO. 25009C0232F, WHICH HAS AN EFFECTIVE DATE OF JULY 3, 2012.

## DATUM:

ELEVATIONS HEREON REFER TO NAVD88 VERTICAL DATUM AND MassSPC NAD 1983 HORIZONTAL DATUM.

## UTILITY NOTE:

ALL UNDERGROUND UTILITIES SHOWN ARE APPROXIMATE ONLY AND ARE BASED ON LOCATIONS OF OBSERVABLE FIELD EVIDENCE AND RECORDS OBTAINED FROM VARIOUS GROVELAND MUNICIPAL DEPARTMENTS. ACTUAL LOCATIONS MUST BE DETERMINED IN THE FIELD. BEFORE DESIGNING, EXCAVATING, BLASTING, INSTALLING, BACKFILLING, GRADING, PAVEMENT RESTORATION, REPAVING OR OTHER CONSTRUCTION, ALL UTILITY COMPANIES MUST BE NOTIFIED INCLUDING THOSE IN CONTROL OF UTILITIES NOT SHOWN ON THIS PLAN. SEE CHAPTER 370, ACTS OF 1963, MASSACHUSETTS. CALL "DIG SAFE" AT 1-888-344-7233. THE MORIN-CAMERON GROUP, INC. ASSUMES NO RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES OMITTED OR INACCURATELY SHOWN. BEFORE FUTURE CONNECTIONS, THE APPROPRIATE UTILITY ENGINEERING DEPARTMENTS MUST BE CONSULTED.

## ZONING NOTE:

THE LOT LIES WITHIN THE RESIDENTIAL DISTRICT (R-2) & AQUIFER PROTECTION DISTRICT (ZONE III).

### RESIDENCE DISTRICT R-2 ZONING DISTRICT

| SETBACK | REQUIRED | EXISTING |
|---|---|---|
| MIN. AREA | 30,000 S.F. (1) | 245,945± S.F. |
| MIN. FRONTAGE | 150 FT. (1) | 180.26± FT |
| FRONT | 30 FT. (3) | N/A |
| SIDE | 15 FT. (2) | N/A |
| REAR | 15 FT. | N/A |
| MAX. BUILDING HEIGHT | 35 FT. | N/A |
| MAX. % LOT COVERAGE | 25% | 0% |
| MAX. % IMPERVIOUS AREA | 50% | 0% |
| % OF MIN. REQUIRED LOT AREA AS CONTIGUOUS BUILDABLE AREA | 60% (4) | 100% |

(1) TWO-FAMILY OR DUPLEX STRUCTURES REQUIRE A MIN. OF TWO HUNDRED (200) FEET OF FRONTAGE AND 40,000 SF AREA IN THE R-2 DISTRICT.

(2) ON A LOT WITH LESS THAN ON HUNDRED FIFTY (150) FEET OF FRONTAGE AND IN EXISTENCE AT THE TIME THIS BY-LAW IS PASSED, NO BUILDING SHALL BE ERECTED WITHIN TEN (10) FEET OF A SIDE LOT LINE.

(3) IN ANY RESIDENTIAL DISTRICT NO BUILDING OR ROADSIDE STAND SHALL BE ERECTED OR PLACED WITHIN THIRTY (30) FEET OF A STREET LINE UNLESS IT IS DETERMINED THAT THE LINE OF HOUSES EXISTING AT THE TIME THIS BY-LAW IS ADOPTED IS LESS THAN THIRTY (30) FEET FROM THE STREET LINE, AND NO BUILDING OR ACCESSORY USE OR FARM OR POULTRY FARM BUILDING OTHER THAN A DWELLING, OR ROADSIDE STAND, OR PRIVATE GARAGE, SHALL BE BUILT WITHIN SIXTY (60) FEET OF A STREET LINE.

(4) FIFTY (50) PERCENT IF PARCEL IS SERVICED BY TOWN WATER AND SEWER.

## CONTIGUOUS BUILDABLE AREA:

THAT AREA OF A LOT THAT IS CONTIGUOUS AND BUILDABLE LAND AS REQUIRED BY SECTION 8.1 TABLE OF DIMENSIONAL REQUIREMENTS, TOGETHER WITH THAT AREA WITHIN REQUIRED SETBACKS TO THE EXTENT SUCH AREA COMPLIES WITH THE FURTHER REQUIREMENTS OF THIS DEFINITION. WETLANDS DESCRIBED BY G.L. C. 131, INCLUDING ANY NO DISTURBANCE AND NO BUILD SETBACK AREAS IN ACCORDANCE WITH G.L. C. 131, AND THE TOWN OF GROVELAND WETLANDS BY-LAW AND ACCOMPANYING REGULATIONS, AND SLOPES IN EXCESS OF TWENTY (20) PERCENT SHALL NOT BE CONSIDERED AS BUILDABLE FOR THE PURPOSE OF CALCULATING SQUARE FOOTAGE.

## LOT REGULARITY:

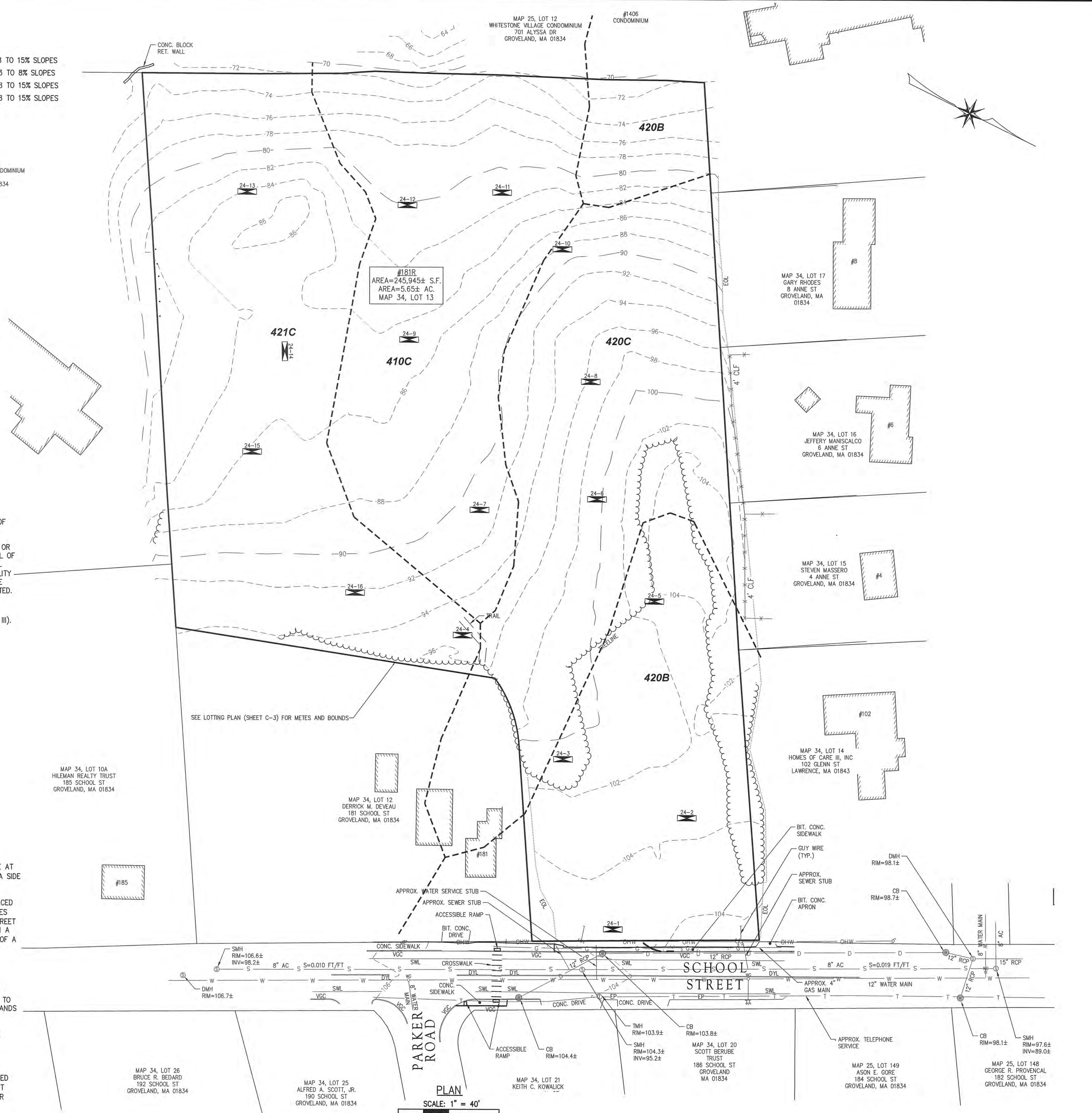
SECTION 50-8.2.A: NO LOT SHALL BE CREATED SO AS TO BE SO IRREGULARLY SHAPED OR EXTENDED THAT IT HAS A "SHAPE FACTOR" IN EXCESS OF (32), EXCEPT THAT A LOT MAY EXCEED THE REQUIRED "SHAPE FACTOR" IF A CONTIGUOUS PORTION OF THE LOT MEETS THE MINIMUM LOT AREA REQUIREMENT AND DOES NOT EXCEED THE REQUIRED "SHAPE FACTOR." THE SHAPE FACTOR EQUALS THE SQUARE OF THE LOT PERIMETER DIVIDED BY THE LOT AREA.

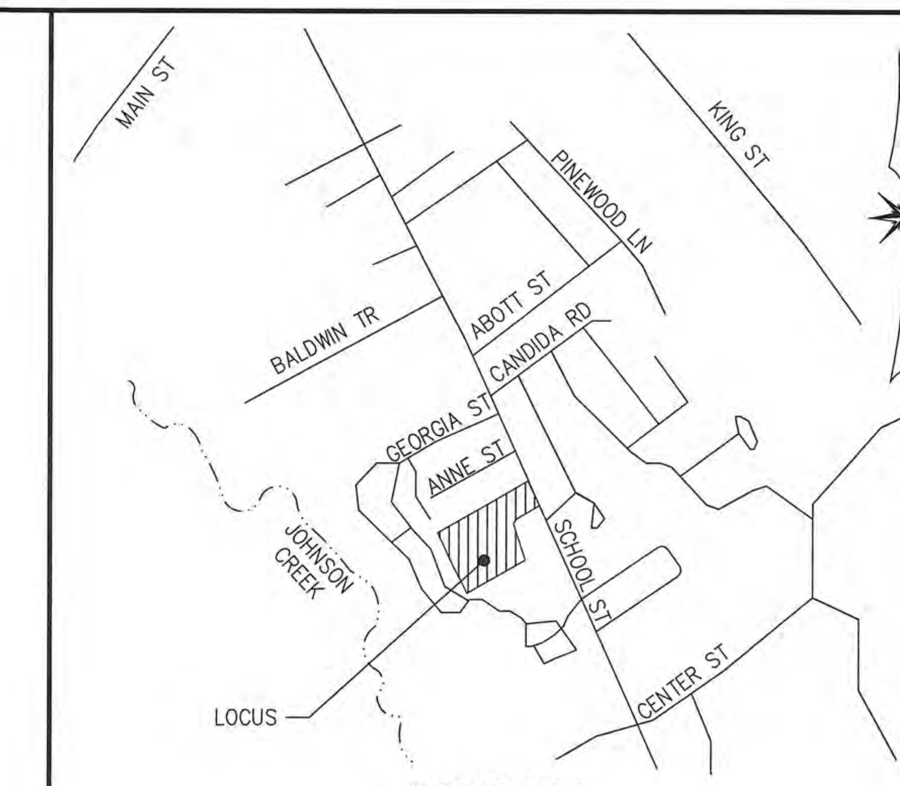
SHAPE FACTOR = $(\text{LOT PERIMETER})^2/\text{LOT AREA}$

DRAWING: 3634 MAIN.dwg

## 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




## LOCUS MAP

SCALE: 1" = 1000'

TOWN OF GROVELAND OFFICE OF THE TOWN CLERK

THIS IS TO CERTIFY THAT ON ______________ I RECEIVED FROM THE GROVELAND PLANNING BOARD CERTICATION OF TIS APPROVAL OF THIS PLAN AND THAT DURING THE TWENTY (20) DAYS NEXT FOLLWOGIN I HAVE RECEIVED NO NOTICE OF ANY APPEAL FROM SAID DECISION.

______________________
CLERK DATE

APPROVED UNDER SUBDIVISION CONTROL LAW M.G.L. CHAPT. 141 SEC. 81U
DATE: ______________
APPROVED BY:
______________________
______________________
______________________
______________________
______________________

APPROVED __________, __________ SUBJECT TO TERMS AND CONDITIONS STATED IN A MEMORANDUM OF DECISION DATED __________, __________ BETWEEN THE GROVELAND PLANNING BOARD, ON BEHALF OF THE TOWN OF GROVELAND, __________. A COPY OF WHICH DECISION IS RECORDED HEREWITH AND SUBJECT ALSO TO RECORDING OF THIS PLAN AND SAID DECISION IN THE SOUTH ESSEX REGISTRY OF DEED ON OR BEFORE __________, __________. SUBJECT TO TERMS AND CONDITIONS OF A COVENANT DATED __________, __________. __________, __________ GROVELAND PLANNING BOARD.

COMMONWEALTH OF MASSACHUSETTS
SCOTT P. CAMERON
CIVIL
No. 47601
REGISTERED PROFESSIONAL ENGINEER
7/31/24

# DEFINITIVE SUBDIVISION
FOR A
# STREET TO BE NAMED
IN
## GROVELAND, MASSACHUSETTS
AT
# 181R SCHOOL STREET
(GROVELAND ASSESSOR'S MAP 34 LOT 13)
PREPARED FOR/APPLICANT:
## GROVELAND REDEVELOPMENT, LLC
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5 ATKINSON FARM ROAD
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25 KENOZA AVENUE, MASSACHUSETTS 01830
P: 978-373-0310, W: WWW.MORINCAMERON.COM


REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |
| | | |

EXISTING CONDITIONS

DRAWING NO. C-2

FOR REGISTRY USE ONLY

I HEREBY CERTIFY THAT THIS PLAN HAS BEEN PREPARED IN CONFORMANCE WITH THE RULES AND REGULATIONS OF THE REGISTERS OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS.

MICHAEL J. SERGI PLS No.33191 — DATE 7/3/24

ASSESSOR REFERENCE:

MAP 34 LOT 13

NOTES:

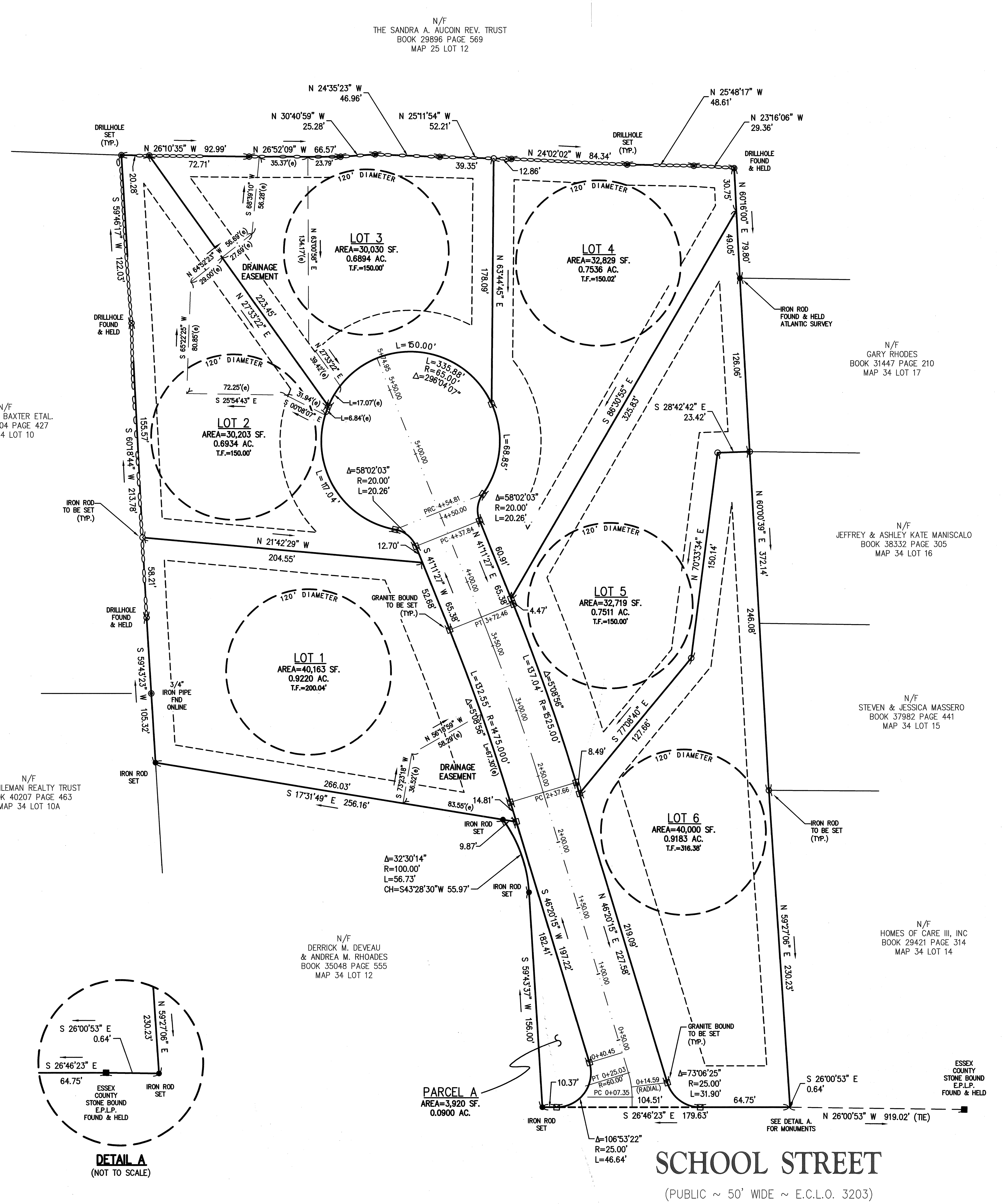
1. ORIENTATION IS TO NAD83 MASSACHUSETTS STATE PLANE COORDINATES.

KEY REFERENCE DEED:

1. DEED FROM FRANK J. FRANZONE TO 181R SCHOOL STREET, LLC. DATED JUNE 23 2017 AND RECORDED AT THE SOUTH ESSEX REGISTRY OF DEEDS BOOK 35976 PAGE 77.

KEY REFERENCE PLANS:

1. A PLAN OF A PORTION OF SCHOOL, GARDNER AND ELM PARK STREETS FROM SALEM STREET TO MAIN STREET IN THE TOWN OF GROVELAND AS RELOCATED. DRAWN BY F. RICHARD GELOTTI, SENIOR ASSISTANT COUNTY ENGINEER. DATED DEC. 18, 1984, E.C.L.O. No. 3203 AND RECORDED IN THE SOUTH ESSEX REGISTRY OF DEEDS.
2. PLAN OF LAND AT 171 SCHOOL STREET IN GROVELAND, MASSACHUSETTS BY ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC. DATED MARCH 2, 2010 AND RECORDED IN THE SOUTH ESSEX REGISTRY OF DEEDS PLAN BOOK 423 PLAN 27.
3. PLAN OF LAND IN GROVELAND, MASS. OCCUPIED BY CHARLES A. & NORMA J. MCGLEW BY PHILLIP A. BEVELAQUA. RLS DATED OCT. 25, 1965 AND RECORDED IN THE SOUTH ESSEX REGISTRY OF DEEDS PLAN 667 OF 1965.
4. PLAN OF LAND FOR WHITESTONE VILLAGE II AT SCHOOL STREET IN GROVELAND, MASSACHUSETTS BY ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC. DATED OCT. 21, 2004 AND RECORDED IN THE SOUTH ESSEX REGISTRY OF DEEDS PLAN BOOK 381 PLAN 79.
5. PLAN OF LAND IN GROVELAND, MASS. AS SURVEYED FOR RAY B. DREW. BY ROBERT G. GOODWIN, RLS. DATED MAY 2, 1983 AND RECORDED IN THE SOUTH ESSEX REGISTRY OF DEEDS PLAN BOOK 178 PLAN 67.
6. PLAN OF LAND IN GROVELAND, MASS. AS SURVEYED FOR DAVID DALE CORP. BY CHARLES H. MORSE & SON, ENGINEERS. DATED JULY 1968 AND RECORDED IN THE SOUTH ESSEX REGISTRY OF DEEDS PLAN 301 OF 1968.




SCALE: 1" = 40'

0 20 40 80 160

LOT REGULARITY CALCULATIONS

| LOT# | PERIMETER (L.F.) | AREA (S.F.) | P²/A | STATUS |
|---|---|---|---|---|
| 1 | 834 | 40,163 | 17 | PASS |
| 2 | 876 | 30,203 | 25 | PASS |
| 3 | 802 | 30,030 | 21 | PASS |
| 4 | 860 | 32,829 | 22 | PASS |
| 5 | 952 | 32,719 | 28 | PASS |
| 6 | 1,094 | 40,000 | 30 | PASS |

*PARCEL A IS NOT A BUILDABLE LOT

TOWN OF GROVELAND OFFICE OF THE TOWN CLERK

THIS IS TO CERTIFY THAT ON ______________ I RECEIVED FROM THE GROVELAND PLANNING BOARD CERTICATION OF TIS APPROVAL OF THIS PLAN AND THAT DURING THE TWENTY (20) DAYS NEXT FOLLWOGIN I HAVE RECEIVED NO NOTICE OF ANY APPEAL FROM SAID DECISION.

CLERK DATE

APPROVED UNDER SUBDIVISION CONTROL LAW M.G.L. CHAPT. 141 SEC. 81U

DATE: ______________

APPROVED BY:

APPROVED __________, ________ SUBJECT TO TERMS AND CONDITIONS STATED IN A MEMORANDUM OF DECISION DATED __________, ________ BETWEEN THE GROVELAND PLANNING BOARD, ON BEHALF OF THE TOWN OF GROVELAND, _____. A COPY OF WHICH DECISION IS RECORDED HEREWITH AND SUBJECT ALSO TO RECORDING OF THIS PLAN AND SAID DECISION IN THE SOUTH ESSEX REGISTRY OF DEED ON OR BEFORE __________, __________, SUBJECT TO TERMS AND CONDITIONS OF A COVENANT DATED __________, __________, __________ GROVELAND PLANNING BOARD.

COMMONWEALTH OF MASSACHUSETTS — MICHAEL J. SERGI No.33191 — PROFESSIONAL LAND SURVEYOR

MICHAEL J. SERGI, PLS 7/3/24

# DEFINITIVE SUBDIVISION

FOR A

# STREET TO BE NAMED

IN

## GROVELAND, MASSACHUSETTS

AT

# 181R SCHOOL STREET

(GROVELAND ASSESSOR'S MAP 34 LOT 13)

PREPARED FOR/APPLICANT:

GROVELAND REDEVELOPMENT, LLC

231 SUTTON STREET, SUITE 1B
NORTH ANDOVER, MA 01845

OWNER:

181R SCHOOL STREET, LLC

5 ATKINSON FARM ROAD
ATKINSON, NH 03811

JULY, 2024


The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
25 KENOZA AVENUE, MASSACHUSETTS 01830
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DRAWING NO. C-3

FOR REGISTRY USE ONLY

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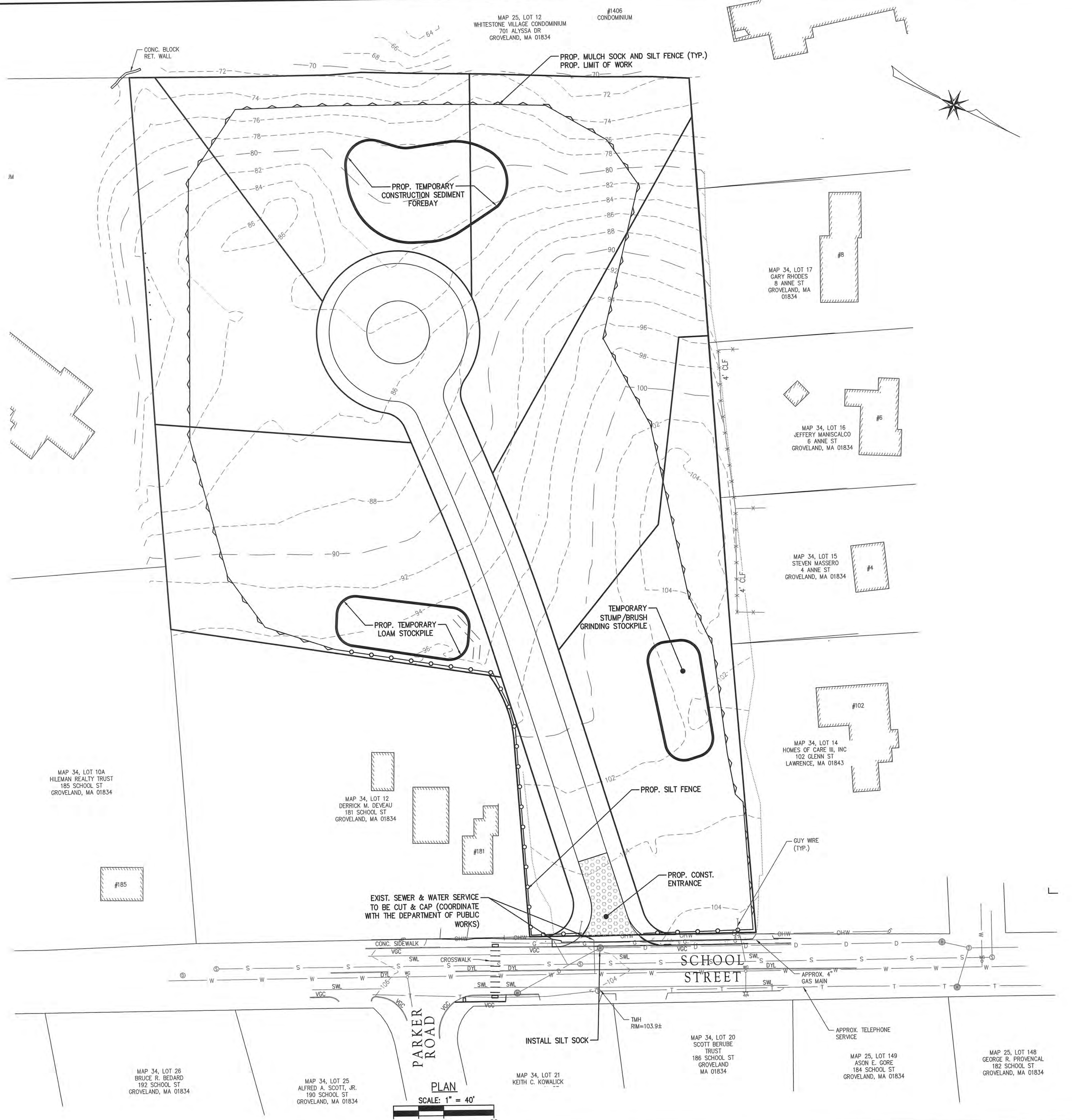
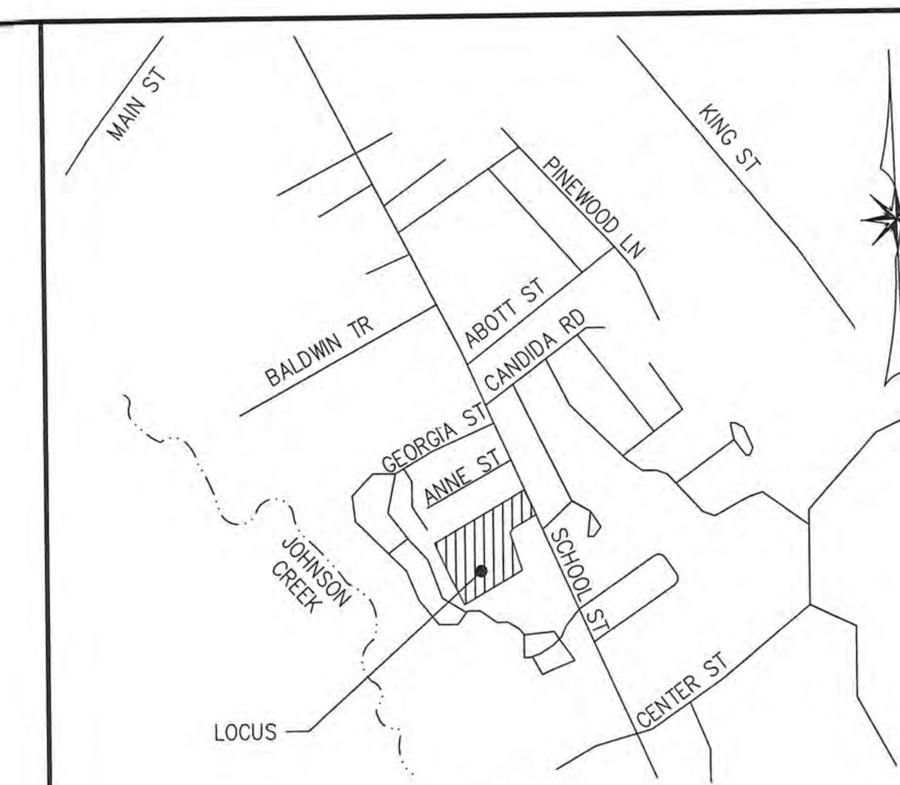
7/31/24
DATE




LOCUS MAP
SCALE: 1" = 1000'

TOWN OF GROVELAND OFFICE OF THE TOWN CLERK

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CLERK DATE

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DATE: ______________
APPROVED BY:

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COMMONWEALTH OF MASSACHUSETTS
SCOTT P. CAMERON
CIVIL
No. 47601
REGISTERED PROFESSIONAL ENGINEER
7/31/24

# DEFINITIVE SUBDIVISION
FOR A
## STREET TO BE NAMED
IN
GROVELAND, MASSACHUSETTS
AT
## 181R SCHOOL STREET
(GROVELAND ASSESSOR'S MAP 34 LOT 13)
PREPARED FOR/APPLICANT:
GROVELAND REDEVELOPMENT, LLC
231 SUTTON STREET, SUITE 1B
NORTH ANDOVER, MA 01845
OWNER:
181R SCHOOL STREET, LLC
5 ATKINSON FARM ROAD
ATKINSON, NH 03811
JULY 31, 2024

The Morin-Cameron GROUP, INC.
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EROSION CONTROL & DEMO

DRAWING NO. C-4

DRAWING: 3634 MAIN.dwg

FOR REGISTRY USE ONLY

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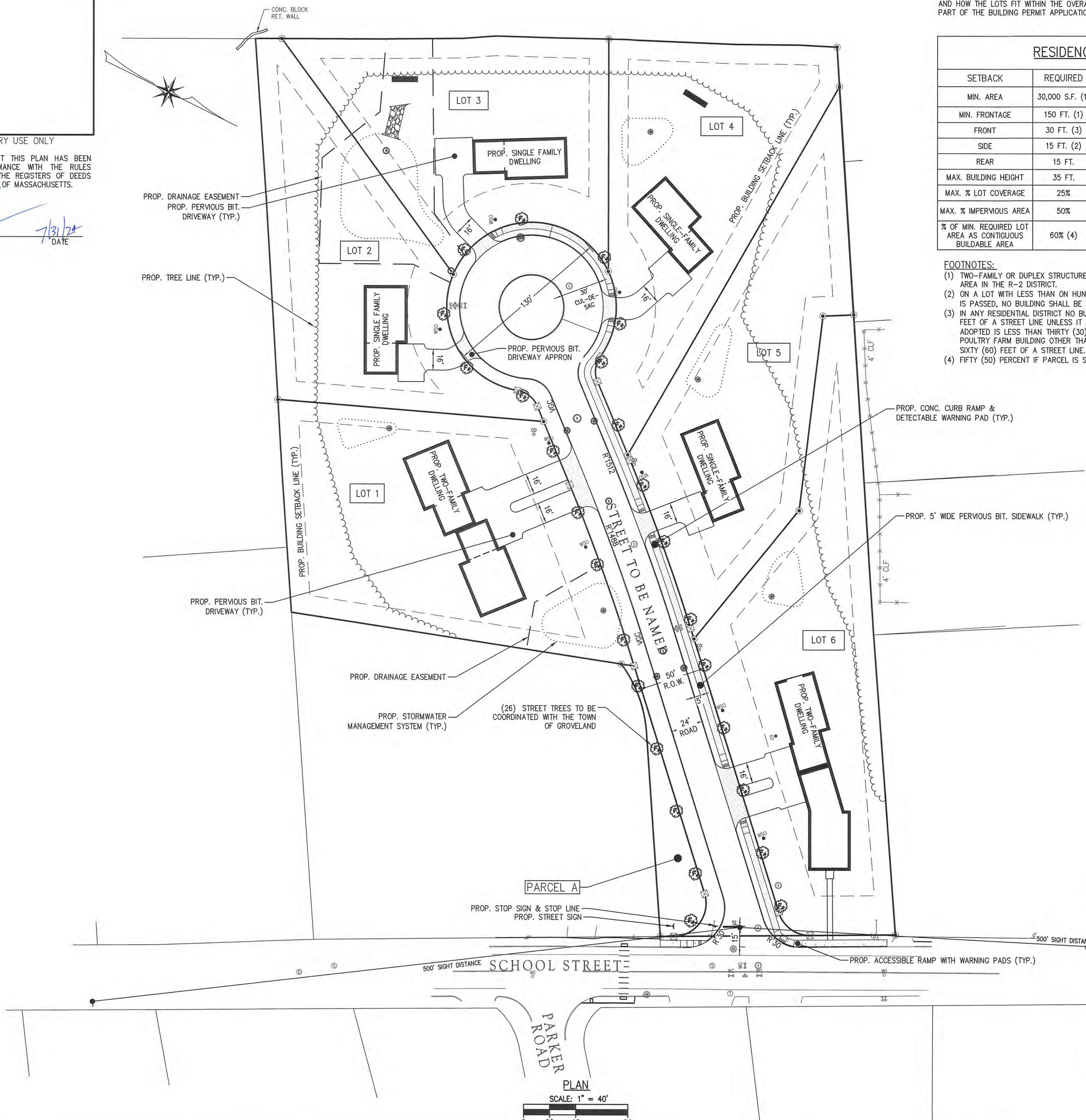
7/31/24
DATE




PLAN

SCALE: 1" = 40'

0 20 40 80

## LOT DESIGN NOTE:

THE LOT IMPROVEMENTS HEREON ARE INTENDED TO BE CONCEPTUAL FOR THE PURPOSE OF DEMONSTRATING CONSTRUCTABILITY AND HOW THE LOTS FIT WITHIN THE OVERALL DEVELOPMENT PLAN. FINAL LOT DESIGN SHALL BE COMPLETED BY OTHERS AS PART OF THE BUILDING PERMIT APPLICATION PROCESS.

### RESIDENCE DISTRICT R–2 ZONING DISTRICT

| SETBACK | REQUIRED | EXISTING | LOT 1 | LOT 2 | LOT 3 | LOT 4 | LOT 5 | LOT 6 | OVERALL |
|---|---|---|---|---|---|---|---|---|---|
| MIN. AREA | 30,000 S.F. (1) | 245,945± S.F. | 40,163 | 30,203 | 30,030 | 32,829 | 32,719 | 40,000 | – |
| MIN. FRONTAGE | 150 FT. (1) | 180.26± FT | 200 | 150 | 150 | 150 | 150 | 251 | – |
| FRONT | 30 FT. (3) | N/A | >30 | >30 | >30 | >30 | >30 | >30 | – |
| SIDE | 15 FT. (2) | N/A | >15 | >15 | >15 | >15 | >15 | >15 | – |
| REAR | 15 FT. | N/A | >15 | >15 | >15 | >15 | >15 | >15 | – |
| MAX. BUILDING HEIGHT | 35 FT. | N/A | <35 | <35 | <35 | <35 | <35 | <35 | – |
| MAX. % LOT COVERAGE | 25% | 0% | 22% | 11% | 11% | 10% | 10% | 17% | 21% |
| MAX. % IMPERVIOUS AREA | 50% | 0% | 12% | 8% | 8% | 8% | 8% | 11% | 14.98% |
| % OF MIN. REQUIRED LOT AREA AS CONTIGUOUS BUILDABLE AREA | 60% (4) | 100% | 100% | 100% | 100% | 100% | 100% | 100% | – |

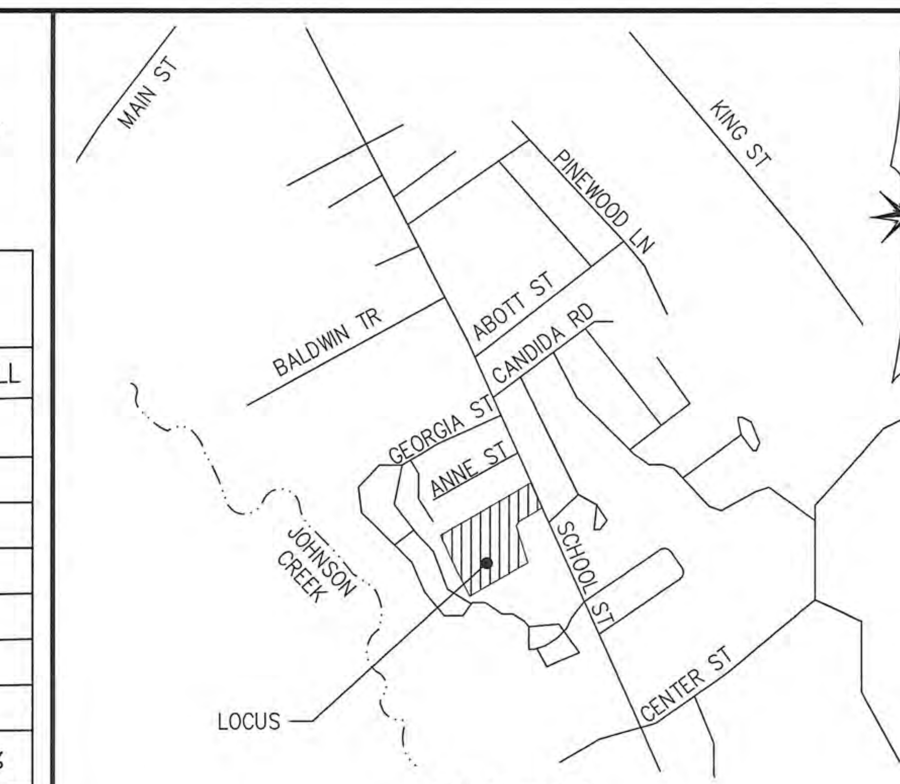
FOOTNOTES:

(1) TWO–FAMILY OR DUPLEX STRUCTURES REQUIRE A MIN. OF TWO HUNDRED (200) FEET OF FRONTAGE AND 40,000 SF AREA IN THE R–2 DISTRICT.

(2) ON A LOT WITH LESS THAN ON HUNDRED FIFTY (150) FEET OF FRONTAGE AND IN EXISTENCE AT THE TIME THIS BY–LAW IS PASSED, NO BUILDING SHALL BE ERECTED WITHIN TEN (10) FEET OF A SIDE LOT LINE.

(3) IN ANY RESIDENTIAL DISTRICT NO BUILDING OR ROADSIDE STAND SHALL BE ERECTED OR PLACED WITHIN THIRTY (30) FEET OF A STREET LINE UNLESS IT IS DETERMINED THAT THE LINE OF HOUSES EXISTING AT THE TIME THIS BY–LAW IS ADOPTED IS LESS THAN THIRTY (30) FEET FROM THE STREET LINE, AND NO BUILDING OR ACCESSORY USE OR FARM OR POULTRY FARM BUILDING OTHER THAN A DWELLING, OR ROADSIDE STAND, OR PRIVATE GARAGE, SHALL BE BUILT WITHIN SIXTY (60) FEET OF A STREET LINE.

(4) FIFTY (50) PERCENT IF PARCEL IS SERVICED BY TOWN WATER AND SEWER.




LOCUS MAP

SCALE: 1" = 1000'

TOWN OF GROVELAND OFFICE OF THE TOWN CLERK

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CLERK DATE

APPROVED UNDER SUBDIVISION CONTROL LAW M.G.L. CHAPT. 141 SEC. 81U

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__________, __________ GROVELAND PLANNING BOARD.

COMMONWEALTH OF MASSACHUSETTS
SCOTT P. CAMERON
CIVIL
No. 47601
REGISTERED PROFESSIONAL ENGINEER

7/31/24

# DEFINITIVE SUBDIVISION

FOR A

# STREET TO BE NAMED

IN

GROVELAND, MASSACHUSETTS

AT

## 181R SCHOOL STREET

(GROVELAND ASSESSOR'S MAP 34 LOT 13)

PREPARED FOR/APPLICANT:

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231 SUTTON STREET, SUITE 1B
NORTH ANDOVER, MA 01845

OWNER:

181R SCHOOL STREET, LLC
5 ATKINSON FARM ROAD
ATKINSON, NH 03811

JULY 31, 2024


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SITE LAYOUT

DRAWING NO. C–5

DRAWING: 3634 MAIN.dwg

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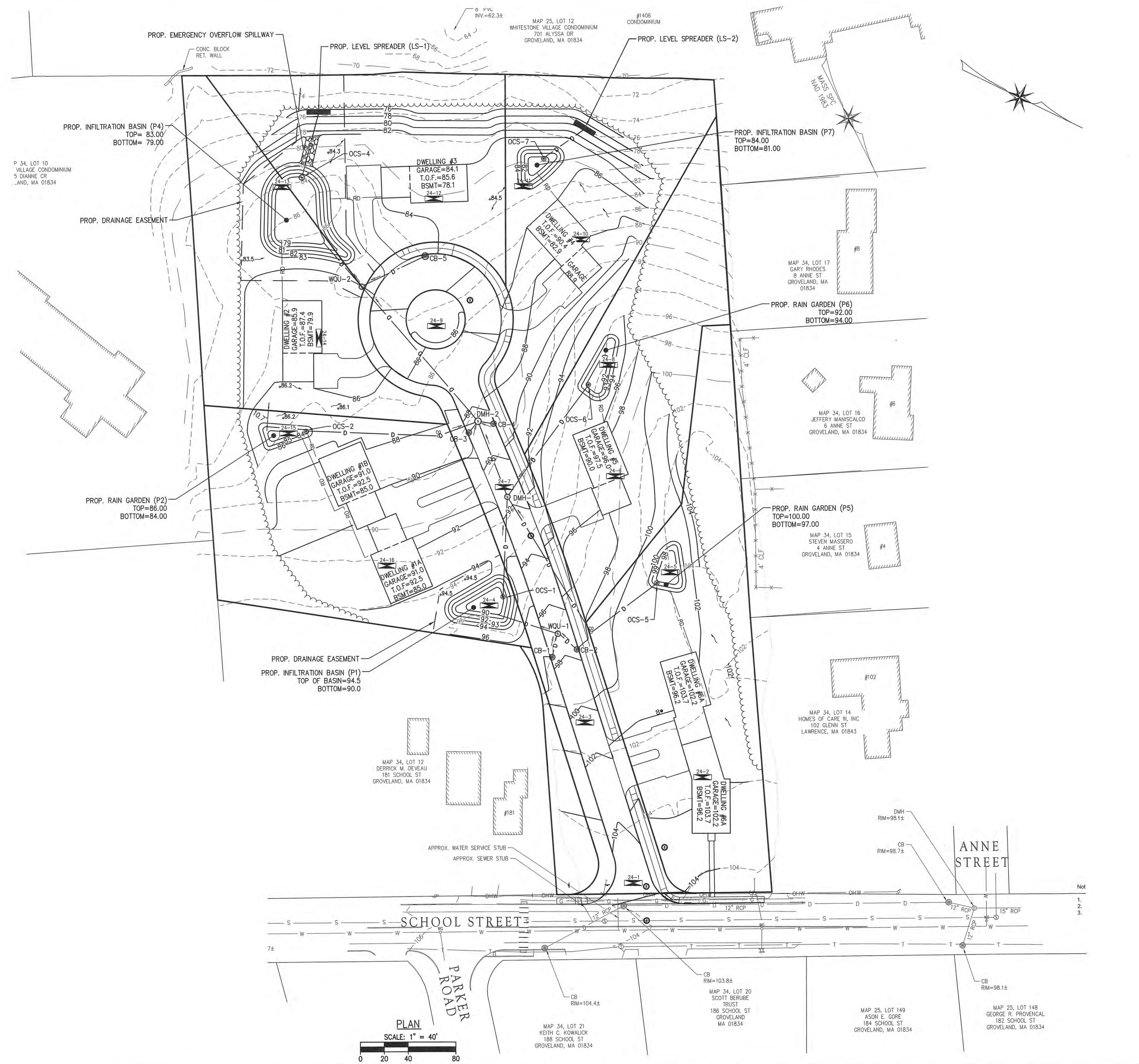
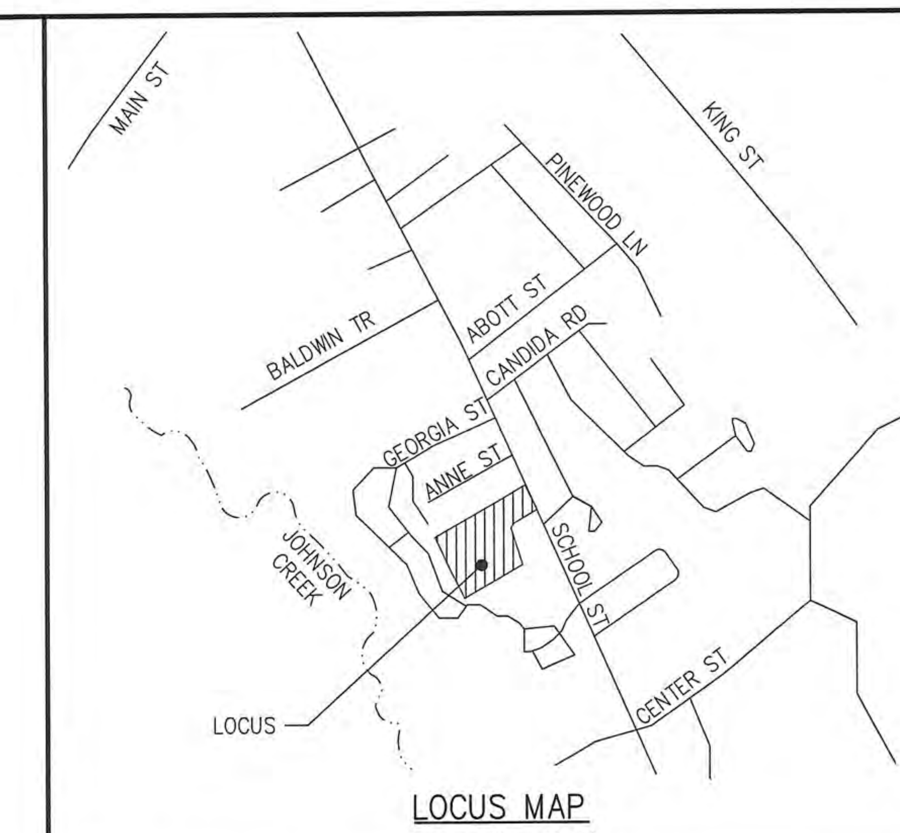
DATE




LOCUS MAP
SCALE: 1" = 1000'

TOWN OF GROVELAND OFFICE OF THE TOWN CLERK

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____________ GROVELAND PLANNING BOARD.

COMMONWEALTH OF MASSACHUSETTS SCOTT P. CAMERON CIVIL No. 47601 REGISTERED PROFESSIONAL ENGINEER
7/31/24

# DEFINITIVE SUBDIVISION
FOR A
# STREET TO BE NAMED
IN
GROVELAND, MASSACHUSETTS
AT
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| NO. | DESCRIPTION | DATE |

GRADING & DRAINAGE

DRAWING NO. C-6

DRAWING: 3634 MAIN.dwg

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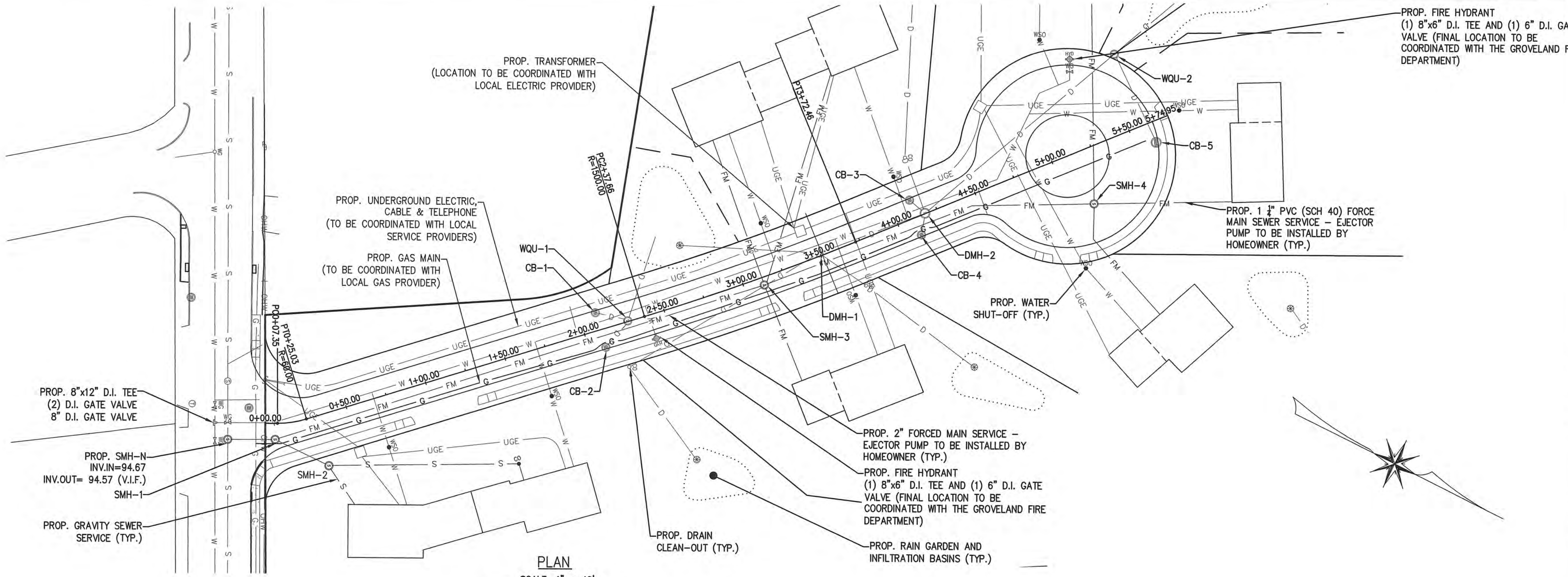
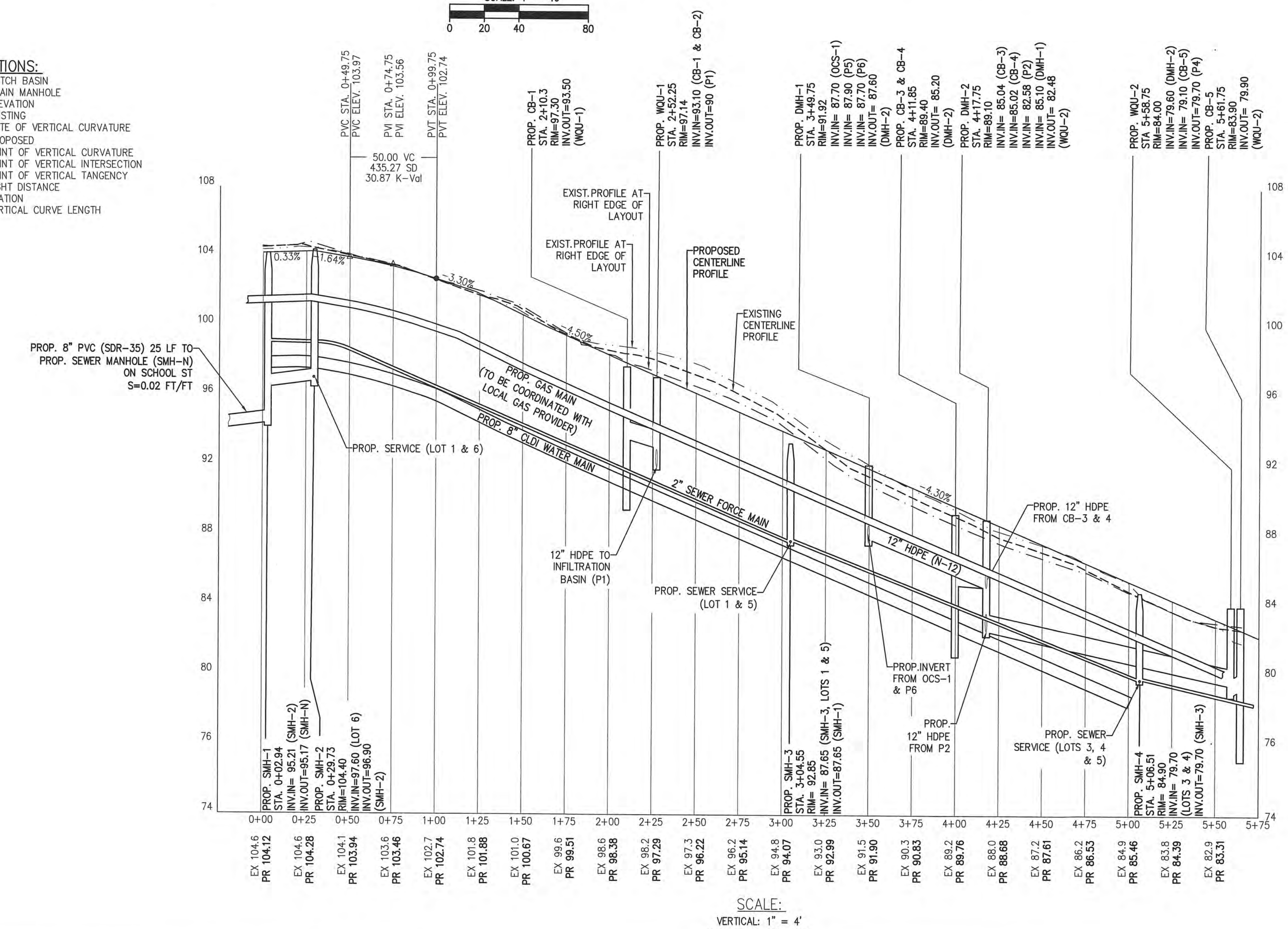
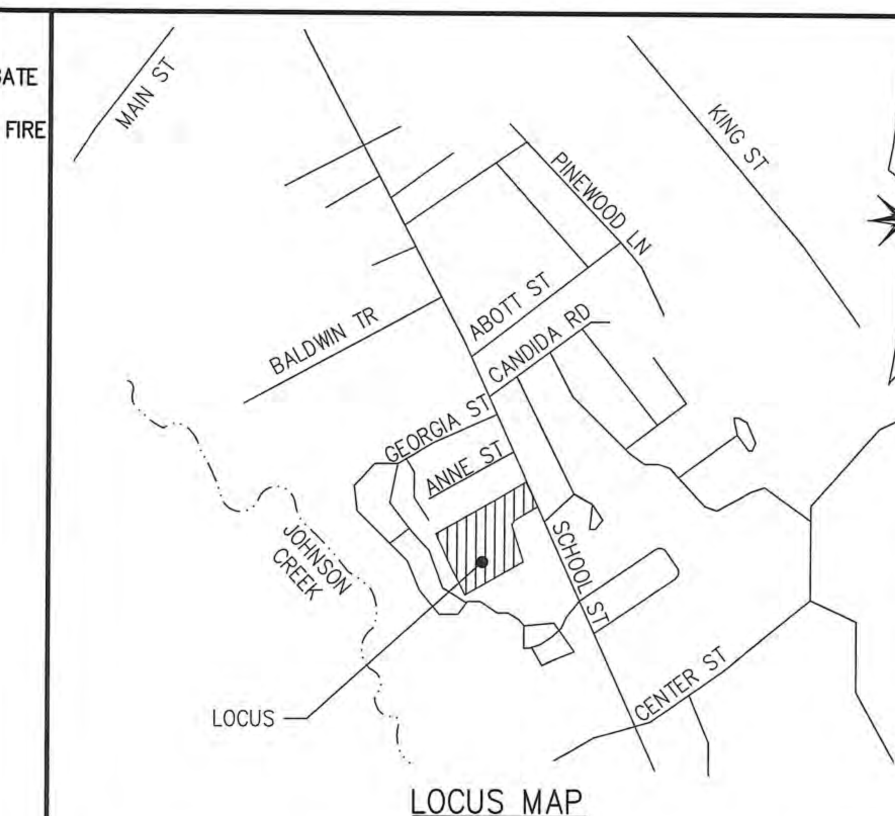
DATE




## ABBREVIATIONS:

| | |
|---|---|
| CB | CATCH BASIN |
| DMH | DRAIN MANHOLE |
| ELEV | ELEVATION |
| EX | EXISTING |
| K | RATE OF VERTICAL CURVATURE |
| PR/PROP. | PROPOSED |
| PVC | POINT OF VERTICAL CURVATURE |
| PVI | POINT OF VERTICAL INTERSECTION |
| PVT | POINT OF VERTICAL TANGENCY |
| SD | SIGHT DISTANCE |
| STA. | STATION |
| VC | VERTICAL CURVE LENGTH |

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__________, ________ GROVELAND PLANNING BOARD.


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UTILITIES & ROAD PROFILE

DRAWING NO. C-7

DRAWING: 3634 MAIN.dwg

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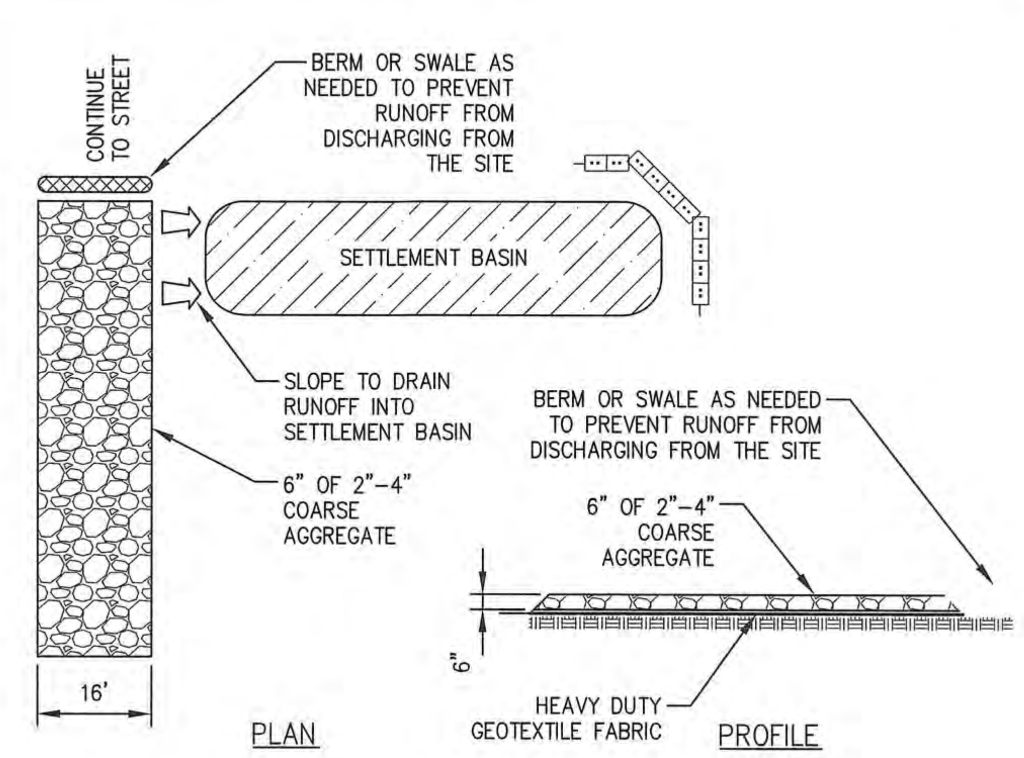
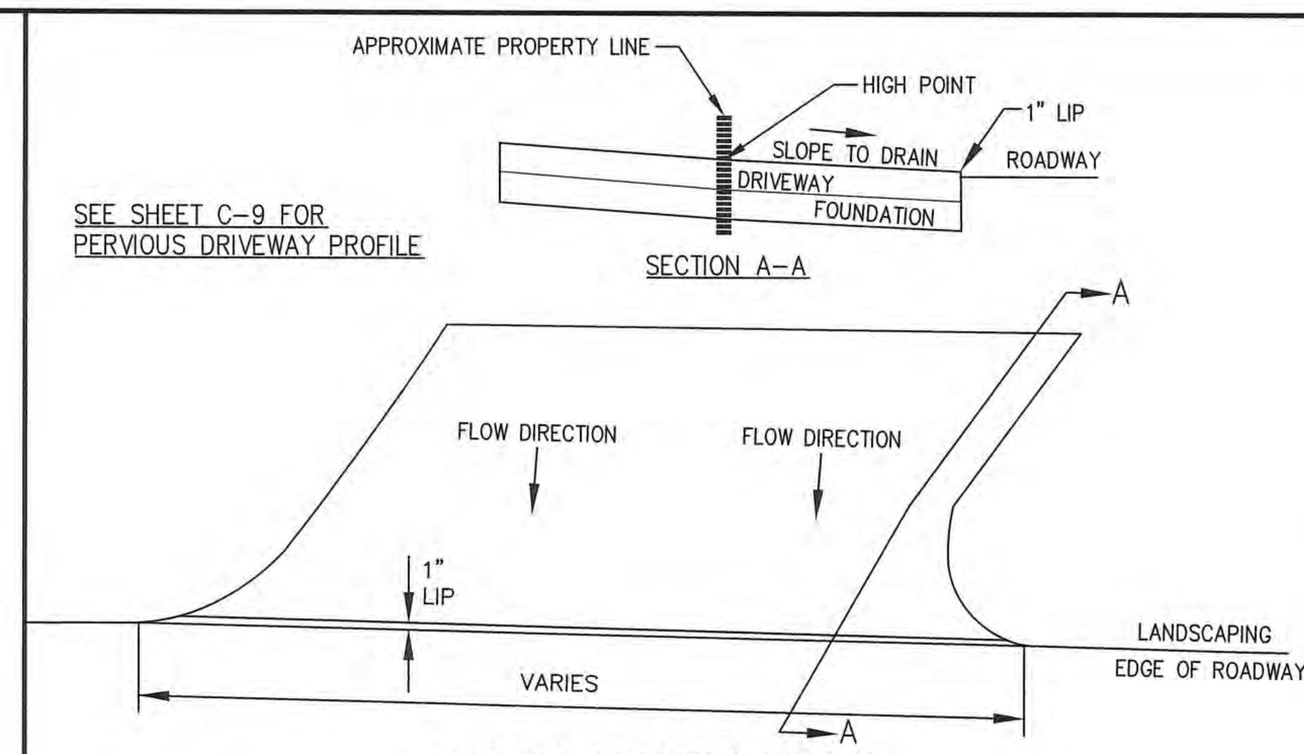
DATE



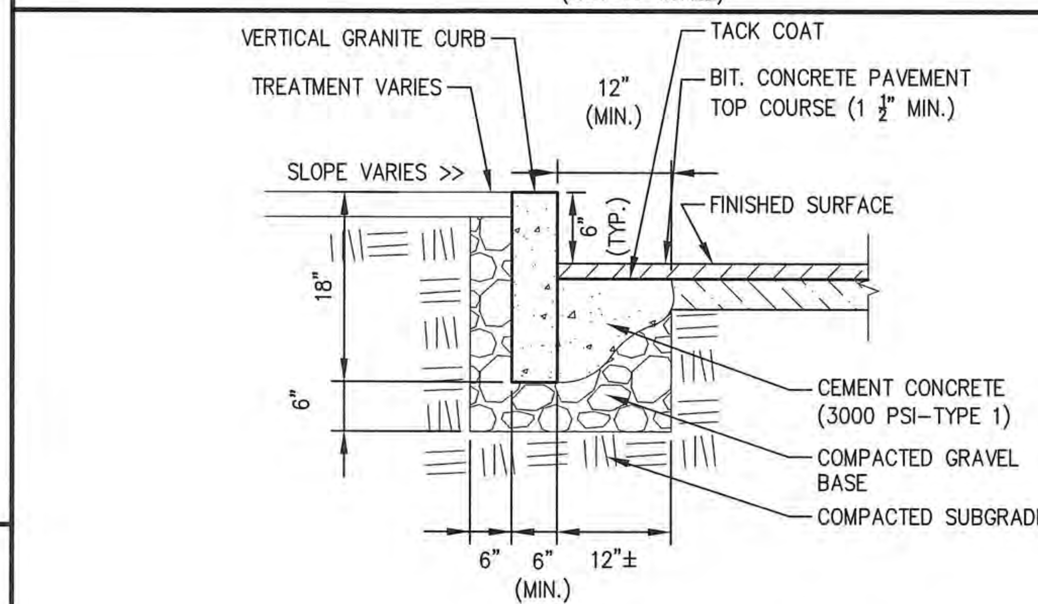

SITE CONSTRUCTION EXIT SPECIFICATIONS FOR BOSTON WAY:

1. STONE FOR STABILIZATION CONSTRUCTION ENTRANCE SHALL BE 2"-4" STONE.
2. THE LENGTH OF THE STABILIZED ENTRANCE SHALL NOT BE LESS THAN 40 FEET.
3. THE WIDTH OF THE ENTRANCE SHALL BE NO LESS THAN THE WIDTH OF THE INGRESS OR EGRESS DRIVE, OR 16 FEET, WHICHEVER IS GREATER.
4. GEOTEXTILE FILTER FABRIC SHALL BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING STONE.
5. ALL SURFACE WATER THAT IS FLOWING TO OR DIVERTED TOWARDS THE CONSTRUCTION ENTRANCE SHALL BE PIPED BENEATH THE ENTRANCE. IF PIPING IS IMPRACTICAL, A BERM WITH MINIMUM 1 TO 5 SLOPES THAT CAN BE CROSSED BY VEHICLES CAN BE SUBSTITUTED.
6. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO RIGHTS OF WAY. THIS MAY REQUIRE PERIODIC TOPDRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. SEDIMENT SPILLED, WASHED OR TRACKED ONTO THE RIGHT OF WAY MUST BE REMOVED IMMEDIATELY.

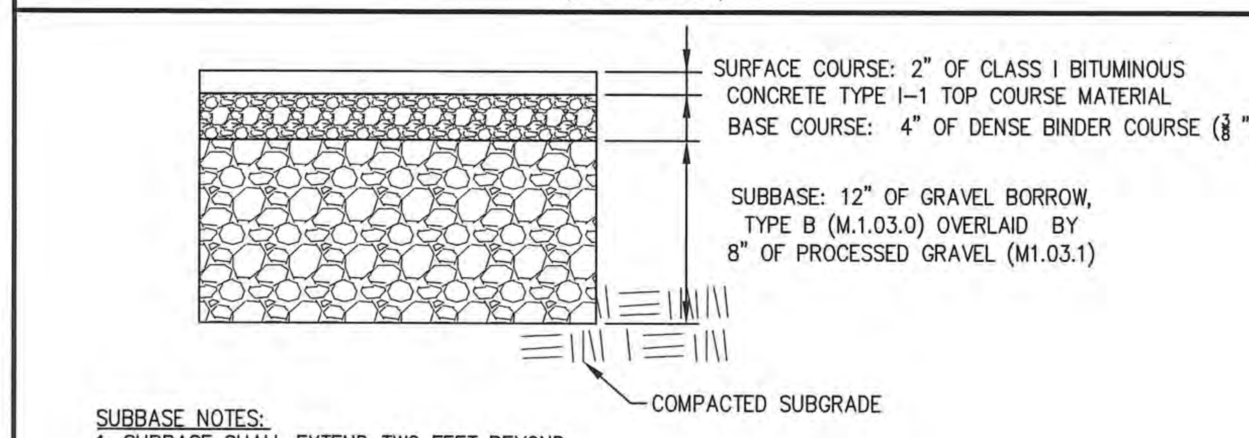
STABILIZED CONSTRUCTION ENTRANCE DETAIL
(NOT TO SCALE)




PERVIOUS DRIVEWAY APPRON
(NOT TO SCALE)



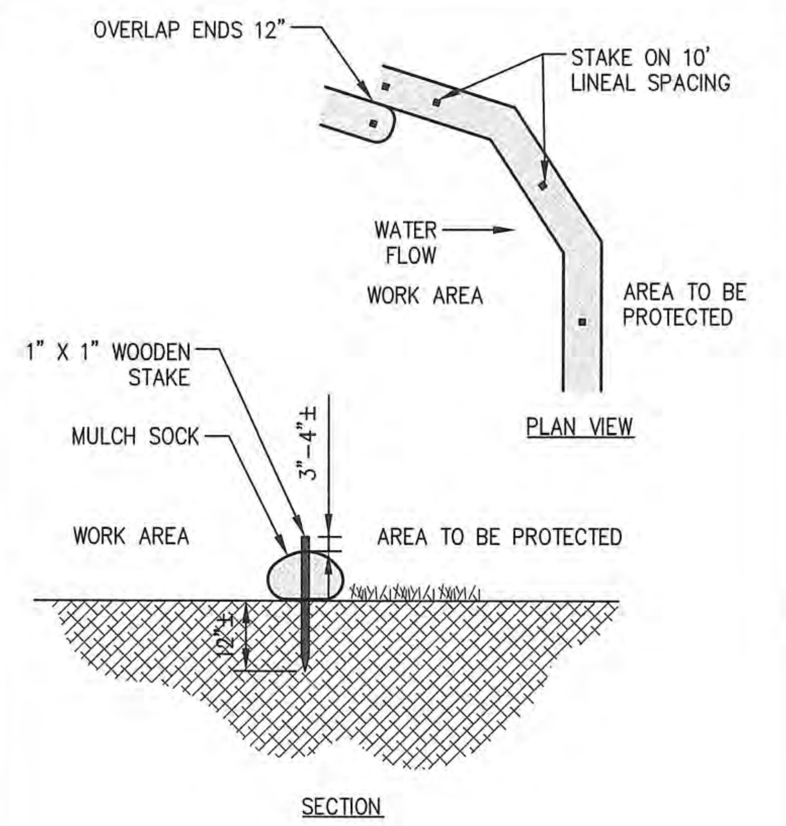

VERTICAL GRANITE CURB (VGC)
(NOT TO SCALE)




SUBBASE NOTES:
1. SUBBASE SHALL EXTEND TWO FEET BEYOND THE EDGE OF THE BINDER COURSE, ON EACHSIDE OF THE ROADWAY, FOR STABILIZATION OF THE ROADWAY SHOULDERS.
2. PROCESSED GRAVEL SHALL BE PLACED IN TWO 4" COMPACTED COURSES AS REQUIRED FOR THE GRAVEL BORROW COURSES.
3. GRAVEL BORROW SHALL BE PLACED IN TWO 6" COURSED ON THE PREPARED SUBGRADE.

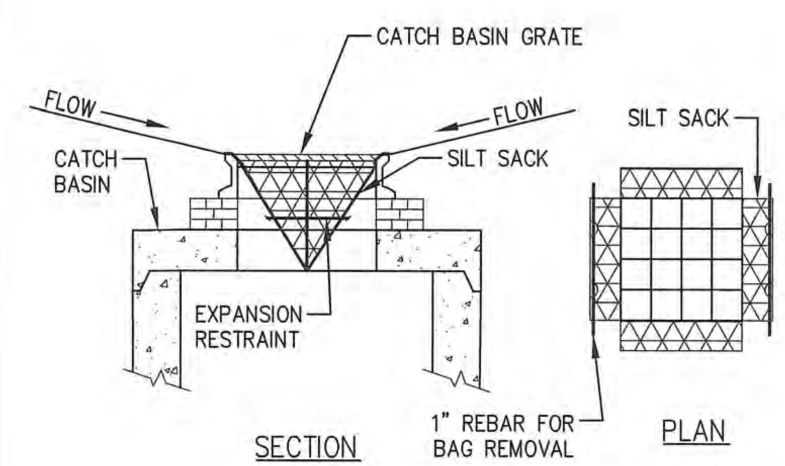
SUBSOIL NOTE:
SUBSOILS TO BE INSPECTED PRIOR TO INSTALLATION OF PAVEMENT SUBBASE. IF UNCOMPACTED FILL OR UNSUITABLE SOIL IS PRESENT IT SHALL BE REMOVED TO UNDISTURBED NATIVE SOIL AND REPLACED WITH STRUCTURAL FILL COMPACTED TO 95% R.C.

TYPICAL PAVEMENT SECTION – MINOR STREET
(NOT TO SCALE)

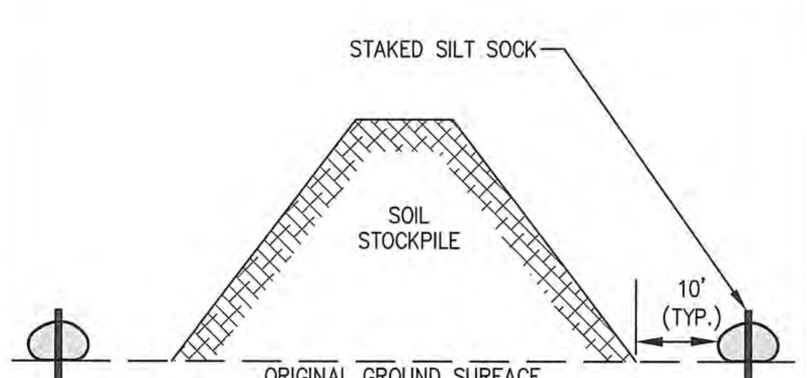



MULCH SOCK
(NOT TO SCALE)

SILT SACK NOTES:
1. INSTALL SILT SACKS IN EXISTING CATCH BASINS. INSTALL SILT SACKS IN NEW CATCH BASINS AFTER INSTALLATION.
2. GRATES TO BE PLACED OVER SILT SACKS.
3. SILTSACK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS AND CLEANING OR REPLACEMENT SHALL BE PERFORMED WHEN DEPTH OF SEDIMENT IS WITHIN 6" OF GRATE.

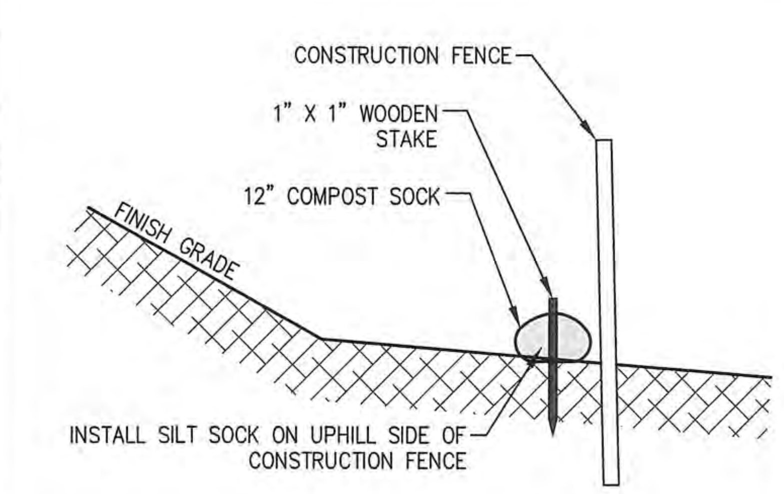



SILT SACK SEDIMENT TRAP
(NOT TO SCALE)

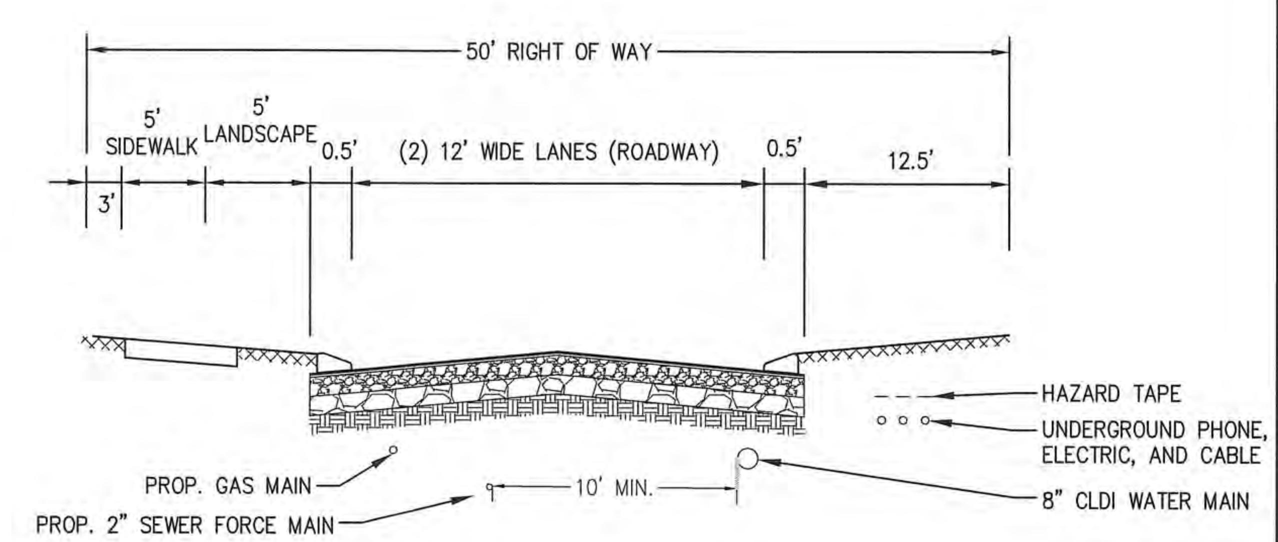



NOTES:
1. SILT SOCK TO EXTEND AROUND ENTIRE PERIMETER OF STOCKPILE IF ON LEVEL GROUND OR TO EXTEND AROUND DOWNGRADIENT PORTION STOCKPILE IS ON SLOPE.
2. IF THE STOCKPILE IS TO REMAIN FOR MORE THAN 14 DAYS IT SHALL BE STABILIZED WITH AN EROSION CONTROL BLANKET OR SEEDED (IF LOAM).
3. INSPECTION OF SILT SOCKS SHALL BE AT LEAST ONCE PER WEEK AND AFTER RAIN EVENTS IN EXCESS OF 1/2". REPAIR OR REPLACEMENT OF SILT SOCK SHALL BE MADE PROMPTLY AS NEEDED.
4. SEDIMENT TRAPPED BY SILT SOCKS SHALL BE REMOVED AND PROPERLY DISPOSED OF WHEN SEDIMENT DEPTH REACHES 12".
5. SILT SOCKS SHALL BE MAINTAINED UNTIL STOCKPILE IS ELIMINATED.

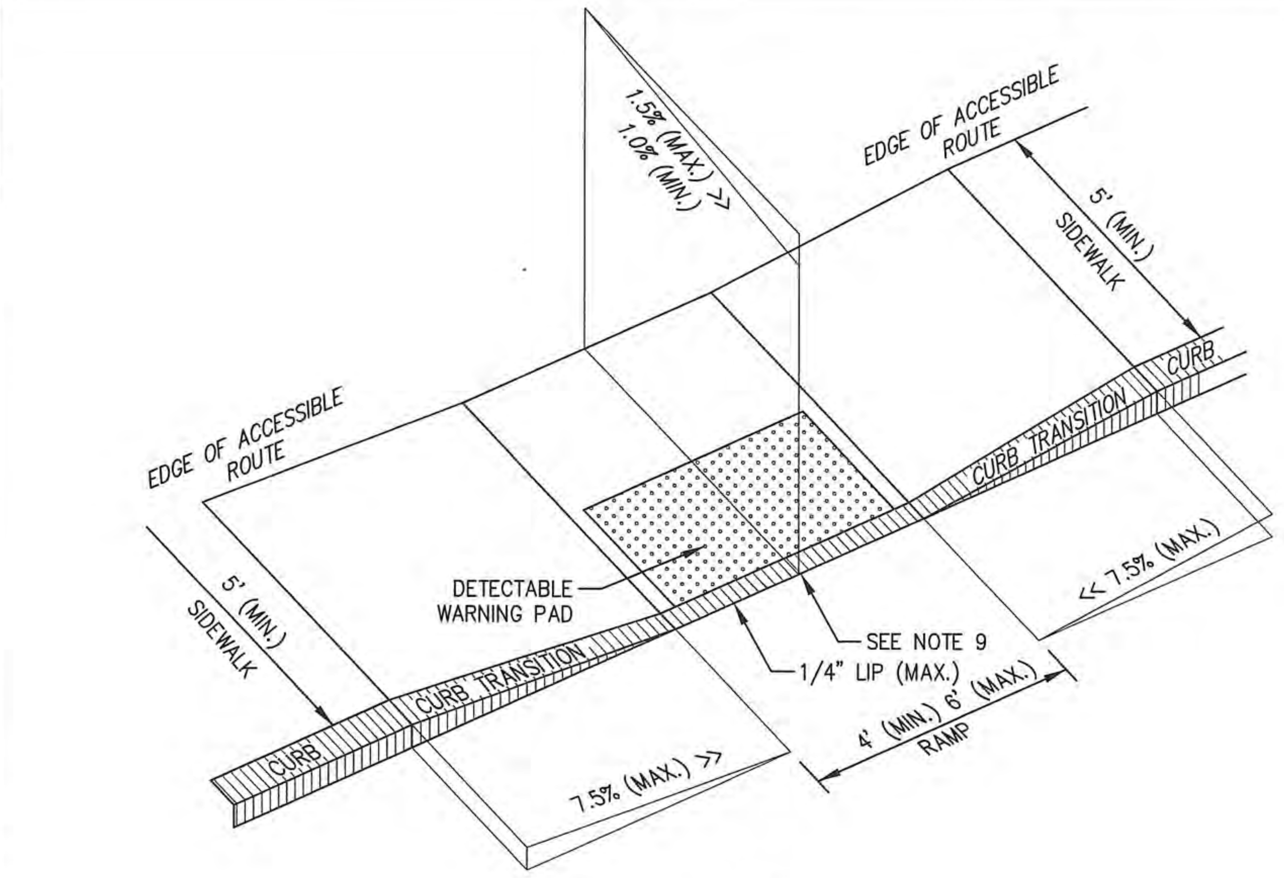
TEMPORARY SOIL STOCKPILE
(NOT TO SCALE)



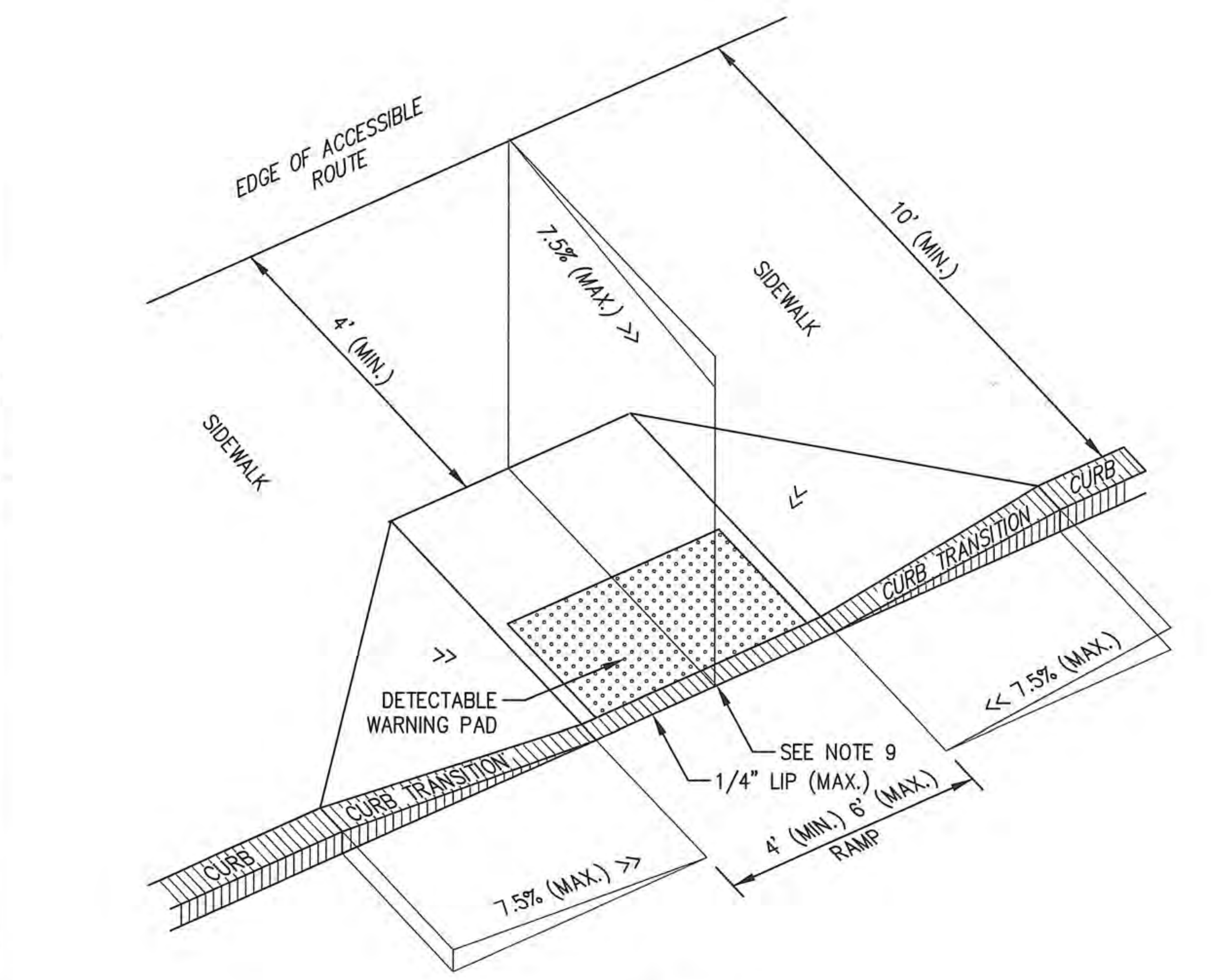

MULCH SOCK BACKED WITH CONSTRUCTION FENCE
(NOT TO SCALE)



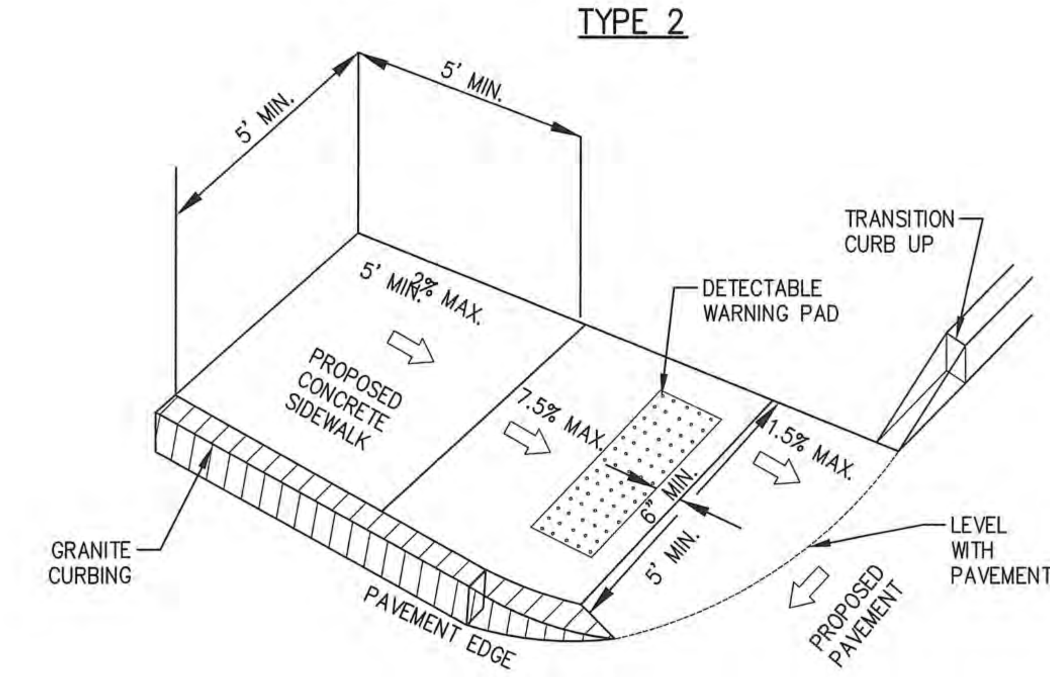

TYPICAL ROAD CROSS SECTION
(NOT TO SCALE)




TYPE I




TYPE 2



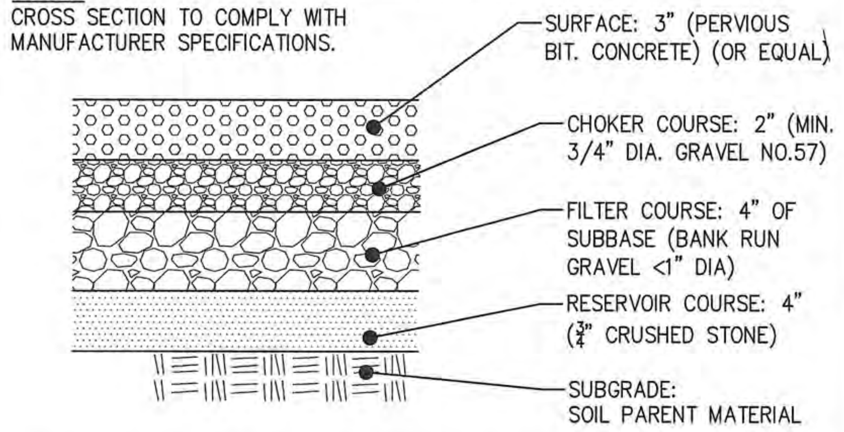

TYPE 3

NOTES:
1. THE MAXIMUM ALLOWABLE SIDEWALK AND CURB RAMP CROSS SLOPES SHALL BE 1.5% (1% MIN.).
2. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE EXCLUDING CURB RAMPS SHALL BE 5%.
3. THE MAXIMUM ALLOWABLE SLOPE OF ACCESSIBLE ROUTE CURB RAMPS SHALL BE 7.5%.
4. A MINIMUM OF 3 FEET CLEAR SHALL BE MAINTAINED AT ANY PERMANENT OBSTACLE IN ACCESSIBLE ROUTE (I.E., HYDRANTS, UTILITY POLES, TREE WELLS, SIGNS, ETC.)
5. CURB TREATMENT VARIES, SEE PLANS FOR CURB TYPE.
6. BASE OF RAMP SHALL BE GRADED TO PREVENT PONDING.
7. SEE TYPICAL SIDEWALK SECTION FOR RAMP CONSTRUCTION.
8. WHERE ACCESSIBLE ROUTES ARE LESS THAN 5' IN WIDTH (EXCLUDING CURBING) A 5' x 5' PASSING AREA SHALL BE PROVIDED AT INTERVALS NOT TO EXCEED 200 FEET.
9. ELIMINATE ALL CURBING AT RAMP (OTHER THAN VERTICAL CURBING, WHICH SHALL BE SET FLUSH) WHERE IT ABUTS ROADWAY.

WHEELCHAIR ACCESS RAMP DETAILS
(NOT TO SCALE.)

| GRADATION REQUIREMENTS FOR SUBBASE | |
|---|---|
| SIEVE DESIGNATION | PERCENT PASSING |
| 3 IN. | 100 |
| 1 1/2 IN. | 70-100 |
| 3/4 IN. | 50-85 |
| NO. 4 | 30-60 |
| NO. 200 | 0-10 |

NOTE:
CROSS SECTION TO COMPLY WITH MANUFACTURER SPECIFICATIONS.




PERVIOUS CONCRETE SIDEWALK CROSS-SECTION
(NOT TO SCALE)

TOWN OF GROVELAND OFFICE OF THE TOWN CLERK

THIS IS TO CERTIFY THAT ON ____________ I RECEIVED FROM THE GROVELAND PLANNING BOARD CERTICATION OF TIS APPROVAL OF THIS PLAN AND THAT DURING THE TWENTY (20) DAYS NEXT FOLLWOGIN I HAVE RECEIVED NO NOTICE OF ANY APPEAL FROM SAID DECISION.

CLERK DATE

APPROVED UNDER SUBDIVISION CONTROL LAW M.G.L. CHAPT. 141 SEC. 81U
DATE: ____________
APPROVED BY:

APPROVED ________, ________ SUBJECT TO TERMS AND CONDITIONS STATED IN A MEMORANDUM OF DECISION DATED ________, ________ BETWEEN THE GROVELAND PLANNING BOARD, ON BEHALF OF THE TOWN OF GROVELAND, ________ ________. A COPY OF WHICH DECISION IS RECORDED HEREWITH AND SUBJECT ALSO TO RECORDING OF THIS PLAN AND SAID DECISION IN THE SOUTH ESSEX REGISTRY OF DEED ON OR BEFORE ________, ________, SUBJECT TO TERMS AND CONDITIONS OF A COVENANT DATED ________, ________, ________ GROVELAND PLANNING BOARD.


# DEFINITIVE SUBDIVISION
FOR A
# STREET TO BE NAMED
IN
## GROVELAND, MASSACHUSETTS
AT
## 181R SCHOOL STREET
(GROVELAND ASSESSOR'S MAP 34 LOT 13)
PREPARED FOR/APPLICANT:
## GROVELAND REDEVELOPMENT, LLC
231 SUTTON STREET, SUITE 1B
NORTH ANDOVER, MA 01845
OWNER:
## 181R SCHOOL STREET, LLC
5 ATKINSON FARM ROAD
ATKINSON, NH 03811
JULY 31, 2024


The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
25 KENOZA AVENUE, MASSACHUSETTS 01830
P: 978-373-0310, W: WWW.MORINCAMERON.COM

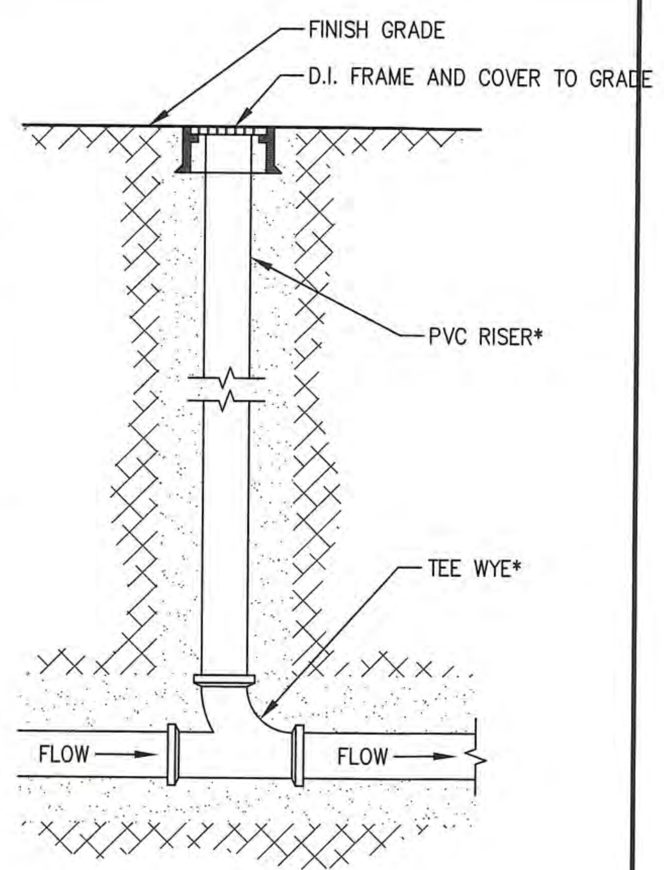

| REVISIONS | | | SITE DETAILS | DRAWING NO. |
|---|---|---|---|---|
| NO. | DESCRIPTION | DATE | | C-8 |

DRAWING: 3634 MAIN.dwg

FOR REGISTRY USE ONLY

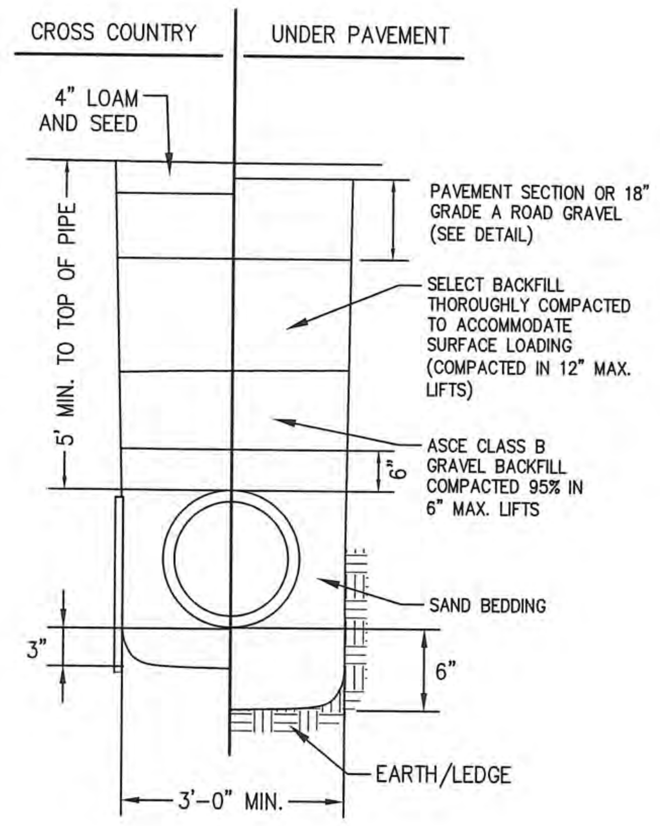
I HEREBY CERTIFY THAT THIS PLAN HAS BEEN PREPARED IN CONFORMANCE WITH THE RULES AND REGULATIONS OF THE REGISTERS OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS.

7/31/24
DATE

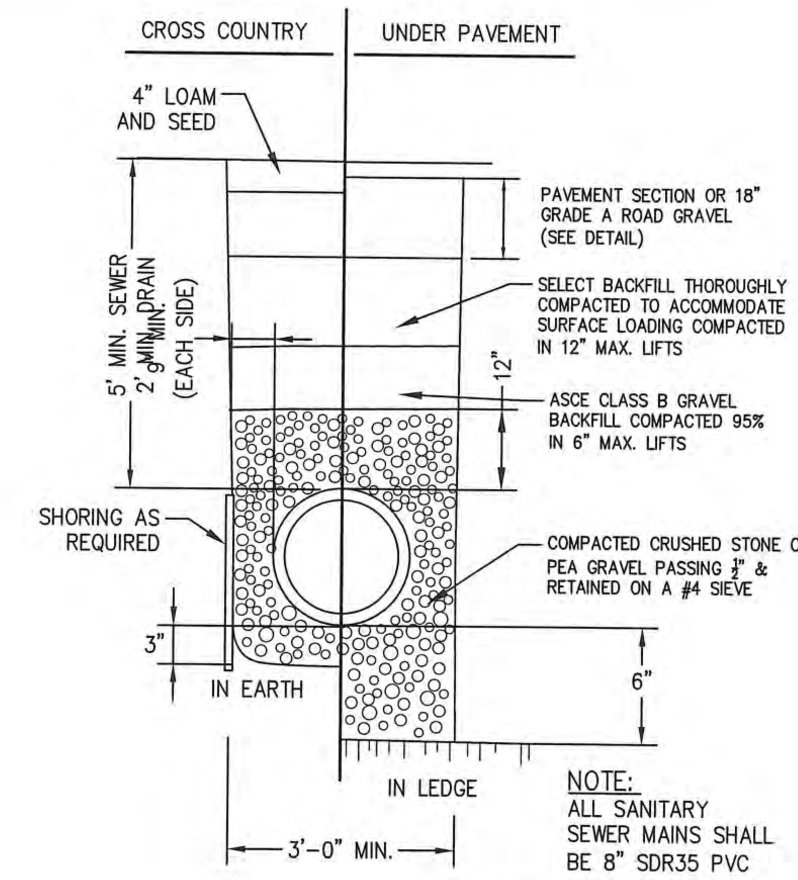



*FITTINGS TO MATCH DIAMENTER OF MAIN

SEWER CLEANOUT
(NOT TO SCALE)

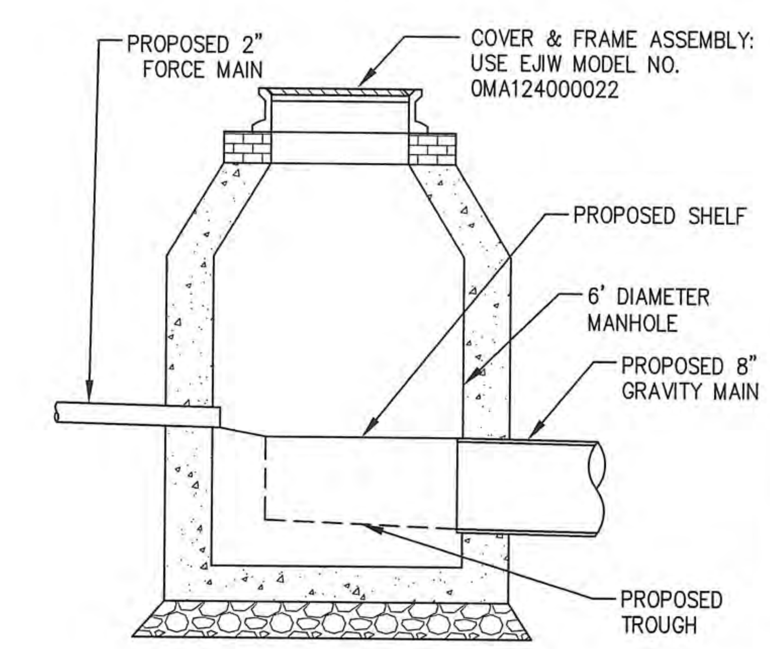



TYPICAL WATER TRENCH DETAIL
(NOT TO SCALE)

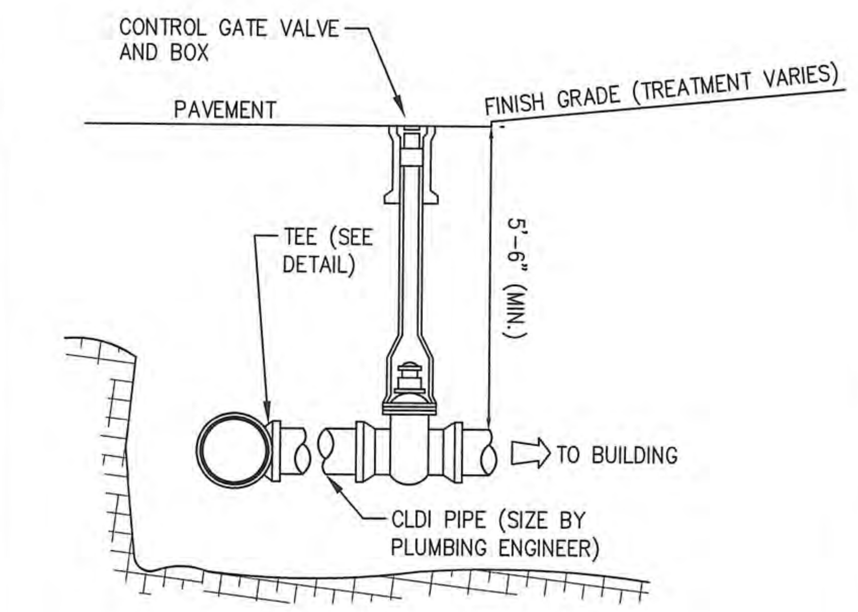



NOTE:
ALL SANITARY SEWER MAINS SHALL BE 8" SDR35 PVC

TYPICAL SEWER/DRAIN TRENCH DETAIL
(NOT TO SCALE)




IN-LINE FLUSHING CONNECTION
(NOT TO SCALE)




GATE VALVE DETAIL
(NOT TO SCALE)

TOWN OF GROVELAND OFFICE OF THE TOWN CLERK

THIS IS TO CERTIFY THAT ON ______________ I RECEIVED FROM THE GROVELAND PLANNING BOARD CERTICATION OF TIS APPROVAL OF THIS PLAN AND THAT DURING THE TWENTY (20) DAYS NEXT FOLLWOGIN I HAVE RECEIVED NO NOTICE OF ANY APPEAL FROM SAID DECISION.

CLERK DATE

APPROVED UNDER SUBDIVISION CONTROL LAW M.G.L. CHAPT. 141 SEC. 81U
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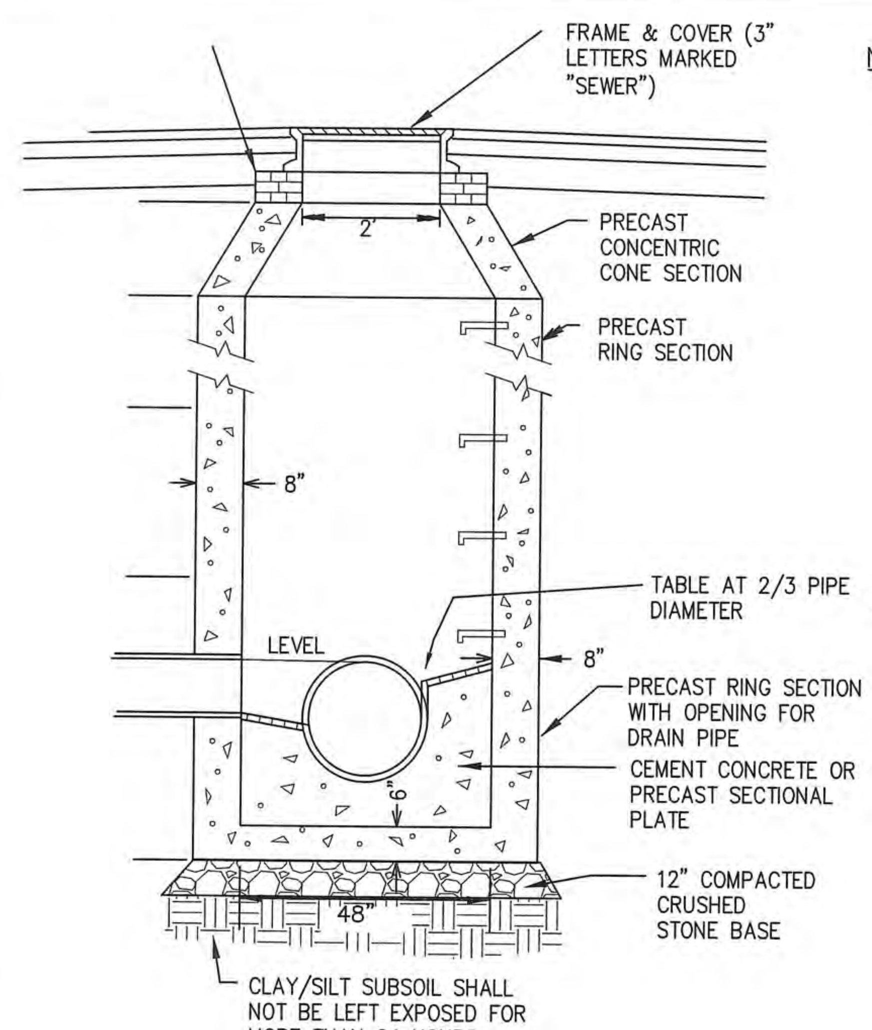
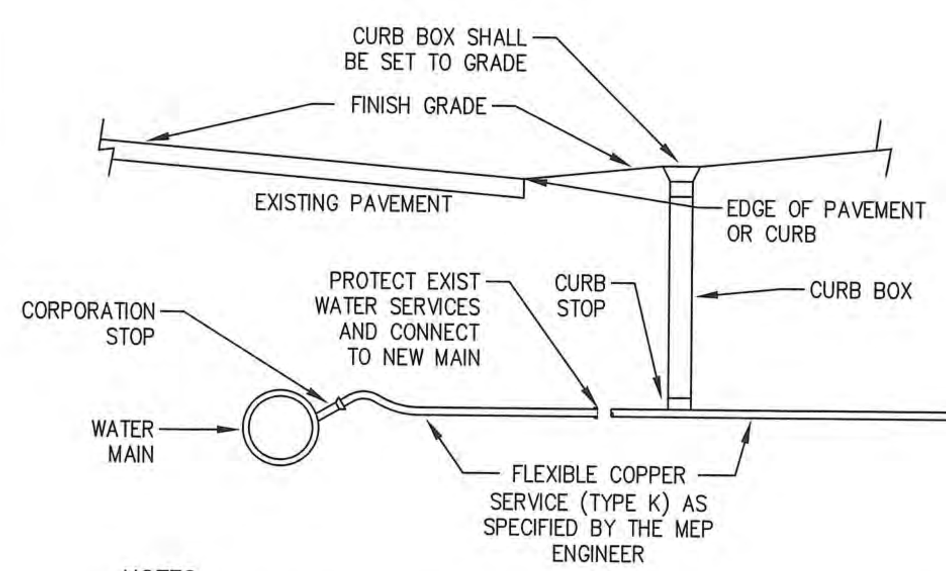
APPROVED BY:

APPROVED ________, ________ SUBJECT TO TERMS AND CONDITIONS STATED IN A MEMORANDUM OF DECISION DATED ________, ________ BETWEEN THE GROVELAND PLANNING BOARD, ON BEHALF OF THE TOWN OF GROVELAND, ________. A COPY OF WHICH DECISION IS RECORDED HEREWITH AND SUBJECT ALSO TO RECORDING OF THIS PLAN AND SAID DECISION IN THE SOUTH ESSEX REGISTRY OF DEED ON OR BEFORE ________, ________, SUBJECT TO TERMS AND CONDITIONS OF A COVENANT DATED ________, ________ GROVELAND PLANNING BOARD.




NOTES:
1) SUBSOILS TO BE INSPECTED PRIOR TO INSTALLATION OF ALL STRUCTURES. IF UNCOMPACTED FILL OR UNSUITABLE SOIL IS PRESENT IT SHALL BE REMOVED TO UNDISTURBED NATIVE SOIL AND REPLACED WITH STRUCTURAL FILL COMPACTED TO 95% R.C.
2) OUTLET INVERT IS A MINIMUM 0.10' LOWER THAN INLET INVERT

TYPICAL SEWER MANHOLE
(NOT TO SCALE)

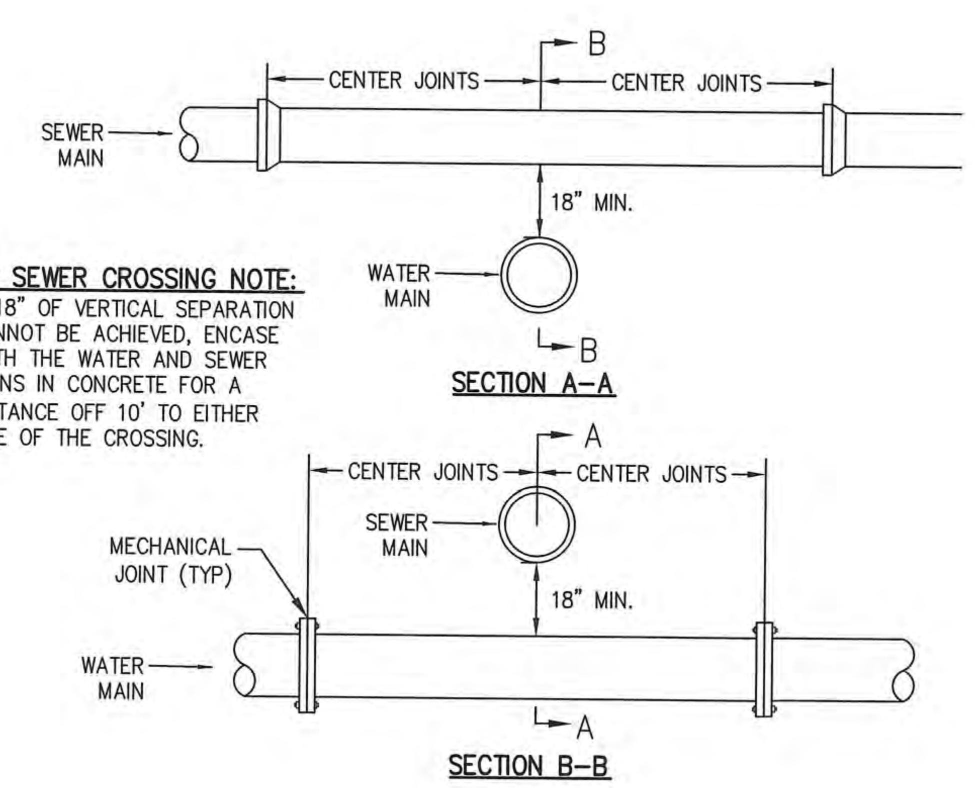



NOTES:

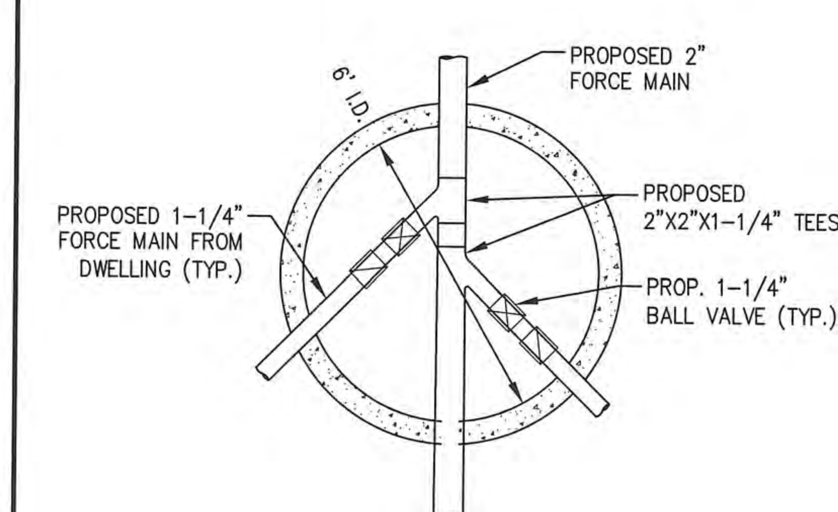
1. EXISTING WATER SERVICE SHALL BE SHUT OFF AT EXISTING CURB STOP AND SERVICE LINE CUT AND CAPPED JUST BEYOND CURB STOP.
2. TAP EXISTING WATER MAIN WITH NEW CORPORATION STOP AND INSTALL NEW CURB STOP AND CURB BOX WITHIN EXISTING SIDEWALK
3. SAW CUT EXISTING PAVEMENT AND SIDEWALK TO MINIMIZE REPAIRS. REPLACE ASPHALT PAVEMENT AND CONCRETE SIDEWALK TO MATCH EXISTING ELEVATIONS.

WATER SERVICE CORPORATION
(NOT TO SCALE)

WATER SEWER CROSSING NOTE:
1. IF 18" OF VERTICAL SEPARATION CANNOT BE ACHIEVED, ENCASE BOTH THE WATER AND SEWER MAINS IN CONCRETE FOR A DISTANCE OFF 10' TO EITHER SIDE OF THE CROSSING.




WATER/SEWER CROSSING DETAIL
(NOT TO SCALE)




SEWER MANHOLE (IN-LINE) PLAN VIEW
(NOT TO SCALE)

COMMONWEALTH OF MASSACHUSETTS SCOTT P. CAMERON CIVIL No. 47601 REGISTERED PROFESSIONAL ENGINEER
7/31/24

# DEFINITIVE SUBDIVISION
FOR A
# STREET TO BE NAMED
IN
## GROVELAND, MASSACHUSETTS
AT
## 181R SCHOOL STREET
(GROVELAND ASSESSOR'S MAP 34 LOT 13)
PREPARED FOR/APPLICANT:
## GROVELAND REDEVELOPMENT, LLC
231 SUTTON STREET, SUITE 1B
NORTH ANDOVER, MA 01845
OWNER:
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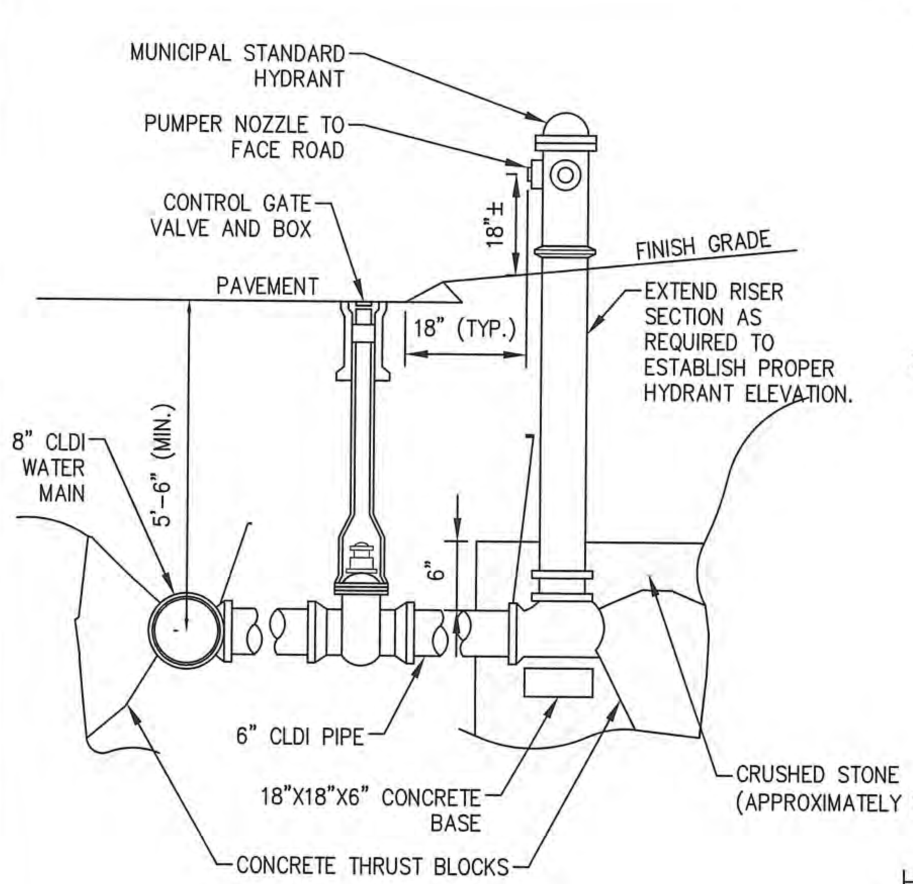
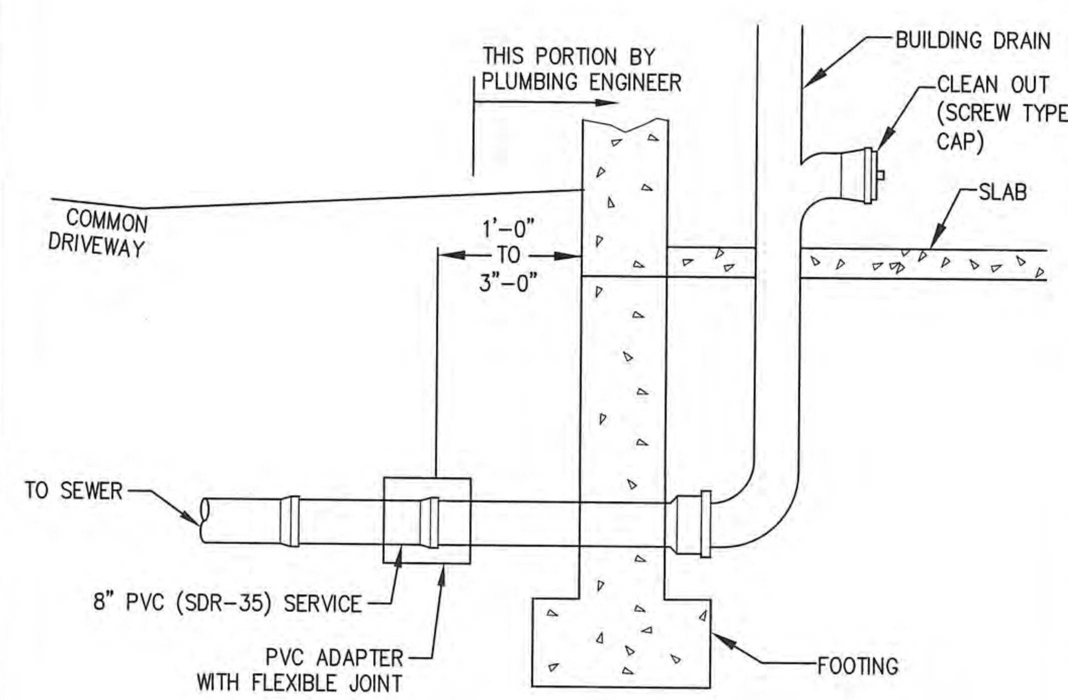
5 ATKINSON FARM ROAD
ATKINSON, NH 03811
JULY 31, 2024

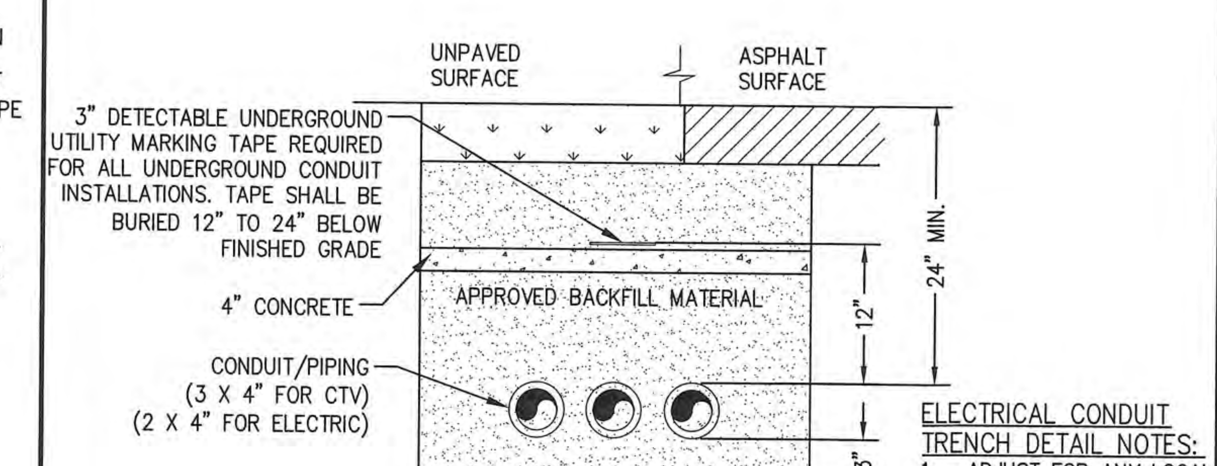



NOTES:
1. CONCRETE THRUST BLOCKS TO BE USED ONLY WHERE THEY CAN BEAR ON UNDISTURBED EARTH AS SHOWN. USE CLAMPS AND TIE RODS OR OTHER ACCEPTABLE METHOD OF JOINT RESTRAINT WHERE SOIL CONDITIONS PROHIBIT THE USE OF THRUST BLOCKS.
2. HYDRANT IN SIDEWALK AREAS TO BE LOCATED TO PROVIDE MINIMUM CLEAR SIDEWALK PASSAGE WIDTH OF 3 FEET AT HYDRANT.

HYDRANT DETAIL
(NOT TO SCALE)




TYPICAL BUILDING SEWER SERVICE BELOW SLAB
(NOT TO SCALE)

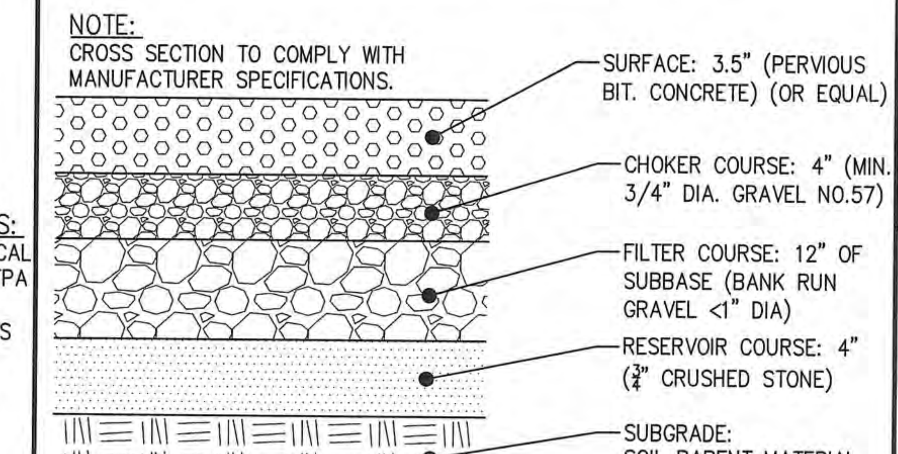



ELECTRICAL CONDUIT TRENCH DETAIL NOTES:
1. ADJUST FOR ANY LOCAL MODIFICATIONS TO NFPA 70/NEC
2. COORDINATE CONDUITS WITH APPLICABLE SERVICE PROVIDERS.

TELEPHONE, CABLE, FIBER AND ELECTRICAL CONDUIT TRENCH DETAIL
(NOT TO SCALE)

| GRADATION REQUIREMENTS FOR SUBBASE | |
|---|---|
| SIEVE DESIGNATION | PERCENT PASSING |
| 3 IN. | 100 |
| 1 1/2 IN. | 70–100 |
| 3/4 IN. | 50–85 |
| NO. 4 | 30–60 |
| NO. 200 | 0–10 |

NOTE:
CROSS SECTION TO COMPLY WITH MANUFACTURER SPECIFICATIONS.




TYPICAL PERVIOUS DRIVEWAY
(NOT TO SCALE)

The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
25 KENOZA AVENUE, MASSACHUSETTS 01830
P: 978-373-0310, W: WWW.MORINCAMERON.COM

| REVISIONS | | |
|---|---|---|
| NO. | DESCRIPTION | DATE |

UTILITIES & SITE DETAILS

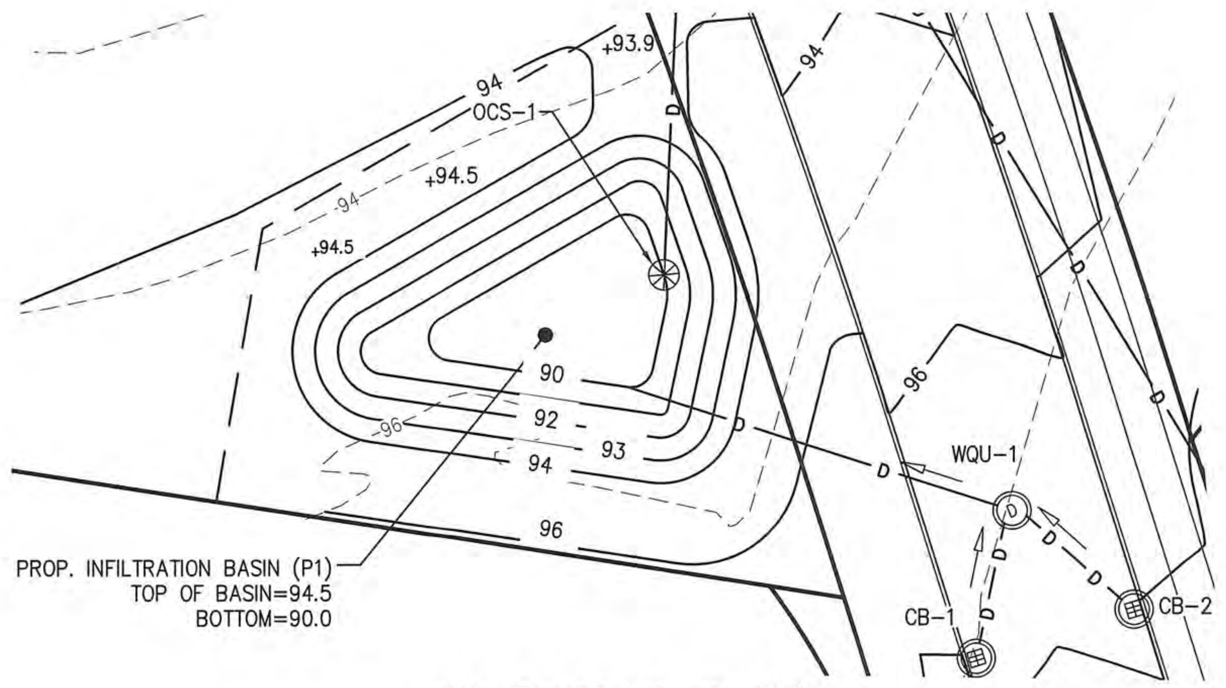
DRAWING NO. C-9

DRAWING: 3634 MAIN.dwg

FOR REGISTRY USE ONLY

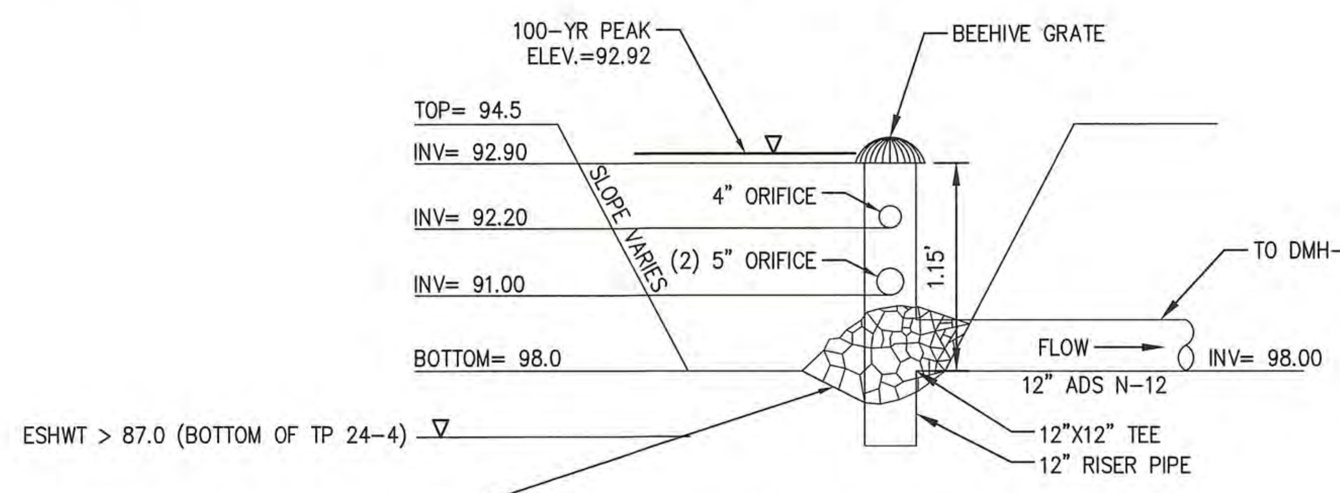
I HEREBY CERTIFY THAT THIS PLAN HAS BEEN PREPARED IN CONFORMANCE WITH THE RULES AND REGULATIONS OF THE REGISTERS OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS.

7/31/24
DATE

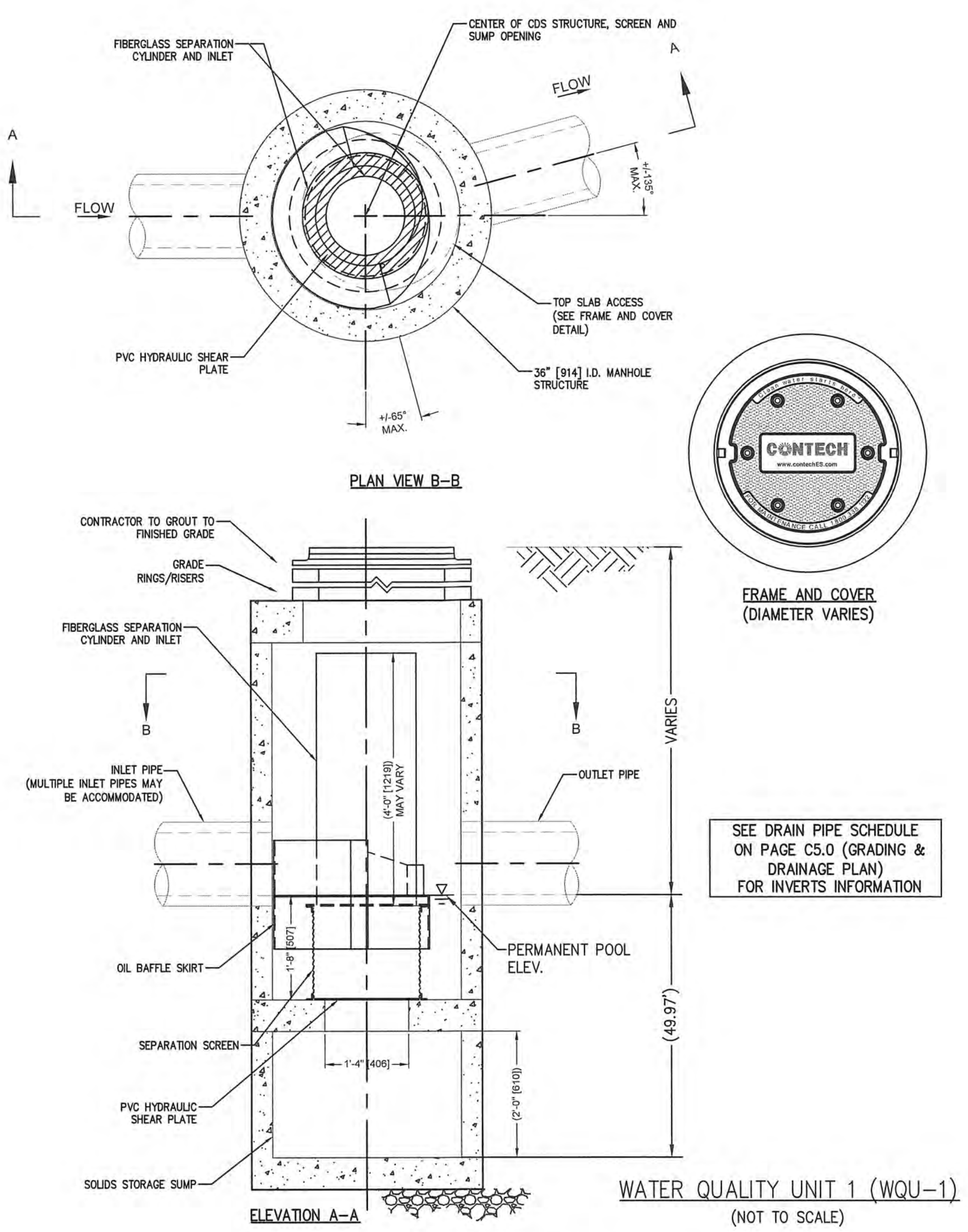



INFILTRATION BASIN (P1)
(SCALE= 1"=20')

2-YEAR STORM ELEV. = 90.92
910-YEAR STORM ELEV. = 91.43
25-YEAR STORM ELEV. = 92.24
100-YEAR STORM ELEV. = 92.92



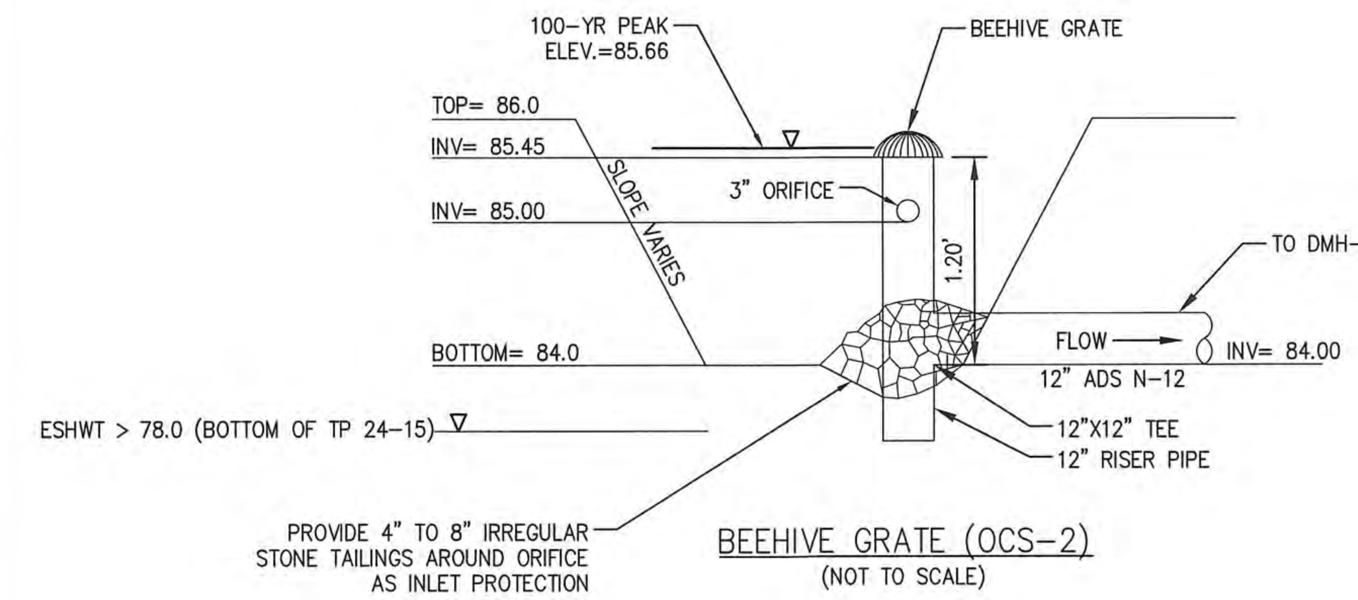

BEEHIVE GRATE (OCS-1)
(NOT TO SCALE)




SEE DRAIN PIPE SCHEDULE ON PAGE C5.0 (GRADING & DRAINAGE PLAN) FOR INVERTS INFORMATION

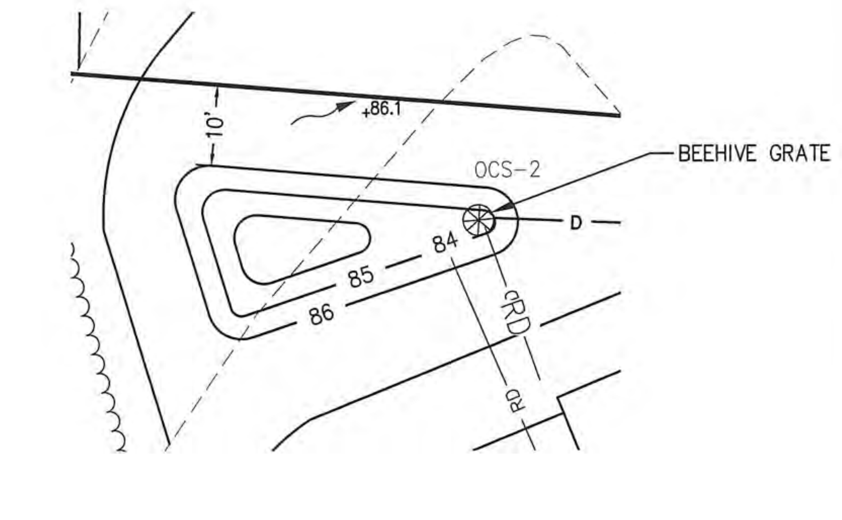
WATER QUALITY UNIT 1 (WQU-1)
(NOT TO SCALE)

INFILTRATION BASIN (P1)
(NOT TO SCALE)



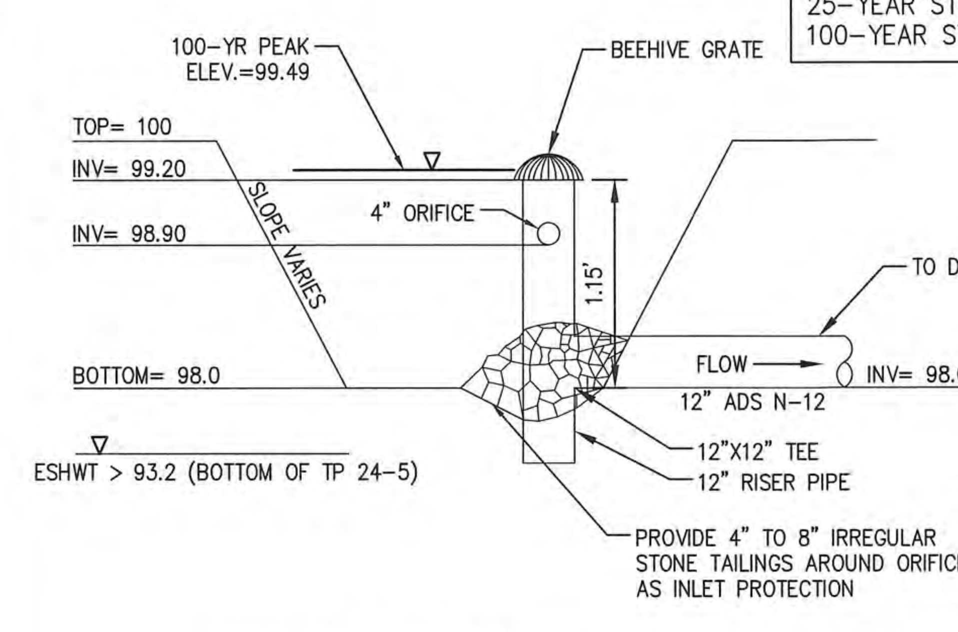

BEEHIVE GRATE (OCS-2)
(NOT TO SCALE)

2-YEAR STORM ELEV. = 85.22
10-YEAR STORM ELEV. = 85.56
25-YEAR STORM ELEV. = 85.61
100-YEAR STORM ELEV. = 85.66

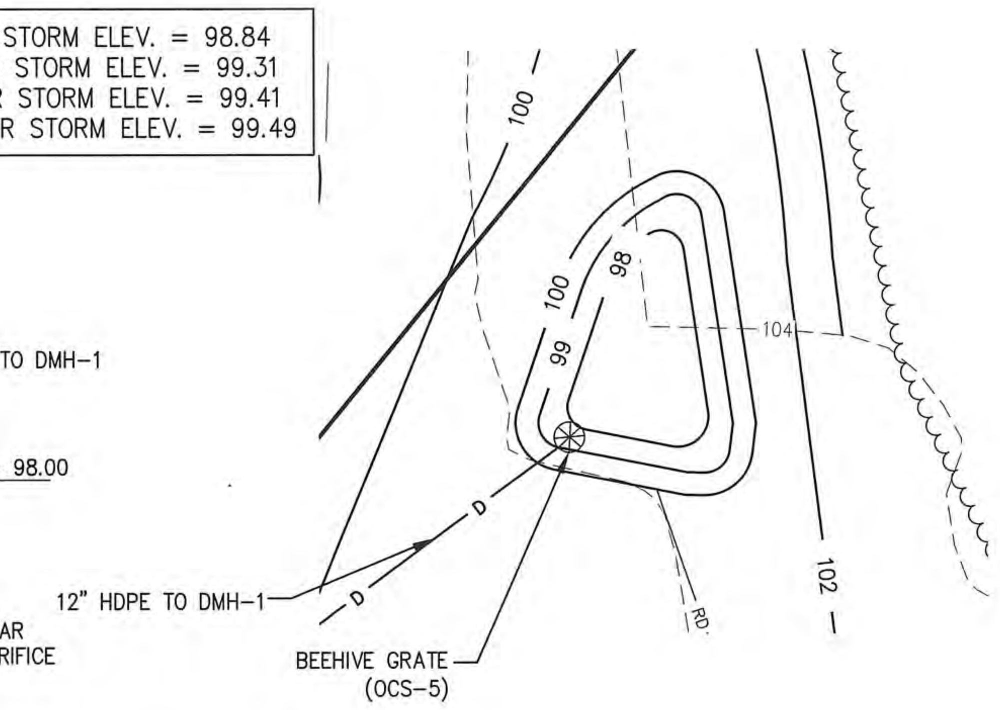



RAIN GARDEN (P2)
(NOT TO SCALE)

2-YEAR STORM ELEV. = 98.84
10-YEAR STORM ELEV. = 99.31
25-YEAR STORM ELEV. = 99.41
100-YEAR STORM ELEV. = 99.49




BEEHIVE GRATE (OCS-2)
(NOT TO SCALE)




RAIN GARDEN (P5)
(NOT TO SCALE)

TOWN OF GROVELAND OFFICE OF THE TOWN CLERK

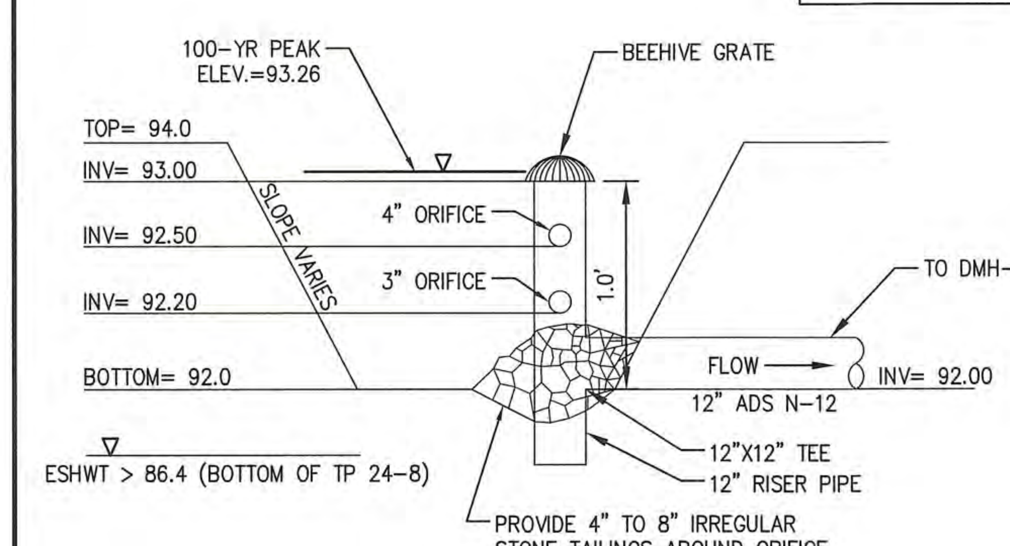
THIS IS TO CERTIFY THAT ON ______________ I RECEIVED FROM THE GROVELAND PLANNING BOARD CERTICATION OF TIS APPROVAL OF THIS PLAN AND THAT DURING THE TWENTY (20) DAYS NEXT FOLLWOGIN I HAVE RECEIVED NO NOTICE OF ANY APPEAL FROM SAID DECISION.

CLERK DATE

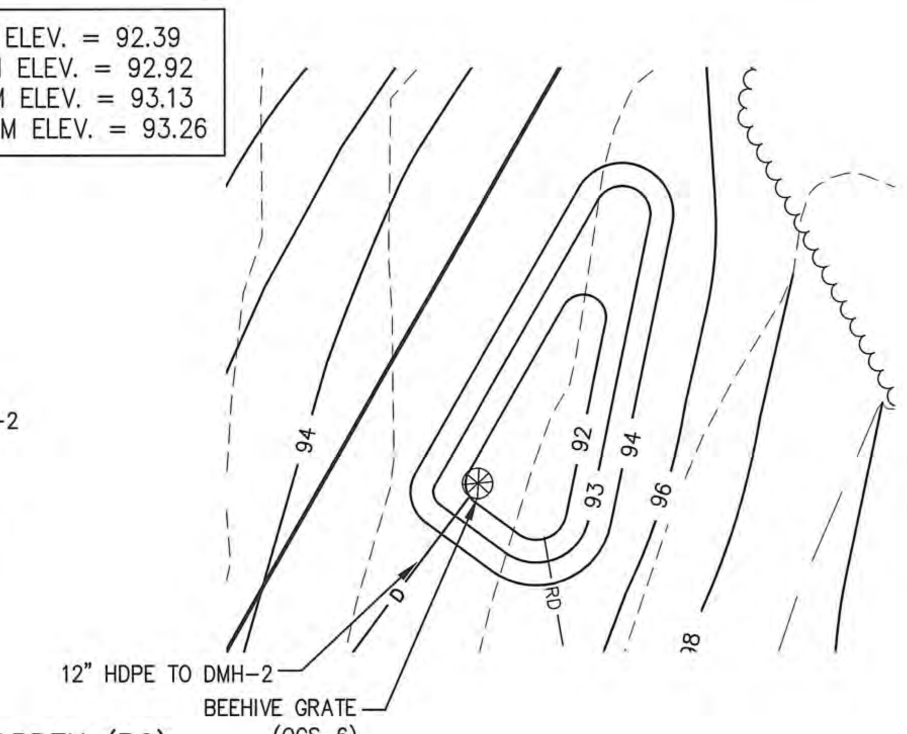
APPROVED UNDER SUBDIVISION CONTROL LAW M.G.L. CHAPT. 141 SEC. 81U
DATE: ______________
APPROVED BY:

APPROVED ____________, __________ SUBJECT TO TERMS AND CONDITIONS STATED IN A MEMORANDUM OF DECISION DATED ____________, __________ BETWEEN THE GROVELAND PLANNING BOARD, ON BEHALF OF THE TOWN OF GROVELAND, ________ _____. A COPY OF WHICH DECISION IS RECORDED HEREWITH AND SUBJECT ALSO TO RECORDING OF THIS PLAN AND SAID DECISION IN THE SOUTH ESSEX REGISTRY OF DEED ON OR BEFORE ____________, __________, SUBJECT TO TERMS AND CONDITIONS OF A COVENANT DATED ____________, __________, ____________, __________ GROVELAND PLANNING BOARD.

2-YEAR STORM ELEV. = 92.39
10-YEAR STORM ELEV. = 92.92
25-YEAR STORM ELEV. = 93.13
100-YEAR STORM ELEV. = 93.26



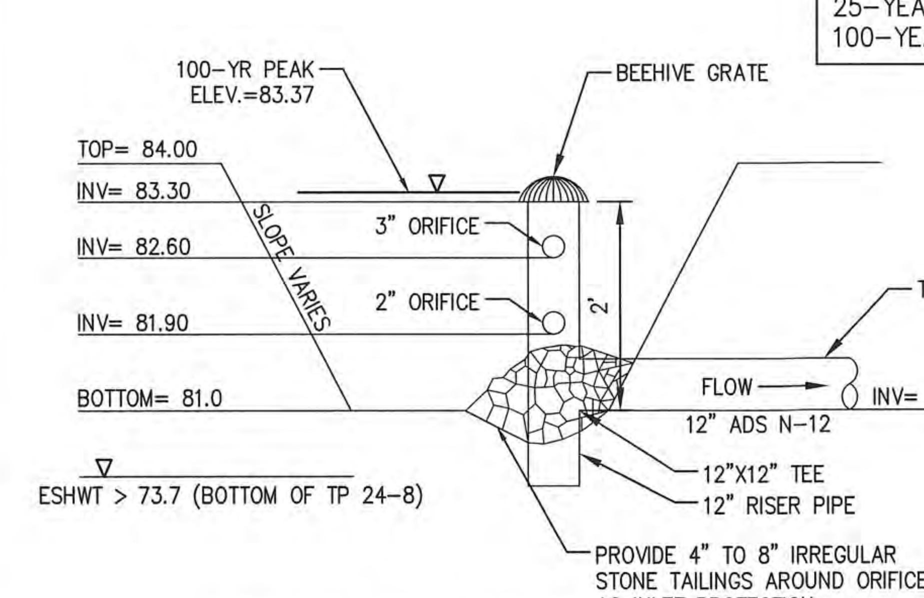

BEEHIVE GRATE (OCS-6)
(NOT TO SCALE)



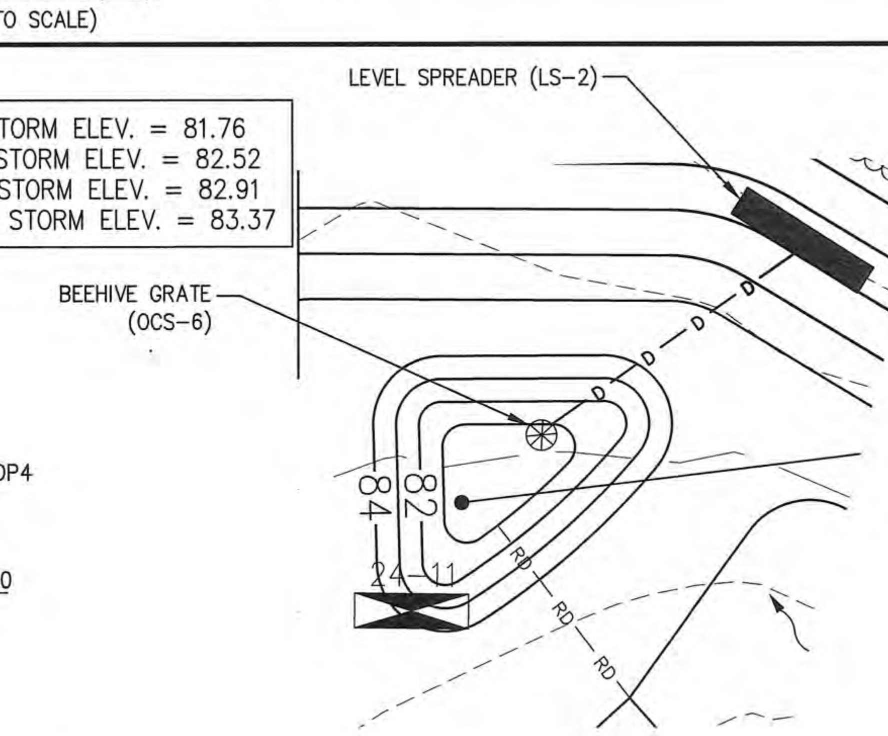

RAIN GARDEN (P6)
(NOT TO SCALE)

SCOTT P. CAMERON CIVIL No. 47801 REGISTERED PROFESSIONAL ENGINEER COMMONWEALTH OF MASSACHUSETTS
7/31/24

2-YEAR STORM ELEV. = 81.76
10-YEAR STORM ELEV. = 82.52
25-YEAR STORM ELEV. = 82.91
100-YEAR STORM ELEV. = 83.37




BEEHIVE GRATE (OCS-7)
(NOT TO SCALE)




RAIN GARDEN (P7)
(NOT TO SCALE)

# DEFINITIVE SUBDIVISION
FOR A
# STREET TO BE NAMED
IN
## GROVELAND, MASSACHUSETTS
AT
## 181R SCHOOL STREET
(GROVELAND ASSESSOR'S MAP 34 LOT 13)
PREPARED FOR/APPLICANT:
GROVELAND REDEVELOPMENT, LLC
231 SUTTON STREET, SUITE 1B
NORTH ANDOVER, MA 01845
OWNER:
181R SCHOOL STREET, LLC
5 ATKINSON FARM ROAD
ATKINSON, NH 03811
JULY 31, 2024


The Morin-Cameron GROUP, INC.
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P: 978-373-0310, W: WWW.MORINCAMERON.COM


REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

DRAINAGE DETAILS

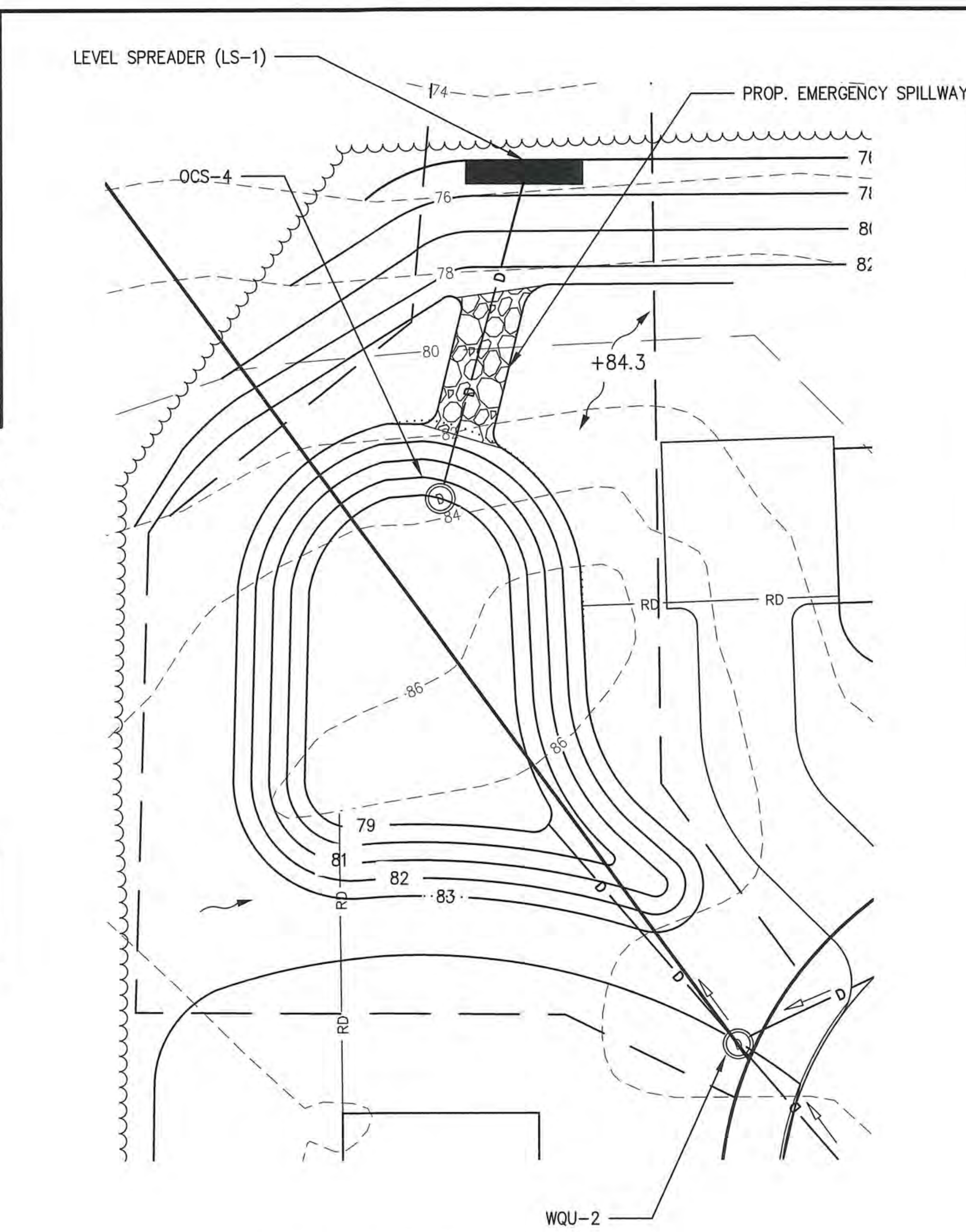
DRAWING NO. C-10

DRAWING: 3634 MAIN.dwg

FOR REGISTRY USE ONLY

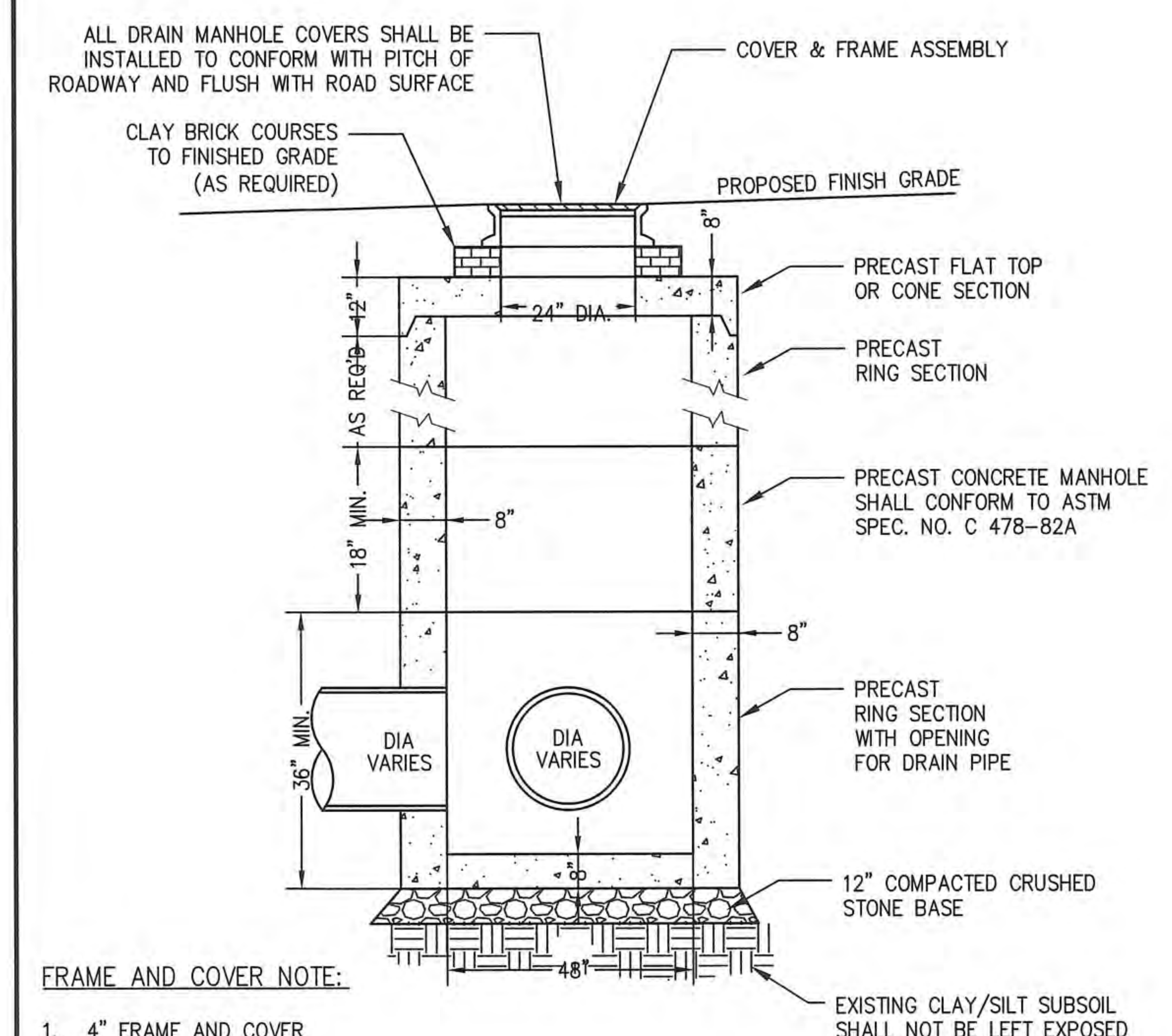
I HEREBY CERTIFY THAT THIS PLAN HAS BEEN PREPARED IN CONFORMANCE WITH THE RULES AND REGULATIONS OF THE REGISTERS OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS.

7/31/24
DATE




2-YEAR STORM ELEV. = 79.55
10-YEAR STORM ELEV. = 80.48
25-YEAR STORM ELEV. = 81.17
100-YEAR STORM ELEV. = 81.99

ESHWT > 77.0 (BOTTOM OF TP 24-13)




FRAME AND COVER NOTE:

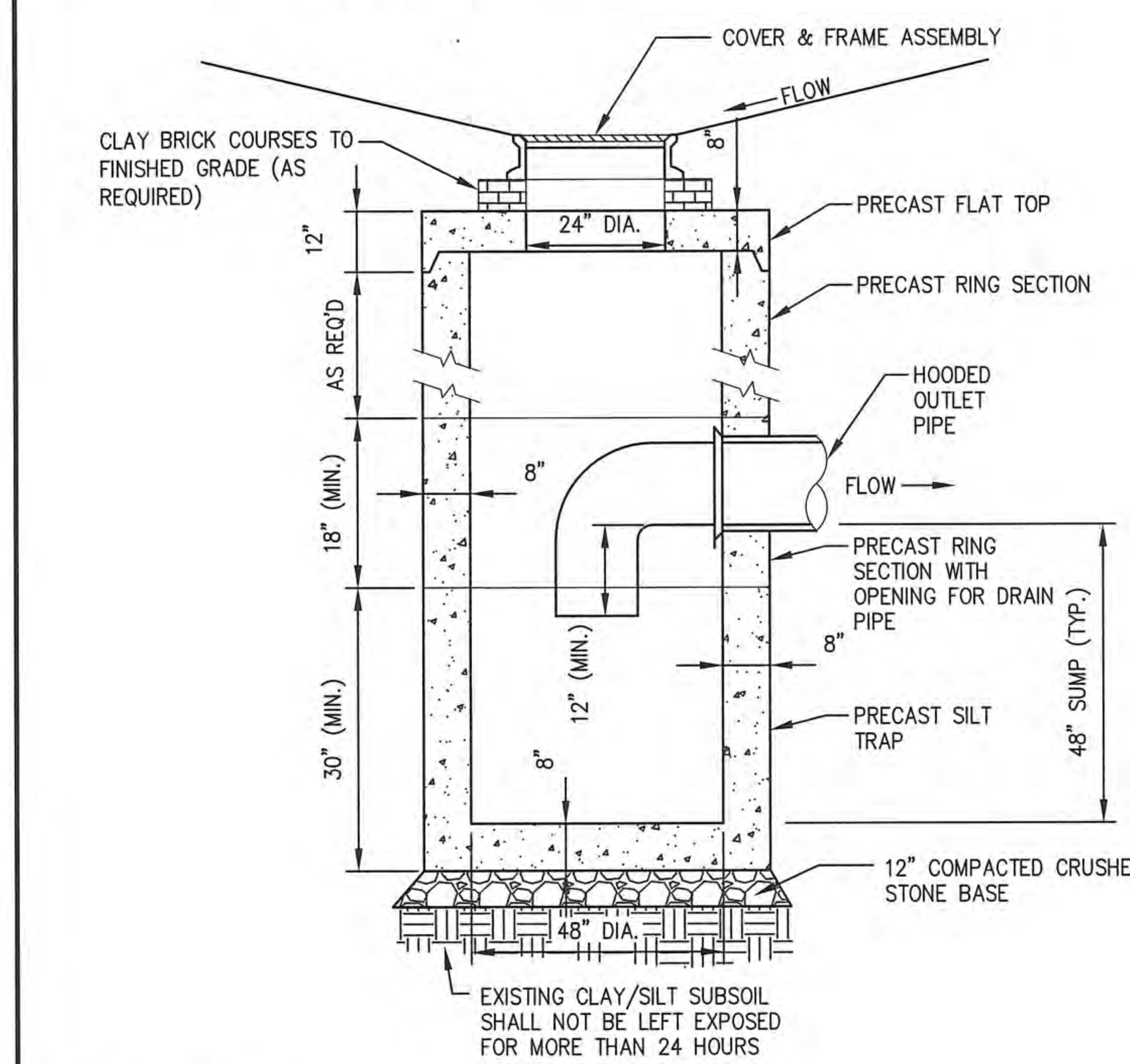
1. 4" FRAME AND COVER SHALL BE NEENAH FOUNDRY MODEL No. R-1706-1 OR APPROVED EQUIVALENT.
2. 8" FRAME AND COVER SHALL BE NEENAH FOUNDRY MODEL No. R-1670-A OR APPROVED EQUIVALENT.

SUBSOIL NOTE:

SUBSOILS TO BE INSPECTED PRIOR TO INSTALLATION OF ALL STRUCTURES. IF UNCOMPACTED FILL OR UNSUITABLE SOIL IS PRESENT IT SHALL BE REMOVED TO UNDISTURBED NATIVE SOIL AND REPLACED WITH STRUCTURAL FILL COMPACTED TO 95% R.C.

TYPICAL DRAIN MANHOLE
(NOT TO SCALE)

NOTE:
1. ECCENTRIC CONE SECTION MAY BE SUBSTITUTED




SUBSOIL NOTE:

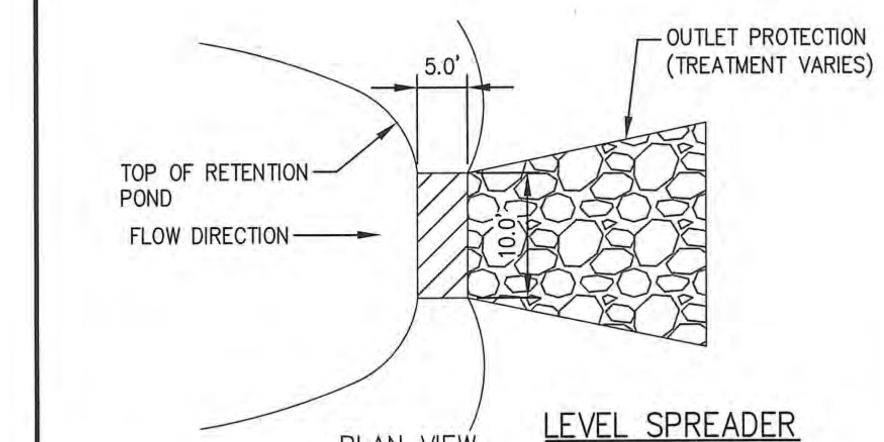
SUBSOILS TO BE INSPECTED PRIOR TO INSTALLATION OF ALL STRUCTURES. IF UNCOMPACTED FILL OR UNSUITABLE SOIL IS PRESENT IT SHALL BE REMOVED TO UNDISTURBED NATIVE SOIL AND REPLACED WITH STRUCTURAL FILL COMPACTED TO 95% R.C.

FRAME AND COVER NOTE:

1. 3" FRAME AND COVER SHALL BE NEENAH FOUNDRY MODEL No. R-3560 OR APPROVED EQUIVALENT.
2. 6" FRAME AND COVER SHALL BE NEENAH FOUNDRY MODEL No. R-3405 OR APPROVED EQUIVALENT.

TYPICAL CATCH BASIN
(NOT TO SCALE)

LEVEL SPREADER NOTES:
1. IT IS CRITICAL FOR THE CURB TO BE SET LEVEL ACROSS ITS ENTIRE LENGTH TO ENSURE PROPER LEVEL SPREADER FUNCTION.
2. MAXIMUM ALLOWABLE TOLERANCE FOR LEVELING CURB IS <0.25".
3. PRECAST CURB IS A SUITABLE SUBSTITUTE FOR GRANITE CURB.
4. CURB JOINTS SHALL BE MORTARED TO CREATE A SMOOTH TRANSITION BETWEEN SECTIONS. MAXIMUM SECTION LENGTHS SHALL BE USED TO MINIMIZE JOINTS.
5. ALL EXPOSED SOIL AREAS SHALL BE REINFORCEMENT WITH AN EROSION CONTROL BLANKET (JUTE MESH) OR EQUIVALENT. SEED SHALL BE APPLIED AT A RATE OF 4 LBS PER 1000 SF AND SHALL INCLUDE A MAJORITY OF PERENNIAL RYE FOR QUICK GERMINATION TIMES.




LEVEL SPREADER
NOT TO SCALE

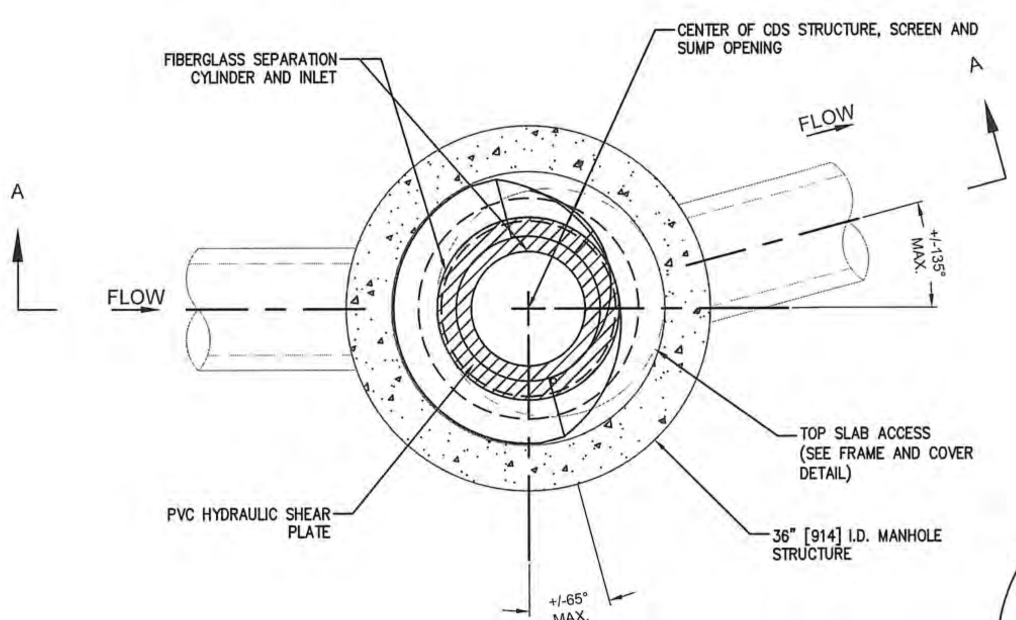
TOWN OF GROVELAND OFFICE OF THE TOWN CLERK

THIS IS TO CERTIFY THAT ON ______________ I RECEIVED FROM THE GROVELAND PLANNING BOARD CERTICATION OF TIS APPROVAL OF THIS PLAN AND THAT DURING THE TWENTY (20) DAYS NEXT FOLLWOGIN I HAVE RECEIVED NO NOTICE OF ANY APPEAL FROM SAID DECISION.

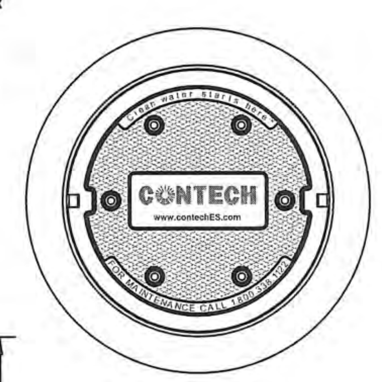
CLERK DATE

APPROVED UNDER SUBDIVISION CONTROL LAW M.G.L. CHAPT. 141 SEC. 81U
DATE: ______________
APPROVED BY:

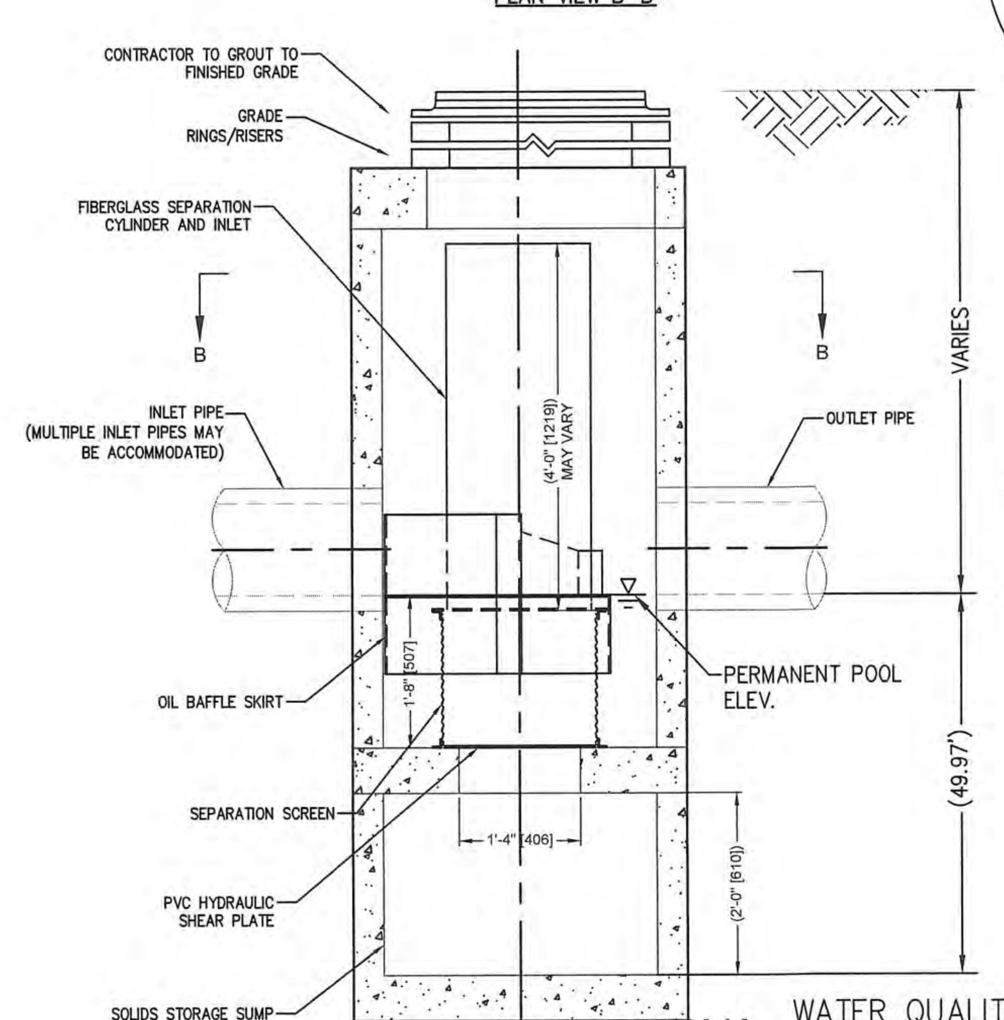
APPROVED __________, __________ SUBJECT TO TERMS AND CONDITIONS STATED IN A MEMORANDUM OF DECISION DATED __________, __________ BETWEEN THE GROVELAND PLANNING BOARD, ON BEHALF OF THE TOWN OF GROVELAND, __________, A COPY OF WHICH DECISION IS RECORDED HEREWITH AND SUBJECT ALSO TO RECORDING OF THIS PLAN AND SAID DECISION IN THE SOUTH ESSEX REGISTRY OF DEED ON OR BEFORE __________, __________, SUBJECT TO TERMS AND CONDITIONS OF A COVENANT DATED __________, __________ GROVELAND PLANNING BOARD.




PLAN VIEW B-B




FRAME AND COVER
(DIAMETER VARIES)

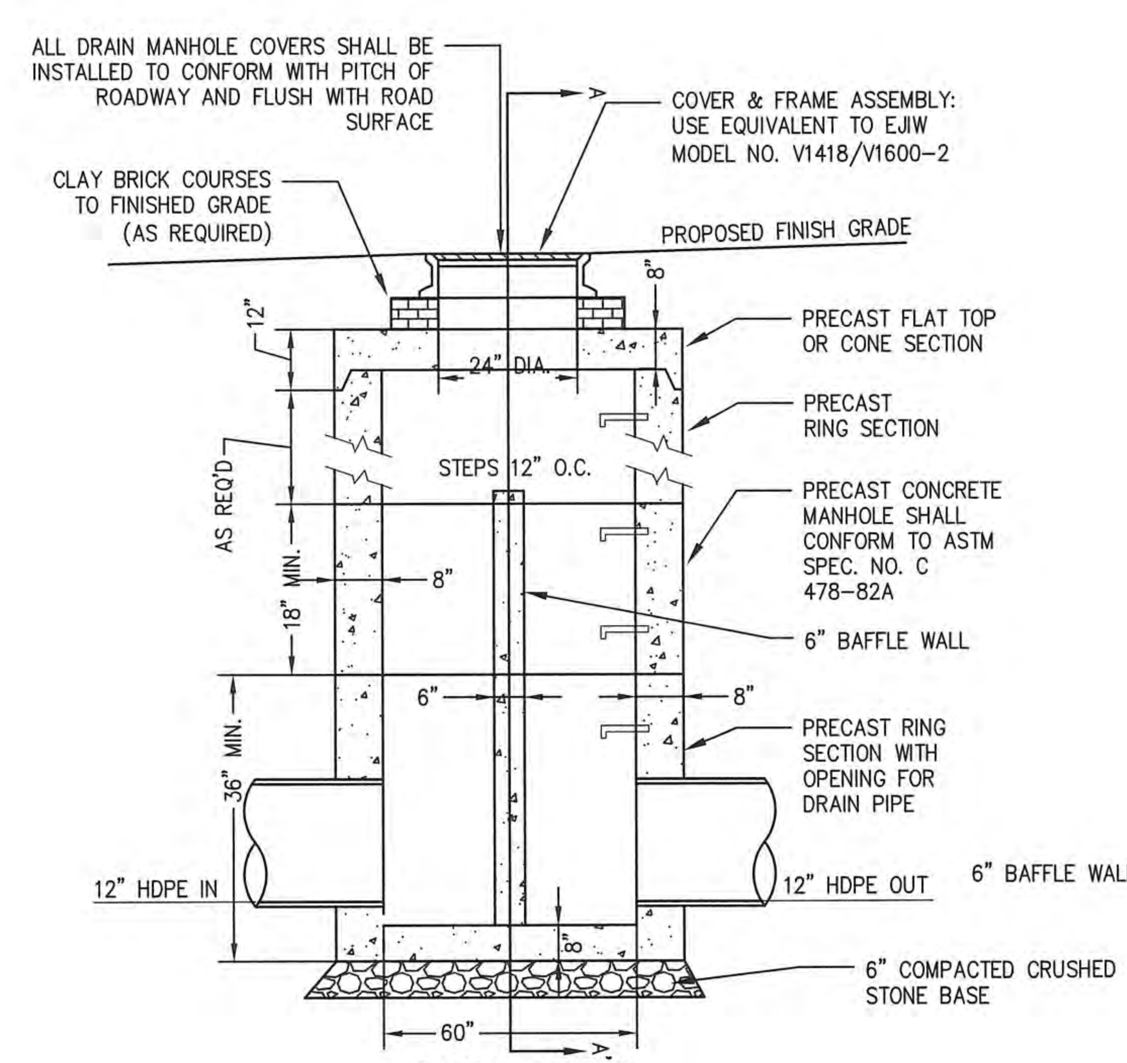



SEE DRAIN PIPE SCHEDULE ON PAGE C5.0 (GRADING & DRAINAGE PLAN) FOR INVERTS INFORMATION

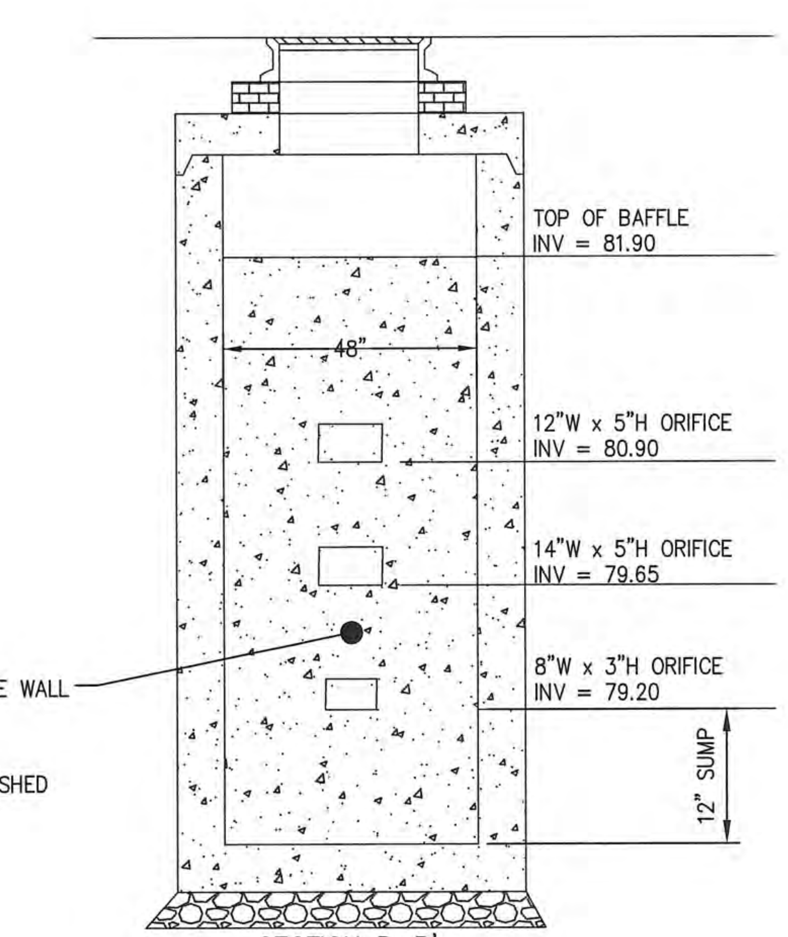
ELEVATION A-A

WATER QUALITY UNIT 2 (WQU-2)
(NOT TO SCALE)

INFILTRATION BASIN (P4)
(NOT TO SCALE)




TYPICAL SECTION




SECTION B-B'

NOTE: BAFFLE WALL TO BE SECURED TO PRECAST MANHOLE AND THE BOTTOM AND SIDES SHALL BE GROUTED WITH HYDRAULIC CEMENT.

OUTLET CONTROL STRUCTURE (OCS-4)
(NOT TO SCALE)


# DEFINITIVE SUBDIVISION
FOR A
## STREET TO BE NAMED
IN
GROVELAND, MASSACHUSETTS
AT
## 181R SCHOOL STREET
(GROVELAND ASSESSOR'S MAP 34 LOT 13)
PREPARED FOR/APPLICANT:
GROVELAND REDEVELOPMENT, LLC
231 SUTTON STREET, SUITE 1B
NORTH ANDOVER, MA 01845
OWNER:
181R SCHOOL STREET, LLC
5 ATKINSON FARM ROAD
ATKINSON, NH 03811
JULY 31, 2024


The Morin-Cameron GROUP, INC.
CIVIL ENGINEERS | ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS | LAND USE PLANNERS
25 KENOZA AVENUE, MASSACHUSETTS 01830
P: 978-373-0310, W: WWW.MORINCAMERON.COM


REVISIONS

| NO. | DESCRIPTION | DATE |
| --- | --- | --- |
| | | |

DRAINAGE DETAILS

DRAWING NO. C-11

DRAWING: 3634 MAIN.dwg

# 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**

COMMONWEALTH OF MASSACHUSETTS
SCOTT P. CAMERON
CIVIL
No. 47601
REGISTERED
PROFESSIONAL ENGINEER

7/31/24

# 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


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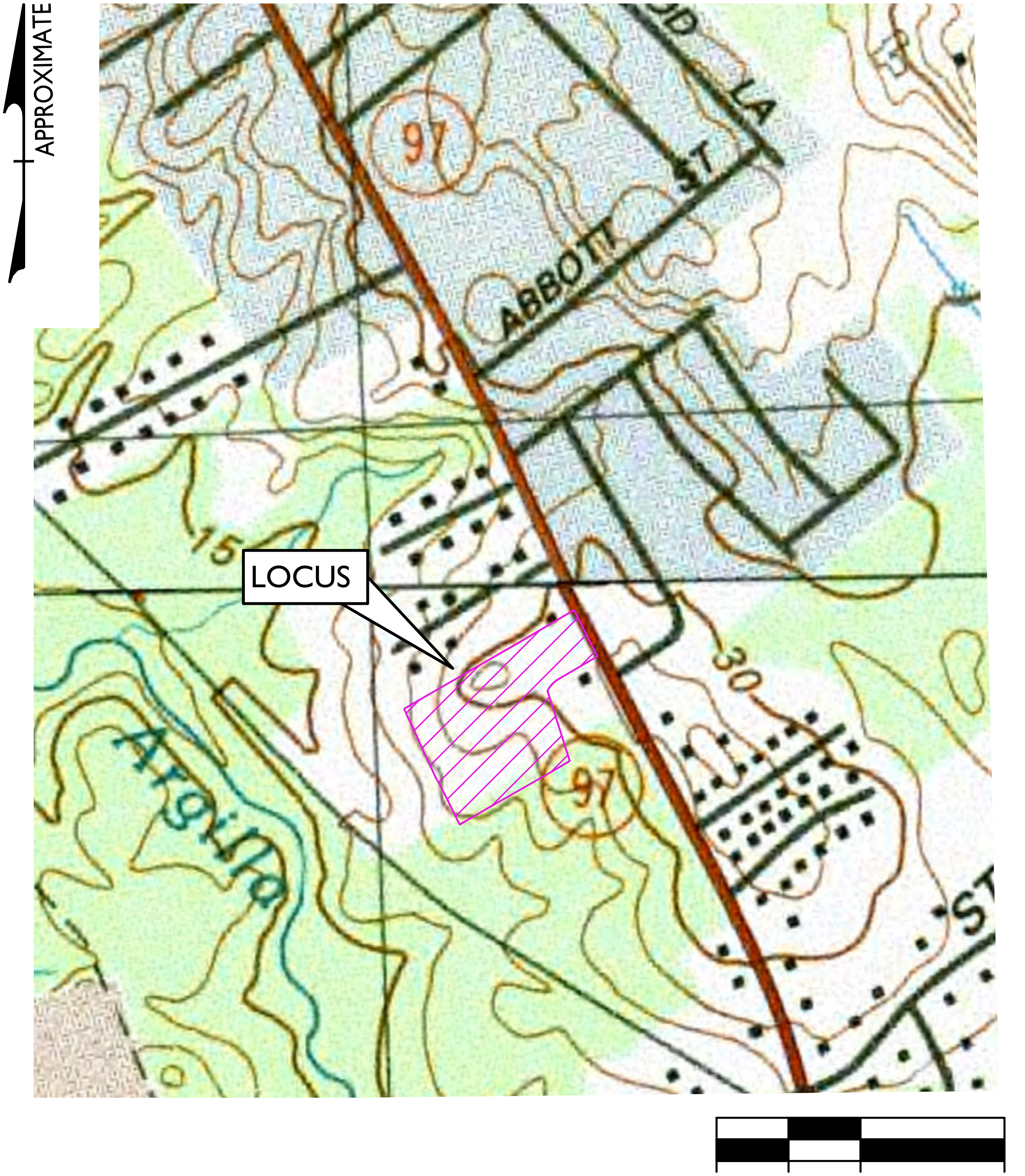
ORTHO MAP
181R SCHOOL STREET
IN
GROVELAND, MA

| DATE: JULY 31, 2024 | Scale: 1" = 300' | **FIGURE #1** |
|---|---|---|

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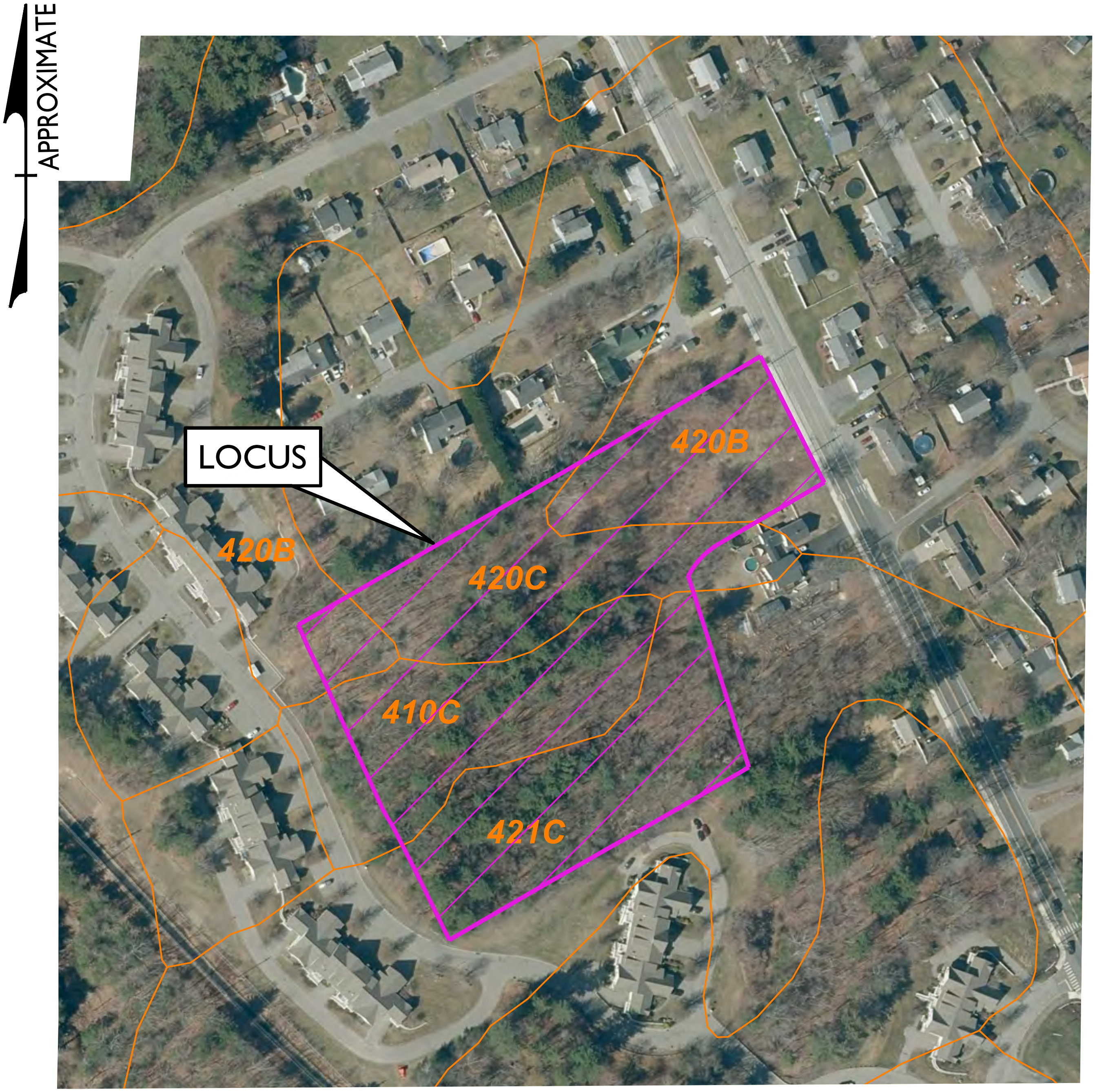
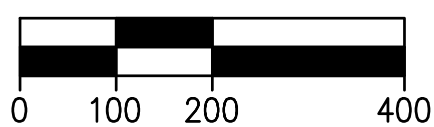
USGS MAP
181R SCHOOL STREET IN
GROVELAND, MA

| | | |
|---|---|---|
| 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

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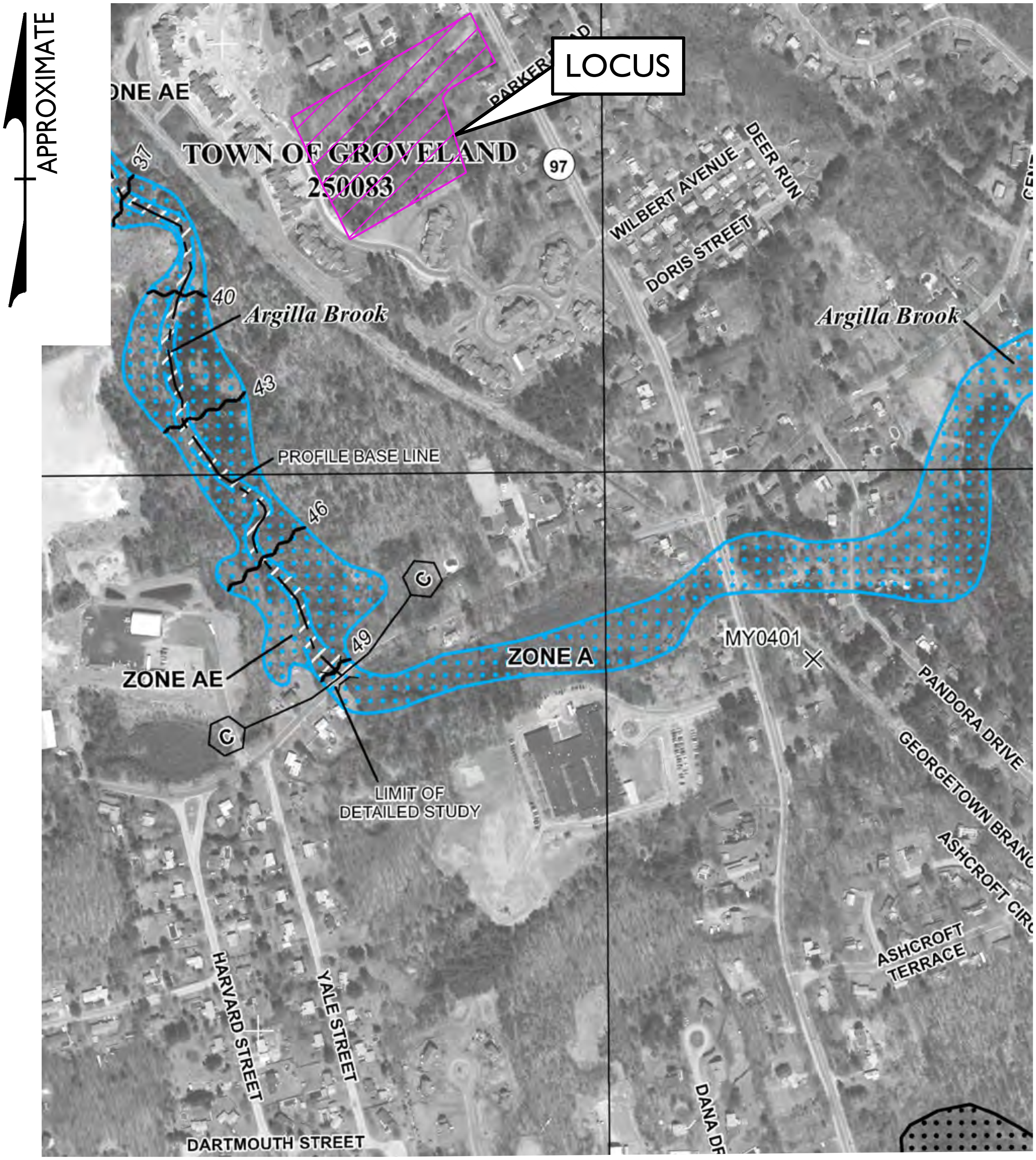
SCS SOILS MAP
181R SCHOOL STREET
GROVELAND, MA

| 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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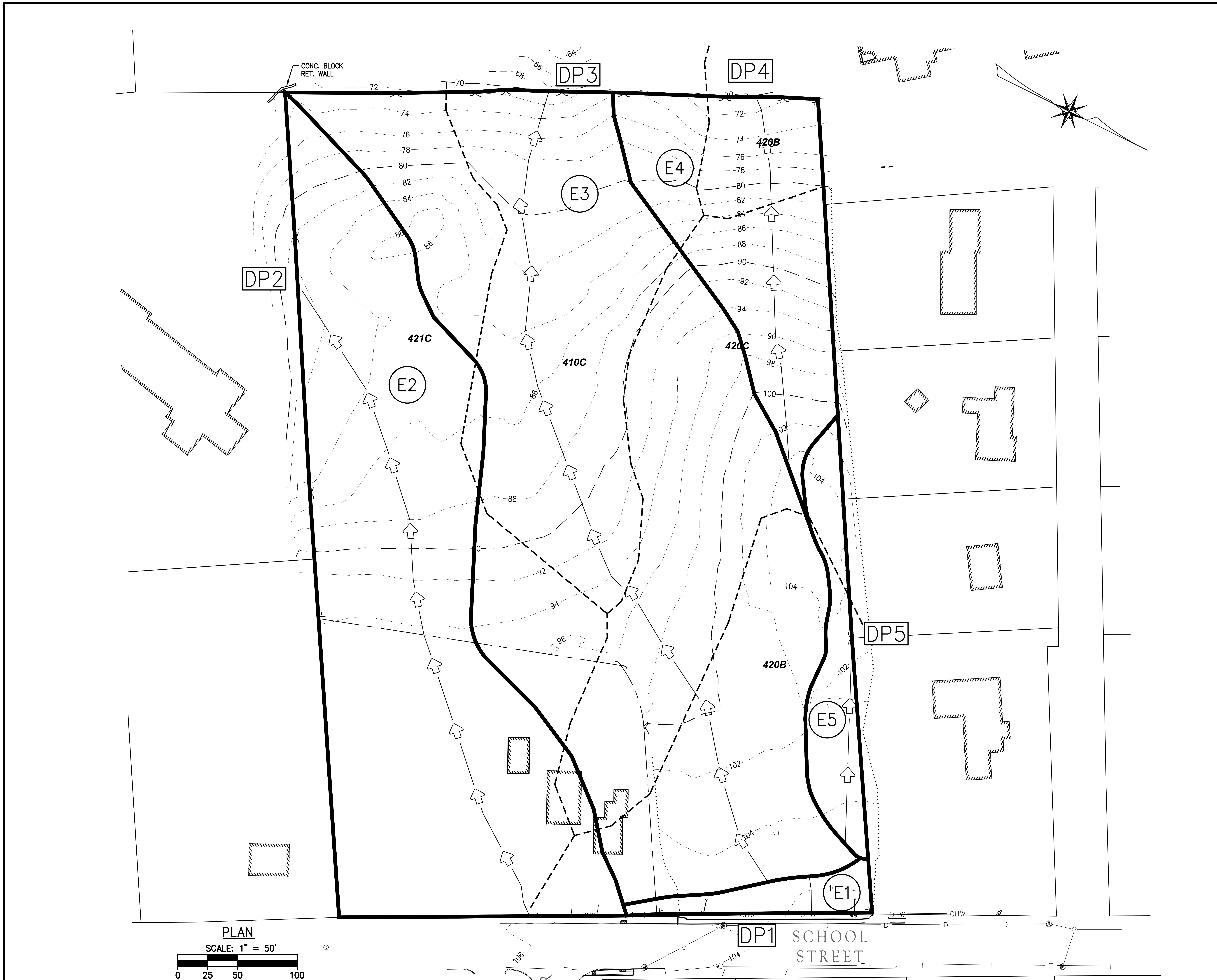
# FEMA MAP
181R SCHOOL STREET IN GROVELAND, MA

| DATE: JULY 31, 2024 | Scale: 1" = 500' | **FIGURE #4** |
|---|---|---|

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FIELD SURVEY BY: MCG
DRAFTED BY: LNO
CHECKED BY: SPC
APPROVED BY: SPC
SCALE: 1"=50'
DATE: JULY 31, 2024

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |

# FIGURE 5: EXISTING WATERSHED PLAN

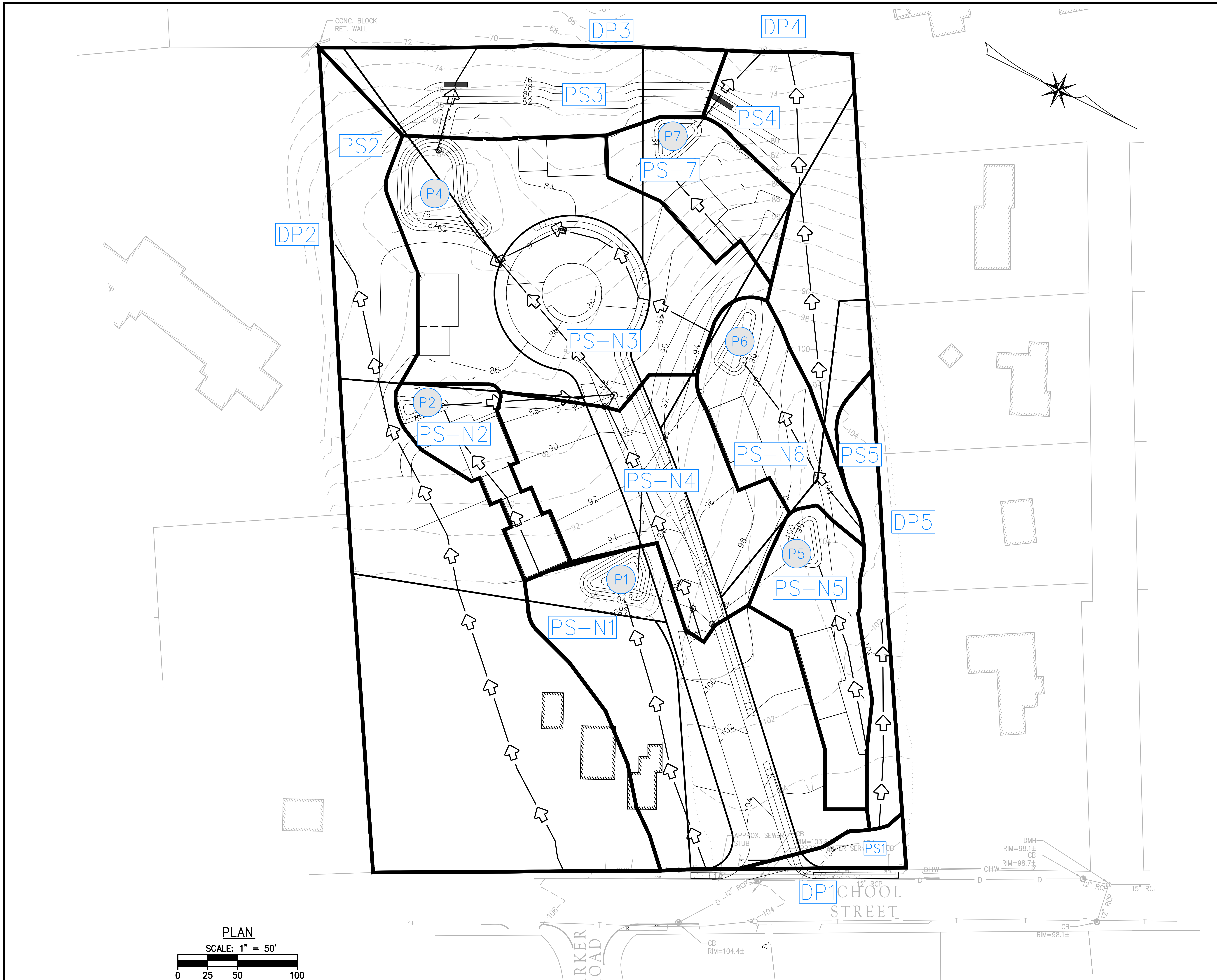
IN

**GROVELAND, MASSACHUSETTS**
**181R SCHOOL ST**

PROJ. NO. 3634

SHEET NO. 1 OF 1

DRAWING: 3634 Watersheds.dwg

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P: 978-777-8586, W: WWW.MORINCAMERON.COM

FIELD SURVEY BY: MCG
DRAFTED BY: LNO
CHECKED BY: SPC
APPROVED BY: SPC
SCALE: 1"=50'
DATE: JULY 31, 2024

REVISIONS

| NO. | DESCRIPTION | DATE |
|---|---|---|

# FIGURE 6: PROPOSED WATERSHED PLAN

IN

**GROVELAND, MASSACHUSETTS**
**181R SCHOOL ST**

PROJ. NO. 3634

SHEET NO. 1 OF 1

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.

# 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

COMMONWEALTH OF MASSACHUSETTS
SCOTT P. CAMERON
CIVIL
No. 47601
REGISTERED
PROFESSIONAL ENGINEER

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 (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 (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** (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** (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;

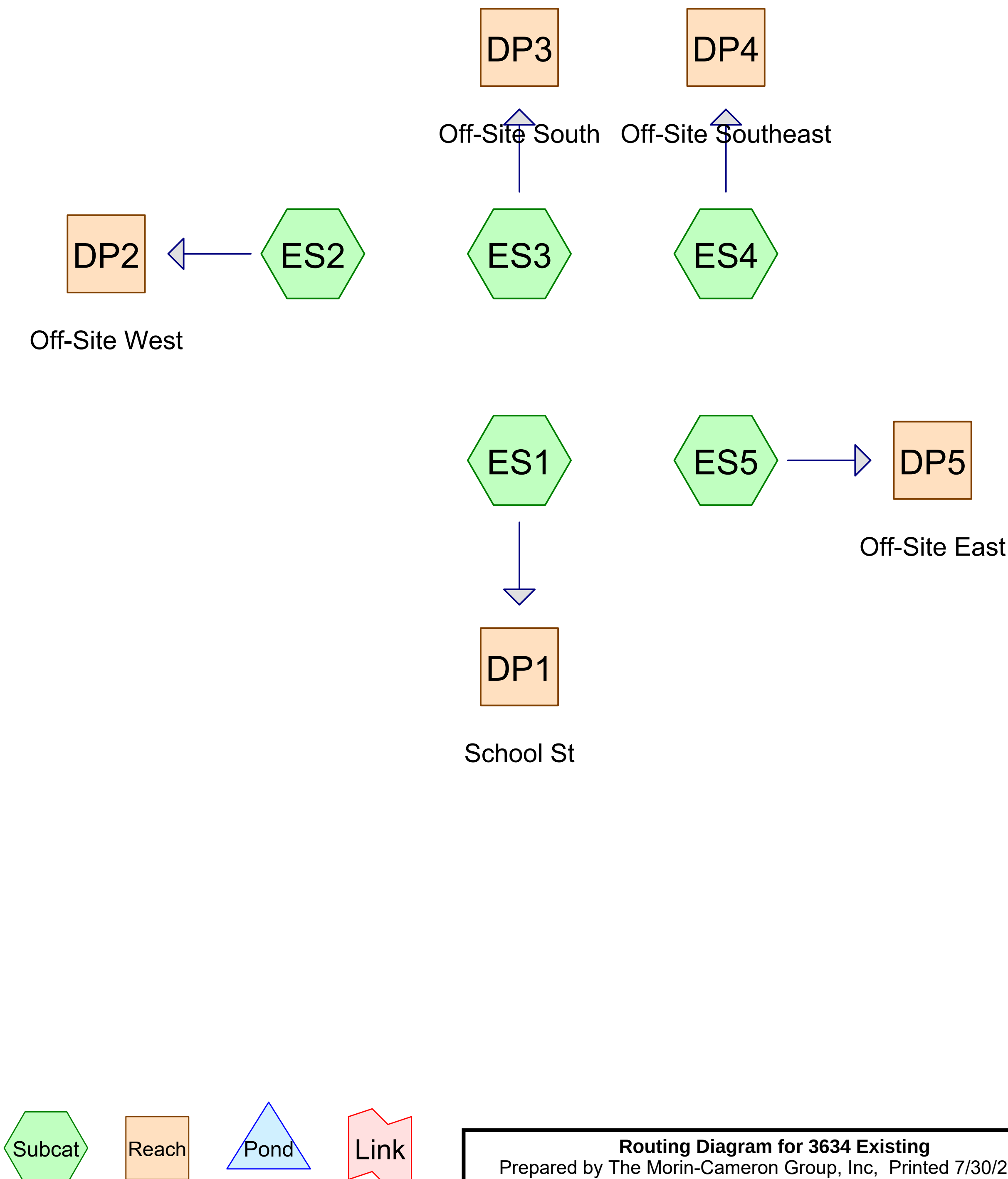
☒ An Illicit Discharge Compliance Statement is attached;

☐ 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




**Routing Diagram for 3634 Existing**
Prepared by The Morin-Cameron Group, Inc, Printed 7/30/2024
HydroCAD® 10.20-5a s/n 00401 © 2023 HydroCAD Software Solutions LLC

## 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**<br>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**<br>Grass: Short n= 0.150 P2= 3.24" |
| 0.4 | 100 | 0.0700 | 4.26 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 0.7 | 100 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.6 | 303 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Grass: Dense n= 0.240 P2= 3.24" |
| 1.8 | 359 | 0.0440 | 3.38 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.7 | 319 | 0.0390 | 3.18 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.24" |
| 0.8 | 265 | 0.1100 | 5.34 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.24" |
| 1.0 | 122 | 0.0155 | 2.00 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>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**<br>Grass: Short n= 0.150 P2= 3.24" |
| 0.4 | 100 | 0.0700 | 4.26 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 0.7 | 100 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.6 | 303 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Grass: Dense n= 0.240 P2= 3.24" |
| 1.8 | 359 | 0.0440 | 3.38 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.7 | 319 | 0.0390 | 3.18 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.24" |
| 0.8 | 265 | 0.1100 | 5.34 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.24" |
| 1.0 | 122 | 0.0155 | 2.00 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>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**<br>Grass: Short n= 0.150 P2= 3.24" |
| 0.4 | 100 | 0.0700 | 4.26 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 0.7 | 100 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.6 | 303 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Grass: Dense n= 0.240 P2= 3.24" |
| 1.8 | 359 | 0.0440 | 3.38 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.7 | 319 | 0.0390 | 3.18 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.24" |
| 0.8 | 265 | 0.1100 | 5.34 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.24" |
| 1.0 | 122 | 0.0155 | 2.00 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>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**<br>Grass: Short n= 0.150 P2= 3.24" |
| 0.4 | 100 | 0.0700 | 4.26 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 0.7 | 100 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.6 | 303 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Grass: Dense n= 0.240 P2= 3.24" |
| 1.8 | 359 | 0.0440 | 3.38 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.7 | 319 | 0.0390 | 3.18 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.24" |
| 0.8 | 265 | 0.1100 | 5.34 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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

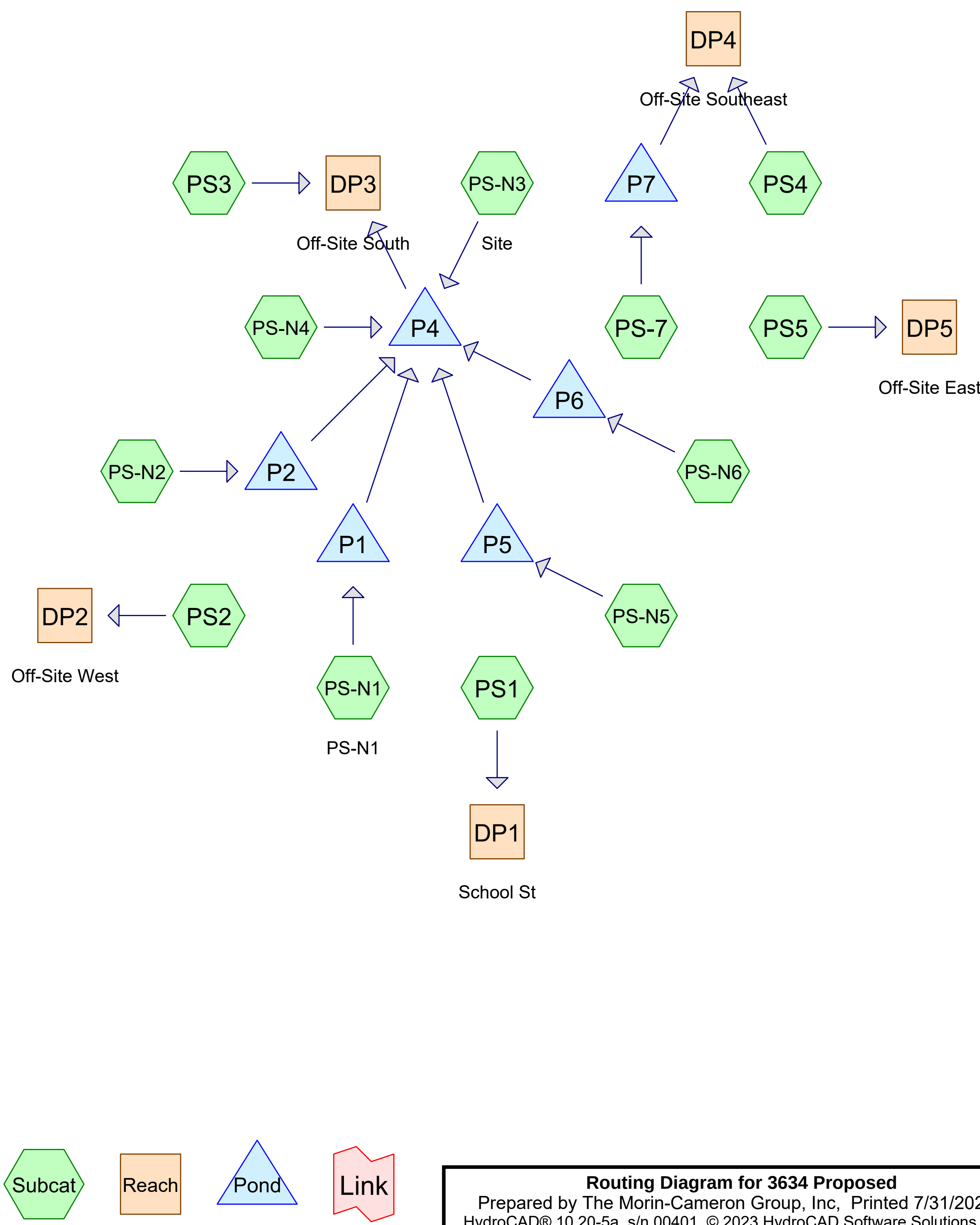
Inflow Area = 10,871 sf, 0.00% Impervious, Inflow Depth = 3.08" for 100-Year event
Inflow = 0.5 cfs @ 12.37 hrs, Volume= 2,791 cf
Outflow = 0.5 cfs @ 12.37 hrs, Volume= 2,791 cf, Atten= 0%, Lag= 0.0 min

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

# APPENDIX C:

# PROPOSED CONDITIONS

# HYDROLOGIC ANALYSIS




**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**<br>Smooth surfaces n= 0.011 P2= 3.10" |
| 0.3 | 45 | 0.0200 | 2.87 | | **Shallow Concentrated Flow, Roof Drain Pipe**<br>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**<br>Smooth surfaces n= 0.011 P2= 3.10" |
| 0.6 | 154 | 0.0380 | 3.96 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>Grass: Short n= 0.150 P2= 3.10" |
| 0.4 | 100 | 0.0700 | 4.26 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 0.7 | 100 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.6 | 303 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.10" |
| 1.0 | 122 | 0.0150 | 1.97 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>L= 40.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 90.00' / 89.20' S= 0.0200 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 92.20' | **4.0" Vert. Orifice/Grate-25yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 92.90' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 135.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 84.00' / 81.97' S= 0.0150 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 85.45' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 66.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 79.00' / 76.00' S= 0.0455 '/' Cc= 0.900<br>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<br>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<br>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<br>Limited to weir flow at low heads |
| #5 | Device 1 | 81.90' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>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**<br>L= 195.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 98.00' / 89.00' S= 0.0462 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 99.20' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 112.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 92.00' / 87.50' S= 0.0402 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 92.50' | **4.0" Vert. Orifice/Grate-10yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 93.00' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 29.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 81.00' / 80.00' S= 0.0345 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 82.60' | **3.0" Vert. Orifice/Grate 25-yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 83.30' | **12.0" Horiz. Orifice/Grate 100-yr** C= 0.600<br>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**<br>Smooth surfaces n= 0.011 P2= 3.10" |
| 0.3 | 45 | 0.0200 | 2.87 | | **Shallow Concentrated Flow, Roof Drain Pipe**<br>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**<br>Smooth surfaces n= 0.011 P2= 3.10" |
| 0.6 | 154 | 0.0380 | 3.96 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>Grass: Short n= 0.150 P2= 3.10" |
| 0.4 | 100 | 0.0700 | 4.26 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 0.7 | 100 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.6 | 303 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Grass: Dense n= 0.240 P2= 3.10" |
| 1.8 | 359 | 0.0440 | 3.38 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.7 | 319 | 0.0390 | 3.18 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.10" |
| 0.8 | 265 | 0.1100 | 5.34 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.10" |
| 1.0 | 122 | 0.0150 | 1.97 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>L= 40.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 90.00' / 89.20' S= 0.0200 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 92.20' | **4.0" Vert. Orifice/Grate-25yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 92.90' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 135.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 84.00' / 81.97' S= 0.0150 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 85.45' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 66.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 79.00' / 76.00' S= 0.0455 '/' Cc= 0.900<br>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<br>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<br>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<br>Limited to weir flow at low heads |
| #5 | Device 1 | 81.90' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>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**<br>L= 195.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 98.00' / 89.00' S= 0.0462 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 99.20' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 112.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 92.00' / 87.50' S= 0.0402 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 92.50' | **4.0" Vert. Orifice/Grate-10yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 93.00' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 29.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 81.00' / 80.00' S= 0.0345 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 82.60' | **3.0" Vert. Orifice/Grate 25-yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 83.30' | **12.0" Horiz. Orifice/Grate 100-yr** C= 0.600<br>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**<br>Smooth surfaces n= 0.011 P2= 3.10" |
| 0.3 | 45 | 0.0200 | 2.87 | | **Shallow Concentrated Flow, Roof Drain Pipe**<br>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**<br>Smooth surfaces n= 0.011 P2= 3.10" |
| 0.6 | 154 | 0.0380 | 3.96 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>Grass: Short n= 0.150 P2= 3.10" |
| 0.4 | 100 | 0.0700 | 4.26 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 0.7 | 100 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.6 | 303 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Grass: Dense n= 0.240 P2= 3.10" |
| 1.8 | 359 | 0.0440 | 3.38 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>Unpaved Kv= 16.1 fps |
| 1.7 | 319 | 0.0390 | 3.18 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.10" |
| 0.8 | 265 | 0.1100 | 5.34 | | **Shallow Concentrated Flow, Shallow Concentrated**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.10" |
| 1.0 | 122 | 0.0150 | 1.97 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>L= 40.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 90.00' / 89.20' S= 0.0200 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 92.20' | **4.0" Vert. Orifice/Grate-25yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 92.90' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 135.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 84.00' / 81.97' S= 0.0150 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 85.45' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 66.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 79.00' / 76.00' S= 0.0455 '/' Cc= 0.900<br>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<br>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<br>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<br>Limited to weir flow at low heads |
| #5 | Device 1 | 81.90' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>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**<br>L= 195.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 98.00' / 89.00' S= 0.0462 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 99.20' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 112.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 92.00' / 87.50' S= 0.0402 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 92.50' | **4.0" Vert. Orifice/Grate-10yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 93.00' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 29.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 81.00' / 80.00' S= 0.0345 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 82.60' | **3.0" Vert. Orifice/Grate 25-yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 83.30' | **12.0" Horiz. Orifice/Grate 100-yr** C= 0.600<br>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**<br>Smooth surfaces n= 0.011 P2= 3.10" |
| 0.3 | 45 | 0.0200 | 2.87 | | **Shallow Concentrated Flow, Roof Drain Pipe**<br>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**<br>Smooth surfaces n= 0.011 P2= 3.10" |
| 0.6 | 154 | 0.0380 | 3.96 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>Woods: Dense underbrush n= 0.800 P2= 3.10" |
| 1.0 | 122 | 0.0150 | 1.97 | | **Shallow Concentrated Flow, Shallow**<br>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**<br>L= 40.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 90.00' / 89.20' S= 0.0200 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 92.20' | **4.0" Vert. Orifice/Grate-25yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 92.90' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 135.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 84.00' / 81.97' S= 0.0150 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 85.45' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 66.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 79.00' / 76.00' S= 0.0455 '/' Cc= 0.900<br>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<br>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<br>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<br>Limited to weir flow at low heads |
| #5 | Device 1 | 81.90' | **4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>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**<br>L= 195.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 98.00' / 89.00' S= 0.0462 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 99.20' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 112.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 92.00' / 87.50' S= 0.0402 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 92.50' | **4.0" Vert. Orifice/Grate-10yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 93.00' | **12.0" Horiz. Orifice/Grate-25yr** C= 0.600<br>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**<br>L= 29.0' CMP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 81.00' / 80.00' S= 0.0345 '/' Cc= 0.900<br>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<br>Limited to weir flow at low heads |
| #3 | Device 1 | 82.60' | **3.0" Vert. Orifice/Grate 25-yr** C= 0.600<br>Limited to weir flow at low heads |
| #4 | Device 1 | 83.30' | **12.0" Horiz. Orifice/Grate 100-yr** C= 0.600<br>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

# 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** |

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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<br>BMP | C<br>TSS Removal Rate | D<br>Starting TSS Load (*F) | E<br>Amount Removed (C*D) | F<br>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

*Mass. Dept. of Environmental Protection*

**THE MORIN-CAMERON GROUP, INC.**
25 Kenoza Avenue,
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**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<br>BMP | C<br>TSS Removal Rate | D<br>Starting TSS Load (*F) | E<br>Amount Removed (C*D) | F<br>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

*Mass. Dept. of Environmental Protection*

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.

# 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 | C | C x A | SUM | FLOW TIME (MIN) | | i* | DESIGN | | | | | CAPACITY | | PIPE PROFILE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FROM | TO | (AC.) | | | C x A | 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**


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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


PROJ. #????
DRAWING: 3634 Watersheds.dwg

# 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<br>231 Sutton Street, Suite 1B<br>North Andover, MA 01945<br>P: (978) 687-6200 |
| Groveland Planning Board: | Groveland Town Hall<br>183 Main Street<br>Groveland, MA 01834<br>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).

**<u>Structural Practices</u>:**

**<u>1)</u>** **<u>Silt Sock</u>** – 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.

**<u>(2)</u>** **<u>Sediment Track-Out</u>** – 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.

**<u>(3)</u>** **<u>Inlet Protection</u>** – 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.

<u>Silt Sack (or equivalent) Inlet Protection Inspection/Maintenance Requirements *</u>

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<br>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<br>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<br><br>2002 or equivalent | 0.300 mm opening |
| Outlet Protection | Amoco | Nonwoven polypropylene 4551 or equivalent | 0.150 mm opening |
| Erosion Control<br><br>(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.

<u>Mulch (Straw) Materials and Installation</u>

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.

<u>Mulch Maintenance *</u>

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) **<u>Land Grading</u>** – Grading on fill slopes, cut slopes, and stockpile areas will be done with full siltation controls in place.

<u>Land Grading Design/Installation Requirements</u>

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<br>231 Sutton Street, Suite 1B<br>North Andover, MA 01945<br>P: (978) 687-6200 |
| Groveland Planning Board: | Groveland Town Hall<br>183 Main Street<br>Groveland, MA 01834<br>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 15$^{th}$ and November 15$^{th}$. 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.*<br><br>Thereafter, twice a year<br>(April / October)<br><br>Inspections should include the following:<br>• Signs of differential settlement<br>• Erosion<br>• Tree growth on the embankments that were not part of the design plan<br>• Sediment accumulation<br>• Health of turf<br>• Cracked/Disconnected Roof Leaders<br>• 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<br><br>Remove any obstructions from outlets/pipes<br><br>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 | |
| | | | | | | | | | | | |
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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 | |
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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 | |
| | | | | | | | | | | | |
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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 | |
| | | | | | | | | | | | |
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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 | |
| | | | | | | | | | | | |
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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<br>D: 2.5Y6/2 | | | | Single grain | Loose | |
| | | | | | | | | | | | |
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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 | |
| | | | | | | | | | | | |
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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 | |
| | | | | | | | | | | | |
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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 | |
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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 | |
| | | | | | | | | | | | |
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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<br>D: 5Y 6/2 | | 20% | | Massive | Friable | |
| | | | | | | | | | Massive | Friable | |
| | | | | | | | | | | | |
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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 | |
| | | | | | | | | | | | |
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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<br>D: 2.5Y 6/2 | | | | Single grain | Loose | |
| | | | | | | | | | Massive | Friable | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Additional Notes:
No refusal – boulder @ 80", Roots to 32"

**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:** TP24-15 (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"

**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:** TP24-16 (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<br>D: 5Y 6/2 | | | | Single grain | Loose | |
| 50-108 | C2 | Sandy loam | 2.5Y4/3 | | | | | | Massive | Friable | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Additional Notes:
No refusal, Roots to 56"

**Commonwealth of Massachusetts**
**City/Town of** Groveland

# 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

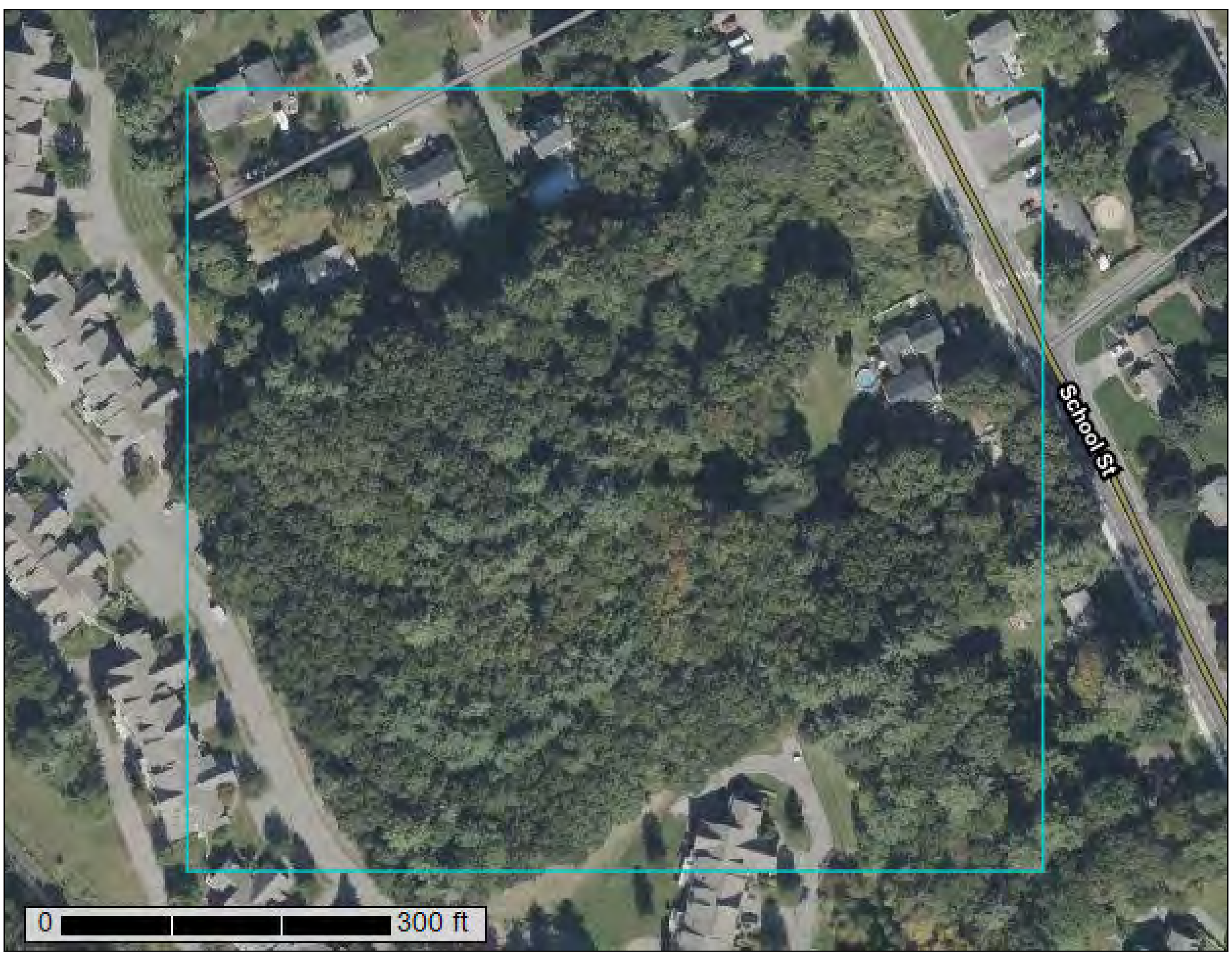
NRCS

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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# 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.

# Soil Map


Map Scale: 1:1,830 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 25, 50, 100, 150

Feet: 0, 50, 100, 200, 300

N

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:* Recessional 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

Your Contech Team

**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.

**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 |

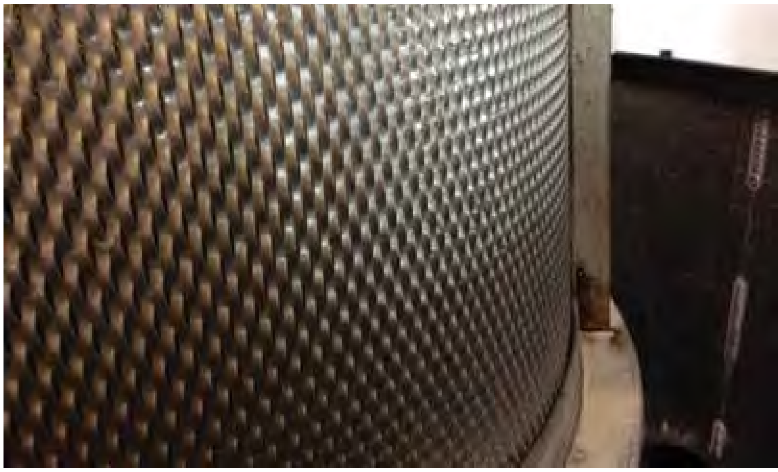
## APPLICATION TIPS

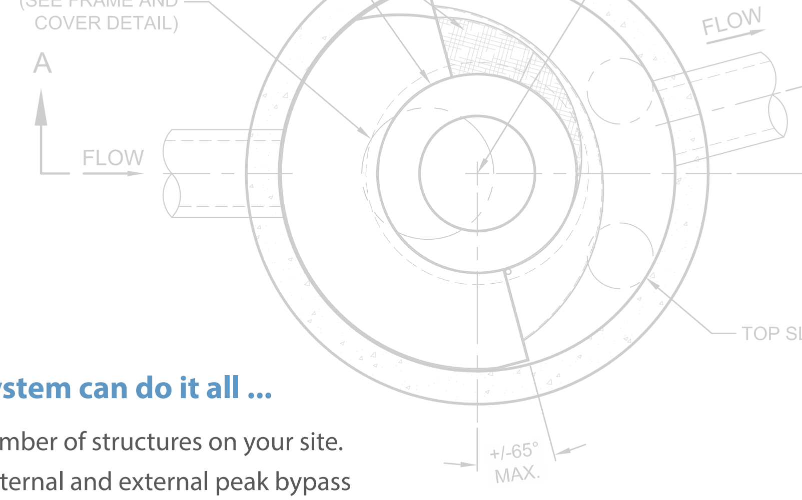
- Because of its internal peak bypass weirs, CDS systems can provide cost savings by eliminating the need for additional structures.
- Pretreating detention, infiltration, and green infrastructure practices with CDS can protect downstream structures and provide for easy maintenance.
- The CDS an ideal 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.

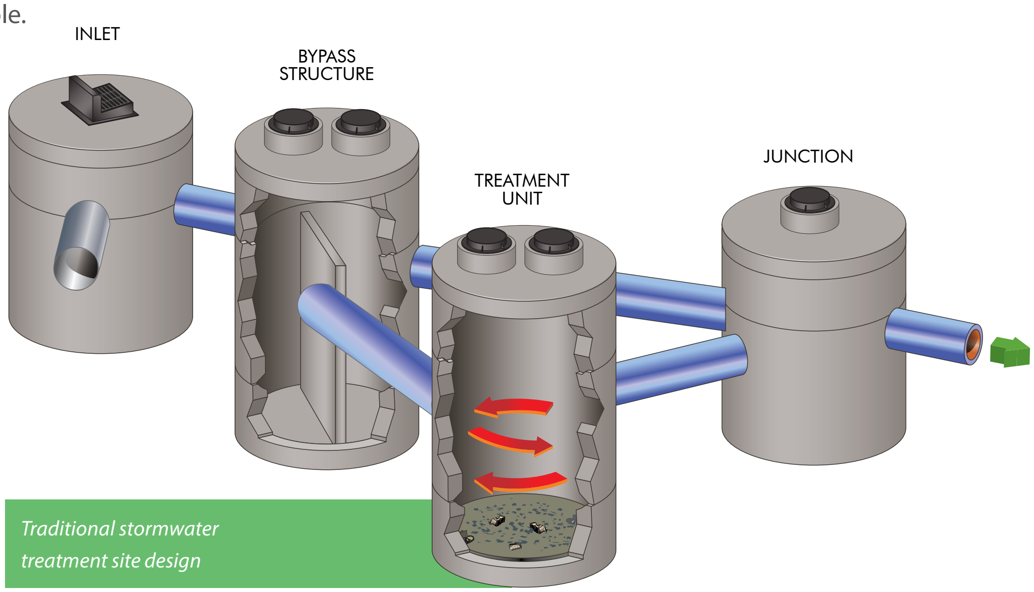





# CDS® Design Configuration

### 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.

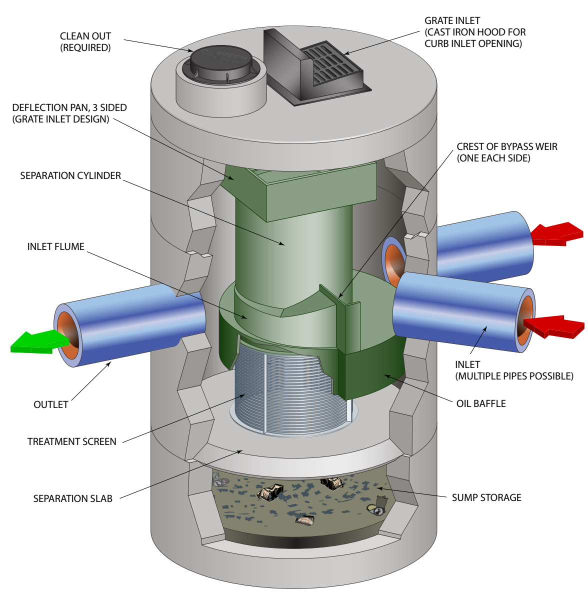



*Traditional stormwater treatment site design*

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*

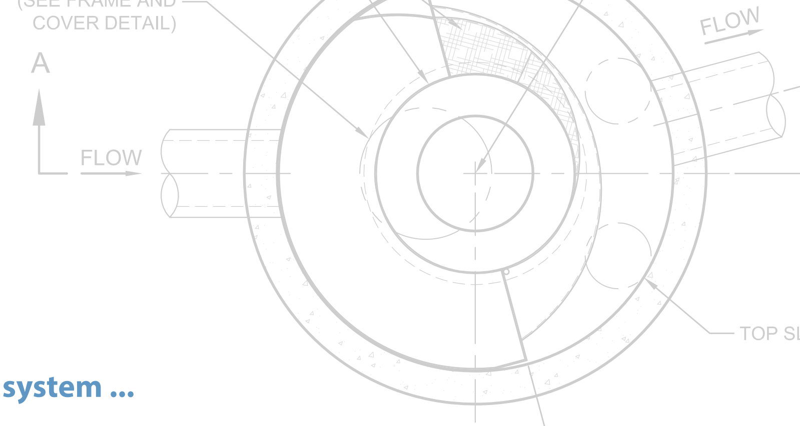
*CDS® pretreats a bioswale*

# 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.*




# 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

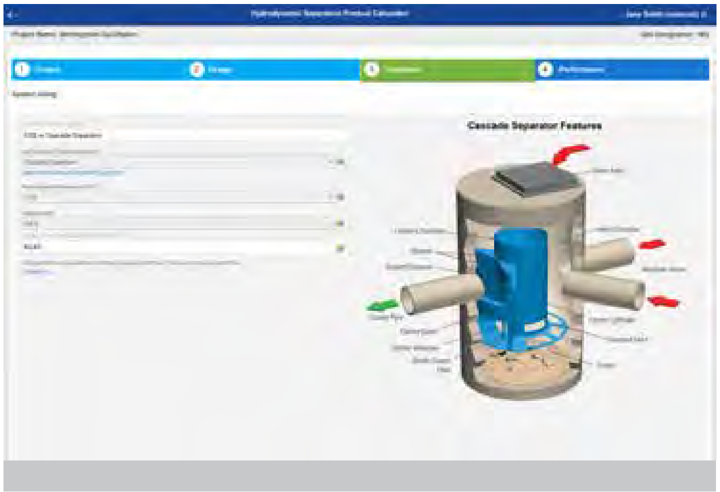
The recommended cleanout of solids within the CDS unit's sump should occur at 75% of the sump capacity. Access to the CDS unit is typically achieved through two manhole access covers – one allows inspection and cleanout of the separation chamber and sump, and another allows inspection and cleanout of 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.

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# 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.

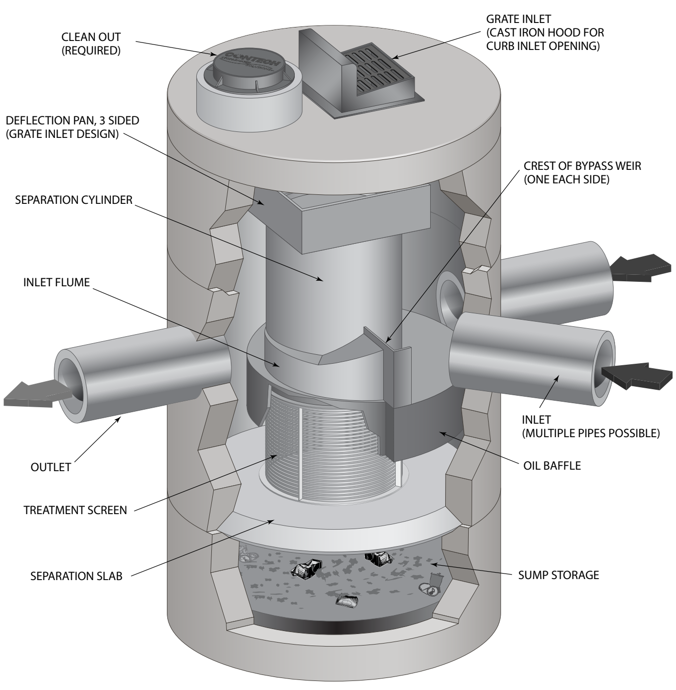
# Operation Overview

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 ($\mu$m). 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 ($\mu$m) or 50 microns ($\mu$m).

### 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 $\mu$m) 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 $\mu$m) (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.

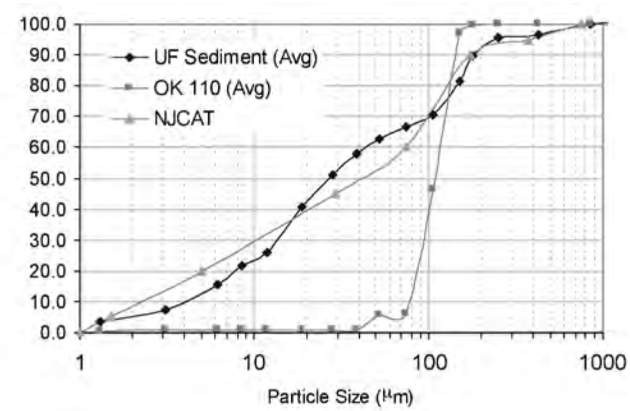



Figure 1. Particle size distributions

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.

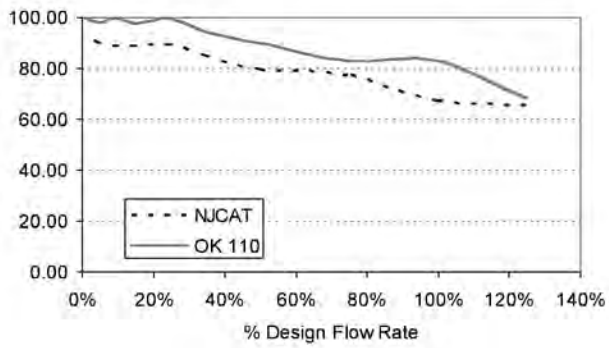



Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

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 $\mu$m).

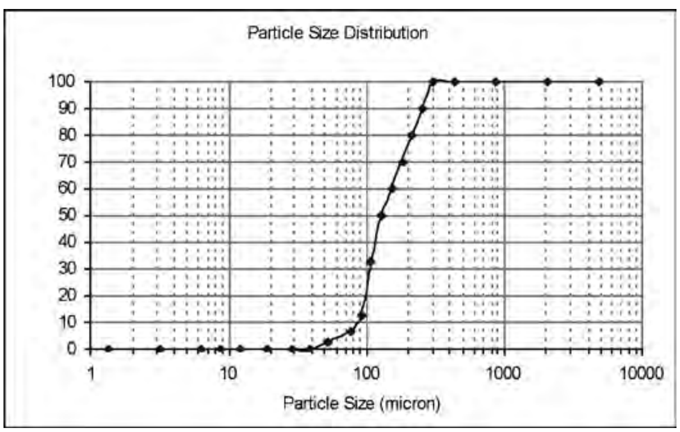



Figure 3. WASDOE PSD

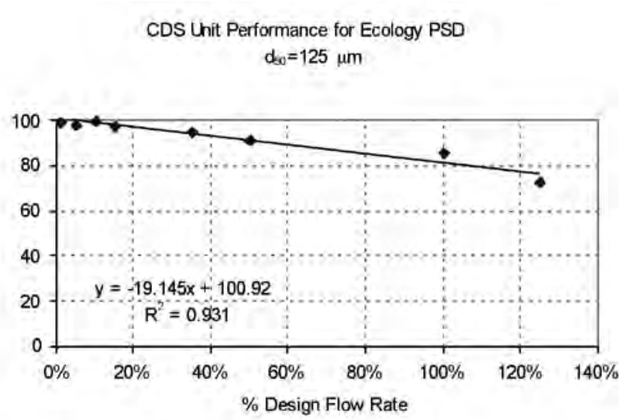



Figure 4. Modeled performance for WASDOE PSD.

## 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.

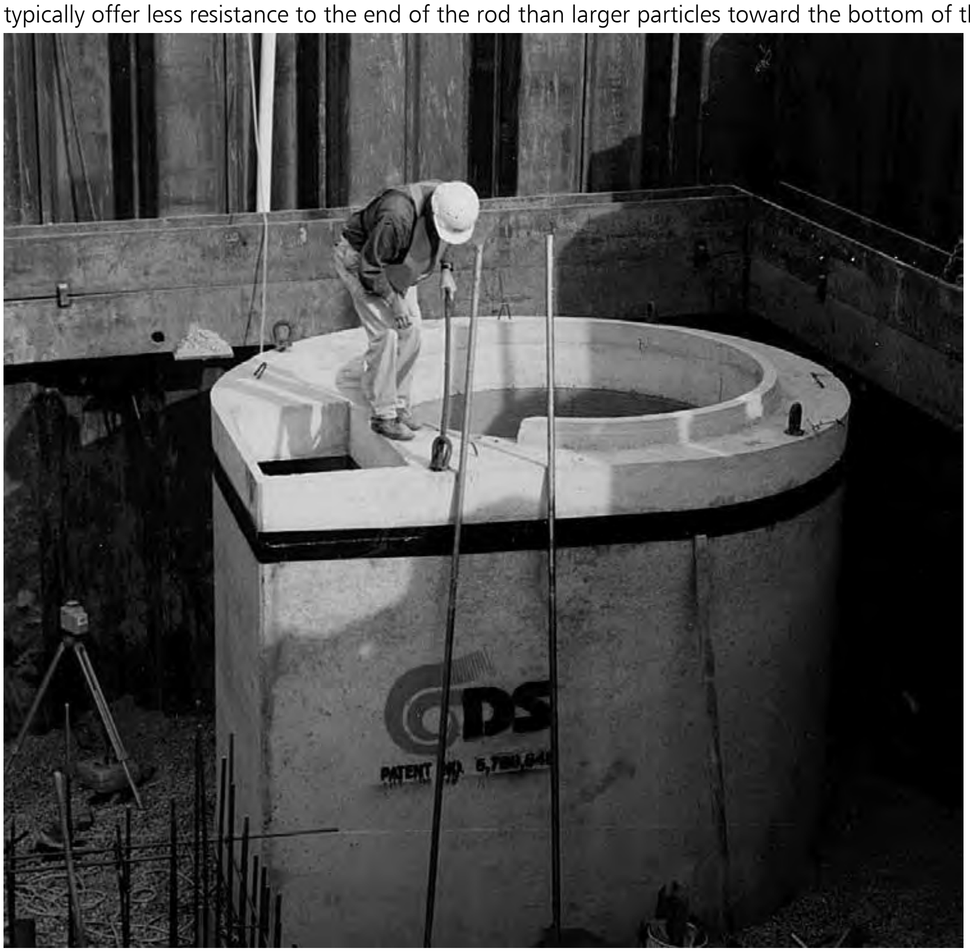
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should 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 |
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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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cds_manual 3/17 PDF

RECYCLED PAPER

# 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)

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Rebecca Oldham
Town Administrator & Town Planner
Town of Groveland
183 Main Street
Groveland, MA 01834

September 24, 2024

Re: Peer Review #1
Definitive Subdivision: 181R School Street

Dear Ms. Oldham:

On behalf of the Town of Groveland, TEC, Inc. reviewed documents as part of the civil engineering peer review for the proposed site plan to be located at 181R School Street in Groveland Massachusetts. The Morin Cameron Group, Inc. has submitted the following documents which were reviewed by TEC for conformance with the Town of Groveland Zoning Bylaw, Subdivision Regulations, Groveland Stormwater Management and Land Disturbance Regulations, Massachusetts Stormwater Standards, industry standards and best management practices:

- *Definitive Subdivision Plans of 181R School Street, Groveland, MA*; Prepared by The Morin Cameron Group, Inc.; dated July 31,2024
- *Technical Report for 181R School Street, Groveland, MA*; Prepared by The Morin Cameron Group, Inc.; dated July 31,2024
- *Application for Approval of a Definitive Subdivision Plan: 181R School Street*; Prepared by The Morin Cameron Group, Inc.; dated August 1, 2024

Upon review of the documents and plans, TEC has compiled the following comments for the Board's consideration:

**Zoning Bylaw**

1. **50.8.2 –** The lot regularity calculations provided on Sheet C-3 do not include Parcel A. Parcel A should be added to this table. Considering Parcel A is detailed as a non-buildable lot, the applicant should specify the intended owner of this parcel (i.e. a neighboring parcel, the Town of Groveland, etc.).

**Groveland Subdivision Regulations**

2. **70.3.4.B.6 –** The applicant should provide a list of proposed street names.

3. **70.4.3.H.5 –** The waiver requested should be modified to include the 150' distance to the intersection with Parker Road.

4. **70.4.4.B.1 –** The applicant has utilized rainfall data that differs from the table provided in the subdivision regulations. However, the applicants model represents a more conservative evaluation of each design storm event.

5. **70.4.4.B.3 –** Multiple time of concentration values provided within the technical report do not comply with the minimum of 10 minutes specified within the subdivision regulations. The applicant should revise their calculations accordingly.

6. **70.4.4.B.4.A –** The pipe sizing calculations provided had multiple values that did not match the proposed design (i.e. pipe slope, rim elevations, etc.). The applicant should revise the calculations appropriately.

7. **70.4.5.A.6 –** Quantity and velocity proposed sewage flow have not been provided. A hydraulic gradient and the energy gradient for each run of pipe should also be provided for the proposed sewage pump system.

8. **70.4.7.C –** No proposed street lighting or lighting plan has been provided with this submission. TEC refers to the Planning Board to determine whether proposed street lighting is necessary with this subdivision.

9. **70.4.9 –** The applicant has requested a waiver to use pervious bituminous concrete. Additional maintenance would likely be needed to maintain the pervious bituminous concrete's functionality compared to impervious sidewalks. Specific maintenance practices for these sidewalks' sections should be included. TEC refers to the Planning Board to determine whether pervious bituminous concrete sidewalks are acceptable for use.

10. **70.4.12 –** A detail of the proposed street sign should be provided.

11. **70.4.14 –** Twenty-six street trees have been displayed as part of the proposed submission. A registered landscape architect should provide a proposed landscape plan as part of this submission. The type of each tree proposed should also be detailed.

## <u>Groveland Stormwater Management and Land Disturbance Regulations</u>

12. **14.10.C.14 –** Estimated seasonal high groundwater table (ESHGWT) elevations are provided for multiple test pits referenced within the technical report. No ESHGWT elevations are provided for the test pits within the limits of Infiltration Basin 4P, Rain Garden 5P, or Rain Garden 6P. The test pits surrounding Rain Garden 5P and 6P detail similar results or an ESHGWT greater than 2' below the bottom of the garden(s). However, Infiltration Basin P4 shows a test pit (24-13) down to two feet below bottom of proposed basin and no groundwater table noted. This could be due to the high elevation point within the existing conditions. Bedrock could exist at a higher elevation which could potentially divert water away from the test pit (24-13) location. According to surrounding test pits (24-9, 24-12, and 24-14), the seasonal high groundwater could potentially be higher than 2 feet below the bottom of the proposed basin after excavation.

13. **14.10.C.16 –** The proposed drainage area of leading to DP-1 does not appear accurate given the proposed grading and roadway layout seen on sheets C-6 and C-7. The applicant should revise their plans and associated calculations accordingly.

14. **14.10.C.19 –** Multiple drainage structures appear to have errors present with their current design:

    a. The overflow control structure for Basin P4 (OCS-4) appears to be intended to be installed within a roadway rather than within the limits of an infiltration basin. The proposed manhole rim would be difficult to access from the rim of the basin. The 12" inlet pipe also is not clearly displayed on the site plans.
    b. The beehive grate for infiltration basin 1 (OCS-1) references a pipe invert of 98.00 to DMH-1 while the top of the grate is set at 92.90. Along with this, the same detail references a 910-year storm. The applicant should revise these values accordingly.
    c. On Sheet C-6, The bottom contour (elevation 97) appears to be missing from rain garden P5.
    d. On Sheet C-7, there is no label detailing the prosed rim or invert elevation(s) for proposed catch basin 2 (CB-2).
    e. On Sheet C-7, water quality unit 2 (WQU-2) appears to have pipe inverts leaving the structure that are higher than the inverts in.

15. **14.10.C.25 –** Phasing of the project should be detailed/displayed on the construction plans.

16. **14.11.C –** Total suspended solids (TSS) removal calculations are provided with the technical report detailing the proposed stormwater management system meeting the required 90% removal rate. However, similar calculations have not been completed for the required 60% removal rate for total phosphorus (TP). The applicant should provide these calculations in line with their current stormwater management system.

## <u>Stormwater Management Review</u>

17. Infiltration basin P1 is approximately 16' away from Dwelling #1A. Volume 2 Chapter 2 of the Massachusetts Stormwater Handbook states that a building needs to be 100' away from an infiltration basin upslope of that building. Dwelling 1 has basement, garage, and T.O.F. elevations set below or within the depth range of Basin P1. Dwelling's 2, 3, 4, and 5 have similar conditions present with their surrounding infiltration basin(s) and rain garden(s). This design could lead to basements, and more, being flooded within the proposed dwellings. The applicant should revise their stormwater design appropriately.

18. Given the proposed use of multiple infiltration basins and rain gardens, TEC recommends the applicant add a note detailing the following "During construction, to avoid compaction of the parent material, work from the edge of the area proposed as the location of an exfiltrating rain gardens/infiltration basin. Never direct runoff to the basin/garden until the basin/garden and the contributing drainage areas are fully stabilized." TEC Also

recommends adding a physical barrier (i.e. silt fence, compost filter tubes, etc.) around these infiltration basins/rain gardens to protect them during construction.

19. Infiltration basin P1 shows an ESHGWT (92.0') two feet above the proposed bottom of basin (90.0'). Chapter 2 Volume 2 of the Massachusetts Stormwater Handbook requires a minimum of two feet of separation between the bottom of a proposed infiltration basin and the ESHGWT.

20. TEC recommends mounding analysis to be completed for each proposed rain garden and infiltration basin.

21. For rain garden P6 shown on sheet C-6 of the site plans, the top of garden elevation is lower than the bottom of garden elevation. The applicant should revise this label accordingly.

22. On sheet C-10 of the site plans, the detail is labeled as OCS-2 instead of OCS-5.

**Site Plan Review - General**

23. TEC recommends the applicant coordinate their design with the Groveland Water and Sewer Department to ensure the proposed injector pump system is an acceptable sewage disposal system. The applicant should also specify who is responsible for the maintenance of the system components (i.e. pumps, piping, manholes, etc.).

24. No rim elevation is provided for SMH-1.

25. Pipe sizing and proposed material type should be provided for the proposed sewer connection from Lot 6.

26. Two utility conflicts can be observed on Sheet C-7:

    a. SMH-3 appears to be in the middle of the proposed drainage line connection, between Rain Garden P5 and DMH-1.
    b. The forced main connection between SMH-4 and the Lot 2 dwelling appears to conflict with the drainage line between DMH-2 and WQU-2.

27. Locations of proposed silt sacks in existing and proposed catch basins should be detailed on the plans provided.

28. TEC recommends specifying a maximum slope of 3H:1V on the temporary soil stockpile detail.

29. TEC recommends adding the title of Sheet C-3 to the title block for clarity.

30. Multiple drainage easements are detailed on the provided plans. Additional drainage easements may be needed for Basins P2, P5, and P6 given their connections to the central drainage line leading to the bottom of the existing hill.

31. At the front of each proposed dwelling (except for the eastern most unit in lot 6), there are no apparent walkways/paths to the front and/or rear doors of each unit.

32. There are no proposed gas line connections or gas shutoff valves to each proposed dwelling. TEC recommends these connections be added to avoid potential conflicts.

33. The proposed intersection between School Street and the proposed road appears to afford sight lines that meet or exceed industry requirements. The eight proposed lots are not anticipated to generate sufficient traffic to warrant a project-specific traffic study because the impacts at the adjacent key municipal intersections are not likely going to be measurable or noticeable.

34. The Applicant should explore the feasibility of an emergency access connection near the end of the cul de sac that can be considered within an easement between two of the proposed lots. This will require coordination with one of the abutting property owners to evaluate if a connection is possible and an easement for emergency access can be reasonably obtained.

## Massachusetts Stormwater Standards

1) Standard 1 (Untreated discharges): *No new stormwater conveyance may discharge untreated stormwater directly to or cause erosion in wetlands or water of the Commonwealth.*

**The standard has been met.**

2) Standard 2 (Peak rate control and flood prevention): *Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for land subject to coastal storm flowage.*

**Multiple stormwater BMP’s require adjustment/redesign. Refer to the comments above.**

3) Standard 3 (Recharge to Ground water): *Loss of annual recharge to ground water shall be eliminated or minimized through the use of infiltration measures, including environmentally sensitive site design, low impact development techniques, 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 the 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’s Stormwater Handbook.*

**Based on the findings mentioned above regarding the proposed infiltration basins and rain gardens, the applicant should revise their proposed recharge calculations appropriately.**

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

**Based on the comments in the sections above, the applicant should revise their TSS removal calculations appropriately.**

5) Standard 5 (Higher Potential Pollutant Loads): *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 has been met.**

6) Standard 6 (Critical Areas): *Stormwater discharges to a Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or any other critical area require the use of the specific source control and pollution prevention measures and the specific stormwater best management practices determined by the Department to be suitable for managing discharges to such area, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters or Special Resource Waters shall be set back from the receiving water and receive the highest and best practical method of treatment. A "stormwater discharge," as defined in 314 CMR 3.04(2)(a)1. or (b), to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to Zone I or Zone A are prohibited unless essential to the operation of the public water supply.*

**This standard is not applicable.**

7) Standard 7 (Redevelopment): *A redevelopment project is required to meet Standards 1-6 only to the maximum extent practicable. Remaining standards shall be met, and the project shall improve existing conditions.*

**This standard is not applicable.**

8) Standard 8 (Erosion, Sediment Control): *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), must be developed, and implemented.*

**See comments 18, 27, and 28 above. The applicant should revise their plans appropriately.**

9) Standard 9 (Operation and Maintenance): *A long-term operation and maintenance plan must be developed and implemented to ensure that stormwater management systems function as designed.*

**See comments 9 and 30 above. The applicant should revise their plans appropriately.**

10) Standard 10 (Illicit Discharges): *All illicit discharges to the stormwater management system are prohibited.*

***This standard has been met.***

Please do not hesitate to contact me directly if you have any questions concerning our comments at 978-794-1792.Thank you for your consideration.

Sincerely,
TEC, Inc.
*"**T**he **E**ngineering **C**orporation"*

Peter Ellison, PE
Director of Strategic Land Planning

282 Merrimack Street, 2nd Floor
Lawrence, MA 01843
978.794.1792
TheEngineeringCorp.com
Create | Design | Innovate

# FIELD REPORT

| | |
|---|---|
| Project | Groveland Auto – Vault Review |
| Location | 929 Salem Street, Groveland, MA 01834 |
| Project No. | T0845.15 |
| Client | Town of Groveland |
| Contractor | ERA Equipment |
| TEC PM | Peter Ellison |

| Date | Time In | Time Out |
|---|---|---|
| 08/15/2024 | 11:55 AM | 12:15 PM |

| Day | S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☒ | ☐ | ☐ |

| Temp | To 0 | 0 - 32 | 32 - 50 | 50 - 75 | 75 + |
|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☒ |

| Weather: | Cloudy | Report No. 6 |
|---|---|---|

## Construction Activities

TEC conducted a site visit on Thursday, August 15, 2024, to observe construction activities at 929 Salem Street and to assess the site for compliance with general industry standards.

As noted in the prior field report, the proposed gas tanks were observed to be in place within the proposed concrete vault. Rebar sections and a rubber gasket continue to be observed in place around the top rim of the foundation.

Steel I-beams were observed in place within the “cap” portion of the vault. Multiple sections of I-beams have yet to be installed. The installed sections of I-beams were observed to be installed per the approved plan set.

The area around the proposed vault remains backfilled. A construction fence was noted around a majority of the vault, with an opening present near a parked excavator south of the vault.

Stockpiles of rebar and used wood forms were observed near the southwest corner of the existing parking lot, adjacent to the concrete vault.

Approximately 3” of water were observed partially pooled within the interior of both portions of the vault (west and east).

Erosion controls in place along the western and southern portions of the site continue to be observed sagging in place.

See attached photos for additional details.

TEC Field Representatives: William Burnham, E.I.T.


**Figure 1 –** Status of eastern vault section, installed I-beams, and construction fencing. Photo taken facing southwest.

**Figure 2 –** Status of western vault section. Water build-up was observed within the vault. Photo taken facing northeast.

**Figure 3 –** Status of the stockpiles near the southwest corner of the site. Photo taken facing north.

**Figure 4 –** Sagging silt fence located near the southwestern site limit. Photo taken facing southwest.

# 181R School Street Subdivision – Department Comments

## Economic Development, Planning & Conservation Department

1. What is the approximate size of land to be cleared?
2. Are the rain gardens to remain private? How will it be ensured they remain maintained?
3. What is the plan with Parcel A? The Town has had issues with small parcels like this not being maintained/going into tax title/etc. Can it be offered to 181 School St?

- Rebecca Oldham, Town Administrator & Town Planner, Annie Schindler, Executive Coordinator

## Police Department

"I have reviewed the plans. I don't have any concerns with the roadway, it appears there is a good line of sight on School St. at the egress. If possible, I would suggest a street light at the entrance of School St. at the entrance to the new development. I would ask that the roadway accommodate emergency vehicles being able to maneuver and turn around but I am sure the Fire Chief will address this. The only other thing I thought of was having a sidewalk connected to the School St. sidewalk but I see they have that in the plans so I would like to see that happen."

- Chief Jeffrey Gillen

## Fire Department

"This development will need two fire hydrants, in accordance with NFPA, residential zones require a hydrant every 500 feet, if memory serves me this road exceeds 500 feet. The hydrant locations will be at beginning of the road and at the top of the cul-de-sac. Each home will need fire detection in accordance with Massachusetts General law 148, 527 CMR 1 of the fire codes and any applicable NFPA codes adopted or referenced by the Commonwealth of Massachusetts."

- Chief Robert Valentine

## Groveland Municipal Light Department

1. GMLD has just upgraded the distribution system in front of the subject area. There will be no issue with supplying the project.

2. We will need CAD and PDF copies of the proposed layout of houses and other utilities. GMLD will send these to our engineering firm, GML Utility Services, to design the layout of the electrical distribution system. The developer will be responsible for reimbursement of this cost.

3. GMLD will need the anticipated loading for each unit so we can properly size transformers and conductors.

4. Conduit will be installed by the developer at their expense and will meet the design requirements of GMLD's URD Specifications Packet. Conduit installations need to be inspected by GMLD before backfilling.

5. GMLD will install all primary conductors and connections, transformers, secondary handholes and connections, and streetlights. Developer will be responsible for reimbursement of installation to GMLD.
6. GMLD currently has all the stock on-hand for development, though stock levels can vary. Transformer lead times, if more are needed to be ordered, are approximately 1 year.
7. Upon acceptance of the road, developer will convey all easements for the installed electrical system to the Groveland Municipal Light Department. At that time the system will become the property of GMLD.
8. Metering will be either by meter pedestal, or on the home in a location determined by GMLD Staff. If the location is not approved, GMLD will reject the installation.

- Kevin Snow, General Manager & Kirk Blaisdell, Foreman

## Inspectional Services

"No zoning issues but the "parcel A" should be dealt with. Possibly give a waiver and attach to the closest parcel so it doesn't end up being an abandoned sliver of land."

- Sam Joslin, Building Inspector & Zoning Enforcement Officer

## Conservation Commission

"The Commission has no comment on the project other than that we previously ruled that the property is not within our jurisdiction. Please see the attached Determination of Applicability."

- Michael Dempsey, Conservation Commission Chair

## Water & Sewer Department

"I have requested a peer review proposal from our engineers.

My only comments now would be to let them know that they will be required to follow our regulations, and they will be required to come in front of the Water and Sewer Board if they are approved at the Planning Board"

- Colin Stokes, Water & Sewer Superintendent

## Assessing Department

"I have no comments on the actual project itself. I do feel however that any new growth in the community will be beneficial to the town's revenue."

- Julie Yebba, Assessing Manager

# 181R School Street Subdivision – Department Comments

## Board of Health

“After reviewing the information provided, it does not appear the this project will be within the jurisdiction of the Board of Health.”

- Rosemary Decie, RS, Health Agent

## Select Board

“During the Select Board meeting on Monday, September 16, 2024, several concerns were raised regarding the proposed development at 181R School Street:

1. The development does not align with the community's characteristics. It is overdeveloped.
2. The site distance from the road to the existing side streets is inadequate.
3. The use of individual ejector pumps for the sewer system is not preferred.
4. The town does not have the resources to maintain porous sidewalks.
5. Sidewalks should be on both sides.”

- Shared by Rebecca Oldham

## Annie Schindler

**From:** Mary Lou Costello <mlcostel@comcast.net>
**Sent:** Tuesday, September 10, 2024 6:00 PM
**To:** TownPlanner
**Subject:** 181R School Street

Hello,
My name is Mary Lou Costello. I live at 604 Alyssa Drive, Groveland MA 01834.
Building 6 in Whitestone Village directly abuts this proposed development.
The land behind building 6, directly abutting the subdivision, is already extremely wet, so much so, that we lost two mature trees this past year. There is a variety of wildlife which currently inhabit that property.
What is the plan for the trees which could/ should visually screen the proposed development from Whitestone Village? It doesn't seem apparent in the plans.
I will attend your meeting this evening via Zoom.
Regards,
Mary Lou Costello
978-469-0656

I just looked at the revised subdivision plans Sent from my iPad

**Annie Schindler**

---

**From:** cynthia leonardi <cjleonardi@comcast.net>
**Sent:** Tuesday, September 24, 2024 10:52 AM
**To:** Annie Schindler
**Subject:** Proposed Development 181R School Street

TO: Groveland Planning Board
Groveland Town Hall

SUBJECT: Proposed Development 181R School St

Gentlemen:

Having attended the Planning Board meeting of Sept 10, 2024, we would like to offer observations and comments.

As background, we have been residents of Groveland and WhiteStone Village since 2005. We have been subject to statutes and amendments by the town. For example, a "no salt zone" during snow removal and restrictions on the use of Georgia Street. Making a public street such as Georgia Street a one way for WhiteStone Village residents only.

At the 9/10/24 meeting we were presented with preliminary developers plans and were struck with what appeared to be a density of housing in the development lot and the potential for individual lot buyers to hire contractors for <u>each</u> lot.

We believe this offered the problem of lot development in ways that might be deleterious, for one, to the overall integrity of boundaries, lot lines, and setbacks.

Question: Is it possible to bid out and <u>confirm</u> the construction to one builder for the total number of homes?

Question: What are the specific plans for rainwater mitigation and assurances that retention ponds will work to prevent water runoff to Whitestone Village? Living at the base of the backside of the development, we are concerned about run off onto our properties.

Question: Will there be fencing or some other mechanism to define land boundary and provide security onto WhiteStone Village Private Property?

Thank you for your consideration.

David and Cynthia Leonardi
703 Alyssa Drive
Groveland, MA

## Annie Schindler


| | |
|---|---|
| **From:** | Jessica Massero <jessicamassero@danvers.org> |
| **Sent:** | Wednesday, September 11, 2024 1:11 PM |
| **To:** | Annie Schindler |
| **Subject:** | 181R School Street |
| **Attachments:** | Massero Pool.heic |


Hi Annie,

Following up from last night's planning board meeting.
Please share this letter and photos with the Planning Board regarding 181R School Street.
The attached photo is what happens with a heavy rain, the water comes through the retaining wall on the left hand side and floods the yard/pool.

Please forward my contact information to the board and to the developer, they requested to visit on site and see firsthand some of the concerns. We are home most days from 4:00 on.


Jessica Massero
4 Anne Street, Groveland
(978) 790-7677


Dear Members of the Planning Board,

Thank you for the opportunity to speak tonight. I stand before you not just as a concerned resident but as someone deeply invested in the character and future of our beloved town, Groveland. 5 Years ago my husband and I carefully chose Groveland for its unique blend of greenery, space, and tranquility—qualities that are becoming increasingly rare as other towns give way to rampant overdevelopment.

The proposal before you to cram eight housing units onto this lot is not only alarming but also a direct threat to the very fabric of our community. This is a small, tightly-knit neighborhood characterized by single-family homes that sit on MODEST, well-maintained lots. The idea of squeezing eight units into this acreage is utterly out of step with the character of our neighborhood. This isn't just about adding a few new homes; THE scale of this development is simply out of character with our neighborhood.

It goes beyond just talking about more traffic or a few extra cars on the road; we're talking about fundamentally altering the nature of our neighborhood. The charm of Groveland lies in its open spaces, the privacy that each of us enjoys, and the sense of peace that comes from living in a community that values these attributes. This development would not only disrupt that balance but will directly damage it.

Let's not forget the environmental impact - to the area and to individual homeowners. Many of us have already invested in expensive drainage management systems to combat the existing water issues on our properties. Despite the developers' assurances, adding more impermeable surfaces—roads, driveways, and sidewalks—will only worsen the flooding issues we're already grappling with. The stormwater management plan may meet regulatory requirements, but it does nothing to alleviate our very real concerns about the potential for increased water damage to our homes.

Furthermore, the need for waivers—whether it's reducing the intersection distance or using permeable pavement—signals that this development is being forced into a space that simply cannot handle associated values and sizing and goes against the spirit of what Groveland represents. This is more of a compromise of our town's values for the profit of a developer.

In closing, this proposal represents a clear departure from what Groveland stands for. It prioritizes density over quality of life, short-term gain over long-term sustainability. I urge you to reject this development, not just for the sake of the current residents, but for the future of Groveland as the peaceful, spacious, and green community where our young families can thrive and grow.

Thank you.
Jessica Massero

Jessica Massero
Reading Specialist
Great Oak Elementary
Danvers Public Schools
x4109

## Annie Schindler

**From:** coachdsoini@aol.com
**Sent:** Monday, September 9, 2024 7:03 AM
**To:** Annie Schindler
**Subject:** Re: 181r school Street sub division

Hi Annie, not sure i will get to talk so hoping i can get this letter in to the planning board.

Dear Planning Board Members
My name is Don Soini and i live at 608 Alyssa Drive (also known as 608 Dianne Circle). I moved from Georgetown to Groveland's 55+ community because of its country setting. Unfortunately the zoning board has let me and the resident of White Stone Village down. Wild turkeys and deer will probably be no more. So we are now hoping that the planning board will minimize the impact this development will have on us and all concerned residents. I believe you have the power to increase set backs maintaining the privacy White Stone Village thought they had or at least keeping the developers from cutting down trees from 25 to 50 feet from the boarder. And/or maybe even planting 15 to 20 foot high ever green trees to help with noise. We have noise regulations which won't make sense with neighbors, (lawn mowers, leaf blowers, etc). All of which will be there right but can be minimized. Another bigger concern is drainage, there appears to already be some problems now that don't need to be increased. It is there engineers that are drawing up the plans and it is all about money. So you know they are only doing what they have to, so would it not make sense to have the town hire someone at there expense to review these plans. It will only avoid possible future problems that will and should become town problems for allowing this development. Finaly i would just like to say that the residents of White Stone Village pay taxes and a good part of that money probably goes to schools and I am sure we don't have children in those schools. So maybe you can go the extra mile looking out for us and the other concerned residents. Thank you for your time and appreciate all you do for our town.

Thank You
Don Soini

On Thursday, September 5, 2024 at 01:04:15 PM EDT, Annie Schindler <aschindler@grovelandma.com> wrote:

Hi Don,

Thank you for your email. I will share it with the Planning Board.

Best,

Annie Schindler
Executive Coordinator
Town of Groveland | 978.556.7205



-----Original Message-----
From: coachdsoini (null) <coachdsoini@aol.com>
Sent: Thursday, September 5, 2024 1:02 PM
To: Annie Schindler <ASchindler@Grovelandma.com>
Subject: 181r school Street sub division

Hi my name is Don Soini and I live at 608 Alyssa Drive ( also known as 608 Dianne Circle) and I am concerned on the effects this subdivision will have on the community. This is a 55+ community and I believe noise, wildlife and drainage will all be impacted. Many of us who moved here was because of the quiet and peaceful setting. I hope this will all be considered.
Thanks
Don Soini
Sent from my iPhone

## Annie Schindler

**From:** coachdsoini@aol.com
**Sent:** Monday, September 16, 2024 7:38 AM
**To:** Annie Schindler
**Subject:** Re: 181r school Street subdivision

Hi Annie,
Had to leave meeting early because of debate but going to take the board members up on writing a letter of my concerns. If you could also let me know when next meeting is I would appreciate it.
Thanks

Dear Planning Board Members
My name is Don Soini and I live at 608 Alyssa Drive (also known as 608 Dianne Circle). We are the building on their plan as 305 Dianne Circle and I believe we will be the most impacted by this sub-division. After attending this meeting I have many concerns and will try to keep it brief, but I am concerned of what this will do to my property value and many of the White Stone Village properties. If this subdivision is allowed our living conditions of the sounds and sights of gobbling turkeys and deer will change to houses and sounds of lawn mowers, leaf blowers, snow blowers, and who knows what. I am thinking White Stone Village would not of built so close to the lot line had they known this land could be considered for development. When asked how far buildings would be from lot lines their engineer could not answers. As stated by their engineer they are not going to be the ones building the homes. All they want to do is make lots and get out of there and leave the headaches to whoever buys the lots. Headaches like how close to the buffer area can they build, where is the roof runoff going and how will that effect drainage can they have patios, pools, etc. Bigger houses will have greater amounts of roof runoff. I'm not sure how they can even draw up accurate drainage plans without knowing all this.
They say all drainage will stay on sight, maybe for first year. All Infiltration Basin and Rain Gardens will require some type of maintenance. Leaves will create liners at the bottom of the basins allowing them to fill faster. The basin will naturally fill with leaves and sticks and in some cases homeowners looking to get rid of grass clippings. Buffer areas will slowly be cleared by homeowners looking to create more area for their children to play or cleared naturally by children just playing in them. Who is going to be responsible for the maintenance and keeping buffer areas natural. All this is crucial to White Stone Village from flooding.
White Stone Village is a quite community who takes care of itself, we have our own trash pickup and plow our own streets. We contribute to the town whenever we can and are now asking the town to minimize the impact this subdivision if allowed will have on us. Maybe by paying for White Stone to plant 15+ foot high Evergreen Trees along the entire lot line for privacy and noise, increasing the buffer area to 50 feet (25 feet in the fall/winter doesn't create much privacy) and fencing in the buffer area from the homeowners side to keep it from being disturbed. And all this still can't create what we have but would help and possibly minimize any future drainage issues.
I thank you for your time and realize this is a lot but hope you will take the time to review.

Thanks
Don Soini

On Tuesday, September 10, 2024 at 11:06:33 AM EDT, Annie Schindler <aschindler@grovelandma.com> wrote:

> Hi Don,

The meeting packet for this evenings meeting went out to the Board last week, so this most recent email was not included. Your email dated September 5th was included. I have forwarded it to the Chair and will make copies for the meeting but the Board will not have had time to review it. It will be in the meeting packet for their next meeting.

Please let me know if you have any questions.

Best,

Annie Schindler

Executive Coordinator

Town of Groveland | 978.556.7205

*The Secretary of the Commonwealth's Office has determined that most e-mails to and from municipal offices and officials are public records. Consequently, confidentiality should not be expected.*

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**From:** coachdsoini@aol.com <coachdsoini@aol.com>
**Sent:** Monday, September 9, 2024 7:03 AM
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Stone Village pay taxes and a good part of that money probably goes to schools and I am sure we don't have children in those schools. So maybe you can go the extra mile looking out for us and the other concerned residents. Thank you for your time and appreciate all you do for our town.

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Executive Coordinator
Town of Groveland | 978.556.7205



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Thanks
Don Soini
Sent from my iPhone

## Annie Schindler

**From:** Joe Szczechowicz <joe@sls-landscapes.com>
**Sent:** Tuesday, September 10, 2024 9:41 AM
**To:** TownPlanner
**Subject:** 181R School Street

To Groveland Planning Board,

My wife and I reside at 1103 Alyssa Drive in Groveland, MA. I will be attending the meeting this evening and I was assuming there would be time allotted for a Q&A period but that may not be the case, so I have a few concerns. I was able to view the plans of the proposed project and even though I couldn't attend the last meeting it looks like considerable effort was taken to address the drainage of water on this property and the existing soil conditions are favorable for good percolation.

1) With the increase of the intensities and regularity of severe storms in recent years I question the ability of the storm water drainage plans will prevent runoff from a '100 year storm' onto the property of White stone Village. We already are experiencing excessive water drainage behind Building Six in our development and have hired a company to improve our drainage. Is there a guarantee that there will not be an increase of water onto our property? If not, who would be liable for property damage caused by excess water? If there is an increase in water draining on our property in the winter months that would potentially cause unsafe conditions for a 55 years of age community.
2) The use of permeable berms and driveways will mitigate the amount of surface water but there is only a percentage of water that percolates through those permeable surfaces on heavy rain events. What volume of water will the rain gardens and sediment basins be able to handle before there is an overflow that the spillway and level spreaders will be able to disperse and drain properly? Will residents be advised on the proper use of permeable surfaces, as I'm told that applications of sand will inhibit its' permeability.
3) Permeable hardscape materials have proven to be beneficial for drainage but is the Town of Groveland confident that as stewards of our land that future residents of the abutters will be satisfied with the decisions made on this project?
4) Can you define what the Proposed Tree Line on the plan represents? Will there be vegetative screening planted along most of the perimeter as shown in the plan?
5) I was not able to locate the drill holes along the stone wall. Can you help me understand where the property lines between 181R School Street and the abutters?

I am thanking you in advance for taking the time to read and answer my questions and concerns, preferably this evening but at a minimum to receive an email. I hope that the owner of the project can extent an increased effort in understanding the impact of this proposed project has on the residents of White Stone Village, thank you.

Joe Szczechowicz
1103 Alyssa Drive
Groveland, MA

Joe Szczechowicz, MCLP

President

SLS Outdoor Living
Greener Lawns
421 Newburyport Turnpike
Rowley, MA  01969
978-948-7701  ext. 107
508-726-5498  cell
Joe@SLS-landscapes.com
www.SLS-outdoorliving.com
www.greener-lawns.com

**Town of Groveland**
**Economic Development**
**Planning & Conservation Department**
***Planning Board***
183 Main Street
Groveland, MA 01834



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## COVENANT LOT RELEASE

The undersigned Chairman of the Planning Board of the Town of Groveland, Massachusetts, hereby certifies that the requirements for work on the ground called for by the Covenant, dated August 8, 1988 and recorded in the Essex South District Registry of Deeds in Book 9694, Page 536, have been completed to the satisfaction of the Planning Board as to the following enumerated lot show on the Plan entitled "Plan of Land in Groveland, MA, Prepared for Rockhill Development Corp.", recorded with said Registry of Deeds, Plan Book, 252, Plan 98, and said lot is hereby released from said Covenant.

Lot released on Plan in Plan Book 243, Plan 91, as follows: Lot 24.

Signed this 15th day of October 2024.

____________________________________

Groveland Planning Board

***Commonwealth of Massachusetts***

Essex, ss.

On this 15th day of October 2024, before me, the undersigned notary public, personally appeared the above-named, **__________________________**, proved to me through satisfactory evidence of identification, which were Personal Knowledge of Identity, to be the person whose name is signed on the attached document, and acknowledged to me that he signed it voluntarily for its stated purpose, on behalf of the Town of Groveland Planning Board.

___________________________________

Notary Public

My commission expires;

# Planning Department

## Technical Review Conference (TRC) Application

The purpose of the preliminary consultation meeting is to help applicants through the development review and permitting process by identifying regulations that apply to the project, identify site design issues that are of concern and discussion of potential solutions, identify permits that will be required and the process for obtaining them, clarifying procedures, and establishing relationships early in the process. Not only does this allow prospective applicants to discuss proposed developments and receive input prior to officially submitting permit applications but it also helps departments to find solutions that meet the needs of multiple boards and commissions further facilitating the permitting process.

In an effort to make these preliminary consultation meetings as productive as possible, it is essential that the applicant submit a preliminary plan or conceptual plan for informational purposes.

TRC meetings are held on Thursday at 10AM here in Town Hall by appointment only. It is important that either the applicant or the applicant's representative attend the TRC meeting.

Upon completion of the preliminary consultation meetings, the Town Planner will prepare a Summary Report outlining the issues discussed and identifying the permits to be obtained for the proposed project. This Report will be forwarded to the applicant and to all Issuing Authorities that have jurisdiction over one or more aspects of the project within ten (10) business days.

Please contact the Town Planner, Rebecca Oldham at ROldham@grovelandma.com or (978)556-7215 to schedule a TRC or if have any questions.

**Applicant Information**

Full Name: Nakashian (Last) Rob (First) Date: 9-25-24

Address: 787 North Shore Rd (Street Address) ____ (Apartment/Unit #)

Revere (City) Ma (State) 02151 (ZIP Code)

Phone: 617-593-9111 Email Robbierochets@AOL.com

Proposed Project Location: 102 King St, Groveland, Ma 01834 (Street Address) ____ (Apartment/Unit #)

## Project Details

Zoning District of proposed location: ______________________ Square Footage Proposed Project: ______________________

Number of Employees: ______________________ Hours of Operation: ______________________

Parking Requirements: ______________________

Is Food Preparation Required? YES ☐ NO ☒

Project Description:

Subdivision

NOTE: If you are proposing to open a business in an existing location please submit a copy of a site plan (you can obtain this from the landlord). It is not the intention of the Planning Department to have the applicant incur Architectural or Engineering expenses for submittal of a plan of land for purposes for a TRC meeting.

# 102 King Street Technical Review Conference

October 3, 2024

## Town Employees Present

Annie Schindler, Executive Coordinator (aschindler@grovelandma.com)
Rebecca Oldham, Town Administrator (roldham@grovelandma.com)
Chief Robert Valentine, Fire Chief (rvalentine@grovelandma.com)
Kevin Snow, General Manager (ksnow@grovelandlight.com)
Kirk Blaisdell, Foreman (kblaisdell@grovelandlight.com)
Arthur Markos, Program & Projects Manager (amarkos@grovelandma.com)
Ryan Allgrove, Environmental Partners/Water & Sewer Department Representative (rja@envpartners.com)

## Applicant Present

Rob Nakashian
John Nakashian
Paul Bergman
Taylor Moylan-Hajj

## Applicant Presentation

Looking to see what has changed with the regulations since the subdivision plan for Blueberry Lane was submitted in 2007.

## Water & Sewer Department

- Biggest thing that's changed is the construction of Katie Lane. For that project they extended the water line up from Center Street to the start of Katie Lane. King Street has always been an issue with elevation, so we would need to analyze the system to ensure that there would be enough fire protection. The water line may also need to be extended from where it left off in front of Katie Lane.
- We already have a flow test scheduled and will be taking place in a few weeks, then it'll take a few weeks to input the data, and will be complete by November.
- At the crest of the hill, there is about 30-35 lbs. of pressure.

## Groveland Municipal Light Department

- There are some aspects of this proposal that may be a challenge. There is a feed that goes back to 104 King Street somewhere underground, and there are two underground vaults, but we don't know where they are.
- All new roads have to be designed by our engineers at the expense of the developer.

- The wait time on transformers is two years.
- It will need to be designed as a loop feed since it is a residential neighborhood.
- If it is going to be a public street, then you'll need to think about street lighting, which is not currently on the plans.

## Economic Development Department

- Our bylaws now have a new lot shape variable, not many other changes to the Subdivision Rules & Regulations since 2007.
- Access to 104 King St – during construction you would need to ensure you keep access to the home/business.
- The road will have heavier traffic than a typical dead-end street due to the commercial nature of the horse farm in the back.
- This new road is going to be less than 100 feet away from Katie Lane, which would require a waiver.
- Stormwater will need to be updated to meet the new standards.

## Conservation Commission

- Going to have to file an ANRAD prior to filing a NOI since the delineation was so long ago.

## Highway Department

- Need to consider maintenance of rain gardens and stormwater features. Potential to make the stormwater system maintenance part of an HOA, rather than put it on the Highway Department.

## Fire Department

- Two fire hydrants at the beginning of the new street and one at the end of the cul-de-sac.
- Name of the road would have to change since there is already a street named Blueberry Hill.

**APPROVED X-X-2024**

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|---|---|
| **BOARD:** | PLANNING BOARD |
| **MEETING DATE:** | **April 23, 2024** |
| **MEETING PLACE:** | Town Hall and Zoom |
| **TIME:** | 7:00 PM |
| **MEMBERS PRESENT:** | B. Ligols, C. Goodwin, D. McNulty, J. Naves |
| **MEMBERS ABSENT:** | W.F. Sorenson Jr. |
| **GUESTS:** | Kevin Lopez (6-8 Elm Park), Rod Rivera (rep 6-8 Elm Park), Alice Twombly (91 Seven Star Rd), Peter Ellison (TEC), Ian Mackinnon (833 Salem Steet, Jones & Beach), |

*Note: Minutes are not a transcript; see the recorded meeting for verbatim information.*

*Pursuant to Chapter 20 of the Acts of 2021, "An Act Relative to Extending Certain COVID-19 Measures Adopted During the State of Emergency", extended by the Governor on March 30, 2023, which extended permission for boards and commissions to conduct remote meetings, the Planning Board conducted this meeting in a hybrid format.*

## CALL TO ORDER

**MOTION**: Goodwin motions to open the April 23, 2024, Planning Board Meeting at 7:03. McNulty seconds the motion. Voted all in favor, the motion passes unanimously in favor.

## PUBLIC HEARING

***NEW* 6-8 ELM PARK** – A public hearing in accordance with General Laws, Chapter 40A, as amended, for the application made by Rod Rivera, 97 Beach Street, Malden, for the premises located at 6-8 Elm Park Groveland, Map 10 Lot 013, located in the Business (B) Zoning District for a Special Permit for a Parking Reduction in accordance with Section 50-9.4 and Section 50-14.6 of the Groveland Zoning Bylaw due to an increase in parking for the operation of a restaurant.
Ligols: *Reads the above notice.*
Rivera: I'm going to be the manager for this restaurant. From the last meeting we've been trying to figure out the parking issues with a tenant in the back where the dumpster is, but it was too expensive for rent and insurance of the space. In the lease it does not specify how many parking spaces we are allowed to use. So, we are still asking for a parking reduction. We're looking to be able to operate with the spaces that are available now. We took pictures during the day and there weren't many people parked there and they were only there for 10 minutes.
McNulty: It looks like the existing oil dumpster is sitting right next to the dumpster. It looks like they all share on dumpster.
Ligols: The Zoning Board just issued a permit that required the dumpster to be fenced in.
Rivera: We brought in a 5-yard dumpster that will be picked up weekly, or more often depending on volume. It will be right next to the shared dumpster. The box where people can drop off clothing to donate will be removed.

McNulty: It looks like the salon has signs for reserved spots. I'm not sure if it's in their lease or not.
Goodwin: I think there's plenty of parking in Elm Square.
Ligols: I caution that abutters have concerns about people parking in their private lots. If that happens you may have a towing issue. I would like to put that on the record.
Rivera: We can put signs in the window to say where they can/can't park.
Goodwin: The restaurant can't be held liable for where they park but they aren't liable, so if they park on someone else's private property, they can be towed like anyone else.
Greaney: You have to have the right amount of parking spaces to grant a permit and open the business. They don't have enough parking on their property, you can't count the Town spaces that are around the corner, you can't really use the parking along the back side of Elm Park because it's barely wide enough for two cars, so I don't know how you're coming up with the 16 spaces they need on their property. You can't count the municipal lot up the street because it's over 500 feet away, by the Bylaw, so I don't understand how you can let them do this when every other business had to meet the requirements.
Ligols: Does your business use those 12 municipal spots?
Greaney: I personally don't, but the businesses might, but they're Town spots so anyone can use them. But you can't count it as their parking spaces. You know they need 16 to have 42 seats and 4 employees. You're either going to follow the bylaws or you're not. We've been to land court before and had things flipped around. If you follow what your rules are, you don't have this. I don't want to see them go out of business because they don't have parking. If you aren't going to follow bylaws why have them?
Ligols: Unfortunately, we have a business district that has minimal parking, so what do you do? Close the businesses down and say no more business?
Greaney: Your Place and Ours was in there years ago and they didn't have to do this.
Planner: The Bylaw does allow the Board to reduce parking so a business can open without the required amount of spots.
Goodwin: The mentality of "there isn't enough private parking down at Elm Park" that would impact every business at Elm Park that would end up telling every business to close because all the parking is public. We have a process for the special permit to decide if we want to allow the reduction of parking. I think down the road we should amend the bylaw for this area because I think that part of the bylaw is inhibiting business.
McNulty: We need to review the bylaws and make sure that this proposal meets the bylaw. We have the criteria that we have to go through. Your Place and Ours had 24 seats, and you have to have how many spots per seat?
Planner: 1 parking spot per 4 seats. Your Place and Ours, not employees, was required 6 parking spots. This restaurant was required to have 10.5. Each restaurant had 4 employees.
McNulty: They should have 11 spots, so they're asking for a reduction of how many?
Planner: They're asking for a reduction of 6, saying the spots that are in front of Family Affair count for 10 spots. The increase of spots is a net of 4 between the two restaurants.
Goodwin: So, looking at the bylaw section 9.4, "Any parking requirement set forth herein may be reduced upon the issuance of a special permit by the Planning Board if the Board finds that the reduction is not inconsistent with public health and safety, or that the reduction promotes a public benefit.
Such cases might include: Use of a common parking lot for separate uses having peak demands occurring at different times; Age or other characteristics of occupants of the facility requiring parking which reduces auto usage; Peculiarities of the use which make usual measures of demand invalid; Availability of on-street parking or parking at nearby municipally owned facilities." I think on the face of it, three of those four cases could apply, in my eyes. Use of a common parking lot, peculiarities of the use, and availability of on street parking or parking at municipal facilities.
Ligols: Section 14.6 also provides the general criteria for a Special Permit as well.

Greaney: One other point, their hours are going to overlap with the hairdresser and other two businesses in the building.
Board: We would encourage that employees park in the municipal lot.

Ligols: How many employee spots would you need?
Rivera: Two because some live in the same home and would drive together and most waiters/waitresses get dropped off.
Ligols: We aren't sure if other tenants are leased three spots.
*Discussion on dumpster location and screening.*
**MOTION**: McNulty motions to close the public hearing on 6-8 Elm Park. Goodwin seconds the motion. Voting aye; McNulty, Ligols, Goodwin, Naves. Voted unanimously in favor.
Goodwin: Looking at 50-9.4, (1) Use of a common parking lot for separate uses having peak demands occurring at different times. (2) Age or other characteristics of occupants of the facility requiring parking which reduces auto usage; I don't know if that necessarily applies here. (3) Peculiarities of the use which make usual measures of demand invalid; (4) Availability of on-street parking or parking at nearby municipally owned facilities. There is a common parking lot that addresses #1, there are multiple. #3 there are peculiar circumstances for that business in that location, and there is the availability of on street parking and a municipal lot. I think it meets three out of the four criteria that are called out in the bylaw.
Ligols: I agree.
Goodwin: According to the Elm Square Parking Study there are 147 public accessible parking spaces, and 45 restricted parking spaces. The way I look at it, the municipal parking lot covers anything the restaurant may need.
McNulty: The way I'm reading the bylaw, it meets the 9.4 criteria.
*Additional discussion on where available parking is in Elm Square.*
Naves: While there is some overlap in business hours, their peak hours wouldn't overlap the majority of the time. There was a lot of discussion about making the bylaws more friendly to invite businesses in.
Greaney: I don't want them to spend a lot of money and then have to close.
Naves: That's up to him as a businessman to pivot his business.
McNulty: Based on the data, that prime parking is at 11 AM, which is when they would just be opening and wouldn't be their big rush.
Goodwin: Now we need to look at the Section 14.6 criteria.
Ligols: Social, economic, or community needs which are served by the proposal. I would say yes. Traffic flow and safety, including parking and loading.
Goodwin: Not if people park lawfully.
Ligols: Adequacy of utilities and other public services. I would say there is no impact. Neighborhood characteristics and social structure. It was a restaurant before. Impact on the natural environment, I don't think so. Potential fiscal impact, including impact on Town services, tax base, and employment. I personally think it will be a plus.
Board: We agree.
Ligols: Consistency with the Community Development Plan and Town of Groveland Master Plan, yes.
McNulty: We should discuss conditions, a sign posted that no parking is allowed in certain areas on the business door.
Ligols: I don't think we have the right condition adding signage to other lots.
Planner: You can have a condition that would require the business to post signs in their establishment where there is legal parking and where there is not.
Goodwin: We've determined that it meets 50-9.4 and 50-14.6.
Ligols: What conditions would we want to see?
Goodwin: I like asking them to show where available parking is.
McNulty: I think it would be helpful for the employees to park in the municipal lot to not take spots away from customers.
Goodwin: Besides that, I don't really have any other conditions. But a nice map showing customers showing where parking is.
McNulty: Can we add a condition that notes if it becomes a nuisance, this can be recalled?

Planner: Yes, the following is in the permit; This Special Permit is subject to recall, given written notification to the Applicant and discussion at a public meeting, if written complaints are received from abutters.
**MOTION**: Goodwin motions to approve the application for 6-8 Elm Park for a Special Permit for a parking reduction in accordance with Section 50-9.4 and Section 50-14.6 of the Groveland Zoning Bylaw for operation of a restaurant with the contingencies of the detailed map inside the facility detailing the publicly available parking spots for their tenants, a recommendation that the staff does not park in any of the spots adjacent to the building to allow their clientele to park there, and the contingencies already listed in the draft permit done by the Town Planner. McNulty seconds the motion. Voting aye; McNulty, Ligols, Goodwin, Naves. Voted unanimously in favor.

**6-8 ELM PARK**: Minor Site Plan Review.
Planner: I only received this final application this morning. It was not in your meeting packet.
**MOTION**: Goodwin motions to table the minor site plan review for 6-8 Elm Park until May 7th. McNulty seconds the motion. Voting aye; McNulty, Ligols, Goodwin, Naves. Voted unanimously in favor.

**929-931 SALEM STREET**: Project update.
Ligols: I would like to know where TEC stands with the project. Specifically, the slab.
Ellison: The Board issued a special permit for work within the Aquifer Overlay District in 2021 with very specific conditions about the construction of these underground storage tanks. TEC was supposed to be notified q0 days before construction was supposed to begin, to inspect compaction of the subgrade, placement of any gravel, form work, placement and spacing of rebar, and be present for the pouring of the concrete. We were notified after the floor slab of the tank had already been poured. The applicants team was able to provide signed and sealed affidavits by a PE in Mass. They basically had their own team certify that the work was all done in accordance with the plan and building code. We can't sign off on something we didn't witness, but reading the affidavits that were provided, we just have to take them at their word as PEs that they're signing off on this. Since then, communication has been much better than they've been notifying us ahead of time of any work that takes place. We inspected all the rebar and form work. We also witnessed most of the pour for the walls. We'll be back on-site tomorrow morning to look at the walls after the forms have been taken off the walls. The Applicant has already performed the water tightness test, which is very important here because of the aquifer. We were told it was done by UTS, but we haven't seen the results yet. We would've liked to be there for the test, but just the results were supposed to be reviewed by us.
McNulty: Were you required to be onsite for that?
Ellison: The decision states that the test shall be conducted, and the results shall be reviewed by us. There was no requirement that we be there for it.
McNulty: Are you now getting the proper 10-day notification?
Ellison: We're past that at this point.
McNulty: As far as I'm concerned, they should be following the letter of the decision.
Ligols: Just so the Board knows, I did have a conversation with the Building Inspector, and he has been pretty fair with them. He is not happy.
Ellison: We did request a construction schedule through completion that we haven't received yet. We've been calling the contractor to try to keep up to take with where they're at.
Board: We want them to submit a construction schedule.
Goodwin: Can the Board recommend to the Building Inspector to require a construction schedule.
Ligols: I think we should let it play out the way it has been.
Goodwin: I have concerns about that, what if something gets missed?
Ligols: It will be up to the Building Inspector to cease-and-desist them. They have the walls poured and they did the water test, those are the biggest components of this. We'll know from the Fire Department and there will annual or bi-annual testing by the Fire Department.

McNulty: TEC is the Town representative, and they have to follow up with the contractor. Other Town employees have asked for a construction schedule, and we haven't received it.
Ligols: I can talk to the Building Inspector about the next steps if this continues.
Goodwin: My concern is that the people managing the construction aren't having the oversight that has been requested and they are putting the Town at risk.
Ligols: What is left for TEC to witness?
Ellison: Tomorrow we're going to insect the condition of the walls after the forms have been removed, they're going to be putting water proofing on the side of the walls, and once we get the water tightness test they will start to backfill the vault, and then they'll pour the top of the vault.
McNulty: Is there any water tightness testing done after the backfilling?
Ligols: Are they using a typical waterproofing system?
Ellison: We aren't sure about the waterproofing system.
McNulty: Right now, they are up to snuff?
Ellison: Yes, we'll just stick to the decision and make sure we're there for the major milestones. I don't think it's to a level where TEC needs to be onsite every day.
Ligols: Are you going to witness the piping?
Planner: That was not part of the decision, it was just the structural integrity of the vault. It is not within the Board's purview.
Goodwin: I just want to strongly stress to the applicant to please cooperate with the steps and TEC, and if steps are being missed I hope the Building Inspector issues a cease-and-desist, because I think zero tolerance.

**91 SEVEN STAR ROAD:** Discussion on possible common driveway proposal.
Alice Twombly: I'm looking at a potential subdivision. I have adequate frontage, 401 feet, but if I do he 150 feet for the lot it cuts across my septic system and my front porch. If I move my current driveway over to the left on the sketch, that is where all the critters go through, so I would like to avoid that. I would like to do a common driveway if possible. My current lot is 5.5 acres. I want to put in a common driveway along the property line with lot 4 to access the proposed new lot which would be about 1.6 acres.
Ligols: Is this an ANR?
Planner: No, this would be a special permit for a common drive. I was taking a look at this with the Building Inspector earlier today and when we had spoken about this before, he had been thinking of West Newbury's regulations. The way our bylaw reads, each lot needs to have frontage shown on Seven Star Rd, even if it is on a common driveway. The frontage cannot come from the common driveway.
Ligols: Do you own any of the adjacent lots?
Twombley: No those are neighbors.
Ligols: What is the frontage requirement on Seven Start Road?
Planner: 150 feet.
Ligols: Can you cut into the 401 lot?
Twombley: If I create that, it would cut across the center of my septic system. The system can't go anywhere else.
Planner: The proposed new lot line would need to be 15 feet from the edge of the home, in accordance with our bylaw.
*Board discussion on possibilities.*
Ligols: You should sit down with an engineer, they would be able to have different ideas and put a plan together for us to look at. We aren't here to create a plan for you, we aren't engineers, we can only look at a plan before us.
McNulty: There seems to be a possibility, but it's not for us to tell you at this point.

*Ligols recuses himself.*
Ligols: Can I remain seated at the table.

Planner: No, that is a conflict of interest.

**MOTION**: Goodwin motions that McNulty serves as acting chair. Naves seconds. Voting aye; McNulty, Goodwin, Naves. The motion passes.

**833 SALEM STREET:** Decision of change of plans from grass to rip rap.
Ian Mackinnon: Here from Jones & Beach and on behalf of the applicant. I'm here for a construction change that stemmed from comments from TEC. There are some areas of the site that are reflected in a document called site plan report. On page 4 you can see riprap areas on the ends of the buildings and on page 6 there is a picture showing large riprap areas. They were shown on the plans as a retaining wall potentially, and the others were showed as grassed surface. There was some concern during construction about long term maintenance. They are essentially pass through swales. On of the larger areas was slope in place of a retaining wall, instead of that there is large rip rap. It was placed early in the construction phase due to some unexpected flow from the construction site. There is still visible sediment that came from the site. It wasn't identified originally as natural flow when the plan was put in place. With some of the rains that came through, there was a pretty good stream from that area. It was just a leafed forest when we did the original survey. TEC made a comment about needing to model the riprap differently than a standard open surface. We reviewed the HydroCAD guidance documents they don't get into site specific coverage very often. They try to generalize things. My opinion is that it comes down to best engineering practice and company standards, each company does different things. In past projects I haven't models riprap slopes as anything else but open space. That is where things were left before coming to the Board and what they would like to do.
McNulty: Our vice-chair wasn't able to make it but he had a comment on this, "Should file a minor modification to the plan for the riprap, this is acceptable to the Board and a plan showing the onsite changes should be approved with no major modifications to the permit. This has always been Planning Board practice, then a temp CO can be issued by the Building Inspector."
Ellison: We identified this plan change in the field and we think it is a practical method, it looks like it was placed properly. Our opinion is that the change from grass to riprap should get captured in some type of adjustment to either the plan, the stormwater calcs, or an combination of the two. On this project, the riprap is not a substantial area, the change to the modeling is probably going to be insignificant. The things that the Board should keep an eye out for is that we don't' want to set a precedent where it's okay to change grass to rip rap without any type of modification to the calcs. This would set a precedent moving forward with other plan adjustments.
Ligols: Just so the Board knows, we did put the grass on the slope in, we did have it stabilized, due to the significant amount of rain we had last year, we lost that slope three time. It was best business practice to put that riprap up so it didn't come sliding down again. I think understandably it was a construction modification on the fly. It was a $3,000 fee every time we put that slope back together. It hasn't had a problem since the riprap went in.
McNulty: A change from grass to riprap, the plan has grass, is it okay to do that first? I sit something you're supposed to ask prior to, is it common?
Ellison: It depends on the site. If it is a concentrated area that keeps getting ruined by erosion. They probably did the right thing to immediately stabilize it with riprap.
Mackinnon: I also want to note that we worked in the existing disturbance of the plan. This wasn't a change for cost, it was a change for a structural purpose. Our HydroCAD won't change if we try to model it with our system. If the Bard asks for an upgraded one. I know TEC asked to model it differently, we didn't change the lot coverage type.
Goodwin: The riprap would have a different impact than grass would, so I think we should have modeling that shows that.
Mackinnon: If I had modeled it as riprap, it would have been modeled the same way. My question is that we didn't model riprap in the approved one, we just came down to each firm does things differently. It's a large riprap that water goes right through. I could argue that some grass could have more runoff.

Goodwin: I can see that, but I would still like to see the modeling.
Mackinnon: I'm just not sure how I would change my report because of the way my firm models it.
Naves: I want to lean towards what TEC is recommending, I think it would be very accommodating for you to model it how they're requesting.
*Discussion on modeling with HydroCAD.*
Ellison: Mackinnon can come up with the numbers between us, and I don't think it is going to be a substantial change. I think a minor modification makes sense.
Mackinnon: We're fine with that, but I'm sure we can work something out.
**MOTION**: Goodwin motions to approve the minor modification for 833 Salem Street for moving from grass to riprap with the contingency of receiving an updated plan and HydroCAD that the Town Planner can then sign off on once approved by TEC. Naves seconds the motion. Voting aye; McNulty, Goodwin, Naves. The motion passes.

**833 SALEM STREET:** Acceptance of letter deeming project compliance for Certificate of Occupancy.
Mackinnon: The first letter dated April 1st and April 23rd show site conditions. Some of the first photos you see are the infiltration basin that was put in for this project, as it has been stated before, it is a completely self-contained site. We reviewed the site conditions to make sure the structural components of the system were in. There was an underground stormwater system that was put in last fall. At this time some of the interior electrical work was being done, but the site was at subgrade, compacted gravel. This is the surface that was just paved today. Roof drains were in. In photos 9 and 10 show the riprap slope. Photo 11 shows the site at subgrade. We kept tabs on the site. I made sure the stormwater system was in. Vegetation, which TEC has also been monitoring, the grass came in well. In Report #2, the base course pavement went in today. Everything for Phase I went in today including some trees adjacent to the Phase II area. This is passed, with the traditional storage buildings being built first and the climate-controlled building being built later on. We feel it is operational as a stand alone site right now. The remaining area will just remain as a pad site. The only thing left to do on the paving front is to finish the curbing.
McNulty: Are you keeping it to binder?
Mackinnon: Right now, yes. But when the site is done it will be top coated. The binder that is down now is a nice smooth surface.
Ellison: TEC hasn't been on site yet, but the pictures look pretty good.
Goodwin: I would like TEC to sign off, contingent upon TEC approval.
Naves: I don't have any concerns.
Planner: The Board requires this letter prior to an occupancy in the decision that was issued.
Ellison: We've been out there, and the only issue is really the riprap slope.
**MOTION**: Goodwin motions to accept the letter from Jones & Bach Engineers regarding 833 Salem Street being prepped for a CO to be determined by the building inspector. Naves seconds the motion. Voting aye; McNulty, Goodwin, Naves. The motion passes.

**MINUTES:** Acceptance of January 9, 2024, and April 2, 2024, meeting minutes.
**MOTION**: Naves motions to accept the January 9, 2024, and April 2, 2024, meeting minutes. Goodwin seconds the motion. Voting aye; McNulty, Goodwin, Naves. The motion passes.

**TOWN PLANNER UPDATE**
Planner: Next Monday is Town Meeting, I would recommend that someone from the Board is present incase there are any questions about the BESS Bylaw, and that someone can say that the Board did recommend the article. The following Monday is Local Elections, there is someone running for the Planning Board vacancy. If anyone would like their stipends, please let me know.

**OTHER ITEMS NOT REASONABLE ANTICIPATED AT TIME OF POSTING**
*None.*

**<u>NEXT MEETING</u>:** May 7, 2024.

**ADJOURNMENT**

**MOTION**: Naves motions to adjourn the meeting at 9:03 PM. Goodwin seconds the motion. Voted all in favor. The motion passed unanimously.